University of Belgrade
Technical Faculty Bor

PROCEEDINGS

XIX International Scientific and Professional Meeting

Ecological Truth

Edited by
Zoran S. Marković

EcoIst '11

01-04 June 2011
Hotel "ALBO", Bor, SERBIA

University of Belgrade – Technical faculty Bor

XIX International Scientific and Professional Meeting

"ECOLOGICAL TRUTH"

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GHG EMISSIONS MITIGATION WITHIN THE SCOPE OF MSW MANAGEMENT:REQUIREMENTS ACCORDING TO THE EU LANDFILL DIRECTIVE AND THE POTENTIAL OF METAL SEPARATION IN MBT

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ABSTRACT

Due to the EU Landfill Directive, the amount of biodegradable waste going to landfill must be reduced. Accordingly, the GHG emissions from landfilling decrease. When meeting the EU Landfill Directive's targets by introducing MBT, ecologically valuable materials can be recovered additionally. By means on the Republic of Serbia, the GHG mitigation potential of paper waste recycling and metals recovery has been investigated. It was found that the GHG emission mitigation potential of these measures is even higher than the one resulting from the implementation of the EU Landfill Directive. Besides ecological efficiency, material recovery additionally holds economical potential.

Key words: greenhouse gas (GHG) emissions, EU Landfill Directive, municipal solid waste (MSW), mechanical biological treatment (MBT), metal recycling, ecological efficiency, Republic of Serbia

INTRODUCTION

The waste management industry is a sector relevant to the climate. On the one hand, climate harming methane is produced and emitted to the atmosphere, when biogenic waste is landfilled without appropriate measures such as landfill gas collection. On the other hand, secondary resources can be recovered from waste. The substitution of primary resources by secondary ones can avoid greenhouse gas (GHG) emissions and raises resource efficiency, at the same time. The *Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste* (EU Landfill Directive) makes demands on the EU member states in terms of waste management. Based on these requirements, this study investigates the potential of direct and indirect GHG emission reductions in the field of municipal solid waste (MSW) management. Thereby, technological, ecological as well as economical aspects are taken into account.

THE EU LANDFILL DIRECTIVE AND RESULTING GHG EMISSIONS REDUCTION POTENTIALS

In 1999, the EU Landfill Directive came into power. The Directive's objective is to avoid, as far as possible, negative impacts on humans and the global environment - including the greenhouse effect - from landfilling. Therefore, it prohibits the disposal of untreated MSW in landfills. To implement its goal, the EU Landfill Directive demands to successively reduce the amount of biodegradable municipal waste going to landfills. After total implementation of the Directive, not more than 35% of the amount of biodegradable waste, which has been produced in 1995 (or the latest year before 1995 for which standardised Eurostat data is available), must be disposed in landfills [1]. The Republic of Serbia aims to become a full member of the EU, what necessitates the implementation of the EU Landfill Directive. Within the study, the impact of the Directive's implementation on the climate are assessed, as well as further GHG emission reduction potentials resulting from the implementation of the Directive. Therefore, different scenarios are investigated.

Within the *Baseline Scenario*, the GHG emissions resulting from the current waste management practice in Serbia are determined. *Scenario MBT* simulates the technological approach to fulfill the requirements of the EU Landfill Directive in Serbia by installing mechanical biological treatment (MBT) plants. The impact of the presented approach on the GHG emissions was investigated. The implementation of *Scenario MBT* enables additional GHG emission reductions through material recovery. This option is investigated under *Scenario MBT Extended*. In order to evaluate the different GHG emission reduction measures, the ecological efficiency of each measure is determined. *Scenario MBT* is designed to implement statutory provisions. GHG emission reductions, which go beyond statutory provisions, need an incentive additional to the ecological gain to be implemented. This has been considered for *Scenario MBT Extended*. Therefore, besides the ecological benefit, the economical value of potentially recovered secondary raw materials is determined for *Scenario MBT Extended* also. Potential monetary revenues that could arise from GHG emission reductions according to the introduction of a carbon trading scheme have not taken into account in the frame of this study.

BASELINE SCENARIO

In order to calculate the GHG emissions resulting from the waste management sector in Serbia, the *'Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site*' has been applied, which is approved by the *'United Nations Framework Convention on Climate Change'* (UNFCCC)[2]. The calculations are based on waste generation data from 2009, in which the MSW generation rate was equal to 2.8 Mio. Mg in Serbia [3]. Following assumptions were made: 100% of the generated MSW go to unmanaged landfills (methane correction factor = 0.8) without previous treatment (Figure 2). Landfill gas collection systems are not installed; waste compaction is not implemented. The applied waste composition is shown in Figure 1[3].The average organic content amounts to 55% consisting of the fractions 'Paper' and 'Organic Waste'.

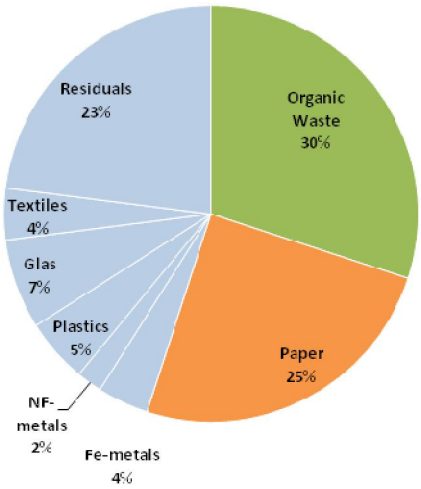

Figure 1. Average MSW composition of Baseline Scenario

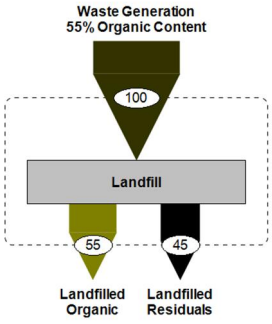

Figure 1. Relative mass flow of Baseline Scenario

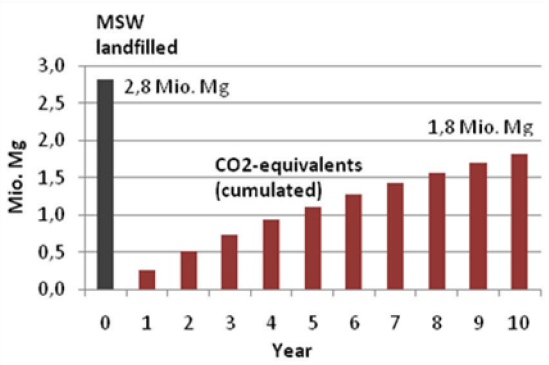

Figure 3. GHG emissions resulting from Baseline Scenario

Landfill gas generation takes place over a period of many years up to decades. Within this study, GHG emissions, which are generated within a period of 10 years after landfilling, are taken into account. According to the applied tool and assumptions, after ten years, the *Baseline Scenario* results in GHG emissions equal to 1.8 Mio. Mg CO_2eq, as shown in Figure 3.

SCENARIO MBT

The EU Landfill Directive requires the reduction of biodegradable waste going to landfill by 65% compared to the amount of biodegradable waste produced in 1995 (since no data has been available on the waste generation in Serbia in 1995 in English language, the data used in the *Baseline Scenario* was also applied for *Scenario MBT*). As demonstrated in Figure 4, the implementation of the EU Landfill Directive in Serbia

requires a reduction of the fraction 'Organic Waste' and 'Paper' going to landfill, which leads to a redirection of 36% of the total amount of MSW going to landfill. The required reduction of the biodegradable fraction of MSW can be achieved in two ways. These are MSW incineration, on the one hand, and mechanical biological treatment (MBT) of MSW, on the other hand. Compared to incineration, the installation of MBT plants requires lower technical efforts. Therefore, MBT is the technology chosen to achieve the EU Landfill Directive's requirements in this model. The waste management process is set up as follows:

The MSW is treated mechanically by a comminuting device, which homogenises the material flow. Furthermore, the waste is sieved at a diameter of 100 mm. As a result of the particle size distribution of the different fractions, the organic waste fraction is enriched in the underflow, which, therefore, becomes suitable for biological treatment, designed as a rotting process by active aeration. Based on literature research, during a rotting process, 60% of the biogenic rotting input material can be assumed to get lost due to biological activity [5].

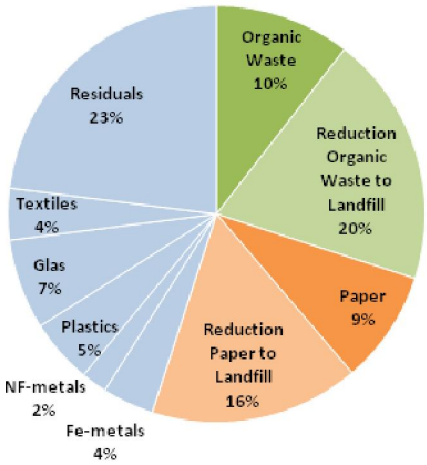

Figure 4. Requirements in order to fulfill the EU Landfill Directive

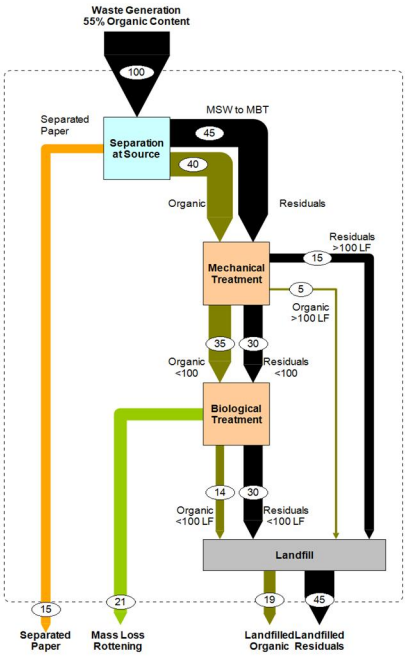

Figure 5. Relative mass flow of Scenario MBT

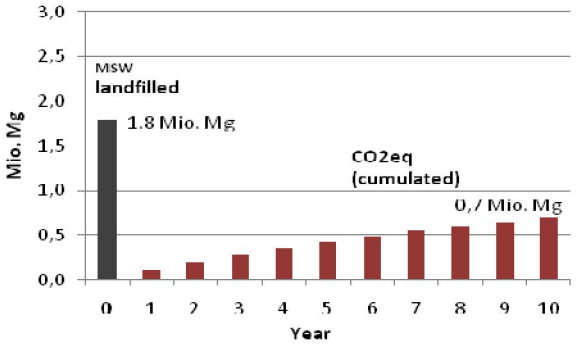

Figure 6. GHG emissions resulting from Scenario MBT

The rotting output, as well as the sieving overflow, is sent to landfill site. The modelled MBT process is based on plants already installed and operating in other countries. According to experiences with the process design, paper waste mainly remains in the sieving overflow and would therefore go directly to landfills. This results in the requirement of a separate paper waste collection. A collection rate of 60% of the totally generated paper waste is assumed to be realistic.[4] As demonstrated in Figure 5, 36% of the total MSW generated are prevented from landfilling by separate collection of paper waste and MSW treatment in MBT plants. On the national level, *Scenario MBT* yields in 1.8 Mio. Mg MSW landfilled annually, which in turn causes GHG emissions equal to 0.7 Mio. Mg CO2eq (Figure 6). The energy demand for treating MSW by MBT can be assumed to result in about 30 kg CO_2eq/Mg MSW [6].

SCENARIO MBT EXTENDED

Scenario MBT Extended aims to improve the ecological performance of *Scenario MBT* by including material recovery. *Scenario MBT* provides the separate collection of paper waste to prevent it from going to landfill. Apart from avoiding methane emissions from paper waste degradation in landfills, separate paper waste collection also allows for recycling activities. *Scenario MBT Extended* includes the recycling of separately collected paper waste. Each ton of paper waste that is recycled avoids about 3 Mg CO_2eq from being emitted, by replacing primary paper production [7]. Since paper waste already is separated at source due to *Scenario MBT*, the only GHG emissions arising from paper waste recovery in *Scenario MBT Extended* results from paper waste collection and transportation. The emission factor for paper waste collection and transportation can be assumed to amount to about 10 kg CO_2eq/Mg paper waste [7]. On the European market, one ton of recovered paper waste generates 100 € revenues or more, depending on the paper's quality [8].

Figure 7 shows the simulated composition of the final waste stream going to landfill in *Scenario MBT*. Considering technological, ecological and economical aspects, in terms of material recovery the metal content of this waste stream is relevant. Ferrous (Fe) and non-ferrous (NE) metals can be separated in MBT plants by integrating magnetic and eddy current separators into the mechanical treatment stage. *Scenario MBT*

Extended considers this metal separation technology. Assuming that 90% of the Fe-metal content and 50% of the NF- metal content is recovered, the mass flow of the extended MBT process displays as shown in Figure 8. The specific emission factor of Fe-metal recycling amounts to about -1.2 Mg CO_2eq/Mg [9]. Mechanical Fe-metal recovery from MSW consumes about 2 kWh el/Mg MSW [5].

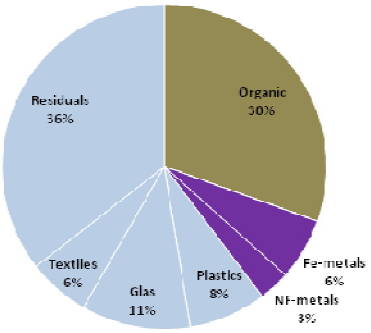

Figure 7. Composition of the mass flow going to landfill in Scenario MBT

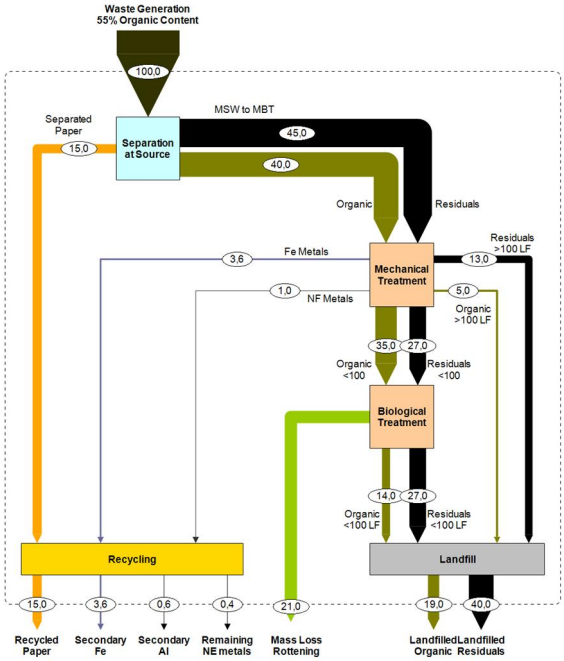

Figure 8. Relative mass flow of Scenario MBT Extended

Analyses show that at least 60% of the NF-metal concentrate, recovered from MSW, consist of Aluminium [10]. The specific emission factor of aluminium recycling amounts to about -7 Mg CO_2eq/Mg [11,12]. Neither the ecological nor the economic benefits from recycling the remaining NF-metals that can be recovered, e. g. copper, tin and brass, are taken into account within this study. NF-metal separation consumes an estimate of 1.8 kWh el/Mg MSW [6]. The revenues from Fe-metal scrap add up to 50-100 €/Mg, whereas one ton of NF-metals scrap creates revenues ranging from 300-400 €/Mg [6].

RESULTS

In Figure 9, the GHG emissions and emission savings, arising from the different, previously investigated scenarios, are illustrated related to the national level of Serbia. The figure indicates that both measures, the implementation of *Scenario MBT*, which aims at fulfilling the requirements of the EU Landfill Directive, as well as the extension of the

MBT process by paper and metal recovery, as implemented in *Scenario MBT Extended*, result in relevant GHG emission reductions, compared to the *Baseline Scenario*.

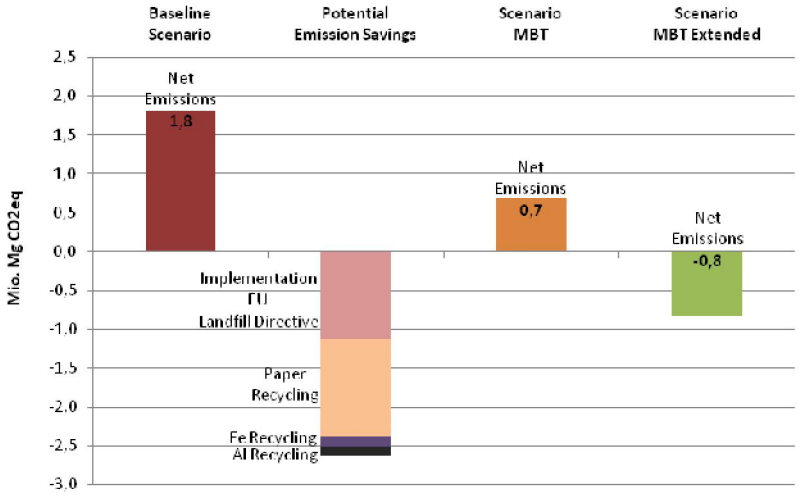

Figure 9. GHG emissions and potential savings of MSW management related to Serbia

In the *Baseline Scenario*, 2.8 Mio. Mg MSW are generated and landfilled each year, which causes GHG emissions from landfill gas equal to 1.8 Mio. Mg/a CO_2eq. The specific emission factor respectively adds up to 640 kg CO2eq/Mg MSW.

The implementation of *Scenario MBT* yields, analogiously to the reduction of biodegradable waste going to landfill, in a reduction of GHG emissions from landfilling by 65% (1.1 Mio. Mg CO_2eq). The GHG emissions resulting from MSW management in Serbia thereby decrease from 1.8 Mio. Mg CO_2eq/a to 0.7 Mio. Mg/a. The specific emission factor, related to 2.8 Mio. Mg input, is decreased by 390 kg CO_2eq/Mg MSW and amounts to 250 kg CO_2eq/Mg MSW. However, there are still GHG emissions remaining that are released from landfills and harm the climate.

The additional separation and recycling of valuable materials contained in MSW, such as paper waste and metal scrap, allows the MSW management sector in Serbia to serve as an indirect carbon sink instead of being a source of GHG emissions. This is calculated in *Scenario MBT Extended*. The separate collection of paper waste in *Scenario MBT* allows GHG emission reductions of more than 1.2 Mio. Mg CO_2eq/a and indirectly can reduce the specific emission factor of MSW by another 450 kg CO_2eq/Mg through recycling activities (*Scenario MBT Extended*). Through metal separation, 100,800 Mg/a Fe-metals and 28,000 Mg/a NF-metals containing 16,800 Mg/a Al-metals can be recovered from MSW in Serbia. This is equal to indirect GHG emission savings of about 120,000 Mg CO_2eq due to Fe-metal recycling and of another 120,000 Mg CO_2eq due to Al-recycling. Related to the total MSW generation rate, the separated metals, a small part of 3% of the total MSW generated, can indirectly decrease the emission factor of each ton of MSW by almost 70 kg CO_2eq. Compared to *Scenario MBT*, the implementation of *Scenario MBT Extended,* on a national level, saves an additional of 1.5 Mio. Mg CO_2eq/a by indirect GHG emission reductions. In total, the

implementation of *Scenario MBT Extended* enables Serbia a net GHG emission avoidance of 800,000 Mg CO_2eq annually. Compared to the *Baseline Scenario*, this results in a GHG emission reduction rate of 2.6 Mio. Mg CO_2eq/a.

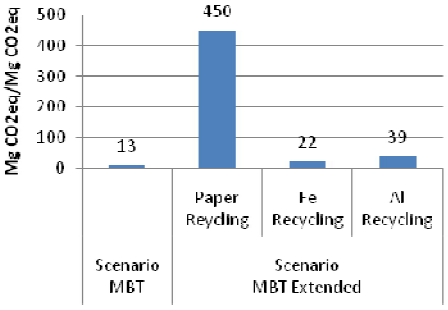

Figure 10. Ecological efficiency (benefits/expenses)

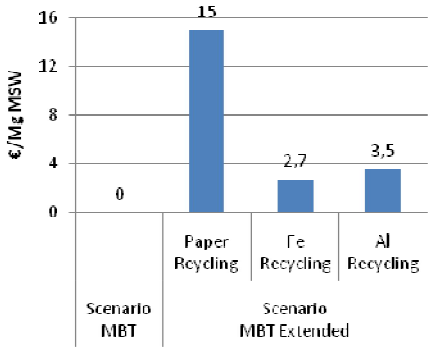

Figure 11. Revenues

In order to compare the specific efficiency of each GHG emission reduction measure, the measure's emission savings are put in relation to the emissions that are released through its implementation. Figure 10 shows the ecological efficiency of the investigated measures. Assuming, the GHG emission factor of electricity consumption constitutes 1 kg CO_2eq/kWh, the ecological efficiency of *Scenario MBT* is 30 [12]. The efficiency for paper waste recycling, in contrast, adds up to 300. The ecological efficiency of Fe-metal recovery amounts to 22 and is clearly lower than the one of paper waste recovery. However, it is still higher than the one of *Scenario MBT*. Due to the production process of primary aluminium, which is known to be emission intensive, the ecological efficiency of aluminium recovery amounts to almost 40. Within *Scenario MBT*, no products are generated. However, when implementing *Scenario MBT Extended*, valuable goods are recovered, which carry a positive market value. As presented in Figure 11, related to the total MSW generation in Serbia, which amounts to 2.8 Mio. Mg/a, the revenues from separate paper collection results in a benefit of at least 20 €/Mg MSW. Marketing the separated metals increases the specific value of one ton of MSW by another 6 €. In total, treating the MSW in Serbia potentially can generate revenues higher than 70 Mio. €/a.

CONCLUSION

Currently, the disposal of each ton of MSW to unmanaged landfills in Serbia yields in more than 0.64 Mg CO_2eq that are emitted to the atmosphere. Meeting the requirements of the EU Landfill Directive by installing MBT plants reduces the GHG emissions resulting from landfilling, by 65%. Furthermore, the recovery of secondary raw materials by utilising advanced MBT technology enables additional GHG emission reductions. The study shows that the ecological benefit of recovering paper and metal from MSW alone can be considerably higher than the benefit of simply fulfilling the EU Landfill Directive's demands. At the same time, the ecological expenses of material

recovery constitute 15% of the one, necessary to meet the EU Landfill Directive's targets only. Hence, the ecological efficiency of material recovery measures is comparably high. When combining the implementation of the EU Landfill Directive and recovery of valuable materials, the MSW sector indirectly can functions as a carbon sink instead of being a source of GHG emissions.

Material recovery measures from MSW go beyond the requirements of the EU Landfill Directive and thus are of a voluntary nature. Since the recovered materials hold a positive market value, this gives economical incentives for the implementation of material recovery measures, besides ecological ones. The economic expenses however are not yet taken into account within this study. In case of indirect GHG emission reductions from the MSW sector being covered by a carbon emissions certification system, the economical value of one ton of MSW would rise additionally and make recycling more cost effective.

REFERENCES

1. European Commission 1999, Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste, Article 1,1; 6a; 5,2
2. UNFCCC 2010, Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site, http://cdm.unfccc.int/methodologies/SSCmethodologies/approved
3. Faculty of Mechanical Engineering Kraljevo 2009, OSNOVNO o OTPADU, http://www.mfkv.kg.ac.rs
4. Fricke, K., Beitrag der Abfallwirtschaft zum Ressourcen- und Klimaschutz p. 5, TU Braunschweig Abteilung Abfall- und Ressourcenwirtschaft, http://www.ggsc.de/service/downloads/293_4_Fricke.pdf
5. Ketelsen, K. 2010, Umrüstung der MBA zur Biogasgewinnung, Bio- und Sekundärrohstoffverwertung V p. 631, Witzenhausen-Institut für Abfall, Umwelt und Energie
6. Pretz, T. 2011, oral notification, Aachen
7. ICF Consulting 2005, Determination of the Impact of Waste Management Activities on Greenhouse Gas Emissions p. 61, Environment Canada and Natural Resources Canada
8. Euwied Europäischer Wirtschaftsdienst GmbH 2011, Händlerpreise für Altpapier in Deutschland p. 19, Euwied Recycling und Entsorgung 19/2011
9. ICF Consulting 2005, Determination of the Impact of Waste Management Activities on Greenhouse Gas Emissions p. 38, Environment Canada and Natural Resources Canada
10. Wens, B. et al. 2010, Environmental Impacts of Metal Recycling – MSW as a Resource, Proceedings of the ISWA World Congress 2010, Hamburg
11. European Aluminium Association 2008, Environmental Profile Report for the European Aluminium Industry
12. International Aluminium Institute 2007, Life Cycle Assessment of Aluminium: Inventory Dara for the Primary Aluminium Industry
13. Ifeu – Institut für Energie- und Umweltforschung Heidelberg GmbH 2011, UmweltMobilCheck p. 25, Deutsche Bahn AG

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AIR POLLUTION AND ADVERSE HEALTH EFFECTS

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In memoriam-prof dr Dragana Nikić

ABSTRACT

The influence of the environmental on health has increasingly become a subject of concern to the general public in recent years, initially in relation to air quality and water quality, but latterly because of climate change. In the ambient air pollution setting, the main approach for quantifying acute and chronic dose responses at the population is through epidemiological studies, respectively. Significant studies have been made to identify effect measures to reduce exposures to these pollutants. Globally a substantial ill-heath burden from exposure to hazardous air pollutants remains and future attention should also focus on indooor as well as outdoor air.

Key words: air pollution, health, effects

AIR POLLUTION AS A GLOBAL HEALTH PROBLEM

Clean air is considered to be a basic requirement of human health and well-being.The average adult breathes enough air to fill over 3,000 balloons each day that represent volume of 10-20 m^3 and children breathe even more. In spite of the introduction of cleaner technology in industry, energy production and transport, air pollution remains a major health risk in the world.

Worldwide more deaths per year are linked to air pollution than to car accidents. According to a WHO, more than 2 million premature deaths each year can be attributed to the effects of urban outdoor air pollution and indoor air pollution [1]. More than half of this disease burden is borne by the populations of developing countries with low economic world power and high poverty and population rates.

In the developed world environmental standards generally are stricter than in developing countries, but energy consumption is greater, and levels of air pollution still often exceed national or international standards.

Worldwide health costs of urban air pollution are estimated at $1 billion a year. In Asia, 1.5 million people die every year from pollution related diseases. In the United

States particulate pollution causes one-fifth of all lung cancers and 4% of death can be attributed to air pollution. 310,000 Europeans die from air pollution annually [2].
Air pollution is usually concentrated in densely populated metropolitan areas, especially in developing countries where environmental regulations are relatively lax or nonexistent. However, many urban areas in developed countries achieve unhealthy levels of pollution.

Indoor air pollution is often regarded as a problem of homes, especially in rural areas and poor urban areas of developing countries where majority of households use unprocessed solid fuels for cooking and heating. More than 3 billion people use unprocessed biomass to meet their basic household energy demands [3]. These fuels emit large amounts of smoke, directly inside dwelling without ventilation and women and children suffer most. In many rural areas of developing countries air pollution exposure tend to be highest indoors. In cities, millions of urban poor also suffer, because poor tend to live and work in most heavilly areas and in rural areas poor are more likely to cook with dirtier fuels.

SOURCES OF AIR POLLUTION

According to the definition, air pollution is the introduction of chemicals, particulate matter, or biological materials into the atmosphere that cause harm or discomfort to humans or other living organisms, or cause damage to the natural environment or built environment.

Air pollutants come in different forms and from many sources. The various locations, activities or factors are responsible for the releasing of pollutants in the atmosphere. Aeropollutants can be in the form of solid particles, liquid droplets and gases.

The main source of air pollution is fuel. Burning fields, wood fires, vehicle emissions,cooking and heating oil all contribute to air pollution. Some of the air pollutant may be present in the atmosphere as a result of direct emissions from natural or manmade sources ('primary' components), but the majority are 'secondary' components formed within the atmosphere by the chemical reactions of primary precursors.. The lifetimes of different components in the atmosphere range from less than a few minutes to more than a century. Dispersion and transport processes within the atmosphere also contribute to determining the widely varying spatial and temporal patterns in atmospheric concentrations of different components.

HEALTH EFFECTS OF AIR POLLUTION

Effects of air pollution are rarely isolated and could be direct and indirect (acid rains, poluting drinking water and entering the food chain, global warning, associated climate change and sea level rise, ecosystem destruction, bioaccumulation). Exposure to air pollution is dependent on the type and source of the pollutants, the strength of the source(s) and the behaviour of the individual(s) potentially exposed. Even in areas with relatively low levels of air pollution, public health effects can be significant and costly,

because effects can occur at very low levels and a large number of people breathe in such pollutants.

It is often difficult to establish a cause-effect relationship between air pollution and illness. There area number of ways of measuring the health effects resulting form exposure to air poluution (epidemiological studies, experimental studies on human subjects, experimental studies on animals, experimental in vitro work on cells).

Health effects of air polllution can result from acute exposure leading to mild short-term impacts such as irritation to the exes, nose and throat, or more serious effects such as exacerbations of respiratory and cardiovascular diseases resulting inhospital admission or detah (). Effects mostly occur on the day of exposure or the succeeding day, but in some conditions lagged effects are seen over days or even weeks. The effects of short-term (1-3 days) exposure to air pollutants have been demonstarted for all ranges of severity.This was not surprising for respiratory disease, but the fact that all-cause (non-trauma) mortaity was associated wih particle exposure suggested that air pollutants might affect individuals with cardiac disease.

Long-term exposure to air pollution may have a greater overall impact on public health than acute exposures, and may have a clear impact on mortality. Chronic exposure over months or years can contribute to both the initiation and the progressive worsening of a variety of diseases (impaired ability, infertility, birth defects include chronic respiratory disease, lung cancer, heart disease, stroeks, cystic fibrosis), even damage to the brain, nerves, liver, or kidneys and premature deaths. Continual exposure to air pollution affects the lungs of growing children and may aggravate or complicate medical conditions in the elderly.

Various expert group worldwide have identified air pollutants whose concentrations in ambient air may cause an unacceptable morbidity and/or mortality burden, and make recommendations on ambient atmospheric concentrations to reduce this burden. Recommendations may subsequently become incorporated into legislation as air quality standards. In the USA, criteria outdoor air pollutants are carbon monoxide, lead, nitrogen dioxide, PM_{10}, $PM_{2.5}$, ozone and sulphur dioxide.

Particulate matter (PM) is a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles. The size of particles is directly linked to their potential for causing health problems. EPA is concerned about particles that are 10 micrometers in diameter or smaller because those are the particles that generally pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects. EPA groups particle pollution into two categories: a)"Inhalable coarse particles," such as those found near roadways and dusty industries, are larger than 2.5 micrometers and smaller than 10 micrometers in diameter and b) "Fine particles," such as those found in smoke and haze, are 2.5 micrometers in diameter and smaller. These particles can be directly emitted from sources such as forest fires, or they can form when gases emitted from power plants, industries and automobiles react in the air.

Numerous scientific studies have linked particle pollution exposure to a variety of problems, including: increased respiratory symptoms, such as irritation of the airways, coughing, or difficulty breathing, for example; decreased lung function; aggravated

asthma; development of chronic bronchitis; irregular heartbeat; nonfatal heart attacks; and premature death in people with heart or lung disease. People with heart or lung diseases, children and older adults are the most likely to be affected by particle pollution exposure [4].

Black smoke was widely used as a measure of airborne PM, particularly in Europe, for many decades and consequently has been the exposure metric in many epidemiological studies of air pollution in Serbia [5-9].

Ozone, consisting of three oxygen atoms, in the lower atmosphere is an air pollutant. It is not emitted directly by car engines or by industrial operations, but formed by the reaction of sunlight on air containing hydrocarbons and nitrogen oxides that react to form ozone directly at the source of the pollution or many kilometers down wind. Exposure to ozone and the pollutants that produce it is linked to premature death, asthma, bronchitis, heart attack, and other cardiopulmonary problems [10].Long-term exposure to ozone has been shown to increase risk of death from respiratory illness. A study of 450,000 people living in United States cities showed a significant correlation between ozone levels and respiratory illness over the 18-year follow-up period. The study revealed that people living in cities with high ozone levels such as Houston or Los Angeles had an over 30% increased risk of dying from lung disease [11].

Sulfur dioxide is one of a group of highly reactive gasses and the largest sources of its emissions are from fossil fuel combustion at power plants (73%) and other industrial facilities. Although ambient concentrations of SO2 have declined in many cities in Western Europe and North America, they remain higher often in a number of cities in Eastern Europe, Asia, and South America, where residential or industrial coal use is still prevalent and diesel traffic is heavy. SO_2 can affect the respiratory system and the functions of the lungs, and causes irritation of the eyes. Inflammation of the respiratory tract causes coughing, mucus secretion, aggravation of asthma and chronic bronchitis and makes people more prone to infections of the respiratory tract. Hospital admissions for cardiac disease and mortality increase on days with higher SO_2 levels [12]. High concentrations of ambient air sulfur dioxide can result in breathing problems with asthmatic children and adults who are active outdoors. Short-term exposure has been linked to wheezing, chest tightness and shortness of breath. Other effects associated with longer-term exposure to sulfur dioxide, in conjunction with high levels of particulate soot, include respiratory illness, alterations in the lungs' defenses and aggravation of existing cardiovascular disease. Sulfur dioxide and nitrogen oxides are the major precursors of acid rain, which has acidified soils, lakes and streams, accelerated corrosion of buildings and monuments, and reduced visibility. Sulfur dioxide also is a major precursor of fine particulate soot, which poses a significant health threat.

Nitrogen dioxide is part of a group of gaseous air pollutants produced as a result of road traffic and other fossil fuel combustion processes. Its presence in air contributes to the formation and modification of other air pollutants, such as ozone and particulate matter, and to acid rain. Nitrogen dioxide acts mainly as an irritant affecting the mucosa of the eyes, nose, throat, and respiratory tract. Like ozone, it reacts with substrates present in the lung and it is therefore unlikely to interact directly with the pulmonary epithelium. Continued exposure to high nitrogen dioxide levels can contribute to the development of acute or chronic bronchitis. Low level nitrogen dioxide exposure may

cause increased bronchial reactivity in some asthmatics, decreased lung function in patients with chronic obstructive pulmonary disease and increased risk of respiratory infections, especially in young children [13].

Carbon monoxide (CO) is a colorless, odorless, and poisonous gas and one of six "criteria pollutants" for which EPA has established protective standards. Carbon monoxide forms when the carbon in fuels does not completely burn. Vehicle exhaust contributes roughly 60% of all CO emissions nationwide. Other sources include fuel combustion in industrial processes and natural sources such as wildfires. Carbon monoxide concentrations typically are highest during cold weather because cold temperatures make combustion less complete and cause inversions that trap pollutants low to the ground. Carbon monoxide enters the bloodstream through the lungs and binds chemically to haemoglobin, the substance in blood that carries oxygen to cells. In this way, CO interferes with the ability of the blood to transport oxygen to organs and tissue throughout the body. This can cause slower reflexes, confusion, and drowsiness [14]. It can also reduce visual perception and coordination and decrease the ability to learn. People with cardiovascular disease are most at risk from exposure to CO. These individuals may experience chest pain and more cardiovascular symptoms if they are exposed to CO, particularly while exercising.

Lead is a metal found naturally in the environment as well as in manufactured products. Historically, the major sources of lead emissions were motor vehicles (and industrial sources. Due to the phase-out of leaded gasoline, however, airborne lead is no longer a problem in most of the developed countries. The major source of lead emissions today is metals processing and the highest levels of lead in air are generally found near lead smelters, waste incinerators, utilities, and lead-acid battery manufacturers. Exposure to lead can occur through multiple pathways, including inhalation of air and ingestion of lead in food, water, soil, or dust [15]. Excessive lead exposure can cause seizures, brain and kidney damage, mental retardation and/or behavioral disorders. Children six and under are most at risk because their bodies are growing quickly.

The acute and chronic effects of air pollution on the health of both adults and children have been well demonstarated in many studies in Sebia, specially in Niš [16-26].

MEASURES OF HEALTH PROTECTION

Exposure to air pollutants is largely beyond the control of individuals and requires action by public authorities at the national, regional and international level [27-28]. Air quality guidelines for outdoor air have been recommended by the WHO in 1987 and they were revised in 1997. These guidelines had a European scope. The WHO Air quality guidelines 2005 represent the most widely agrees and up-to–date assessment of health effects of air pollution, recommending targets for air quality at which the health risks are significantly reduced. The new (2005) guidelines apply worldwide and are based on expert evaluation of current scientific evidence, including important new research from the low- and middle-income countries where air pollution levels are at their highest. Standard are available in developed countries for the workplaces and in the USA, the Environmental ProtectionAgency sets the National Ambient Air Quality

Standards. The Clean Air Act requires EPA to set air quality standards to protect both public health and the public welfare (e.g. crops and vegetation). As the result of the legislation, much progress has been made in tackling air pollutants such as sulphur dioxide, lead, nitrogen oxides, carbon monoxide and benzene. However, despite a reduction in some harmful emissions, air quality continues to cause problems.

Key findings in 2005 Air Quality Guidelines are

- There are serious risks to health from exposure to PM and O3 in many cities of developed and developing countries. It is possible to derive a quantitative relationship between the pollution levels and specific health outcomes (increased mortality or morbidity). This allows invaluable insights into the health improvements that could be expected if air pollution is reduced.
- Even relatively low concentrations of air pollutants have been related to a range of adverse health effects.
- Poor indoor air quality may pose a risk to the health of over half of the world's population. In homes where biomass fuels and coal are used for cooking and heating, PM levels may be 10–50 times higher than the guideline values.
- Significant reduction of exposure to air pollution can be achieved through lowering the concentrations of several of the most common air pollutants emitted during the combustion of fossil fuels. Such measures will also reduce greenhouse gases and contribute to the mitigation of global warming.

CONCLUSION

Air pollution is a statistically significant but small contributor to respiratory and cardiovascular deaths worldwide, and has also been implicated in children's health. The major causal factors are particles and ozone and , in countries where high-sulphur fuels are still in use, sulphur dioxide. However, longer term exposure is associated with an even great burden on society, populations with higher exposures suffering shorter life expectancy and in all probability more sever cardiopulmonary disease.It has been argued that traffic-related air pollution could be causally implicated in the development of asthma.

REFERENCES

1. http://www.who.int/mediacentre/factsheets/fs313/en/index.html
2. http://www.citywindsor.ca/003119.asp
3. World Health Organization. Fuel for life-Household energy and health. Available from:http.//www.who.int/indoorair/publications/fuelforlife.pdf(accessed September 14, 2009)
4. Sacks JD, Stanek LW, Luben TJ, Johns DO, Buckley BJ, Brown JS, Ross M. Particulate matter-induced health effects: who is susceptible? Environ Health Perspect. 2011 ;119(4):446-54.

5. Stanković A. Air pollution as risk factor for pregnant women health and characteristics of newborn, Master thesis, Faculty of Medicine University of Niš, 2004.
6. Nikić D, Stojanović D, Nikolić M. [Effects of air pollution on children's health in Nis and Niska Banja].Vojnosanit Pregl. 2005 ;62(7-8):537-42.
7. Stošić Lj, Nikić D, Milutinović S, Nikolić M. Zagadjenje spoljašnjeg vazduha i učestalost javljanja zdravstvenih problema i korišćenja primarne zdravstvene zaštite, Ecologica 2005; 12:149-54.
8. Nikolić M. Sulphur dioxide and soot as the risk factors of children's health. Master thesis, Faculty of Medicine University of Niš, 2000.
9. Milutinović S, Nikić D, Stosić L, Stanković A, Bogdanović D. Short-term association between air pollution and emergency room admissions for chronic obstructive pulmonary disease in Nis, Serbia.Cent Eur J Public Health. 2009;17(1):8-13.
10. Bauer AK, Kleeberger SR. Genetic mechanisms of susceptibility to ozone-induced lung disease.Ann N Y Acad Sci. 2010 ;1203:113-9.
11. Jerrett M, Burnett RT, Pope CA 3rd, Ito K, Thurston G, Krewski D, Shi Y, Calle E, Thun M. Long-term ozone exposure and mortality. N Engl J Med. 2009;360(11):1085-95.
12. Johns DO, Linn WS. A review of controlled human SO_2 exposure studies contributing to the US EPA integrated science assessment for sulfur oxides. Inhal Toxicol. 2011;23(1):33-43.
13. Hesterberg TW, Bunn WB, McClellan RO, Hamade AK, Long CM, Valberg PA. Critical review of the human data on short-term nitrogen dioxide (NO2) exposures: evidence for NO2 no-effect levels.Crit Rev Toxicol. 2009;39(9):743-81.
14. Prockop LD, Chichkova RI. Carbon monoxide intoxication: an updated review.J Neurol Sci. 2007 ;262(1-2):122-30.
15. Choudhari R, Sathwara NG, Shivgotra VK, Patel S, Rathod RA, Shaikh S, Shaikh MI, Dodia S, Parikh DJ, Saiyed HN. Study of lead exposure to children residing near a lead-zinc mine.Indian J Occup Environ Med. 2010 ;14(2):58-62.
16. Nikić D, Stojanović D, Stanković A. Cadmium in urine of children and adults from industrial areas.Cent Eur J Public Health. 2005;13(3):149-52.
17. Nikolić M, Nikić D, Stanković A. Indoor air pollution in primary schools and children's health in Niš (Serbia), Cen Eu J Occup Environ Med 2005; 11(3):189-96.
18. Stošić Lj, Milutinović S, Nikolić M, Nikić D, Radulović O, Stanković A. Indoor exposure to chemical and biological agents and health efects in primary school children, Cen Eur J Med 2006; 1(4): 379-91.
19. Nikolić M, Nikić D, Lazarević K. / Exposure to environmental tobacco smoke and respiratory symptoms in school children of Nis/ Srp Arh Celok Lek. 2006;134 Suppl 2:104-7.
20. Stošić Lj, Nikić D, Nikolić M, Milutinović S, Stanković A. Detemination of environmental tobacco smoking in schoolchildren with urine cotinine

measurements, Facta Universitatis Series:Medicine and Biology 2006; 13(2):119-22.
21. Stanković A, Nikić D, Nikolić M, Bogdanović D. Short-term effects of air pollution on cardiovascular mortality in elderly in Nis, Serbia.Cent Eur J Public Health. 2007;15(3):95-8.
22. Stanković A, Nikić D, Nikolić M. The effects of air pollution on the frequency of respiratory symptoms in the population of Nis and Niska Banja].Med Pregl. 2007 ;60(3-4):173-7.
23. Nikić D, Bogdanovic D, Stankovic A, Nikolic M, Milosevic Z. [Impact of air pollution on the rate of hospital admission of children with respiratory diseases]. Vojnosanit Pregl. 2008;65(11):814-9.
24. Nikolić M, Nikić D, Stanković A. Effects of air pollution on red blood cells in children, Polish journal of Environmental Studies 2008; 17(2):267-71.
25. Nikić D, Bogdanović D, Nikolić M, Stanković A, Zivković N, Djordjević A. Air quality monitoring in NIS (SERBIA) and health impact assessment. Environ Monit Assess. 2009;158(1-4):499-506.
26. Nikolić M, Stanković A, Arandjelovic M. Air pollution and skin effects in children, Journal of Environmental Protection and Ecology 2010; 11(4):1215-21.
27. Air quality guidelines for Europe, 2nd ed. Copenhagen, World Health Organization Regional Office for Europe, 2000 (WHO Regional Publications, European Series, No. 91).
28. The Regulation of Guideline Values of Imission (Official Register Republic of Serbia 54/92).

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LEVELS OF ACTIVITY OF ^{40}K AND ^{137}Cs IN SAMPLES OF BIOINDICATORS FROM THE NATIONAL PARK DJERDAP

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ABSTRACT

In this work activity levels of the natural radionuclide ^{40}K and the artificial radionuclide ^{137}Cs in moss and lichen collected in June 2010 in NP Djerdap are presented. All samples contained these radionuclides making further monitoring of radionuclide activity levels in bioindicators necessary in order to be able to, based on the ^{137}Cs content, evaluate whether this territory has been polluted with radionuclides created by man.

Key words: Mosses, lichens, ^{40}K, ^{137}Cs, NP Djerdap

INTRODUCTION

The National park 'Djerdap" is located in South East Europe, North-Eastern Serbia close to the boundary with Romania. The total park area is 63.608 hectars with a protection zone of 93.968 hectars. In 1974 it became a national park. It has the oldest geological history in Europe. It is the longest composite valley in Europe with three gorges, two canyons and three basins. It is the largest and oldest water break through in Europe where the Danube is the narrowest. NP Djerdap is the largest natural and archeological museum in Europe, the largest, oldest and best expressed due to relict flora, fauna and vegetation. Over 1100 plant species grow in the park area, among which moss and lichen, bioindicator species most significant for our research [1-3].

Sources of ionizing radiation by their genesis and occurrence in the environment can be divided into: natural, anthropogene and radioactive waste. Natural radionuclides formed before the creation of planet Earth and have remained to this day. ^{40}K is a natural radionuclide with a half-life of ~ 10^9 y, which is part of environmental

background radiation. Isotopes of potassium are chemical analogues of cesium and, consequently, they are included in the nutrient cycle and cause long term irradiation to biota and man. Potassium has an important role as a macronutrient for plants, responsible for adjusting the osmotic pressure of cells, and being, then, directly related to the plant growth.

Anthropogene radionuclides were created by human activities. Pollution with these radionuclides has a mainly regional character, but it can be wider in the case of strong nuclear explosions. The accident in the Chernobyl nuclear power plant has marked the XX century (26. 4. 1986. Ukraine). As a result of the accident a high energy reactor of 1 million watt power and production of $7.4x10^{19}$ Bq different radionuclides was destroyed and the consequences of this accident were felt in the whole Northern hemisphere and by millions of people. The most significant and dangerous radionuclides released into the atmosphere were ^{131}I, ^{134}Cs and ^{137}Cs. Distribution of the released materials and thus pollution of territory was mostly the consequence of meteorological conditions. Of $1.5x10^{17}$ Bq of the totally emitted ^{134}Cs and ^{137}Cs $45x10^{15}$ Bq was deposited in the Soviet Union, while most activity of ^{90}Sr and trans-uranium elements stayed within the Soviet Union. According to data from the UNSCEAR the radioactive cloud included the territory of the Federal Republic of Yugoslavia in two waves. It was evaluated that during 1986 about 2.4% of totally released radionuclides (without inert gases) was deposited, i.e. about 5% ^{131}I and about 10% ^{137}Cs. Processes of cesium absorption from the environment can be: physical and chemical sorption and ion exchange [4,5].

Radionuclides that have entered into an organism become a source of internal radiation for other organisms linked in the food chain.

MATERIAL AND METHODS

The samples of mosses and lichens were collected in June 2010 on the territory of the National park Djerdap. The samples were dried in air and then homogenized, and the activities were measured gammaspectrometrically. The specific activity of radionuclides was measured using a HPGe gamma-ray spectrometer (ORTEC-AMETEK, with 8192 channels, resolution of 1.65 keV and relative efficiency of 34% at 1.33 MeV for ^{60}Co). Samples were measured in Marinelli vessels. Sample weight was about 0.1 kg. The counting time for each sample was 60000s. The relative error for sample preparation and measurement was 10%. Gamma Vision 32, MCA emulation software, was used to analyze gamma-ray spectra. The specific activity of the artificially produced radionuclide ^{137}Cs was measured via the γ-line at the energy of 661.6 keV. The specific activity of the ^{40}K radionuclide was determined from its 1460.8 keV gamma-ray line.

RESULTS AND DISCUSSION

An ecological system, such as NP Djerdap, represents an almost closed biogenocenosis, in which pollution levels due to radioactive isotopes remain relatively stable in a long time period. ^{40}K and ^{137}Cs radionuclide concentrations in moss from the

territory of NP Djerdap have been investigated in previous years in INEP (Institute for the Application of Nuclear Energy) and the data is given in table 1. In the observed period minimal activity concentrations of ^{40}K in moss was 95 Bq/kg, and the maximal one was 992 Bq/kg. The ratio between minimal and maximal radionuclide concentrations of ^{40}K was from 6.1 to 10. Activity concentrations of ^{137}Cs in moss both minimal and maximal, except for 2002 have reduced in the investigated period (minimal - 5.43 Bq/kg; maximal - 4923 Bq/kg) [6-10]. The ratio between minimal and maximal radionuclide concentrations of ^{137}Cs was from 6.1 to 65.

Table 1. Minimal (Min) and maximal (Max) radionuclide concentrations (Bq/kg dry weight) of ^{40}K and ^{137}Cs in moss collected on the territory of NP Djerdap in the period 2003-2009

Year	Radionuclide concentrations (Bq/kg dry weight)					
	^{40}K			^{137}Cs		
	Min	Max	Min/Max	Min	Max	Min/Max
2002[6].	157	960	6.1	271	1661	6.1
2003[7].	95	992	10	76	4923	65
2006[8].	---	---	---	72	3463	48
2008[9].	168	484	2.9	7.14	417	58
2009[10].	140	471	3.4	5.43	111	20

Table 2. Radionuclide concentrations (Bq kg^{-1} dry weight) of radionuclide ^{40}K and ^{137}Cs in moss samples collected from the territory of NP Djerdap in 2010*

NO.	LOCALITY	SECTION	^{40}K	^{137}Cs	$^{137}Cs/^{40}K$
1	G.J. Poreč wood	44	160	179	1.12
2	G.J. Poreč wood	60	157	200	1.27
3	G.J. Poreč wood	45	85	152	1.79
4	G.J. Poreč wood	45	230	88	0.38
5	G.J. Zlatica	80a	248	208	0.84
6	G.J. Zlatica	86c	198	309	1.56
7	G.J. Zlatica	87b	190	178	0.94
8	G.J. Zlatica	72a	165	110	0.67
9	Brnjic river	2	249	231	0.93
10	Brnjic river	3	232	207	0.89
11	Brnjic river	10	185	107	0.58
12	Brnjic river	9	181	187	1.03
13	GJ Kožica	63a	240	127	0.53
14	GJ Kožica	26a	222	114	0.51
15	Crni vrh, Dobra	13b	148	1131	7.64
16	Crni vrh, Dobra	1b	98	847	8.64
17	Crni vrh, Dobra	1b	105	858	8.17
18	Crni vrh, Dobra	1a	115	451	3.92
19	Poreč pond	33a	231	1090	4.72
20	Poreč pond	40a	201	1034	5.14
21	G.J. Desna reka	16a	195	104	0.53
22	G.J. Desna reka	15a	187	99	0.53
23	G.J. Čezava	75c	169	50	0.30
24	Leva reka	13c	154	78	0.51

*G.J. Governing section

Table 2 shows radionuclide concentrations (Bq/kg dry weight) of the natural radionuclide ^{40}K and the artificial radionuclide ^{137}Cs in moss samples collected on the territory NP Djerdap in June 2010. Analysis of the data presented in table 2 shows that both ^{40}K and ^{137}Cs are present in moss samples collected on the territory of NP Djerdap in 2010.

The lowest radionuclide concentrations of ^{40}K were measured in moss sample number 3 (85 Bq/kg) and the highest was measured in moss sample number 5 (248 Bq/kg).The ratio between the maximal and minimal radionuclide activity in moss from Djerdap was 2.9. The mean value of radionuclide concentrations of ^{40}K in moss was 181 Bq/kg.

The lowest radionuclide concentrations of ^{137}Cs were measured in moss sample number 23 (50 Bq/kg) and the highest was measured in moss sample number 15 (1131 Bq/kg). The ratio between maximal and minimal activity in investigated moss was 23. The mean value of radionuclide concentrations of ^{137}Cs in moss was 339 Bq/kg. Analysis of the results presented in table 2 showed that activity concentrations of ^{137}Cs in moss from Crni vrh and Poreč pond are higher than 1000 Bq/kg (1034-1131 Bq/kg). Activity concentrations of ^{137}Cs in moss from the Crni vrh locality are higher than in other localities (451-1131 Bq/kg). In 2006 also, activity concentrations of ^{137}Cs in moss from the Crni vrh locality were higher than in other localities in the park. This leads to the conclusion that radionuclide concentrations of ^{137}Cs in moss from NP Djerdap are not evenly distributed confirming that they depend on the locality height above sea level, fall amount that the locality received after the Chernobyl accident, the sample location, age and species. Moss tissue reflects the elementary composition of the environment.The $^{137}Cs/^{40}K$ ratio is from 0.30 to 8.64. In moss from 2005 this ratio was higher: from 4.4 to 25.8.

Table 3. Radionuclide concentrations (Bq kg^{-1} dry weight) of radionuclide ^{40}K and ^{137}Cs in lichen samples collected from the territory of NP Djerdap in 2010*

NO.	LOCALITY	SECTION	^{40}K	^{137}Cs	$^{137}Cs/^{40}K$
1	G.J. Poreč wood	44	100	204	2.04
2	G.J. Poreč wood	60	160	133	0.83
3	G.J. Poreč wood	45	85	152	1.79
4	G.J. Zlatica	87b	58	247	4.26
5	G.J. Zlatica	72a	62	233	3.76
6	Brnjic river	10	50	228	4.56
7	Brnjic river	9	104	232	2.23
8	GJ Kožica	63a	117	79	0.68
9	GJ Kožica	26a	115	60	0.52
10	G.J. Desna reka	73a	137	8	0.06
11	G.J. Desna reka	72a	133	9	0.07
12	G.J. Čezava	46b	121	43	0.36
13	G.J. Čezava	40a	111	39	0.35

*G.J. Governing section

^{40}K and ^{137}Cs radionuclide concentrations were also investigated in previous years in liche collected on the NP Djerdap territory. Thus in *Hypogymnia physodes* lichen from Oman (1999) activity concentrations of ^{40}K 294 Bq/kg, while for ^{137}Cs they

were 1613 Bq/kg [11], while in lichen collected in 2003 in NP Djerdap activity concentrations of ^{40}K were 151 Bq/kg, while for ^{137}Cs they were 663 Bq/kg[7].

Analysis of data presented in table 2 enables the conclusion that both ^{40}K and ^{137}Cs are present in lichen samples collected from the NP Djerdap territory in 2010. The lowest radionuclide concentrations of ^{40}K were measured in lichen sample number 6 (50 Bq/kg) and the highest was measured in moss sample number 2 (160 Bq/kg). The ratio between minimal and maximal ^{40}K activity was 3.2. The mean value of ^{40}K radionuclide concentrations is 104 Bq/kg.

The lowest radionuclide concentrations of ^{137}Cs were measured in lichen sample number 10 (8 Bq/kg) and the highest was measured in lichen sample number 4 (247 Bq/kg). The ratio between minimal and maximal ^{137}Cs activity in lichen was 31. The mean value of ^{137}Cs radionuclide concentrations is 128 Bq/kg. The ^{137}Cs/^{40}K ratio was from 0.06 to 4.56.

CONCLUSION

In all inveatigated moss and lichen samples from the NP Djerdap territory the presence of ^{40}K and ^{137}Cs was established. ^{137}Cs activity concentrations in moss samples and not equally distributed. Due to the great significance of moss and lichen constant monitoring of radionuclide concentrations is necessary in order to, based on moss radioactivity data, estimate environment opollution with radiocesium. Due to radiation safety of the population monitoring of radionuclide concentrations in bioindicator species is necessary.

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REFERENCES

1. Grupa autora, NP Đerdap: Pamtivek prirode i čoveka, Ecolibri, Beograd, 1996
2. Delfanti R., Papucci C., Benco C., Mosses as indicators of radioactivity deposition around a coal-fired power station, Sci. Tot. Environ., p. 49-56, 227, 1999
3. Godoy J.M., Schuch L.A., Nordemann D.J.R., Reis V.R.G., Ramalho M., Recio J.C., Brito R.R.A., Olech M.A., ^{137}Cs, $^{226.,228}$Ra, ^{210}Pb and ^{40}K Concentrations in Antarctic soil. Sediment and Selected Moss and Lichen Samples, J. Environ. Radioact., p.33, 41 (1), 1998
4. Savezni komitet za rad, zdravstvo i socijalnu zaštitu, Nivo radioaktivne kontaminacije čovekove sredine i ozračenost stanovništva Jugoslavije 1986. godine usled havarije nuklearne elektrane u Černobilju, Beograd, 1987
5. Aakrog, A., Global radiological impact of nuclear activities in the former Soviet Union, Proceedings of a symposium: Environmental Impact of Radioactive Releases, p.13-32, Vienna, 1995

6. Stanković S., Čučulović A., Dragović S., Janković Lj., Veličković B., Akumulacija radionuklida i teških metala u bioindikatorima Nacionalnog parka Djerdap, Zbornik radova Ekološka istina 2003, XI Naučno-stručni skup o prirodnim vrednostima i zaštiti životne sredine, str. 74-78, Donji Milanovac, 2003
7. Čučulović A, Veselinović D., Miljanić Š.S., Akumulacija radionuklida u bioindikatorima Nacionalnog parka Đerdap, Zbornik radova Ekološka istina 2005, str. 105-108, Borsko jezero, 2005
8. Čučulović A, Veselinović D., Nivoi aktivnosti ^{137}Cs u uzorcima mahovina sa područja NP Đerdap., Zbornik radova Ekološka istina, EkoIst´08, str. 43-46, Sokobanja, 2008
9. Čučulović A., Veselinović D., Nivoi aktivnosti ^{137}Cs i ^{40}K u mahovina Istočne Srbije, Zbornik radova Ekološka istina, EkoIst´09, str. 37-40, Kladovo, 2009
10. Čučulović A., Marković D., Čučulović R., Veselinović D., Moss as biomonitors of radiopollution of NP Djerdap, XVIII International Scientific and Professional Meeting Ecological Truth Eco-Ist-10, Proceedings, p. 57-61, Spa Junaković, Apatin, 2010
11. Čučulović A., Stanković S., Dragović S., Pantelić G., Radioaktivna kontaminacija bioindikatora Karpatsko-balkanske Srbije, Zbornik radova Ekološka istina, X naučno-stručni skup o prirodnim vrednostima i zaštiti životne sredine, str. 53-56, Donji Milanovac, 2002

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IMPACT OF CLIMATE PARAMETERS ON INTRODUCED WOODY SPECIES IN BELGRADE

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ABSTRACT

Climate changes, especially the changes in air temperature, insolation, air humidity and precipitation, have an effect on biodiversity, i.e. cause the changes in plant species range and distribution.

Taking into account the above, the impact of climate parameters on non-native woody plants was analysed on the green spaces of Banovo Brdo in Belgrade. The study area, with the prevailing changed conditions of temperate continental climate, contains 13 exotic woody species with altogether 383 individuals.

The analysed introduced woody plants at Bano Brdo in Belgrade attained the height, ornamental values and vitality which characterise the individuals of the same species on the green spaces in the Mediterranean region, by which their good adaptation is confirmed. Based on the study results, but also based on biological and ecological characteristics, the selected introduced species can be recommended for wider application on green spaces in Belgrade and in the regions in Serbia with similar climate characteristics.

Key words: introduction, acclimatisation, competition, ecological amplitude

INTRODUCTION

Plant communities' appearance, development, survival and prevalence are determined by altitude, terrain features, slope, exposition, soil composition and climate factors. (Janković et al., 1984).

Due to global warming and the change of climate in Serbia, several non-native woody plants, seeking a mild climate without low temperatures and with an abundance of sun hours, from the *Oleo-Ceratonion* alliance, *Oleo-Ceratonion* Br.-Bl. 1936., *Quercion ilicis* Br.-Bl. 1936. and *Cisto-Ericion* H-Ić 1958 (Tomić, 2004) - have been noted in Belgrade.

MATERIAL AND METHOD

This work analyzes the impact of global climate changes on presence and adaptability of non-native woody plants in the urban open spaces of Banovo Brdo

(Banovo Hill), Belgrade, under the conditions set by the changed temperate continental climate during the vegetation period of 2009.

Belgrade is situated in the North-Eastern part of Serbia, at the confluence of the Sava and Danube rivers. Banovo Brdo belongs to the municipality of Čukarica, in the South-Western part of Belgrade. The average altitude of Banovo Brdo is 159 m. This part of the city shows strong terrain features: it is very uneven, with many streams and small rivers, ravines, slopes and hills of different heights. At the site of the research, the soil is Eutheric cambisol, largely degraded by anthropogenic factors (Živković et al., 1979). Beograd and Banovo Brdo lie in the Moesian botanical and geographical province, where Pontic, Central-Asian and Submediterranean floral elements prevail (Jovanović, 1951; Sarić et al.1997, Obratov-Petković et al., 2000). An urban area like Banovo Brdo imposes important changes on the conditions for the life of plants. The air is rich with carbon dioxide, methane, sulfur dioxide, nitrogen oxides, chlorofluorocarbons, hydrogen halides; it also contains large quantities of dust, ash, and soot particles, bacteria and spores.

Belgrade lies in the temperate continental climate zone, marked with hot summers and cold winters. The meteorological data analysis is based on the data supplied by the Hydrometeorological Institute of Serbia, covering thirty-year periods from 1960 to 1990 and form 1970 to 2000. The data indicate a rise in the average monthly temperatures. The average yearly air temperature for 1970-2000 is 12 ºC, which is 0.1 ºC higher than the average for the previous period. The coldest month in Belgrade is January with 1.2 ºC, but this also indicates a rise because for the previous period this parameter was 0.4 ºC. Winter temperatures in the Mediterranean areas are 5-12ºC, which is 4-11ºC above Belgrade temperatures. July is usually the hottest month in Belgrade with 22 ºC on the average - which is 3 ºC lower than in the Mediterranean. The average maximum monthly temperature for January (the coldest month) in Belgrade is 11 ºC higher for the period between 1970 do 2000 than for the previous period. The month with the highest average maximum monthly temperature is July with 34.9 ºC, which is 7.6 ºC more when compared with the previous period. The average minimum monthly temperatures are below zero for November, December, January, February and March. Month of January has the lowest average minimum temperature: -8.9 ºC and -2.3 ºC. During the last thirty-year period Belgrade had, on the average, 2051.1 sun hours every year, 30.5 hours more than in the previous period. The yearly average (1970-2000) for the precipitation was 692.1 mm, compared to 683.4 mm during the previous period. These quantities resemble the ones characteristic of the Mediterranean climate - 500-700 mm per year. The end of spring and the beginning of summer brings most precipitation, while in the Mediterranean it is fall and winter. The most common form of precipitation in Belgrade is rain, while snow is less common and it usually does not stay long on the ground. During the colder part of the year the falling snow can be very wet, and there are instances of icy rain. In the Mediterranean, snow is a very rare occurance. The average yearly relative humidity was 69% for both thirty-year periods in Belgrade, 9% more than in the Mediterranean. According to the average monthly wind speeds and their frequency, the prevailing wind at the beginning of the vegetation period is from the South-East, and during the second half of the vegetation period - from the North-West. In the Mediterranean region, the most common winds are sirocco, bora and mistral.

The field research covered identification and charting of the woody species from the Mediterranean floral element in the urban open spaces in Banovo Brdo, measuring with a tape measure, while decorative value and vitality were graded on a scale from 1 to 5, where 1 means - a specimen of low vitality, without decorative value, and 5 - a specimen of exceptional decorative value and of good vitality.

THE RESULTS OF THE WORK AND THE DISCUSSION

The research in the urban open areas of Banovo Brdo identified 13 non-native woody plants, 383 specimens in total. They are the sample material which enables us to study their ecophysiological characteristics:

Actinidia deliciosa **(A. Chev.) C. F. Liang & A. R. Ferguson (**Fam. *Actinidiaceae* Van Tiegh.**) -** 29 specimens of kiwifruit were found. All specimens were of maximum vitality and decorative value.

Albizzia julibrissin **Dur. (**Fam. *Mimosaceae* R. Br.**)** - Silky ablizzia is represented by 16 specimens. The average height of the analyzed specimens is 3.9 m, the minimum height being 0.5 m, the maximum being 6 m. In the optimal ecological environment this deciduous tree can grow to be 18 m tall (Ocokoljić et al., 2003), three times taller than the tallest specimen in Banovo Brdo. The average grades for vitality and decorative value are 4.4 and 4.3 respectively, while minimum and maximum grades are 2 and 5, 1 and 5, respectively.

Amygdalus communis **L. (**Fam. *Rosaceae* Juss.**) -** There are 4 almond trees in the researched area. The average height of the analyzed specimens is 4.7 m, the minimum height being 3 m, the maximum being 8 m. These values - when compared to the values that can be found in the literature for the species in general (Ocokoljić et al., 2003) - indicate good adaptability of the species: 8 m is the maximum height almonds generally reach in the Mediterranean area, with rare specimens up to 12 m tall. Furthermore, the average grades are 4.2, with all specimens graded 4 and more for both qualities.

Cupressus arizonica **Greene (**Fam. *Cupressaceae* Neger**)** - 34 specimens of Arizona cypress were identified. The average height of the analyzed specimens is 5.4 m, the minimum height being 2 m, the maximum being 14 m. The tallest individual plant reached the height noted in the literature (Ocokoljić et al., 2003). The average grades for vitality and decorative value are 4.2 and 3.8 respectively, with all specimens graded 4 and more for both qualities, except for the specimens which had their tops cut off because of the power lines above.

Cupressus sempervirens **L. (**Fam. *Cupressaceae* Neger**)** - Mediterranean cypress is represented by 134 individual trees. The average height of the analyzed specimens is 6.9 m, the minimum height being 3 m, the maximum being 12 m. The tallest of the trees has reached only a half of the biological potential of the species, which is 25 meters, according to literature (Vukićević, 1996,). However, several trees had their tops cut off (because of the power lines), so the heights can not be realistically analyzed. The average grades for vitality and decorative value are 4.5 and 4.1 respectively, while minimum and maximum grades are 2 and 5, 1 and 5, respectively.

Eriobotrya japonica **(Thunb.) Lindl. (**Fam. *Rosaceae* Juss.**) –** 6 specimens of the loquat were identified. The average height of the analyzed specimens is 2.7 m, the minimum height being 2.5 m, the maximum being 3 m. According to literature (Šilić, 1990), loquats can be 5 to 7 meters tall, but none of the trees in Banovo Brdo is that tall. The average grade for vitality is 4.7 (3 to 5). The average grade for decorative value is 4.7 (3 to 5).

Ficus carica **L. (**Fam. *Moraceae* Link.**)** - Figs are the most numerous; 221 specimens were found. The average height of the analyzed specimens is 3 m, the minimum height being 1 m, the maximum being 8 m. These values show that figs generally reach the height assigned to them by the literature (Ocokoljić et al., 2003; Šilić, 1989) - 10 m in the Mediterranean region. The average grades for vitality and decorative value are 4.1 and 3.8 respectively, within a full span from 1 to 5.

Laurus nobilis **L. (**Fam. *Lauraceae* Lindl.**)** - 3 specimens of bay laurel were identified. The average height of the analyzed specimens is 2.8 m, the minimum height being 1.8 m, the maximum being 4 m. All the analyzed specimens have been grown solitarily and none of them reached the height which the literature (Ocokoljić et al., 2003) mentions for the species in general: 15 m for the tree and 7 m for the shrub. The average grade for vitality is 5 (all the specimens were graded 5), while the average grade for decorative value is 4.7 (none of the grades lower than 4).

Lagerstroemia indica **L. (**Fam. *Lythraceae* J. St.-Hil.**)** - 12 specimens of crepe myrtle were identified. The average height of the analyzed specimens is 1.9 m, the minimum height being 1.5 m, the maximum being 3 m. The crepe myrtle is seldom found in Banovo Brdo and Belgrade; its average height is below that recorded in the literature (Šilić, 1990). The average grades for vitality and decorative value are identical: 4.9. There were no grades lower than 4.

Magnolia grandiflora **L. (**Fam. *Magnoliaceae* J. St. Hill.**)** - there are 14 specimens of Southern magnolia. The average height of the analyzed specimens is 4.2 m, the minimum height being 1 m, the maximum being 8 m. In its natural habitat Southern magnolia can grow to be 30 m tall. The average grades for vitality and decorative value are identical: 4.1, while the grades varied from 1 to 5.

Melia azedarach **L. (**Fam. *Meliaceae* Vent.**)** - only one white cedar was found in Banovo Brdo. It is 8 m tall. The grades are high (4) for a species known to be sensitive to low temperatures.

Punica granatum **L. 'Pleniflora' (**Fam. *Punicaceae* Horan.**)** – 77 specimens of pomegranate were identified. The average height of the analyzed specimens is 2.3 m, the minimum height being 0.5 m, the maximum being 5 m, although the literature (Vukićević, 1996) mentions 4 m for the species in general. The average grade for vitality is 4.5 (3 to 5). The average grade for decorative value is 3.9 (2 to 5).

Rosa banksiae **Ait. (**Fam. *Rosaceae* Juss.**)** - 2 specimens of the Lady Banks' Rose were identified. The individual plants of this creeping rose are of exceptional vitality and decorative value (graded 5).

CONCLUSION

383 non-native woody plants were identified in Banovo Brdo. 90% of them is grown in privately owned areas, the remaining 10% growing in public parks. The total number of taxa in the analyzed plant group in the researched area is 13. From the *Pinophyta* division, the following species were identified: *Cupressus arizonica* Greene and *Cupressus sempervirens* L. From the *Magnoliophyta* division: *Actinidia deliciosa* (A. Chev.) C. F. Liang & A. R. Ferguson, *Albizzia julibrissin* Dur., *Amygdalus communis* L., *Eriobotrya japonica* (Thunb.) Lindl., *Ficus carica* L., *Laurus nobilis* L., *Lagerstroemia indica* L., *Magnolia grandiflora* L., *Melia azedarach* L., *Punica granatum* L. and *Rosa banksiae* Ait.

The most numerous in the researched area is *Ficus carica* L. with 221 individual plants, while the most rare is *Melia azedarach* L. (1 individual plant).

The comparison between the actual heights of plant specimens and the heights noted in the literature indicate good adaptability. For example, the individual almonds and figs in Banovo Brdo as tall as their tallest Mediterranean counterparts, while the pomegranate tree is even taller. The remaining ten species did not reach maximum heights, but are generally as tall as their counterparts in the urban areas in the Mediterranean.

The overall average vitality grade (all analyzed specimens) is 4.51, indicating good adaptability to the local conditions. The highest (and maximum) grades for vitality were given to kiwifruit and the creeping rose (*Actinidia deliciosa* (A. Chev.) C. F. Liang & A. R. Ferguson and *Rosa banksiae* Ait.).

The lowest average grade for vitality was given to (*Melia azedarach* L.), but this grade is also relatively high: 4. It is worth noting that the specimens were checked and graded after the winter of 2009, which was very long and cold, bringing two long periods with continuous sub-zero temperatures. After such a winter, it could be expected to see the decorative non-native woody plants damaged by frost and generally less vital, but this analysis produced different results. Even the evergreen species had good grades for vitality - *Eriobotrya japonica* (Thunb.) Lindl. (4,7), *Laurus nobilis* L. (5), *Magnolia grandiflora* L. (4,1) and *Rosa banksiae* Ait. (5) - which is yet another proof of their good adaptability.

The overall average grade for decorative value is slightly lower (but still high): 4.35. The species with highest average grade for decorative value are *Actinidia deliciosa* (A. Chev.) C. F. Liang & A. R. Ferguson and *Rosa banksiae* Ait. The lowest average grades for decorative value went to *Cupressus arizonica* Greene and *Ficus carica* L.

This research confirmed that the global climate changes caused an increase in the number of non-native woody plants in the urban open spaces in Belgrade. Available research also indicates that new research is needed in order to assess the long-term effectiveness of the acclimatization, through long-term research and monitoring of phenological changes.

REFERENCES

1. Janković, M., Pantić, N., Mišić, V., Diklić, N., Gajić, M.: Vegetacija SR Srbije I, Srpska akademija nauka i umetnosti, Beograd, 1984.
2. Tomić, Z.: Šumarska fitocenologija, Šumarski fakultet, Beograd, 2004.
3. Živković, B., Nejgebauer, V., Tanasijević, Đ., Miljković, N., Stojković, L., Drezgić, P.: Zemljište Vojvodine, Novi Sad, 1979.
4. Jovanović, B., Dunjić, R.: Prilog poznavanju fitocenoza hrastovih šuma Jasenice i okoline Beograda, Zbor. radova SAN br. 11, Inst. za ekol. i biogeograf. br. 2, Beograd, 1951.
5. Sarić, M. et al.: Vegetacija Srbije II. Šumske zajednice 1. SANU. Beograd, 1997.
6. Obratov-Petković, D., Đukić, M.: Mala flora Avale. Agena. Beograd, 2000.
7. Ocokoljić, M., Ninić-Todorović, J.: Priručnik iz dekorativne dendrologije, Šumarski fakultet, Beograd, 2003.
8. Vukićević, E.: Dekorativna dendrologija, Šumarski fakultet, Beograd, 1996.
9. Šilić, Č.: Ukrasno drveće i grmlje, Svjetlost, Sarajevo, Zavod za udžbenike i nastavna sredstva, Beograd, 1990.
10. Šilić, Č.: Atlas drveća i grmlja, Svjetlost, Sarajevo, Zavod za udžbenike i nastavna sredstva, Beograd, 1988.

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Chimonanthus praecox (L.) LINK. IN CHANGED CONDITIONS OF TEMPERATE CONTINENTAL CLIMATE IN SERBIAN FLORA

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ABSTRACT

In Serbian flora other than endemic species, foreign species are also planted on green spaces. Work on the determination of these plants and detailed study began during the mid-twentieth century. Final data on acclimatization of the largest part of foreign species are missing because it is not known still how they will behave in the later part of their lives. The work provides information on *Chimonanthus praecox* (L.) Link., which according to discoveries of the authors is cultivated in Serbia only on the infield of the Faculty of Forestry in Belgrade; also no information is available in scientific and academic literature regarding this cultivation, as well as the possibility of using analyzed specimens as basis for systematic breeding and generative reproduction.

Key words: winter sweet, reproductive functionality, acclimatization, climate change

INTRODUCTION

Chimonanthus Lindl. genus belongs to ***Calycanthaceae*** Lindl. family. Scientific name of the genus derives from Greek words *cheimon* (winter) and *anthos* (flower) which indicate the timing of flowering. Genus is consistent of six species with range in China. Only the ***Chimonanthus praecox*** (L.) Link. is cultivated in Serbia, among people it is known as "winter sweet". Winter sweet is deciduous bush with height ranging from 2,5m to 4m which has fountain shaped habitus with large number of small trunks (Vukićević, 1996; Ocokoljić et al, 2003). It is most attractive during winter, because flowering occurs in December and January, but depending on climate conditions flowering can last until March as well (Ocokoljić et al, 2005). Woody species which flower during winter in temperate continental climate conditions can be found in small number, which is why they should be produced in higher quantities and cultivated on green spaces (Stojičić et al., 2009; 2010).

Taking into account sensitivity of allochthonous dendroflora and as well as need for higher attention so that it can be preserved and for more rational usage of its genetic potential , this paper shows results of analysis including adaptability, fruiting and

seed germination of winter sweet which is cultivated in changed conditions of temperate continental climate.

MATERIAL AND METHODOLOGY

Objective of the investigation is winter sweet (*Chimonanthus praecox* (L.) Link.) wish is particular dendrofloristic characteristics of the infield of the Faculty of Forestry in Belgrade. Analysed specimens are located on a sunlit position in front of the main building of the Faculty, south-west near Knez Višeslav Street (specimen number 1) and in Faculty of Forestry's Arboretum in shadowy position in a protected area on the south side (specimen number 2).

Bushes were cultivated in changed conditions of temperate continental climate. Namely, during the past few decades global worming was increased in large urban areas such as Belgrade. Changes in temperature, insolation, humidity, rainfall, wind, and air pollution brought about alteration is phenology of angiosperms (Thuiller et al., 2008). Climate parameters were analyzed for two 30 years long periods including one from 1960 until year 1990 and the second one from 1970 until year 2000 (according to measurements done by Republic Hydrometeorological Service of Serbia research)The increase of 0.1˚C for mean month temperatures of air was found when two 30 year periods were compared. January is the coldest month in Belgrade with mean temperature of 1.2˚C (during phenophases of winter sweet's blooming). Nevertheless, January is affected by the high increase of temperature (in the previous 30 year period mean temperature was 0.4˚C). Mean maximal air temperatures in coldest month, January, increased by 11˚C in the period from 1979 until year 2000 in relation to previous 30 year period. Mean minimal air temperatures are going under zero during winter months - November, December, January, February, and March. The lowest mean minimal air temperature was in January (-8.9˚C and -2.3˚C). In Belgrade, during the last 30 year period, there were on average 2051.1 sun hours which is 30.5 hours more than in the previous period. On average annually between 1970 and year 2000 there was 692.1mm of precipitation, while in the former 30 year period there was 684.4mm of precipitation. The highest volume of rainfall occurs in the end of Spring and at the beginning f the Summer, which is very favorable for vegetation. In Belgrade rain is prevalent. While during colder parts of the year very wet snow is characteristic of this area. Mean annual relative humidity during both 30 year periods in Belgrade was 69%.

Chosen specimens were evaluated with the determination of: height, crown diameter, abundance of yield, vitality, and decorative value. Heights were measured with Blume-Leisse altimeter, while crown diameters were determined with measuring tape. Vitality and decorative value were graded on a scale raging from 0 to 5 (where 0 is lowest and 5 highest score). Abundance of yield was graded through the method of quantifying phenological observations on a scale raging from 0 to 5 (where 0 is lowest and 5 highest score).

Fruits were collected in December of year 2010. Quantitative analysis of the collected fruits was done and the seeds were separated. Before the seeds were stratified, absolute masses of the seeds were calculated based on the sum of the values gained from

measurements in two trails. Electronic scale with accuracy of 0.001 grams was used for measuring.

In order for the combined dormancy of the seed to be removed (physiological dormancy and hard seedling), the seed was stratified for 3 months on 5°C (Grbić, 2003). One half of the seeds was classically stratified on a moisturized perlite. On the other half of the seed naked stratification, without medium, was used (Stilinović, 1985; 1987).

Seed germination was determined on filter paper with a sample of 1175 seed, with four repetitions. Analysis of the germination lasted for 28 days, during which the number of germinated seeds was recorded daily, moreover the number of parsimonious seeds was determined. Next, seed germination parameters were set: germination capacity (Kt), absolute germination (Ka), germination energy (Ek), mean germination time (SVTK) and germination intensity (Ik).

Obtained data were statistically processed using STATGRAPHICS Plus, software for data processing.

RESULTS AND DISCUSSION

Through multiple examination of winter sweet bushes on the infield of the Faculty of Forestry in Belgrade two specimens have been singled out due to their differential characteristics (Table 1). Specimen number 1 reached a height of 3.20m and crown diameter of 3.48m; while specimen number 2 reached a height of 5.20m and crown diameter of 8.48m. According to the achieved growth parameters, specimen number 1 achieved average height for this species according to the literature, differently specimen number 2 overreached the value which is found throughout the literature by 1.20m (Ocokoljić et al., 2003).

Based on a ten-year phenological observation of the chosen specimens, maximal flowering phenophase was confirmed during 2000-2011 period for each year. During the vegetation period (year 2010) which was analyzed, both specimens yielded. Accepting the criterion of grading with whole numbers and not with decimals; yield was graded 5 for specimen number 2 and grade 1 was given for specimen number 1 (Table 1).

Table 1. Biometrical features analyzed specimen of winter sweet on Banovo Brdo

Specimen number	**Abundance of seed yield** (0-5)	**Vitality** (0-5)	**Decorative value** (0-5)	**Capsule lengths** (mm)	**Capsule width** (mm)	**The number of seeds per capsule**
1	1	5	5	34.0 *b*	12.9 *b*	2,95 *a*
2	5	5	5	36.1 *a*	13.5 *a*	2,17 *b*

*Table key: The symbols **a** and **b** represent the classification to homogeneous groups*

Based on the multiple scale analysis of capsule length mean values, individuals were classified into two homogeneous groups. A higher value of capsule length (36.1 mm) is assigned to specimen number 2, which belongs to homogeneous group ***a***. Specimen no. 1 belongs to the second homogeneous group ***b*** with the mean value of 34.0 mm. There is statistically significant difference between mean values of fruit lengths of

these individuals. The F- ratio, which equals 11.93 is determined by analysis of variance and shows significance due to p-ratio 0.0006.

Based on the multiple scale analysis of capsule width mean values, individuals were classified into two homogeneous groups. The highest value of capsule width (13.5 mm) is assigned to specimen number 2, which belongs to homogeneous group ***a***. Specimen no. 1 belongs to the second homogeneous group ***b*** with the mean value of 12.9 mm. There is statistically significant difference between mean values of parameter - fruit width of these individuals. The F- ratio, which equals 4.30 is determined by analysis of variance and shows significance due to p-ratio 0.0380.

Based on the multiple scale analysis of the mean value of the number of seeds per capsule, individuals were classified into two homogeneous groups. The highest value of seeds number per capsule (2.95) is assigned to specimen number 1, which belongs to homogeneous group ***a***. Specimen no. 2 belongs to the second homogeneous group ***b*** with the mean value of 2.17. There is statistically significant difference between mean values of parameter - the number of seeds per fruit of these individuals. The F- ratio, which equals 24.45 is determined by analysis of variance and shows significance due to p-ratio 0.0000.

To analyze the quality of seeds, the absolute seed weight is determined. Table 2 presents the absolute seed weight. The F- ratio which equals 25.06 for this parameter, is determined by analysis of variance and shows significance due to p-ratio 0.0041. This indicates that there is statistically significant difference between Am for different individuals. Based on the multiple scale analysis of mean values of absolute seed weight, individuals were classified into two homogeneous groups. A higher value of absolute seed weight (209.157 g) is assigned to specimen no. 2, which belongs to homogeneous group ***a***. Specimen no. 1 belongs to the second homogeneous group ***b*** with the mean value of 183.318 g. There is statistically significant difference between mean values of parameter - absolute seed weight. The results show that specimen number 2 has higher absolute seed weight.

Based on the comparative analysis of the results of germination for winter sweet which is grown under the changed condition of temperate continental climate, with literature sources (Tang et al., 2010) we can make a conclusion that germination testing was very low - 1.02 % (1 % for specimen no. 2 and 1.14 % for specimen no. 1). Seeds that were classicaly stratified had lower germination (0.67 %) comparing to seeds that has naked stratification (1.39 %). Table 2 presents the mean values of seed germination parameters.

Table 2. Mean values of absolute seed weight and germination parameters of winter sweet

Specimen number	**Am** (g)	**Kt** (%)	**Ka** (%)	**Ek** (%)	**SVTK** (%)	**Ik** (%)
1	183,32 *b*	1,14 *a*	1,78 *a*	0 *a*	2,29 *a*	2,29 *a*
2	209,16 *a*	0,81 *a*	1,14 *a*	0,18 *a*	3,02 *a*	5,62 *a*

*Table key: The symbols **a** and **b** represent the classification to homogeneous groups*

Based on the multiple scale analysis of the mean value of the germination capacity, absolute germination, germination energy, mean germination time and germination intensity, individuals were classified into one homogeneous group (Table 2). There is not statistically significant difference between mean values of germination. The germination parameters like germination capacity and absolute germination shows better results for specimen no. 1 (1.14 % and 1.78 %), but specimen no. 2 has higher germination energy (0.18 %), shorter mean germination time (3.02 %) and higher germination intensity (5.62 %).

CONCLUSION

The results of the investigation show that *Chimonanthus praecox* (L.) Link., which was cultivated on the infield of the Faculty of Forestry on Banovo Brdo in Belgrade, features good phenotypical and biological characteristics. This is manifested through general appearance, resistance to diseases and pests, general functionality, and visual and aesthetic value. Starting with differential attributes of analysed bushes and literature data, it can be stated that these specimens can be basis material for synthetic breeding, pollen collection, and vegetative production of winter sweet seedlings.

With the means of annual monitoring it was determined that analyzed bushes flower abundantly, but fructify differently depending on the specimen. Comparative analysis of morphometric characteristics of the yield singled out specimen number 2, but this specimen also showed lower number of seed inside the fruit. Furthermore, specimen number 2 had bigger absolute mass of the seed.

Seed germination in both specimens was low. Somewhat bigger germination was found in seeds which were on naked stratification. Comparative analysis of values gained from examined germination parameters singled out specimen number 1 with better germination capacity and absolute germination, while specimen number 2 had highest yield, higher germination energy, shorter germination mean time, and higher germination intensity. Previous research outline the need for further investigation, with the goal of auditing results by doing long-term research.

This work supplements hitherto inventarisation and monitoring Serbian dendroflora with one more cultivated species from the *Chimonanthus* Lindl. genesis. The research has confirmed that winter sweet is species which, in changed conditions of temperate continental climate, according to cultivation values can have important place in landscaping and horticulture.

REFERENCES

1. Vukićević, E.: Dekorativna dendrologija, Šumarski fakultet, Beograd, 1996.
2. Ocokoljić, M., Ninić-Todorović, J.: Priručnik iz dekorativne dendrologije, Šumarski fakultet, Beograd, 2003.
3. Ocokoljić, M., Ninić-Todorović, J.: Zimska radost – zimocvet, Poljoprivredni calendar, 535p, ISSN 1450-5436. COBISS SR-ID 11296007. Novi Sad, 2005.

4. Stojičić, Đ., Ocokoljić, M, Obratov-Petković, D.: Global change influence on decorative woody species of Mediterranean floral elements. XIII OPTIMA Meeting, Book of Abstracts, Proceedings, 91p, Antalya, Turkey, 2010.
5. Stojičić, Đ., Ocokoljić, M.: Effect of high temperatures on Angiosperm flowering in Belgrade. 5th Balkan Botanical Congress, Book of Abstracts, 63-64p, ISBN 978-86-7078-056-9, COBISS. SR-ID 168835084, Publisher: Faculty of Biology, University of Belgrade, Studentski trg 3, 11000 Belgrade, Serbia, 2009.
6. Thuiller, W., Albert C., Araújo M. B., Berry P. M., Cabeza M., Guisan, A., Hickler T., Midgley G. F., Paterson J., Schurr F. M., Sykes M. T., Zimmermann N. E.: Predicting global change impacts on plant species' distributions: Future challenges, Perspectives in Plant Ecology, Evolution and Systematics 9, 137–152p., 2008.
7. Grbić, M.: Dormantnost i klijanje semena - mehanizam klasifikacije i postupci. Glasnik Šumarskog fakulteta, 87, 25-49p., Šumarski fakultet, Univerzitet u Beogradu, 2003.
8. Stilinović, S.: Semenarstvo šumskog i ukrasnog drveća i žbunja. 399 p., Univerzitet u Beogradu, Beograd, 1985.
9. Stilinović, S.: Proizvodnja sadnog materijala šumskog i ukrasnog drveća i žbunja. Univerzitet u Beogradu, Beograd, 1987.
10. Tang, A. & Tian, M.: Breaking combinational dormancy in seeds of *Chimonanthus praecox* L., Seed Science and Technology 38, 551-558p., 2010.

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INFLUENCE OF TECHNOLOGICAL PROCESSES OF LIMESTONE EXPLOITATION FROM SM „SKLOP“ NEAR GRACANICA TO AIR QUALITY

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ABSTRACT

Surface type of exploitation of mineral raw materials is followed by inevitable destruction of natural environment that is reflected in hazardous influences on to soil, water and air. Problem of environment pollution is expressed especially during the summer dry period, when drying out the road routes and permanent downsizing of road bed caused by movement of mechanization, increased dust emission into the surrounding atmosphere. Critical area in regards to increased dust is surface mine itself as well as facilities at the distance of 100 m from the source of dust emission. In this paper represented are data about total quantity of floating dust that is being emitted from the surface mine “Sklop” near Gracanica during performance of technological process of exploitation.

Key words: Influence, exploitation, limestone, quality, air

INTRODUCTION

Emission of dust is result of technological procedures of exploitation of minerals in all their stages. Quantity of emitted dust from crushing unit will depend on de-dust cleaning system of the crusher unit and its maintenance. Dust emission from diffuse sources will depend on condition of roads and manipulation surfaces, driving speed on them, and frequency of traffic on them. Further to that, it will depend on terms of storing of finished products, quantity of exploited rock at blasting stage and its composition. Quantity of dust emission will also depend on weather conditions (wind, temperature and moisture of air).

Procedures at quarry at which dust is spread into the environment are at first line process of enrichment of minerals (crushing and grinding), and classification at vibrating screens. Dust emission is being created during loading of mineral raw materials into trucks, and their reloading into crushing separation unit. Movement of trucks, as well as other vehicles on the mine roads, disposal and storing different grain sizes at open space, their disposal to wind also causes dust emission. At technological procedures of drilling mining boreholes and blasting that disintegrate rock mass (downsizing it to the dust) higher quantities of the smallest particle are being distributed into the

environment. Dust particles can be divided as floating and settling. Total floating particles represent floating dust in size of up to 40 micro meters. During technological process of exploitation of technical construction stone, point of sources are getting out of system for dust removal and emissions from them are simply controlled. Higher influences have diffuse sources. In fact, diffuse sources are huge in surface and their control and measurement of emission due to change of position and size itself is hardly conducted. To spreading of emission from diffuse sources it is affected indirectly to a way to remove conditions that support their emission (cleaning and watering the surface, covering, etc.).

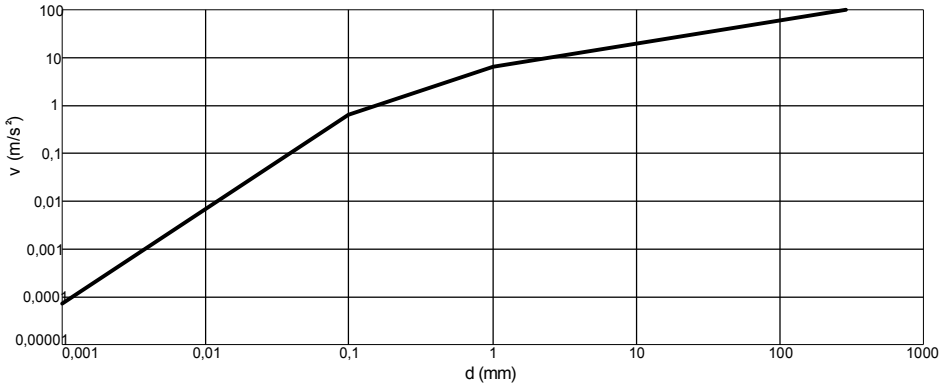

Figure 1. Diagraph of velocity of particles from the air

Dust, that is in the air , in floating condition, creates a dispersed system with the air and it represents a dispersion stage in it, and air represents dispersion environment.

Dispersive composition of dust

Under dispersive composition of dust is understood an internal relation of certain fractions of dust that is accountable (particles per 1 cm^3) or in weight (gram per 1 m^3).

At determination of dispersive composition of dust, sieve analysis is primarily done. Possibility of sieve analysis is limited. The smallest sized sieve that cannot practically be used for sieving has an opening size of 42μmd. For the purpose of studying dust in mines and industry, it is accepted that the smallest size of dust is 75μm. In different countries there are different standards for sieves what creates difficulties for comparison of dust analysis.

Dispersion of floating dust cannot be measured with sieve analysis. Nowadays, recognizable are the following analyses of dispersion dust: microscopic, filtration, viscosimetric, sedimentation, separation and others. Microscopic method is of determination of dispersion of dust is considered as the most reliable. Relation, more exactly representation of certain fractions of floating dust is expressed in numerically (particles / cm^3).

Conversion of numeric values of certain fractions in weight can be, for particles of ball shape, determined using the following formula:

$$P = \frac{n \cdot d^3}{\sum_{n,d=k}^{n,d=1} n \cdot d^3} \cdot 100, (\%)$$

Where is:

P – weight of dispersion, %
n – numeric (quantity) dispersion, %
d – average diameter of particles for given fraction

This formula can be taken mainly as a theoretical position of exchange of quantity relations of certain fractions because it conditions:

- Ball shaped, circle shape of dust particles, what is practically unrealistic to expect;
- Precise determination of average diameter of dust particles for each fraction (this data can be determined but with approximate accuracy);

Sedimentation method is based on the principle of different settlement velocity of dust particles with different size in fluid environment. Sedimentation velocity is determined according to Stocks law.

Results of dispersion analysis are usually represented in weight percentages, but the most obvious way is with distribution curve. It represents relative content of certain fractions of dispersion system represented in the shape of surfaces limited with curve line and axe of abscise.

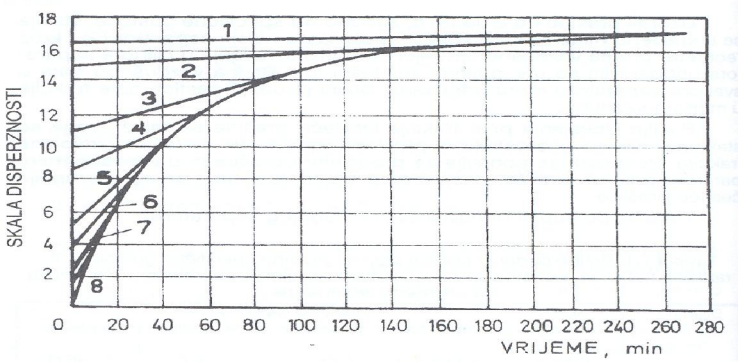

Figure 2. Representation of test of dust particle dispersion. [1]
Sedimentation curves: 1–for d=8.4μm, 2-for d=10μm, 3–for d=13μm, 4–for d=17.2μm, 5–for d=19.6μm, 6–for d=26μm, 7–for d=30.6μm.

CALCULATION OF DUST EMISSION FROM POINT AND DIFFUSION SOURCES AT SM "SKLOP" NEAR GRACANICA

This method of calculation includes all sources of dust emission, from point of loading of blasted rock into vehicles, over processing processes, to open storage yards of finished products. Technological processing process (separation) of rocks is typical for most of the limestone quarries. Capacity of units is approximately 70 m^3/sat. Separation unit is of opened type and it represents significant source of dust in the air in working and living environment. Therefore, it is required that on such units are installed adequate systems of protection from emission of dangerous mineral dust and other dangerous manifestations of technological process of limestone separation on to working and living environment. Taking mineral dust onto the ground is done with water nozzles, placed on top of places where dust elimination is done (crushers, sieves and reloading points), and their efficiency is in function of stream, system of sprinkling and in any way in a function of conditioned operation of nozzles during the whole process of separation works. Placement of nozzles at mentioned spots of crushing unit is done with placement of water curtains, which takes down dispersed dust and moisturizes complete mass, more exactly whole material in the area of effect of water curtain.

Calculation of dust emission from all processes within the technological procedure of exploitation of construction-technical stone at SM PK "Sklop" includes:

- Emission of dust in procedure of separation of mineral raw material,
- Emission of dust in the process of loading and unloading,
- Emission of dust at storage placed on open space,
- Emission of dust as result of transport,
- Emission of factors with measures for reduction of emission from transport (moisturizing)

Calculation of dust emission in the process of separation of mineral raw materials of aero dynamic diameter lower than 10 μm (PM-10) *(National Pollutant Inventor (NPI)-Emission Estimation Technique Manual)*:

$$E10 = EK10 \cdot GP \cdot N$$

On the basis of above formula we get:

Parameter	Unit measure	Calculated value
Emission coefficient PM 10	EK (kg/t)*	0,02
Number of crushers	N (pcs)	2
Annual production of quarry	GP (t)	100.000
Number of annual working hours	RS(h)	2000
Total dust emission	**E 10 (kg/year)**	**4000,0**

* According to NPI in process of mineral raw material crushing for units with system for dust reduction

Calculation of emission of dust with aero dynamic diameter between 10 μm (PM-10) and 30 μm (PM-30) *(EPA, USA-Aggregate Handing and Storage Piles)*:

$$EK = 0{,}0016 \cdot K \cdot (v/2.2)^{1.3} / (M/2)^{1.4}$$

On the basis of given formula we are getting:

Parameter	Unit measure	Calculated value
Moisture content in mineral	M (%)*	2
Aero dynamic coefficient	K (<10μm)	0,35
Aero dynamic coefficient	K (<30μm)	0,74
Average wind velocity	V (m/s)	4
Coefficient of emission PM10	EK (kg/t)	0,0012
Coefficient of emission PM30	EK (kg/t)	0,0026
Annual production at quarry	GP (t)	100.000
Annual emission PM 10	GE 10 (kg)	120,0
Annual emission PM 30	GE 30 (kg)	260,0
Total dust emission	**EGE (kg/year)**	**380,0**

*Average value according to EPA-Aggregate Handing and Storage Piles

Calculation of dust emission from storage sites on open space Dust emission PM 10:

$$E = (EK \cdot P \cdot N)/1000 \cdot RS \cdot KR$$

On the basis of given formula we are getting:

Parameter	Unit measure	Calculated value
Emission coefficient PM10	EK 10 (kg/t)*	0,3
Average diameter of site	D (m)	15
Average surface of site	P (m^2)	353,2
Number of sites	N (pcs)	5
Reduction coefficient	KR (for opened site)*	1
Annual number of working hours	RS (h)	2000
Total emission of dust	**E 10 (kg/year)**	**455,52**

* According to NPI

Calculation of dust emission created as a result of transport and loading (truck, loader), dust emission PM 10, PM 30 *(EPA):*

$$E = K \cdot (S/12)^a \cdot (W/39^b / (M/0.2)^c$$

On the basis of above formula we are getting:

Parameter	Unit measure		Calculated value	
Constants*				
	K	a	b	C
PM 10	0,73	0,8	0,4	0,3
PM 30	2,82	0,8	0,5	0,4
Powder content *	S (%)		10	
Moisture content *	M (%)		11	
Average mass of unit	W (t)		25	
Dust emission PM 10 per km.	E 10 (kg/train/km)		0,443	
Dust emission PM 30 per km.	E 30 (kg/train/km)		1,416	
Total dust emission per km.	UE (kg/train/km)		1,859	
Annual production	GP (t)		100000	
Load capacity of truck	N (t)		16	
Transportation length	DT (km)**		0,5	
No. of required passes of truck	BP		6250	
Total kilometer in a year of transport	GDT (km)		3125	
Length of loading maneuver	DM (km)***		0,006	
Annual length of loading	GMD (km)		600	
Total annual length	U (km)		3725	
Annual emission PM 10	GE 10 (kg/year)		1650,17	
Annual emission PM 30	GE 30 (kg/year)		5274,6	
Total dust emission	**EGE (kg/yea.)**		**6924,77**	

*EPA –Unpaved Roads; **average distance of transport at quarry; ***average value for loader

Calculation of emission factors with measures for reduction of emission, by procedure of watering.

$$C = 100 - (0{,}8 \cdot p \cdot d \cdot t / i)(\%)$$

On the basis of noted parameters we get as follows:

Parameter	Unit measure	Calculated value
Evaporation (from precipitation data)	p (m/h)	0,42
Number of cycles of wetting in one hour	d (N)	40
Time period between two wetting	t (h)	1
Annual production	GP (t/m^3)	100000/75000
Quantity of water for wetting	I (l/m^3)	0,4
Efficiency	**C (%)**	**66,4**

Corrected annual emission of total dust that is result of exploitation of technical construction tock at SM PK „Sklop" is: $UGE = UGE \cdot C/100 =$ **7.808 kg/year.**

DISCUSSION

Dust is produced as a product of mechanical destruction, wearing, crushing and therefore process of dust production goes in direction of particle downsizing. Calculation of annual emission of dust that is being emitted into the atmosphere during processing of technical construction rock was done in line with empiric formulas of *National Pollutant Inventor (NPI)-Emission Estimation Technique Manual*. It is obvious from the results that dust emission into atmosphere can be reduced during all segments of technological process. Reduction of emission coefficient reduces also quantity of emitted dust into atmosphere. If in the process of enrichment of minerals at the processing units dust removers are installed that can reduce quantity of dust for over 100 times. Reduction of dust emission from the storage areas can also be done in a way of storing area wetting, and that can reduce dust emission into the air for up to 50%, and by construction of obstacles for spinning the dust by the wind of up to 90%. Also, during transport and loading, wetting transportation roads and construction of as better as possible road surface can significantly reduce total emission of dust into atmosphere.

CONCLUSION

In previous practice, environment protection always ends up at the second place, just after economy. Management of industrial companies, during decision making, shall also at the same time review environmental and economical conditions. There are very few surface mines that use contemporary processing technologies during production of construction technical rock and that in the process of classification and crushing of rocks have installed systems for dust reduction. System for dust reduction using water nozzles is good in general but is not fully efficient when is used as the only one. In combination with installed dust reducers on crushing units, as well as on reloading points, emission coefficient can e drastically reduced, what in the end result in a very small quantity of dust that is in the end emitted into the air during the year.

REFERENCES

1. Dr Hamid Tanović, "Gases in mines", Tuzla, 1999
2. V. Mikulić, Exploitation of technical-construction rock at quarry Mironja and influence of blasting and classification to environment, Mining-Geological herald, Croatian Association of miners and geologists Mostar, 2009 (51-70)
3. Ekrem Bektašević, "Research of influence of truck transport of overburden from SM of coal to air pollution and noise on surrounding settlements", Masters degree paper, Technology Faculty of Banja Luka, 2006
4. Activity plan with measures and time frames for gradual reduction of emission, more exactly pollution and adjustment with the best available technique of SM PK „Sklop" near Gračanica, ″Mining Institute ″ Tuzla, October 2010.
5. Dr Čedomir Benac, "Environment protection for students of civil engineering", Rijeka, 2005.

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CONTRIBUTION TO APPLY GPS TECHNOLOGY IN MAINTAINING GREEN AREAS ON THE EXAMPLE OF TREES IN STREET MILOŠ OBILIĆ IN VRŠAC

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ABSTRACT

Planning and maintenance of greenery requires establishment of a database, regular monitoring of the changes and timely interventions in urban space. To achieve this goal terrestrial positioning methods are slow and require a set of measurements with the involvement of a number of skilled workers. Terrestrial methods include measurement of horizontal and vertical angles, length, height differences and the gravity and astronomical measurements. Although designed primarily as a military GPS system is widely applied in surveying and all institutions which are of interest tracking for real-time. In this paper is presented a possibility for application of GPS technology in landscape architecture to enhance the work of planning and maintaining the greens.

Key words: Planning, maintenance, GPS, landscape architecture

INTRODUCTION

With the development of society it was developed a group of satellite positioning methods such as a satellite long basis interferometry, the photographic determination of directions, inertial systems, laser measuring distances to satellites, satellite altimetry, satellite gradiometry, satellite tracking and satellite Global Positioning System (GPS). Global Positioning System (GPS) allows you to quickly obtain quality data on absolute and relative positions of points and their easy processing [2], which would be the appropriate application of digital mapping significantly accelerate the formation of a database on a greenery of the city.

MATERIAL AND METHODS

GPS consists of three segments: the cosmic, controlling and user segment. Cosmic segment contains about 25 satellites that transmit signals on two frequency modulated, controlled by the stable atomic clocks with cesium and rubidium containing within itself. Satellite schedule is such that over each point on Earth at all times to monitor at least four satellites which is the minimum for their use [1]. The control

segment consists of five stations on Earth (Hawaii, Colorado Springs, Ascension, Diego Garcia and Kwajalein). They perform control and management system, the determination of GPS system time, satellite orbit determination and ephemeris service. The user segment consists of all users of GPS receivers using the services that receive satellite signals and then processed them for their own purposes [2]. After determining the position of the first checkpoint at the entrance to the street Miloš Obilić in Vršac, started in continuous route, successively to the remaining control points. Mobile GPS device connected to a laptop computer was locating the geographical position in the database, almost instantly. At the all control points at intersections with streets Đuro Daničić, Kosančić Ivan, Paja Marganović, Dubrovačka, Školska, Ljutica Bogdan , Hajduk Veljko, Jug Bogdan, Kraljević Marko and Radakova, laser rangefinder was measure the distance to the building line. At next phase was determined position of trees and graphically processed obtained data.

RESULTS AND DISCUSSION

After transforming from geodetic coordinate system to the user with an appropriate program, positions are entered into the CAD application. On that way, the graphical representation of the street Miloš Obilić with width of pavements and green belt was obtained. The next stage of work was the positioning of trees and digitization. After this process it is necessary to link to a database which contains attributes such as tree height, diameter at breast height, crown projection, phytopathological and entomological damage, digital photos and all other relevant indicators of vegetation. All data can be used on a local network with basic computer skills.

Figure 1. The street of Miloš Obilić before reconstruction (Štrbac O.2003)

Figure 2. The street of Miloš Obilić after reconstruction (Štrbac O.2011)

CONCLUSION

With the rapid development of information systems and software packages for digitizing, the use of GPS technology in landscape architecture should become imperative. A simple and rapid measurements, satisfactory accuracy and automatic data processing in the presence of the Windows environment allow for the creation review tables and charts that represent an irreplaceable tool for the practice of planning and maintenance of greenery.

REFERENCES

1. Ogrizović V. Softversko rešenje simulacije uticaja nekih izvora na tačnost GPS faznih merenje, Diplomski rad, Građevinski fakultet, Beograd, 1996.
2. Ogrizović V. GPS za svaki dan, Beograd, 2007.

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EKONOMIC-ECOLOGICAL EVALUATION OF FOREST RESOURCES

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ABSTRACT

Economic-ecological evaluation of natural resources is the main focus of natural resource economics. Various methodologies are used for evaluating the value of natural resources, such as: determination of economic value, exploitation cost analysis, calculation of revenue obtained by natural resource exploitation, environmental valorisation, etc. Forest resources are the most complex and the most universal ecosystem which integrates other systems and creates conditions for their formation, development, stability, and renewability. Therefore, it is of paramount importance to conduct an economic-ecological evaluation of forest resources based on data regarding the area of forest resources, the area under special protection, works being carried out in forests, forest inventory, hunting areas, and tourist or sport activities.

Key words: evaluation, forest resource, economics, ecology

INTRODUCTION

Forests provided humans with their first habitat and food sources. They used the first construction materials from forests to build stilt houses. The first clothing and footwear was made of wicker and wild game hide. Fire was discovered in forests and today it is one of the fundamental requisites of material culture. It was used for heating, food preparation, and clay pottery manufacture. It was also used to make the first metal tools and to deforest large areas of land for agricultural use. The first utensils and cutlery were made of wood. Wood was also used to light rooms. Wood was responsible for the first water transport, initially by rafts and afterwards by boats with oars and wooden ships. Wood was used to build the first fishing traps and fruit-gathering baskets. The first items that produced sound, and later the first musical instruments, were also made of wood. Numerous works of art were drawn on trees or created with the help of wood. The forest and the tree inspired the work of many artists. Wild game, fruits, and plant sap were the first food for humans and were used to create the first food and beverage reserves for their offspring.

Even today, forests are both an important factor economically and ecologically and an important factor in the overall social development of every nation. Nations rich

with forests have better conditions for a fast socio-economic development. Forest resources are the basis for employment of many people, formation of various economic activities, and the social development of healthcare, culture, art, education, science, etc. Additionally, forests provide a healthy environment[1].

ECONOMIC-ECOLOGICAL EVALUATION OF FOREST RESOURCES

For a quality economic [2] and ecological evaluation of forest resources [3], data on the following need to be available:

- Area of forest resources and forest estates,
- Area under special protection (e.g. national parks and nature reserves),
- Works being carried out in forests,
- Forest inventory by tree species, their age and state,
- Qualitative and cumulative forest properties,
- Types and quantities of the so-called forest wealth,
- Size of forest parcels planned for deforestation,
- Areas used for hunting,
- Areas used for tourism, sports, and recreation.

Economic-ecological evaluation of forest resources (EEEfr) can be conducted based on the following formula[4]:

$$EEEfr = (VFM + AEF + IEF + EEF + EFF + LF) – (LD + EEA)$$

Where:

- VFM – value of forest materials,
- AEF – additional exploitation of forests,
- IEF – indirect exploitation of forests,
- EEF – economic exploitation of forests,
- EFF – ecological functions of forests,
- IFF – ideal functions of forests,
- LF – location of forests,
- LD – level of development,
- EEA – ecological effects of anthropogenic impact on forests.

Accordingly, basic elements of the method of economic-ecological evaluation of a single forest resource include land registry value, time of exploitation, etc. Therefore, it is necessary for us to present each of the abovementioned factors, which are interconnected and mutually conditioned.

VALUE OF FOREST MATERIALS

Value of forest materials includes, i.e., depends on:

- Forest type (deciduous, evergreen, mixed, species-specific, maquis shrubland, etc.),
- Forest age (Figure 1),
- Quality of wood mass,
- Forested areas, and others.

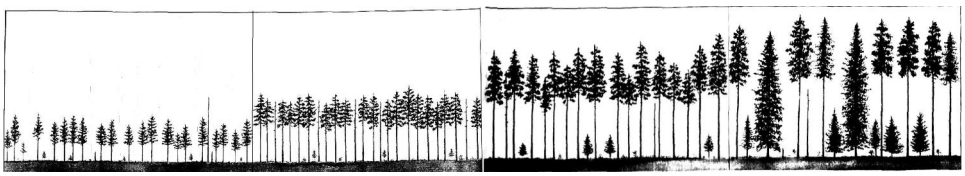

Figure 1. Forest appearance depending on age (50-300 years old)

ADDITIONAL EXPLOITATION OF FORESTS

Additional exploitation of forests includes:

- Extraction of tree sap (e.g. from birch, maple, or elm),
- Extraction of resin from evergreen trees,
- Creation of ethnic or other wooden sculptures,
- Collection of leaves from certain tree species (linden, mulberries) and their flowers, cones, and bark.

INDIRECT EXPLOITATION OF FOREST ECOSYSTEMS

Indirect exploitation of forest ecosystems includes the so-called gathering activity, i.e., the gathering of forest fruits such as:

- Sweet chestnut and walnut, hazelnut, wild apples and pears, rowan, mulberries, and rose hips,
- Forest strawberries, raspberries, blackberries, blueberries, cranberries, European cornel berries, sloe berries, juniper berries, etc.
- Fungi, edible plants, roots, and tubers, as well as
- Medicinal and aromatic plants.

Owing to their beneficial properties, forest fruits are nowadays in high demand in the food industry for manufacturing natural healthy food, which is highly valued in the global market.

ECONOMIC EXPLOITATION OF FORESTS

Forests are sources of raw materials, primarily wood, whose role in the life of humans is as old as humankind itself. The only thing that changed over the course of history was the way wood was used. It was long believed that the use of wood would decrease with the rise of civilisation, as it would be replaced with other materials (metal or plastic) but the exact opposite happened. Wood consumption and its use value are ever-increasing while the number of forests is dropping. Today, wood is used in wood industry (mechanical wood processing), chemical industry (cellulose, paper), engineering, construction, transportation, ship building, mining, crafts, agriculture, households, and for building physical exercise equipment, musical instruments, and school supplies. According to some sources, wood is currently used in ca. 25,000 products. Humans are constantly surrounded with items containing wood. Estimates show that in the next ten years the needs for wood will double. Wood consumption grows

at double the rate of population growth and two and a half times more than the national income. Globally, wood consumption grows at a higher rate than its production[5].

Wood used to be, and still is, an essential energy resource. Regardless of the awareness that wood consumption for heating is highly irrational, it is still substantially used for that purpose. Almost a half of global and 40% of European deforestation is aimed at obtaining wood for heating.

Apart from the abovementioned inadequate use, economic exploitation of wood also includes hunting, tourism, sports and recreation, beekeeping, cattle breeding, etc[6].

ECOLOGICAL FUNCTIONS OF FORESTS

Ecological functions of forests are as old as forests themselves. However, human awareness of the mechanisms and significance of these functions is generally more recent, simply because changes caused by the development of civilisation were not of the quality and scope to significantly endanger both the environment and humans. This development over the last several hundred years, and especially during the 20th century, was so rapid and devastating to the biosphere that it required the study of its elements and how various factors affected it. Consequently, a study of forests was unavoidable since they represent an essential part of the biosphere.

Vegetation, and in particular, forest vegetation has a leading role in the accumulation of solar energy. It simultaneously releases huge amounts of oxygen and binds carbon-dioxide, which practically makes life on Earth possible. The role of forests in these processes is of paramount importance.

While binding energy, forest ecosystems produce organic matter, which is in fact the essence of life. Consumers feed on organic matter and further activity by reducers puts the circulation of mater into motion. Forests are the biggest producers of organic matter in the world. Simultaneously, the process of transpiration occurs, whereby the purest water is released into the atmosphere from the forest.

With their organic waste, forests affect soil formation, its mineral enhancement, and increased fertility. Forests are very rich in fauna. Microorganisms in forest soil accelerate the decomposition of organic matter and, consequently, accelerate soil formation.

Through their height and distribution of trees and other plants, as well as their substantial inner surface of numerous elements, especially broad leaves and needle leaves, forests, which are actually situated between the pedosphere and the atmosphere, act as a great environmental stabilizer – they reduce climate extremes, transform precipitation and partly increase them, and positively affect air streams.

Forests are an important factor for the atmospheric circulation of water. They regulate to a large extent the water regime by increasing infiltration and decreasing outflow, thus affecting the water quantity, which is essential for water flow supply in mountain regions. Forests also affect water quality as they are the best natural bio-filter. Likewise, the moist regime is more favourable under the impact of forest ecosystems since they affect the reduction of water evaporation from the soil surface.

Regardless of the constant depletion of forest areas, they are still the habitat of numerous animal species. In modern times, this fact holds special significance

considering that other natural ecosystems that used to be animal habitats are slowly disappearing. Even animals from agroecosystems often find habitat within forest areas. With the large number of plant and animal species in them, the significance of forests for biodiversity preservation is immense, especially because formation of large-area agroecosystems threatens the survival of many plant and animal species.

Nowadays, the role of forest ecosystems is also irreplaceable as regards the prevention of environmental degradation and the recultivation of already degraded and purification of already polluted parts of the environment.

Throughout millennia, forests have prevented both water and aeolian erosion, which bears special significance in sandy terrains with prominent configuration. If erosion has already occurred, planting of forest plants in the area will first and foremost help recultivate the terrain. With the renewal of plant and animal life, the process of soil reformation will begin as well.

IDEAL FUNCTIONS OF FORESTS

Ideal functions of forests include[7]:

- **Aesthetic-decorative function of forests**, manifested through an exquisite visual-aesthetic experience of beauty and attractiveness or an aesthetic-decorative experience of space covered with forest trees in and around cities, roads, shores, etc.
- **Hygienic-health function of forests**, manifested through air and water quality, material flow and exchange and through the fact that the best clinics, sanatoriums, and recovery facilities are located near mountains.
- **Recreational function of forests**, manifested through active or passive spare-time activities such as games, sports, or other types of recreation.
- **Development of winter sports**, for example skiing, ski jumps, and running or development of tourism.

LOCATION OF FORESTS

Location of forests includes the forest site, altitude, and distance from roads, sawmills, or the like.

Thus, for example, National Park "Kopaonik" is divided into the following vertical vegetation zones:

- Up to 800 m.a.s.l. – oak forests,
- 800 to 1100 m.a.s.l. – mesophytic oak and beech forests,
- 1500 to 1800 m.a.s.l. – spruce forests
- Above 1800 m.a.s.l. – communities of sub-alpine tundra shrubland with sparse phytocenoses of spruce, blueberry, juniper, and a sub-alpine spruce ecotype.

LEVEL OF DEVELOPMENT

Level of development includes areas with construction objects, roads, and infrastructure. The first step in the construction of these objects is to remove the

vegetation, i.e., the part of the forest that is "in the way". The next step is the construction work itself, which requires additional space for material storage and tools, equipment and machines to be used during construction. In addition to "occupying" given areas, built objects also cause the introduction of various artificial materials (concrete, bricks, metal, plastic, etc.) while construction machines release pollutants into the environment.

The fact that this is a very big problem is best corroborated by data on the number of illegally built objects in Serbian national parks (Table 1).

Table 1. Number of illegally built objects

National park	No. of objects	%
Fruška gora	160	20.9
Kopaonik	125	16.3
Tara	130	16.9
Đerdap	350	45.8
Total	**765**	**100.0**

Objects of infrastructure (water supply, transfer of electric power, telecommunications, sewerage, etc.) also have a significant negative impact on the environment. For instance, residential areas and objects in the National Park "Kopaonik" are connected via a network of power lines which stretches for 170.5 km in length.

Transportation infrastructure, viewed through all modes of transportation (road, rail, water, and air), represents the basis for exterior space design, including the space of national parks. In contrast, the dominant feature of transportation infrastructure in Serbian national parks is its inadequacy and inefficiency. For illustrative purposes, we may mention that National Park "Fruška Gora" is intersected by E-roads of 13.7 km in length, national routes of 78.2 km, and regional roads of 131.7 km, as well as several "local" roads. Within this national park, final products are transported by trucks (65%), rail (20%), and articulated trucks (15%).

ECOLOGICAL EFFECTS OF ANTHROPOGENIC IMPACT ON FORESTS

Humans cause immense damage to forests. It is, however, difficult to enumerate all direct and indirect ways in which humans harm forests. Accordingly, we shall limit ourselves to the most prominent instances of negative anthropogenic impact on forests[8]:

- Forest fires [9],
- Grazing,
- Fruit gathering,
- Tourism,
- War activities,
- Illegal deforestation (Table 2),
- Ecological pollution, etc.

Of the abovementioned detrimental factors, forest fires are particularly dangerous for their destructive effect. Wherever they occur, they cause overall destruction of forest components – trees as well as other flora and fauna – leading to disturbances in the superficial soil layer[10].

Table 2. Illegal deforestation in Serbia from 2000 to 2009

Year	Illegal deforestation (m^3)	Index	
		Basic	Chain
2000	10 000	100.00	-
2001	12 506	125.06	125.06
2002	8 954	89.54	71.60
2003	16 720	167.20	186.73
2004	11 991	119.91	71.72
2005	10 534	105.34	87.85
2006	7 455	74.55	70.77
2007	11 480	114.80	153.99
2008	16 671	166.71	145.22
2009	9 063	90.63	54.36
Total	**115 374**		
Annual average	**11 537**		

Presented data reveal that in the observed decade over 115,000 m^3 of forests (ca. 11,500 m^3 per year) have been deforested. In particular, highest deforestations occurred in 2003 and 2008, over 16,500 m^3.

Loss of ideal forest functions implies the loss of aesthetic-decorative, hygienic, health, sports, recreational, tourist, educational, and other functions.

CONCLUSION

Economic and ecological significance of forests results from numerous resources generated within forest ecosystems and beneficial to humans. Modern rate of development and growing needs require a valorisation of economic, ecological, and social benefits provided by forests. This would cover the smallest of our debts for everything forests have "done" for humans and guarantee future reliance on all the benefits forests have to offer. It is thus necessary for humans to perceive forests from multiple viewpoints and not only from the perspective of immediate benefit. Current knowledge of the economic and ecological significance of forests will necessarily change our relationship to them, as this knowledge already indicates the profoundness of their significance. Their role is immeasurable in aspects such as process stabilization in the biosphere, accumulation of renewable energy, active participation in the formation and sustenance of human environment, which goes through constant changes as our civilization continues to develop.

REFERENCES

1. Grupa autora, 2007. Šume i promena klime, Ministarstvo za poljoprivredu, šumarstvo i vodoprivredu, Uprava za šume i Šumarski fakultet, „Planeta print", Beograd.
2. Osten, G., Roeder A. 2002. Management von Forstbetrieben. Band 1: Grunglagen, Betriebs-politik. Verlag Dr. Kesel, Remagen – Oberwinter.

3. Radenković, V. 2010. Ekonomsko-ekološka procena prirodnih resursa. Magistarska teza. Fakultet zaštite na radu u Nišu. Niš.
4. Редина, М. М., Хаустов, А. П. 2006. Экономика природопользования. „Высшая школа". Москва.
5. Magdalinović, N., Magdalinović-Kalinović M. 2006. Ekonomika prirodnih resursa. „Nauk". Beograd.
6. Vučičević, S. 1999. Šuma i životna sredina. Šumarski fakultet. Beograd.
7. Bojadžić, N. 1990. Poremećaji ekonomskih funkcija šuma kao posledica šumskih požara. „Požar, eksplozija-preventiva", Sarajevo, br.1-2.
8. Spasić, D., Avramović D. 2008. Štete na šumama prouzrokovane aktivnostima čoveka. Zbornik radova „Ekološka istina 08". Tehnički fakultet u Boru. Bor.
9. Đorđević, G. 2009. Procena štete šumskih požara- materijalne i ekološke štete šumskih požara. „Zaštita u praksi", Beograd, br. 175.
10. Kostić, M. 2010. Ekološke posledice šumskih požara. I Seminarski rad. Fakultet zaštite na radu u Nišu. Niš

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STRICTLY COPYRIGHTED AND PROTECTED SPECIES IN RESERVE ZASAVICA

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INTRODUCTION

The first data on the diversity of North Mačva and present state reserve FW Taube (1776), Pancic, J. (1867) and Dombrowski (1895). Followed by a period of half a century of sporadic surveys by groups and individuals. Then, in 1995. vol. launched an initiative to protect. The following year, the Institute for the Protection of Nature explores and adopts the Regulation on previous care. (Official Gazette of the Republic of Serbia no. 51/95) After a year of research the Government of the Republic Serbia declares 1997th vol. Zasavica a Special Nature Reserve one categories with an area of 1825 hectares, of which 671 ha in the second mode of protection (Official Gazette of the Republic of Serbia, No. 19 / 97). Zasavica putting the protection of the environment, started a more intense with an inventory of flora and fauna, a synthesis of previous results is given in the first proceedings of the Conference 2001. Following years of research were continued or expanded in some areas. To 2007. was held another conference with the results summaryed in the last 10 years. All these studies have caused the formation of a serious database of species diversity that we reserve the basis for a comparative review of the lists with lists of strictly protected and endangered species.

MATERIALS AND METHODS

Compare the lists of the recorded species in the Reserve with lists of species listed in the Law on Environmental Protection Annex I and Annex II.

RESULTS AND DISCUSSION

According to the current state of species diversity were found in the reserve Zasavica following types of flora and fauna are strictly protected, or protected by the Nature Protection Act (Official Gazette of RS 88/2010) and they are:

PROTECTED SPECIES:

Fungi: *Cantharellis cibarius, Morchella esculenta, Lactarius deliciosus.* **Flora:** *Equisetum arvensis, Dryopteris cartusiana, Achillea asplenifolia, Achillea mileifolia, Arctium lappa, Sonchus palustris, Tusilago farfara, Cyperus glomeratus, Symphitum officinalis, Sambucus nigra, Corylus avelana, Galium rubioides, Galium verum, Hypericum perfoliatum, Stratiotes aloides, Zanichellia palustris, Galanthus nivalis, Leucojum aestivalis, Pulmonaria officinalis, Epilobium hirsutum, Glycirrhiza glabra, Melolotus officinalis, Ononis spinosa, Prunus spinosa, Acorus calamus, Iris pseudacoris, Allium atropurpureum, Ruscus aculeatus, Althaea officinalis, Tilia cordata*
Fauna: Invertebrata: Gastropoda: *Helix lucorum, Helix pomatia;*Annelidae: *Hirudo medicinalis;* Hexapoda: Odonata: *Epitheca bimaculata, Gomphus flavipes;* Orthoptera: *Locusta migratoria* i *Zeuneriana ammplipenis;* Hymenoptera: *Liometapum microcephalum;* Coleoptera: *Stenopterus similatus.***Vertebrata: Pisces**: *Cobitis taenia, Abramis brama, Cyprinus carpio, Esox lucius, Perca fluviatilis, Silurus glanis;* **Amphibia:** *Rana kl.esculenta, Rana ridibunda, Rana lessona;* **Reptilia:** *Testudo hermannii;* **Aves:** *Anas crecca, Anas penelope, Anas platyrrhinchus, Anas querquedula, Anser albifrons, Aythya ferina, Cysnus olor, Larus ridibundus,Larus cachinnans, Scolopax rusticola, Ardea cinerea, Columba palumbus, Streptopelia decaocto, Streptopelia turtor, Accipiter gentilis, Coturnix coturnix, Perdix perdix, Phasanus colchicus, Fulica atra, Galinula chloropus, Corvus corax, Corvus cornix, Corvus fragilegus, Corvus monedula, Garrulous glandarius, Pica pica, Passer domesticus, Passer montanus, Sturnus vulgaris, Phalacrocorax carbo;* **Mammalia:** *Sus scrofa, Canis aureus, Vulpes vulpes, Martes foina, Martes martes, Meles meles, Mustela nivalis, Mustela puturis, Erinaceus roumanicus, Lepus europeus, Arvicola amphibia, Microtus agrestis, Glis glis, Sciurus vulgaris,Crocidura suaveoleus, Crocidura leucodon, Sorex araneus, Sorex minutus, Talpa europea, Apodemus uralensis,Capreolus capreolus,Nemys anomalus.*

STRICTLY PROTECTED SPECIES:

Algae: *Chara globularis, Nittela mucronata, Tolypera intricate*; **Fungi:** *Hygrophorus marmolis*; **Flora:** *Thelypteris palustris, Cyperus rotundus, Schenoplectus triqueter, Orchys laxiflora, Hippuris vulgaris, Hottonia palustris, Nuphar lutea, Nymphaea alba, Ranunculus aquatilis, Ranunculus lingua, Aldrovanda vesiculosa, Callitricha palustris, Callitricha stagnallis, Urtica kioviensis, Viola persicifolia*
FAUNA: Invertebrata: Araneidae:*Tegenaria domestica*; Coleoptera: *Carabus ulrichii, Cerambyx cerdo, Morimus funereus, Pilemia tigrina, Osmoderma eremita, Adalia bipunctata, Anatis occelata, Oryctes naesicornis, Lucanus cervus;* Lepidoptera: *Lycena dispar, Satyrium w-album, Apatura iris, Apatura metis, Papilio machaon, Zerynthia polyxera, Pieris brasica, Melitaea aurelia*; Orthoptera: *Acrida ungarica, Tettigonia cantans*; Hymenoptera: *Myrmica saboleti i Myrmica scabrinodis.*
Vertebrata: Pisces: *Misgurnus fossilis, Carassius carassius, Rhodeus sericeus amarus, Tinca tinca,Umbra krameri;* **Amphibia**:*Salamandra salamandra, Triturus vulgaris, Triturus dobrogicus, Bombina bombina, Bufo viridis, Bufo bufo, Hyla arborea, Pelobates fuscus, Rana dalmatina, Rana temporaria;* **Reptilia***: Emys orbicularis, Coluber caspius, Elaphe longissimus, Coronella austriaca, Natrix natrix, Natrix*

tessellate, Vipera berus; **Aves*:*** *Anas acuta, Anas clypeata, Anas strepera, Aythya nyroca, Apus apus, Charadrius dubius, Vanellus vanellus, Himantopus himantopus, Recurvirostra ovosetta, Actitis hypoleuca, Calidris minuta, Calidris alpina, Gallinago gallinago, Gallinago media, Limosa limosa, Numenius arquata, Numenius phaeopus, Tringia erithropus, Tringia glareola, Tringia nebularia, Tringia ochropus, Tringia stagnatilis, Tringia totanus, Chlidonias hybrida, Chlidonias niger, Sterna albifrons, Sterna hirundo, Sterna nilotica, Ardea purpurea, Ardeola ralloides, Butaurus stellaria, Bubulcus ibis, Egretta alba, Egretta garzetta, Ixobrichus minutus, Nycticorax nycticorax, Ciconia ciconia, Ciconia nigra, Plegadis falcinellus, Platalea leucorodia, Phalacrocorax pygmeus, Alcedo atthitis, Coracias garrulus, Merops apiastri, Upupa epops, Cuculus canorus, Accipiter nisus, Aquila heliaca, Cricetus galicus, Buteo buteo, Circus aeruginosus, Circus cyaneus, Circus pygargus, Haliaetus albicila, Milvus migrans, Pernis apivorus, Falco cherrug, Falco columbarius, Falco peregrinus, Falco subbuteo, Falco tinnunculus, Falco vespertinus, Pandion heliaetus, Gavia arctica, Gavia stellata, Grus grus, Porzana porzana,Porzana parva, Rallus aquaticus, Alauda arvensis, Galerida cristata, Bombycilla garrulus, Certhia brachydactyla, Certhia familiaris, Emberisa citrinella, Emberisa schoeniclus, Carduelis cannabina, Carduelis carduelis, Carduelis chloris, Carduelis spinus, Coccothraustes coccothraunsters, Columba livia, Columba oenas, Fringilla coelebs, Fringilla montifringila, Pyrrhula pyrrhula, Serinus serinus, Delchion urbica, Hirundo rustica, Riparia riparia, Lanius collurio, Lanius minor,Lanius excubitor, Anthus campestris, Anthus pratensis, Motacilla alba, Motacilla cinerea, Motacilla flava, Fircedula albicollis, Fircedula hypoleuca, Muscicapa striata, Oriolus oriolus, Aegithalos caudatus, Parus coeruleus, Parus major, Parus palustris, Remiz pendulinus, Sitta europea, Sturnus rosea, Acrocephalus arundinaceus, Acrocephalus palustris, Acrocephalus schoenobaenus, Acrocephalus scirpaceus,Hippolias icterina,Hippolias pallid, Locustella luscinioides, Phylloscopus collybita, Phylloscopus sibilatrix, Phylloscopus trochilus, Regulus regulus, Sylvia atricapilla, Sylvia borin, Sylvia communis, Sylvia curruca, Panurus biarmicus, Erithacus rubecula, Luscinia luscinia, Luscinia megarhynchos, Luscinia svecica, Loxia curvirostra, Oenanthe oenanthe, Phoenicurus ochrurus, Phoenicurus phoenicurus, Saxicola rubetra, Saxicola torquata, Troglodytes troglodytes,Turdus iliacus, Turdus philomelos, Turdus pilaris, Turdus merula, Turdus torquatus, Turdus viscivorus, Philomachus pugnax, Dendrocopus major, Dendrocopus minor, Dendrocopus syriacus, Junx torquilla, Picus canus, Picus viridis, Podiceps cristatus, Podiceps grisigena, Tachybaptus ruficollis, Asio flammeus, Asio otus, Athene noctua, Strix aluco, Tyto alba;* **Mammalia:** *Barbastella barbastella, Felis silvestris***, Lutra lutra, Mustela ermine, Rhinolophus ferrimequinum, Eptesicus serotinus, Miniopterus schreibersii, Myotis blythii, Myotis brandtii, Myotis dasycneme, Myotis eharginatus, Myotis mystacinus, Myotis nattereri, Myotis bechsteni, Myotis daubentoni, Myotis myotis, Nyctelus noctua,Nyctalus leisleri,Pipistrellus nathusii, Pipistrellus pygmaeus, Pipistrellus austriacus, Pipistrellus kuhlli, Pipistrellus pipistrellus, Plecotus auritus,Vespertilio murinus, Spalax leucodon, Castor fiber, Cricetus cricetus, Muscardinus avellanarius, Micromys minutes.* (Legend: *** - only in the Vojvodina province of the strictly protected species)

Among the 30 endangered species of flora reserve the Preliminary Red List of flora of Serbia and Montenegro, six species are vulnerable and one is endangered or is on the CITES list. There *Achillea asplenifolia* the Pannonian subendemic, which grows in damp meadows, and aquatic species *Stratiotes aloides* is a Tertiary relic. Of these invertebrate species that are protected identifies two kinds of insects, and Odonata-*Epiteca bimaculata* who has long thought extinct species in Serbia. Reserve Zasavica the first place in Serbia for which there is a reasonable assumption that it is safe habitat for this species in Serbia (Jovic, et al, 2007) and Orthoptera *Zeuneriana amplipennis* typical of wetland habitats in the southernmost part of the Pannonian Plain and the endemic species from Fam *Tettigonidae* in Serbia and this is the first official data on this species for the past 30 years. (Stankovic,2009) Among the protected bird species, one species has a SPEC 2 (*Aythya ferina*) and eight species of SPEC three criteria. From a total of 30 protected birds 23 species or 76.6% of nests in the reserve and a kind of a bird of prey (*Accipiter gentilis*).*Anas querquedula* population is estimated to 20 pairs, and deserves special attention because the nest Zasavica 2.33% of national populations and the IBA areas in Serbia in population of this species in Zasavica is in second place. (Radisic, et al, 2010) Of protected species in teriofauni reserve has a total of 22 species, of which three species or 13.6% were dependent on protection and 18 species or 81.8% of the nearly endangered by IUCN. (Karapandza,et al,2007) Among the strictly protected species in the flora of the reserve are *Aldrovanda vesiculosa* which is the only proven Zasavica habitat in Serbia and *Tolypela intricata* new species in the flora harofita Serbia. The site of the hare in the Reserve is the only reliable data on the presence of species *Tolypela intricata* in the central and western Balkans. (Stankovic, 2007; Blaženčić & Stankovic, 2008) Of 15 strictly protected species in the flora of the reserve six species or 40% are endangered, four species or 26% are critically endangered and two kinds or 13% are vulnerable to the Preliminary Red List of Flora of Serbia and Montenegro. (Stankovic, 2010) Of the 22 strictly protected species of invertebrates, 21 species are insects and nine types of Coleoptera, eight species Lepidoptera and two types of Orthoptera and Hymenoptera. (Stankovic, 2011) Among these is the longhorn *Pilemia tigrina* by Nickel et Reman, 2002 listed as very rare and endangered in Evropi. Also the longhorn is listed in Annex II and IV of the EU Habitats Directive (Council Directive 92/43/EEC) In addition to the types of *Pilemia tigrina* Annex II of the EU Habitats and species are cited *Morimus funereus* and *Cerambyx cerdo* both the status of vulnerable species. (Pil&Stankovic, 2007) According to the Red List of butterflies of Serbia referred strictly protected species of butterflies have a significant international status. So *Lycena dispar* is at the World Red List, but also on the European red list in Annex II and IV of the Habitats Directive of the EU, and Serbia have the status of vulnerable species. On the European Red List as *Zerynthia polyxera, Melitaea aurelia, Apatura metis, Apatura iris Satyrum w-album, Papilio machaon* and *Pieris brassica*. Two butterfly species under the EU Habitats Directive, Annex II and IV (*Lycena dispar, Zerynthia polyxera*). Five species of butterflies have the status of vulnerable species, while three species (*Apatura iris Satyrum w-album, Papilio machaon*) are an endangered species in Serbia according to IUCN. (Jaksic, 2003) Among the five species of fish that are strictly protected species is located and *Umbra krameri* Zasavica for which one of the two remaining sites in Serbia. (Bajic & Stankovic, 2007). According to Simic,et.al,(2007) fish *Umbra krameri*

is a highly endangered species, rasprotranjena in Southeastern Europe in Danube Basin, Prud and Dnjestra. On global level by the criterion of the IUCN's species is classified into the category of vulnerable species (IUCN 2006 made). subpopulations of research at regional and national level within the range of this kind point to their greater vulnerability in the category of endangered species (EN). The results of the same group of authors suggest that remaining subpopulations in the area Zasavica be included in the category CR - critically endangered species, which means that this is the most vulnerable subpopulations in the entire area of this kind. All three representatives of Caudata in the Reserve are strictly protected species, including the Balkan endemic *Triturus dobrogicus*. (Stankovic,2008) The 157 strictly protected bird species and five species 3.1% belonging to SPEC 1 (*Aythya nyroca, Aquila heliacal, Haliaetus Albicia, Phalacrocorax pygmeus, Gallinago media*), 14 species or 8.8% belong SPEC 2 and 38 species or 24% belong to SPEC 3 species. Of these strictly protected species of birds 77 species or 49% of the breeding or potential breeding within the reserve, one species has the status of vulnerable species and four species are endangered by IUCN almost 2009th Duck *Aythya nyroca* is one of the most endangered birds in the reserve, because this highly endangered species in the world nest in Zasavica with an estimated 25 pairs, which is almost 5% of the total national population and special emphasis is the fact that the 5% of the national population of 0.054 nesting % of Serbia. In addition to ducks Ferruginous globally endangered species is strictly protec *Gallinago media* and *Phalacrocorax pygmeus* (Radisic,et.al,2010) Today Zasavica enjoys legal protection and a number of negative processes were stopped, which resulted in ornithofauna. During the last years of research appear indications of the return of some of the missing species (*Haliaetus albicia, Cygnus olor, Butaurus stellaris*, etc). *Butaurus stellaris* data also point to the return of its kind in the area Zasavica (Mačva), since it is probably the only nesting place Zasavica in this part of Serbia. From the point of care is important Zasavica nesting place area is strictly protected species, namely: *Ixobrichus minutes* dozens of pairs, 1-2 pairs *Butaurus stellaris, Ciconia ciconia* 10-odd couples, *Ciconia nigra* 2 pairs, 10 pairs *Vanellus vanellus* et al. (Radisic,et.al.,2007) If we compare the number of species that have been protected as natural rarities to the previous regulations, which amounted to 116 species and the current number is only strictly protected bird reserve of 157 species we observed a substantial increase in the number of species, which only indicates the importance of protection of wetlands now IBA area. In teriofauns reserve the strictly protected species dominate Chiroptera with a total of 22 species, of which type of *Plecotus auritus* in the European Red List. Among these mammals have two types of semiaquatic *Lutra lutra* and *Castor fiber*, which is reintroduction extinct species in Serbia 2004. Species *Felis silvestres* is strictly protec kind in the Province.

CONCLUSION

According to a diversity of species in the reserve has recorded 98 or 4.8% protected and 221 or 9.3% of strictly protected species. The percentage share of protected and strictly protected species in biodiversity reserves in groups seem follows: Fungi-3 protected (0.8%) and a strictly protected species (0.2%); Algae: three strictly protected species (0.8%); Flora-30 protected (3.7%) and 15 strictly protected species

(1.8%); Invertebrata -9 protected (1.6%) and 22 strictly protected species (4.0%), Pisces-6 protected (24 , 0%) and 5 strictly protected species (20.0%); Amphibia-3 protected (46.1%) and 10 strictly protected species (76.9%); Reptilia-1 protected (7.1%) and 7 strictly protected species (50.0%), Aves-29 protected (15.2%) and 157 strictly protected species (71.0%) and protected Mammalia-17 (28.3%) and 18 strictly protected species (30, 0%). For some species such as *Aldrovanda vesiculosa* approved is the only settlement in Serbia, while the kind of *Tolypela intricata* this is the only known habitat in the Balkans. Many of protected and strictly protected species are found in European or World Red List, then the EU Habitats Directive Annex II and IV, as well as globally endangered species, and when the bird comes to present SPEC 1 species are certainly among the most important ones, especially if they have a status globally threatened species such as *Aythya nyroca*.

REFERENCES

1. Bajić,A.,Stanković,M.(2007): Novi rezultati u istraživanju diverziteta ihtiofaune Specijalnog rezervata prirode Zasavica, Zbornik Naučno-stručnog skupa "ZASAVICA 2007" sa međunarodnim učešćem,Sremska Mitrovica
2. Blaženčić,J.,Stanković,M.,(2008):*Tolypella intricata (Treutopohi ex Rhot)Lenhardi*- nova vrsta za floru Srbije,I Simpozijum „Zaštita prirode u Srbiji", Zavod za zaštitu prirode Srbije Beograd-Novi Sad
3. Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (1992), Annex II: Animal and plant species of community interest whose conservation requires the designation of special areas of conservation, Annex IV: Animal and plant species of community interest in need of strict protection.
4. Dombrovski,V.(1895):Osnovi ornitologije Sjeverozapadne Srbije.,Glasnik Zemaljskog muzeja BiH, Sarajevo.
5. IUCN (2006): 2006 IUCN Red list of Threathened Species
6. Jakšić,P.(2003):Crvena knjiga dnevnih leptira Srbije (Lepidoptera:Hesperioidea i Papilionoidea), Zavod za zaštitu prirode Srbije,Beograd
7. Jović,M.,Stanković,M.,Santovac,S.(2007):Prvi prilog poznavanju odonata Specijalnog rezervata prirode Zasavica, Zbornik Naučno-stručnog skupa " ZASAVICA 2007" sa međunarodnim učešćem,Sremska Mitrovica
8. Karapandža,B.,Paunović,M.,Stanković,M.(2007): Preliminarna lista sisara (*Mammalia*) Specijalnog rezervata prirode Zasavica, Zbornik Naučno-stručnog skupa " ZASAVICA 2007" sa međunarodnim učešćem,Sremska Mitrovica
9. Nickel, H., Remane, R.(2002): Check list of the planthoppers and leafhoppers of Germany, with notes of food plant, diet width, life cycles, geographic range and conservation status (Hemiptera, Fulgoromorpha and Cycadomorpha). *Beiträge zur Zikadenkunde*,
10. Pančić,J.(1867): Ptice u Srbiji,Državna štamparija,Beograd
11. Pil,N.,Stanković,M.(2007): Retke vrste,prirodne retkosti i balkanske endemične vrste strižibuba (Coleoptera:Cerambycidae) registrovane u Specijalnom

rezervatu prirode Zasavica, Zbornik Naučno-stručnog skupa "ZASAVICA 2007" sa međunarodnim učešćem, Sr. Mitrovica

12. Radišić,D.,Ružić,M,Šćiban,M.,Stanković,M.(2007):Pregled faune ptica Specijalnog rezervata prirode Zasavica od 1894 do 2007 godine, Zbornik Naučno-stručnog skupa "ZASAVICA 2007" sa međunarodnim učešćem,Sremska Mitrovica
13. Radišić,D.,Šćiban,M.,Ružić,M.,Stanković,M.(2010):Ptice Zasavice, Sremska Mitrovica
14. Simić,V.,Simić,S.,Paunović,M.,Petrović,M.,Stanković,M.(2007):Neke ugrožene vrste u Specijalnom rezervatu prirode Zasavica (*Umbra krameri*, Piscec i *Batrachospermum gelatinosum,*Rodophyta),Zbornik Naučno-stručnog skupa "ZASAVICA 2007" sa međunarodnim učešćem,Sremska Mitrovica
15. Službeni glasnik RS 51/95-Uredba o prethodnoj zaštiti Zasavice
16. Službeni glasnik RS 19/97-Uredba o proglašenju Specijalnog rezervata prirode Zasavica
17. Službeni glasnik RS 88/2010-Zakon o zaštiti prirode sa Anex I i II
18. Stanković,M.(2007): Rezultati istraživanja globalno ugrožene vrste A*ldrovanda vesiculosa l.* (*fam. Droseraceae)* tokom 2006. godine u Specijalnom rezervatu prirode Zasavica, Zbornik Naučno-stručnog skupa " ZASAVICA 2007" sa međunarodnim učešćem,Sremska Mitrovica
19. Stanković,M.(2008):Vodozemci i gmizavci Specijalnog rezervata prirode Zasavica,Sr. Mitrovica
20. Stanković,M.(2009): Rezultati istraživanja endemskog zrikavca *Zeuneriana ammplipennis* u Specijalnom rezervatu prirode Zasavica, Zbornik Naučno-stručnog skupa "EKOIST 2009"sa međunarodnim učešćem,Kladovo
21. Stanković,M.(2010): Rare,threatened and relict species in flora of SNR Zasavica, 10th Symposium on the Flora of Southeastern Serbia and Neigbouring regions,Vlasina lake
22. Stanković,M.(2011): Strictly protected and endangered species in entomofauna of the Special Nature Reserve Zasavica, 22 Symposium internationale entomofaunisticum Europae, Varaždin,Croacia.
23. Taube,W.F.(1777):Historisch und geografische Beschreibung des Königreiches slavonien und das Herzogthumes Syrmien,Leipzig

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THE SPECIES POPULATIONS OF THE GENUS CROCUS L. IN THE RIVER BASIN OF ZAPADNA AND VELIKA MORAVA-SERBIA

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ABSTRACT

In the paper, the synopsis of distribution and population state of the species of the Genus Crocus L. in the basin of Zapadna and Velika Morava is given.

Key words: Zapadna and Velika Morava, the species of the Genus Crocus L.

INTRODUCTION

The Genus *Crocus* L. or saffron (international name), kacunka (Serbian-Macedonian name), minzufr (Bulgarian name) brndjaslj (Romanian name) and ljuljcordokl (Albanian name) belongs to family of *Iridaceae* (iris), together with the genus *Iris*, *Gladiolus* and *Sysirinchium*.

The saffron is ephemera, it occurs in the early spring or in the early autumn (Macedonia). They start to blossom from January, during nice sunny days (*C. alexandri*) in lower hill areas, to July-August in alpine areas of high mountains (*C. veluchensis*). During their ontogenetic development, the flowers appear first with their perigon peaks that penetrate soil and leaves and they are like colored candles standing on the surface of soil. With the spring Sun shining, they open differently colored flowers for pollination. They easily can be seen, they have picturesque colored leaves of perigon: white, blue, purple, orange or yellow. They have big populations, they breed very fast, in one saffron shell there are 10-20 seeds which germinate and give new plant. They breed vegetative too, by bulb.

In the past, the saffron was used as spice (today we can find the saffron stigmas in the stores). It is about the color of saffron which is used for food coloring. The shepherds use their bulbs for food. Besides that, the saffron is very decorative plant, their flowers beautify the sides of many mountains, and hybrid species beautify the gardens of many growers. There are numerous hybrid species. There are numerous admirers of this species grouped at associations. They change seed material, bulbs etc.

Today, there are over 100 saffron species, in Europe there are 43 species, and 32 species at Balkan Peninsula. During our researches in Serbia and Macedonia, we found 2 new species: *C. rujanensis* at Rujan mountain and *C. jablanicensis* at Jablanica mountain in Macedonia.

THE DESCRIPTION OF BIOTOPE

The basin of Zapadna and Velika Morava covers big area of West Serbia and the part of Central Serbia from Stalać to Belgrade.

The Zapadna Morava wells up at the mountains Mučanj (1534 m) and Javor (1519 m) as the river Moravica. Its left tributaries are Rzav near Arilje, Detinja near Užice and Skrapež near Požega bringing the waters from Zlatibor, Tara and Povlen. There are the numerous springs too, from Maljen (1103 m), Suvobor (856 m), Kotlenik (749 m) and Gledićke mountain (922 m). The most important right tributaries are Ibar with Lab and Sitnica, which collects water from lower mountains around Kosovo polje (Čičavica, Jasenica, Grmija, Rogozna, Mokra Gora, Hajla) and Central Serbia (Kopaonik, Stolovi, Željin, Rodočelo, Čemerno and Jelica), and Rasina that collects water from east sides of Kopaonik and Željin and from west side of Veliki Jastrebac, and the numerous nameless springs too.

On this nature objects, the saffron is mountain plant of forests and pastures, and there are hill representatives in brush woods, forests and pastures.

THE SYSTEMATIC REVIEW OF GENUS CROCUS L. IN THE VALLEY OF ZAPADNA AND VELIKA MORAVA

I Subgenus CROCUS Mathew 1982.

A. Section *Crocus* Mathew 1982.
   a. series *Verni* Mathew 1982.
      1. *Crocus vernus* Hill subsp. *vernus* Hill.
      2. *Crocus tommasinianus* Herbert
      3. *Crocus kosaninii* Pulevic

B. Section *Nudiscapus* Mathew 1982.
   b. series *Reticulati* Mathew 1982.
      4. *Crocus veluchensis* Herb.
      5. *Crocus reticulatus* Steven.
   c. series *Biflori* Mathew 1982.
      6. *Crocus chrysanthus* Herb.
      7. *Crocus pallidus* Kitanov et Drenovski 1975.
      8. *Crocus adami* Gay
   d. series *Flavi* Mathew 1982.
      9. *Crocus flavus* (L.) Hill.

SERIES *VERNI* Mathew 1982.

1. *Crocus vernus* Hill 1765. – spring saffron

Distribution: West Serbia: Gučevo, Zlatibor, Crni Vrh, Zlatar, Studena mountain, Goč, Željin, Kraljevo, Stolovi, Kopaonik, Mokra Gora, Hajla etc. Central Serbia: Rudnik (Gornji Milanovac), Kosmaj (Velika Ivanča, Ratari, Rajkovac, Zagorica, Jagnjilo, Kopljare), Rudnik (Aranđelovačka bath) (Randđ. et al. 1990).
Flowering time: from February to April (May), fruiting from June to August.
Biotope: at alpine, subalpine and mountain meadows, in forests and bush woods of mountain beech.
General distribution: South-Eastern Europe to North-Western Macedonia.
Variability: Besides typical species var. *vernus*, the next three varieties can be found: *minoriflorus, albidus* and *jocici.* The typical species var. *vernus* can be found on all territory of Western Serbia as like as the variety var. *albiflorus* N. Randđ. 2008. with white flowers, than the variety with white flowers but with purple heart-like ornament at outer leaves of perigon var. *jocici* N. Randđ. 2008., and the variety with small flowers in alpine areas var. *minoriflorus* Borb. ex Prod. (Mokra Gora).

2. *Crocus tommasinianus* Herbert 1847. – Tomassini's saffron

Distribution: Kragujevac (Beloševac, Popova šuma, Košutnjak, Dobro Polje, Paškov Izvor, Lovačka Češma, Tumbas and Bukurevac), Košutnjak near Karujevac, Gledićke mountains: Oparić, Sugubina (Pančić, 1874); Konjuh and Lazarevac, Vrba near Vrnjačka bath, Ćićevac near Stalać (N. Randđ. et al., 1990).
Flowering time: February, April, fruiting: June and July.
Biotope: in oak zone (*Quercetum frainetto-cerris*) and acacia plantations.
General distribution: Balkan Peninsula (Serbia, Bulgaria, Montenegro, Croatia, Macedonia), and Hungary.
Variability: Besides typical species, the variety var. *jeremici* (Randđ., 1990) with white flowers can be found.

3. *Crocus kosanii* Pulević 1976. – Košanin's saffron

Distribution: In explored area, it can be found at springs of Lab and Sitnica, at locality Štimlje and whole Lipovica (Randđ. et al., 1990), Majdan (Randđ., 1982), Brezanci near Vučitrn (Košanin, 1926. sub *C. heuffelianus* Herb.). The populations on the peak of Majdan mountain are small, but the populations at Lipovica are very good and big. The populations near Vučitrn must be checked, because no one describes them after Košanin.
Flowering time: from February to April (May), fruiting from June to August.
Biotope: In explored area, it grows at oak forests and bush woods.
General distribution: Serbia.
Variability: In explored area, besides typical species with purple flowers, the individuals with white flowers var. *albidus* N. Randđ. 2008. and individuals with purple-blue-white leaves of perigon var. *jovanovici s* N. Randđ. 2008. can be found also.

SERIES *RETICULATI* Mathew 1982.

4. *Crocus veluchensis* Herbert 1845. – Balkan saffron

Distribution: In the basin of these rivers, we saw the Balkan saffron only on Kopaonik, at the highest peaks. The North-Western and North-Eastern parts of the biggest Serbian mountain.

Flowering time: from March to July, fruiting from July to September.
Biotope: at alpine, subalpine and mountain meadows, in forests and bush woods of mountain beech.
General distribution: Balkan peninsula.
Variability: The considerable equability rules.

5. *Crocus reticulatus* Steven ex Adamas 1805. – Weblike saffron

Distribution: The very nice populations of this species were found by S. Jocić on one hill near Rakovica (Avala), the verbally notice, although the last information of this species existence was given by Maw, on 1886.
Flowering time: from February to March, fruiting from April to May.
Biotope: at steppe pastures.
General distribution: With disjoint areal: Bulgaria, Serbia, Macedonia, Italy, Croatia, Slovenia, Hungary, Romania, Russia and Turkey.
Variability: The considerable equability rules.

SERIES *BIFLORI* Mathew 1982.

6. *Crocus chrysanthus* (Herb.) Herbert 1843.

Distribution: Tara (BEO), Stolovi (BEO), Zlatibor (Randđ.), in the valley of Lab and Sitnica (Grmija near Priština; Randđ.), Kopaonik – Oštro Koplje (around Kosovska Mitrovica) Košanin 1926.
The populations of this species in this area are explored well, and on these localities they are in good shape, they are not endangered.
Flowering time: from February to April, fruiting from April to May.
Biotope: at thermophile forest ecosystems and on the pastures made by degradation of them.
General distribution: Balkan peninsula and Asia Minor.

7. *Crocus pallidus* Kitanov et Drenkovski 1975. Blanky-yellow saffron.

Distribution: Grmija (Priština, Randđ. et al., 1990), leg. N. Randđelović and Z. Krivošej.
On Grmija, the small mixed population of species *C. chrysantheus* and *C. pallidus* can be found. It belongs to category of rare species on this locality.
Flowering time: from March to May, fruiting from April to June.
Biotope: in small white beech and oak forests and at pastures.
General distribution: Serbia, Macedonia and Bulgaria.

8. *Crocus adamii* Gay 1831. Adam's saffron.

Distribution: We suppose that it can be found on Kučaj mountains and on Beljanica. This supposition must be proven.
Flowering time: from February to April, fruiting from March to May.
Biotope: it grows on hill pastures and thermophile bush woods, and in mountain region at beech forests and meadows.
General distribution: Serbia, Macedonia, Bulgaria, Turkey, Iran, Russia.

SERIES *FLAVI* Mathew 1982.

9. *Crocus flavus* Weston 1771. Moesia's saffron

Distribution: Gazimestan (leg. N. Randđ. et Z. Krivošej). This is not enough chorological explored species.
Flowering time: from March to May, fruiting from May to July.

Biotope: the forests of oak, bitter oak and secondary vegetation developed in biotope of that forest.
General distribution: Serbia, Macedonia, Bulgaria, Greece, Romania and Turkey.

CONCLUSIONS

Zapadna and Velika Morava with their tributaries are waters that covers around half of territory of Serbia. This region starts from Prokletije (Mokra Gora, Žljeb and Hajla), Tara, Zlatibor, across Užice, Kragujevac, to Belgrade. In this area we found the next species of saffron: *C. vernus, C. tommasinianus, C. kosaninii, C. veluchensis, C. reticulatus, C. chrysanthus, C. pallidus* and *C. flavus.*

The species *C. tommasinianus, C. kosanii, C. veluchensis* and *C. pallidus* are endemics of Balkan Peninsula.

The species *C. chrysanthus* and *C. flavus* are not enough chorological explored species.

The next species grow in hilly regions: *C. vernus, C. tammasinianus, C. kosaninii, C. reticulatus, C. pallidus* and *C. flavus*.

The next species grow at subalpine and alpine areas: *C. veluchensis, C. kosaninii* and *C. vernus*.

REFRENCES

1. Mathew, B., 1983: The Crocus L. Revision of the Genus Crocus L. (Iridaceae). B. T. Batsford. London.
2. Pulević, V. 1976: Revizija Genusa Crocus L. u Jugoslaviji. PhD dissertation. Biotehnička fakulteta. Ljubljana.
3. Ranđelović, N., Hill, D., A., Ranđelović, V., 1990: The Genus Cocis L. Serbia. SANU. The Book 66. The Special Editions. Belgrade.
4. Ranđelović, N., Sekovski, Ž., Dimeska, G., 2007: Systematic, chorological and genetics research into the Genus Crocus L. in Macedonia. MANU. The special edition dedicated to Academic K. Micevski, 97-131. Skopje.
5. Ranđelović, N., et al., 2009: Stanje populacija roda Crocus L. u jugoistočnoj Makedoniji. The Collection of papers Ekološka istina. Kladovo. pp. 49-52.
6. Ranđelović, N., et al., 2008: Populacije vrsta roda Crocus L. u slivu reke Toplice. The Collection of papers Ekološka istina. Sokobanja. pp. 70-75.
7. Ranđelović, N. et al. 2010: The species populations of Genus Crocus L. in the river basin of Nisava. The Collection of papers Ekološka istina.. pp. 403-407.Banja Januković.

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GEOHERITAGE SITES OF FRUŠKA GORA MOUNTAIN AND METHODS OF THEIR GEOLOGICAL INVESTIGATIONS

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ABSTRACT

As result of long tradition of geological investigations of Fruška Gora mountain as well as great geological diversity, total of ten important geosites are enlisted in the paper. According to scientific, educational and aesthetic values, they are recognized as geoheritage objects. They are situated not only in area of Nature Park "Fruška Gora" but also outside of protected area. Some sites are still undergo geological investigations. Because of protection measures, field methodology therefore has to be chosen according to protection procedure also. Beside of sites which were situated in active quarries, loess sections are under extensive investigations. Likely, petrological properties of loess and rapid erosion processes might annulated nature disturbance in quite short period.

Key words: Geoheritage, Fruška Gora, geological investigations, environment protection

INTRODUCTION

Fruška Gora is low, isolated, horst mountain rising above the Pannonian plain in northern Serbia, with the highest peak at 539m a.s.l. (Crveni Čot). According to recently developed models, Fruška Gora could have been young (Late Pliocene/Early Quaternary) push-up structure [1,2,3].

The geological composition of Fruška Gora is very complex but almost unreachable for direct observation due to its soil and vegetation cover. Therefore, the sites on which geological formations are visible, are very important for understandig origin and evolution of the mountain. Some of these sites can be recognized as geoheritage, regardless of their position in the area of National Park „Fruška Gora" or outside broadly protected zone. Methods of geological researches for geoheritage sites must be agreed with nature protection regulations.

GEOHERITAGE OF FRUŠKA GORA MOUNTAIN

Geoheritage represents a group of all geological, gemorphological, pedological and particularly arheological features that are of great scientific and cultural importance [4]. Geoheritage sites of Fruška Gora mountain can be selected on the following criteria: scientific importance, educational significance, degree of preservation, aesthetic attraction and approachability for visitors [5]. Geoheritage sites listed below are geological objects chosen according to scientific and education significance, aesthetic attraction and approachability (Figure 1).

1. The palaeontological site Grgeteg

The site is located on southern slopes of Fruška Gora Mnt., next to Grgeteg monastery.

Succsession of Sarmatian, Pannonian and Upper Pontian sediments were discovered here, including yellowish and whitish marls, marly clays, gray sandy clays, alevrite sands and conglomerates.

An abundant malacofauna of caspi-brackish mollusks was recorded at the locality and studied in details. So far the research included over 40 species of gastropods and bivalves. Moreover, 12 species were firstly determined here.

The presence of a large number of species of freshwater fauna points to the coastal character of sediments. Recently, some detailed palinological studies proved existence of warm-temperate to slightly subtropical climate [6, 7].

Level of protection: Nature Monument (1973); Importance: European

2. Locality of volcanic tuff near Rakovac village – "Galerija"

The zone of volcanic (dacite) tuff is recorded in several localities on the northern slopes of Fruska Gora mountain. Outcrops were situated near Bukovac, Beočin monastery, Stari Ledinci, Stari Rakovac. Dacite tuffs are results of Middle Miocene volcanic activities and tectonic events in Fruska Gora area.

The most instructive site is "Galerija", located on the southern edge of Rakovac village.

Identical succession of tuffous marls and sandstones limestones ("Leithakalk"), sandstones and tuffs from the upper level of Lower Badenian is characteristic for all mentioned sites. At the "Galerija" site tuff layer is about 8m thick. A lot of well preserved microfossils were found here– mainly foraminifera and algae [6, 5, 7]

Level of protection: Nature Monument (1982); Importance: National

3. Palaeontological site „Filijala"

Filijala is situated in a cement marls quarry on the hill SE from Beočin village. The present-day quarry is situated next to the former Austrian site "Filiijal" which profile is published by A. Koch [8, 9].

At the 80 m thick outcrop, sediments of Pannonian and Pontian were recorded. Four horizons were recognized in litological column. Above the fourth Pannonian horizon, lies a ferruginous sandy bank with characteristic of Upper Pontian mollusks and gray, grayish yellow and reddish Pliocene sand.

In the international stratigraphy of Neogene of central Paratethys, the profile with the exposed Pannonian marsl at Filijala was separated as a facies stratotype of Pannonian Stratum in the marl development type [10, 11].

Both, micro and macro fosills were found here, including fishes and tortoises sceletons.

Despite that the outcrop is situated in an active quarry, on the northern side, one column with seven levels were chosen for conservation [5].

Level of protectin: in the procedure; Inportance: European

4. Palaeontological site Čerević brook

In the valley of Čerević brook and its spring legs, Orlovac and Dobri brook, the most completed sequence of Upper Cretaceous sediments was found. The history of palaeontological researches of this site dates more than 150 years. Fossils collection from Čerević brook represents the richiest Maastrichtian fauna in Serbia with overall of 127 species. The most important part of the collection is exhibited in the Natural History Museum in Budapest, and the rest of the collection is exhibited in the Heritage Museum in Čerević [5, 11].

Level of protection: in frame of „Fruška gora" National Park; Importance: National

5. Gem raw deposit Kozje brdo

The Kozje brdo deposit of gem raw materials is located about 2,5 km NNW from the Crveni Čot (539m a.s.l.). This deposit is represented by two basic gem raw materials: chalcedony and carbonate-silica breccia with agate, and small quantities of red-brownish jasper. Deposit was formed in intensely altered and tectonically shattered seprentinite.

The bluish transparent chalcedony is the most beautiful, but the rarest one. Violet chlacedony is very atractive, usually transparent, with slightly expressed pattern. The colourless chalcedony occurs more frequently, usually in form of irregular veinlets, thickness 0,5-1cm [12].

Level of protection: in frame of „Fruška gora" National Park; Importance: National

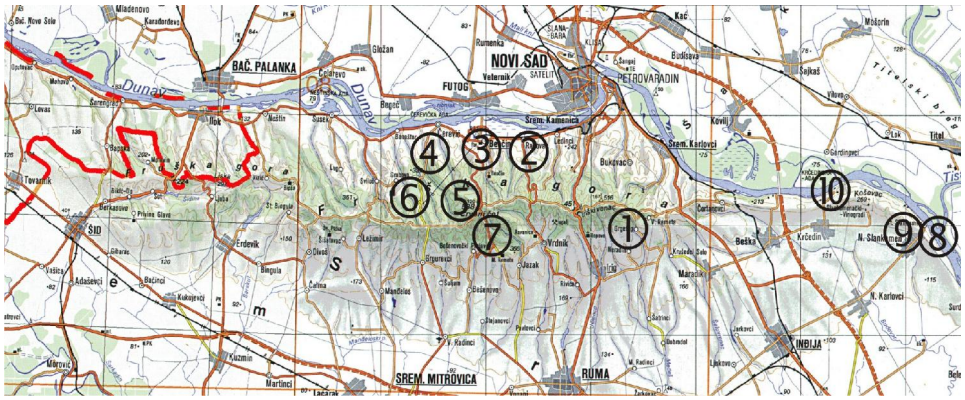

Figure 1. The position of Geoheritage sites of Fruška Gora mentioned in the paper (Numbering according to their appearance)

6. Srednje brdo quarry

The site is located near Andrevlje village and it is approachable from the southern and the northern side. During the stone exploatation, Cretaceous limestones were found here, depositted in relatively deep and calm water. Except sedimentary characteristics, it is indicated by marine planktonic fauna structure. They are strongly tectonicaly disturbed, and except special instructive characteristics, this site has ambiental value as well [6, 13].

Level of protection: in frame of „Fruška gora" National Park; Importance: National

7. Limestone quarry Beli kamen

Beli kamen is abandoned limestone quarry, situated SE from Bešenovo village. Quarry is currently under a process of re-cultivation.

Thick Middle Miocene limestone (Leithakalk), massive, reefy, developed by life activities of algae *Lithotamnium*, foraminifers and bryozoans, are exposed on N side of quarry. Numerous fossil of mollusks, remains of sea urchins and corals are visible on the quarry surface. On the opposite side, at the same altitude, heterogeneous sediments know as "Srem series" [14] are exposed. These sediments represents polygenetic belt which covers slopes of Fruska Gora mountain, formed in torrent streams fan deltas and complex alluvial fans in period of strongest uplift of Fruška Gora horst.

Level of protection: /; Importance: National

8. Loess section Stari Slankamen – Čot

Čot loess section is situated in the eastern part of the Srem Loess Plateau, on the right bank of the Danube river, opposite the Tisa river junction. The loess sequence is comprised of multiple couplets of loess and palaesol units totaling approximately 40m thickness of sediments. 8 palaesol units can be distinguishly separated by several meters thick loess layers. According to reccognized Matuyama-Brunhes palaeomagnetic boundary (MBB), the oldest loess-paleosol layer were formed more than 1 Ma. Čot site is one of the most important loess-paleosol section (LPSS) for reconstruction of global palaeoclimatic and palaeoenvironment reconstruction on Euroasian continent. Moreover, the site is one of the key section for global chronostratigraphic correlation of LPSSs [15]

Level of protection: in procedure; Importance: Global

9. Loess site in gully between Novi- and Stari Slankamen

Outcrop is situated in loess gully between Novi- and Stari Slankamen. It was the first loess section from the area which were presented to the international geological community during 11th IGC Congress which was held in Stokholm, 1910 [16, 17]. In total five fossil pedocomplexes were recognized, and those below erosion level (marked by gravel horizon) are tectonically disturbed. Because of long history of research, great aesthetic and education value, the site was the first and still only protected loess section in Jugoslavia/Serbia.

Level of protection: Nature monument (1975); Importance: Regional

10. Palaentological site Janda

The site is situated on the right bank of the Danube river, between the village of Krčedin and Stari Slankamen.

In the cca 20m thick Oligocene sedimentary series, which contains conglomerates, coarse-grained sandstones, with lenses of alevrolites and claystones, deposited in conditions of a very high-energy fluvial environment, very rich palaeoflora is preserved. In the recently collected more than 1500 leaf imprints, predominated are trifoliate leaves of *Platanus neptuni* mf. *fraxinifolia*, *Lauraceae (laurels)*, *Cupressaceae* (conifers) and *Arecaceae (palms)*. Collected association inhabited warm humid haitats of subropicum [18].

Level of protection: in frame of „Fruška gora" National Park; Importance: National

GEOLOGICAL INVESTIGATIONS OF FRUŠKA GORA

Geological investigations of Fruška Gora has a long tradition. The promising geological prospecting that had begun at the turn of the 18th and 19th centuries ceased all over the former Habsburg Empire following the economic decline due to the Napoleonic wars. Between 1710 and 1850 the Royal Court in Vienna paid more attention to mining than any other branch of industry. Therefore contemporaneous geological literature discussed mineral localities only [19]. Several "geologic"and "geognostic" maps appears in that time on which Fruška Gora was mapped also (F.S. Beudant, 1818/1823; Haidinger, 1845; Hauer 1867-1871). Mineral resources as brown coal in Vrdnik basin, cement marls and limestone near Beočin where extensively exploited, as well as loess-like sediments near Čerević village and Sremski Karlovci in more recent times.

Since 1960 Fruška Gora is proclaimed as Nature Park with very strict measures of protection or conservation. Some of sites which were under exploatation now are under protection (Filijala, Kozje brdo), and some are in procedure.

Nevertheless, out of excavations areas degradation of nature as result of geological investigations eminently were stopped. Recent borehole drillings and palaeomagnetic researches of some Neogene and Mezozoic formations cannot disturb nature environment.

Contrastingly, due to methodology and petrological characteristics of loess, nature disturbance has greater extent. These investigations (rock magnetic, palaeomagnetic, sedimentological, absolute dating...) were inevitable because of great scientific interests for loess studies. Moreover, due to rapid erosion processes which affect loess sediments, consequences of field investigations will be annulated in short period. As an illustration, trenches which were digged in the base of Čot loess section after three years are almost completely covered by slope material.

As a result of recent loess researches great scientific and education importance for many loess sections has be recognized. Many of them, not only on Fruška Gora, will be under protection measures.

CONCLUSIONS

Geological investigations of Fruška Gora has a long tradition - from the 18th and 19th centuries. In the beginning, it was for sake of mineral resources prospecting. Good results of these investigations and industry demands, led to extensive exploitations, especial in Vrdnik brown coal basin and in vicinity of Beočin. Thanks to detailed geological studies and great diversity of geological formation, some localities on Fruška Gora were recognized as geoheritage objects. Geoheritage sites were chosen according to their great scientific, educational and aesthetic value. Some sites are still undergo geological investigations. Because of protection measures in National Park, field methodology therefore has to be chosen according to protection procedure also. Beside of sites which were situated in active quarries, loess sections are under extensive investigations. Likely, petrological properties of loess and rapid erosion processes might annulated nature disturbance in quite short period.

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REFERENCES

1. Horvath, F., Cloetingh, S.A.P.L. Stress – induced late stage subsidence anomalies in the Pannonian basin. Tectonophysics, 266: 287-300, 1996.
2. Marović, M., Krstić, N., Stanić, S., Cvetković, V., Petrović, M. The evolution of Neogene sedimentation provinces of Central Balkan Peninsula. Bull. of Geoinstitute, vol. 36: 25-94, 1999.
3. Marović, M., Toljić, M., Rundić, Lj, Milivojević, J. Neoalpine Tectonics of Serbia. Serbian Geological Society, Belgrade: 1-87, 2007.
4. Mijović, D., Marković, S. B., Marinčić, S. Šehovac, E., Miličić, O., Panić, N, Stojčić, V., Milić, R. Geo trip 99 - Fruška Gora. Nature protection survey, National Commity for Geoheritage conservation, Belgrade (in Serbian), 1999.
5. Mijović, D., Miljanović, D. Scientific and educational criteria geoheritage evaluation in planning the protection of natural landscapes. Protection of nature, 51(2): 133-139, 1999.
6. Stevanović, P. (1977): Kenozoik – Geology of Serbia, II (3). Mining-geological Faculty, Belgrade: 1-443 (in Serbian)
7. Knežević, S. Neogene sites on Fruška Gora Mt. Protection of Nature, 48/49: 275-283 (in Serbian), 1995/97.
8. Koch, A. Geologie der Fruskagora. Math. Naturwiss. Beriche aus Ungarn, Bd. XIII, Budapest, 1896.
9. Koch, A. Neuere Beitrage zu der geo-paleontologischen Verhaltnissen des Beocsiner Cementmergels. Fulut, Kozl. 32, Budapest, 1902.

10. Stevanović, P., Papp, A. Beočin, Syrmien (Jugoslawien), Chronostratigraphie und Neostratotypen. Miozan der Zentralen Paratethys, M-6, Pannonien (Slavonian und Serbien), bd. VII, 205-255, Budapest, 1985.
11. Rundić, Lj., Dulić., I., Knežević, S., Bogićević, G., Gajić, V., Cvijić, P. (editors) The first International workshop: Neogene of Central and Southeastern Europe – Field guide, Serbian Geological Society 1-31.
12. Ilich M., Toshovich R., Miladinovich Z., Antonovich A., Gem Raw Materials of the Frushka Gora Mountain (Serbia). Geological Characteristics and Economic Significance of Deposits, Geologica Carpatica, vol. 53, special issue (CD ROM), 6 p., Bratislava, 2002.
13. Jovanović, M. Geoheritage sites in Nature protected areas of Vojvodina (N Serbia). In: A feasibility study of eco-tourism development in Nature protected areas in Vojvodina (N Serbia) (Editor: Stojanović, V) (in Serbian with English sumamry), *in press*.
14. Rakić, M. Contribution to knowledge of Pleistocene on the southern slopes of Fruška Gora mountain. Zapisnici SGD, 1972: 27-33, Belgrade (in Serbian), 1973.
15. Marković, S.B., Hambach, U., Stevens, T., Kukla, G.J., Heller, F., McCoy, W., Oches, E.A, Buggle, B., Zöller, L. The last million years recorded at the Stari Slankamen (Northern Serbia) loess-palaeosol sequence: revised chronostratigraphy and long-term environmental trends. Quaternary Science Reviews, *in press.*
16. Gorijanović-Kranberger, D. Uber eine diluviale Storung im Loss von Stari Slankamen in Slavonien. Comte Rendu du XI Congres Geologique International: 1055-1061, 1910.
17. Jovanović, M., Zvizdić, O. Geoheritage of leoss sites in Vojvodina. DMI „Branislav Bukurov", Novi Sad: 1-109, 2009.
18. Milutinović-Đorđević, D., Dulić, I. Leaf polymorphism of *Platanus neptuni* Mf. *Fraxinifolia* (Johnson & Gilmore) Kvaček & Manchester from Oligocene deposits at Janda (Mt. Fruška Gora, Serbia). Bulletin of the Natural History Museum, 2009, 2: 7-33, 2009.
19. Gaudenyi, T., Jovanović, M. Franz Ritter von Hauer's work and the first loess map of Central Europe. Quaternary International, 234, 1-2: 4-9, 2011

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SPATIAL DISTRIBUTION OF TREES AS THE ELEMENT OF PURE BEECH STANDS STRUCTURE AND DIVERSITY IN THE REGION JUŽNI KUČAJ

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ABSTRACT

This paper deals with the spatial distribution of beech trees in the largest complex of pure beech forest in Serbia. The following approaches were applied: distance based spatial indices (Clark-Evans index, the index of dispersion I and index of spatial pattern C) and the second-order spatial statistics (K- and L-function). Spatial patterns indicate that beech trees have a tendency to be randomly dispersed in their immediate vicinity, but with increasing distance from the tree it begins to drift towards uniformity. It can be concluded that in the studied stands the basic conditions of thetree growth are uniform and optimal.

Key words: spatial distribution of trees, stand structure and diversity, beech

INTRODUCTION

Quantitative data on forest stand structure are essential inputs for understanding ecosystem structure and functioning, and hence for sustainable forest management (Kint et al. 2003). In Serbian forestry, stand structure can be conventionally assessed by mean and summary stand parameters and by analysing distribution of certain elements of growth, as well as their comparison with the theoretical distributions (Stajić, Vučković 2007). However, this approach ignores the spatial dimension of the stand structure, because the structure of any population is a three-dimensional phenomenon with horizontal and vertical components. For this reason, the forest structure has been described, in the most general terms, as the distribution of biomass in space, that is, a vertical and horizontal spatial arrangement of plant species, plant sizes, or age distributions (Zenner, Hibbs 2002).

The spatial distribution of plants is an important characteristic of ecological communities (Kershaw 1973, Payandeh 1970, Ludwig, Reynolds 1988). Except for structural researches, the importance of spatial distribution of trees within forest stands has been widely recognized in other aspects of forest growth investigations, e. g. in the studies of intertree competition and in the construction of tree growth models and simulators. The knowledge of spatial distribution of trees in forests is also important

from the forest inventory (Schreuder et al. 1993, Šmelko 1993), managament (Gadow 1993) and silviculture (Ferlin, Bobinac 1999) point of view.

In the forestry research in our country, spatial distribution of trees, as a characteristic of stand structure, has so far been evaluated visually and without a precise quantification. The numerical description of the form of spatial distribution of forest trees hasn't been often used in the researches of forest structure in Serbia (Stajić, Vučković 2006, Stajić et al. 2009). In this context, the aim of this study is to make a numerical desription of the spatial pattern of beech trees distribution in the region Južni Kučaj, which is the largest beech forest complex in Serbia. In this region, beech grows in optimal conditions and tends to build large pure stands.

As the study results can depend on the sample size or the applied method, the final conclusion on the form of spatial distribution of trees was based on the implementation and analysis of different methods.

MATERIALS AND METHODS

Experimental plots (4 sample plots of 0,2 ha) were sampled in thesouth-western part of the Južni Kučaj Mountains, in the MU "Valkaluci-Nekudovo". This management unit ranges from 19˚19' - 19˚27' of east longitude and from 43˚58' - 44˚02' of north latitude. The plots were sampled so as to represent typical conditions in these forests (*Fagetum moesiacae montanum*). Two of these plots were positioned in the forests on limestone (Ls1, Ls2) and others in the forests on phyllites (Ph1, Ph2).

The relative coordinates of the center in the space were determined for each tree on the experimental plot by using the level. These measurements were then used to map the trees in space. (Figure 1). On the basis of the defined relative coordinates, all the relevant data necessary for the application of different methods for quantification of spatial distribution of beech trees were determined in the developmental environment *Dev* CPP and the computer language C++ within it.

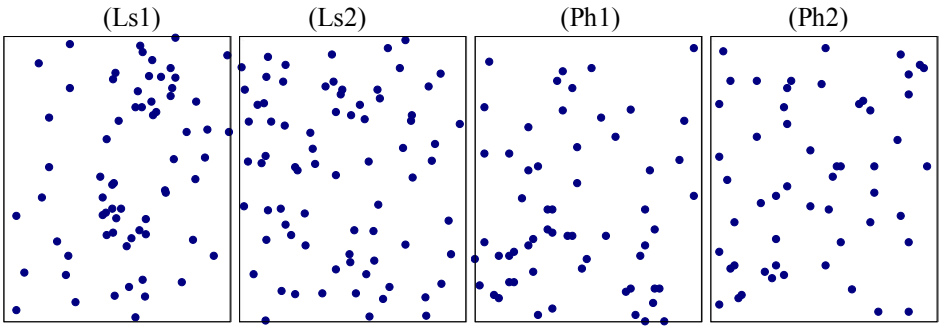

Figure 1. Tree location maps for plots on limestone (Ls 1, Ls 2) and on phyllites (Ph1, Ph2)

Indices and functions for the spatial pattern analysis were calculated from the plots' tree maps (Figure 1). The general trend of the spatial arrangement of the trees is determined with the distance based spatial indices. The following indices were used: (1)

R-index (Clark, Evans, 1954), (2) I-index of dispersion (Johnson, Zimmer, 1985) and (3) C-index of spatial pattern (Diggle *et al.*, 1976):

1. $R = \frac{\bar{r}_A}{\bar{r}_E}$,

   where: $\bar{r}_A$ - the average distance between a tree and its nearest neighbor and $\bar{r}_E$ – the expected mean distance if trees were randomly distributed.

2. $I = \frac{(r+1)\cdot \sum_{i=1}^{r} V_i^2}{(\sum_{i=1}^{r} V_i)^2}$

where r is the total number of random points, V_i is the volume of the m-dimensional sphere having radius equal to R_i, i = 1, 2, ..., r.

3. $C = \frac{\sum_{i=1}^{N}\left[x_i^2 /(x_i^2 + \frac{1}{2} y_i^2) \right]}{N}$

where N is the total number of sample points, x_i – point-to-tree distances, y_i – tree-to-nearest neighbor distances.

After determining the general trend with the spatial indices, a more detailed analysis is performed with Ripley's (1977) K function and its linear form by Besag's (1977) L function. A circle of constantly increasing radius is drawn around every tree of the plot. Then, all the trees inside of the circle are counted, excluding the base tree, and divided by the plot's average density (λ), giving us a K estimates for that tree and radius.

$$K(r) = \frac{n_r}{\lambda}$$

Here, n_r is the observed number of trees inside the circle with the center at the tree's base point and radius r. After calculating the K estimates for all trees their unbiased average gives us K estimate of that plot for any chosen radius r with the summary equation (Ripley, 1977):

$K(r) = \sum_{i=1}^{N} k_i(x,y) v(E) N^{-2}$, which is equal to $K(r) = \frac{1}{\lambda} \frac{\sum_{i=1}^{N} k_i(x,y)}{N}$, if $\lambda = N / v(E)$.

In the above expression $k_i(x,y)$ is equal to the number of trees inside the circle which has a center in the coordinates in the base of the tree *i* and radius r. Estimated values of K(r) are than compared with theoretical values for Poisson random distribution:

$K(r) = \pi \cdot r^2, \quad r \geq 0$

Besag (1977) showed that K estimates can be transformed in order to get a linear form of the K function. With K function's linearization, the interpretation of the

results has become much easier, because it is easier to spot deviations from the linear function than from the parabola.

$$L(r) = \sqrt{\frac{K(r)}{\pi}}$$

If K(r) and L(r) are above the expected values, the distribution is aggregated. Smaller values indicate a uniform spatial pattern of the observed point pattern.

RESULTS AND DISCUSION

The basic stand growth parameters (Table 1) are conventionally used to describe forest stands. The parameters used in this study are: number of trees per hectare (N), mean diameter (dg), basal area (G), mean height (hg) and total volume of stands per hectare (V).

The mean volume of limestone stands is 371 m^3 and of phyllites stands 519 m^3. The phyllite stands have a smaller average number of trees per hectare (231) than the limestone stands (346). The average tree dimensions (dg, hg) of the phyllite stands are larger than those in limestone stands (Table 1).

Table 1. Basic stand growth elements

	Ls1	**Ls2**	**Ph1**	**Ph2**
N/ha	335	357	268	193
dg [cm]	30.6	31.1	39.5	41.7
G [m^2]	25	27	40	33
hg [m]	27.8	27.6	30	28.3
V [m^3]	357	385	563	475

On the basis of the survey data, the trees were plotted into two dimensional maps (Figure 1). These maps were treated as observed point processes and their departure from Poisson (Random) point process was tested. The trees and the points that were near the edge of the plots were excluded from the calculations since there was a possibility that their nearest neighbors were outside the plot borders. The width of this buffer zone is 5 m, since that is approximately the maximal distance from a tree to its nearest neighbor.

Table 2. Values of the analysed spatial indices and the applied statistics

Plot	Clark-Evans		Johnson-Zimmer		Diggle et al.	
	R	c	I	z	C	z
Ls1	1.19	2.74	1.38	-4.45	0,59	5.59
Ls2	1.15	2.19	1.40	-4.34	0,55	2.93
Ph1	1.14	1.79	1.53	-3.41	0,54	2.14
Ph2	1.12	1.57	1.30	-5.04	0,55	2.87

For all four plots, the values of computed spatial indices, the standard variate from the normal curve (c) and z-statistic are illustrated in Table 2.

The values of *Clark Evans index R* indicate that both the limestone and the phyllite stands tend to have uniform distribution. The significance of the departure of $\bar{r}_A$

from $\bar{r}_E$ is tested by the normal curve (c-values). The computed c-value in the phyllite stands is smaller than the c-value of 1.96 and 2.58 (the 5 per cent and the 1 per cent levels of significance, for a two-tailed test), indicating no significant departure from randomness toward uniformity. For the trees of both limestone stands, a significant deviation from randomness in the direction of uniform spacing is concluded, because the difference was shown to be significant at the 5 per cent level significance by the c test (Table 2).

The index of dispersion I and the index of spatial pattern C disagree with each other, as well as with Clark Evans index. Namely, values of I index indicate that all stands are uniformly distributed, in contrast to values of C-index indicating clumping in all stands.

It's obvious that we will need more powerful tests in order to understand spatial patterns in the studied forest stands. For this reason, the spatial pattern of trees was also evaluated in terms of second-order statistics. The second-order spatial statistics test spatial randomness of all trees within a given distance. The statistics used in this analysis were Ripley's (1977) K function and its linear form by Besag's (1977), L function. These functions estimate the average change of spatial trend with the increasing distance (r) from the tree's base points (Pretzsch, 2009).

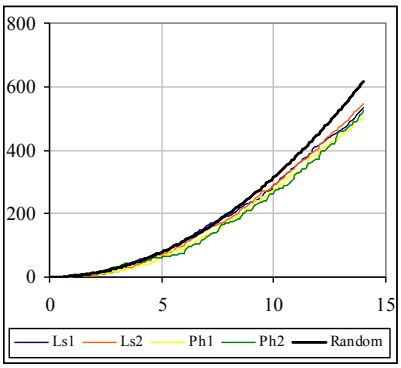

Figure 2. K functions

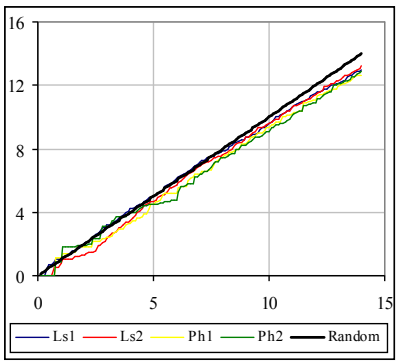

Figure 3. L functions

The stands' spatial pattern is random in the immediate neighborhood of trees. However, with increasing distance from the tree, it begins to drift towards uniformity. Distance based indices cannot detect these changes on their own, since they quantify the spatial pattern with a single value and a single type of distribution. Their value will depend on the scale of their observations, i.e. the mean value of the used distances.

CONCLUSIONS

From this study we have made the following conclusions:

1. Beech trees in pure stands have a tendency to be randomly dispersed in their immediate vicinity. Further away trees dispersion drifts towards uniformity.

This spatial pattern in forest ecology is an indication of optimal ecological conditions in the stands for observed species. Thus this research indicates that the beech in the region of Južni Kučaj grows in optimal conditions.

2. The complex spatial patterns are not identifiable with simple distance based indices. Correlation functions (K and L) are able to identify subtle changes in spatial patterns and identify them even if they are complex. Thus, we would have to recommend using those functions whenever it's possible.
3. Spatial distribution of trees has important effects on a variety of physical and ecological processes in a forest stand including inter-tree competition, tree size variability and distribution as well as the growth and development of trees.

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REFERENCES

1. Besag J. E. (1977): Comments on Ripley's paper. Journal of the Royal Statistical Society, Series B (Methodological), Vol. 39, No. 2, pp. 193-195
2. Clark P. J., Evans F. C. (1954): Distance to nearest neighbour as a measure of spatial relationships in populations. Ecology 35: 445 – 453
3. Diggle P.J., Besag J., Gleaves J. T. (1976): Statistical analysis of spatial point patterns by means of distance methods. Biometrics 32: 659-667
4. Ferlin F., Bobinac M. (1999): Natural structure development and social rank changes in younger, untended pedunculate oak stands. Allgemeine Forst und Jagdzeitung 170, Num 8, pp. 137-142
5. Gadow K. V. (1993): Zur Bestandesbeschreibung in der Forsteinrichtung, Forst und Holz 48, (602-606)
6. Johnson R. B., Zimmer W. J. (1985): A more powerful test for dispersion using distance measurements. Ecology 66: 1669-1675.
7. Kershaw K. A. (1973): Quantitative and Dynamic Plant Ecology. Second edition, Edward Arnold, London
8. Kint V., Van Meirvenne M., Nachtergale L., Geudens G., Lust N. (2003): Spatial Methods for Quantifying Forest Stand Structure Development: A Comparison Between Nearest-Neighbor Indices and Variogram Analysis. Forest Science 49, Number 1, pp. 36-49
9. Ludwig J. A., Reynolds, J. F. (1988): Statistical Ecology. San Diego State University, John Wiley, New York-Chichester-Brisbane-Toronto-Singapore
10. Pretzsch H. (2009): Forest Dynamics, Growth and Yield: From Measurement to Model. Springer-Verlag Berlin Heiderberg
11. Ripley B.D. (1977): Modelling spatial patterns. Journal of the Royal Statistical Society, Series B (Methodological), Vol. 39, No. 2, pp. 172-212.
12. Стајић Б., Вучковић М. (2006): Анализа просторног распореда стабала у шумским састојинама. Гласник Шумарског факултета 93, Београд, (165-176)

13. Стајић, Б., Вучковић М., Смиљанић М. (2009): Просторни распоред стабала смрче у резервату природе 'Јанкове баре' на Копаонику. Гласник Шумарског факултета 100, 191-204.
14. Schreuder H.T., Gregoire T.G., Wood G.B. (1993): Sampling Methods for Multiresource Forest Inventory. A Wiley-Interscience Publication, John Wieley & Sons, New York-Chichester-Brisbane-Toronto
15. Šmelko, S. (1993) Die räumliche Bestandesstruktur und die Genauigkeit der Waldzustandserfassung durch verschiedene Stichprobeninventurverfahren. Deutscher Verband forstlicher Forschungsanstalten, Sektion Forstliche Biometrie und Informatik 6, Tagung, 76-87
16. Zenner, E.K. and D.E. Hibbs (2000): A new method for modeling the heterogeneity of forest structure. Forest Ecology and Management 129:75-87.
17. Стајић Б., Вучковић М. (2007): Структура и диверзитет шумских састојина. Зборник радова: Основне еколошке и структурно производне карактеристике типова шума Ђердапа и Таре. Београд (81-99)

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MODEL OF OPTIMAL INVESTMENTS FOR ACCIDENT SUPPRESSION IN MINES

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ABSTRACT

Determination of optimal investments to attain a maximum safety possibility from accidents in mining objects at occurrence of natural potential dangers which possible lead to mining and ecologic catastrophes in environment, can be solved by application of classical mathematical methods of differential calculus.

Key words: potential dangers, probabilities of safety, mathematical models

INTRODUCTION

Mine accident means manifestation of certain natural potential danger which can cause damage of mine rooms, miners' injuries and shorter or longer period of production interruption or environmental catastrophe. Natural potential source of danger and accidents in mines are:

- Huge cave-in in mine rooms and on surface
- Water and watery material breaks,
- Explosions of explosive systems,
- Endogenous and exogenous fires in mines,
- Breaks of poisoning and suffocating gasses from their collectors

Design of layer's exploitation is performed based on data about layer and data obtained by laboratory research or estimations of ways of occurrences for particular potential natural dangers. In technical project for operational mine safety, an optimal investment policy should be adopted, which will ensure the achievement of satisfactory safety probability from mine accidents caused by particular natural potential sources of danger.

Risk probability from any source of accident depends of its manifestation method in mine and on the earth's surface. If the particular potential treat does not manifested in layer, than probability of danger is equal nil, and investments in protection systems are unnecessary. If natural potential treat is manifested with a lower incidence probability ($p < 0,3$), than the protection system from that source of danger manifestation

should be made, and investments for its acquisition and installation correspond to the probability of safety that it provides, and its reliability and complexity should correspond to the level of expression of risk. If the natural potential source of danger manifests with risk probability $p > 0,8$, to ensure the safety of accident it is necessary to install very complex and expensive protection system, with high reliability of detection, alarming and suppression of the source of danger for which it is intended.

INVESTMENT IN SECURITY SYSTEMS AND PROBABILITY OF SAFETY

For suppression of natural potential hazards expression and accidents occurrences, can be applied different ways and systems for detecting, alarming and control of hazards, which can be divided into four groups. In mines where there is no manifestation of natural potential danger is unnecessary to invest in separate protection system from that risk, and the expenses for installation of protective system equal zero but probability of mine safety from manifestation of such danger and accidents caused is also equal zero. In case that during geological researches is an error committed and that natural hazards could be manifested for which no protection is designed, than probability of accident manifestation from that source of danger is big, i.e. equal to one. In mines where particular natural potential danger is manifested with certain probability (degree) of danger, an appropriate system for detecting, alarming and suppression of danger is installed. Systems efficiency and their probability of safety depend of type of system and technical reliability. All types of systems for detecting, alarming and suppression of accidents at risk manifestation have their price of procurement, installation and use. Depending of installed safety system, a corresponding probability of safety from accidents at manifestation of natural potential danger is achieved. Therefore, it can be established functional connection between security system installation costs and probability of safety from accidents occurrences as follows:

If with T_i is marked an amount of investments for purchase, installation and use of protection system from accidents caused by certain natural potential danger, and with a p_i probability of safety provided by that system (corresponding to T_i). A small change of T_i expressed by differential dt, causes small change dp, quantity of probability of safety p. Relationship dp to dt is proportional to difference between value A - which is maximum probability of safety which can be achieved by installation of protective devices and to which tends: $A = 1$; and pi- which is probability of safety which is achieved by investing of funds T_i, and always is smaller than one. If bigger assets is invested, bigger probability of safety work in mine will be achieved from that hazard, until a maximum probability of safety reaches A, when difference $A - p_i$ will be equal zero. Graf of this function is given in figure 1, representing connection between probabilities of safety of individual security systems, $p_{i,}$ and costs of their acquisition, installation and use T_i.

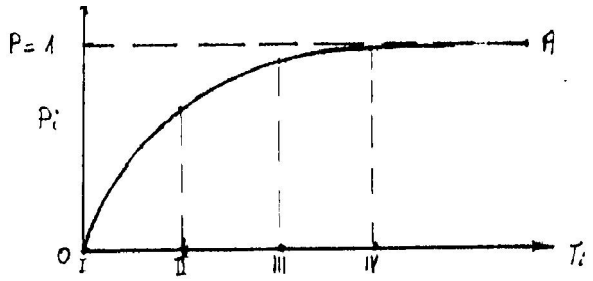

Figure 1. Chart of probability of safety as a function of T_i

Relation dp/dt is proportional to the difference A - p_i, which can be written as:

$$\frac{dp}{dt} = \frac{1}{k}[A - p_i]$$

The equation is a differential equation of first order in which figures function p, its first derivative and the independent variable T_i. Number k is the coefficient of proportionality. It depends of type (way) and applied system for detection, alarming and suppression of manifestation of certain natural potential hazard. For protection of certain natural potential hazard, value for coefficient k is constant. Avoiding to engage into the theory of differential equations, it can be by simple integral determine the size of independent variable T_i, i.e. the amount of investments for purchasing and installing of adequate system for hazard detection, to achieve the probability of safety p, that the designer wants /2/'. Previous function can be written as:

$$\int \frac{dp}{A - p} = \int \frac{1}{k} dt$$

If the integral of the left and right sides of the function it will be obtained, as it must be (A - p)>0:

$$-\log(A - p) = \frac{1}{k}T + c$$

Arbitrary constant C is determined from the condition for T = 0; p = 0, because if there is no built a particular protective system, probability of safety p is zero. From the previous given is C = - log A, and by the replacement of the value C in the function gets:

$$\log A - \log(A - p) = \frac{1}{k}T$$

From these relations can be explicitly expressed procurements for purchase and installation of protection system T_i:

$$T_i = k \log \frac{A}{A - p_i}$$

The relation is a solution of the task and analytical expression of function presented in figure 9.1.10. In the design and analysis of variants of the mine protection, or system selection for protection against certain natural potential danger, is determined primary possibility of protection safety which system has to offer. According to the selected probability of security and selected protection system is determined the amount of required investment for procurement, installation and use of the system. For each type of system can be determined probability of safety given in the literature /3/' or manufacturer's brochures. It depends on type of the system for protection and the probability of technical reliability of the system. Based on these data for each natural potential hazards which may occur in the mine, may be determined a coefficient of proportionality k between the amount of investment in protection systems and probability of safety that is achieved with these investments. Coefficient k has dimensions (din/% p). For security system of certain natural potential danger its value is constant.

Determination of coefficient k can be traced on the example of the cost of procurement, installation and use of the protection system from oxidative processes and the emergence of endogenous fires in mines with self-igniting coal layers. Its size is determined based on functional relationship between costs of procurement, installation and use of system and probability of safety which is thus achieved by. In the design of safety from accidents and for other sources of danger, costs for individual security systems are determiner as variants. Therefore, the proposed formulae can be applied to them, not only in mines but in other industrial objects.

Table 1 shows hypothetical cost for the installation of system for early detection of endogenous fires in mines and protection of them for different categories of manifestation of this danger in coal mines (I; I; III; IV category). Based on these data, using the theory of correlation and theory of lest squares, may be determined coefficient of proportionality k, and then the total cost following the next procedure:

$$f(T_i, k, p_i) = \sum \left(T_i - k \log \frac{A}{A - p_i} \right)^2 \min$$

$$df / dk = 2 \sum \left[T_i - k \log A / (A - p_i) \right] \log A / (A - p_i) = 0$$

$$\sum T_i \log \frac{A}{A - p_i} - k \sum \left(\log \frac{A}{A - p_i} \right)^2 = 0$$

$$k = \frac{\sum T_i \log A / (A - p_i)}{\sum \left[\log A / (A - p_{i)} \right]^2}$$

Table1. Data for determining of coefficient k for the installation of devices for early detection of fires

Methods and systems for the detection and suppression of fire and oxidative processes and categories of efficiency	Installation costs T_i	Probability of safety	lg $A/(A-p_i)$; T_i lg $A/(A-p_i)$; $[\lg A/(A-p_i)]^2$		
Fire detection by senses (cat. I)	0	0	0	0	0
Fire detection by indicators (cat. II)	2000	0,3	0,15490	309,80	0,02399
Automatic detection and prevention (cat. III)	5000	0,5	0,30103	1505,15	0,09062
Automatic detection of fire per year (cat. IV)	10000	0,8	0,69897	6989,70	0,48855
Σ				8804,65	0,60316

On the basis of hypothetical data from table 1 value of coefficient k is determined as k=14597,54. When the coefficient k is known than we can determine the amount of investment for the purchase, installation and use of security system which will has the desired maximum probability of safety. For example: probability of safety for the protection system is wanted to be p = 0,9. To achieve this probability of safety is necessary to invest T = 1459$.

CONCLUSION

Amount of investment to achieve the maximum of probability of safety from mine accidents of certain natural potential danger depends of probability of safety to be achieved. Based on the investment levels for individual security systems, coefficient of proportionality between the cost of installing security system and probability of safety is determined. Based on the known coefficient of proportionality and desired probability of safety from accidents, selection of protection system and determination of costs for purchase, installation and use of security systems in mine is performed.

REFERENCES

1. Časlav Đaja, Higer mathematics, Part I, Scientific book, Belgrade
2. M. Miljković, Probability of activation of minefields at the open pit mines, Ecology, No 1. (Special edition),1999, Belgrade.

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LOW-GRADE MANGANESE ORE BENEFICIATION TECHNOLOGY

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ABSTRACT

The main concern of this study is to find a feasible and economical technology to recover manganese from low-grade manganese ore. Owing to the large quantities of metals that are embodied in low-grade ores and mining residues, these are considered new sources of metals. There is no question that the decrease in the reserves of high-grade manganese ores is making necessary to consider the processing of poor manganese ores. The low-grade ore from Bužim manganese deposit, NW Bosnia were characterized. Based on the particle size distributions, chemical and mineralogical compositions (textural and structural features of main minerals and mineral complexes) and laboratory experimental results it was established the possibilities to produced manganese concentrates with up 30.0% manganese content from low-grade manganese ore. On the basis of test results a new technology for poor manganese ore beneficiation was developed.

Key words: low-grade manganese ore, beneficiation, manganese concentrates

INTRODUCTION

Manganese is one of the "steel industry" metals. Over 90% of mined manganese ore is used in the iron and steel industries, where it is an essential additive in the steel making process. The remaining 10% of that produced is used in a variety of industries including chemicals, fertilizers, batteries and ceramics. The increased demand for manganese ores and the depletion of some high-grade deposits to support the high level of industrial activity over the years have led to the mining of lower-grade materials and the increased use of beneficiation to provide acceptable products to the customer [1].

Manganese is the twelfth most abundant element in the earth's crust (0.096%). Its deposits are generally of sedimentary origin, with oxide ore layers inter-bedded with iron-rich formations [2]. The most common mineral is pyrolusite, which is mainly MnO_2. The main sources of manganese come from the former U.S.S.R, Brazil, South Africa, Australia, Gabon and India. Russia and South Africa produce about 85% of the world's pyrolusite.

Manganese is the fourth most used metal in terms of tonnage after iron, aluminium and copper. Low grade manganese ores (< 40% Mn) and polymetallic

manganese nodules currently cannot be economically processed by pyro-processes because too much energy is required [3].

The vast majority of manganese ore belongs to the poor must be carried out mineral processing. Manganese ore mineral processing methods include ore washing, screening, gravity separation, high-intensity magnetic separation and flotation separation, pyrometallurgy enrichment and chemical mineral processing method.

Current estimates of world manganese reserves including low grade ore, reach several billion tons. But if only high grade ores (defined as having more than 44% Mn content) are considered then reserves are in the range of 680 million tons of ore, essentially situated in the southern hemisphere, with Australia, Brazil, Gabon and South Africa, supplying over 90% of the international market.

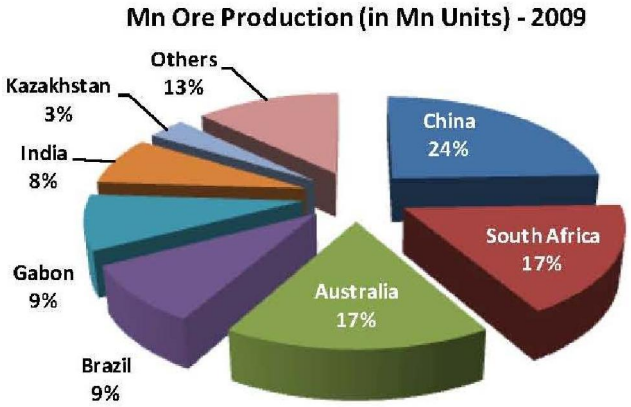

Figure 1. Manganese ore production, metric tons, [7]

Figure 1 show that China was the largest producer of Mn units (2.7 million mt), followed by South Africa (1.9 million mt), Australia (1.8 million mt), Brazil (1 million mt), Gabon (956K mt), India (845K mt) and Kazakhstan (377K mt). Other countries produced 1.4 million mt.

Bužim manganese deposit, NW Bosnia, within the Pannonian nappe of the Internal Dinarides, is a stratiform Mn deposit within Middle Triassic volcanogenic-sedimentary formation represented by variegated argillaceous sediments. Ore beds and lenticular orebodies are interstratified with tuffites and clayey layers. Ore minerals are pyrolusite, psilomelane, manganite, hematite, goethite, braunite, pyrite and marcasite [4]. Manganese ore industrial production from the deposit was made since 1959. Washing mineral processing was used. The annual productions of manganese concentrate with content of Mn 35.0% for 1959-1973 was 15 000 – 20 000 t. Washing factory was made since 1973 with manganese concentrate capacity 30 000 t. per year. Ancillary facilities – tailings and technological water lake were made. This construction described as "Old separation" was been working since 1990. Since 1991 was started building of new dressing plant – "Italian installation", which included washing process, sizing, heavy

media separation, dewatering process and waste water purify. This installation was been working since 1993.

Research and development program has started to established opportunities to obtain manganese concentrates from low grade manganese ore. This paper will discuss a new technology for manganese concentrate production from low-grade manganese ore.

LABORATORY AND PILOT TESTS

In a laboratory and pilot scale it was studied the possibility to obtain the qualitative manganese concentrates from poor manganese ore. The ore samples were characterized. Previous work [5] including the characterization of manganese ore from Bužim manganese deposit, NW Bosnia is investigated by complex methods of research. It was found that the poor manganese ore have relatively low average levels of manganese - 17.44%. For larger fractions the manganese content increased to 30.0%. However, the fine part (below 0.4 mm) has low manganese - 9.36 %. The main part of the fine fraction consist fine clay particles - 70.0% below 10 microns. Chemical analysis of manganese ore selected fragments shows that the manganese can reach 46.0%. It was found that the poor manganese ore have 17.44 - 30.0% content of manganese and they interest potential row materials for manganese concentrates produced. This gives information that suitable technology for obtaining manganese concentrate production could be expected.

Mineral composition of the Bužim manganese deposit was determined by X-Ray Diffraction, infrared spectroscopy and Scan Electron Microprobe (SEM) analysis. There were established mineral and characterization of ores, including textural and structural features of main minerals and mineral complexes.

Mineralogical characterization of low-grade manganese ore from Bužim deposit indicated the presence of the main manganese ore minerals: cryptomelane - $K(Mn^{4+}Mn^{3+})_8O_{16}.nH_2O$; romanechite $(Ba,H_2O)_2(Mn^{4+}Mn^{3+})_5O_{10}$; hematite - Fe_2O_3; pyrolusite $Mn^{4+}O_2$; birnessite $(Ca,Na,K)(Mn,Fe,Al,Mg)_7O_{14}.nH_2O$; tefroite Mn_2SiO_4; vernadite $(Mn,Fe,Ca,Na)(O,OH)_2.nH_2O$ or $\delta MnO_2.nH_2O$; todorokite $(Ca,Na,K)_{0.3-0.5}[Mn^{4+}Mn^{3+}Mg]_6O_{12}.3\text{-}4.5H_2O$; quartz SiO_2; dolomite $Ca,Mg(CO_3)_2$; manganite - $Mn^{3+}OOH$; hausmanite $Mn^{2+}Mn^{3+}{}_2O_4$ or bixbite $(Mn, Fe)_2O_3$; litioforite $(Al, Li)(OH)_2H_2O$ or $LiAl_2Mn^{4+}Mn^{3+}O_6(OH)_6$; illite (hydromuscovite) $(K,H_2O)Al_2[(Al,Si)Si_3O_{10}](OH)_2$; kaolinite $Al_2Si_2O_5(OH)_4$; and montmorillonite $(Na,Ca)_{0.3}(Al,Mg,Fe)_2Si_4O_{10}(OH)_2.\ xH_2O$. Manganese concentrates that has mineral contains cryptomelane, birnessite and todorokite expanded their use. Cryptomelane has a great potential in use of ion-exchange material, battery material, radioactive waste immobilization material, catalytic material and remediation materials used for environmental pollution [6].

Laboratory and pilot testing included ore disintegration in washing trommel for destruction of manganese – clay aggregates. The effect of chemical reagent addition on destruction of aggregates is investigated using five dispersant. It was found that the effective of disintegration depends on the rate frequency of washing with fresh water.

The experimental results clearly indicate that the use of the primary coagulant Accepta 8302 from Accepta Ltd (aluminum sulphate solution), and the secondary anionic

flocculant Magnafloc 155 (Ciba Specialty Chemicals PLC) leads to high settling rate and high mud solids content and clear overflow water. This definitely shows that it is possible to obtain circulating water after dewatering of the clay fraction. The experimental results show that there are possibilities to obtain the quality manganese concentrate with up 30.0% Mn content from low grade manganese ore [5].

Based on the ore characterization data, the laboratory experiments and pilot scale results a technology for low-grade manganese ore beneficiation was developed. The generalized treatment flowsheet for low-grade manganese ore is given in Figure 1. Developed technology for production of manganese concentrate complies with future selective production of manganese ore and available facilities of the company.

The generalized flowsheet (Fig.2) serves to introduce the processing of poor manganese ore. The technology included crushing and vibrating screening processes, four stages of disintegration of manganese ore (in a washing trommel), spiral, hydrocyclone classification and dewatering of the products. Fresh water is used to prepare the raw material for the disintegration process. In the first, second and third stages of disintegration is used a fresh water and reagent dispersant. After vibrating screening processes get three manganese concentrates with different particle size: manganese concentrate "0.5-3 mm", "3-7 mm" and "7-15 mm". Dewatering solid fraction "0-0.5 mm" is released as fine manganese concentrate. Fine clay fraction from spiral classification is final technological waste. Laboratory tests showed that it is necessary to use both reagents - coagulant and flocculant to obtain circulating water after dewatering of the clay fraction.

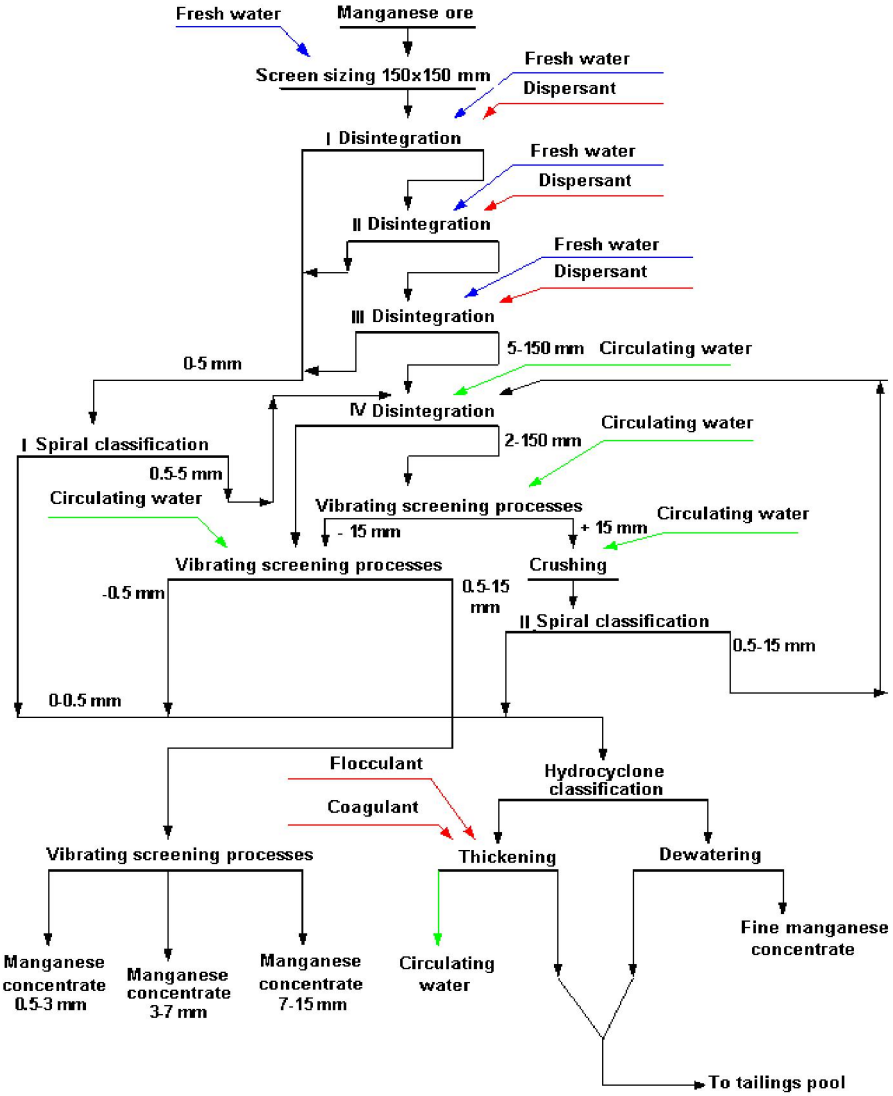

Figure 2. Low-grade manganese ore treatment flowsheet

APPLICATION RANGE

Based on the manganese ore characterization data, the laboratory experiments and pilot scale results a technology for low-grade manganese ore treatment was developed. The schematic flow sheet of manganese concentrate production is given in Figure 3.

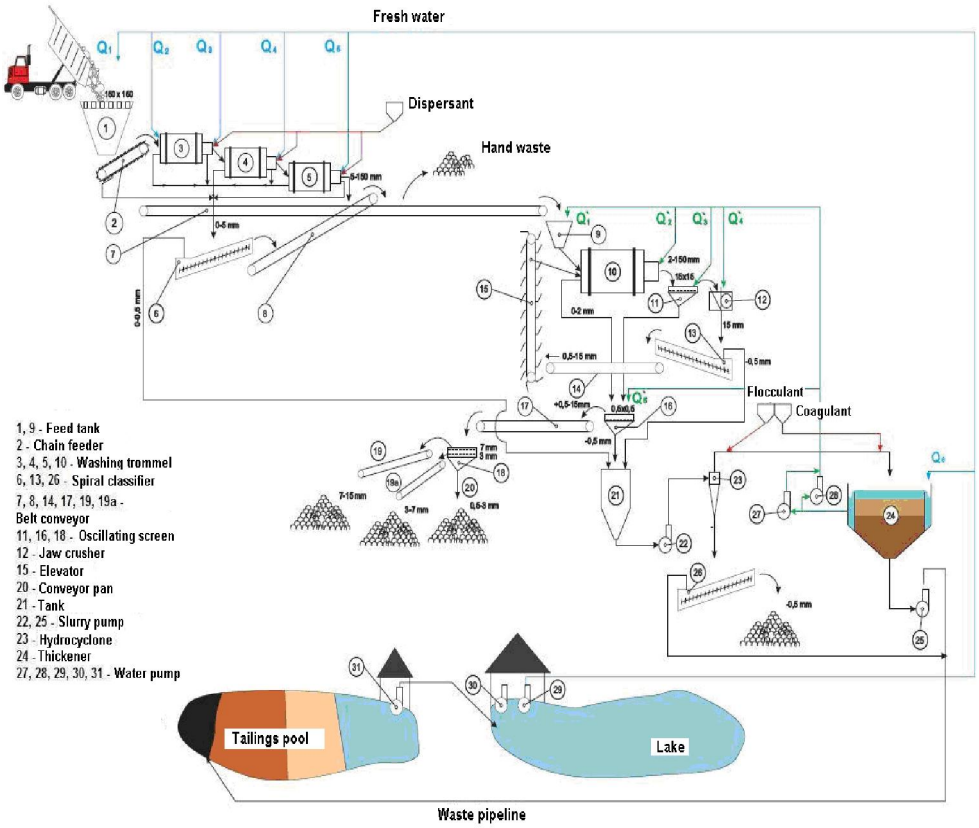

Figure 3. Flow sheet of manganese concentrates production

Low-grade manganese ore from Bužim manganese deposit are transported to the dressing plant with dump-truck and dumped over fixed screen (150x150 mm). For easier transport, sieving and wetting the fresh water Q_1 is used. To remove large pieces of dolomite and hematite the hand separation is used. After passing through fixed screen ore entered in feed tank (1) and under chain feeder passed to first, second and third stages of disintegration in washing trommels (3), (4) and (5). The presence of reagent dispersant supports the destroying of manganese-clay aggregates. In washing trammels the pulp is diluted with fresh water Q_2 Q_3 Q_4 and Q_5. Heavy manganese large fraction "5-150 mm" entered the belt conveyor (7). After fourth stages of disintegration (10), the ore passes to oscillating screening (11), (16), (18), crushing in jaw crusher (12), spiral classifier (6), (13), (23) and hydrocyclone (23). Overflow fraction from hydrocyclone put in thickener (24). The final technological waste processing is precipitates in tailing pond. The fresh water is pumped at different points in technological flow sheet using water pumps. Coagulant and flocculant are used to obtain clear overflow water from the thickener.

The present technology could be realized the low-grade manganese ore into manganese concentrate four different particle size fractions: "7-15 mm", "3-7 mm", 0,5-3 mm" and "-0,5 mm".

CONCLUSIONS

On the basic of the laboratory and pilot test results treatment technology for low-grade manganese ore from the Bužim manganese deposit, Federation of Bosnia and Herzegovina was developed. This technology is an effective solution for the complete utilization of natural resources. Despite increased levels of recycling, it can be expected that there will be an on-going need for primary metals well into the future as the world population increases and more people strive to achieve a higher standard of living. The creation of technologies for processing of lower class raw materials, such as manganese ores with low content of useful component adds stability in the use of natural resources.

REFERENCES

1. Ellison, T.D. 1983. Manganese, Min. Annual Review, pp. 67-69
2. Kaneko et al. 1993. Improvement of Mn yield in less slag blowing at Bof by use of sintered manganese ore, Tetsu to Hagane-Journal of the Iron and Steel Institute of Japan 79 (8) (1993), pp. 941–947.
3. Wensheng Zhang, Chu Yong Cheng. 2007. Manganese metallurgy review. Part I: Leaching of ores/secondary materials and recovery of electrolytic/chemical manganese dioxide. Hydrometallurgy, Vol. 89, Issues 3-4, pp. 137-159
4. Palinkaš, L., S. B. Šoštaric and S. S. Palinkaš. 2008. Metallogeny of the Northwestern and Central Dinarides and Southern Tisia. Ore Geology Reviews. 34. pp. 501-520.
5. Grigorova, I. 2011. Studies and possibilities of low grade manganese ore beneficiation. XXII World Mining Congress & Expo, Istanbul, Turkey. Accepted.
6. Grigorova, I., I. Nishkov. 2010. Manganese technological waste – an effort towards protection of environment. XVIII International Scientific and Professional Meeting "Ecological Truth", Eco – Ist'10, Apatin, Serbia
7. International manganese institute, Paris, France

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MINING INDUSTRY SUSTAINABLE DEVELOPMENT

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ABSTRACT

All products used by the modern human civilization are a result of complex geological and biological processes that form the biosphere – a main source of nature resources. The resources transformation accumulates main reserves, which contributes for the wealth of current and future generations. The natural resources depletion is growing and intensifying problem of the human society. This paper analyses the development necessity of adaptive methods for realization of an effective resources management. This can be achieved through deployment of new and developing technologies and also it requires social discipline to change the behavior and the attitude at all levels. The awareness is a major argument supporting the hope that the sustainable development paradigm considering the natural resources scarcity would be realized.

Key words: resources, depletion, sustainable development, mining

INTRODUCTION

The monitored periodical turbulences in the world mineral resources consumption show serious indications that the growing demand is more and more difficult to be satisfied. The world economic prosperity depends on the discovery of new sources of energy and materials parallel with existing reserves exploitation efficiency rising. Muilerman and Blonk [1] mention that with the growth of earth`s population and increased mineral resources demand come lots of visible issues. The alerts are most reasonable towards natural gas and oil where the demand is growing several times more than the demand for fossil fuels and towards development of new deposits. There are some forecasts that within the next 50 years the demand for metal raw materials will double which sets the question if certain possibilities for maintenance of adequate supply of the main mineral resources exist as within the last few decades [4].

Back in 1978 Malthus developed the concept which states that the increased demand for natural resources is related to the nations improving lifestyle conditions. The fact that the Earths mineral resources are finite and their exploitation is the same as the exploitation of fixed stock reserves that decreases faster or slower depending on their exploration and consumption [Tilton, 1996, 2002] forms the fixed stock paradigm. Therefore, through control of the resources and their responsible use the time of their

depletion is postponed and somehow the requirements for their future storage are satisfied. The fixed stock paradigm has an objective basis and it is associated with the nonrenewable and limited character of some natural resources which are secured for the humanity only for a determined, short period of time compared with the geological period necessary for their formation and its incommensurability to the consumption rates.

The beginning of 21st century marks an increased interest towards the sustainable development problems. This is a result of the reached critical levels of environment pollution; the fast depletion of series of key nonrenewable natural resources; raised sensitivity of the society towards living environment; the deepening social polarization between the industrial and the developing countries as well as the escalation of the poverty problems even in some of the developed market economies. Solving this problems and their global character suggest the demand for non-traditional approaches.

SUSTAINABLE DEVELOPMENT CONCEPTS

The sustainable development is a relatively new concept which is formed in the 80s and is widely supported through the 90s when the boundaries that the environment sets towards the human activity are set. The most popular definition of the sustainable development concept is described in the World environment and development commission report [2], precisely: sustainable is the development that satisfies the needs of the present without risking the future generations' ability to satisfy their needs. The most important idea for the sustainable development is the compliance of people needs satisfaction with the resource scarcity as well as the equity between current and future generations.

If the current models of resources exploitation continue are to be followed, the environment degradation and non effective utilization of resources will proceed. Now the natural resources are used at hazardous rates that put in jeopardy the chances of generations to follow and the developing countries to access their share.

The economic rates take a decent place in the sustainable development system because in their content and scope are synthesized the most important elements of anthropogenic impact on the environment – through the system of production and the infrastructure, lifestyle and the consumption models. In these indicators are included the main ingredients of well being (income, consumption etc.) as a main goal of sustainable development – for the individuals and business objects and the population and the World. The resources exploitation models in the past and the present led to dangerous decrease of the availability ti high rates of pollution and as a result of the appearance of deep and hard to control environment disabilities. There are some evaluations stating that in the last 25 years of XX century the humanity has spent 1/3 of the natural resources potential. The depletion of series of resources leads to expenses growth in exploration and research in hard from geological-geographic point of view locations and in the production of desired final products from raw materials with lower quality indexes. As it was in the early period of history of mankind today also the extraction of resources is trying to satisfy the demand and to respond to the needs of human society but with new, modern technologies. The extensive business activity of the humanity for the last two

centuries is proceeding with the absence of the ideas for global environmental interests and is characterized with uncontrolled treatment of natural resources and energy. Only in USA each year are spent 25% of the world income and 50% of natural gas. The extraction of non-metallic mineral resources worldwide is growing with 114% between 1980 and 2020, the extraction of metallic ores – 200%, biomass – 68% and energy fuels 200% (Fig. 1).

The development of the technologies changes the ideas for the natural resources that the humanity has. For example in the 50s of 20th century it was thought that the world has 77 million tones zinc reserves. Today we assess them at 293 million tones thanks to the opportunities of the new extraction technologies. The same has happened with iron and lead reserves.

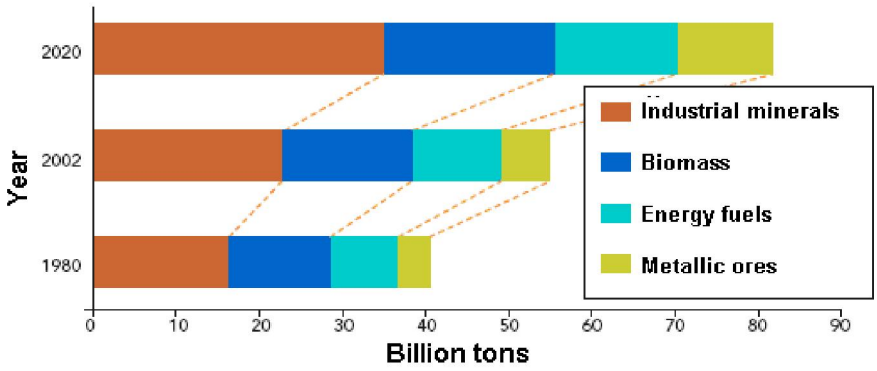

Figure 1. Global extraction of non-metallic, metallic ores, biomass and energy fuels for the period 1980 – 2020 [5]

In the same time recycling technologies are developing fast and are set as obligatory part of the programs for mining company's development. According to Hodges (4) it is necessary to apply market stimulus to raise the application of recycled materials. The second production, in case suitable technologies are present, could mean that impossible and non effective resources in the past now can be accessed and utilized. This helps to postpone the inevitable depletion of the environment resources and confirms the key argument of the paradigm that except the problem of environment degradation related in mining to the lower resources class is becoming a main argument in satisfying the demand and the need to keep the economic and social lifestyle. It is foreseen until 2050 the human population to grow to 9.0 milliard [6] in which relation it is necessary to open the production to meet the challenges of this growth.

MINING WASTE MANAGEMENT

Undoubtedly one of the biggest challenges before the sustainable development of mining industry is related to the mining wastes management. The effective waste management is essential for the sustainable development.

The effective waste management is blocked by series of challenges related to the character of the mining industry. The disposal of the life cycle of mining waste is a unity of complex actions including research, exploration, planning, projecting, building and exploitation of plants and installations, testing and monitoring, as well as closing and reclamation. Waste is produced from the very beginning of the life cycle of a product, long before we as consumers are aware of it (Fig. 2).

The recycling of techno gene raw materials should be assumed as a process increasing the global reserves which in certain conditions provide a reasonable potential opportunities which is obvious by lots of well know facts. At the modern practices of extraction and technologies for mineral processing in the environment are set free millions of tones gas, steam, liquid and hard wastes. From some types of mineral resources only 2% are turned in to ready products and the rest 98% are techno gene accumulations.

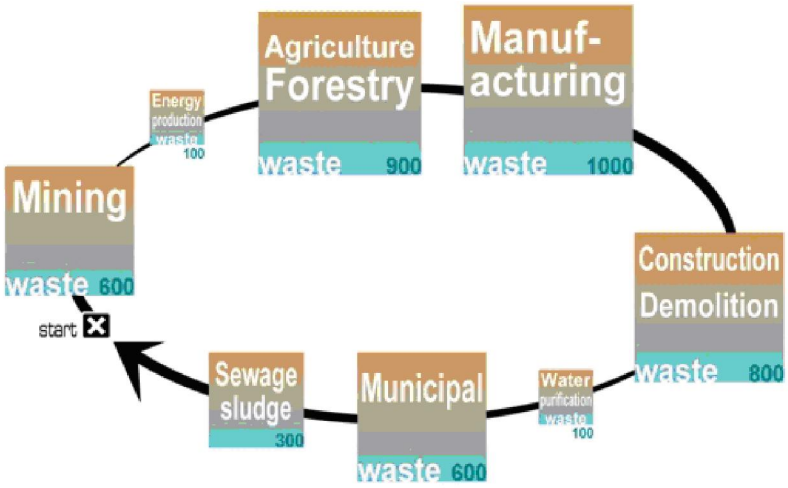

Figure 2. Waste at every stage [5]

Generally from the annual extraction of some 25 milliard tones mineral resources are produced no more than 1,5 milliard tones ready production. Almost two thirds of the mass extracted from the Earth's crust is accumulated for long time in different waste depots. The impact on the environment appears at all stages in the mining operations, starting with the exploration and ending with reclamation. The nature damage created by the mining activities exists by three forms: direct impact on landscape, surface and underground waters; destruction of natural habitats and potential non effective waste management impact. Figure 3 gives a general illustration of a waste generation and management scheme.

The world is facing one of the most serious challenges ever – to develop sustainable in a way that satisfies the needs of current generation without neglecting the opportunities for future generations to meet their needs. In other case the aftermath will not be only environmental, but they will be related to the security, the political, economical, social, migration, health and demographic aspects of development. Each

activity needs to be planned and realized in a manner not to change the environment; to create least risk for the environment and human health; to reduce to minimum application of goods and materials; to provide opportunities for recycling, second use and/or extraction of recycled materials and energy from waste, created by the use of goods; to prevent and limit the negative effects on the environment at the very source of pollution.

The intensive development of the economy is possible only at rational application of material resources – raw materials, energy, natural resources as well as full utilization of recycled resources, by products and waste energy. It is true that the current orientation towards growing consumption of non renewable resources could not be sustainable and will lead to long term and peak decrease in the expectations for life quality of future generations due to resource base exhaustion.

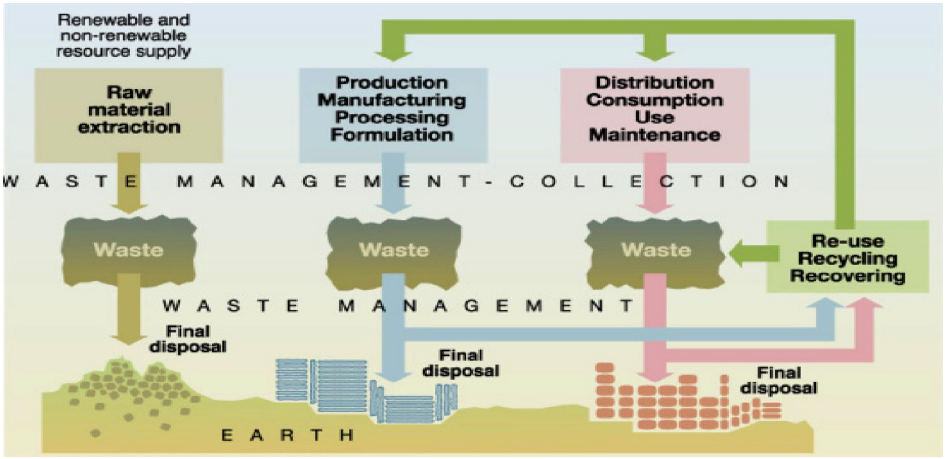

Figure 3. Waste generation scheme [5]

CONCLUSIONS

The modern civilization has opportunities to give sustainable character of natural resources exploitation and the demographical processes for long time. This requires united and pointed efforts of the world countries for rational and effective utilization of natural resources in XXI century, gradually decrease of the vast expenses for exploitation of non renewable resources and increase of the expenses for environmental equilibrium, increase in the share of renewable energy sources in the structure of the currently used resources and exploration for new energy.

The economy potential of a country, development and wealth of the current society and future generations depend on the mineral resources base, the scale of extraction and processing of the resources.

The technology and the society should develop to reach new more developed and economy reasonable alternatives to grant the balance between the current and future generations regarding the non renewable natural resources. If the extraction of natural

resources on Earth continues this way in close future the economical benefits of such an activity will decrease due to the urgent need to achieve expensive programs of environment and society preservation.

Undoubtedly in close future the mining industry will have a key importance for the world. To achieve sustainability in the sector is needed integrated and complete approach, accounting the economical, social and ecological component in the development of the society. This is a key to the mechanism of maintenance of the life quality without disturbing the entirety of the environment and the possibility of the future generations to meet their needs.

The humanity has proven its abilities to cope with the problems that follow the way. The evolution on the other hand requires change. As in the past the people have abandoned part of their habits and instincts so they can live together in towns, now we should change part of our old habits with new ones so that we all survive the narrowing and resources decreasing planet. The orientation towards utilization of mining waste is a direction for real growth of the resources for which the society needs a change of its consumer instincts towards innovative approach for utilization.

The sustainable use of resources that includes sustainable production and consumption is an important condition for long term prosperity in the EU and worldwide. In the spirit of changes in the modern world economy it is necessary to give initial push for new policy of management, application and storage of mining waste as natural resources in sustainable margins.

The management of waste from mining industry is complex activity which has to follow the corresponding directives of European Union for protection of human health, water condition, air, soils, landscape and nature. The sustainable management of continuously growing waste is one of the most serious challenges before the modern societies.

Along with the generated waste volume, growth is observed as well in their variety, complexity, toxicity and the involved difficulties and expenses for their disposal. The growing global consumption leads to more and more serious crisis and conflicts concerning the limited resources on our planet, which requires reassessment of the one way materials flow which is wide spread these days.

REFERENCES

1. Muilerman, H. and H. Blonk, 2001, Towards a Sustainable Use of Natural Resources, Stichting Natuur en Milieu.
2. Paper of the World environment and development commission "Our common future", 1987, Brundtland.
3. Malthus, T.R, 1798, An Essay on the Principle of Population. A Norton Critical Edition. Appleman, P. (Ed), (republished 1976), Norton, New York.
4. Hodges, C.A, 1995, Mineral Resources, Environmental Issues and Land Use, Science, 268 (5215), pp. 1305-1312.
5. European Topic Centre on Resource and Waste Management.
6. Lutz, W., W. Sanderson, S. Scherbov, 2001, The end of world population growth: Nature, v. 412, pp. 543-545.

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ENVIRONMENTAL TECHNOLOGIES BASED ON POLYPHOSPHATE GLASSES

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ABSTRACT

In this paper the results of investigation of the polyphosphate glass dissolution in water at T=20-50 ^{o}C were presented. It was shown that the pH of solution decreased from 1 to 3 units. The dissolution rate constants depended on temperature were determined in the range 0.0114-0.0361 h^{-1}. The ratios of elements in the glass and solution do not change that indicate a congruent mechanism of dissolution of this glass. The results showed that the application of this glass for plant nourishment reduces soil contamination and increases the level of environment protection.

Key words: environment protection, polyphosphate glasses

INTRODUCTION

The need for production of large quantity of food causes an excessive application of mineral fertilizers which contain N , K, P and other chemical elements in the form of relative high soluble compounds. However, such application induces a numerous disturbances of biology balance in environment. Even the health of humans and animals can be endangered directly or indirectly [1]. Only one part of mineral fertilizers is absorbed by plants while a large amount remains unused. The present unassimilated forms of chemical elements disturb the chemical balance of different ecosystems and influence harmfully on environment [1,2]. These elements influence on pH, structure and soil biogenity and can contribute to accumulation of harmful substances in the plants. Also, they induce the contamination of surface and groundwater. The incorrect application of mineral fertilizers can cause an increase of harmful substances in air.

Therefore, the protection of environmental balance and prevention of degradation induced by the uncontrolled development, became a most important tasks.

To attain this goal a lot of different substances and materials with specific properties are necessary. The production of appropriate eco-materials intended for environmental protection and eco-engineering is very promising trend in the world. Therefore, in the developed countries a significant attention was paid on reduction of negative influences in agriculture by application of new advanced technologies which does not disrupt environment significantly.

New direction of development in this area is the application of soluble glasses which show bioactivity [3]. These amorphous materials with complex structure can react flexible on changes in environment. Their main advantage is adaptability on changes of chemical composition that enables an introduction of new components in different amounts and in such a way the kinetics and mechanism of dissolution can be designed as needed. Also, the same compositions can be obtained with amorphous (glasses) or the ordered crystal structure (glass-ceramics) that makes possible to adjust their properties additionally. It is very important that the rates of release of the components from these materials can be equalized with rates of consumption in environment (nourishment and growth of living organisms). In such a way their accumulation and insufficiency which can be harmful is fully eliminated.

Recent investigation showed that the phosphate glasses can be appropriate materials for this application [3,4]. In this paper the results of examination of dissolution process in water of polyphosphate glass 62 $P_2O_5 \cdot 23K_2O \cdot 8CaO \cdot 4MgO \cdot 2SiO_2 \cdot 0{,}5ZnO \cdot 0{,}5MnO$ [mas%] were presented.

MATERIALS AND METHODS

The glass of the selected composition was obtained by melting of homogenous mixture of: $(NH_4)_2HPO_4$, K_2CO_3, $CaCO_3$, MgO, SiO_2, ZnO i MnO. The melting was performed in porcelain crucible at 1200 ^oC for 1 h and the melt was cast on steel plate. XRD analysis confirmed that the glassy material is obtained. The sample was transparent without residual glass bubbles.

Powder X-ray diffraction (XRD) analysis was made by using a Philips PW-1710 automated diffractometer with a Cu K_α radiation tube operating at 40 kV and 32 mA. Data were collected from 5 to 70^o 2θ, with step size of 0.02^o and a counting time of 1s per step.

The chemical composition was determined by spectrophotometric (AAS – PERKIN ELMER 703, PHILIPS UV/VIS 8610 spectrophotometer) and gravimetric methods.

The crystallization behavior of the glass under non-isothermal conditions was analyzed using a Differential thermal analysis (DTA)- Netzch STA 409 EP device with Al_2O_3 powder as the reference material.

Leach tests were conducted in the distilled water with following parameters: pH = 6.93, conductivity (χ) = 4.91 μS/cm (T=25 ^oC) and content of $[K^+]$=0,37 mg/l. The glass grains size 0.1-0.3 mm was used for experiments. The samples were prepared by crushing of bulk glass in an agate mortar and then sieving to appropriate grain size. After washing in distilled water and drying, 1 g of glass sample was placed into volumetric flask of 50 ml and then a distilled water is added. The closed flask was placed in a water

bath with the determined temperature and kept for the fixed time. This procedure is repeated for each temperature and time previously determined. The temperatures 20, 25, 30, 37 i 50 ^{o}C and times 0.5 do 720 h. were used for experiments.

The solution from a volumetric flask was filtered and pH and content of the present elements were determined. The rest of glass grains were dried at T=100 ^{o}C to constant mass of sample and then the mass of dissolved glass was calculated.

The measurement of pH values was performed with the pH - meter Consort, model C830P and the instrument was calibrated with appropriate standards.

RESULTS AND DISCUSSION

The results of chemical analysis showed that the obtained glass composition corresponds to initial one. The glass transition temperature T_g = 367 ^{o}C and temperature range of crystallization T_c = 435-570 ^{o}C were determined by DTA method.

The pH solution as a function of time examined at different temperatures is shown in Fig.1.

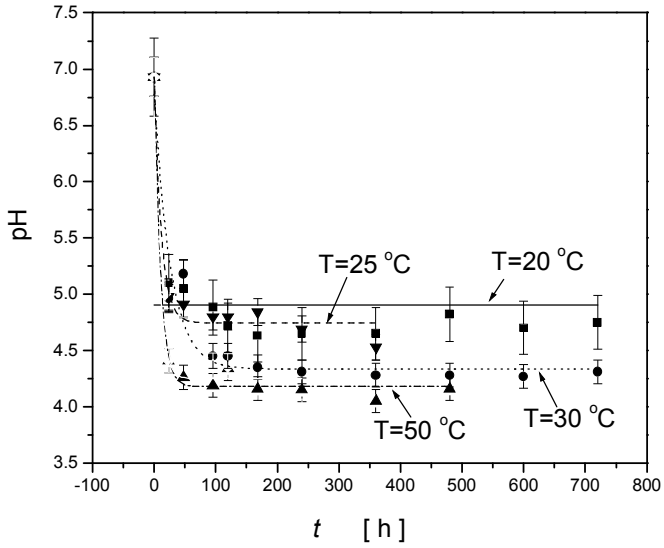

Figure 1. The effect of time on pH solution for glass sample grain size 0.1 -0.3 mm at different temperatures.

As seen in Fig.1, the values of pH solution decrease and for a relative short times (up to 100 h), pH reach the values which correspond to the glass dissolution equilibrium at fixed temperature. As expectable by increasing of temperature, the pH solution decreases because the solubility of glass increases.

In Fig. 2 the concentration of elements determined in solution after leaching experiment at T=30 ^{o}C is shown.

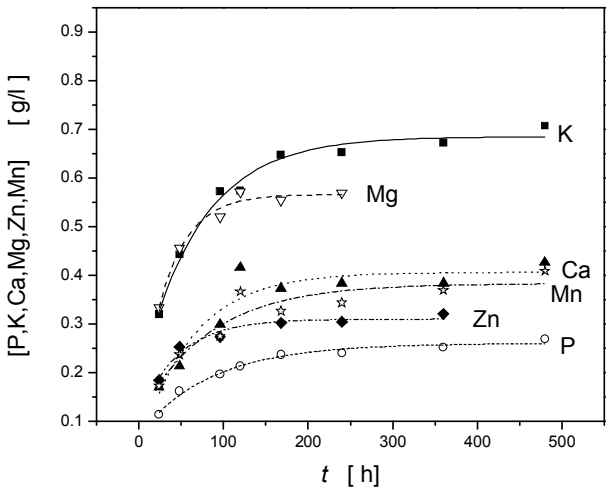

Figure 2. The effect of time on concentration of elements P, K, Ca, Mn, Zn and Mn in solution after leaching of glass sample granulation 0.1 -0.3 mm at T=30 ^{o}C.

The comparison of ratio of the elements present in solution and glass shows that this ratio does not change. This indicates a congruent process of dissolution, e.g the glass dissolves completely.

The analysis of mass loss during leaching at the selected temperatures showed that the dissolution can be described as first-order kinetics process according to expression [5,6]:

$$dn = -N_s\, k_d\, dt \tag{1}$$

where: n - the number of unforced transition of particles into solution from surface; k_d - transition probability; t – time ; N_s – total number of particles passed from surface of granules into solution. By integration of equation (1) and introduction of the mass of granules an expression in the form is obtained:

$$\Delta m = \Delta m_o\,(1\text{-}e^{-kt}) \tag{2}$$

where: Δm – mass loss for time selected , Δm_o – mass loss at dissolution equilibrium , k dissolution rate constant. By using the experimental data according to equation (2) the dissolution rate constants at selected temperatures were determined, Table1.

Table1. The dissolution rate constant at different temperatures

T [^{o}C]	k [h^{-1}]
20	0.0114
25	0.0135
30	0.0163
50	0.0361

The values of *k* show that for a total dissolution of this glass a long period of time is necessary, and that during dissolution process all elements present in the glass were released. Also, the results show that the dissolution of glass is a complex process which depends on different parameters as: glass composition, dissolution conditions (pH solution, temperature, time, etc) and glass structure. The glass dissolution is a multi phase process where in the first step the weakest chemical bonds of cations modifiers and non- bridging oxygen were broken and then the process of substitution of cations modifiers with H^+ ions from solution was occurred. The cations modifiers cross into solution and H^+ ions replace their position in glass structure. In such a way the hydrated layer on glass surface is formed and the zone of solution in which the electrolytic dissociation, H^+ ions diffusion into glass and ions modifiers from glass to solution take place. In the next phase the molecules of water diffuse into hydrated glass layer, react with network formers tetrahedra and break the bonds between tetrahedra which start to release from polyanionic network into the surrounded solution. As a consequence a complete destruction of polyanionic glass network occurs.

CONCLUSIONS

The results of investigation show that the polyphosphate glass with addition of microelements was obtained. This glass of complex composition enables the controlled release of ions. Its application has many significant advantages as:

-contamination of agricultural soil is reduced and the total level of environmental protection increased.
- unconsumed part of material does not rinse and remains in upper layer of soil .
- all nourishing elements are provided.
- necessary conditions for production of the balanced and healthy food are assured.

REFERENCES

1. Karapetyan G., Karapetyan K., Maksimov L., Glassy Environmentally Friendly Fertilizers of Prolonged Action, Phosphorous Research Bulletin, 15 (2004) 60-67.
2. Waclawska I., Szumera M. , Reactivity of silicate-phosphate glasses in soil environment, J. Alloy. Compd. , 468(2009) 246-253.
3. Waclawska I., Szumera M., Thermal analysis of glasses for proecological applications, J.Therm.Anal.Calorim., 72 (2003) 1065-1072.
4. Cailleteau C., Weigel C., Ledieu A., Barboux P., Devreux F., On the effect of glass composition in the dissolution of glasses by water, J. Non-Cryst. Solids 354(2008) 117-123.
5. Gao H., Tan T., Wang D., Dissolution mechanism and release kinetics of phosphate controlled release glasses in aqueous medium, J.Control. Release 96(2004) 29-36.
6. Devreux F., Barboux Ph., Filoche M., Sapoval B., A simplified model for glass dissolution in water, J.Mater.Sci. 36 (2001) 1331-1341.

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REMOVAL OF CU(II) ION FROM WASTE PRINTING DEVELOPER

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ABSTRACT

The objective of this research was to examine the adsorption efficiency of natural, low-cost adsorbents: zeolite, activated carbon and their mixtures (NZ+AC) in the removal of Cu(II) ion from waste printing developer. The adsorption equilibrium data for Cu(II) ion on NZ, AC and NZ+AC were analyzed in terms of the Freundlich isotherm model. The results provided strong support for Cu(II) ion adsorption onto these adsorbents, and all the data fitted well to the Freundlich isotherm ($R^2 \geq 0.975$). The adsorption capacities of Cu(II) ion decreased in the order: NZ+AC>AC>NZ.

Key words: Cu(II) ion, clinoptilolite, activated carbon, adsorption, waste printing developer

INTRODUCTION

In the printing industry waste is generated from the three basic phases of the technological process: pre-press, press and post-press. The offset pre-press process is a complex printing operation which involves the use of many toxic and hazardous chemicals, such as printing developer. The most present components of fresh printing developer are potassium silicate, sodium silicate, sodium carbonate, potassium hydroxide, D-sorbitol, sodium sulfite, potassium bromide, metol (4-(methylamino)phenol sulfate) and hydroquinone. After the development process, printing developer (waste developer) is enriched by plate surface compounds: novolac, organic polymeric binders, photosensitive compounds, dyes and some others. Heavy metal ions found in waste printing developer come from the dye residue. Therefore, in order to have a pollution-free environment, the toxic metals should be removed from wastewater before its disposal. The requirements for an adequate treatment of waste printing developer are to be met, to prevent increased the concentrations of heavy metals and organic pollutants from the printing industry [1-10].

Among all the approaches proposed, adsorption of heavy metals on low-cost effective adsorbents is one of the most popular methods, and it is currently considered as an effective, efficient and economic method for liquid waste purification [11-12].

The aims of the study were to examine the efficiency of natural, low-cost adsorbents: natural zeolite (NZ, clinoptilolite), activated carbon (AC, Norit Row 0.8 Supra) and their mixture (NZ+AC) for immobilization of Cu(II) ion from waste printing developer and to investigate the equilibrium parameters involved in the adsorption process.

MATERIAL AND METHODS

The adsorption of Cu(II) ion from waste printing developer was investigated using natural zeolite (NZ, clinoptilolite), activated carbon (AC, Norit Row 0.8 Supra) and the mixture of NZ and AC (NZ+AC), as adsorbents. Samples of fresh and waste printing developer were taken from the pre-press unit of a Novi Sad (Serbia) offset printing plant.

The commercial powdered clinoptilolite (High Tech zeolite producer, Turkey) and activated carbon (Row 0.8 Supra, Norit, USA) characterized as like as in Tables 1 and 2.

Table 1. Chemical composition of clinoptilolite

Oxides	%
SiO_2	66.9
Al_2O_3	13.5
Fe_2O_3	0.98
MgO	0.69
CaO	3.85
K_2O	0.54
Na_2O	0.37
SO_3	1.18
H_20	11.88

Table 2. Physicochemical characteristics of activated carbon

Characteristic	Value
Iodine number	1050
Methylene blue adsorption (*g*/100*g*)	22
Total surface area (BET) (m^2/g)	1150
Apparent density (kg/m^3)	390
Density backwashed and drained (kg/m^3)	345
Particle size < 0.60 *mm* (*wt %*)	0.1
Ash content (*wt %*)	7
pH value	10.3
Moisture (as packed) (*wt %*)	2

All the chemicals were of analytical reagent grade (Merck, Germany). Deionized water was used throughout the experiments. Working solution was prepared by diluting the stock metal solution (1000 *mg/l*) with deionized water to 3.059 *mg/l* Cu(II) ion.

Concentration of Cu(II) ion was determined by Inductively Coupled Plasma Mass Spectrometry (ICP-MS), using a PerkinElmer Elan 5000 mass spectrometer.

The pH and temperature were measured on a Multi pH/Cond/Temp 340i handheld meter. Samples were shaken with a mechanical shaker (26 *rpm*), and by centrifuging at 3000 *rpm* (Tehtnica Železniki, Slovenia) the solid phase was separated.

Adsorption isotherm model

The equilibrium isotherms were obtained using the different amounts (0.04-0.24 *g*, with an increment of 0.04 *g*) of NZ, AC and NZ+AC. The equilibrium amount of Cu(II) ion adsorbed from the aqueous solution was calculated from the equation

$$Q_e = \frac{V(C_0 - C_e)}{M}, \tag{1}$$

where Q_e is the amount of Cu(II) ion adsorbed at equilibrium (*mg/kg*); C_0 is the initial concentration of Cu(II) ion (*mg/l*); C_e is the equilibrium concentration of Cu(II) ion (*mg/l*); M is the adsorbent mass (*kg*); and V is the volume of the aqueous solution (*l*).
The adsorption equilibrium data of Cu(II) ion on NZ, AC and NZ+AC were analyzed in terms of the Freundlich isotherm model, which is written as:

$$\log Q_e = \log K_f + \frac{1}{n}\log C_e, \tag{2}$$

where Q_e is the equilibrium removal, i.e. the amount adsorbed per unit weight of the adsorbent (*mg/kg*); C_e is the equilibrium Cu(II) ion concentration in the solution (*mg/l*). The Freundlich isotherm constants, K_f and n, are related to the adsorption capacity and adsorption intensity, respectively [11-12].

RESULTS AND DISCUSSION

Equilibrium time and adsorption experiments

Experimental starting conditions were: 0.2 *g* the adsorbent, 25 *ml* of Cu(II) working solution, concentration 3.059 *mg/l* of Cu(II) ion, shaking speed 26 *rpm*, and time varied from 60 to 110 *min*. As can be seen from Fig. 1, the adsorption of Cu(II) ion first increased and then remained constant as like as equilibrium is attained. Equilibrium established after 90 minutes for all the adsorbents. Based on the trend of the curves in Fig. 1, it can be predicted that the optimum contact time for adsorption on NZ+AC would be also 90 minutes.

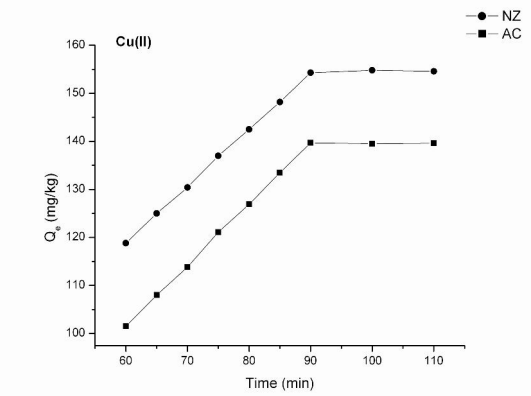

Figure 1. Time dependence of Cu(II) ion adsorption on NZ and AC

Adsorption isotherms

The adsorption isotherms for Cu(II) ion were obtained for different amounts of all three adsorbents with constant contact time. Fig. 2 shows that all three adsorption isotherms have similar shapes, characteristic for the Freundlich model.

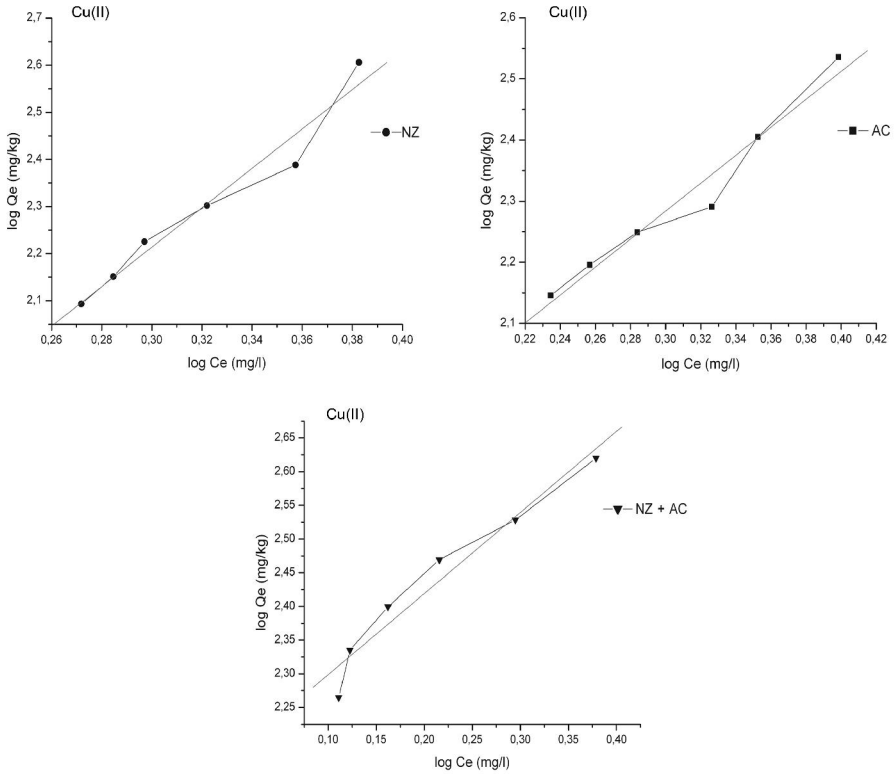

Figure 2. Freundlich isotherms of Cu(II) ion on NZ, AC and NZ+AC

The corresponding adsorption parameters being summarized in Tables 3. The values in Table 3 show that Cu(II) ion adsorbed effectively on all three adsorbents.

According to the K_f values, the adsorption capacity of Cu(II) ion follows the sequence of adsorption efficiency: NZ+AC>AC>NZ. It is evident that highest adsorption capacity for Cu(II) ion on mixture NZ+AC was 150.85 *mg/kg*. On the other hand, the least effective was the adsorption of Cu(II) ion on NZ.

Table 3. Freundlich parameters in the equilibrium isotherms for NZ, AC and NZ+AC

Freundlich adsorption isotherm constants			
Adsorbents	K_f (*mg/kg*)	n	R^2
NZ	9.09	0.24	0.979
AC	39.60	0.44	0.975
NZ+AC	150.85	0.83	0.982

The correlation coefficients (R^2) presented in Table 3 indicate that the adsorption data of Cu(II) ion on NZ, AC and NZ+AC fitted well to the Freundlich isotherm. The highest values being: 0.979, 0.975 and 0.982 for NZ, AC and NZ+AC, respectively. It can be concluded that mixture NZ+AC is most effective for the removal of Cu(II) ion from waste printing developer.

Adsorption efficiency

Dependence of adsorption efficiency in the removal of Cu(II) ion due to the different amount of adsorbents (NZ, AC and their mixture) is shown in Fig. 3. The adsorption efficiency of Cu(II) ion increases considerably with increasing of adsorbent amount. The maximum adsorption efficiencies for Cu(II) ion removal of with NZ, AC and NZ+AC were 31.5, 32.9 and 45.1%, respectively. Besides the amount of adsorbents, the removal efficiency of Cu(II) ion depends on adsorbent fraction size and physicochemical characteristics of Cu(II) ion.

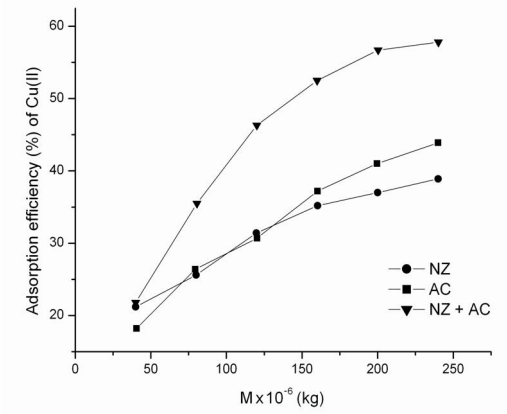

Figure 3. Adsorption efficiency of Cu(II) ion due to adsorbent amount

The adsorption efficiency of used adsorbents in Cu(II) ion removal is presented in Table 4, pointed out the corresponding decreases of Cu(II) ion concentration in waste printing developer after adsorption processes. The reduction of Cu(II) ion concentration in waste printing developer after adsorption is almost 1.5 to 2 times.

According to the Regulation of hazardous matters in water recipients [13], the maximum allowed concentration (MAC) for Cu(II) ion is 0.1 *mg/l*. It is evident that the concentrations of Cu(II) ion in the waste printing developer after adsorption are almost 17-21 times higher than the MAC values. Hence, waste printing developer must not directly discharge into sewerage, but it can be reuse in process of plates development with adequate treatments.

Table 4. Concentrations of Cu(II) ion in the printing developer before and after adsorption

Heavy metal	Concentration (*mg/l*) ± RD				
	Before adsorption		After adsorption		
	Fresh developer	Waste developer	NZ*	AC*	NZ+AC*
Cu(II)	0.517 ± 0.026	3.059 ± 0.153	2.053 ± 0.103	2.094 ± 0.105	1.679 ± 0.084

* Waste printing developer after adsorption on NZ, AC and NZ+AC

CONCLUSIONS

Based on equilibrium data it can be concluded that the adsorption of Cu(II) ion from waste printing developer using three adsorbents (NZ, AC and their mixture) was most effective within the first 90 minutes of contact time. The adsorption process was presented in terms of Freundlich isotherm model. It was found that the Freundlich isotherm gave the best agreement over the whole adsorption range and the corresponding correlation coefficients (R^2) for Cu(II) ion on NZ, AC and their mixture being 0.979, 0.975 and 0.982, respectively. These investigations pointed out that use of low-cost adsorbents may be an effective way of Cu(II) ion removal from waste printing developer. The adsorption capacity of Cu(II) ion decreased in the following order: NZ+AC>AC>NZ. The adsorption efficiency achieved using NZ, AC and NZ+AC were 31.5, 32.9 and 45.1%, respectively. Thus, the application of mixture NZ+AC was the most effective for the removal of Cu(II) ion.

Acknowledgment

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REFERENCES

1. Kiurski J., Vojinovic Miloradov M., Cveticanin L., Kovacevic S., The graphic industry and its waste management in Vojvodina, Proceedings of the 15th International Symposium on Analytical and Environmental Problems, (2008) Szeged, Hungary, pp.11-15.

2. Kiurski J., Vojinovic Miloradov M., Stojkov M., Environmental modeling of a waste management system in the graphic industry of Vojvodina, Proceedings of the 4th International Conference on Engineering Technologies, (2009) Novi Sad, Serbia, pp.120-123.
3. Prica M., Kiurski J., Karlovic E., Lack of waste treatments in printing industry in Serbia, Proceedings of the 18th International Scientific and Professional Meeting, (2010) Apatin, Serbia, pp. 14-19.
4. Shuiping C., Effects of heavy metals on plants and resistance mechanisms, Environ. Sci. Pollut. Res. (2003a) 10: 256-264.
5. Shuiping C., Heavy metals in plants and phytoremediation, Environ. Sci. Pollut. Res. (2003b) 10: 335-340.
6. Vengris T., Binkiene R., Butkiene R., Nivinskiene O., Melvydas V., Manusadzianas L., Microbiological degradation of a waste offset-printing developer, J. Hazard. Mater. (2004) 113: 181-187.
7. Llanes Monter M. M., Olguin M. T., Solache Rios M. J., Lead sorption by a Mexican, clinoptilolite-rich tuff, Environ. Sci. Pollut. Res. (2007) 14: 397-403.
8. Oliveira A.S., Bocio A., Beltramini Trevilato T.M., Magosso Takayanagui A.M., Domingo J.L., Segura-Munoz S.I., Heavy metals in untreated/treated urban effluent and sludge from a biological wastewater treatment plant, Environ. Sci. Pollut. Res. (2007) 14: 483-489.
9. Vengris T., Binkiene R., Butkiene R., Dikcius A., Karitanas R., Manusadzianas L., Treatment of waste offset-printing developer with Fenton's reagent, Chemija (2007) 182: 1-6.
10. Malakootian M., Nouri J., Hossaini H., Removal of heavy metals from paint industry's wastewater using Leca as an available adsorbent, Int. J. Environ. Sci. Tech. (2009) 6: 183-190.
11. Rao G. P. C., Satyaveni S., Ramesh A., Seshaiah K., Murthy K. S. N., Choudary N. V., Sorption of cadmium and zinc from aqueous solutions by zeolite 4A, zeolite 13X and bentonite, J. Environ. Manag. (2006) 81: 265-272.
12. Kocaoba S., Orhan Y., Akyüz T., Kinetics and equilibrium studies of heavy metal ions removal by use of natural zeolite, Desalination (2007) 214: 1-10.
13. Regulatons of hazardous matters in water recipients, "Official Gazette SRS", No. 31/82, Belgrade.

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INFORMATION SYSTEM FOR COLLECTION OF WASTE IN THE CITY OF VALJEVO

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ABSTRACT

This paper describes the establishment of an integrated information system about facts relevant to the situation of Valjevo municipal waste, and increasing of awareness for all relevant structures (citizens, media, political and economic entities ..)regarding the amount, characteristics and state of municipal solid waste.

The decision of introducing an information system represents a major step to modernize the way of performing many functions in the business, and thus leads to significant cost reduction in the operating performance of tasks.

This paper presents the development of information system PUC Valjevo, whose activities are: collection, storage, transportation, treatment, recycling, use and disposal of recyclable materials, hazardous and dangerous materials collection of municipal, industrial and medical waste disposal, sanitation and similar activities. The goal is to create conditions so positive effects can be felt for a relatively short time (economic, energetic, environmental...) in all parts of treatment chain for municipal waste in the city of Valjevo.

Key words: information system, municipal waste, waste treatment

INTRODUCTION

Pollution of air, water and soil, and hence food get dramatic consequences, not only at the local but at the global level. The most prominent forms of threats to nature are: pollution of the atmosphere which leads to climate change, sea level rise and ozone depletion. Changes caused by man's actions are occurring so rapidly that nature is not able to rebuild and recover by itself. Modern man changed the entire look of landscapes. Therefore, last decades of the twentieth century were largely marked by a variety of programs and actions of the protection, restoration and improvement of the environment, and it is certain that this century will be characterized by solving the inherited and new problems related to pollution and environmental protection on global, regional and local levels.

The influence of air pollutions on the environment is multiple. They have influence on the reduction of solar radiation, increasing rainfall, create haze and reduce visibility.

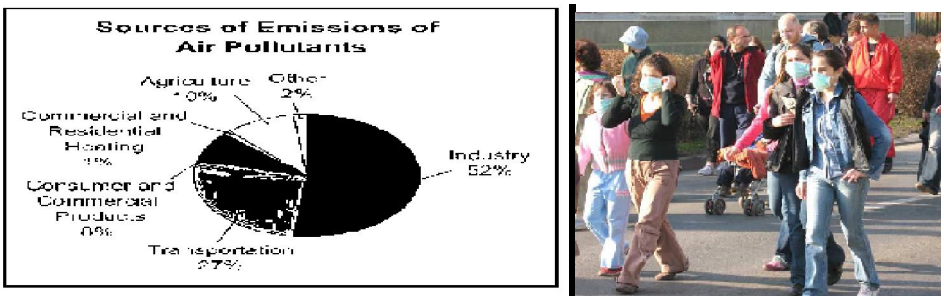

Figure 1. Sources of air pollution and its effects on mankind

In a world many measures are taking for air pollution remediation or prevention of further pollution. There are different approaches regarding the issue of treatment and application of technologies for waste disposal. According to the Law on Waste Management *("Official Gazette of RS", No. 36/2009 and 88/2010),* kinds of wastement are: 1) municipal waste (household waste); 2) commercial waste; 3) industrial waste. Waste described in paragraph 1 of this article, depending on the hazardous characteristics that affect human health and the environment, can be: 1) inert; 2) harmless; 3) dangerous. For planning of waste management, following documents shall be adopted in the Republic of Serbia: waste management strategy (further: Strategy); national plans for individual waste streams; regional plan for waste management; Local plan for waste management; waste management plan at the plant for which the permit is issued; work plan of the facility for waste management.

In the fight against climate change the European Union has a leading role and poor countries (Third world countries). However, climate changes are is still an issue of dispute between great powers. Science should be quick to react.

PROPOSAL ON WASTE INFORMATION SYSTEM

Numerous analysis of domestic and foreign experts in the field of environmental protection indicate that there are no reliable data on waste in Serbia. Data on municipal waste municipalities have declared as a "best estimate" since mass of waste is almost non-existent, and the composition of the waste has never been fully understood. Also, it was noted that there is no mechanism for collecting data from the generator for all categories of waste that is generated. Based on analysis of the Regional Environmental Center for Central and Eastern Europe, one of the primary recommen dation is to establish a sustainable system for collecting and managing data on waste strengthening. Data on waste, which lie to avail service in the Municipality of Valjevo are insufficient for predictions about the emergence of waste in the future. Hence, the development of software tools and creation of database on municipal waste are essential for the development of appro priate strategies, especially for determining the capacity and type of plant and equipment for sustainable waste management. The whole activity of collecting and treatment of waste in the municipality of Valjevo is related to the activities of PUC „Vidrak" in Valjevo.

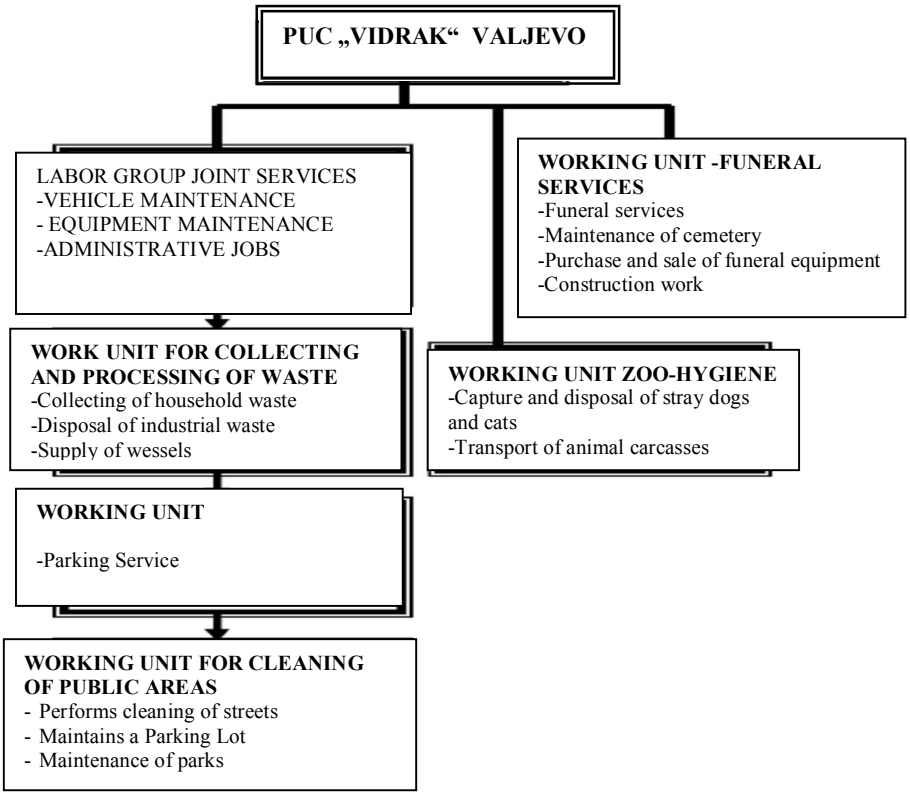

Figure 1. The organizational structure of enterprises

Numerous analysis of domestic and foreign experts in the field of environmental protection indicate that there are no reliable data on waste in Serbia. Data on municipal waste municipalities have declared as a "best estimate" since mass of waste is almost non-existent, and the composition of the waste has never been fully understood. Also, it was noted that there is no mechanism for collecting data from the generator for all categories of waste that is generated. Based on analysis of the Regional Environmental Center for Central and Eastern Europe, one of the primary recommen dation is to establish a sustainable system for collecting and managing data on waste strengthening. Data on waste, which lie to avail service in the Municipality of Valjevo are insufficient for predictions about the emergence of waste in the future. Hence, the development of software tools and creation of database on municipal waste are essential for the development of appro priate strategies, especially for determining the capacity and type of plant and equipment for sustainable waste management. The whole activity of collecting and treatment of waste in the municipality of Valjevo is related to the activities of PUC „Vidrak" in Valjevo.

Activities of this company are collection, storage, transportation, treatment, recycling, use and disposal of recyclable materials, hazardous and dangerous substances, collection of municipal, industrial and medical waste disposal, sanitation and similar activities. Internal organization, organizational units, business units and services, company activities are provided in accordance with the process of work carried out by work units and it can be seen on the block diagram in figure 1. Organizational structure is recorded by the method of conversation and interviews. The interview was conducted with the main manager of the company, director. The PUC Vidrak until recently used the software that was based on a DOS application, which further slowed the obtaining of information and increased the number of operations that were executed in hand, without the use of modern information resources.

The introduction of a new software by idependent developers includes much more automated operations, integrated steps, which were previously conducted in two or more phases. However, due to lack of funds, primarily, and then because of the reluctance of employees to new ways of working, which determines the use of modern information technology there still continues to be a lot of paperwork which should be done manually. Accepting the fact that in information technologies the hardware which is used is good as the money invested in its purchase, and the financial situation that is clearly expressed in social and public organizations, we understand why he bought computer equipment and the acquisition time was least season or two behind the current trends even in the domestic industry. Unfortunately, the same is the case with software solution. When choosing a solution that should satisfy the needs of companies which have more branches that are spatially distant, the last thing on mind was the software solution that will maximize automated data processing. Instead of that, a software solution which units operate independently in each business unit was bought. It can be noted that the qualification structure of the company is very unfavorable, i.e. there is a large number of unskilled workers. So, here is a pronounced resistance to changes. Lack of qualified staff is the burning issue of a large number of our companies including this company. Therefore, training can not be conceived more as the introductory course to introduce the company and its operations, but as a constant learning, training and acquiring of new knowledge. Information is still collected based on interviews with employees and analysis of the forms used in internal communication, both between employees and between business units. There are also forms used in communicating with consumers - customers.

Figure 2. The forms used in communication with consumers - customers.

Risk Management – supports proactive risk management, continuous risk assessment and decision making during the project life cycle. Project Team continually evaluates, monitors and actively manage risks.

By identification of project objectives and constraints we give a list of initial risk, and provided which are requirements, highlighted funds to provide incentives and development. Table 1.

Table 1. Risk evaluation document

Condition	Consequences	Probability	Effect	Exposure	Reduction	Contigency	Triggers	Responsibl
incomplete data on customers	Inability to detect user	80%	6	4.8	Determine the manner of data collection	Clear data by pulling them from the live system	Incomp leteness of data	Administration
data redundancy in the database	difficult review for data analysis	90%	10	9	Good relations	Clear data by pulling them from the live system	Repetition of data	Base administrator
Irregular payment of citizens	Inliquidity	40%	4	1,6	Monitoring of payments	Postponeme nt of some activities	Sloppy Handing of accounts	Finance collectors

MODELING PROCESS

Within the development of complex information systems, it is desirable to use modeling techniques for analysis - modeling process. Process modeling is a technique that easily and systematically implements the logic, policies and procedures system. In the analysis of business systems PUC "Vidrak", IDEF0 methodology was used. Graphical language IDEF0 describes method of functional decomposition over diagram set, from which each describes limited amount of details defined with appropriate sintax and semantics. Diagrams are connected to describe the system hierarchy, from the top down. Diagrams are composed of rectangles that represent some part of the whole. They are connected to each other with directed lines representing connections between parts. There are the three kinds of IDEF0 sheme: graphical, textual and glossary. Graphical sheme defines functions and process connections using boxes, arrows and appropriate sintax and semantics. Text and glossary provide additional information and support graphic diagrams. Sintax of graphical language IDEF0 contains boxes, arrows and rules. Diagrams based on IDEF0 methodology are defined over three types: **context diagrams, decomposition diagrams and activities tree.** The context diagram is defined by a box that represents the boundary of the system under study. It is the highest level of abstraction that decomposition diagrams translate into a lower level of abstraction. A-0 activity that occurs in the context diagram describes the model and must be determined by an active verb phrase as an example: "Management Company". Process modeling is a technique with which the logic, policies and procedures system can be easily and systematically implemented. Using standardized modeling techniques facilitates the creation of information system, which in the era of the Internet leads to faster and easier description, verification and implementation of prototype values. In the analysis of

business systems PUC "Vidrak", IDEF0 methodology was used. With defining of context diagram, boundaries of the system, we provide a framework of observation and define the environment that affects the system. Bearing in mind the look of the structure and context diagram, we can define tree operations, as shown in the following figure 3. Activities tree is defined with problem solving method from top to down, when complex function is divided on more subordinates and then solving simple tasks can start. The vertical hierarchy established by business tree provides linkages between the strategic management (vision, politics, established goals) till level of monitor and evaluation of established processes.

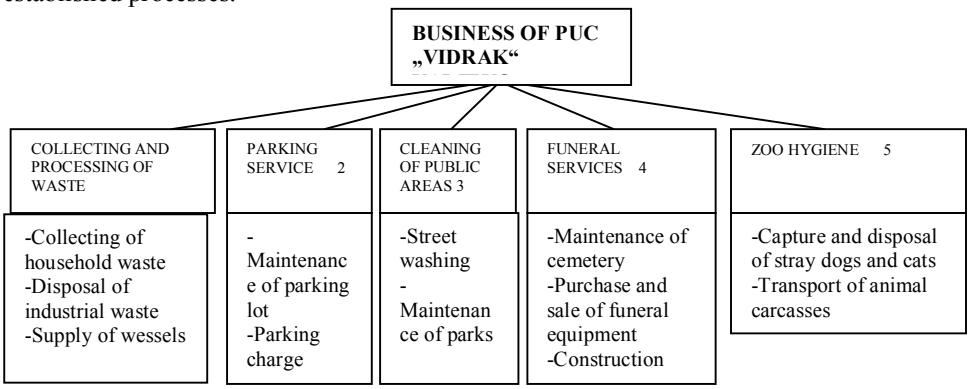

Figure 3. Activities tree of PUC „Vidrak"

In light of such a set of tree activities, the next step is defined by the decomposition diagram, Diagram of decomposition of PUC "Vidrak" which included five activites: waste collection, cleaning of public areas, funeral services, parking service and zoo-hygiene.

Defining activities tree, a vertical link between the business evolved, while making of decomposition diagrams established horizontal links between the circulation of information operations in the PUC "Vidrak" Valjevo.

We describe fields that are located in streams. They are potential attributes of objects in the database. Data flow diagrams show all processes of a system derived by gradual decomposition of the system, as well as data packets, which data flows circulate in the system, or which are stored in data storage. In addition to the structure of the system obtained a detailed process decomposition, DTP with respect to information provided only insight into that data in the system appear, without addressing their detailed structure, i.e. *structure of data flows and databases*. Just as the processes and data flow, storages can have a complex structure, so it is necessary to decompose them into simpler elements.

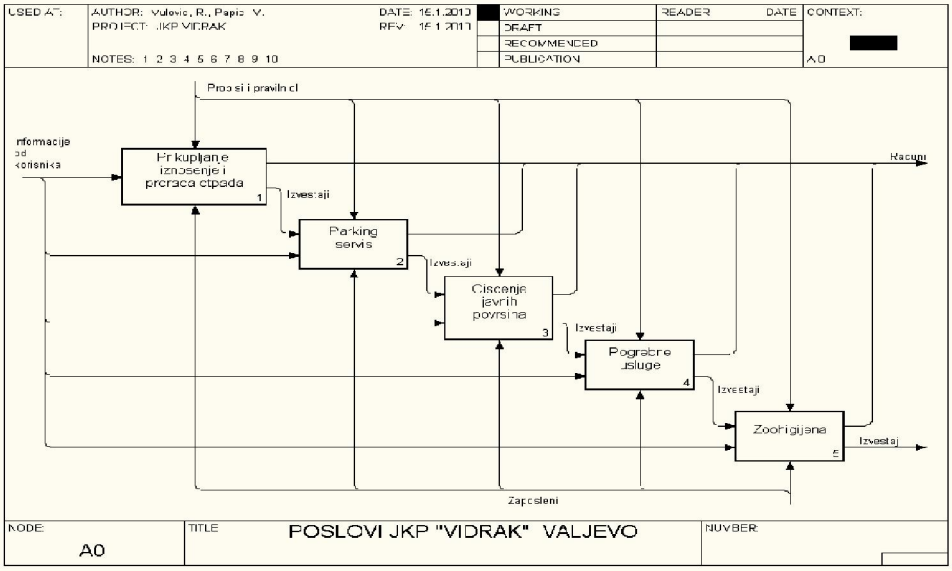

Figure 4. Level 0 diagram

Worker:<WorkerID, Name, Surname, JMBG, Telephone, Workplace, BusinessUnit, Age, GodineStaza, Street>
User:< UserID, Name, Surname, StreetNumber>
Street: < Name, Town area>
Payment of services:< Assignment, Date of Liability, Date of Disbandment, Amount, UserID, WorkerID ,>
Vehicle:<VehicleID, Registration, Type, Year of manufacture, Year of purchase>

MODELING DATA, CREATING DATABASE IN SQL

Process modeling is a technique that organizes and documents the processes of the system and / or implement the logic, policies and procedures of the system. Data flow diagram (DTP) is a tool that describes the data flows through the system and processes running in the system.

Defining the physical data model, ie. implementation of entities and their attributes in the tables and columns of a DBMS, using ERWin is a relatively simple work. ERWin software module for the construction of physical models of reading a description of the entities and attributes and create tables and fields of physical models. When translating the logical model to physical model, following conversions appear: Entities from the model data in a table of physical database; Attributes in a column in the corresponding tables; Candidates for key entities are becoming the primary keys in tables; Relationships between entities achieve that primary keys in tables become foreign keys in linked tables. So, ERwin defined tables and columns automatically, ie. Table names by default are named based on the entity name and attribute names by default

become the column names. Other features are assigned as default values (values to be inserted in the column). Scheme of logical database includes a separate set of data (the appropriate data glossary) with the appropriate semantics and relationships between the elements of a database. Physically, these links are stored in a database, for later use. fig.5.

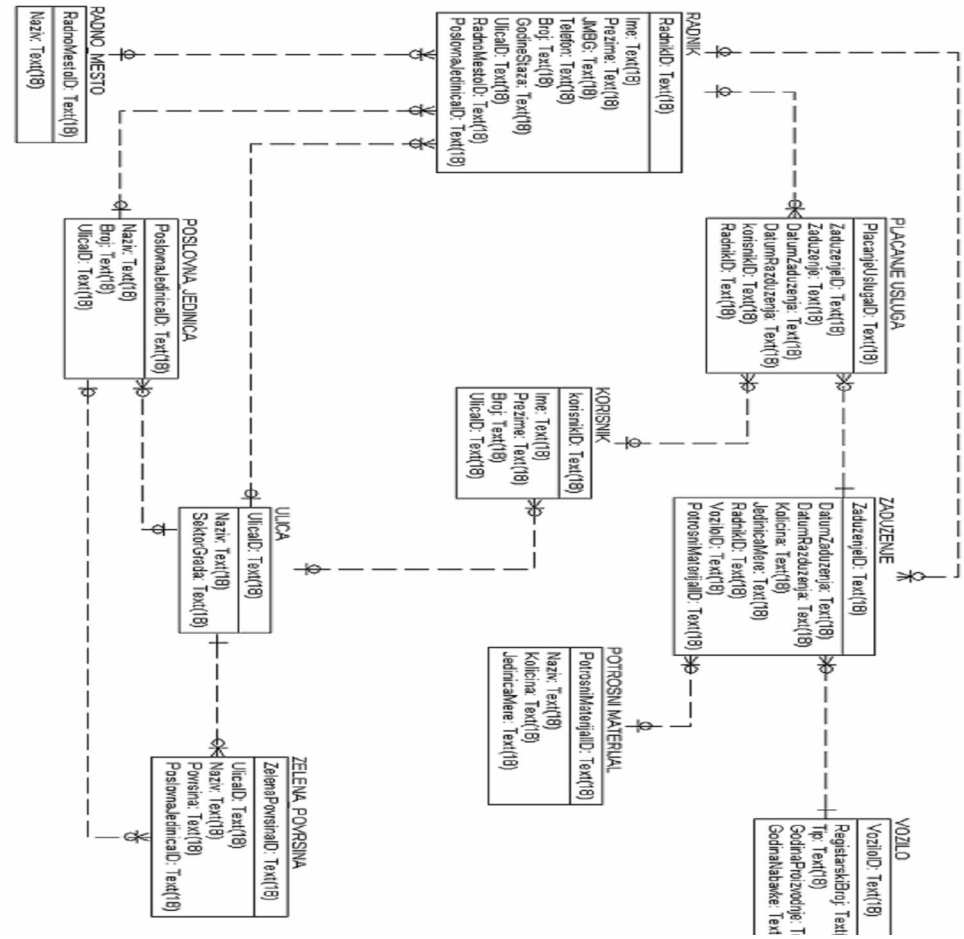

Figure 5. The data model shown in ERwin

Generating database sheme process from phisical data model is direct engineering. When you generate a database schema, entities transferr to the tables, attributes to columns, and connections in the relationships, referential integrities define including triggers, procedures, indexes and other characteristics that support the selected DBMS, which will be discussed in more detail in the next chapter.

CREATE TABLE User
(
UserID INTEGER NOT NULL ,
Name CHAR(20) NULL ,
Surname CHAR(25) NULL ,
Number CHAR(5) NULL ,
Green areaID INTEGER NULL ,
StreetID INTEGER NULL
);
CREATE TABLE Paying of services
(
Paying of servicesID INTEGER NOT NULL ,
AssignmentINTEGER NULL ,
UserID INTEGER NULL ,
Date of assignment INTEGER NULL ,
Date of disbandmentINTEGER NULL
);

The starting point is defined in the options menu based on the set of process models in Bpwin. The following picture shows the scheme of the main menu of the application containing the following options:

Pressing Command opens the next search criteria dialog box for all service users of this company. It is the same for the street.

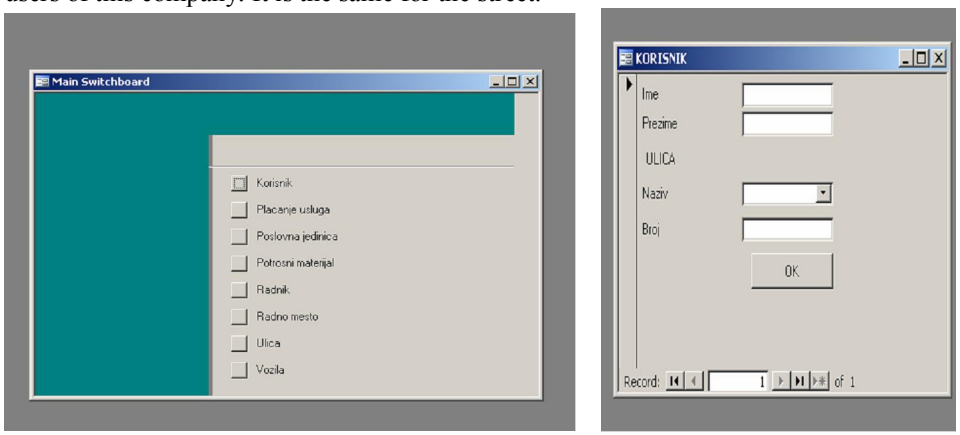

Figure 6. Main window

CONSLUSION

This information system has a task to follow all activities in PUC "Vidrak" Valjevo system. According to that, analysis on the structure, quantity and methods of waste treatment can be carride out, bearing in mind that the system worked in various locations. The system should enable quick and efficient data entry by workers. The existing system would be modernized and expanded to include new work units and data

relevant to their work. This would be easier way to manage household waste in the municipality.

REFERENCES

1. Veljović, A., Radojičić, M., Vesić, J., Management Information Systems, Technical Faculty Čačak, 2008.
2. Veljović, A., Vulović, R., Damnjanović, A., Information Communication Technologies in Management,Technical Faculty Čačak, 2009.
3. Njeguš, A., Business Information Systems,Singidunum FIM, Belgrade, 2009.
4. http://www.cqm.co.yu/ii/materijal/uputstva/BPwin%20Methods% 20Guide.pdf
5. http://www.cqm.co.yu/ii/materijal/uputstva/ERwin% 20Methods%20Guide.pdf

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FLOTATION KINETIC OF COPPER FROM SMELTING SLAG BY GRAIN SIZE

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ABSTRACT

In this paper are given results of investigations the influence of grain size of smelter slag on the process of flotation concentration. It was performed the sampling of industrial processing of smelter slag in Bor flotation plant. Also was made the characterization of smelter slag. The samples were sieved by grain size and determined the content of copper, total, sulfide and oxide. We present the dependence of copper in concentration from time of flotation and particle size. It was determined the flotation kinetics for the total, sulphide and oxide copper from smelter slag.

Key words: smelter slag, grain size, kinetics of flotation, froth flotation

INDRODUCTION

Slag from copper smelter in Bor, in 2002 using the method of flotation concentration start to processed at the facility in Bor flotation plant in order to obtain copper concentrate. As with natural resources, ore, the technogenic raw materials, in our case, smelter slag, copper particles depending on their size can not behave the same in flotation cell. With this research we wanted to find out what the particle size of copper smelter slag flotating best.

SAMPLING AND SAMPLE TREATMENT

Samples to determine the kinetics of flotation of copper smelter slag by grain size were taken from the technological process in the Bor flotation plant. It was determined three characteristic products of the process and products were taken during processing.

Table 1 give the names and code of samples and data in Figure 1 the technology of flotation processing of smelter slag with marked products that are sampled.

***Table 1** – Name and sample code*

SN	Sample name	Sample code
1	The entrance to the rough flotation	U_M
2	Rough flotation concentrate	K_O
3	Rough flotation tailings	$J_Š$

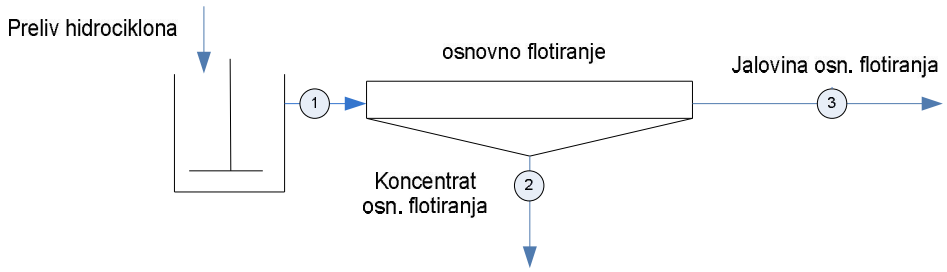

Figure 1. The flowsheet of flotation processing of smelter slag in Bor flotation plant

The samples were taken at determined points. Sampling was done when the Bor flotation plant processing smelting slag only.

CHARACTERIZATION OF SAMPLES

After taking and treatment of samples, the characterization of samples performed and determined by:

- density,
- natural pH value of the sample,
- particle size distribution and
- chemical composition.

The density of solid samples was determined in the laboratory glass pycnometer in technical preparations station in Bor flotation plant. The measurement results are shown in Table 2.

Table 2. Density of solid samples

Sample name	Density, (kg/m^3)
U_M	3.500
K_O	3.600
$J_Š$	3.400

The natural pH of the sample was determined in the laboratory for technical preparations station in Bor flotation plant and it was pH = 7.40.

Grain size composition of samples was determined in the laboratory for technical preparations station in Bor flotation plant, with metof of wet sieving on a standard series of Tayler sieves, with sieve openings from 0.212 mm to 0.037 mm. Grain size composition of the entrance to the rough flotation and product of rough flotation are given in Tables 3-5 [1].

Table 3. Grain size composition of the entrance to the rough flotation , U_M

Grain size (mm)	M (%)	R (%)	D (%)
+0.212	1.90	1.90	100.00
-0.212+0.147	6.70	8.60	98.10
-0.147+0.106	13.96	22.56	91.40
-0.106+0.074	19.19	41.75	77.44
-0.074+0.053	7.26	49.01	58.25
-0.053+0.037	8.39	57.40	50.99
-0.037+0.000	42.60	100.00	42.60

Table 4. Grain size composition of rough flotation concentration, K_O

Grain size (mm)	M (%)	R (%)	D (%)
+0.212	0.25	0.25	100.00
-0.212+0.147	1.43	1.68	99.75
-0.147+0.106	4.50	6.18	98.32
-0.106+0.074	7.92	14.10	93.82
-0.074+0.053	3.33	17.43	85.90
-0.053+0.037	11.82	29.25	82.57
-0.037+0.000	70.75	100.00	70.75

Table 5. Grain size composition of rough flotation tailings, $J_Š$

Grain size (mm)	M (%)	R (%)	D (%)
+0.212	2.03	2.03	100.00
-0.212+0.147	7.12	9.15	97.97
-0.147+0.106	14.70	23.85	90.85
-0.106+0.074	20.07	43.92	76.15
-0.074+0.053	7.57	51.49	56.08
-0.053+0.037	8.12	59.61	48.51
-0.037+0.000	40.39	100.00	40.39

Chemical analysis of samples were done for total, sulphide and oxide copper. Chemical analysis laboratory conducted the HTK, Institute of Mining and Metallurgy in Bor. Chemical analysis are shown in Table 6.

Table 6. Chemical composition of the samples

Chemical element	U_M	K_O	$J_Š$
Cu, %	0.881	6.449	0.432
Cu_{sulf}, %	0.761	5.745	0.359
Cu_{ox}, %	0.120	0.704	0.073

In order to deeper insight into trends in the products of copper flotation and events in the process, seven characteristic size class of all samples were sent for chemical analysis of total and oxide copper from smelter slag. Chemical analysis was performed in the laboratory HTK, Institute of Mining and Metallurgy in Bor, the results are shown in Table 7.

Table 7. Chemical composition of the samples by grain size

Grain size (mm)	U_M		K_O		$J_Š$	
	Cu_T (%)	Cu_{OX} (%)	Cu_T (%)	Cu_{OX} (%)	Cu_T (%)	Cu_{OX} (%)
+0.212	0.580	0.065	7.260	0.658	0.515	0.059
-0.212+0.147	0.642	0.184	5.197	1.046	0.560	0.168
-0.147+0.106	0.734	0.062	5.899	0.431	0.575	0.051
-0.106+0.074	0.703	0.035	6.977	0.316	0.481	0.025
-0.074+0.053	0.888	0.103	7.880	0.800	0.406	0.055
-0.053+0.037	0.780	0.064	7.529	0.460	0.227	0.031
-0.037+0.000	1.080	0.185	6.200	0.795	0.376	0.101

FLOTATION KINETIC OF COPPER FROM SMELTING SLAG

Kinetics of copper smelting slag was observed for each size class. On Figures 2, 3 and 4 are shown copper (total, sulfide and oxide), in rough flotation concentrate by individual size class in dependency of time duration of the rough flotation. Since the total time duration of the rough flotation is 18 min, it was observed the movement of copper from the beginning to the end of a pough flotation for each size class.

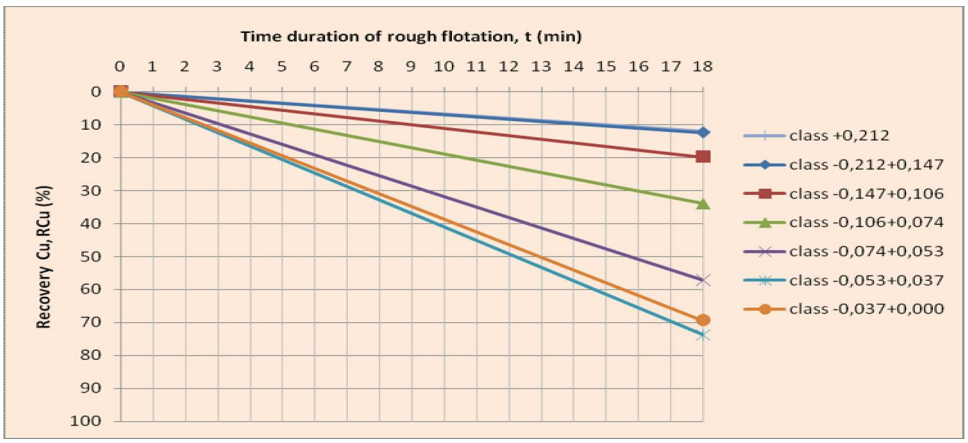

Figure 2. Flotation cinetic of total copper by size class

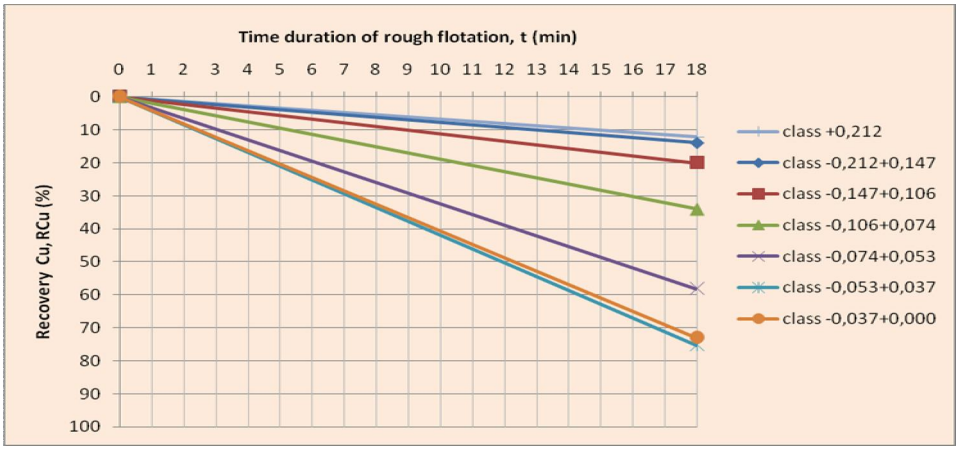

Figure 3. Flotation cinetic of sulphide copper by size class

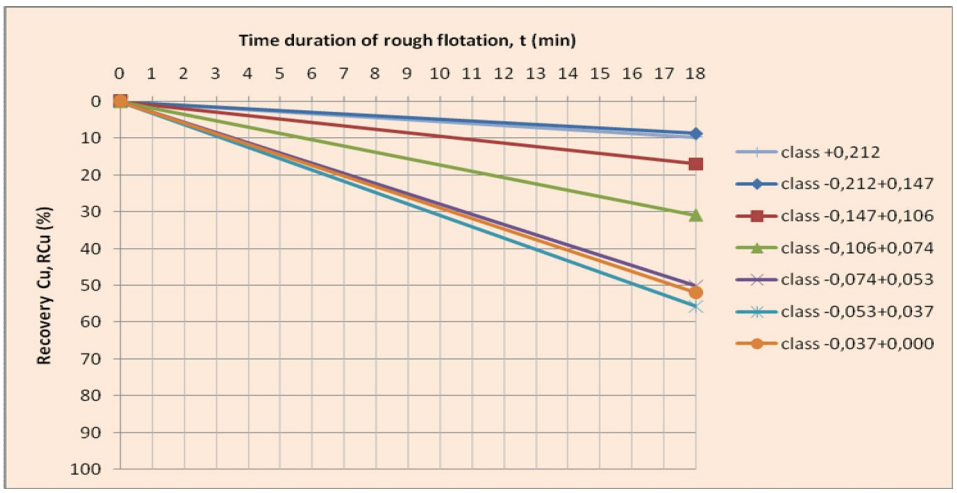

Figure 4. Flotation cinetic of oxide copper by size class

From Figure 2, 3 and 4 can be concluded that there are three ranges of real grouping representing the dependence of copper in relation to the time of flotation, and size of particles, one in which the grouping of a larger particle size class +0.212 mm, -0.212 +0.147 mm and -0.147 +0.106 mm, the second in which the particles are grouped medium large, -0.106 +0.074 mm and +0.053-0.074, and the third in which the clustered smaller particles of size class -0.053+0.037 mm and +0.000-0.037. Sulphide copper particles have a highest flotability speed. Also, the highest flotability speed have the smallest particles, and with increasing seed size flotability decreases.

In Figure 5 presents the flotation cinetic of total, sulphide and oxide copper for the entire observed range of size particles.

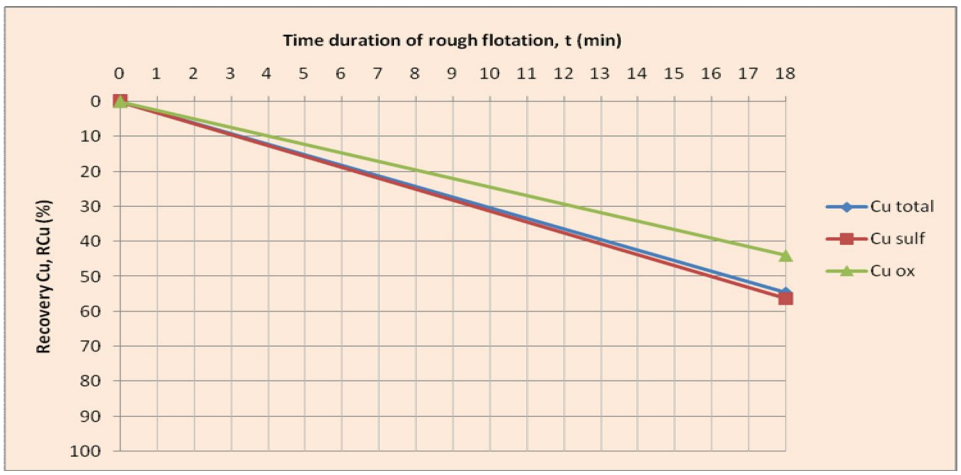

Figure 5. Flotation cinetic of total, sulphide and oxide copper for the entire observed range of size particles

For showing the time duration of flotation is sufficient agreement with the adopted model of flotation rate, with the model of chemical kinetics of the firs order [2], M(t)=Mo×e-kt,

where:

• M (t) - mass of residual carrier particles of copper in slag at time t who are still in flotation cell,

• Mo. - weight carrier particles of copper in the slag before flotation (t = 0),

• k - the coefficient of flotation speed

• t - flotation time diration.

During the flotation of the total, sulphide and oxide copper holders may be particularly appropriate to write mathematical expressions for use of copper recovery:

• the total copper holders, $I = 100\times(1-e^{-0,044t})$,% where k = 0.044

• for holders of copper sulphide, $I = 100\times(1-e^{-0,046t})$,% where k = 0.046

• for holders of copper oxide, $I = 100\times(1-e^{-0,032t})$,% where k = 0.032

The coefficient k was determined from experiments and is valid in the total range of size of particles during the flotation of 18 min.

Figure 6 shows the ratio of flotation speed coefficient (k) depending on the size of the opening screens for the total, sulphide and oxide copper, k = f (d).

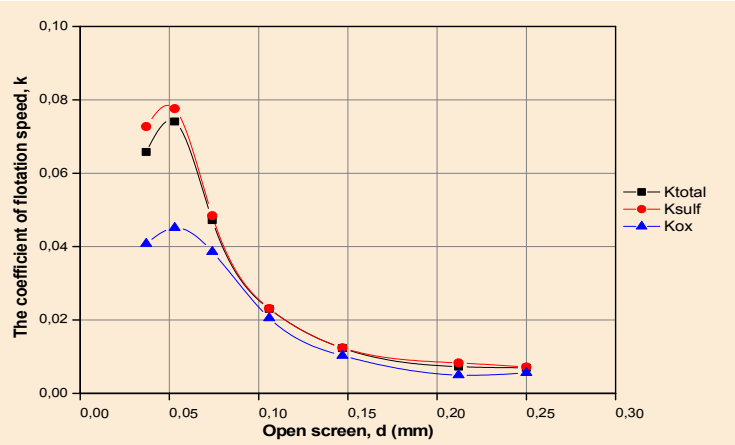

Figure 5. Coefficient of flotation speed value for total, sulphide and oxide copper in the total range of size particles

In Figure 5 can be seen trends of coefficinet of flotation speed value compared to the size of copper particles, which tells us flotation process trends by size class.

The higher coefficient k get greater recovery of copper particles. Value of coefficient k in Figure 50 show us that the highest recovery is for sulphide copper slag as well as smaller particles better than larger. With increasing of particle size thay flotability decreases. Drastic reduction of flotability was observed for particle sizes above 0.100 mm.

CONCLUSION

Considered the order of flotation rate of copper in individual size class. It was concluded that the different speed from the flotation of copper smelting slag, depending on their size. Fastest flotation speed have smallest particles and with increasing particle size flotation rate decreases. It can be concluded that there are three ranges of grouping the right to represent the dependence of copper in relation to the time of flotation, and size of particles. Also, the conclusion is that flotation process of sulfide copper particles from smelter slag is much better than the oxide copper particles from smelting slag.

Acknowledgments

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REFERENCES

1. RBB Bor, Bor Flotation Plant: Bor flotation plant processing reports, Bor, Serbia, 2005
2. Milošević S.: Flotation concentration, page 202, Tehnical faculty in Bor, Bor, Serbia, 1994

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DEPENDENCE OF CONCRETE PROPERTIES ON SECONDARY LEAD SLAG SHARE AND ADDITIVE TYPE SELECTION

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ABSTRACT

Automotive batteries are a major source for secondary lead processing, followed by generation of hazardous waste such as secondary lead slag. It has been used in presented research in a cement based stabilization/solidification process for the manufacture of concretes. The dependence of concrete properties with slag (10%, 20%) and additive (MgO, CaO, $Ba(OH)_2$, $CaSO_4 \cdot CaO$) on the properties of concrete has been studied by measuring the compressive strength and lead leachability by TCLP method. Stabilization/solidification of secondary lead slag in concrete was most effective with 10% of slag as replacement of 15% aggregate and magnesium oxide as replacement of 5% cement.

Key words: secondary lead, slag, concrete, compressive strength, leaching, TCLP

INTRODUCTION

One of the main goals of sustainable waste management is to maximize recycling and reuse of metals. The reuse of metal containing waste help to preserve and sustain natural resources of metals which cannot be replenished, decreases the environmental pollution and enables to save and recycle energy in production processes [1].

Secondary lead metallurgy using lead-acid battery scraps as raw material generates a large amount of solid waste. The impurities present in the lead-containing raw materials, together with other materials added to promote the necessary reactions in the process, constitute the slag. It is not possible to ascertain the precise quantity of slag generated in the world, but it is estimated that the annual production from primary and secondary lead processes is 3 Mt [2]. All kinds of slags from secondary lead smelters are classified as hazardous waste in the European Waste Catalogue [3]. The aim of slag treatment before disposal is to immobilize present soluble constituent.

Stabilization is a pre-landfill waste treatment process, which has been successfully used for different types of industrial waste, but is particularly suited to those containing heavy metals. The continuous need to develop economical and improved waste

management techniques has increased the potential importance of solidification technology throughout the world, in a process defined as the best demonstrated available technology (BDAT) [4]. Stabilization/solidification (S/S) of heavy metals containing inorganic materials with cement as a binder in mortar and concrete is an effective way of immobilization. The objectives of S/S are to achieve and maintain the desired physical properties and to chemically stabilize or permanently bind contaminants and to reduce their leachability.

With increasing environmental pressure to reduce waste and pollution and to recycle as much as possible, the concrete industry has begun adopting a number of methods to achieve these goals [5].

Since oxides contained in the slag, a waste product from battery smelting using $CaCO_3$ as flux, are similar to those of Portland cement, the application of the slag for construction material is fully attractive. As well, slag is known for a good aggregate substitution. Use of hard slag aggregate in concrete will be beneficial, particularly in areas where good-quality aggregates are not easily available [6].

Reuse of industrial solid waste as a partial replacement of aggregate in construction activities not only saves landfill space but also reduces the demand for extraction of natural raw materials. Preserving natural resources is a matter of sustainable development to ensure sufficient resources for future generations [7]. Since approximately three-quarters of the volume of concrete are occupied by aggregate, it is not surprising that aggregate quality is of considerable importance. Not only can the aggregate limit the strength of concrete, but the aggregate properties also greatly affect the durability and structural performance of the concrete.

De Angelis et al. [8] studied the performance of products arising from the stabilization/solidification of secondary lead slag into a Portland cement matrix. The goal of the study was to permit stabilized waste to be disposed according to current legislation and also to obtain a recyclable material. The results showed that only a limited amount of slag can replace siliceous sand, if problems caused by the interactions of lead with cement components are to be avoided.

This paper presents the investigation of the influence of addition of secondary sodium lead slag and selected additives on properties of concrete. In this work, selected additives were used to partially replace the ordinary Portland cement and the slag was used as partial replacement of aggregate. The compressive strength and leachability of lead from obtained samples was carried out to assess its mechanical properties and toxicity.

EXPERIMENTAL WORK

Concrete mixtures were prepared by mixing cement, aggregate, additives and secondary lead slag with water. Portland cement (PC 35M (V-I) 32.5 R), natural aggregates (coarse and fine) and powder form of additives (p.a. qualty) were used in this investigation. Secondary lead slag was obtained from the process for lead recovery lead from automotive batteries (Engitec CX process). Full characterization of slag used for research is presented in previous work of authors [9]. The maximum particle size of the slag was 1 mm.

Different types of concrete mixtures were prepared in this study (*Table 1*). Control concrete mixture consisted of cement, aggregates and water. The other concrete mixtures contained secondary lead slag and selected type of additives (MgO, CaO, $Ba(OH)_2$, $CaSO_4CaO$), as well as cement, aggregates and water. The additives replaced 5 wt. % of cement, slag replaced 15 and 30 wt. % of fine aggregates, which makes 10 wt. % and 20 wt. % of slag in whole mixtures. All samples were made using water to binder ratio of 0.60, where the workability requirements were met. The mixtures were cast into molds (edge length 100 mm) and vibrated to reduce the volume of entrapped air. Mold was removed after 24 h and samples were cured in a humidity chamber. Compressive strength and leaching of lead from the concrete mixtures were investigated after 28 days.

Table 1. Concrete mixtures

Sample	*Additive*	*Slag content, wt. %*
Control	-	-
M10	*MgO*	*10*
M20		*20*
C10	*CaO*	*10*
C20		*20*
B10	*$Ba(OH)_2$*	*10*
B20		*20*
G10	*$CaSO_4 \cdot CaO$*	*10*
G20		*20*

The compressive strength was measured by crushing 100 mm cubes in accordance with standard SRPS U.M1.020, using a servo-hydraulic testing machine, Instron 1332, loading capacity 100 kN, control module Fast track 8800, fast moving clips 1mm/min.

The Standard Toxicity Characteristic Leaching Procedure (TCLP) [10] was used in this study to evaluate the leachability of lead from the concrete mixtures. All samples in this study were ground to <0.85 mm. At the end of 18 h extraction period, liquid phase was separated and metal concentrations in the leachates were measured by atomic absorption spectroscopy (AAS).

RESULTS AND DISCUSSION

Hardened concrete mixtures as stabilized products are submitted to compressive strength and TCLP leaching tests to assess the obtained results and to evaluate the efficiency of the treatment [11].

Compressive strength

Compressive strength of concrete mixtures prepared in this work is determined in order to compare influence of selected additives and secondary lead slag on their mechanical properties. The compressive strengths of the concretes studied were presented in Figure 1.

Compressive strength of concretes C20 and M20 are higher than that of control concrete. Measured values of the compressive strength showing a increasing of compressive strength with increasing content of secondary lead slag in concrete

mixtures. Influence of CaO on properties of solidificates is known in literature [12,13]. It was determined that the content of CaO is determined by thermodynamics and kinetics of the S/S process, i.e. formation, structure and morphology of C-S-H gel. Namely, if the CaO present in excess, a displacement of equilibrium in the reaction of dissolution portlandit, which can influence the change in the characteristics of the gel.

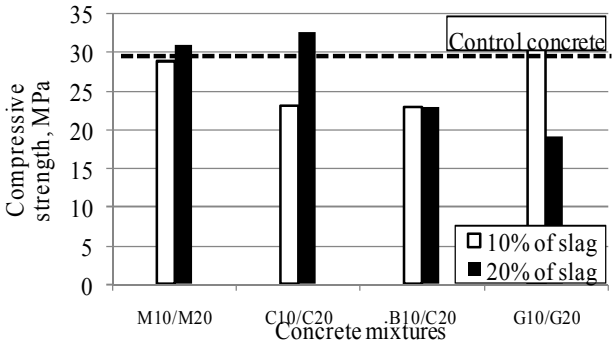

Figure 1. Compressive strength of concrete mixtures

Content of slag in concrete prepared with $Ba(OH)_2$ had no influence on their mechanical properties. Compressive strengths of concretes B10 and B20 are lower than that of control concretes. It is assumed that this was a consequence of the formation of compounds with barium which position, size or shape had the significant influence on mechanical properties of concrete due to weak cement matrix and increased porosity of material.

Decreasing of compressive strength with increasing content of secondary lead slag in concrete mixtures prepared with gypsum was measured in this investigation. This is in contrast with that gypsum induces the structural densification by formation of AFt and AFm phases. Therefore, the value of compressive strength increases and leaching of metals like lead decreases. By using gypsum and fly ash, compressive strength increased via active generation and substitution of aluminate hydrates [14].

Optical microscopy

The sample of control concrete, mixture C20 as concrete with the highest compressive strength and G20 as concrete with lowest compressive strength were analyzed by optical microscopy. It was assumed that the increase of compressive strength was the result of increasing hydraulic binder properties due to addition of CaO and slag, which has a greater positive effect on strength of materials from the presence of unreached coke and impregnated hematite in the mass of binder. Presence of closed porosity, as the result of poor bonding between the cement and slag, caused a substantial reduction in strength of concrete G20 (Figure 2).

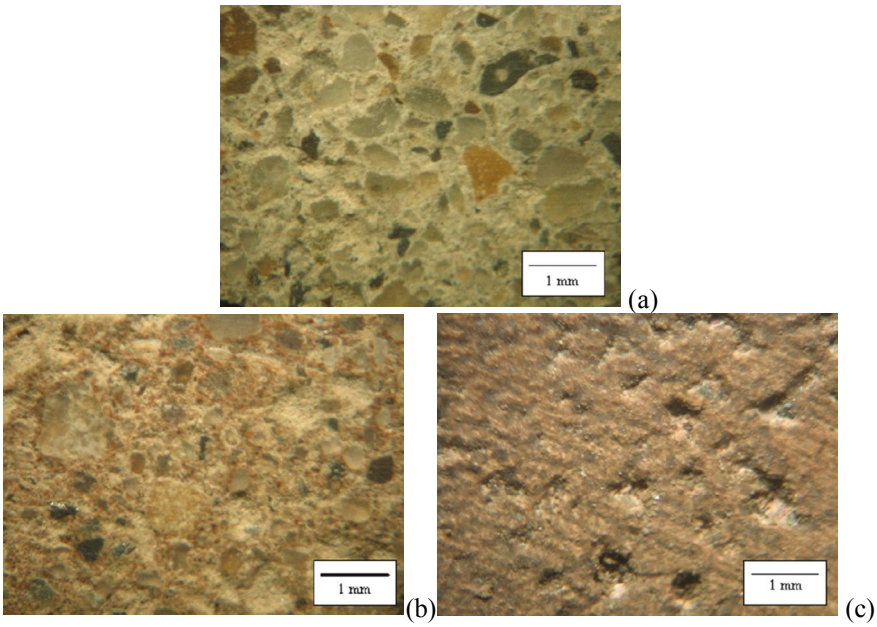

Figure 2. Porosity of concrete cubes (a) Control (b) C20 (c) G20

Leaching of lead from concrete mixtures

From measured results of leached amounts of lead from concrete mixtures (*Figure 3*), according to TCLP method, it can be concluded that slag was well-stabilized in all concrete mixtures prepared with a smaller content of slag (10%). Good stability was achieved in concrete mixtures M20 and B20. Leaching of lead was the highest from concrete cubes C20 and G20.

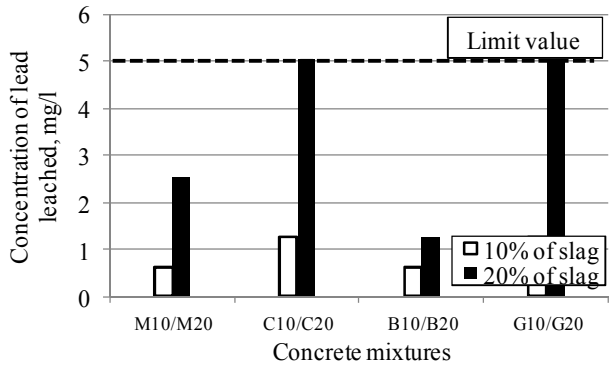

Figure 3. Concentration of led leached from concrete mixtures

Influence of selected additive on properties of concrete mixtures depends from content of secondary lead slag into concretes. It was observed that positive influence of selected additives on compressive strength of concrete mixtures prepared with 10% of slag decreasing in order: gypsum, magnesium oxide, calcium oxide and barium hydroxide, respectively. Decreasing of compressive strength was measured for concrete mixtures prepared with 20% of slag and calcium oxide, magnesium oxide, barium hydroxide and gypsum, respectively. Concentrations of lead leached from mixtures prepared with barium hydroxide and magnesium oxide were lower than concentrations of lead leached from concrete mixtures prepared with calcium oxide and gypsum, apart from its slag content.

Acknowledgments

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CONCLUSION

Based on the presented results, it can be concluded that the properties of concrete depend on the quantities and qualities of its components, amount of slag and type of additive. Stabilization/solidification of secondary lead slag in concrete cement matrix was most effective on concrete M10. Slag content was a limiting factor in the production of concrete with calcium oxide and gypsum. Also, using barium hydroxide in the production of concrete was a limited factor due to poor mechanical properties.

REFERENCES

1. Hassani A., Ganjidoust H., Maghanaki A., Use of plastic waste (Poly-Ethylene Terephthalate) in asphalt concrete mixture as aggregate replacement, Waste Management & Research. 23, 322–327 (2005)
2. Rodriguez-López D., Lead slags leachability characterization: a critical study with different laboratory assays, Proceedings of the Third Regional Forum of energy and the Environment, Canoas (Rio Grande do Sul, Brasil) 235–244 (1999)
3. European Waste Catalogue (EWC), Commission Decision 2000/532/EC
4. Malviya R., Chaudhary R., Journal of Hazardous Materials, B137, 267-276 (2006)
5. Sear L., Towards zero waste, Concrete 39 (5) 50–52 (2005)
6. Penpolcharoen M., Utilization of secondary lead slag as construction material, Cement and Concrete Research 35, 1050– 1055 (2005)
7. Rakshvir M., Barai S.V, Studies on recycled aggregates-based concrete, Waste Management & Research**.** 24 225–233 (2006)
8. De Angelis G., Medici F., Montereali M., Pietrelli L., Reuse of residues arising from lead batteries recycle: a feasibility study, Waste Management 22 (8) 925–930 (2002)

9. Knežević M., Korać M., Kamberović Ž., Ristić M., Possibility of secondary lead slag stabilization in concrete with presence of selected additives, Journal of Metallurgy, Association of metallurgical engineers of Serbia Vol. 16 (3) 195-204 (2010)
10. US EPA The toxicity characteristics leaching procedure, US Code of Federal Relations, 40th ed. Part 261, Appendix II (1992)
11. Hills C. D., Sollars C. J., Perry R., Ordinary Portland cement based solidification of toxic wastes: the role of OPC reviewed, Cement and Concrete Research 23, 196–212 (1993)
12. Batchelor B., Overview of waste stabilization with cement, Waste Management 26, 689–698 (2006)
13. Palomo A., Palacios M., Alkali-activated cementitious materials: alternative matrices for the immobilization of hazardous wastes, Part II, Stabilization of chromium and lead, Cement and Concrete Research 33, 289–295 (2003)
14. Guide to disposal of chemically stabilized and solidified wastes, U.S. EPA SW 872 (1982)

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RECULTIVATION OF SMALL OPEN PIT MININGS

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ABSTRACT

In Vojvodina, the most degraded areas in the rural areas of surface mining of clay, sand and gravel. Small irregular depression or no water or filled with groundwater. We presented the preliminary design of the open pit design with no water. The preliminary decision is regulated by the camping area with a lake for fishing in the Krajisnik.

Key words: open pit, lake, fishing

INTRODUCTION

Many human activities cause temporary or permanent degradation of the environment. This conflict is especially emphasized in open pit mining where mineral resources is exploited. Among the most important conflicts include: soil occupation and change the purpose of its utilization, changes in water regimes, conflicts with the created environment, destruction of habitats of protected species of flora and fauna and others.

In Vojvodina, in smaller settlements, dominated abandoned surface mines small brick. When the depression filled with water, usually lead to spontaneous reclamation. Open pit inhabited marsh flora and fauna. In this way, restore or create new ornithological habitat. In the abandoned open pit without water, mostly spontaneous recultivation become wild unmanaged landfills. Required are a small financial investment that such a dump into a landscaped area. Because of the small areas are usually regulated as a settlement camp for fishing or as a production ponds.

MATERIAL AND METHODS

When reclamation of surface mines in principle can be considered the following options:

- Reclamation to establish the prior conditions, including depression fill surface mine tailings, waste management, material from newly opened mines, pits, etc., and placing top soil to return to the previous destination surface;
- Surface Mine Reclamation depression with the goal of establishing environmentally valuable habitats, especially when it comes to location in a nature park at different levels of protection or restoration of an indigenous habitats;
- Reclamation with the purpose of setting the sports and recreational areas, and aqua park, especially if the mine is located near the resort;
- Surrendering spontaneous natural development after the suspension of operation. This ability comes into account if the pit edge, or slope, so designed that the possible spontaneous or rehabilitation interventions with little landscape architect. It is usually necessary to dig fencing areas to exclude damage that can cause people, wildlife and domestic animals. This solution should not mean complete abandonment of the statutory duties of reclamation.

The task of reclamation and Physical Planning of the open pit of depression is the investigation of measures and methods of training in this area for specified purposes. First, therefore, explore the basic directions, restrictions and basic natural characteristics of depression pit. The purpose of the space depends on natural conditions of the location, size, and surface reclamation, construction of infrastructure and hobbies of potential users. In the following phase, there are explored elements of recreation program and than follows the solution for recultivate and planning.

Among the given options presented is a variant of cultivation in order for the area for fishing with the protection of ecologically valuable habitat. The formation of water surface for recreational fishing must meet the following criteria: minimum water surface of 2 hectares, more than half of the surface water depth over 2 m, forming shallow water for spawning fish on the sunny side of the lake, the water quality standards for fish farms, a permanent source of water, wetland forming water filtration before indulging in canal or lake water recycling project (Stojiljkovic, 2011)..

In the lake for fishing is not justified to apply any form of intensive cultivation of fish for a big ichtyoproduction. Future settlement fish in the lake should also establish and maintain that it can be used for sport and recreational fishing. His production has to be consistent with the productive potential of the lake. Organizing and constructing permanent objects with necessary protection measures of water and green surfaces, contribute to the future water ecosystem conservation, stability and quality. Necessary safeguards are minimal: allowed to use equipment and tools, guards and prevent unauthorized use of funds and theft of fish.

Because of the danger of eutrophication should be limited and over-throwing bait to attract fish, as anglers tend to cast them out of control. In the design water surface should be taken into account the water quality according to the criteria for fish farms (Table 1).

Table 1. The criteria of water quality in the fish ponds

Parameters	Desirable contents (mg/l)	MAC (mg/l)
Water color	30^0	50^0
Transparency	Transparency	Little muddy water
O_2	4-8	2.5
Free CO_2	10	20
H_2S	0	0.1
pH	7	6.5
Alkalinity /mg-ekv	1.8-2	3.5
Total hardness	5-8	3-5
N albumin	0.5-1.5	2
Oxidation of O_2	15-20	40
Ammonium salts	0.5-1	1.5
Nitrites	Do 0.2	1.5
Nitrates	1-2	0
Phosphate P_2O_2	0.2-0.5	0.5
Fe	1-2	4
Cl	5-10	25
SO_4	10	20-30
Salinity	1 000	1 500

Plant material is allocated to green areas as a group or in a linear arrangement. Has primarily the role of physical and biological filter. The choice of material depends on many years of natural environmental conditions and degree of land degradation, water and air. Plant material has the following tasks:

- Produkcion of oxygen: yew 118 units, pine 164, big leaf linden 450, berlin poplars 691 units,
- Retention of particle: the poplar *Populus* 34 kg, the elm *Ulmus* 28 kg, the maple *Acer* 33 kg, the beebread *Acer Platanoides* 28 kg, the horse chestnut *Castanea* 16 kg..
- Air ionization: greatest impact on the creation of light ions in the air have *Pinus silvestris* – 80%, *Betula nana* – 64%*, Sorbus aucuparia* – 49….
- Phytoncide effect of different types have different production ability phytoncide: *Acer platanoides* - destroys bacteria in 12 minutes and, in the air above the plants, *Acer tataricum* - 20, *Betula verucosa* - 22, *Carpinus betulus* - 7, *Taxus baccata* - 6, *Juglans regia* - 18 , *Laurus nobilis* - 15, *Cedrus atlantica* - 3, *Populus alba* - 25*, Ribes nigrum* - 10 bacteria per minute.
- Protective forest belts
- Barrier thermal
- Barrier sonic
- Retention of heavy metals and dangerous materials in the water and soil
- Aesthetic significance

RESULTS AND DISCUSSION

Current situation: wild landfill waste and borrow pits brick is located west of the settlement Krajisnik is surrounded by residential areas to the west Zitiste, from northern New Itebej, Krajisnik from the east and from southern localities Medieval. Surface mining is a communal brick unfurnished. The former made structures are destroyed, except the chimney which also tends to decline. Kota the terrain varies from 75.00 to 79.00 meters. Leftover ravine after termination of brick used as uncontrolled dumps, municipal and other waste people Krajisnik and other urban areas in the vicinity of (al, 2008). Location is three unrelated depression-gully irregular in shape, size and depth. Space is covered with weeds and low vegetation and the litter pests. It is placed next to the regional road No 123 to which there is a way to approach by the unarranged macadam path (Figure 1).

Conceptual design: The planned purpose of land forming a lake for fishing and swimming and the formation of the field of sports and recreation. Defining the shape and size, fitting the required content, linking spatial units, resulted in the unique space center with all the features, amenities and infrastructure facilities. Movement within the site is provided for by the marked out routes paved, plateaus and green areas. Arrangement of all areas and connecting routes enabled the circulation of pedestrians within the complex. The Project of the approaching road and parking spaces defines all details. The general disposition of objects is given in Fig. 2.

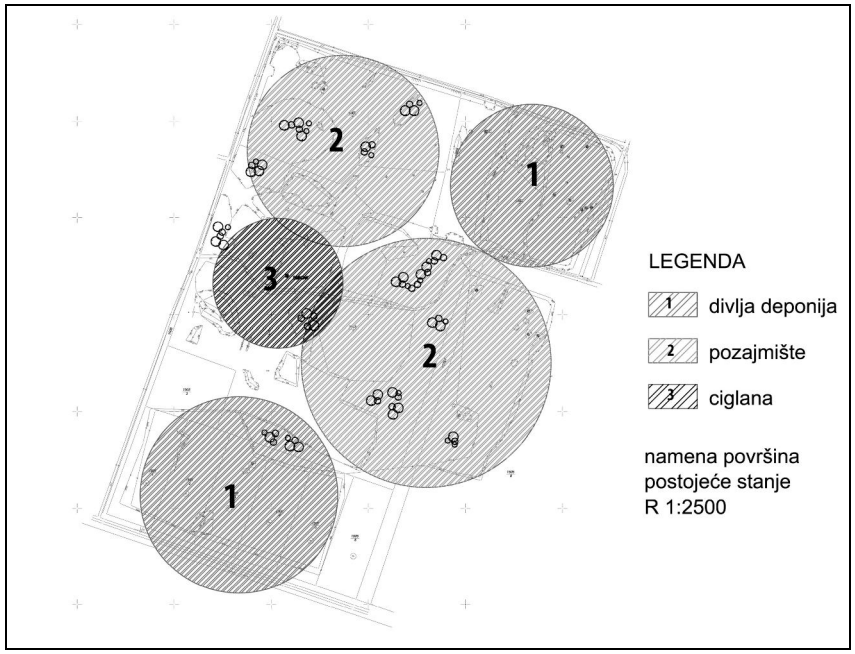

Figure 1. Application areas- Krajišnik
Legend: 1. landfill; 2. borrow pit; 3. brick kiln

To the following areas: access road, connection to the transmission line from transformer station, water well to supply drinking water, wells for water supply pecališta and baths, the waters pecališta with platforms and places for fishing, swimming beach with a nice coast restaurant with parking (Fig. 2 .) plant to treat waste water, forest shelterbelts-belt, chimney, telephone connection and green.

Plant cover: the southeastern part of the plot provides an intensive afforestation of high-and low-deciduous native species to form vetrozaštitnog belt. The most frequent winds blow during the year from the southeast direction. On the part of the camping are projected plantings of high and middle-deciduous species. On the surfaces of the fence and the agricultural areas, crops are set high thickets of native species. In the complex, regulated areas, green spaces and park beach of the fishing center provides for the planting of ornamental species. Plant a deciduous high-rows of trees will be followed by an access road and parking spaces provided for car.

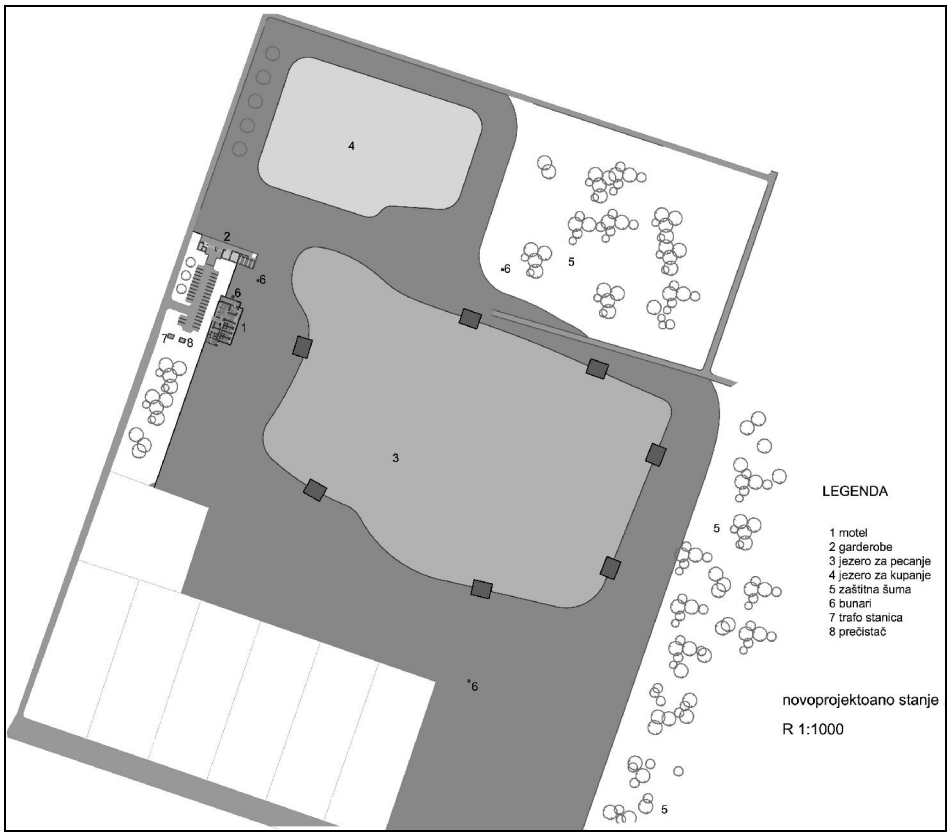

Figure 3. Conceptual desing- Krajišnik

Legend: 1. Motel; 2. Checkroom; 3 .lake for fishing; 4 lake swimming; 5. Shelterbelts forest zone; 6 wells; 7 Substations; 8th Purifier

CONCLUSION

Conceptual solution to fit into the space because it does not disturb other neighboring facilities, but contribute to the rehabilitation of the existing poor condition of the deposit of waste and improve the appearance of the degraded zone change for the better microclimate and provide enrichment area. Assessment of environmental impact is as follows: Surface Mine reclamation measures contribute to improvement of environmental protection and environmentally friendly. Objects by their content and function provide secure functionality and the possibility of taking measures for its security. The rationality of the decision stems from achieving the double benefit, both in terms of environmental protection, as well as upgrading the space, the possibility of hiring a certain number of people and the possibility for sales of goods and services of the local population. This will reduce migration from smaller communities and all the links related to this process.

REFERENCES

1. Grupa autora, 2008.: Idejni projekat ribolovnog centra, kupališta i rekreacionog centra Krajišnik;" Tehnoproing", Novi Sad.
2. Stojiljković D**.,** Vranešević M.: Rekultivacija površinskih kopova ciglana, Eds: Univerzitet u Novom Sadu, Poljoprivredni fakultet, Departman za uređenje voda, tematski zbornik radova MELIORACIJE 11, ISBN: 978-86-7520-204-2, UDK: 626.8(082), str 158-165, Novi Sad, Srbija, januar 2011.

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CONSERVATION AND SUBSTITUTION OF NON-RENEWABLE NATURAL RESOURCES

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ABSTRACT

In recent decades, as a result of continuously growing demands for all mineral resources, that tend to maintain such a trend, the approach to the problem of depletion and non-renewability of useful mineral concentrations has become more studious and scientific in order to " postpone " the total depleton of mineral resources as much as possible. One of the approaches that elaborates the question of the mineral resources depletion and its correlation with the rational utilization of non-renewable natural resources is the theory of conservation of mineral resources. The foundations of the theory were laid in the late nineteenth century in the United States. The substitution of mineral resources represents the appropriate replacement of mineral resources by other organic or non-organic materials.

Key words: conservation, substitution, natural resources

INTRODUCTION

The amount of non-renewable natural resources in the Earth's crust is limited and that’s because it is necessary that the occurrence of depletion of mineral deposits that are closely associated with non-regenerative nature of these natural resources, in relation to the duration of human civilization, and the average life expectancy should be relativized. The exploitation should be proportional to the strategy of sustainable development, and "development complies with the needs and constraints of nature and necessity of taking into account economic and ecological interest, although the local and the global level."

The relativization of non-renewable natural resources includes the following ways:

- Increase of the useful products or use of the values per case units and energy consumption in technological procedures,
- increase the productivity in the process of exploitation of raw materials,
- increase the efficiency of exploration and discovery of new raw material supplies,

- develop recycling technologies – multiple use of certain raw materials / elements,
- develop new material and subsitutes that replace " the most endangered " raw materials,
- develop technologies for the use of not very rich ores – rational exploitationr,
- reduce the unnecessary consumption of raw materials – rational consumtion and
- conservation of raw materials.

In this paper, we are going to introduce the procedures of conservation and substitution of non-renewable natural resources [1].

CONSERVATION OF NON-RENEWABLE NATURAL RESOURCES

In the early developmental stages of the theory of conservation of mineral resources, the following views were prevailing:

- certain mineral deposits should be preserved, i.e. " conserved " for the future generations, so that they could equally participate in the distribution of natural resources ,
- mineral resources should be treated rationally in every stage of the production process that includes exploration, exploitation, preparation and use of raw materials,
- conservaton, i.e. mineral deposits freezing should be applied only to critical mineral substances.

Nowadays, the conservation of mineral resources involves a long-term, planned policy of national and international character, aiming at determination and practical application of optimal methods and measures that should ensure rational and efficient research, obtaining and use of mineral resources[2] .In addition, the integral part of this policy involves the efforts and obligation of the present generations to treat mineral resources rationally and complexly on the basis of achieved scientific and technical processes in order to provide an opportunity for the future generations to fully participate in the benefits of these specific natural resurces that are extremely imortant for the socio-economic development.

Depending on the geological, economic, political, technological and other factors that are closely related to the conservation of mineral resources, the process can be divided into:

- conservation in the narrow sense and
- conservation in the broad sense.

CONSERVATION IN THE NARROW SENSE

In the process of conservation in the narrow sense, certain mineral deposits or the primary products of critical mineral resources, ore stocks and concentrates are frozen and preserved.

This type of conservation can be:

- strategic,
- technological and economic,
- natural and
- monopolistic conservation.

Strategic conservation includes the creation and preservation of strategic reserves of mineral resources – stocks, either raw materials and unprepared mineral substances in their original state when extracted from their deposits, or ready products and products of primary production, which has been particulary characteristic for the last decade.

There is a special form of strategic conservation that involves freezing of whole prepared mineral deposits that serve as national reserves in the cases of emergencies. The main goal of creation of " mineral resources national reserves ", like, for example, oil, iron, copper, chromium..., is to provide tha country with mineral suplies in case of emergencies or war.

This type of " freezing " the mineral deposits is actually the postponement of the production process for the future.

Technological and economic conservation is a consequence of the fact that a vast number of various mineral deposits containing huge reserves cannot be included in the process of production because their useful substances cannot be profitably exploited and refined due to the current state of science, technology and general economic conditions which are manifested through the market prices of mineral resources[3].

According to the data, world's off-balance reserves are:

- 3000 billion tons of iron ore,
- 10 billion tons of titanium,
- 6 billion tons of chromite,
- 10 billion tons of bauxite and other aluminum materials,
- 2000 billion tons of manganese and others.

The invention of new cost-effective technological processes of extraction, changes in market and political conditions, as well as in terms of extraordinary opportunity comes to retraining of the conditional-balance and off-reserve in the balance reserves.

Nowadays, a technological procedure for exploitation can be developed for almost every mineral raw material, no matter how complex its mineral and chemical structure is or how negative its structural characteristics are. However, the question is - what are the expenses of this extraction and is the value of the obtained substance greater than its expenses or not. Therefore, according to these facts we can reach the following charateristc conclusion that refers to the " freezing of non-renewable natural resources ": what makes the boundary reagrding the natural resources is not the limited physical capacity but the expenses of the extraction of the desired material from its environment and the creation of useful priducts.

Natural conservation refers to the deposits that practically haven't been yet discovered. They are actually " naturally conserved " and the " release " from such a state of " being frozen " is achieved by planned, targeted and prospective research

projects in the fields in which, based on direct or indirect prospective indications and geological, tectonic and geochemical elements and indicators, economical and profitable exploitation is possible.

The so-called " blind ore bodies " are more likely to remain " conserved " than the ones whose parts protrude to the surface or make characteristic, easily detectable aureoles of diffusion.

However, the development of new methods of prospective, research explorations and discoveries of these " blind ore bodies " , like geophysical, geochemical, aerophotogeological and satelitte images, has reduced the number of these " blind ore bodies ".

Monopolistic conservation occurs in the conditions when there is private ownership of the deposits and mines. In such cases, the private capital has the opportunity to monopolize specific mineral deposits and , in order to achieve surplus profit, keeps them away from the exploitation thus preserving their mineral resources .

We can conclude, in the end, that the conservation of mineral resources in the narrow sense represents the postponement of the production process for some future time.

CONSERVATION OF MINERAL RESOURCES IN THE BROAD SENSE

Conservation of mineral resources in the broad sense represents a planned policy and srategy for research, exploitation and use of mineral resources so that the most diverse needs of the present generations can be fulfilled as much as possible and, at the same time, to enable the future generations to have their share in the exhausting natural resources[4].

Therefore, this type of conservation includes planned balancing of the time factor and available natural mineral resources with the help of the modern scientific, technical, prodctional and organizational achievments.

General characteristics of individual measures and methods of conservation in the wider sense is further manifested through the individual stages of treatment of mineral resources and economic effects that are realized in these stages as a result of properly or improperly driven policies of mineral raw materials in general. In this connection, the conservation policy in a broader sense can be achieved in the:

- prospects and researches,
- exploitation,
- preparation and concentration,
- metallurgical processing and other types of primary production,
- substitution of mineral resources,
- gathering of old and waste material and
- protection from corrosion.

Conservation of mineral resources in the broad sense is manifested through:

- the application of planned, long-term, continuos, optimal, high-quality actions,
- the application of modern scientific and technical achievments and methods of research,

- timely substitution of exhausting deposits for new mineral deposits,
- creation of prerequisits for expanded reproductions, not only the simple ones by finding new reserves and mineral deposits,
- reducing qualitative and quantitative losses of mineral resources by increasing the level of exploitation in the process of production, ...

Modern science and technology, theoretically and practially enable the possibility of absolute exploitation of mineral deposits, but the expenses and costs limit the losses that strictly depend on the value of the obtained material and therefore any increase of the production expenses over the limit of its profitability leads to the termination of exploitation[5].

SUBSTITUTION OF NON-RENEWABLE NATURAL RESOURCES

Substitution of mineral resources represents the adequate substitution of mineral resources for other organic or non-organic materials.

The main reasons for substitution are:

- deficit of specific raw material,
- economic and market conditions (for example, the substitution of expensive material for the cheaper one),
- technical progress (for example, the new material has properties that are more suitable for the needs of consumption),
- negative supply conditions,
- inability of getting mineral supplies (for example, due war, embargo, etc),
- the consumer stops paying high prices to the producers ...

For all these reasons, scientific researches and projects are conducted in order to find adequate replacements, i.e. substitutes.

Based on the type of material that is being used in certain condition and cicumstances and regarding the mineral materials, there are several types of substitution[6]:

- substitution of mineral resources for mineral resources,
- substitution of mineral resources for non-mineral resources and
- „the reverse substitution".

Each of these types has several forms, depending on:

- the type of mineral raw material (metal, non-metal, coal, oil, natural gas, ...) and
- the origin of the substitute (organic, non-organic, natural, artificial...).

SUBSTITUTION OF MINERAL RESOURCES FOR MINERAL RESOURCES

Subsitution of mineral resources for mineral resources includes:

- substitution of metal for metal,
- substitution of fossil fuel resources,

- substitution of metallic mineral resources for non-metallic mineral resources and
- substitution of metals for non-metals and other raw materials.

Substitution of metal for metal inludes, for example:

- copper or tin for auminium,
- tungsten is substituted for molybdenum or vice versa,
- cobalt for nickle and others.

Substitution of fossil fuel resources includes:

- substitution of coal for oil,
- substitution of oil for uranium,
- substitution of coal or oil for natural gas and so on.

Substitution of metallic mineral resources for non-metallic mineral resources includes:

- substitution of lead for barite olova – baritom,
- substitution of metal pipes and other products for the products made of molten basalt.

Substitution of metals for non-metals and other raw materials includes:

- substitution of rare high-quality talc for talc-magnesium rocks,
- substitution of magnesite for dolomite and others..

SUBSTITUTION OF MINERAL RESOURCES FOR NON-MINERAL RESOURCES

Substitution of mineral resources fornonmineral resources includes:

- substitution of mineral resources for chemical products and
- substitution of mineral resources for wood.

Substitution of mineral resources for chemical products means that plastics is used instead of lead, zinc, steel and many other materials.

„ REVERSE SUBSTITUTION "

All previous examples of substitution are considered " normal " since they include the substitution of mineral resources by other materials. The substitutes can also be mineral raw materials but of different structure or some chemical industry products, or in certain cases, wood.

With the reverse substitution, non-mineral products are substituted for mineral, and in some extreme cases, non-rational exploitation of mineral resources can thus occur. It is especially evident in the areas where a non-mineral material could be used adequately instead of the mineral one. A typical example, for instance, is the use of copper for the production of packaging instead of cardboard or wood.

CONCLUSION

At the significant level of technological and economic development no natural resource is not inexhaustible. Even the current natural resources, such as water and air, gaining more and more characteristics of economic goods, which must be effectively used. Discovering new sites and finding effective solutions for the economical use of less abundant and less accessible natural resources does not solve the problem of scarcity of resources. They remain a significant constraint on future economic development. It is expected that the development of science and technology and more efficient use of knowledge in discovering the rational use of existing resources and discovering new materials and energy sources, which substitute the existing natural resources, to enable a gradual easing and resolving problems of limited natural resources.

REFERENCES

1. Radenković, V. 2010. Economic and environmental assessment of natural resources. MS thesis. Faculty of Occupational Safety in Niš, Niš.
2. Radičević, P. 1995. Mineral resources in war and peace. "Army", Belgrade.
3. Group of authors, 1997. Economic aspects of evaluation and protection of natural capital. Institute of Economic Sciences, Belgrade.
4. Magdalinović, N., Magdalinović-Kalinović M. 2006. Economics of natural resources. "Doctrine", Belgrade.
5. Pešić, R. 2002. Economics of natural resources and environment. Faculty of Agriculture. Belgrade.
6. Milanović, D. 1967. Substitution as a method of rational utilization of mineral resources. Mining Bulletin, Vol sixth No3. pp. 68.

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SOURCES OF AIR POLLUTION AND EMISSIONS OF POLLUTANTS

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ABSTRACT

Air pollution is a significant environmental problem, which was created partly as a consequence of poor conditions in the economy, and partly as a result of inadequate implementation of environmental policy. Major influence on the environment of Lime Plant Zagradje - Copper Mines Bor (Serbia) with associated limestone quarry, is the influence on the air. Air pollution is primarily related to dust and products of combustion of fuel used in the plant and vehicles. Due to obsolete technology and lack devices that reduce emissions, pollutants easily get into the environment. In accordance with the requirements of the Air Protection Act and supporting Regulation of limit values for pollutants emissions into the air, the plan of emission measurement is defined, in order to monitor emission and to take appropriate procedures for harmonization of existing emissions within the permitted values.

Key words: emission, pollutants, air

INTRODUCTION

Clean air is the basis for human health and the whole ecosystem. The air is a mixture of gases, consisting mostly of nitrogen and oxygen. The composition of air in small quantities is represented by argon, carbon dioxide and other rare gases. The total volume of air, nitrogen and oxygen make up about 99%, argon 0.9% and carbon dioxide 0.03%. Air pollution is the presence of various substances and gases in the air that mean a risk to human health and the entire ecosystem. Air pollutants are: nitrogen oxides, sulfur dioxide, carbon monoxide, particulate solids, volatile organic substances and toxic substances [1].

The men directly or indirectly affect air pollution. Sources of air pollution can be natural or man-made (anthropogenic) sources. Man-made (anthropogenic) sources of air pollution are categorized as:

- Point sources - stationary emitters, such as electricity generators, refineries, and other industries, that can be identified by name and location. A major source emits a threshold amount (or more) of at least one criteria pollutant and must be inventoried and reported.
- Area sources - small stationary emitters, such as residential heating, small generators, and small industries. This category also includes large but diffuse

emitters such as wildfires and dust from agricultural tilling. These sources do not individually produce sufficient emissions to qualify as major sources.

- Mobile sources that are not located at fixed points, such as on-road cars and trucks, as well as nonroad locomotives, ships, aircraft, construction equipment, farm equipment, and mobile generators. These are usually powered by gasoline and diesel engines and are regulated by different sectors by emission limits, fuel specifications, and inspection and maintenance programs [2].

INDUSTRY AS A POLLUTER OF AIR

One of man-made sources of air pollution is industry. Due to lack of use of clean fuel and using outdated technology in the industry, as a byproduct of the process of transformation of energy or work there are also various emissions that adversely affect air, water and land [3].

Air pollutants are divided into primary and secondary. The primary components of waste emissions are released from known sources. Secondary pollutants are the result of chemical reactions between primary pollutants and reaction with naturally components of air, and are often more damaging than the initial substances that react in response [4].

Sulfur dioxide, ozone, lead, carbon monoxide, nitrogen oxides and particulate matte are listed as criteria pollutants. Sulfur dioxide (SO_2) is one of a group of highly reactive gasses known as "oxides of sulfur". The largest anthropogenic sources of SO_2 emissions are from fossil fuel combustion at power plants (73%) and other industrial facilities (20%). Smaller sources of SO_2 emissions include industrial processes such as extracting metal from ore, and the burning of high sulfur containing fuels in gasoline and diesel engines. SO_2 is taken as a reference parameter to assess the quality or degree of air pollution due to the quantitative representation and adverse effects on biological systems. Nitrogen compounds present in the air as nitrous oxide. From the standpoint of pollution, distribution and biological effects, the most significant oxides are nitric oxide and nitrogen dioxide. The major sources of anthropogenic atmosphere pollution by nitrogen oxides are fossil fuels, and their combustion in industry, power generation, internal combustion engines.

In any process of incomplete combustion of carbon in elemental form or the form of compounds leads to oxidation of carbon to carbon monoxide from various sources - the furnace, the burning of waste, machines with internal combustion engines. When the air looks clean, when there is no cloud of dust and smoke, can be contaminated with tiny invisible particles - aerosols. Particulate emissions in the industrial zones depends on the type of industry (the particles of cement, coke, metal oxides, etc.). In the atmosphere, heavy metals are in the form of particles and gases. Retention time for aerosols in the air depends on particle size [4].

TESTING OF EMISSIONS AT THE SOURCE OF POLLUTION AT THE LIME PLANT ZAGRADJE, COPPER MINES BOR SERBIA

RTB Bor Group after decomposing of the holding company RTB Bor and privatization of its subsidiaries, the company has operated as a single system with four main production subsidiaries: Copper Mines Bor, Copper Mine Majdanpek and Smelter and Refinery and the parent company, that deal with core activities such as mining and ore processing.

Within Copper Mines Bor, secondary activities that not part of the core mining and metallurgy are: Lime Plant Zagradje and Exploration activities.

In accordance with the obligations arising from the Regulations on emission limit values, methods and terms for measuring and recording data, the plan of testing is defined (table 1) and measuring emissions are carried out (table 2), in Lime Plant Zagradje.

Table 1. Plan of testing

Plant	**Plant work**	**Sampling location**	**Fuel Type**	**Dynamics measurements**
Lime Plant Zagradje, Copper Mines Bor	Vertical shaft furnace No. 2	Duct of waste gases	Generator gas	Twice per year

Table 2. Monitoring emissions of pollutants (vertical shaft furnace)

Date	**Time (h:min)**	**Parameter**	**Test method- techniques**
11.11.2010.	12:24-13:26	Particulate matter	Isokinetic sampling Gravimetric method
	12:06-13:42	Inorganic gaseous substance hazard class IV (oxides of nitrogen expressed as NO_2)	Non-extractive sampling, Instrumental methods- electrochemical sensor
		Carbon monoxide CO	

Lime plant Zagradje is located 12 km east of Bor. In the vicinity of lime plant, there are a railway station and railway (2.5 km from the open pit) which connects Zaječar and Bor with Zagradje. In this area, as commercial facilities, there are the lime plant and administration building (2 miles from the open pit). In the vicinity, there are no other commercial facilities.

Geolocation: 44°01′51,84″ N 22°13′05,49″ E.

This area is sparsely populated. Houses and huts are located at large distance from each other. Due to population migration to nearby towns, there are a lot of abandoned houses. Two family households are located near lime plant, at a distance 30 and 500 m, near road Bor-Majdanpek, at the distance more than 2 miles from the pit.

Measuring emissions of pollutants (from the process of thermal-dissociation of limestone) were carried out on the waste gas duct. Waste gases containing particulate

matter is removed in the stack and then into the atmosphere through the system for transport gas furnace, without prior purification.

Measuring point was set to duct of the waste gases, rectangular cross-section (0.76 x 0.5 m), in front of fans for exhausting waste gas - entrance to stack no.2. Sampling location and the view of access port (ZD2.2.2010) is shown in Figure 1.

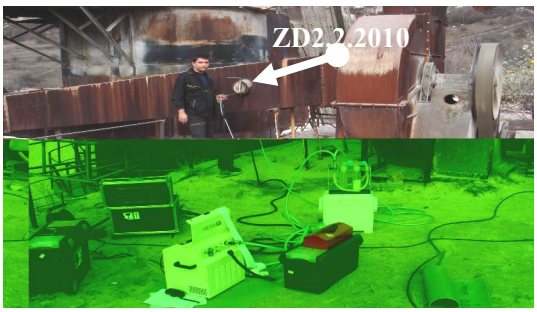

Figure 1. Sampling location and the view of access port ZD2.2.2010

For rectangular cross sections, cross-sectional size of 0.09 to 0.38 m^2, the requirement of standard ISO 9096: 2003 (E) is to be sampled at least two sampling lines.

In this case, this requirement was not realized - sampling was carried out by sampling at single line (one access port), because there was no possibility of setting up another port.

Also, the position of sampling plane is not in compliance with these standard due to the proximity of the fan, which causes instability of the velocity profile in the sampling plane and the occurrence of turbulence.

The procedure for determining the concentration of pollutants in the gas flowing through the precise sections (stacks, pipes, ducts) is described in ISO 9096:2003 (E).

Automatic isokinetic sampler - Isostack Basic HV Tecora with instack probe and accessories (serial number 823681PT) are used for isokinetic sampling of particulate matter.

Electronic gas analyzer MRU Vario Plus Industrial (serial number 292091) was used for non-extractive sampling and determination of gaseous pollutants (CO, NO_2).

Using the same device, temperature and relative humidity of the gas and gas flow velocity are measured, too. The device includes electrochemical sensors for specific gas components which are tested by the manufacturer and calibrated by accredited calibration laboratories.

Measurement of pollutants emission was carried out in the following conditions of work of vertical shaft furnace no.2:

- first sampling of particulate matter was performed in conditions before discharge and charge furnace (12:24 to 12:39 h).
- second sampling of particulate matter was performed in conditions before discharge and charge furnace, to the third sampling point (13:05 to 13:15 h), when a few skips of source material - limestone are charged into the furnace (13:15 to 13:20 h);
- third sampling of particulate matter was performed during the discharge and charge furnace (13:26 to 13:41 h)

RESULTS AND DISCUSSION

Results of testing thermo-physical parameters and concentration of gaseous pollutants are presented in Table 3. Table 4 presents the results of the thermo-physical parameters and concentration of total particulate matter.

Table 3. Results of testing the concentration of gaseous pollutants

Sampling location		ZD2.2.2010		
Date		11.11.2010.		
The characteristics of atmospheric air				
Air temperature		°C	21,6	
Barometric pressure		mbar	985,3	
Measurement of gaseous pollutants				
Measurement no.		**1**	**2**	**3**
Measuring time	**h**	**12:06**	**13:41**	**13:42**
Temperature gas	°C	76,7	96,5	98,8
Dew point	°C	14,2	16,1	24,6
Moisture content in gas	%v/v	1,6	1,8	3,1
Measured O_2 content in gas	%	20,55	20,51	20,41
Measured CO_2 content in gas	%	0,5	0,6	1,1
Measured CO content in gas	ppm	90	66	94
Concentration of CO reduced to normal conditions and dry gas	mg/m^3	112	83	118
Measured NO_x content in gas	ppm	1	1	2
Concentration of NO_x reduced to normal conditions and dry gas	mg/m^3	2	3	4

Table 4. Results of testing the concentration of total particulate matter

Sampling location		ZD2.2.2010		
Date		11.11.2010.		
The characteristics of atmospheric air				
Air temperature		°C	13,4	
Barometric pressure		mbar	982,7	
Sampling Parameters				
Number of sampling points		3		
Number of sampling lines		1		
The mean value of moisture content in gas		%v/v	1,6	
The density of wet gas (0°C, 1013 mbar)		kg/m^3	1,289	
The mean value of O_2 content in gas		%	20,55	
The mean value of CO_2 content in gas		%	0,5	
Sampling and determination of total particulate matter				
Measurement no.		**1**	**2**	**3**
Sample designation		**1-ZD2**	**2-ZD2**	**3-ZD2**
Measuring time	h:min (min)	12:24 (15)	13:05 (15)	13:26 (15)
Temperature gas	°C	116,74	161,15	75,78
Gas velocity	m/s	22,97	25,75	24,31
Gas volumetric flow rate, dry gas (0°C, 1013 mbar)	m^3/h	20733,8	20860,4	24436,5
Volume of dry gas sampled (0°C, 1013 mbar)	m^3	0,1301	0,1718	0,1960
Concentration of particulate matter in the dry gas, reduced to normal conditions	mg/m^3	**9,2**	**33,2**	**200,0**
Mass flow rate of total particulate matter	g/h	**191**	**693**	**4887**
	kg/h	**0,2**	**0,7**	**4,9**

Based on these results, which are shown in Tables 3 and 4, it can be concluded that, in the Lime Plant Zagradje - Copper Mines Bor, in conditions of the furnace no.2 operating, emitted into the atmosphere:

- permissible concentration of CO, and nitrogen oxides expressed as NO_2 (individual values do not exceed the emission limit value);
- increased concentration of total particulate matter (mass concentration of total particulate matter in the third test is above the emission limit value).

CONCLUSION

Obviously, little can be done to reduce pollutants from the natural sources (fires, wind erosion, volcanic eruptions) when produced significant amounts of solid particles and gases that can have significant effects on the global short-and long-term changes in weather conditions and human health. Significant steps can be taken to control and reduce pollutants from man-made sources of pollution (stationary and mobile). Such control measures are regulated at the governmental level [5]. Particularly notable has been the adoption of the new law on air protection that complies with the relevant EU legislation. This law regulates the management of air quality and determines the measures, ways of organizing and controlling the implementation of protection and improvement of air quality as the natural values of general interest.

REFERENCES

1. Snezana Besermanji, Air pollution in Serbia, Geographical Institute »Jovan Cvijic«, Collection of Papers N°57, 2007, pp.495-501.
2. Committee on Changes in New Source Review Programs for Stationary Sources of Air Pollution, National Research Council, New Source Review for Stationary Sources of Air Pollution, Washington, DC, USA: National Academies Press, 2006, p. 211.
3. Zegarac Dragan, dr Hodolic Janko, dr Stevic Miodrag, Systems for Minimizing Particulate Matters Emission from Asphalt Mix Manufacturing Plants, 32nd National Conference on Quality, Kragujevac, May 2005, C-10
4. Ljiljana Trumbulovic-Bujic, Zagorka Acimovic-Pavlovic, Influence of Air Pollutants on Air Quality in Industrial Environment, Journal of Metallurgy, 14 (3) 2008, p.230
5. Terry Gordon, Pollution, Air, 2005 Elsevier Inc, p.468
6. Air Protection Act, Ministry of the Environment Protection, Republic Serbia, Belgrade, 2009
7. Regulations on emission limit values, methods and terms for measuring and recording data, Ministry of the Environment Protection, Republic Serbia, Belgrade, 1997.

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MINING IN EUROPE-THE WINDS OF CHANGE

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ABSTRACT

Mining was not very far in the past one of the most undesirable branches of industry, frequently referred to as "dirty technology". The knowledge about deleterious effect of mining activities on living beings as well as negative social anomalies have led to hostility of broader community worldwide towards any form of mining activities, from various environmental non-governmental organizations to affected local communities. However, in previous decades situation has changed dramatically, as a result of a more or less synchronous action of numerous international and national institutions, metals industry, mining companies, non-governmental organizations and local communities. In fact, in many places worldwide, new mining activities are welcome as the local communities are fully aware that in agreement with the mining companies fully sustainable operations are more than possible, thus bringing economic benefit to all stakeholders. Europe was one of leaders in almost banning mining industry and was heavily reliant on commodity production elsewhere. This has slowly been proven to be unsustainable especially with commodities that are highly asymmetrically distributed worldwide. In recent years European Union has started a campaign to promote sustainable mining in Europe. In accordance with these policies this paper deals with place of Serbia as traditionally mining state.

Key words: mining, Europe, policy

INTRODUCTION

European Union (EU), a highly industrialized area of the world, had for long time wrong policy towards mining [1]. Mining was considered a "dirty technology" that should take place elsewhere. Thus EU heavily relied on production of mineral commodities worldwide, especially in countries of third world. Although sustainable mining [2, 3, 4] was demonstrated in many places and in the meanwhile technologies had greatly advanced towards high safety, low emission, less deleterious effect, etc, policy within EU did not change. However, high fluctuations in commodity prices as well as economic crises and current recession have started to change thinking in EU in this century. Concrete activities started in 2000 [5] with EU commission paper which gave overview of current state in mining industry and needs within EU.

In Serbia mining industry is in sad state [6] due to lack of policy towards this branch of industry. Although the country has ambitions to join EU policies in Serbia do not adequately follow the policies that are propagated by European official entities

ACTIVITIES IN EUROPEAN UNION

Since European Commission Communication from 2000 many activities took place in EU. Promotion of sustainable mining is quite aggressive in many countries. The European Network of Mining Regions (ENMR) has been formed. Review of mining legislation had been undertaken through this body and as an off spin project The European Mining Heritage Initiative (MINTOUR) has been launched recently. This project was formed with the aim to catalogue mining and related sites and to assess their value as tourist sites. Also its aim is to promote coexistence of mining and tourism. However, main aim is to promote extractive industry. This was attempted through Euro Mine Expo in Sweden [7] which is supposed to be European answer to highly successful Canadian PDAC [8]. It is quite interesting to notice that one of the most aggressive countries is Sweden, a country with very high environmental standards in all segments of society. Similar is with Finland which is also very active in latest years in promotion and development of mining industry. This year Mine Expo was supported by EU Commission to promote EU Raw Materials Initiative [9]. All in all it is quite clear that EU has a definitely different attitude towards mining.

ACTIVITIES IN SERBIA

In Serbia there is a quite bizarre situation. A still Titoistic-Kardelj type of environment exists where everyone expects development of market based economy and capitalist principles. It is simply hardly possible. Outdated laws [10] and retrograde government officials from communist times are great obstacle to any kind of idea of reforms. Lack of any kind of policy, far from those in EU, has devastated mining industry in Serbia completely with very little hope for change in near future. Radical reforms and coherent policy is necessary to give momentum to this deeply fallen ages old activity in the area. Even with the reforms not much can be expected in the next decade as it takes time to create enabling environment and build trust.

CONCLUSION

European Union made a sharp u turn in attitude towards mining industry and results are visible in countries that were most aggressive in promoting and applying new policies. Countries like Sweden and Finland are recipients of substantial investments and the industry is experiencing the renaissance. Mines that were closed for decades are swung into motion again, new ones are being constructed and numerous exploration projects are carried out.

On the contrary to the above Serbia is in completely disoriented situation as far as mining is concerned. Whole environment (laws, policies, personnel) is outdated with retrograde ides and thus hardly competitive for investment which is crucial in this moment of greatest recession so far experienced. As transition in this sector never even started and no reforms were undertaken nothing much can be expected in near future to be comparable with policies of EU.

REFERENCES

1. Radošević, B., Masurenko, C. and Tanasković, D., Mining policy in european union. 39th International october conference on Mining and Metallurgy. Proceedings. EDITED BY Rodoljub Stanojlović and Jovica Sokolović. University of Belgrade, Technical faculty Bor and Copper Institute Bor. J07-10 October 2007. Sokobanja, Serbia. 2007 p.228-232.
2. Radošević, B., Sustainable mining - an example of nickel laterite mining. XX International Serbian Symposium on mineral processing. Edited by Zoran S. Marković. Proceedings. Hotel Zdravljak - Soko Banja, Serbia. 01 - 04 November, 2006, p.257-264.
3. Radošević, B., Faktori uticaja na održivi razvoj rudarske industrije. VII Kolokvijum o pripremi mineralnih sirovina - "Priprema mineralnih sirovina i održivi razvoj". Rudarsko-geološki fakultet - Katedra za pripremu mineralnih sirovina. Beograd, 2006, p.84-93.
4. Radošević, B.: Mining and sustainable development at the beginning of 21st Century. TEHNIKA. Godina 58 - 2007. Godina LXI 2007. Broj 1. Časopis saveza inženjera i tehničara Srbije. (2006) p.7-13.
5. commission of the european communities, (2000). Communication from the Commission. Promoting sustainable development in the EU non-energy extractive industry. Brussels, 3.5.2000. COM(2000) 265 final.
6. Radošević, Branislav, Radošević, Bogdan, Mining industry in serbia - quo vadis? 41st International October Conference on Mining and Metallurgy. Proceedings edited by Milenko Ljubojev & Ana Kostov. Mining and Metallurgy Institute Bor and University of Belgrade technical faculty Bor. 4-6 October 2009, Hotel „Aquastar Danube" Kladovo, Serbia. 2009 p.309-312.
7. http://www.euromineexpo.com/.
8. http://www.pdac.ca/.
9. http://ec.europa.eu/enterprise/policies/raw-materials/index_en.htm.
10. Radošević, Branislav, Radošević, Bogdan, Zakoni o geologiji i rudarstvu republike Srbije - Problemi i smetnje. misko MMX. Mineralno-sirovinski kompleks Srbije danas: Izazovi i raskršća. Urednik Slobodan Vujić. 2010 p.435-440.

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TYPOLOGY OF SEWAGE TREATMENT AND DISPOSAL METHODS IN BREWING INDUSTRY

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ABSTRACT

The paper presents a typology and review of the most popular sewage treatment methods used in brewing industry. Author distinguished three groups of methods which are currently applied in industries and especially in brewing industry. Mechanical, physical and chemical as well as biological methods are described and discussed. Technological processes are presented and information on advantages and disadvantages on selected methods.

Key words: biological methods, sewage treatment, active sediment, biological bed

INTRODUCTION

Brewery sewage induce deficit in oxygen content of receiving ponds as a result of high BOT_5. This leads to fast concrement expansion of *Filamentous bacteriae* and *Sphaerotilus natans*. Prompt decay processes in bottom sediments cause exhaust of reek gases, which contaminate atmospheric air in surroundings. Influence of brewery sewage on receiving ponds is seen in: sedimentation of slurry, fungi expansion, strong oxygen absorption, distribution of hydrogen sulphide and others accompanying undesirable and harmful phenomena [1]. Brewery sewage treatment can be classified into three main groups of methods:

- Mechanical treatment
  - Grills
  - Sieves and molecular sieves
  - Sand separators and tanks
- Physical and chemical treatment
  - Neutralization
  - Coagulation
  - Filtration

- Sedimentation
- Biological treatment
  - Active sediment
  - Trickling filter
  - Sewage ponds

All methods are exploited, however individual conditions create preferences as well as experience, being a tool of selection.

MECHANICAL TREATMENT

Methods of mechanical treatment of slurry and sewage from brewing industry is based upon removal of insoluble particles, namely impurities suspended in water. In course of mechanical treatment of sewage the following particles are deposed:

- bigger solid particles
- grain fraction
- slope down suspension (preliminary sludge)
- floating suspensions (oils and fats)
- majority of parasites and eggs
- part of microorganisms and in this number also pathogenic microbes. In correctly operating mechanical treatment installations there should be attained the following results: removal of 90 – 100% of easily dropping suspensions, 60 – 70% of overall suspensions, 25 – 40% of BOT_5, 20 – 40,% of COD, 70 – 95% parasites' eggs and 25 – 75% of bacteria. Grills, sieves, sand tanks and receiving ponds are used to treat sewage mechanically [2]. **Grills** are installations used in separation of bigger, floating or dragged, solid particles.

Division of grills depends on their width:

- runny $b > 40$ mm
- medium $20 < b < 40$ mm
- dense $b < 20$ mm

Type of grill depends on how it will be deployed [3].

Sieves and molecular sieves are used to strain all impurities and, similarly at it was with grills, they can be classified based upon dimensions.

- runny, aperture size more than 1.5 mm
- medium, aperture size 0.1-1.5 mm
- dense, aperture size below 0.1 mm [4]

Sand separators and tanks are next mechanical method of brewery sewage treatment. They are used to remove and dispose sand, which consists of slug, coke breeze, coal different grains and other particles. Exploitation of sand separators is connected with sedimentation process.

In settling ponds there is possibility of separation of solid particles with diameter over 0.03 mm. Sewage which undergone treatment in sand separators has considerably reduced BOT_5. In double chamber Imhoff tanks occurs release of methane

and carbon dioxide, apart from separation of precipitate from sewage. Time and intensity of fermentation depends on temperature.In temperature between 10-15^{o} C, overall decomposition of residue follows after 2 - 4 months. Sand separators reduce BOT_5 about 40%, and suspension approximately 70%. Slope down precipitate is skimmed and removed outsider separator, in turn – purified sewage is directed to other water treatment factories or to receiving ponds [3].

PHYSICAL AND CHEMICAL TREATMENT

Physical and chemical methods are exploited more frequent when density of pollution is increasing. Usually pollutions can't be removed by biological method, so chemical and physical methods are necessity [5]. **Neutralization** is chemical reaction whereby an acid and a base react to form water and a salt. It is used as one of preliminary decontamination of brewery sewage before direct disposal to receiver, before draining to communal sewage system, before other chemical methods of decontamination and at repeat of pH correction used to standardize sewage to other treatment processes [6].

The following reagents are used:

- **to neutralize acid sewage:**
  1. NaOH, solution concentration of 20- 30%
  2. Ca $(OH)_2$ solution concentration of 5-15%
  3. $Na_2 CO_3$ as solution
  4. $CaCO_3$ as grain bed
  5. MgO as granulate bed
- **to neutralize base sewage:**
  1. $H_3 PO_4$ as solution
  2. HCl as solution
  3. $H_2 SO_4$ as solution
  4. CO_2 as pure or flue (exhaust) gas [7].

Coagulation is defined as a process of colloid particles and fine suspension concentration into complexes (agglomerates) resulting from destabilization of set up, what can be attained by:

- adding electrolyte, decreasing electro-kinetic potential to colloid, suspension solution
- discharge of particles
- hydroxides formation of polyatomic cations, which absorb ions, particles of colloids and suspension
- mutual attraction and agglomeration of particles with different surface electric charge.

Obtained agglomerates can be very small and sediment extremely slowly, especially when granularity of particles was very high. Salts of aluminium and iron are usually used as coagulants, especially the following:

- aluminium sulphate $Al_2 (SO_4)_3 * 18H_2O$
- sodium aluminate $Na_2Al_2O_4$
- ferrous sulphate (II) $FeSO_4 * 7H_2O$

- ferric sulphate (III) $Fe_2(SO_4)_3*9H_2O$
- ferric chloride (III) $FeCl_3*6H_2O$

Main factors which influence coagulation are dose and type of coagulant, reaction, sewage temperature, speed of mixing, and supporting substances [8]. **Filtration** is a mechanical or physical operation which is used for the separation of solids from fluids (liquids or gases) by interposing a medium through which only the fluid can pass. Oversize solids in the fluid are retained, but the separation is not complete; solids will be contaminated with some fluid and filtrate will contain fine particles (depending on the pore size and filter thickness). Filtration ensure removal particles from the fluid of diameter > 0.1 μm. Filters can be divided into six groups using criteria of exploitation conditions and type of filtration base:

- gravitational and pressurised
- slow and speedy
- single- and multilayer
- opened and closed
- filters with high and low bed
- two-level filters with biologically or chemically active bed [9].

The most frequently used filtration materials are: quartz sand, antracite and granulated activated charcoal. Furthermore fired and crushed materials are exploited, like fired clay pebbles (known as LECA), granite as well as plastics with density lower then density of water [10]. **Sedimentation** is the tendency for particles in suspension or molecules in solution to settle out of the fluid in which they are entrained, and come to rest against a wall. This is due to their motion through the fluid in response to the forces acting on them: these forces can be due to gravity, centrifugal acceleration or electromagnetism. Very popular and one of main methods applied to brewery sewage treatment. Slope down of particles in water is complex process and depends from density of solution, dimensions, shapes of particles and simultaneously from temperature and speed of water flow. Depending on character and volume of particles in suspension slope down of grain and flock particles are distinguished [11].

BIOLOGICAL TREATMENT

Crucial aim of biological sewage treatment is removal from the sewage all biologically decomposed impurities. Decomposition of organic pollutants comes up from natural colonies of micro organisms suspended in fluid, which initiate and carry out the process naturally (method of active sediment) or microorganism creating harden biomass (trickling filter method). Organic pollutants are exploited by microorganisms due to biochemical changes as pasture inducing increase of bacterial biomass. Remaining part of decomposed pollutants are discharged in oxygen conditions as carbon dioxide and water. In case of anaerobic processes gaseous products of organic mass decomposition are methane and carbon dioxide [12]. **Active sediment.** Sewage treatment, in which active sediment was applied, is based upon creation in fluid flocks with 50 - 100 mm diameter and extremely well developed surface. Flocks are built of mineral, brown,

grainy nucleus placed in mucosal envelope and consisting of numerous heterofites bacteria species such as *Acinetebacterium, Pseudomonas, Zoogloea, Enterobacteriae, Aeromonas, Flavobacterium, Achromobacter* and *Micrococus*. Metabolism of microorganism results in mineralization of organic pollutants and absorption on outer surface of flocks. Active sediment method need to deliver oxygen as bio oxidation substrate of organic impurities [13]. Advantage of sewage treatment using active sediment method is high effectiveness of disposal sedimentation up to 95% and liquidation of pathogenic microbes up to 98% with relatively low demand for oxygen (BOT_5). In turn disadvantage is high vulnerability of microorganisms to toxic complexes and other factors affecting their expansion. High performance of active sediment method in brewing industry is proved by decreasing BOT_5 between 85 – 95% [14].

Trickling filter. The most popular biological beds are trickling filters. Nowadays biological beds are erected on scaffolding, which is made up of bricks and concrete prefabrications. On such prepared base plate the layer of crushed stones, slag, gravel, coke and plastics are imposed. This layer is called fulfillment and it's role is to aerate sewage.

Thickness of fulfillment is 4 to 10 cm (upper layers) and 3 to 6 cm (lower layers).

Surface of fulfillment is covered by thin biological membrane. Membrane consists of colonies of microorganisms existing in sewage. Time needed to biological membrane creation on fulfillment with 1 to 2 com thickness is 30 to 50 days [15]. Sewage brought to trickling filter should contain at least 3 - 4% nitrogen and 1% of phosphorus. The task of nitrogen and phosphorus is to assure proper biological development of microorganisms. Optimum temperature is 20°C. Effectiveness of trickling filter method is reflected by decreasing BOT_5 to 75% [16].

Sewage ponds are natural, ground or artificial reservoirs, which are used to decontamination of sewage with light density of pollutants and consist of easily decomposing impurities.

Automatically there are physical and chemical processes initiated by microorganisms, light and oxygen leading to purification. Decomposition process in sewage ponds can occur in anaerobic conditions. Sewage ponds are distinguished in three categories: stabilized, aerated and fishery. In stabilized ponds oxidation of sewage coincide in oxygen presence (aerobic ponds) and in anaerobic conditions (anaerobic ponds) as well as in mixed conditions, partly aerobic and partly anaerobic (facultative ponds) [17]. In aerobic ponds oxygen is delivered by photosynthesis of algae and oxygenation of surface waters.

Intensity of photosynthesis is determined by access to light and level of insolation. Oxygen pond has to have the following parameters: area of 4 ha, depth between 0.30 – 0.90 m, hydraulic aggravation 0.05 – 0.10 m^3/ m^2 * day; BOT_5 load to 220g O_2 / ha * day. Time of holding sediment in such a pond is from 5 to 12 days, and purification level should be 90 - 95% in summertime. In anaerobic ponds mineralization is run with heterotrophic bacteria. Anaerobic ponds have area below 0.8 ha and depth between 2.4 to 3.6 m, hydraulic aggravation should be 0.02 – 0.9 m^3 / m^2 * day, and BOT_5 in g O_2 / ha * day not higher then 60. Time of keeping sewage in such pond is between 8 to 60 days. Attaining such parameters allow to purify sewage up to 70% during summertime. Facultative ponds should have area of 0.8 to 2.0 ha, depth of 1.5 – 1.8 m, hydraulic

aggravation 0.05 - 0.4 m^3 / m^2 * day and BOT_5 in g O_2 / ha * day shouldn't exceed 60. Time of purification of sewage up to 70% is between 60 to 90 days in summertime [18].

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REFERENCES

1. Bartkiewicz B., Oczyszczanie ścieków przemysłowych, PWN Warszawa 2002, pp. 46 – 88
2. Ruffer H., Rosenwinkel K.-H., Oczyszczanie ścieków przemysłowych, Wydawnictwo Projprzem – EKO, Warszawa 1998, pp. 56 - 89
3. Żygadło M., Bartkiewicz B., Oczyszczanie ścieków, Wydawnictwo Politechniki Świętokrzyskiej w Kielcach, Kielce 2002, pp. 28 – 44
4. Kowal A. L., Świderka – Bróż M., Oczyszczanie wody. Podstawy teoretyczne i technologiczne, procesy i urządzenia, PWN, Warszawa 2007, pp. 32 – 67
5. Anielak A.M., Chemiczne i fizykochemiczne oczyszczanie ścieków, PWN, Warszawa 2002, pp. 52 – 79
6. Nawrocki J., Biłozor S. (Ed.), Uzdatnianie wody, PWN, Warszawa 2002, pp. 116 - 143
7. Bień J. B., Bień J. D., Inżynieria i ochrona środowiska, Wydawnictwo Politechniki Częstochowskiej, Tom 1, Numer 2, Częstochowa 1998, pp. 12 – 24
8. Maćkiewicz J., Flokulacja w procesach koagulacji i filtracji wód, PWN, Warszawa 1987, pp. 26 – 37
9. Kowal A. L., Świderka – Bróż M., Intensyfikacja procesu koagulacji w wodzie, Wydawnictwo Politechniki Wrocławskiej, Wrocław 1974, pp. 33 – 96
10. Siuta J., Inżynieria i ochrona środowiska, Wydawnictwo Politechniki Częstochowskiej, Tom 3, Numer 1 - 2, Częstochowa 2000, pp. 22 – 29
11. Krzywy E., Przyrodnicze zagospodarowa- nie ścieków i osadów, Wydawnictwo Akademii Rolniczej w Szczecinie, Szczecin 1999, pp. 16 – 43
12. Hartmann L., Biologiczne oczyszczanie ścieków, Wydawnictwo Instalator Polski, Warszawa 1996, pp. 66 – 95
13. Bazeli M., Mikroorganizmy osadu czynnego, PWN, Warszawa 2001, pp. 32 -76
14. Brózda J., Chlęch E., Kubaczka E., Oczyszczanie ścieków przemysłu piwowarsko – słodowniczego metodą osadu czynnego i złóż zraszanych, Wydawnictwo Naukowo- Techniczne, Katowice 1987, pp. 54 – 94
15. Lipowska E., Analiza wód i ścieków, Wydawnictwo Szkolne i Pedagogiczne, Warszawa 1998, pp. 33 – 89
16. Krzywy E., Iżewska A., Gospodarka ściekami i osadami ściekowymi, Wydawnictwo Akademii Rolniczej w Szczecinie, Szczecin 2000, pp. 116 – 146
17. Kowal A. L., Odnowa wody, Wydawnictwo Politechniki Wrocławskiej, Wrocław 1997, pp. 67 – 112
18. Skalski K., Gospodarka ściekami przemysłu spożywczego, Wydawnictwo Nauk Technicznych, Warszawa 1991, pp. 51 – 86

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IMPORTANCE OF RECYCLING IN VIEW OF THE FULFILLMENT OF ECOLOGICAL AND ECONOMIC CRITERIA

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ABSTRACT

This concept implies the maximum rationalisation in the utilisation of limited resources, environment protection, fulfillment of the economic criteria 0as well as the compliance with social demands in order to meet the long-term society demands in better way. Recycling has great influence on the sustainable economy concept. Recycling contributes to the realisation of appropriate economic results by creating new use value of the recycling products, and by employing the new workers as well as by influencing on the decrease of import of the deficient raw materials. Particularly important role in the reuse process, recycling and product disposal has a society community, which can influence on the formation of the citizens' conscience about the importance of waste collection, as well as on improvement of the need recognition for its recycling, by using the appropriate education and informing process, and legal act. In this way, the responsibility to reuse, recycle and dispose the product should take both the producers and consumers as well as the entire society community.

Key words: environment protection, recycling, sustainable development, economy development

INTRODUCTION

In order to achieve sustainable development, in accordance with the demands and nature limits, determined by the modern world on Conference on environmental issues held in 1992 in Rio de Janeiro, it is determined that adequate connection between economic policy and environmental development on all levels of social communities and in all economy and non economy sectors is necessary, and they should be integrated into modern processes. The first warning that former concept of sustainable development was non-sustainable was raw materials and energy sectors crisis during the 1970. Developed countries reacted first by adopting saving programme and rational use of primary resources, as well as mineral raw materials and energy preservation programme. Use of raw materials scrap takes special place within the activities. Sustainable development concept is mostly based on the secondary resources. Knowledge on low natural resources and necessity for their rational usage conditioned a new approach in concepting future economic development. It is based upon long-term sustainable development as well as upon high stability degree in business operations.

Economy growth and development, introduction of new processes and products, and constant growth of city population, produces large amounts of waste materials from the households and industry, and the necessity for their taking out and dumping. It is necessary to take certain measures for the most appropriate way of waste dumping, and further processing, that is, recycling, in order to stop waste material from polluting the environment.

Globally observed, the greatest benefit form recycling is seen in environment protection and preservation. Environment protection and preservation are one of the most important civilization tasks whose future and survival will depend upon its fulfilment. Creation and deepening of awareness of both consumers and producers on environmental preserving and protection importance and significance will greatly influence on successful task fulfilment.

However, it is necessary to point out the fact that recycling represents economy activity, which can have significant economic effects. Recycling produces many products used as raw materials in final products fabrication (various metals), as energy fuel and as finished product intended for final consumption. There is real demand for these products, and therefore its production is manifold justified in technical-technological and social-economical way.

According to the present situation, domestic economy will not reach the level of highly developed countries in recycling sector. However, in the starting phase it is necessary to register amounts and locations of recyclable materials, research the possibilities of its regional collection, sorting, transport, treatment or disposal, as well as to determine the conditions for treating the material in the least harmful way for human health and environment.

MAIN FEATURES OF SUSTAINABLE DEVELOPMENT CONCEPT

Sustainability or sustainable development is crucial precondition and final goal of efficient organisation of numerous human activities on the Earth. Sustainable development disrespect leads to inefficient economy development, greater waste of resources and energy, that is, the tendency of long-term input-output ratio deterioration in global scale. Sustainable development is therefore, the development, which establishes balanced relation between ecology and economy, in order to preserve natural wealth of our planet for future generations. It can be said that sustainable development represents general orientation, desire to create better world by balancing social, economic and environmental factors [1].

Second Conference on environment and development was held in the early 1990. The Conference was held in Rio de Janeiro in 1992, and as one of the main deliberation directions was *sustainable development concept,* which was examined in the late 1980. ***Agenda 21*** represents instructions for appliance and conduction of sustainable development concept in all development and environment usage sectors in 21st century, and all countries signatories are obligatory to apply and to form committees for sustainable development. The Agenda contains 4 basic chapters: social and economic issues, protection and management of the development resources, role and importance of social groups strengthening and instruments for realising the Agenda [2].

Based on the set directions, UN Conference Planet Summit +5 was held in New York in 1997 with a view to perceive how much has been done regarding the agreement and accepted documents form the summit held in 1992 and especially the implementation of Agenda 21. Ecological rationality has become component of economic practice of the most developed countries in the world. Preservation of natural resources and especially rational usage of all resources and their potentials, gains strategic importance, perceived form the development priority point of view. Sustainable development and environmental preservation concept is of high priority of the EU (Article 2 from the Amsterdam agreement) [3]. EU committee adopted theme strategy on prevention and waste recycling [4] in December 2005 and it represents one of the frameworks, which marks the beginning of the changing decade in the EU.

One of the basic Agenda 21 conclusions, which represents instructions for appliance and implementation of sustainable development concept in all development sectors and environment usage in the 21st century, is that the **waste recycling is undoubtedly the best and the most rational way to manage waste materials.** By applying various waste material recycling procedures, the spending of natural resources is shrinking by returning useful substances and energy saving is achieved. Recycling effects useful to the society are seen in the following:

- a part of the ecological problems that are the result of waste materials pollution, are solved effectively, and
- conditions for starting the low cost production along with decreasing the volume of primary raw materials usage are created.

According to Canadian experiences [5], the key for reducing the waste materials for 50% is so-called **4R: reduction, reuse, recycling, recovery.** The stated "4R" formula represents the hierarchy, starting from reduction, which is primarily a choice – minimising the creation of waste materials, and if it is created then it should be reused many times, if it is possible. The third and the best alternative is recycling. Finally, tendency for regeneration of raw materials, materials and energy from waste materials, which cannot be reduced, reused or recycled, should be used if possible.

Regarding European accomplishments in this area, the EU has made decision upon decreasing waste disposal for 25%, that is, upon necessity to increase average recycling degree until 2010. The most significant results in this area in the EU countries are made in Holland, Denmark, Germany and Sweden [6].

IMPORTANCE OF RECYCLING

Recycling process often demands discovering new technological procedures, as well as new production machines and gadgets that are used for returning waste – production redundancy, as well as used products from the consumption sphere back into production process and in further consumption. One of the way to reuse the waste involves collecting the various waste materials, which can be potentially reused. The advantage of the process is reusing and recycling and resource preservation. The other recycling advantage is decreasing the effects made during raw materials usage and transformation (influences on environment, energy and natural resources consumption) [7].

Recycling is mainly defined as a production process, which encompasses reuse of the same raw materials in a production process. These raw materials have already been used, that is, they have had certain function in the reproduction process. Recycling enables them to gain higher utility value. Many useful goods are produced by recycling. They are used as raw materials for final products fabrication (various metals), energetic fuels, and finished products intended for the use. Therefore, those utility goods are necessary, and their production is justified.

Besides, modern technology and technique enable production of high quality products by processing waste materials. In this respect, there is a constant progress, which leads to a higher degree of resources usage, and also business rationality and profitability.

One of the recycling goals is protection and preservation of available primary resources, from those that are non-renewable, to their further usage. There are noticeable results in this filed. It is real to expect this trend to continue in the future. The state can have special role in usage of secondary raw materials in economic development. The preservation and protection of natural resources and providing healthy environment is in its best interest. For many countries, it means less import dependence, because development resources already present in the country are used. Therefore, many countries, first of all developed ones, create convenient business environment and directly encourage massive usage of secondary raw materials by applying various measurements and activities.

Certainly, a special benefit form recycling is seen in protection and preservation of the environment. Recycling process has useful purpose, instead of leaving the waste materials in environment often uncontrolled and without proper waste disposal site, and by doing it so the soil, air, water and other natural wealth are polluted.

This activity, as the other ones, contributes to the accomplishment of relevant economic effects. These effects, besides the production of utility goods, are new employment in secondary industry branches, as well as in similar economic areas, profit creation, which contributes to the faster economic development and higher life standard of the employees, and the growth of the general welfare.

Secondary raw materials' recycling has impressive development in the world. Annual transaction of these goods is about 160 billion American dollars. 1.5 million people work in this sector, which enable to annually recycle and offer on the market over 600 million tones of waste paper, non-ferrous metals, plastics, textile, glass, electronic waste and other. Many analysis show that waste material recycling is economically justified, which is perceived mainly in decrease of business costs, but also in energy and other inputs saving.

WASTE RECYCLING IN REPUBLIC OF SERBIA

Waste collecting and disposal, as especially waste processing, was not of great interest in Serbia. However, a certain progress has been perceived lately. Communal waste is put on the waste disposal sites, and small proportions of industrial waste are used. Due to the lack of proper data, structure and amount of waste cannot be estimated with certainty. It is estimated that 2.5 million tones of waste are collected in Serbia, but

half of the waste stays in the yards, next to the roads or in the river beds. It is estimated that 0.8 kg of communal waste is daily produced per citizen. Waste structure analysis in bigger cities in Serbia shows that the greatest part is organic waste – 30%, then paper – 26%, then glass – 7%, plastic – 5%, textile, iron and other metals – 4% r, non-ferrous metals – 2%, rubber – 1% and other waste – 21% [8]. Waste structure that an average European family throw is similar to the waste structure in bigger Serbian cities.

Collected waste has no adequate treatment. Communal waste is mainly disposed on the waste disposal sites without any treatment. No composting is performed even though it contains large part of organic waste. In addition, there is no waste incineration nor it is used as alternative fuel in railway station or cement plants. There is no primary recycling, that is, separation on the source.

Things are a bit better regarding industrial waste recycling [8]. Greater numbers of economic subjects have dealt with this business in the past few years. 3% of waste material was recycled in Serbia in 2003, in 2007 9% was recycled, and it is expected that the percentage will rise up to 15% and 20% in the near future. Recycling encompasses between 15% and 40% of waste in the developed countries. 300 companies are in waste recycling business in our country.

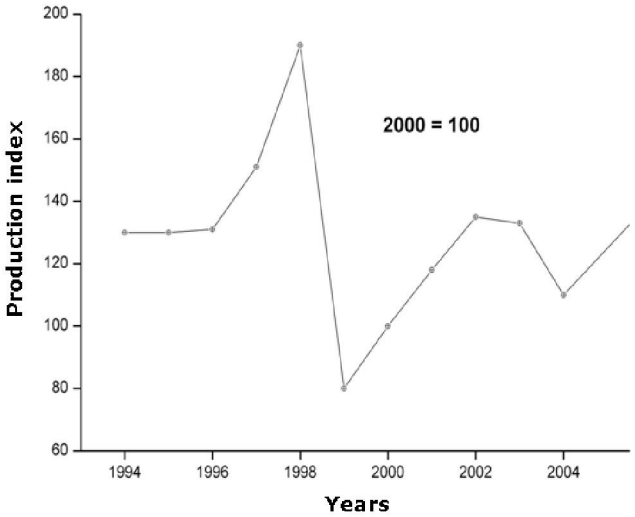

Figure 1. Waste recycling index movement

Volume of secondary raw material recycling is constantly increasing since 1990, but during the NATO aggression (1999) it dramatically falls, and then it rises again. The most collected waste are various metals and paper. Significant amounts of waste materials are exported, that is, imported.

Table 1. Collecting, processing and foreign trade of secondary substances in 2005 in tones

Name	Amount collected	Amount processed	Production	Foreign trade	
				Export	Import
Metal	307.971	337.145	376.319	143.975	173.149
Paper	144.944	105.798	523.205	39.593	447.000
Glass	31.262	12.446	16.371	18.816	
Copper	22.500	15.000	17.500	7.500	
Aluminium	20.000	60.000	110.000	7.500	47.500
Plastic	15.000	5.000	15.000	10.000	
Total:	541.677	535.389	1.058.395	227.384	221.096

Source: Statistical office of the Republic of Serbia, Recycling agency

If previous amounts are expressed in value, it comes to certain market state of secondary raw material in our country. In comparison to the possibilities, the results are still modest.

Table 2. Secondary raw material market in Republic of Serbia – in Euros –

Name	Waste collected	Waste processed	Production	Foreign trade	
				Export	Import
Metal	42.825.960	46.882.804	58.943.392	22.017.214	24.077.802
Paper	10.112.865	7.381.604	58.366.703	2.794.801	43.735.000
Glass	375.803	149.616	9.923.429	226.187	
Copper	30.282.750	20.288.500	20.094.250	10.094.250	
Aluminium	15.885.100	47.655.300	89.425.500	5.956.913	37.727.113
Plastic	8.609.010	2.869.670	7.130.330	5.739.340	
Total:	108.091.488	125.127.494	777.883.604	46.783.805	105.539.915

Source: Statistical office of the Republic of Serbia, Recycling agency

Data on production movement fulfil the market picture where recycled waste substances are used as raw material. The data refer to the period 2004-2006. The growth of recycled waste production is perceived in majority of the products. It mainly refers on the iron, copper, aluminium, zinc and lead products. There is a certain decrease in glass and paper production.

Table 3. Recycled waste industrial production – in tones

	Year		
	2004.	**2005.**	**2006.**
Iron and mild steel	107.180	153.346	197.625
Alloy steel	1.249	643	7
Copper and copper alloys	921	2.002	2.108
Aluminium and aluminium alloys	988	1.691	2.031
Zinc and zinc alloys	55	212	327
Lead and lead alloys	2.004	2.499	2.676
Glass	14.792	12.318	11.697
Paper	44.378	36.956	35.093
Total:	157.092	197.737	240.522

Source: Statistical office of the Republic of Serbia

Generally speaking, waste recycling is insufficient in our country. One tenth of collected waste is recycled. It is one of the problems that have to be solved in the near future, if our country wants to become a member of the EU. Besides, from the economic aspect, it is a chance for our weary economy to form a special branch that would provide new working places, profit increase and general welfare.

CONCLUSION

From the energy and raw material preservation point of view, recycling represents the most desirable waste treatment. Its contribution to the environment protection is perceived in decreasing ecological pollution, in decreasing waste amount and in saving raw material resources. From the economical point of view, recycling represents justified process, because it creates new utility value of recycling products, new working possibilities, import of deficient raw material is decreased, and the most important thing, it contributes to the environment protection and preservation. However, recycling process in domestic economy is insufficiently developed, since only one tenth of collected waste is recycled. According to the present situation, domestic economy will not reach the highly developed countries level in the recycling area. Involvement into European integration flows will force domestic economy to solve the problem in a relatively short period. However, since it is a relatively new economy branch, help of the competent state institutions is necessary in order to organise special centres for waste collecting and to increase recycling capacities. In conclusion it can be said that investing in this economic branch is long-term justified from both techno-economic and social, first of all ecological, criteria.

REFERENCES

1. Kostadinović A., Vuković M., Ekološki menadžment, Visoka škola strukovnih studija za menadžment u saobraćaju, Niš, 2009., str.11.
2. Đukanović M., Civilizacije na prekretnici: Samit Planete+5, Ecologica, broj 4/97, Jugoslovensko društvo za širenje i primenu nauke i prakse u zaštiti životne sredine, Beograd, 1997., str. 1.
3. www.europa.eu
4. http://europa.eu/legislation_summaries/enviroment/waste_management/indeks_en..htm
5. Recycling in Canada, Published bz Environment Canada, Authority of the Minister of the Environment, Cat. No. En 40-204/1, 1990.
6. Environment in the European Union at the turn of the century-Integration of the economy and environment, EU 1999.
7. Urošević S., Recikliranje tekstila-nove tendencije i obaveze prema glavnom cilju globalnog očuvanja životne sredine, Ecologica, Naučno-stručno društvo za zaštitu životne sredine Srbije-Ecologica, Beograd, 2009, vol 16, br. 54, str.173-180.
8. Nikolić R., Ekonomija prirodnih resursa, Kompjuter centar, Bor, 2010. god., str. 511.

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THERMOGRAPHY AND OTHER NEW TECHNOLOGIES FOR TREE DIAGNOSTICS

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ABSTRACT

This paper summarizes the application of new technologies in the field of tree diagnostics and it shows the results of our study. In recent years, intensive investigation in the field of thermal imaging application in tree's diagnostics are proceeding. There are great possibilities of application, especially in the prevention of destruction due to insect attacks and diagnostics of decay, cracks and other anomalies. Thermovision is contactless method and it is very convenient for screening of anomalies. After thermal imaging, other more invasive methods could be applied for method verification and more precise diagnostics. The results of thermal imaging are compared with „Arbotom" sound impulsed tomograph and for more quantified results with the most invasive method of resistography where it was measured the tree resistance using the rotating needle. It was found the excellent match of results, but thermal imaging has a great advantage because it is noninvasive and very speed diagnostics method.

Key words: thermography, thermal imaging, arbotom, sound tomography, resistography

INTRODUCTION

In recent years, intensive investigation in the field of thermal imaging application in tree analysis and diagnostics are proceeding with aim to trees protection [1]. There are great possibilities of application, especially in the prevention of destruction due to insect attacks and diagnostics of decay, cracks and other anomalies. Other new diagnostics technologies that is used in tree and wood analysis are „Arbotom" sound impulse tomography and resistography [2-4]. Here are shown some results of authors studies in the field of non-destructive inspection of the inner condition of trees.

METHODS

It was used an infrared (IR) Wohler IK21 digital camera [5,6], which operates based on non-cooled germanium thermoelectrical linear detector. It forms the thermal image measuring infrared radiation of a particular part of the object or the whole scene. Camera has a softwer which converts thermal image in thermogramme. It represents an accurate temperature record or temperature distribution in the scene. Advantage of IR camera is a working mode in wide temperature range, as well as possibilitiy to show the large temperature differeces in one picture. It is powered by standard batteries for video camera and it has a color LCD screen with 10.2cm in diagonal. Surface temperature distribution of one object is shown by different colors. Blue color present the cool places, and the red the hot spots (living beings).

The „Arbotom", 3D impulse tomograph is a novel impulse tomography unit that enables an inside view of condition of trees and round wood. Hidden decay, invisible cavities and cracks and how large they are become visible using sound impulses. Multi-function sensors (16 were maximal used) serve as transmitter and recipient of acoustic impulses at different levels of tree. Special software calculates the measured values and converts them into a colored chart. Damaged material appears as red and intact material is green on the cross section of tree. There were made records at the different levels of tree.

Resistograph is exposes the inner condition of trees using electronically controlled drill resistance measurement. Drilling depth of rotational needle is about 45 cm. The measurement profiles are synchronously printed and additionally stored in the unit's internal memory and data are transmited to PC and evaluated with the software.

These technologies have been applied to several tree species: mulberry, linden, plane-tree and cedar at different location in Pec (Pecka Patriarchy), Novi Sad, Futog and Opatija.

RESULTS

Studies have shown that insects colonies under the bark rise a local temperature at the surface of the tree and that is registered by IR camera (Figure 1).

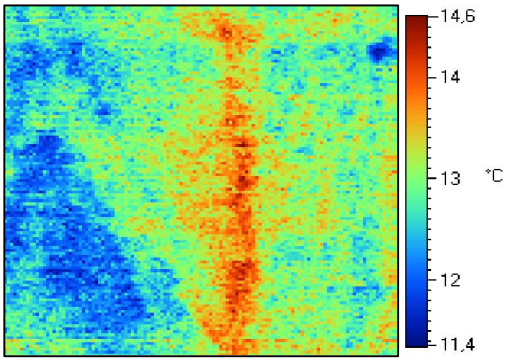


Figure 1. Thermogram of insect colony under the bark of linden-tree.

Figure 2 shows thermogram and normal digital photo of plane-tree surface. Under the bark was found the colony of grid bugs insects.

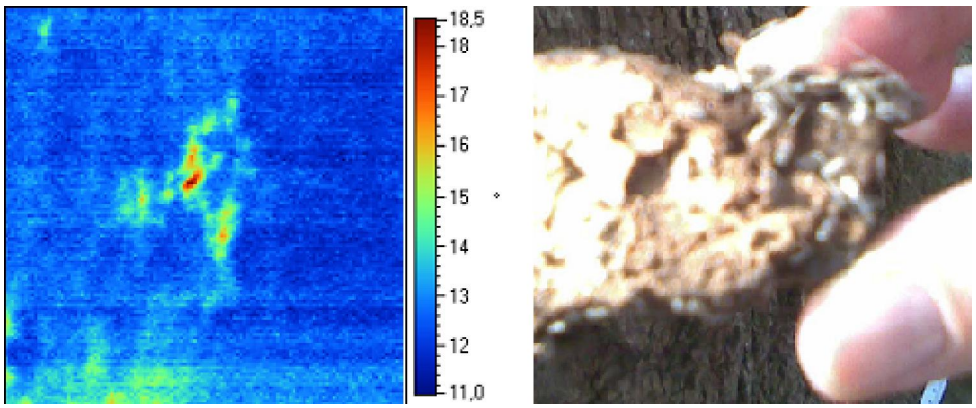


Figure 2. Thermogram and photo of planetree with insect colony under the bark.

Figure 3 shows crawled mulberry with acoustic sensors of „Arbotom", sound impuls tomograph. Figure 4 shows lateral thermovisual view and a cross section of the tree made by tomograph. The rain has been moisted the tree but the most massive part captured the heat and it shows at the thermograph the higher temperature.

Figure 3. Crawled Mulberry tree with acoustic sensors of sono scanner

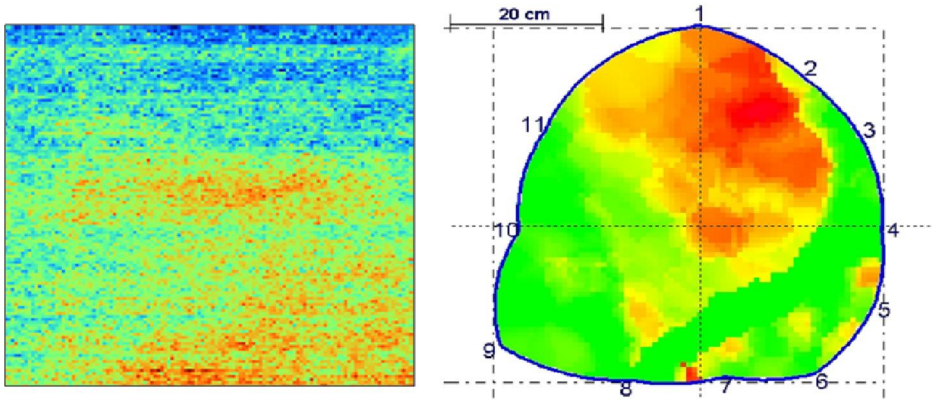


Figure 4. Thermal image (lateral view) and scanner (cross record) of mulberry tree.

The rotten analysis of the same mulberry position was cofirmed by resistogramme (Figure 5). It was measured penetration resistance by rotating the needle.

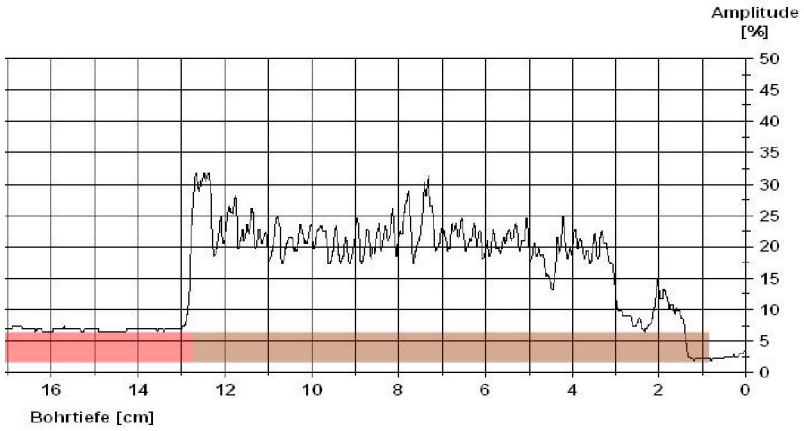


Figure 5. Resistogramme of partially rotten tree

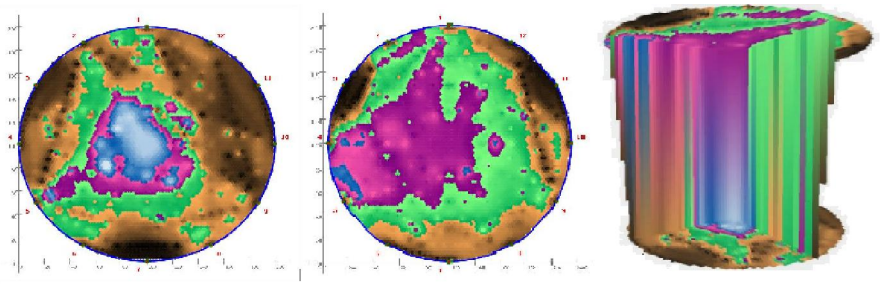
The diagram shows an increase of force with the increase in penetration resistance penetration depth (from right to left). The sudden drop of force means the cavity or decay.

Results show that the mulberry-tree structure ist not too much disturbed, and that there are only local cracks which reach its core. These damages causes a gradual landing of the main trunk and that is the reason why the cambial layer stretchs, cracks and consequently dies. Such and occurrence is not unusual at mulberry species. Treetop, due to phototropism escape to the side and gradually make it more weighty. Branch wood fibers stretch and cambium cracks. The main trunk and branches are unequally loaded and tend to lie down to the ground if not before than break. Over time, in contact with the ground may appear offsprings from the trunk and branches, followed by the creation of adventitious roots. That is one of the solution for the stabilization of old trees: it is

necessary to obtain a quality young mulberry tree and plant them within a certain distance on both sides of the main trunk, under the branches that need to be underpinned. Excellent parts of trees bent into a bow and folded over each other should be attached with hemp rope to the branches. After 10 years, young trees coalesce with the old branches and made one structure (Figure 6). Treetops of young trunks upgrade and improve the treetop of old mulberry and facilitate its supply.

Figure 6. Natural underpinned branches

By multislice scanner can be obtained data about all wood mass along the trunk. Figure 7 shows 3D model of cedar tree in two tomogrammes.



a) b) c)

Figure 7. Tomogramme of cedar tree: on the ground (a), at the level of 1,8m (b) and 3D model (c)

DISCUSSION AND CONCLUSION

Thermography can show the insect colonies and rotten wood in the old trees and mark it as dangerous spots which have to be healed. After thermovisual screening, other technologies, such as sound tomography and resistography, could be used for tree analysis. They are less or more invasive, but they could better precise the location of damage.

Thermography is very fast method and it is covenient for inspection, diagnostics and continuous environmental monitoring. The equipment is not too expensive, it is mobile, and it could be used in the protection of all forest.

REFERENCES

1. Leuzinger S, Vogt R, Korner Ch. Tree surface temperature in an urban environment. Agricultural and Forest Meteorology, 2010;150:56-62.
2. Rust S. Geräte und Verfahren zur eingehenden Baumuntersuchung. In: Roloff A. Baumpflege. Stuttgart, Ulmer: 2008. http://www.baumtomographie.de/pubs/Baumdiagnose_Geraete.pdf
3. Mariño RA, Fernández ME, Fernández-Rodríguez C, Méndez M. Detection of pith location using acoustic tomography: an application to longitudinal stress-wave velocity in chestnut lumber (Castanea sativa Mill.). Holz als Roh- und Werkstoff, 2011. DOI : 10.1007/s00107-009-0366-5. http://peer.ccsd.cnrs.fr/docs/00/56/82/47/PDF/PEER_stage2_10.1007%252Fs00107-009-0366-5.pdf
4. Rinn F. Holzanatomische Grundlagen der Schalltomographie an Bäumen. Neue Landshaft. 2004;7:44-47. http://www.mandel-gruene-dienste.de/images/Microsoft%20Word%20-%20Word%20Holzanat.%20Grundlagen_neu.pdf
5. Zoran Stević, M. Rajčić-Vujasinović, D. Nikolovski, B. Popović. Prevencija samozapaljenja uglja na otvorenim skladištima primenom termovizije. XVII Naučno-stručni skup sa medjunarodnim učešćem "Ekološka istina". Sokobanja, 2009.
6. Zoran Stević, Dubravka Nikolovski, Primena novih tehnologija u zaštiti životne sredine. U: Tehnika i tehnologija u funkciji zaštite životne sredine. Beograd: SMEITS, 2010, str 19-55. ISBN 978 -86 -81505-56-4.

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CHARACTERIZATION OF LIGNITIC FLY ASH PELLETS FROM TPP NT-B OBRENOVAC

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ABSTRACT

This work presents detailed characterization of fly ash from the Nikola Tesla Steam Power Plant B, Obrenovac, Serbia, and the ash pelletization process using Portland cement and bentonite clay binders in 5, 8, 10, 12, 15 and 18 percent proportions. Each pellet-size is tested on the compressive strength, impact strength, attrition and other mechanical properties. Pellets produced using bentonite are calcified and sintered at the temperature of 1100ºC. Finally, the recommended applications of palletized fly ash are the aggregate for lightweight concrete in the building-materials industry, in agriculture, for soil stabilization in landfills, or in landscaping.

Key words: fly ash, pelletization, ash characterization, mechanical properties, uses

INTRODUCTION

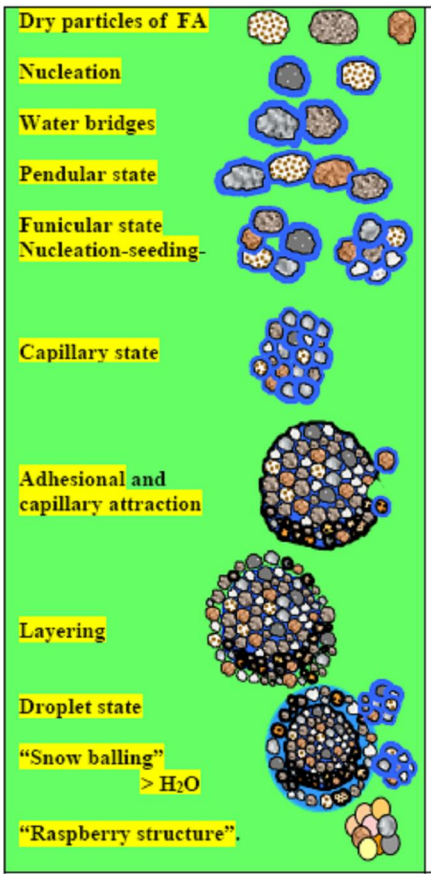
Artificial aggregates produced by pellet agglutination, or pelletization, are used largely in metallurgy, agriculture, pharmaceutical industry, less in building industry or, lately, in the treatment of refuse fines. The 1985 figures show that the pellet production for use in metallurgy was 435 million tons. In 1989, the lightweight agglomerate production for the building and road construction was only 1.2 million tons. The reason for treatment by pelletization of a so small amount of waste materials such as fly ash, primarily lightweight aggregates used in construction, is the availability of natural resource products and relatively higher costs of agglomeration process due to initial investments and - energy requiring curing procedures to obtain adequate strength for construction applications [1].

The thermal power plants in Serbia use 35-40 million tons of coal, mainly lignite, producing about 7-8 million tons of fly ash and slag. The lignites of Serbia have 20 % average ash content, which after combustion is disposed with slag in open-air ash dumps. The slag-to-ash percent ratio is mostly 10/90. Ash and slag form huge amounts of the greatest artificial mineral pollutant. The yearly production at present of fly ash in the major lignite-fired power plants in Serbia are Nikola Tesla PP A and B 3,700,000 tons; Veliki Crljeni of PP Kolubara 375,000 tons; Morava 100,000 tons; Kostolac A and B 2,100,000 tons; Drmno about 600,000 tons; and other power and heating plants about 500,000 tons [8].

Utilization of fly ash changed in the first decade of the 21st century, at least in Europe. Fly ash is no more a waste disposed, but a fully used in road construction, cement industry and the like in many European countries that have the coal-fired power plants.

The **purpose of pelletization** is the improvement of fly ash properties and densification for easier transport and disposal. It also controls porosity, grain shape, solubility, reactivity or thermal condition, all giving it an environmental or economic aspect. The fly ash, like many fine-grained loose or artificial refuse materials (mud, slag, coal dust, different wastes) that may be agglomerated by pelletization, are suitable for: • Environment-nonaggressive disposal of very fine-gained wastes; • Pelletization before recycling artificial wastes; • Production of artificial aggregates for lightweight concrete; • Pelletization for dedusting; • Pellets for use in drainage; • Pellets for landfills; • Pellets as volume-reducing agent in some fills; • Pellets as ornamental material in landscaping; etc.

DEFINITION AND THEORY



The process of pellitization is a free, chaotic movement of particles in a moisturized agglomerating material. Moisturized particles, while being moved and bumping one another, activate the capillary bonding forces, with resulting growth of the nuclei by agglutination of new particles, then abrasion, attrition and transition to large particle aggregates or pellets (Fig. 1). The mechanism of particle aggregation are: • nucleation (formation of nuclei); • dissociation; • coalescence (of the formed grains); • breaking (of particle aggregates); • layered ('snowball') agglutination; • attrition (wearing down by friction); • abrasion and transition.

The basic mechanisms are: **Nucleation** (initial nucleus formation), is the aggregation of free solid particles through interaction with the medium. Nucleation enhances formation of new particles with the growth of the newly formed aggregates. **Coalescence** of aggregates begins in the advances stage of nucleation, resulting in the growth of aggregates composed of smaller and fewer grains. The third stage of the aggregation mechanism is the **layered agglutination** of free particles by interaction of single dispersed particles in the immediate surrounding. Agglutination increases the mass of the agglomerate, not the number. Layered agglutination of the aggregate may occur only in the presence of new free particles. The growth of nuclei, the growth of aggregates in the transitional stage and the growth rate of the pellet as a (snow)ball – all these areas and the extent of pellet growth, and the pellet growth kinetics, mostly depend on the following: • Moisture content in the input material; • Particle-size range and fineness of input material; • Raw material processing technique, and • Kind and amount of added binder.

Figure 1. The stage and mechanism of the pellet growth processes

MATERIALS AND EXPERIMENTAL METHODS

A fly ash sample for this research was collected in the Nikola Tesla Power Plant B, Obrenovac, which burns lignite from the Kolubara colliery. The primary (four-ton) sample was taken from the electrofilter zone (1) where about 80% of total fly ash is generated, from which a representative laboratory sample was prepared. The binder used in the pelletization process for the research was Portland cement Titan PC 35 M provided from the Titan-Kosjerić of bentonite clay from Aranđelovac. Chemical composition of the bentonite (kaolin clay) used is SiO_2 65-68%; Al_2O_3 28-31%; Fe_2O_3 3-5%; CaO 0.8-1.5%; MgO 0.5-1.5%; Na_2O 0.8-2%.
The fly ash size distribution was determined using the standard Tyler sieves for wet sieving. The ash particle mean diameter (d_m) was 0.090 mm, and $d_{5\%}$ was 0.320 mm. Chemical composition of the fly ash from the Nikola Tesla Power Plant B is analysed on several representative samples, and then average contents of the constituents calculated (Table 1).

Table 1. Chemical composition (Tomanec, 2003, mean values) of fly ash from the Nikola Tesla – B Power Plant, Obrenovac.

Compound (W_t %)	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	P_2O_5	TiO_2	Na_2O	K_2O	LOI
NT TPP	52.27	22.34	6.05	6.64	4.41	2.74	0.085	1.07	0.41	1.36	2.34
M.Ilić, 2003.	52.56	26.33	6.81	5.96	2.21	1.02	-	-	0.24	1.14	3.46
I. Ilić, 2008.	56.33	23.75	5.32	6.42	2.18	2.05	-	0.58	0.48	0.97	2,17

The fly ash from the Obrenovac Steam Power Plant with SAF 80.66% is Class C (min. 50%) according to the international classification. Fly ash from the Power Plant B falls into the group of siliceous ashes, same as the fly ash from the power plants Nikola Tesla A, Kostolac B, Kolubara A, Pljevlja (burning Borovica coal) and Morava. Unburned carbonaceous material (semicoke aggregate) was contained by 2.53%. The light constituent (< 1 g/cm^3) consisted of the unburned semicoke or coke and silicate microspheres or conospheres. The proportion of silicate microspheres by weight varied from 0.58% to 0.86%. For electromagnetic separation both dry and wet treatments were concurrently applied on the primary unclassified samples. This fly ash contained 3.65 % magnetic fraction.

MACHINES AND DEVICES

The laboratory device used for aggregation of loose fly ash particles finer than 2 mm was a pelletization disc unit, **Eirich TR 04**, manufactured by Maschinenfabrik Gustav Eirich. The unit power was 0.5 kW, disc diameter 40 cm, maximum revolution speed 29.5 Nm and range from 20 to 400 min^{-1} (Fig. 2). The angle of disc plane to the horizontal was varied from 30º to 90º. The optimum range of the disc revolutions was from 20 to 90 rpm, or from 30% to 80% of the critical rotation speed of the pelletizing drum, which was the rotation speed of the balling material in it. The rotation speed, angle and capacity of the disc are adjustable. Factors influencing the pelletization are speed of

the disc rotation, angle of the disc, amount of water in the palletized mixture and duration of the process of pelletization.

Figure 2. Laboratory Pelletization disc unit **Eirich TR-04,** diameter 0.4 m

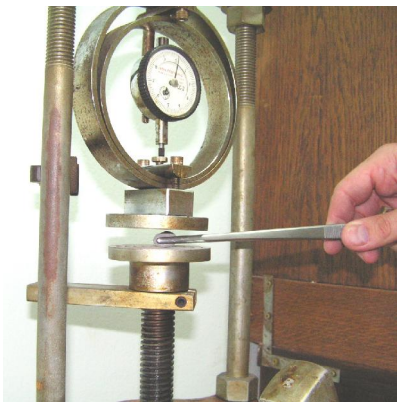


Figure 4. Compressive strength equipment, **Penetrometer LC-2 Soiltest, Inc.** a device for pellet compression test. Placing pellet in the measuring device.

PELLETIZATION TRIAL

The process of pelletization may be **discontinuous** (in laboratory pelletizing disc, as in our research) or **continuous** (controlled feed and pallet size). Most of our pelletization trials were discontinuous, producing in a variety of pellet sizes. (In the end of the nucleation interval, there were no more moisturized particles to agglutinate over the large formed pellets, except a very small amount resulting from the attrition, friction or break of the formed pellets.) The pellets of adequate sizes were removed from the further process. In contrast, several trials of pelletization combined the removal of adequate pellet sizes and the addition of new amounts of the homogenized, moisturized material. These trials simulated the continuous process and produced large pellets. The disc-pelletization was preceded by two-stage homogenization, an essential treatment technique. The first stage was dry homogenization of the proportioned fly ash and cement or bentonite clay binder in a porcelain mill on rotating rollers without milling bodies. The second stage was wet homogenization of the fly ash and binder mixture in an impact mill with gradual addition of spray water for efficient moisturization to avoid the binder removal from the ash grains. The impact mill used was a flotation cell with a low impeller speed. A flow chart of the homogenization and pelletization trial is given in Fig. 3.

TEST RESULTS

The test results for the fly ash pelletization parameters are tabulated and include number of tests, masses of the used binders, feeds to pelletizing unit and further treatment of pellets. The basic parameters are: amount of fly ash, amount of binder (cement Titan PC 35 M); time of dry homogenization in ceramic mill without milling bodies, time of wet

homogenization in impact mill; speed of rotating impeller, amount of water for homogenization; spray water during pelletization, total water; duration of pelletization, pelletizing disc rotation speed and angle; mass of moisturized pellets; pellet mass after 7, 14, 21 and 28 days of curing. Grain size of each final product is given and photos of the produced pellets before and after curing. Physical and mechanical properties of the pellets are given and statistical data processing for each conducted test.

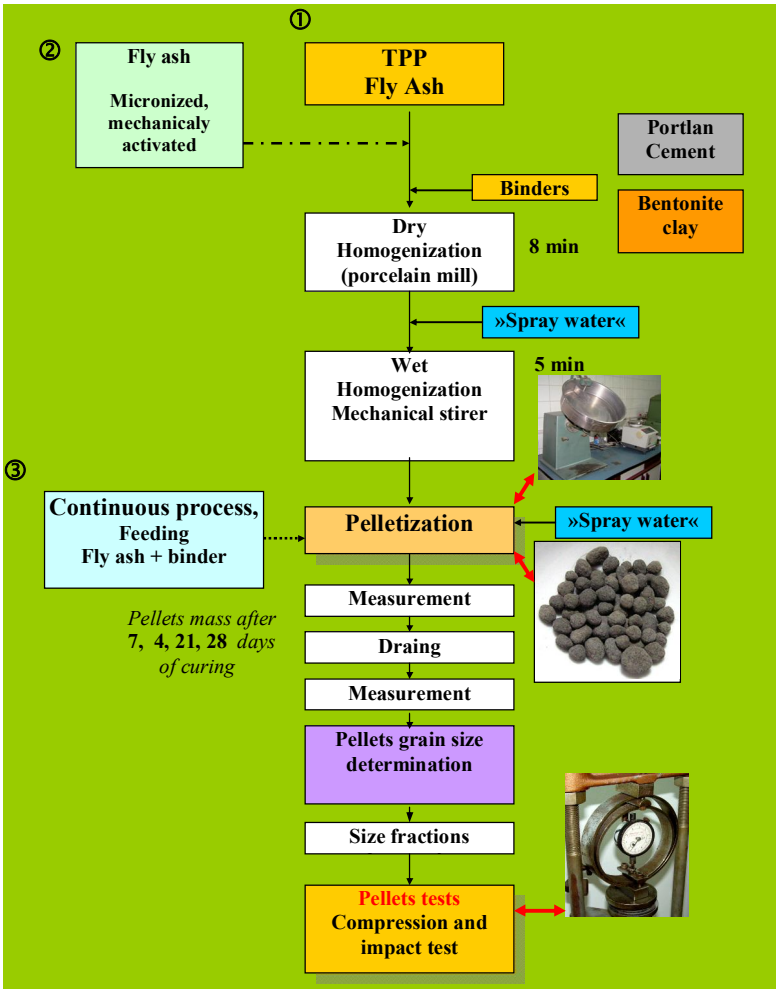


Figure 3. Flow-chart of homogenization, pelletization and pellet tests, basic ①; ② Micronized, mechanically activated; ③ continuous pelletization.

IMPACT TEST

The pellets were impact-tested by the standards for some mineral ores or for building materials, not for fly ash. (A standard draft was prepared in the Mining Institute

of Zemun under the study of coal pelletization.) The impact test consisted of letting pellets fall (previously mass and size measured) from a height of 453 mm on a steel plate 420x250x9 mm in size. Pellets were individually dropped until breaking and the number of falls was recorded. For the given research, ten representative pellets were used and their diameters and number of drops before breaking registered. The data were statistically processed and interpreted. Partial abrasion and similar damages of the group of pellets were observed on sieve size 5 mm and the undersizes (fragments and dust) weighted.

COMPRESSION TEST

Compression test was conducted in a soil mechanics laboratory using two rigid parallel plates, one of which with a dial indicator, a modified **penetrometer LC-2 Soiltest, Evanston, Illinois**, USA. The sample for the compression test consisted of ten pellets (from each size fractions). Sample for the compression test consisted of ten representative pellets from each size class. Each pellet had the diameter measured prior to the test, and mean equivalent diameter and mean resistance to compression were calculated for each size class. Test results are summarized in Tab. 2. The tested size fractions were 16+11.2 mm, 11.2+8 mm and 8+5 mm. A group of ten pellets selected from each size class were individually placed in the cylinder of the equipment and compressive force applied on the piston and increased until the pellet was crushed (Fig. 4).

Table 2. Presentation of pellet compresive stength calculation for the tested size fraction (-11.2 +8.0 mm), Exp. 3

Sample number 3		**Particle size fraction -11.2 +8.0 mm** **Parameters of compressive compresive stength calculation (mechanical penetrometer)**					
1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**
N°	**Diameter d (mm)**	**Observation**	**The failure load P (N)**	**Strenght Index I_s**	**Size correction factor F**	**Strenght Index, $I_{s(50)}$**	**Compression test σ_c (MPa)**
1	9.9	68	101.252	1.033	0.483	0.499	11.976
2	9.6	82	122.098	1.325	0.476	0.631	15.144
3	9.2	56	83.384	0.985	0.467	0.460	11.040
4	10.1	63	93.807	0.920	0.487	0.448	10.752
5	9.8	85	126.565	1.318	0.480	0.633	15.192
6	9.0	80	119.12	1.471	0.462	0.680	16.320
7	10.1	85	126.565	1.241	0.487	0.604	14.496
8	10.3	69	102.741	0.968	0.491	0.475	11.400
9	10.0	80	119.12	1.191	0.485	0.578	13.872
10	10.5	99	147.411	1.337	0.495	0.662	15.888
						Mean values:	**13.608 (MPa)**
						Standard deviation:	**± 2.123 (MPa)**
						Coefficient of variation:	**15.601 (%)**

DISCUSSION

Fly ash from the steam power plant B in Obrenovac may be agglomerated, or palletized, mixed with bentonite clay or cement Titan PC 35 M from Kosjerić. The test results for the pellet resistances to compression and impact, and to attrition, are satisfactory under the following conditions. Pellets with cement binder had satisfactory compressive and crushing strengths for the binder proportion 15% of total fly ash in the mixture. Like in most European counties, we have no standards for the fly ash pelletization, so we compared our results with those of the materials similar in handling behaviour of pellets (fluorite for ironworks, coal, iron ore, etc.).

Pellets with cement binder:

- Compressive strength from 1.562 to 13.608 MPa;
- Impact strength from 3.3 to 9.5 (to over 30) drops per pellet;
- For pellet mean diameters from 2.7 to 9.38 mm.

Pellets with bentonite clay binder:

- Compressive strength from 0.796 to 2.965 MPa (fired pellets 141.158 MPa);
- Impact strength from 2.4 to 5.3 drops per pellet (over 30 for fired pellets).
- For pellet mean diameters from 2.23 to 6.28 mm.

CONCLUSION

The preliminary research and laboratory trial production are summarized bellow:

- The trial pellet production consisted of eighteen tests using different kinds and amounts of binder blended with fly ash. Either binder was used in nine trials. The process of pelletization in a laboratory pelletizer **Erlich TR-04**, power 0.5 kW, was discontinuous in most trials, whereas few were continuous for pelletization of ground and mechanically and chemically activated fly ash.
- The weight proportions of either cement or bentonite clay in pelletization mixtures were 8, 10, 12, 15 and 18 %. Fresh pellets were cured under laboratory conditions 7, 14, 21 and 28 days, and the moisture loss was registered through the curing period. Cured pellets were tested on compressive and impact strengths.

The physical and mechanical properties of the fly ash pelletization trial products are the following:

- The reference size fractions was taken to be -11.1+8 mm for comparison of trial results, and -16+11.2 mm was used in several special trials.
- **Compressive strengths** of the samples with 8, 12, 15 and 18% **cement** binder were 1.562±0.265; 1.805±0.474; 2.314±0.699 and 13.608±2.123 MPa, respectively. Each trial sample consisted of ten representative grains. Samples of the same size classes and cement proportion were tested on impact from falling; their strengths were 3.3, 5.6, 7.2 and >30 drops per pellet, with 40 to over 140 drops per pellet under >30.
- **Compressive strengths** of the samples with 12, 15 and 18 percent by weight **bentonite clay** binder were 1.288±0.310, 1.296±0.385 and 2.119±7.140 MPa (for milled fly ash 2.963 MPa), respectively. Samples of the same size classes and

bentonite clay proportions had the respective impact strengths 3.4, 4.0 and 4.9 (the milled fly ash sample 5.3) drops per pellet.

- The pellets (with bentonite clay binder) firing/sintering cured for one hour at the temperature of 1100ºC reached the compressive strength as high as 141.158 MPa and impact strength in excess of 130 falls per pellet.
- Pellets with the equal amount of binder mixed with additionally fine ground fly ash indicated better quality, which is yet to be researched.

Fly ash pellets produced in the described process are applicable for two uses: solid pellets in soil consolidation, landfill, stabilization of ash (or some other artificial loose waste) dumps, screens in landscaping; and calcinated or sintered extra-hard pellets in different fills, ornamental pavements, soil consolidation, as substitute for natural rock materials (less dense aggregate for lightweight concrete), and the like. Pellets with bentonite clay binder may be used in agriculture for amelioration of farmland.

REFERENCES

1. Gokhan Baykal, Ata Gurhan Doven, 2000: Utilization of fly ash by pelletization process; theory, application areas and research results. – Resources, Conservation and Recycling 30. pp 59-77.
2. Harikrishnan K. I, Ramamurthy K., 2006: Influence of pelletization process on the properties of fly ash aggregates. - Waste Management, 26. pp 846–852.
3. Haydar Arslan, Gokhan Baykal, 2006: Utilization of fly ash as engineering pellet aggregates. - Environ Geol. 50. pp 761–770.
4. Kumar V, Goswami G. and Zacharia K. A., 1999: Fly Ash: Its Influence on Soil Properties. Indian Society Soil Sciences Workshop, 18-21st October 1999, Calcutta
5. Rumpf H., 1962: Strenght of Granules and Agglomerates. – In Agglomeration, Ed., Knepper W. A., Interscience, New York, pp. 379-418.
6. Sastry, K. V. S. and Mehrotra V. P., 1971: Laboratory Investigation on Coal Pelletiyation. – Proceedings of 16 th Biennial Conference of the Institute of Briqueting and Agglomeration, Vol. 16, San Diego, California.
7. Sastry, K. V. S. and Fuerstenau, D. W., 1973: "Mechanisms of Agglomerate Growth in Green Pelletization," Powder Techmlogy, Vol. 7, pp. 97-105.
8. Tomanec R., Tanić S., Vakanjac B., 2003: Characterization of lignitic fly ash byproducts from TPP Obrenovac, Serbia. – 7th International Conference on Environmental and Mineral Processing VSB – Technical University of Ostrava, Czech Republic. pp. 249-260.

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ENERGY ABSORPTION CAPACITY OF GLASS-POLYESTER COMPOSITE TUBES

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ABSTRACT

In general, mechanical behavior of composite materials and composite tubes is different than that of metals. Unlike metals, they exhibit brittle cracking with maximal deformations of 1.5-2%. In spite of that they can be used as damping elements, for example in auto industry. Until recently, as a form of safety, all automotive components which require large breaking resistance have been made of metals. Today, however, with intensive development of composite materials and their wide selection, producers in automotive and other industries turn more and more to non-traditional composite materials. Every new material has to satisfy standard criteria for fracture energy. Latest research shows that composite materials satisfy all safety standards requirements.

Subject of this paper is experimental determination of energy of static fracture of glass-polyester composite tubes with defined structure and known processes of fabrication. The aim was to determine the possibility of their usage as damping elements during impact. Two types of tubular samples with different diameters were tested until fracture under static (low speed) compressive loading. The applied forces and sample lengths were measured until complete destruction of samples. From the diagrams received directly from testing devices, certain energy values explained in the paper were determined. The tests were done on servo-hydraulic testing machine INSTRON 1332 with hydraulic grips. Controller INSTRON FAST TRACK 80800 was used for collection and reduction of measured data.

Key words: Polymer-matrix composites, Specific energy absorption; Low velocity compression

INTRODUCTION

Composite materials are often used to reduce the weight of structures. In the automotive industry weight reduction is important because fuel consumption is directly related to vehicular weight. Government regulations requiring increased fuel efficiency are forcing the industry to examine new light weight materials for major structural components. In addition, there is an increased concern for occupant safety during roadway accidents. Though active devices such as front, side, and knee airbags, and pop-out devices may be one solution, using the passive capacity of the structure is also as attractive. Metals are currently used in car frames and integrated frame-body structures, and these and other metallic components are designed to passively absorb energy during

accidents. However, automotive manufacturers are moving toward nontraditional materials [1] and new structural material under consideration should be capable of participating in the energy absorption process associated with accidents. When studying energy absorption there are many important variables. These include material; manufacturing method; microstructure; geometry of specimen, including crush initiator used; and rate of crush. An important parameter when studying energy absorption, and one often used in the automotive industry, is the energy absorbed per unit mass of crushed material. This is often called the *specific energy absorption* (SEA) [2]. The SEA provides a measure of energy absorption efficiency of a structural component but, of course, says nothing about the efficiency of the structure in regards to other areas, such as resisting buckling, damping vibrations, or its ease of manufacture.

It is one of several parameters that must be considered in automotive design.

The subject of the paper [3] was investigation of the effect of interlaminar fracture toughness on the specific energy absorption of stitched glass/polyester composite cylindrical shells under axial compression. The laminated composite cylindrical shells used as energy absorbers, absorb large amount of impact energy during collision. Since delamination in the thin wall of axially collapsed shell is one of the major energy absorbing modes, contribution to specific energy absorption (SEA) of tubes is significant during collision.

The energy absorbing capability of fiber reinforcement polymer (FRP) composite cylindrical tubes used as energy absorbers, by destroying itself progressively, depends on the way in which the tube material is crushed i.e., trend of petalling [4]. This paper investigates the influence of fibre orientation and stacking sequence on the petal formation and specific energy absorption (SEA) of glass/polyester composite cylindrical shells under axial compression.

The effect of the processing conditions on the specific energy absorption capacity of composite tubes was investigated in [5]. Structures capable of absorbing large amounts of energy are of great interest, particularly in the automotive and aviation industries, in an effort to reduce the impact on passengers in the case of a collision. The energy absorption properties of composite materials can be tailored, thus making them an appealing option as a substitute of more traditional materials in applications where energy absorption is crucial. Tubes of circular and square cross sections were fabricated using orthophthalic polyester resin and plain weave E-glass fabric with fibers oriented at 0°/90°, with respect to the tube axis. Test specimens consisting of tube segments were prepared and tested under static compression load.

Very important factor in the study of energy absorption for energy management capabilities is the shape of the crush load vs. crush length graph. As the crushing begins, the load quickly rises to a peak value, then drops off slightly and stays relatively constant. In this way the energy absorption is maximized for the length of crushed material. One does not want the initial peak load (F_{imax}) to be much greater than the average crush load (F_a), because large loads would be needed to initiate crushing, and the goal in energy management is to absorb all the energy without imparting large forces to the people involved. One measure that is used to characterize the shape of the graph is called the *load ratio* [2]. The load ratio, which is defined as

$$Loadratio = \frac{F_{i\max}}{F_a} \tag{1}$$

is one metric that may be used as an important parameter for measuring crushing efficiency.

EXPERIMENTAL

The pipes of producer "Poliester" from Priboj were tested. The properties were given in official certificates of certain producers of components made of used glass-polyester pipes. The producers of reinforced glass fibers A.D. "OHIS" and "Vidoe Smilevski-Bato" from Gostivar-Macedonia by certificate confirm "E" glass with 1% of alkali (Tables 1 and 2). Thermo-reactive polyester resin was used as matrix, produced by "Color"-Medvode from Slovenia. Certificate was given for "COLPOLY 7510" for the type: UP/SOM which is highly reactive, low with viscose polyester with the basis of ortoftaly acid in standard glycol (Table 3).

Table 1. Structural components of "E" - glass

Structural component	Percentage (%)
Silicon(IV) oxide	52 - 56
Aluminum(III) oxide	12 - 16
Boron(III) oxide	5 - 10
Sodium(I) oxide, Potassium(I) oxide	0 - 2
Magnesium(II) oxide	0 - 5
Calcium(II) oxide	16 - 25
Titan(IV) oxide	0 - 1.5
Iron(III) oxide	0 - 0.8
Iron	0 - 1

Table 2. Physical properties of "E"-glass fiber

Properties		
Specific weight	g/cm^3	2.54
Tension strength	MPa	2400
Modulus of elasticity	GPa	73
Extension	%	3.3
Thermal extension	$10^{-6}\ K^{-1}$	5
Thermal installing	W/mK	1
Dielectrical constant	ξ	6.7
Specific electrical resistance	Ωcm	10^{14}
Moisture absorption at 20 °C	%	0.1

Table 3. Catalog properties of polyester resin

Properties		Specification
Appearance		Viscous yellow liquid
Density	g/cm^3	1.11–1.12
Viscosity at 25 ºC	mPas	220 – 320
Specific weight	g/cm^3	1.19-1.21
Tension strength	MPa	75 - 85
Modulus of elasticity	GPa	3.6
Extension	%	2 - 3
Impact toughness /Charpy/	10 - 15	KJ/m^2

The pipes were made by the method "Filament Winding", with angle of glass fibers reinforcement ±55°. Two samples of pipe were made, with outside diameter ∅70 mm and ∅50 mm. The specimens for tests (three specimens per each test) were cut from the samples of pipes (Table 4). The cut was done on machine type NC-2010 (Nr 95110, Ar 001) with diamond tip tools and at speeds which minimized heating of samples.

Table 4. The dimensions of tested samples

Specimen	Outside diameter D_1, mm	Inside diameter D_2, mm	Thickness t, mm	Length of the specimen L, mm	Volume V, mm^3	Load speed v, mm/min
T-70-1	70.9	63.8	3.55	128.3	4823.7	
T-70-2	71.1	63.9	3.6	126.9	5166.7	5
T-70-3	70.6	63.9	3.35	132.1	4657.4	
T-50-1	50.5	36.4	3.45	129.1	3215.9	
T-50-2	50.3	36.1	3.55	131.2	3540.2	1
T-50-3	49.9	36.3	3.4	127.3	3157.4	

Testing was done on servo-hydraulic testing machine INSTRON 1332 with controller INSTRON FAST TRACK 80800, with the usage of hydraulic jaws. The testing was defined by standard ASTM D 3039 [6, 7]. Loading was measured with a load cell of 100 kN capacity. Displacements were measured by double extensometer HOTTINGER DD1. The static specimen was placed on the stationary lower plate with the beveled end up. The cross-head was then lowered until the upper plate was just touching the specimen. The cross-head was then set into motion and the load and cross-head displacement were recorded for each test. The static setup test is shown by Fig. 1.

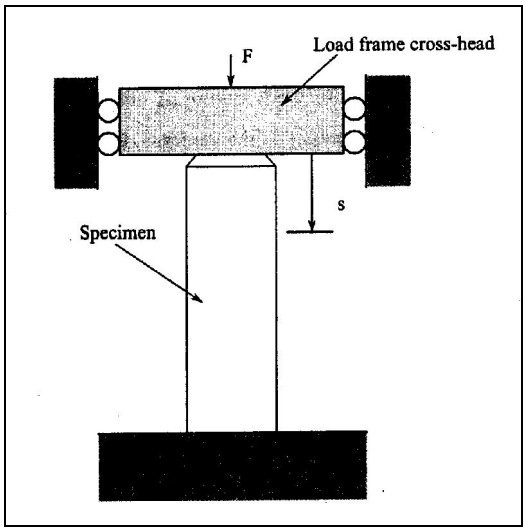

Figure 1. Schema of the static setup test

TEST RESULTS AND DISCUSSION

During the test the diagrams crush load – crush length (*F-s*) were plot, Fig. 2.

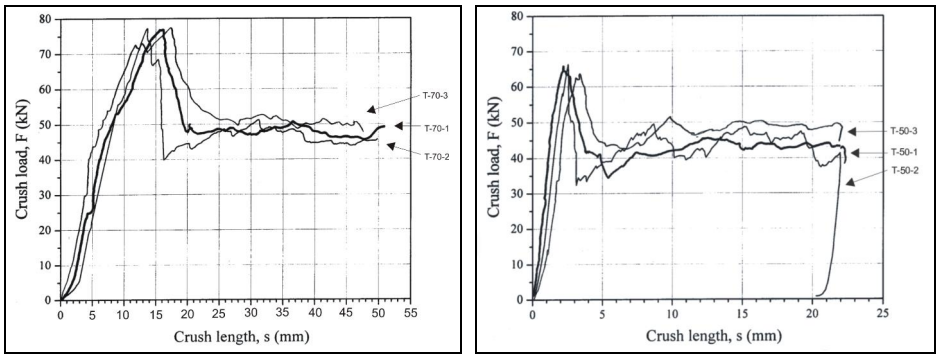

Figure 2. Crush load vs., crush length for static test
left - specimen 70 mm diameter (T-70); right – specimen 50 mm diameter (T-50)

The most important parameter that was from each crush test was the specific energy absorption (SEA). Energy is the product of the force and distance moved at the force level. The energy absorbed during crush, E, was calculated by integrating under the crush load vs. crush distance curve,

$$E = \int_0^{s_f} F \cdot ds \tag{2}$$

Where s_f is the final crush length.

The average crush force was calculated continuously as the tube was crushed, as follows:

$$F_a = \frac{\int_0^{s} F \cdot ds}{s} \tag{3}$$

In order to calculate the load ratio using Equation (1), the value of the crush load at the initial peak, F_{imax}, was divided by the average crush load,

$$Load\ ratio = \frac{F_{i\max}}{F_a} = \frac{F_{i\max}}{\dfrac{\int_0^{s} F \cdot ds}{s}} \tag{4}$$

To get the SEA, the energy absorbed during crush was divided by the mass of the

crushed material, m_c. The crushed mass was found by the following:

$$m_c = m_l \cdot s_f \tag{5}$$

Where m_l is the linear density or mass per unit length of the tube, (average value was 1250 g). The linear density was determined from the length and mass measurements from each specimen. Specific energy absorption is defined as:

$$SEL = \frac{E}{m_C} = \frac{\int_0^{S_f} Fds}{m_l \cdot s_f} \tag{6}$$

The experimental results are presented in Table 5. From Fig. 2 we obtained values of energy absorption during crash, crush length, and initial peek of load. Load radio was calculated from Equation 4 and specific energy absorption from Equation 6. Mass of the crushed material was obtained from Equation 5.

Table 5. Test results

Specimen	Initial peek load F_{imax}, kN	Average crush load F_a, kN	Crush length s, mm	Load ratio F_{imax}/F_a	Energy absorbed during crush E, J	Mass of the crushed material m_c, g	Specific energy absorption SEA, J/g
T-70-1	78	61	52	1.27	958.3	24	39.9
T-70-2	78	63	50	1.23	940.6	25	37.6
T-70-3	78	62	47	1.26	939.8	22	42.7
T-50-1	66	52	22.2	1.27	462.8	12.0	38.5
T-50-2	67	51	21.8	1.31	447.1	12.5	35.8
T-50-3	63	50	22.0	1.26	442.3	11.9	37.2

The valley-to-peak variations seen in the crush load vs. crush distance graphs varied. Overall, the T-70 specimens showed smaller valley-to-peak variations in the crushing load than did the T-50 specimens.

Average value of energy absorbed during crush was 946.2 J for the samples T-70 and 450.7 J for the samples T-50. Average specific energy absorption (SEA) was 40.1 J/g for the samples T-70 and 37.2 J/g for the samples T-50 and average load ratio 1.25, for the T-70 samples, and 1.28 for the T-50 samples.

Several different modes of fracture can be seen in Fig.3, taken from Sample T-70. The tube wall was torn, while the inner side wall was buckling to the interior of the tubes, and the external side was buckling to the outside. Between these two areas remained crumbled material that is likely to help the wall separate. Buckling was due to the stress increase in the undamaged part of the tube. After exceeding allowed stress, at the same time, cracks appeared in several places along the tube length, accompanied by acoustic effects. During the fragmentation small number of fibers along the tube were damaged, but there has been more significant damage in material matrix. Tear away parts of the wall that were in the forms of leaves remained undamaged.

Figure 3. Crush mode

Also, delamination occurred after the separation of interlaminar links. It was assumed that the separation of interlaminar links preceded large bending stress in the layers. In such a fracture pipe thickness was separated by a large number of individual layers. Rapid layering is further encouraged by breaking the matrix between the fibers that caused high stress concentration on the fiber-matrix connection. It was the place of first cracks. Cracks now developed along the axis of the pipe.

CONCLUSIONS

The aim of presented paper was to investigate the possibilities of application of glass polyester composite tubes as elements for depreciation or absorption of energy. The objective was to compare how the energy absorption characteristics were changed by varying circular cross-section area.

On the basis of the result obtained, it can be noted that as regards the energy absorbed during static loads it is better to use larger diameter pipes. Also, as mentioned in [2], a load ratio of less than 1.25 is desirable, which is the case in the sample T-70, that confirms the previous statement. Of course, the validity of these quantities must be questioned because of the large valley-to-peak variations and the non-distinct initial peaks. The high tow count material has proven that it can be effective in energy absorption, so further study is warranted. There are many interesting avenues to explore as a continuation of this work. First of all it is important to investigate dynamic impact crushing because the specimens tested statically tended to absorb more energy than those tested dynamically. Also dynamic specimens generally have higher load rations and crush modes are different.

REFERENCES

1. McConnell, V. P. ed. Automotive Composites: A Design and Manufacturing Guide, Ray Publishing, Wheat Ridge, CO, Vol. 1, 1997, pp. 6-7.
2. M. R. Schultz, "Energy Absorption Capacity of Graphite-Epoxy Composite Tubes", Master of science thesis, Virginia, (1998), pages 115.

3. S. Solaimurugan, R. Velmurugan, "Progressive crushing of stitched glass/polyester composite cylindrical shells", Composites Science and Technology 67 (2007) 422–437.
4. S. Solaimurugan, R. Velmurugan, "Influence of fibre orientation and stacking sequence on petalling of glass/polyester composite cylindrical shells under axial compression", International Journal of Solids and Structures 44 (2007) 6999–7020.
5. Jose Daniel D. Melo, Andre Luiz S. Silva, John Edward N. Villena, "The effect of processing conditions on the energy absorption capability of composite tubes", Composite Structures 82 (2008) 622–628.
6. Annual book of ASTM Standards, Vol.15.03, American Society for Testing and Materials, Philadelphia, PA. (1999).
7. ASTM D 3039-76, Standard Test Method for Tensile Properties of Fiber-Resin Composites, Annual Book of ASTM Standard, v 36, 1980, p. 734-739.

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BISORPTION AS A NEW „ECO-FRIENDLY" TECHNOLOGY FOR HEAVY METAL REMOVAL

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ABSTRACT

Biosorption of heavy metals by certain types of biomass is cost-effective and eco-friendly new alternative for the removal of heavy metals from wastewaters. Biosorption may be defined as the removal of substances from solution by biological material. Biosorbents, unlike mono functional ion exchange resins, contains variety of functional sites. This paper presents an overview of trends in biosorption and application of biosorbents for removing the heavy metals from wastewater. For developing countries with large quantities of biomass, biosorption technology creates the possibility of developing efficient and cheap materials for pollutant removal, as well as the possibility of opening new markets.

Key words: biosorption, biosorbent, heavy metals

INTRODUCTION

The contamination of water with heavy metals from various industrial sources is a problem of global concern. Almost all heavy metals are toxic even in trace amounts, non - biodegradable, non termodegradable and they can accumulate along the food chain causing a number of serious environmental and health problems [1,2].

Methods for removing metal ions from aqueous solution mainly consist of physical, chemical and biological technologies. Conventional methods for removing metal ions from wastewaters have been proposed, such as: chemical precipitation, filtration, ion exchange, electrochemical treatment, membrane technologies, adsorption on activated carbon, evaporation etc. [3]. Major problems some of these methods are high sludge production, handling and disposal problems, high cost, technical constrains etc. During the 1970s the increasing awareness and concern about the environment motivated research for new efficient technologies that would be capable of treating inexpensively wastewaters polluted by metals. This search brought biosorption/adsorption to the foreground of scientific interest for the design of novel wastewater treatment process [4]. Continuing increases in published research on biosorption is shown in the figure 1 below.

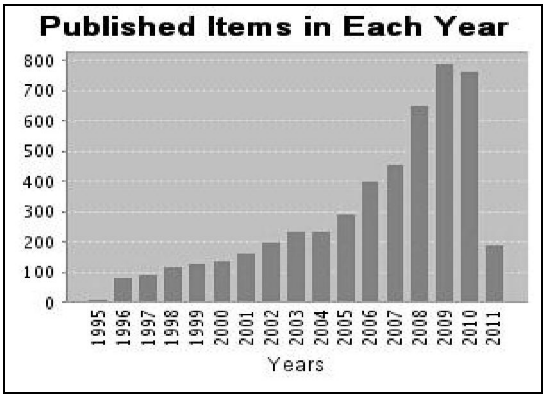

Figure 1. Numbers of papers appearing with 'biosorption' in the topic as listed in the ISI Web of Science database for (1970–2011) (out of a total of 5040 articles appearing: database searched 7.3.2011.).

Biosorption is an emerging and attractive method which involves sorption of dissolved substances by a biomaterial. In addition, the main advantages of this technique can be ordered as follows: the reusability of biomaterial, low operating cost, improved selectivity for specific metals of interest, removal of heavy metals from effluent irrespective of toxicity, short operation time, and no production of secondary compounds [5].

BIOSORPTION

Biosorption can be defined as the removal of selected ions or other molecules from solution by certain biomolecules (or types of biomass) [6].

The 'bio' prefix indicates the involvement of a biological entity, i.e. living organism, component or product produced or derived from a living organism, like in other terms: biotechnology, bioengineering, and bioprocessing. Combinations of 'bio' to a physico-chemical expression like 'sorption' also denotes the involvement of living organisms but doesn't necessarily mean that the 'sorption' process is somehow different to sorption in abiotic systems [7]. Cost-effective sorbents – biosorbents can be defined as materials which are abundant in nature or can be found as a by-product or waste from industry, and which normally don't require pre-processing [8].

For the development of the biosorption process for metal removal there could be identified two trends. One trend is to use hybrid technology for pollutants removal, mainly using living cells. Another trend is to develop the commercial biosorbents using immobilization technology, and to improve the biosorption process including regeneration/reuse creating the biosorbents just like a sort of ion exchange resin [3].

The physical and chemical characteristics of biosorbents are important for understanding the metal binding mechanism on the biomass surface. The characterization of the structure and surface chemistry of the biosorbent is of substantial interest for the development of adsorption and separation processes. There are chemical active sites in the biomass (biosorbents) that are responsible for sequesting metals from surrounding solution.

Table 1. Major binding groups for biosorption [6]

Binding group	Structural formula	pKa	HSAB classif.	Ligand atom	Occurrence in selected biomolecules
Hydroxyl	–OH	9.5-13	Hard	O	PS, UA, SPS, AA
Carbonyl	>C=O	-	Hard	O	Peptide bond
Carboxyl	–C=O | OH	1.7-4.7	Hard	O	UA, AA
Sulfhydryl	-SH	8.3-10.8	Soft	S	AA
Sulfonate	O || –S=O || O	1.3	Hard	O	SPS
Thioether	>S	-	Soft	S	AA
Amine	$-NH_2$	8-11	Int.	N	Cto, AA
Secondary amine	>NH	13	Int.	N	Cti, PG, peptide bond
amide	–C=O | NH2	-	Int.	N	AA
Imine	=NH	11.6-12.6	Int.	N	AA
Imidiazole	–C-N-H || >CH H-C-N	6.0	Soft	N	AA
Phosphonate	OH | –P=O | OH	0.9-2.1	Hard	O	PL
Phosphodiester	>P=O | OH	1.5	Hard	O	TA, LPS

PS - polysaccharides; UA - uronic acids; SPS - sulfated PS; Cto - chitosan; PG - peptidoglycan; AA - amino acids; TA - teichoic acid; PL - phospholipids; LPS - lipoPS.

Depending on the nature of the biosorbents, a variety of techniques are useful for this purpose, e. g., titration, Fourier Transform Infra-Red (FTIR) spectroscopy, X-ray Photo Electron Spectroscopy (XPS), Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD), Energy Dispersive X-ray (EDX) fluorescence spectrophotometry, nuclear magnetic resonance (NMR), etc [3,8]. The most important of active sites with relevant structural formula, pKa, HSAB classification, ligand atom, as well as occurrence in selected biomolecules are presented in Table 1. [6].

Mechanisms responsible for biosorption, may be one or combination of ion exchange, complexation, coordination, adsorption, electrostatic interaction, chelation and microprecipitation (Veglio and Beolchini, 1997;

Factors which have influence on the biosorption performance are [9]:

- co-existing cations (heavy metals, potassium, ammonium, magnesium);
- co-existing anions (nitrate, sulfate, thiosulfate, chloride, fluoride);
- sorbent type and amount;
- pH of the solution;
- contact time
- temperature

Selection of the appropriate metal for biosorption can be done by [6]

- metal toxicity (direct health threat);
- metal costs (recovery interests);
- how representative the metal may be in terms of its behavior (scientific studies)

Equilibrium modeling of biosorption

Equilibrium isotherm models are usually classified into the empirical equations and the mechanistic models. The mechanistic models are based on mechanism of metal ion biosorption, which are able not only to represent but also to explain and predict the experimental behavior [10].

Some empirical models for single solute systems are: Langmuir model (L type, based on monolayer adsorption of solute), Freundlich model (F type, developed for heterogeneous surfaces) BET model, Sips, Redlich–Peterson, Radke–Prausnitz, distribution coefficients model etc. Real wastewaters commonly contain a mixture of metal ions. Therefore, multi-metal biosorption models have been developed, and some of them are: Langmuir (multi-component), combined Langmuir–Freundlich, competitive Redlich–Peterson model, IAST: Ideal Adsorbed Solution Theory etc [3,11].

Kinetic modeling of biosorption in a batch system

Numerous kinetic models have been suggested to describe the reaction order of adsorption systems based on solution concentration. The first-order equation of Lagergren and the pseudo second-order equation are the most widely used kinetic models to describe the biosorption process [3].

Biosorbent selection and assessment

Removal of heavy metals using agricultural waste, industrial by-bioproduct and natural materials of biological origin including algae, fungi, yeasts, bacteria and fungi has been extensively investigated because of the availability in large quantities and low prices. Some of them are: wool, sawdust, wood waste (leaves, pine needles, moss ...), aquatic weeds, seeds, bark (from the stems of various plants), husk (from the processing of grains: wheat, rice, corn, and other stone fruit : walnut, hazelnut, almond, coconut ...), waste from breweries, distillery sludge, tea factory waste, residues from food industries (fruit juice production, processing of seafood: crab shells; sugar beet pulp, olive pits), etc [11].

Pretreatment and modification of biomass using physical or chemical methods such as boiling, drying, autoclaving, mechanical disruption and alkali treatment can be performed with the aim of enhancing the capability and efficiency of biomass adsorption. The effect of pretreatments on the biosorption capability of biomass varies largely according to the biomass and chosen heavy metal ions [3,7,8].

The selection of appropriate bisorbent can be made on the basis of: equilibrium isotherm, diffusion rate and from the viewpoint of practical application, availability and price. The costs of biosorbent preparation must also be taken into account [3].

In the comparison of ion exchange and biosorption processes, the following hold [6]:

- The same equipment (i.e. pipes, columns, etc.) can be used with both (a given treatment installation can be interchangeably used with both types of sorbents).
- According to all estimates, biosorbents can be at least an order of magnitude cheaper (1/10).
- Only a shorter life cycle can be assumed for biosorbents.

Viewed as a water treatment process, biosorption allows significant cost savings in comparison with existing competing technology, i.e. ion exchange, its closest rival; in terms of its technical performance, operational qualities and chemical properties, the technology can be more effective in many cases than ion exchange

CONCLUSION

Biosorption needs a multidisciplinary approach from the point of chemical, microbiological and process engineering, and allows a wider range of remediation techniques in relation to the ion exchange. The most compelling reasons for using biosorption technology, based on renewable or waste raw materials, are that it is effective and inexpensive. That certainly guarantees the possibility of easily opening new markets [6]. The advantages of biosorption are: low cost, high efficiency, minimize the occurrence of chemical and / or biological sludge, removal of heavy metals from effluent irrespective of toxicity, short operation time, and no production of secondary compounds, possibilities for metal recovery and biosorbent regeneration. For developing countries with large quantities of biomass, biosorption technology creates the possibility of developing efficient and cheap materials for heavy metal removal from waste waters.

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REFERENCES

1. Sharma, R.K., Agrawal, M. and Marshall, F. (2007). Heavy metal contamination of soil and vegetables in suburban areas of Varanasi, India, Ecotoxicology and Environmental Safety, 66**,** 258–266.

2. Qaiser S., Saleemi, A.R. and Umar, M. (2009). Biosorption of lead from aqueous solution by Ficus religiosa leaves: batch and column study, Journal of Hazardous materials, 166, 998–1005.
3. Wang, J., and Chen, C. (2009). Biosorbents for heavy metals removal and their future. Biotechnology Advances, 27, 195–226.
4. Ramachandra, T.V., Ahaya, N. and Kanamandi, R.D. Ces technical report – 110 biosorption : techniques and mechanisms http://www.ces.iisc.ernet.in/biodiversity/pubs/ces_tr/TR110/index.
5. Munagapati, V.S., Yarramuthi, V, Nadavala, SK, Alla, SR and Abburi K, (2010). Biosorption of Cu(II), Cd(II) and Pb(II) by Acacia leucocephala bark powder: Kinetics, equilibrium and thermodynamics, Chemical Engineering Journal, 157, 357–365
6. Volesky, B. (2007) Biosorption and me, Water Research, 41, 4017-4029.
7. Gadd, G.M. (2009). Biosorption: critical review of scientific rationale, environmental importance and significance for pollution treatment. J. Chem. Technol. Biotechnol. 84, 13–28.
8. Arief, V.O., Trilestari, K., Sunarso, J., Indraswati, N., & Ismadji, S. (2008). Recent Progress on Biosorption of Heavy Metals from Liquids Using Low Cost Biosorbents: Characterization, Biosorption Parameters and Mechanism Studies, Clean, 36(12), 937–962.
9. Gavrilescu, M., Pavel, L.V. and Cretescu, I. (2009). Characterization and remediation of soils contaminated with uranium, Journal of Hazardous Materials, 163, 475–510.
10. Volesky, B. (2003). Biosorption process simulation tools, Hydrometallurgy, 71, 179–190.
11. Febrianto, J., Kosasih, A.N., Sunarso, J., Ju, Y.H., Indraswati, N. and Ismadji, S. (2009). Equilibrium and kinetic studies in adsorption of heavy metals using biosorbent: A summary of recent studies, Journal of Hazardous Materials 162, 616–645.

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ECOLOGICALS ASPECTS OF APPLICATION OF HYDRAULIC SHOVEL ON BLASTING REDUCTION AT THE PIT MINE RMU BANOVICI

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ABSTRACT

Costs of production are decreased and there is noted positive ecological effects with application hydraulic shovels for digging and loading of waste and coal on the pit mines RMU "Banovići". Statistical analysis of data taken form department of monitoring all production process it was determined that costs of drilling and blasting are significant decreased. It was increased geometry of blasting (burden and spacing), decreased specific consumption of explosives, initial tools, emission of gases, seismic effects of blasting, airblast, noise etc.

Key words: explosives, blasting, hydraulic shovel, specific costs

INTRODUCTION

There is deposit of black coal Black Pit Mine "Banovici" d.d. Banovici in north-east Bosnia and Herzegovina in canton Tuzla and it is one of the biggest deposit of coal in Bosnia and Herzegovina. Annual production of mine is about 1,5 million t of separated coal, which is distributed for industry, ample consumption and about 10.-12. millions m^3_{bcm} of an overburden (waste material). According to public report, Black coal mine is only one which has financial profit in the last five years. Developing and renovation of high-production equipments are on the first place and have special attention. For the last five years it was purchased new loading, transporting and auxiliary equipment which are used for modernization of high-production fleet. Black coal mine Banovici uses modern technologies (shovels) with system of guidance mobile hydraulic, mechanised charging of boreholes with special vehicle for production of explosives on the site of application (MMU), satellite monitoring of vehicles and video monitoring in technological process [1]. Achievement of production isn't possible without using of drilling and blasting works. All those works need significantly financial resources. Because of that, there is need for optimisation of technology for drilling and blasting works on the pit mines at black coal mine Banovici [2,3]. With that optimisation it could be achieving bigger utilization and efficiency of haulage equipments as possibility of rationalisation crusher facility what can

make ability of economic excusable production and better ecological aspects of application all those equipment [4].

BASIC EQUIPMENT AND DESCRIPTION OF PRODUCTION PROCESS

System of surface mining present sequence of performing work on the overburden, ore and other processes which are used for obtaining of projected capacity of the pit mine[5,6]. Exploration performs with next working process: drilling, blasting, hauling and loading of the overburden and the coal and delaying of waste material[7]. The coal, after loading out from the pit, are crashed and transported with railway to a separation plant. For exploration on the pit mines they use discontinues complex with shovels and rigid trucks. Black coal mine "Banovići" use basic equipment for obtaining black coal like shovel and rigid truck. For digging of mass it is in use rope shovels, dragline and hydraulic shovel.

On the pit mines of black coal mine Banovici work next equipments:

- Classic rope bucket shovels: one MARION 201 bucket size 20,6 m^3, two PH1900 Al bucket size 9,15 m^3 and two EKG8i bucket size 8 m^3.
- Dragline: three MARION 7200 bucket size 3,8 m^3 and one MARION 7400 bucket size 9,15 m^3
- Hydraulic bucket shovel: two TEREX RH-120 bucket size 15 m^3 and one LIEBHERR 9350 bucket size 18 m^3
- Rigid trucks: thirteen Belaz 75 316 payloads 136 t, five TEREX MT 3600 B payloads 155,4 t, two WABCO (170D) payloads 155,4 t, two Unit Rig (Mark 36) payloads 155,4 t and two FAUN K-100 payloads 90,7 t

Apart from basic on the pit mine Banovici there are large numbers auxiliary equipments such as graders, bulldozers, wheel loaders, etc.

REASONS OF USAGE HYDRAULIC BUCKET SHOVEL

Because of appraisal favourable and affirmatives effect at work of hydraulic shovel in conditions of black coal mine Banovici it was purchased hydraulic shovel TEREX RH120 in April 2006., TEREX RH120 in December 2007. and LIEBHERR 9350 in 2010. and those are:

- decreasing minimal and increasing maximal radius of digging with shovel (decreasing number of shovel removal, easier digging and better cleaning slope of bench and bench plane),
- significantly increasing of depth digging under level of position shovel (possibility of construction descending ramp on lower bench),
- improving of process digging with optimal angle of digging in concrete conditions, increasing of filling bucket, easier loading of big parts of the rock,
- possibility of digging without blasting,
- capability of horizontal embedment of bucket in rock's mass (selective digging and detachment of layers by contacts) and
- better conditions for loading of transportation equipments [5,2,4,6].

PERFORMING OF DRILLING-BLASTING WORKS

Blast design must be progressively improved to optimise mining operations and costs [3,8]. Optimum designs help to produce the required fragmentation, muckpille looseness, muckpille profile, toe conditions and grade control. Also, blast designs must minimise flyrock and control ground vibrations and air vibrations [8-10]. For drilling are in use rotary drilling set type Gryphon-5c and Hausher HBM 120. Blasthole patterns and them depth is determined depend on type of shovel and bench high. Operating experience and blast modelling results, have shown that in massive rocks, better fragmentation and productivity are obtained with staggered patterns than with either square or rectangular patterns[11]. On the open pit mines in Banovići, for strength rocks (strength marls) it is in use staggered patterns and for plastic marls it is in use square blasthole patterns. Blasting of the waste can be set with 3-4 rows of boreholes, depth 15 m, diameters 110-115 mm and angle 70° [1]. Longterm analysis of drilling and blasting parameters are showed that with increasing of depth of drilling linear increased powder factor and specific costs of drilling and blasting. Because of that specialised equipment and tools are required to safely and effectively mix and charge explosives in surface mines.

With this technique of charge is accomplished [8-11]:

- decreasing of costs for drilling and blasting,
- decreasing a need for workers at drilling and blasting,
- increasing of working conditions in process of preparation the rock for loading and
- favorable parameters of drilling (bigger averaged amount blasted materials by m' blasthole), that make possibility decreasing of investment in equipment for drilling.

Blasting coal and waste on the pit mines RMU "Banovici" performed with combination of plastic and powdery explosives 20:80% in wet boreholes and 30:70% at patron charge[1]. The powdery and emulsion explosives are used for mobile mechanized charging (MMU – mobile manufacturing units) and initiation can be performed with primary explosives with strong initial impulse and busters. It is important to note that there are special protective measures because of objects which are near to zone of blasting (pit mines). Technical characteristics of explosives are presented in table 1.

Table 1. Characteristics of explosives

Characteristic	BOHEX 1	NNEX-1	NNEX-VS	Austrogel	Perunit
Density (kg/l)	0,8 – 0,9	0,8 – 0,9	1,25-1,35	1,5	1,35
Volume of gases (l/kg)	1039	1039	1058	891	815
Velocity of detonation (m/s)	3622-3742	3200-3400	5650-5050	6000	6000
Energy of explosives (kJ/kg)	3787	3784	3315	4520	4563
Temperature of explosion (ºC)	2064	2530	2030	-	-
Balance of oxygen %			balanced	4	+0,85

ANALYSIS OF MEASURED RESULTS

For adequate analysis are collected and calculated data for period from 2006. to 2010. For all pit mines RMU Banovici. Data per years are presented via tables and graphs. Data are related to powder factor, mined and loaded masses (Table 2), planed and realized costs for different types of explosives and tools (table 3), specific costs at manual charging of blasthole (Table 4) and specific costs of charging with mobile manufacturing units – MMU (Table 5)

Table 2. Mined mass, loaded mass and loaded without blasting, powder factor per year

Year	Mined mass (bcm)	Loaded mass (bcm)	Loaded without blasting (bcm)	Powder factor (kg/bcm)
2006.	7418032	11583278	4165246	0,208
2007.	7179769	10505273	3325504	0,184
2008.	7441433	12121059	4679626	0,168
2009.	4998012	11406997	6408985	0,183
2010.	3626494	11233662	7607168	0,168

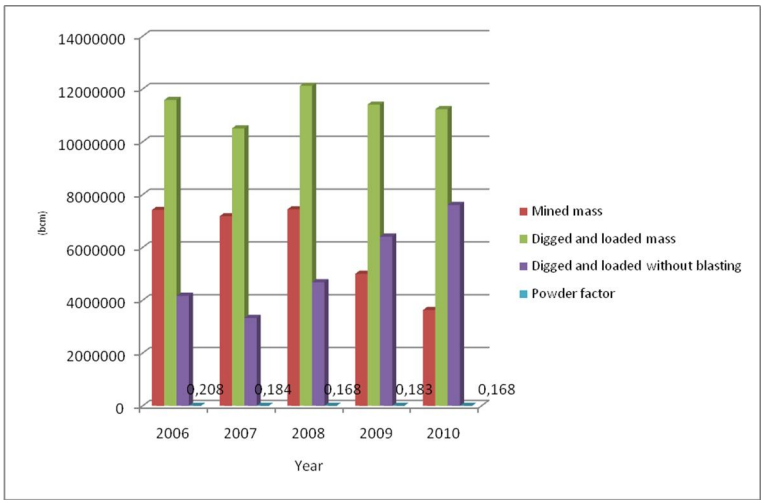

Figure 1. Review of mined and loaded masses vs. powder factor per years

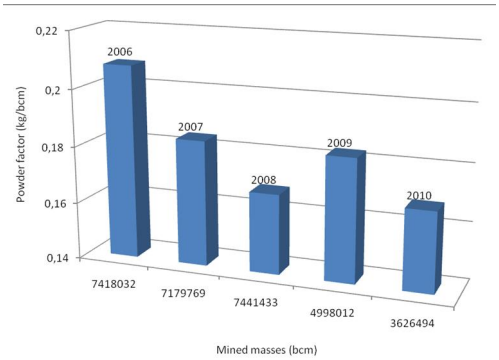

Figure 2. Powder factor vs. mined masses

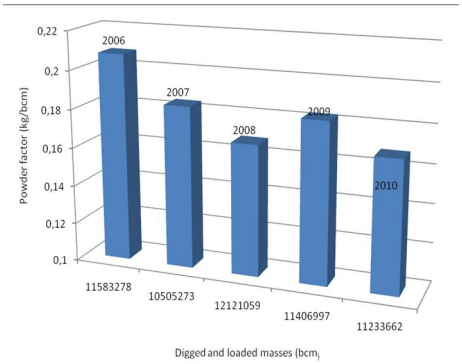

Figure 3. Powder factor vs. loaded masses

As can be seen on the graphics 2 and 3 using hydraulic shovel for digging and loading masses on the pit mines RMU Banovici are important reduced blasted masses, powder factor, consumption explosives and explosives tools.

Table 3. Planed and realized costs per year

Type of explosive and tools	Planed and realized costs (€) per year									
	2006.		2007.		2008.		2009.		2010.	
	planed	realized	planed	realized	planed	realized	planed	realized	planed	realized
Plastic explosive	254954,9	126024,4	254954,9	72148,5	244181,0	53491,5	195247,2	33448,7	33034,9	14371,8
Anfo explosive	971257,4	667163,1	971257,4	607790,8	972340,5	566178,5	777487,2	311427,2	437714,9	173371,3
Emulsion explosive	-	-	-	-	5128,2	22417,4	30769,2	124753,8	355127,2	125048,2
Nonel detonator	19743,6	17654,4	26153,8	14158,5	26108,7	14373,8	21477,9	9212,3	13008,7	6851,3
Nonel connector	17769,2	11322,6	23538,5	11363,6	20887,2	12587,7	17182,1	8484,6	12728,7	5910,8
Delay	48172,3	2818,5	17403,1	436,4	17934,9	103,6	11467,2	162,6	12307,7	1025,6
Safety fuse	2977,9	3530,8	3573,3	1232,8	3581,0	1686,2	2866,7	779,5	535,4	1425,1
Plain det. No. 8	2977,9	3530,8	3573,3	1232,8	3581,0	1686,2	2866,7	779,5	535,4	1233,8
Detonating cord	174760,0	28282,1	63221,5	14205,1	64930,3	3794,9	41739,5	3230,8	45128,2	8846,2

Difference in planed and realized costs per year explosives and explosives tools showed in table 3.

Table 4. Specific costs at manual charging of blasthole

Shovel	Specific costs at manual charging of blasthole (€/bcm)									
	COAL					OVERBURDEN				
	Drilling	Explosive	Initiating tools	Worker costs	Total	Drilling	Explosive	Initiating tools	Worker costs	Total
M 201	-	-	-	-	-	0,10205	0,15333	0,02974	0,01641	0,30154
RH 120	-	-	-	-	-	0,06359	0,08923	0,0159	0,01026	0,17949
EKG 8i	0,09897	0,13077	0,02769	0,01333	0,27077	0,1041	0,14769	0,02667	0,0159	0,29436
PH 1900Al	0,08615	0,12923	0,01128	0,01282	0,23949	0,09795	0,1359	0,02615	0,01487	0,27487
Dragline	0,12103	0,16051	0,04103	0,01487	0,33744	0,1241	0,16256	0,0359	0,0159	0,33846
TOTAL	0,30615	0,42051	0,08	0,04103	0,84769	0,49179	0,68872	0,13436	0,07333	1,38872

Table 5. Specific costs of charging with mobile manufacturing units

Shovel	Specific costs of charging with mobile manufacturing units (€/bcm)									
	COAL					OVERBURDEN				
	Drilling	Explosive	Initiating tools	Worker costs	Total	Drilling	Explosive	Initiating tools	Worker costs	Total
M 201	-	-	-	-	-	0,06462	0,14923	0,02	0,00718	0,24103
RH 120	-	-	-	-	-	0,05949	0,12359	0,02256	0,00513	0,21077
EKG 8i	-	-	-	-	-	0,06256	0,14308	0,02513	0,00564	0,23641
PH 1900Al	0,07385	0,23795	0,02923	0,00821	0,34923	-	-	-	-	-
Dragline	0,09538	0,32359	0,03744	0,01077	0,46718	-	-	-	-	-
TOTAL	0,16923	0,56154	0,06667	0,01897	0,81641	0,18667	0,4159	0,06769	0,01795	0,68821

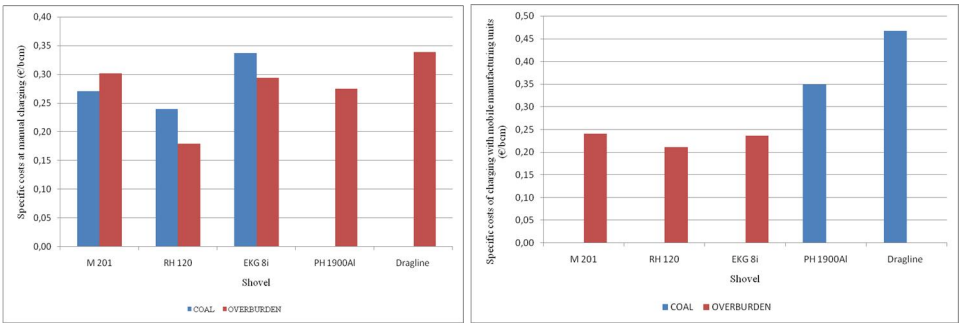

Figure 4. Total specific costs at manual charging (a) and with MMU (b) of blasthole

Total specific costs at MMU charging of blastholes are significant less then with manual charging what are presented in table 5 and figure 4 (a) and (b) for getting of coal and waste.

CONCLUSION

On the base of presented it is evident that with using hydraulic bucket shovels for digging and loading as mobile manufacturing units for charging of blasthole gives numerous advantages in production process at RMU "Banovici" in Banovici. There are noted less requests on prepare of rock mass for digging and loading, masses are blasted with less powder factor what for consequence has achieving reliability function of production process and decreasing costs of productions. Emissions of harmful gases are minimized proportional with decreasing amount of the explosives. Also, there is need for emphasize attenuated share detonating cord, which is replaced with NONEL system of initiating. Energy that is occurring as product of explosive blasting is complete utilized, decreased number of blast field per year and attenuated seismic effects on residential area in neighborhood of the open pit mines. The size of the ground vibrations depends on:

- quantity of co-operating charges,
- the constriction of the blast,
- the characteristics of the rock mass,
- the distance from the blasting site,
- the geology of the surrounding ground and etc.

Properly executed blasts, where surface explosives are adequately covered and borehole charges are adequately confined, are not likely to produce harmful levels of airblast and noise. Every blast generates some amount of dust and gases. The amounts of dust generated by blasting do not present a serious problem. Other phases of the mining operation such as loading, hauling, crushing, and processing produce considerably more dust than blasting on the pit mine RMU Banovici. At least, safety and protection of employees are elevated on highest level, accomplished safer, easier and human work.

REFERENCES

1. Project documentation RMU "Banovići", d.d. Banovići
2. Kukić, M.; Čergić, M.; Halilbegović, V.; Nurić, S.: Tehnološki parametri procesa bušenja i miniranja otkrivke na površinskim kopovima RMU «Banovići» u Banovićima. Rudarski radovi 2/2005, Pg. 52-59, Institut za bakar, Bor, 2005.
3. Nurić, S.; Nurić, A.; Knežiček, T.; Klopić, M.; Halilbegović, V.; Haračić, E.: Ekonomski parametri bušenja i miniranja otkrivke na površinskim kopovima RMU Banovići, Rudarski radovi 1/2006, Pg. 31-36, Institut za bakar Bor, Bor, 2006.
4. Nurić, S.: Kamionski transport u površinskoj eksploataciji, Tuzla, 2009.
5. Kennedy, B.: Surface Mining 2nd edition, Society for Mining, Metallurgy and Exploration, Inc. Littleton, Colorado, 1990
6. Popović, N.: Naučne osnove projektovanja površinskih kopova, NIŠRO 'Oslobođenje', Sarajevo, 1984
7. Hustrulid, W.; Kuchta, M.: Open pit mine, planning & design, A.A.Balkema, Rotterdam, 1995
8. Purtić, N.: Bušenje i miniranje, Rudarsko-geološki fakultet, Beograd, 1991.
9. Kričak, L.: Seizmika miniranja, Rudarsko-geološki fakultet, Beograd, 2006.
10. Olofsson, S.: Applied explosives technology for construction and mining, Applex, Arla, Sweden, 1990.
11. Safe and efficient blasting in open cut mines – technical services, Orica Australia Pty Ltd. 1998.

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ORGANIC MATTER, AN INDICATOR OF DEGRADATION PROCESSES IN SOIL

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ABSTRACT

Following the content of organic matter (OM) in the soil represents the best indicator of big number of physics, chemistry and biology processes in the soil, because the condition of humus is an indicator of quality of soil at first in the producing conditions. The content of OM from the sample fields under the wheat and corn, which are in 35 years long monoculture non fertilized or fertilized by different doses of mineral fertilizers (2 variants) quite changed, became worse, related to start values before establishing the experiments, how in the frame of culture system, such as in variety of fertilizing.

Key words: smonitza, organic matter (OM), monoculture, wheat, corn

INTRODUCTION

Smonitza, as a potentially fertile soil for its nutrient content is one of our best land, very suitable for growing wheat, corn, sunflower, alfalfa and other crops. However, monoculture system of growing crops has very adverse effects on soil properties, growth and development of plants which decreases active (Sokolovsky) and economic (Kauričev and Rozov) fertility of cultural soil (Boguslawski) expressed through the size of crop yields [1].

Many authors [2, 3] emphasize a high stability of humic components, as the most important characteristics of smonitza, owing to the highmolecular, easycoagulating humic acids. Extent of mentioned resistance can best be understood by the fact that smonitzas retained their typical humus over a millions of years. If one takes into account the fact that the smonizas humus has plenty of bitumen as one of the main ingredients of sapropel, it is quite clear the origin of its high resistance to the mineralization. Prolonged use of smonitza under monoculture, in spite of the prominent facts relating to the stability of humus, disturbs already established dynamic equilibrium of formation and decomposition of humus. Perturbation of dynamic equilibrium causes rapid decomposition of organic matter, and therefore to the loss of the content and changes of humus composition in smonitza. Carbon content in the first 35 years of cultivation under monoculture rapidly

decreases, but then the downturn trend becomes much lower [4, 5]. Through the years of content research as well as the composition and properties of humus in the different types of soil, the state of humus is defined as one of the most important indicators of soil quality especially in the manufacturing conditions [6].

RESULTS AND DISCUSSION

Before the experiment, in 1965. detailed investigations of smonitza carried out, which was the starting point for determining the changes of chemical properties caused by the long termed exploitation of land under the monoculture.

Smonitza from the experimental field was characterized by average content of humus (4-6%) in the Ahp-horizon to 20 cm. According to classification of Grišina and Orlova, at a depth below 20 cm, content of humus was low, ranging within the 2-4%. Profile distribution of humus profile to the depth of one meter in smonitza was 5:01 to 4:33 - 3.63 - 3.13 - 2.72 - 2.63%, which according to the aforementioned classification was a gradual reduction of humus content.

Content of the humus was determined using the method of bichromate by Tjurin, in the modification of Simak. Lowest content of humus after a 35 year-old trial was found on experimental plots under monoculture corn smonitza (unfertilized), where at the surface layers (0-10 cm) its content was only 2.39%. It is noticeable that the content of humus gradually decreases at depth zone of 10-40 cm, while at the following 40-60 cm depth it decreases slightly more prominent, reaching a very low content of humus between 1:51 to 1:54%. Wheat cultivated in the monoculture under the same conditions had less negative impact on soil and content of humus in relation to the culture of corn, because the reduction of specified parameter compared to the initial value was between 45-60%. The relative ratio of wheat and corn from non fertilized experimental fields in the content of humus, in Ahp-horizon (to the depth of 20 cm) was in favour of wheat by 10-15%, while at the 20-60 cm depth ratio was for the same percentage in favour of corn.

The reduction of organic matter in smonitza soils comes from deterioration of chemical soil properties caused by long-term (64 years) growing of wheat in the conditions of monoculture, whilst first 20 years faster, but later a much slower [7, 8]. Dalal said that after 30 years of continuous growing of corn carbon content rapidly decreased from 4.22 t / ha at the beginning to 7.4 t / ha, while for wheat this reduction was significantly lower and amounted 14.3 t / ha.

Fertilization of corn with medium and a stronger dose of NPK-fertilizers caused small increase of humus content in smonitza over unfertilized variant to the depth of 20 cm.

The humus content of corn which was fertilized with the highest doses in the defined soil profile depth of 0-10, 10-20, 20-40, 40-60 cm, was 2.45-2.53-2.29-1.51%, respectivelly. Fertilization with a slightly lower amounts of NPK-fertilizer, wasn't to a large extent affected to the change in the content of smonizas humus compared to a more fertilized variant. To the same information, regarding the influence of growing monoculture of corn under different systems of fertilization to change in the humus content, authors came at the experimental stations around the world (Loss-Braunerde of Bonn, Lauchstädt of Halle, Askow et al.) [9, 10]. Thus, in Germany at the experimental field in Halle carbon content from 2:41 % after 80 years of the experiment under corn

decreased to the 1.14% C for unfertilized and to the 1.26% C for variant fertilized with NPK-fertilizer. On the experimental field in Missouri after the 100-year of continuous cultivation of corn, contents of C on the unfertilized plots was 0.58%, on fertilized with NPK-fertilizer 1.1% and fertilized with manure (6t/ha) 1.3%.

Content of humus in soil was reduced for at least 30% to 60% over the entire soil profile for wheat which was most intensively fertilized in the past. Decrease was recorded in the variants with slightly lower amounts of fertilizer, compared to the default content of humus in soil, and in relation to the previous results for 1-5%.

Essays from the Soviet Union, showed that mineral fertilizers can act favorably on the content of organic matter and could to some extent to increase their the content. This is a consequence of enhanced microbial activity which breaks down the remains of plant roots. In the soil which wasn't fertilized with mineral fertilizer, microorganisms are forced to destroy the organic matter in order to obtain an required food. In following the participation of different cultures of wheat, soybean on the land some authors [6] have gone much further, because they track the dynamics of CO2 creation in soil, stating that the land under the wheat produced more CO2 (16.5 kg CO2-C/ha / day) than plots under soybean (8.6 kg CO2-C/ha per day). Textural class of soils plays an important role in the formation and the maintenance of organic matter. Fine and medium fine texture of soil enables the high level of organic matter maintenance and reduces the possibility of sudden, negative changes [11].

Much more accurate indicators for the comparison of emerging changes initiated by growing wheat and corn in monoculture, compared to the humus content in them, expressed as a percentage of the mass of absolutely dry soil, and also a better assessment of the character and intensity of development emerging biological processes in soil, are their stocks given in Tues / ha (Figure 1). Mentioned data in a Figure 1., about stocks (reserves) of humus before establishing assay reflected in a surface profile of Ahp-horizon (0-20 cm) were in medium (125 t / ha) level of provision smonitza with humus. Stocks of humus in a deeper parts of the profile slowly decreases, so that in the Ah layer of 20-40 cm was 103 t / ha, in the layer of 40-60 cm was 91 t / ha, which summarized for the Ah-horizon to the depth of 60 cm was 319 t / ha.

Stocks of humus in the surface layer of Ah-horizon for wheat, which was fertilized in the most intense period of monoculture cultivation, were reduced for 1:45 times compared to the initial values and with a depth this ratio increases up to 2:08 times, which represents a decrease of the 20.5 up to 47 t / ha of humus. Medium fertilization rates of wheat has brought the reduction of stocks of smonitzas humus in ranges as in the previous variants. Smonitza under wheat, unfertilized variant, showed a substantial decrease of humus stocks along the soil profile, which ranges from 1.74 up to 2.25 times, compared to the initial value in tons per hectare amounts to 28-50.5.

In the process of cultivating a wide tillage cultures that requires a row treatment, comes to the changes in hydrothermal regime and increase of soil aeration, which is accompanied by intensified microbial activity and decomposition of humus, mostly in the surface plowing horizon [12]. This conclusion confirms presented data indicating that the supply of humus (t / ha) in smonitza are drastically decreased in the surface probes up to 20 cm depth compared to baseline with a very little variation in terms of a different cultural practices which are related to the introduction of NPK-fertilizers.

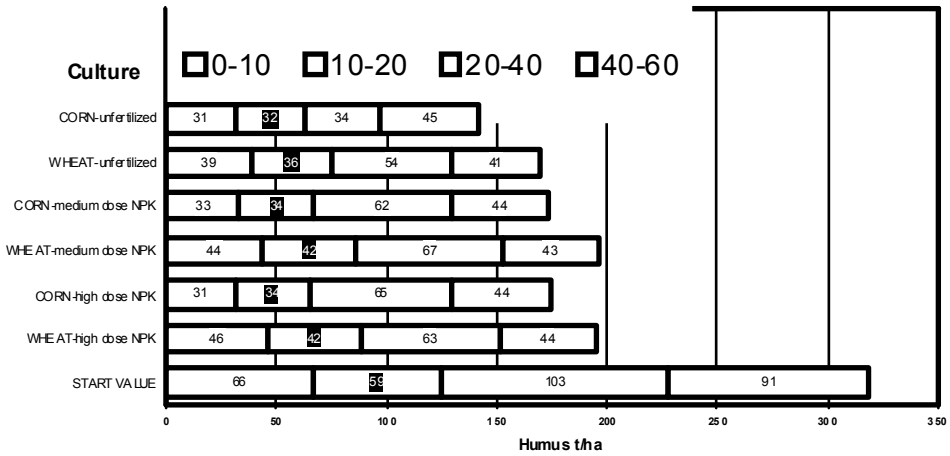

Figure 1. Stocks of humus, t / ha

The ratio of humus stocks, between crops of wheat and corn in all the variants (unfertilized, fertilized) are on side of the wheat for the 25-45% in the Ahp-horizon, and 8-48% at a depth of 20-40 cm, while at a depth of 40-60 cm slight advantage in the stock are on side of corn, 2-7% (Figure 1). Experiments from the United States, have shown that there have been significant changes in stock of humus at a depth of 0-20 cm after a 30-year-old growing of wheat and corn in monoculture because the reserves of humus from the initial 23 t / ha decreased at 14.4 t / ha for the wheat and 8.3 t / ha for the corn [1]. Organization dealing with the assessment of land resources, in its report from 2004. in the journal „Agroecosystem„ displayed the average stock of humus to the soil depth of the 100 cm for Europe, which amounted to 146 t / ha, while stocks of humus in West Asia and North America was significantly less and amounted only 71 t / ha, simultaneously showing the alarming trend of reducing the humus stocks in last fifty years. Study of organic matter content in the Europe [13] points out the disturbing fact that the intensity of reduction in OM has reached alarming proportions underlining the necessity for the measures to increase them.

Investigations in the Soviet Union showed that the results of human activity or the use of different systems of growing crops, besides other changes in species composition and characteristics of soil, often have smaller or larger amendments in the amount and the composition-quality of humus.

CONCLUSION

Generally, the task of future agriculture is to learn to regulate a level of organic matter and its quality, in order to avoid fatigue of soil and to gain larger biological productivity of land territory which is necessary for the solution of three key problems of humanity, energetic, nutritional and environmental.

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REFERENCES

1. Russell E. W. (1982): Soil conditions and plant growth, tenth edition, Longam-London and New York.
2. Manuševa L. (1964): Karakter koloida u smonicama Makedonije, Arhiv za poljoprivredne nauke, god. XIV, sv. 43, Beograd
3. Dalal R. C. and Mayer R. J. (1986): Long-term trends in fertility of soils under continuous cultivation and cereal cropping in southern Queensland 1. Overall changes in soil properties and trends in winter cereal yields. Aust. J. Soil. Sci. Res. Vol. 24, pp 265-279.
4. Webb B. B., Tucker B. B. and Westerman R. L. (1980): The Magruder Plots: Taming the prairies through research. Agricultural Experimental Station, Oklahoma State Univ.
5. Bowman R.A., Reeder J.D and Laber R.W. (1990): Changes in soil properties in central plains rangeland soil after 3, 20 and 60 years of cultivation. Soil Science 153, pp 237-241.
6. Franzluebbers A. J, Hons F. M, Zuberer D. A. (1995): Tillage and crop effects on seasonal dynamics of soil CO2 evolution, water content, temperature, and bulk density. Applied Soil Ecology 2, pp 95-109.
7. Dalal R.C. (1992): Long-term trends in total nitrogen of a Vertisol subjected to zero-tillage, nitrogen application and stubble retention, Austr. J. Soil Science, Vol 30, pp 223-231.
8. Christensen B. T. and A.E. Johnston (1997): Soil organic matter and soil quality-Lessons learned from long-term experiments at Askov and Rothamsted, pp 399-430. In: E.G. and M.R. Carter (eds.). Soil Quality for Crop Production and Ecosystem Health. Elsevier, Amsterdam.
9. So H.B., Cook G.D., Dalal R.C. (1988): Structural degradation of vertisols associated with continuous cultivation, ISTRO, pp 123-128, Edinburge.
10. Bowman R.A., Vigil M.F., Nielsen D.C. and Anderson R.L. (1999): Soil organic matter changes in intenively cropped dryland system, Soil Science Society of America Journal, Vol. 63, Issue 1, pp. 186-191.
11. Hassink J. (1994): Effects of soil texture and grassland management on soil organic C and N and rates of C and N mineralization. Soil Biol. Biochem. Vol. 26, pp 1573-1581.
12. Lal R., Mahboubi A. A. and Fausey N.R. (1994): Long-term tillage and rotation effects on properties of a central Ohio Soil. Soil Sci.Soc.Am.J., Vol. 58, No 2, pp 517-552
13. Powlson D. A., Smith P., Coleman K., Smith Jo U., Glendining M.J., Korschens M. and Franko U. (1998): A European network of long-term sites for studies on soil organic matter, Soil and Tillage Research, Vol 47, No 3-4, pp. 271-282.

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REMOVAL OF COPPER IONS FROM AQUEOUS SOLUTIONS BY ADSORPTION ON NATURAL ZEOLITE

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ABSTRACT

Adsorption of heavy metal ions on the solid adsorbent is a process that allows the environmental protection against wastewaters produced in mining and industry. Copper ions removal from synthetic aqueous solutions was performed using natural zeolite-clinoptilolite.

The adsorption is strongly affected on process time, pH of the solution, stirring rate but less on particles size of the adsorbent. The adsorption kinetics of copper ions on zeolite is fast reaching equilibrium for 20 minutes. A degree of adsorption greater than 65 % has been achieved for copper ions.

Key words: natural zeolite, copper ions, adsorption, adsorption kinetics, adsorption isotherms

INTRODUCTION

Mining and industrial wastes are the primary sources of heavy metal contamination in soil and waters. The presence of toxic pollutants in wastewaters is a threat to the environment and human health.

Acid mine drainages (AMDs) from active and closed mines of the Mining and Smelting Co. Bor, Serbia, containing significant concentration of heavy metals such as copper, zinc, lead, iron, nickel, manganese and sulfuric acid, pollute surrounding water streams. Some of these waters are from underground mines, waters collected at the bottom of open pits in Bor, Veliki Krivelj and Cerovo and from flotation tailing dumps. Type and the amount of dissolved metal ions are directly correlated with the nature of mine deposit. The acidity of such waters is slightly increased having the pH value between 3 and 4. Chemical analysis showed that the concentration of copper ions in these waters is sometimes up to 1 g/dm^3.

Legislature in developed countries prevents uncontrolled discharge of wastewaters into natural recipients. If the problem of mine waters legislation is considering on an European level, it is possible to see a different approaches in resolving of this problem. Namely, only United Kingdom, Czech Republic and Austrian legislature explicitly treats the problem of mine waters and their impact on environmental pollution [1,2]. In the other European countries (Germany, Hungary, and some others), the mine

waters problem is incorporated and defined in the frame of laws relating to mining and water managing and protection, or has not encompassed by law regulations at all. In the current Law on Mining of Republic of Serbia, waters are mentioned in general, not as AMDs or mine waters, but in context of sweet waters protection at mining activities [3]. In Water Law, mine waters, as a serious surface waters pollutant, are not mentioned. With this law, only main terms are defined as well as limiting values of pollutants emission, politics of water flows and resources protection; polluter's duties; particularly in regards of duties concerning water quality control prior their releasing into natural recipients [4].

Numerous processes and techniques are available for metal ions removal and water purification from effluents like AMDs. Heavy metal ions can be removed from effluent solutions, more or less effectively by commercial technologies such as precipitation, cementation, neutralization or electrowinning. Some other technologies such as solvent extraction, adsorption, ion exchange, as well as reverse osmosis or advanced membrane technologies are already in industrial use or under consideration for selective removal of heavy metal ions from wastewaters.

Sorption processes are particularly convenient for metal removal from diluted solutions such as waste- and mine waters. Usages of inexpensive natural materials as sorbents for heavy metal ions such as: peat, lignite, anthracite, fly ash, bentonite, clay [5, 6], natural zeolite [7-9] or biomasses [10] are under consideration.

Zeolites are natural silicate minerals. Their capability to exchange cations, significant adsorption capacity and selectivity are the properties, for heavy metals removal from wastewaters.

The aim of the study was to investigate the ability of natural zeolite as a sorbent for copper ions removal. Synthetic single ion aqueous solutions of copper ions were used in the experiments. The influence of zeolite fraction size, initial pH of the solution and cation concentration on the adsorption properties, such as capacity and degree of adsorption are investigated.

EXPERIMENTAL

Materials and methods

Natural zeolite from the deposit "Igroš", Kopaonik, Serbia, was used in the experiments as adsorbent for copper ions removal from synthetic aqueous solutions. The sample was firstly grinded, then sieved and the fractions :(-1.0+0.8) mm; (-0.8+0.63) mm; (-0.63+0.4) mm and (-0.4+0.0) mm were used for the experiments.

Composition of the sample, determined by chemical, microscopic, X-ray (XRPD) and thermal (DTA) analysis, showed that the sample consists of zeolites, with the main mineral clinoptilolite. It is also determined, by further analysis of the zeolite, that the dominant ion, in the exchangeable position, is Ca^{2+} (90.0 meq/100 g), followed by K^{+} (16.0 meq/100g), Mg^{2+} (4.00 meq/100g) and Na^{+} (3.0 meq / 100g). The total capacity of the cation, defined as a sum of the contents of exchangeable cations, is 113.00 meq/100g.

The chemical composition of natural zeolite is shown in Table 1.

Table 1. Chemical composition of the zeolite

Component	**SiO_2**	**Al_2O_3**	**Fe_2O_3**	**CaO**	**MgO**	**Na_2O**	**K_2O**	**I.L.**
Assay (%)	61,62	12,05	2,02	5,44	1,37	1,00	0,82	15,00
Component	**Si/Al**		**$Na^+/(Na^+ + K^+)$**			**$Ca^{2+}/(Ca^{2+} + Mg^{2+})$**		
Assay (%)	4,42		0,51			0,86		

Synthetic copper ion solutions, used in the experiments, were prepared by dissolving the weighted amount of copper sulphate ($CuSO_4 \cdot 5H_2O$) in 1000 cm^3 of distilled water. Adjustment of solutions pH were performed by adding sulfuric acid and controlled by pH-meter. All chemicals used in the experiments were of analytical grade.

Procedure

Solutions containing 0.025; 0.05; 0.1; 0.25; 0.5 and 1.0 g/dm^3 of copper ions were used in the experiments. The suspensions were formed by adding 50 cm^3 of solution and 1 g of zeolite sample into series of beakers each equipped with magnetic stirrer and agitated at 300 rpm for different process time in an interval between 1 and 120 minutes. At the end of predetermined time, the suspension was filtered and remaining concentration of copper in the aqueous phase was determined by UV/VIS spectrophotometry. The final pH of the solution was measured too. All experiments were carried out at ambient temperature.

Adsorption parameters, such as: particle size of adsorbent, initial pH of the solution and the initial concentration were varied during the experiments.

The amount of adsorbed copper ions on the clinoptilolite in the batch mode experiments is then calculated using the following mass-balance equation:

$$q_e \cdot m = V \cdot (C_0 - C_e) \tag{1}$$

Where q_e is the final metal uptake on the adsorbent, $(mg \cdot g^{-1})$; C_0 is the initial concentration of metal ions, $(g \cdot dm^{-3})$; C_e is the equilibrium metal ion concentration, $(g \cdot dm^{-3})$; V is the volume of the solution, (dm^3); m is the mass of adsorbent, (g).
The adsorption degree (AD%) of metal ions could be expressed as:

$$AD(\%) = \left(1 - \frac{C_e}{C_0}\right) \cdot 100 \tag{2}$$

RESULTS AND DISCUSSION

Adsorption kinetic experiments

The adsorption kinetics describes the reaction to reach the equilibrium between the aqueous and the solid phase. Series of experiments were performed with an initial metal concentration of 0.2 $g \cdot dm^{-3}$ and initial solution pH of 3.5. The pH was monitored during the experiment but no buffer solutions were added in order to avoid an

introduction of foreign ions and their influence on the adsorption. The adsorption kinetics of copper on natural zeolite assumed as pseudo-second order reaction. The metal uptake against time is presented in Fig. 1.

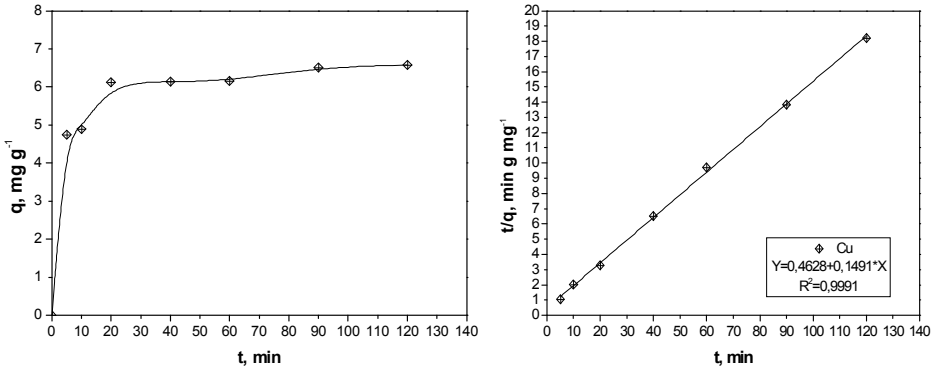

Figure 1. Adsorption capacity vs. process time: particles size (-0.63+0.4) mm; initial pH=3.5; initial Cu^{2+}ion concentration C_0=0.2 g·dm^{-3}

Based on the experimental results, presented on Fig. 1 (left), copper adsorption mostly occurs in the first 20 minutes of the process time. Sudden increase of q at the beginning of the process is in relation with available active sites on internal and external surface area of the adsorbent. In the second step process comes into slower phase in which less accessible sites of the adsorbent are occupied by copper ions. The process time was chosen to be 90 min for further experiments.

Experimental data obtained from kinetic experiments were modeled by using pseudo-second order reaction model, expressed as [11, 12]:

$$\frac{dq(t)}{dt} = K_a \cdot \left[q_e - q(t)\right]^2 \tag{3}$$

Integration of Eq. (3) for boundary conditions (q=0 for t=0 and q(t) =q_e for dq(t)/dt=0) and rearranging it leads to a linear form, as:

$$\frac{t}{q(t)} = \frac{1}{K_a \cdot q_e^2} + \frac{t}{q_e} \tag{4}$$

The plot on Fig. 1 (right), shows a very good fitting with the pseudo-second order reaction, now given in linearized form. The regression coefficient is close to unity, confirming the previous assumption about the reaction order.

Effect of particle size

Influence of particle size on copper ion adsorption was studied in the series of experiments by using zeolite from 0.2 to 1.0 mm. Experimental data plotted in Fig. 2, show the relation between adsorption capacity and particles size of the adsorbent, represented through mean particles diameter of treated zeolite samples.

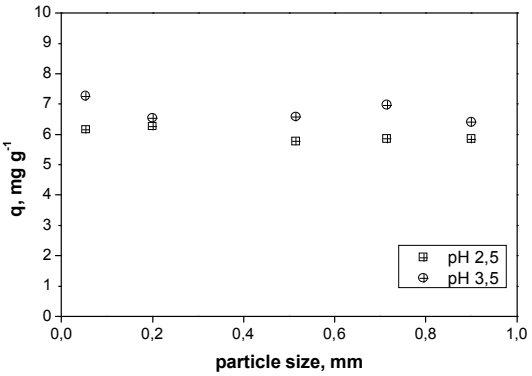

Figure 2. Effect of particle size on the adsorption capacity: initial copper concentration C_0=0.2g·dm^{-3}; stirring rate 300 rpm; adsorption time 90 min

It is obvious that adsorption capacity does not show significant variation as a function of the particle size. This is due to the porous structure of zeolite enabling sufficient active sites on the surface and easy penetration of aqueous phase inside the particles structure.

Effect of initial pH

The initial pH of aqueous phase as one of the major parameters affecting the adsorption of heavy metal ions has previously been reported in literature [7,10,13].

In order to study (to determine) the influence of initial pH value on the adsorption of copper ions onto natural zeolite, a series of experiments were performed. The initial concentration of copper ions as well as the other adsorption parameters like stirring rate, mass of zeolite, particle size and adsorption time were kept constant, varying only the initial pH. Experimental results are plotted in Fig. 3, showing a relationship between the adsorption degree and the pH.

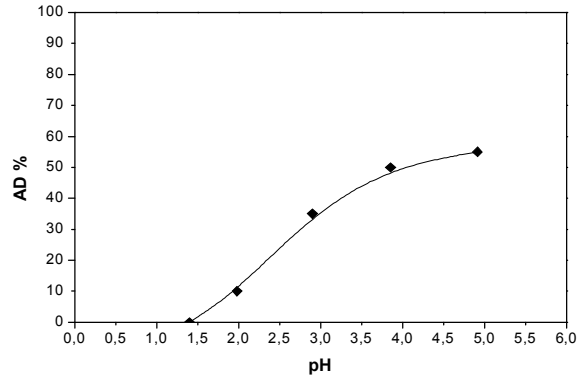

Figure 3. Effect of initial pH value of aqueous phase on adsorption degree: initial copper ions concentration C_0=0.2 g·dm^{-3}; stirring rate 300 rpm; adsorption time 90 min; particle size (-0.4+0) mm

A variation in aqueous phase iInitial pH value of aqueous phase strongly affects the adsorption degree of natural zeolite. Adsorption degree decreases at higher solution acidity, getting almost negligible at pH lower than 1.5. Decrease in the adsorption degree at lower pH values is due to a higher concentration of H^+ ions, which are predominantly adsorbed on the active sites of clinoptilolite. Decreasing of the aqueous phase acidity lowers the concentration of H^+ ions which favors the adsorption of metal ions. Desorption of copper from loaded zeolite, renewing it for a next adsorption cycle can be achieved by means of more acidic solutions (pH < 2), what is important in designing and managing of the adsorption process.

Adsorption isotherms

Adsorption isotherm obtained for copper ion removal by natural zeolites in the terms of Langmuir`s model was expressed mathematically, by the following equation [8,9]:

$$q_e = \frac{q_m \cdot K_l \cdot C_e}{1 + K_l \cdot C_e} \tag{5}$$

or, after linearization, in the following form:

$$\frac{C_e}{q_e} = \frac{1}{K_l \cdot q_m} + \frac{1}{q_m} \cdot C_e \tag{6}$$

where K_l is the Langmuir`s equilibrium constant and q_m is the amount of metal ions required to form monolayer on the adsorbent surface ($mg \cdot g^{-1}$).

Distribution of metal ions between aqueous and solid phase at equilibrium is of a great importance for determining maximal adsorption capacity of adsorbent for certain metal ion specie.

Based on data obtained in a series of experiments, a graphical relationship between adsorption capacity and copper ion concentration is plotted in Fig. 4 (left) and in linearized form (right). The adsorption isotherm parameters, evaluated by using Langmuir model, are presented in Table 2.

Table 2. Equilibrium parameters obtained from linearized form of adsorption isotherm

Metal	K_l ($dm^3 \cdot mg^{-1}$)	q_m ($mg \cdot g^{-1}$)	R^2
Copper	18.40	7.77	0.971

Fig. 4 shows that the adsorption capacity increases with concentration of copper ions. The maximal adsorption capacity, based on Langmuir model, under given experimental conditions, is 7.77 $mg \cdot g^{-1}$ with satisfactorily high correlation coefficient (R^2=0.971).

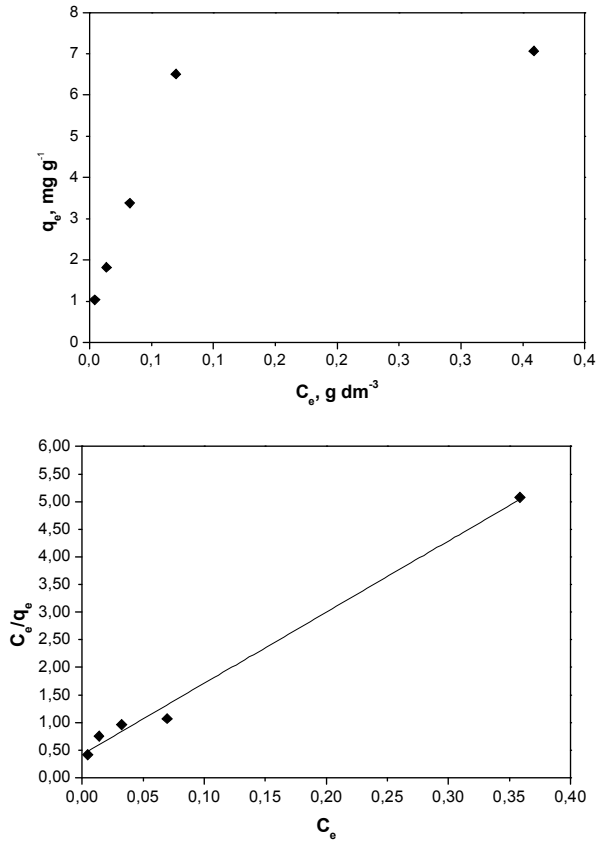

Figure 4. Adsorption isotherm of copper ions on natural zeolite: sieve fraction particle size (-0.63+0.4) mm; initial solution pH=3.5; stirring rate 300 rpm; adsorption time 90 min

CONCLUSIONS

The natural zeolite-clinoptilolitefrom deposit "Igroš", Kopaonik, Serbia appears to be a promising adsorbent for copper ions removal from diluted aqueous solutions such as AMDs and wastewaters.

After adsorbent characterization, some of parameters affecting the adsorption of copper ions such as: particle size of zeolite, initial pH of aqueous phase, initial concentration of metal ions, contact time between phases, etc. were considered. The obtained experimental results can be summarized as follows:

- The adsorption kinetics is fast in first 20 minutes after the contact between phases is established. The kinetics can be fairly described by the pseudo-second order kinetics model.

- The effect of grain size fractions is not pronounced for natural zeolite from deposit "Igroš".The adsorption process does not depend on the grain size of the adsorbent.
- Adsorption degree and initial pH value of aqueous phase is strongly correlated. Adsorption rate decreases significantly in more acidic solutions. At lower pH values, copper adsorption is negligible due to a favorable adsorption of hydrogen ions whose concentration is importantly higher than the concentration of copper ions.
- For a single metal ion system, as shown through this study, the adsorption equilibrium data can be satisfactorily modeled by Langmuir adsorption isotherm. The highest adsorption capacity of copper ions onto natural zeolite, under given experimental conditions, was determined and it is 7.77 $mg \cdot g^{-1}$.

Acknowledgement

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REFERENCES

1. Management Of Mining, Quarrying And Ore-Processing Waste In The European Union,Study made for DG Environment, European Commission, 2001
2. Centar za okolišno održivi razvoj BiH, ″Rudničke vode i okoliš″, Sarajevo, 2004.
3. Zakon o rudarstvu, Sl.glasnik Republike Srbije, br.44/95.
4. Zakon o vodama, Sl.glasnik Republike Srbije, br.30/10.
5. Bailey, S.E.; Olin, T.J.; Adrian, R.D.; Bricka,M. A Review of Potentially Low-cost Sorbents for Heavy Metals. Water Research 2009, 33(11), 2469–2479.
6. Volesky, B.; Holan,Z.R. Biosorption of Heavy Metals.Biotechnology Proggress 1995,11, 235–250.
7. 7.Wang, S.; Peng. Y. Natural zeolites as effective adsorbent in water and wastewater treatment. Chemical Engineering Journal 2010, 156, 11-24.
8. Erdem, E.; Karapinar, N., Donat, R. The removal of havy metal cations by natural zeolites.Journal of Colloid and Interface Science 2004, 280, 309-314.
9. Oren, A.H.; Kaya, A. Factor affecting adsorption characteristics on two natural zeolites. Journal of Hazardous Materials 2006, 31, 59-65.
10. Božić, D.; Stanković, V.; Gorgievski M.; Bogdanović, G.; Kovačević, R. Adsorption of Heavy Metal Ions By Sawdust of Deciduous Trees. Journal of Hazardous Materials 2009, 171, 684-692.
11. Stanković, V: Fenomeni prenosa i operacije u metalurgiji. Tehnički fakultet, Bor, 1998.
12. Molecular Seievs Science and Technology. Adsorption and Diffusion. Karge, H.G.; Weitkamp (Editors), Springer-Verlag Berlin Heidelberg 2008.
13. Motsi,T.; Rowson, N.A.; Simmons, M.J.H.; Adsorption of heavy metals from acid mine drainage by natural zeolite, Int.J.Miner.Process 92 (2009) 117-121.

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CLEAN AND ENVIRONMENTALLY SUSTAINABLE COPPER PRODUCTION

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ABSTRACT

Faced with a fast degradation of the environment as well as the exploitation of natural resources, people want to make an influence on their future and decide to put their heads together demanding the further economic and industrial development be in accordance with to Sustainable development. The basic idea of Sustainable development is to satisfy the needs of today's generations, without endangering possibilities of future generations to satisfy their own. The strategy for Sustainable development in the mining industry is being reduced to permanent, long-term reduction of consuming primary metals reserves, with the constant increase of the recycling metal production. The intent is to equalize the production with consumption.

Traditional mineral processing technologies are being applied in the environmental field for cleanup and recycling processes. This paper presents examples of ways by which crushing and grinding, sizing, magnetic separation, electric separation, gravity and flotation concentration have been effectively used in waste recycling technology - example for cleaner production of copper.

Key words: Sustainable development, cleaner production, mineral processing

INTRODUCTION

Natural resources have always been the common good and natural wealth. Their usage, economic activities and economic evaluation should be planned and controlled carefully.

Regardless the type, structure and particular quantities, they are the base for the future economic and business development of every country, and Serbia too. It is quite logical that there is part of natural resources which must stay away from any economic and business flows, which in fact, must be saved for today's and future generations, and it is particularly true for those resources which are hard to renew and those nonrenewable resources.

The approach to natural resources must cover the definition of the politics and strategies for their sustained usage, as well as the definition of the legislative acts for the sake of their effective implementation.

Natural resources usually mean all the matters that come out from the Earth-soil, plants, animals, water, oil, metals and so on. All we eat, use or buy

present either the natural resource or something that have come out of it. Natural resources are all around us, and due to the increased needs, we consume them very quickly. A lot of natural resources are being exhausted faster than they can be replaced by new ones.

For that reason, we must pay attention to the fact that some of these resources will be completely exhausted if we do not reduce their consumption, as it is a great problem because the living beings on the Earth depend on these resources.

A SHORT HISTORY OF THE CLEANER PRODUCTION

With the development of human civilization on the Earth which has caused the population to increase, the negative influences of human being on the environment also increase. The problems, which were the causes of human carelessness, appeared even in the classical period. The problems usually mentioned relate to the erosions caused by the excessive felling of trees, as well as water pollution by heavy metals exploited in mines. However, all these problems were of local character or regional kind. Such a state lasted up to the industrial revolution. The beginning of the twentieth century has become the turning point with the appearance of the globalization of ecological problems and more intensive degradation of human environment as well. The former approaches to these problems were avoided, and they could be grouped into three categories:

- **Make it dirty and run away** – this approach was typical for the places with a small number of inhabitants and it consisted of population migrations caused by the degradation of the surrounding (most commonly due to the cultivable soil degradation).
- **Dilute and disperse** – this was one of the ways how to control waste in the pre-industrial period based on the natural capacity of self-cleaning.
- **Concentrate and keep** – for some time, it was considered a good method of controlling the waste on the ground, that is, for controlling dumping of toxic and nuclear waste. However, due to the destroying of containers and/or the mere control, it was impossible to guarantee a long-term dumping without a leaking process.

Since 1960s up to now, it has become clear that the strategy "dilute and disperse" has not been efficient any longer in the current fight against the "dotted" sources of polluting. That is why the new technology and business have been based on the introduction of the cleaning-up process at the end of the production process or the so called "end-of-pipe" treatment. Although it really is efficient to a certain level, this approach "end-of-pipe" treatment has not been the real "solution".

The end-of-pipe treatment has got its waste product such as slurry, which must be deposited or burnt, and that presents a new dimension of polluting the human environment which is unpredictable.

It was only in the last 10-15 years that experts got an idea that the reduction of harmful element emission should be done at the source of their presence. This

strategy of preventing pollution and minimizing waste was really necessary in order to reduce the enormous expenses for cleaning up, especially from the moment when the legal system introduced the regulation: "the polluter pays".

This new approach, called "cleaner production", is promising as it unites both ecology and business sides of the problem.

SUSTAINED DEVELOPMENT

The generally accepted definition of sustained development is the one which created the Brundthland's commission:

"The sustained development is the development which satisfies the needs of today's generation without jeopardizing the rights of future generations to satisfy their needs".

The main goal of the sustained development is to provide the future generations with as much possibilities as we have had so far. One of the key issues of its sustainability is the awareness of the fact that the natural and material resources on our planet are limited. The cleaner production presents the goal which perfectly fit into the efforts leading to the sustained development.

The experiences of America and other countries show that, from the long-term point of view the pollution prevention by introducing the cleaner production as well as minimizing the waste, has been more sustained, more profitable and more acceptable ecologically than the traditional pollution control. The initial efforts on controlling the industrial (urban) pollution were focused on treating at the end of the process and in most cases, they were not only expensive but unsustainable as well.

The strategy of sustained development in the field of exploiting mineral raw materials, leads towards a permanent and long-term reduction of using the primary mineral reserves accompanied at the same time by a permanent increase of metal (mineral) production out of the recycling process, leading up to the "final" goal, that is, to equalize it with its usage.

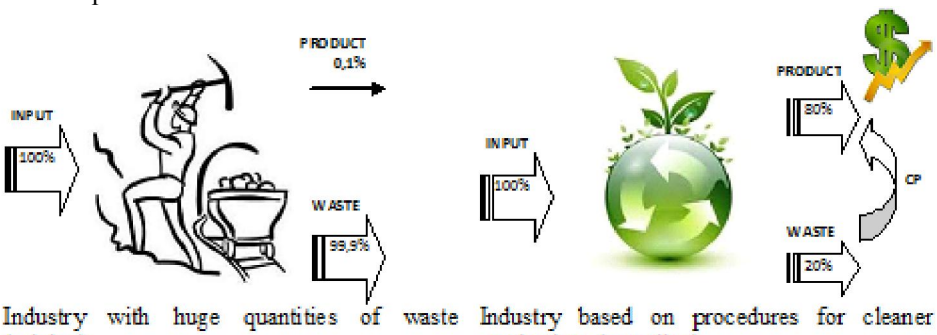
THE CONCEPT AND DEFINITION OF CLEANER PRODUCTION

The concept of cleaner production is based on new methods which are supposed to be cleaner, to consume much less energy and not to produce harmful waste products. The aim of this approach is to satisfy human needs without jeopardizing human lives or the wholeness of the ecological system we depend on. The cleaner production is, in fact, a preventive approach. The main aim of the cleaner production is to focus on the prevention or reduction the quantity of waste, as well as the non-efficient usage of energy and resources. In order to achieve all these issues, it is necessary to adopt new technologies and techniques, together with new values and ways for satisfying needs of mankind. Besides, this new approach should be applied to the production process, consumption and supplying goods and services in order to get the same or higher production rate with much less energy and resources consumption.

UNEP has defined the cleaner production in the following way: "The cleaner production is a conceptual and procedural approach to the production which requires that all phases of life cycle of products should be so processed that it is possible to achieve the main goal: to achieve prevention or minimization of short and long-term risks for people and their environment".

In fact, the cleaner production can be explained as:

- Reduction of the quantity of produced waste, or avoidance of its production at all,
- More efficient usage of energy and resources,
- Production of ecologically acceptable products and services,
- Achieving less quantities of produced waste, lower prices and higher profit.



Industry with huge quantities of waste (mining) Industry based on procedures for cleaner production (recycling)

EXAMPLE OF CLEANER PRODUCTION

Mineral resources belong to the group of non-renewable resources. These are exhaustive resources and that is why it is necessary to use them rationally, that is, to save them. The proper way to do it nowadays can be achieved by recycling, substitution and import.

For example, in Bor, the average copper content in the ore amounts to around 0,25%. For the production of one tone of cathodic copper, some 999 tones of dangerous waste have been produced.

The usage of mineral resources causes a dangerous environmental pollution and it is usually accompanied by the following issues:

- High soil degradation
- High air pollution
- High pollution of surface and underground water
- High quantities of solid and liquid waste
- High quantities of waste waters

Copper can also be obtained from secondary raw materials, for example, from electronic waste. The average copper content in printed circuit boards amounts to around 9,7%. The content of precious metals is also higher in these printed boards (Ag~0,06%, Au~0,023%, Pd~0,01%) in relation to their content in mineral raw

materials, consequently all of these facts point to the economical importance of recycling.

As an IC board contains a high copper concentration, it can be directly sent to the plant for smelting without any previous treatment. However, by smelting process it is not possible to obtain plastics and ceramics, which are present with some 30% in the printed circuit boards and which, during the melting process, cause the formation of dioxine and fuaran which pollute air and have a negative influence on the environment. If these materials are extracted in some other pretreatment (by a mechanical procedure), they can be applied in the civil-engineering industry. For the pretreatment of printed circuit board (IC) there are the whole series of different technological processes, but the things that are of special interest for processing engineers are that the majority of them are based on the procedures and technologies of ore-dressing. By means of these processes, it is possible to achieve the metal recovery of 80%. A great variety of materials, which are used in electric production, have a direct influence on the complexity of technologies of the mechanic recycling of these products. The mere technology of the mechanic recycling can be devided into two unities, and these are:

- Communitation and
- Separation of integrated materials

The first step in recycling the printed circuit boards is communition. Communition has been mainly performed into several phases. The equipment that is used for communition is based on cutting and crushing the raw material and, in fact, these are universal cutters (granulators) and impact crushers of various designs (hammer mills). The transport of raw materials between the phases of communition, has been carried out by pneumatic pipelines, and each device for communition has got the dust separator and it is of particular importance thanks to its dust harmfulness. If we want the recycling technology to be successful, the communition process must provide the highest possible free movement of materials.

Separation of integral materials of electronic devices is a very complex and complicated industrial process. A great number of various materials and elements, which are used in producing electronic devices, of ten require the combination of different separation methods.

The most common separation methods in the recycling process of electronic devices-printed circuit boards-are:

- Magnetic concentration
- Electric concentration
- Gravity concentration
- Flotation concentration

Magnetic concentration has often been the first phase in the separation process of electronic devices. By this magnetic concentration it is possible to extract iron successfully but it can also be used for the regeneration of magnetic suspensions during the process of concentration in heavy solutions.

Electric concentration is based on definite electric occasions, which appear with integral materials and elements of electronic devices. During the process of electrical concentration it is easy to notice different features of some

particular materials and elements relating to their electro conductivity, dielectric porosity, the possibility to be charged with electricity by friction and contact. On the fractions, which have been separated by this method of concentration, a great influence have got the electric and mechanic forces.

Gravity concentration uses combined effects of masses, volume, density and form of fractions in order to obtain various and different trajectory paths in static or dynamic solutions. It is possible to apply the most different designs of devices for gravity concentration.

Flotation concentration is based on different physical-chemical features of the surface fractions and their ability to get wet, that is, not being wet by water. In the recycling processes of electronic devices concentration, there have been used flotation cells of small capacities and sizes.

Methods of ore-dressing, which have been used in the processes of IC boards recycling and shown on the flow-sheet- Figure 1, achieve higher recovery of the present metals, and in accordance with the fact that there is no water or chemical additions in combination with this procedure, there is no problem of waste waters and it is the proper thing that makes this process economically more convenient, and what is more, for the environment more acceptable than the metallurgical processes.

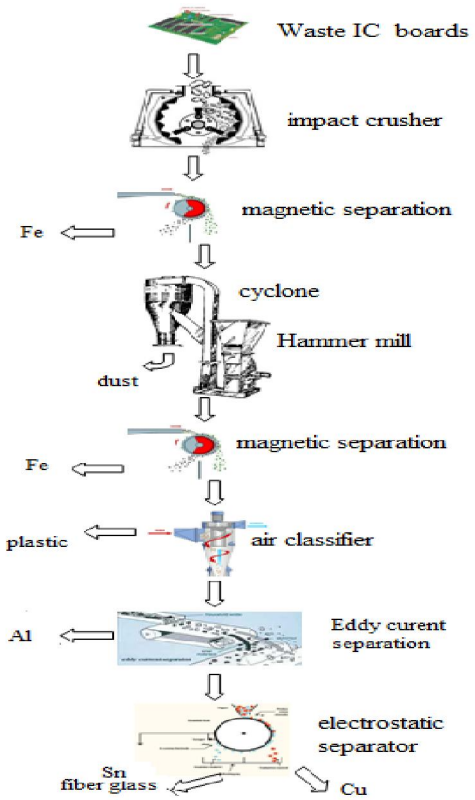


Figure 1. Technological flow sheet of the physical separation of old IC boards

FINAL CONSIDERATION

The metal and power consumption in the world has got a terrifying rate of increase. Reserves are being used quickly. Mineral waste present a very important secondary resource, and if it is being collected and returned into the process of a new treatment, we will reduce the usage of primary resources, prolong the life of their reserves and reduce the pollution of the environment. The mineral reprocessing from waste, as well as the general reprocessing of some other materials (RECYCLING), present the future, which can be accomplished only by an integral approach to the problem and which in its essence tends towards the sustained development. The clear example, which confirms the previous statements, is given in the following tables:

The power savage by using recycling materials

Materials	**(%)**
Copper	85
Lead	65
Zink	60
Aluminum	95
Iron and steel	74
Magnesium	98
Titanium	58
Paper	64
Plastics	80

As it has been noticed from this table, metal waste is a very rich raw material compared to the mere ore; what is more, the transport and handling are much cheaper. The investment expenses for building up the facilities for waste processing and metal production amounts only 16 to 20% out of the costs necessary for building up facilities for processing the primary ore material-ore.

Besides, the processing, technologies based on processing the secondary minerals (metals), are much simpler and even more convenient for the environment, and these statements can be noticed clearly on the examples of iron and steel in the following table.

Conveniences of using iron and steel out of waste ore materials

Conveniences	**(%)**
Power savage	74
Savage of materials obtained from ore	90
Reduced air pollution	86
Reduced water consumption	40
Reduced water pollution	76
Reduced mining waste (waste rock)	97

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REFERENCES

1. Milan Ž. Trumić, Nadežda Ćalić, Ljubiša Andrić, Miroslav Ignjatović, Recycling Technologies and Sustainable Development, XIX Mineral Processing Simposium with International Participation, Topola, Oplenac, Serbia, (2004), pp. 257-265.
2. Milan Ž. Trumić, Radule Tošović, National Strategy for Sustainable Use of Natural Resources and Mineral Processing, VII Mineral Processing Colloquium, Belgrade, Serbia, (2006), pp. 58-69.
3. Hugo Marcelo Veit, et all., Rocovery of copper from printed circuit board scrap by mechanical processing and electrometallurgy, Journal of Hazardous materials B 137 (2006), pp. 1704-1709
4. Milan Ž. Trumić, Grozdanka Bogdanović, Maja S. Trumić, Sanja J. Bugarinović, Industrial waste and its environmental impact – Case study of Bor, ISWA Beacon 2010: Public-private partnership and hazardous waste in developing countries in SEE, Middle East and Mediterranean Region, Novi Sad, 08^{th}-10^{th} December, Serbia (2010), pp. 117-122.

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EFFECTS OF THE BIOLOGICAL RE-CULTIVATION OF THE DEPOSOL ON THE OUTSIDE LANDFILL DRMNO

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ABSTRACT

Process of coal mining will be permanently excluded from agricultural producing large areas of land quality, which in the later stages with some degree of success returning the primary aim, the agricultural production. Research since now and applied measures of protection and cultivation especially in areas outside the landfill Drmno, and several other locations, are often partially and inadequately implemented. Today, the measures of technical and biological recultivation carried out by new materials and technologies to more quickly and rationally optimize all parameters.

Key words: recultivation, deposol, technology, zeolite

INTRODUCTION

The first attempts at land recultivation and landscaping of damaged areas by mining operations was noted in Germany in mid-19th century, and later to the United States and England. First introduced and extensive research necessary in application of itself was observed only after the Second World War. In developed countries, to the success of recultivation mainly have contributed strict legal rules that dictate the way of exploring, allowable quantities of hazardous substances, solving social problems, as well as the selective disposal of overburden. The essence of selective disposal of overburden has that at the beginning of the open pit, productive soil layer temporarily postponed, and in later stages, during the excavation of coal, overburden selectively applied in accordance with existing geological profile. The basic concept of the procedure is the following: to start the process of opening the mine, is formed outside the landfill with gentle slopes and terraces along the contour lines. This avoids to continually sloping of the terrain over long distances and the emergence of stronger affected water erosion. The landfill disposal is done selectively, so that in the lower layers inert material is deposited in the deeper layers of mine. Over this is deposited relatively porous, filtered gritty

material, and on the surface of the landfill ornic productive layer. On the lowest floor is disposed material by the worst chemical, physical and microbiological characteristics on the contact zone with the coal, above is disposed: sand, gravel and other materials, so that achieves the same zonality layers as it was excavated in the profile. When the internal clipboard is filled, to about 1 m below the predetermined kote, the area is flat, plow and so prepared substrate layer is applied the layer of productive land. Such these measures and legislation in Germany is re-cultivated and arranged more than 40,000 hectares of land damaged by mining activities [1]. Surface mining of coal requires the supervision and management of the entire surface of exploring fields and masses of overburden. Recultivation and restructuring of the surface areas arising by surface exploring offers great possibilities for the selection and structuring of land for the purposes and purposes of the human and natural communities. Selection post exploring land use should be based on cultural and community growth factor in the environment [2].

In the countries with strong regulation, standards of recultivation can be a major factor in the choice of post exploitation of land use. The most common method of applying of regulatory controls is to seek approval of any proposed plan of exploring coal from various local, regional and national government agencies prior to commencing operation (Australia, Canada, South Africa, USA etc...). Common elements in all the countries that are found in many laws include requirements for the selective disposal, particularly of fertile soil layer and the overburden, reformatting the land to its original contours, government supervision of the re-cultivation in order is ensure that the established sustainable vegetation and even taking the cash deposit or other form of financial security before land disturbance. In the U.S., the mining companies by law must pass a deposit equal to the value of recultivation activities related to the status of the ownership of land, the minimum deposit is $ 10,000 per hectare of land which would continue uninterrupted. The returning of deposited funds is in three phases. The first part is returned when for example deposit is formed. The second part is released when it established the initial vegetation, while the last part release after a successful proven productivity that has been proven in the period 5-10 years [3].

In our country, on our largest coal mines the Kolubara and Kostolac basin is a common feature of applied technology, which does not allow selective excavation and disposal of overburden. From the point of the target task, the subject of research, this fact opens up a huge and challenging engineering tasks related to analyzing and evaluating the selective excavation and disposal of overburden. Selective excavation and disposal of overburden in the working environment of heterogeneous litho logical composition, has a conflict-multiple criteria dimension. In such circumstances, through the prism of reclamation, revitalization and spatial affected exploitation works, you should consider possible solutions and rational effects. Today, watching the mining in Serbia from aspects of environmental protection and its work that is directly disturbed, land resource, recovery and the revitalization by traditional measures has an alternative for two reasons. First, the measures proposed so far in the technology of cultivation often not observed so multidisciplinary that the success rate the because of this realization was small. Recultivation and rehabilitation of degraded land is not observed from the agrochemisry aspect already as a geological layer with its mineral properties. Involvement of a

multidisciplinary team (Pedology, agro-chemists, geologists, engineers of agricultural the forestry profession, botanist, Technologists, etc...) aims to conquest the new technology in the process of land recultivation. If you order to make compromise (economic and ecological) the provide financial resources for carrying out recultivation on degraded land to all areas in Serbia, the main the only problem was to provide quality borrow soil material. Usually, in the practice, land watched, viewed as a geological layer of 2 meters, and considers it a homogeneous material throughout its depth. Such a practice was wrong with such parameters are often entered into the calculations of stock borrow land, forgetting that frequently only 30-40 cm of top soil is characterized by its fertility. Looking the borrow pit of the soil from soil from the agro chemistry aspect in most cases it is difficult to provide a borrow pit while maintaining the existing land fund. Another reason is that the performance of conventional technology recultivation should be around 15,000 EUR per hectare. Besides that, for the realization of such measures should be engagement of the big number of construction machinery. Therefore the proposal is that on the surfaces where possible, avoid the traditional application of "the humus layer of the soil and application of new generation technology. That was the main reason for this thinking and starts a project aimed at introducing the new technologies using zeolites from the product derived from chemical-technological processing byproducts in the process of coal mining.

MATERIAL AND METHODS OF WORK

Before the commencement of this biological cultivation technology had done the basic agrochemical and physical-mechanical properties of deposol an area of 20 hectares that was planned for recultivation. It was taken a total of 19 samples of the soil sampling network that covers the entire surface. The depth of soil sampling, defined by up to 20 cm depth because it is a deposols. Sites and of the soil sampling lines are defined by GPS coordinates as a basis for further measures from the activities in these areas (Figure 1). All chemical analysis (pH in H_2O and KCl, EC, content humus, NPK, trace element) from the soil texture was made by methods accepted by the Society for the Study of the soil of Republic of Serbia.

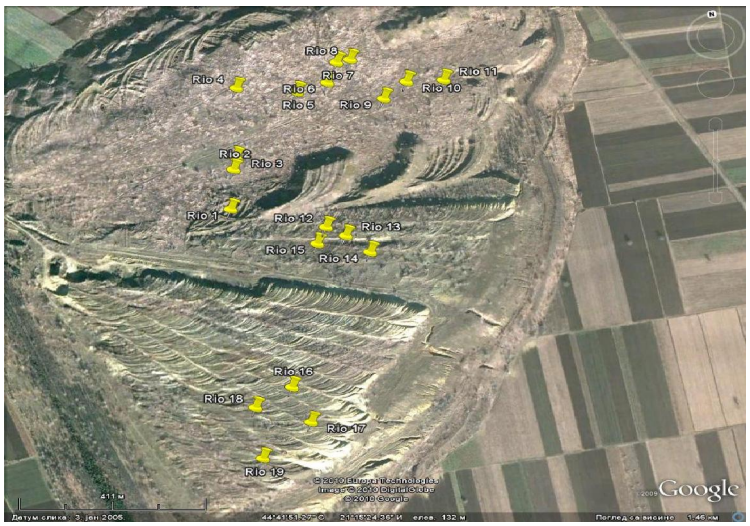

Figure 1. Satellite image of landfill and sampling of deposol

Zeolite used for biological recultivation had a high CEC about 140 Meq/100g, clinoptilolite hejlandite-type, containing a minimum of 50% clinoptilolite, national origin, ZEO-KOP, Igroš. The amount of zeolite that is applied per unit the area (ha) is between 4.5 and 5.0 t. Product based on coal dust, which provides supplies of humus, nitrogen and potassium per hectare entered in the amount of 5,000 liters. A detailed description of products and technology of chemical composition is not described as a technical-technological solution that is waiting for its verification. Cultures that were grown on these areas are mixtures of grass, clover (*Trifolium pratense sp.*), alfalfa (*Medicago sativa*) and oilseed rape (*Brassica napus L*).

RESULTS AND DISCUSSION

External dump Drmno has been created by process of coal exploitation in TE Kostolac as landfill overburden. Depositing process is finished so that now spread over an area of 100 hectares. On the outer part of the landfill Drmno, has been done technical recultivation which included grading, shaping of slopes, where the alternate plain and slope with the intention to reforest such land slope forest tree species and the plateau used for agricultural production. Due to the large heterogeneity of pedology cover in this area and the later unselective depositing, in a small area may be meet some resedimented soil types. The largest areas of resedimented deposol were formed from soil that belong to the class of undeveloped soil with different mechanical composition, sandy and les like-sandy in the class of cambic soil type brown forest soil (Eutric soils). Defined area from 20 hectares on which is carried out chemical and biological recultivation, for its chemical and especially physical and mechanical properties are characterized by a very large heterogeneity on a very small space. Regarding the chemical properties of the values of active acidity (pH u H_2O) before the recultivation, range from 6.64 (neutral) to 8:08 (slightly alkaline), which is not a limiting factor for the performance of biological

recultivation, but rather a stable complex. The values of exchangeable acidity range (pH u KCl) from 4.90 to 7.60. Deposol supply with humus in some places is low while the majority of our almost absent, approaching the limit of detection. Conductivity (EC) of is very heterogeneous, ranging from 144.1 to 455 μs.

The content of macro elements (NPK) is very low. Available forms of trace elements in the total content of (Zn, Cd, Pb, etc.) have increased and they are not a limiting factor for biological recultivation.

Authors Broll in the Kuntze [4, 5] point out that before you begin the biological recultivation, obligatory test the quality of soil in two directions. First in the soil must be determined the content of prohibited concentration of harmful toxic substances. Then determines the agrochemical soil quality, its fertility, in order to realize the corrective measures. In this way, determine the kind of agricultural or forest plantations can be proposed for that area.

Mechanical composition of deposol because of its origin and unselective delay in the process of depositing is very heterogeneous and specific. Within mentioned 20 ha, most of deposol according the mechanical composition belongs to the class of sands while a small part of has loamy texture. On deposols of sand are very visible differences mechanical composition on the lower in the upper plateau where the deposols are stated. The analysis shows that on upper plateau of the content of particles smaller than 44μ is only 14.61% or 12.57% of all smaller from the 8 μ in terms from the aspect of production conditions, especially water-air is a problem. These differences are probably caused due to wind erosion because the finest fraction of the surfaces is the most vulnerable. Technology of biological recultivation was carried out in the several stages. The first phase was has application of zeolites-based products in the volume from 4.5 to 5.0 t / ha. After that, access to the production of products based on coal dust and its application. After that was done as soil preparation for sowing dishing, followed depending on the culture performed sowing from the predetermined depth.

The first morphological parameters of crops germination, emergence, tillering after 60 days, on such a poor sands with such applied technology point on a full justification for mentioned measures (Figure 2). Mentioned technology has prolonged effect and allows the necessary reserve most of the macro and micro elements, as well as humus to cultivated plants. In this way, has savings made in the start fertilizer that needed to be applied at sowing crops. The degree of utilization of macro and micro elements by this technology is much greater and more efficient. Figure 2 shows the sandy surface soil before treatment and after treatment on surface which has performed sowing crops.

Figure 2. Snapshot of sandy surface soil before planting (1), and the effects of this technology with grass and legume mixtures (a) and oilseed rape (b)

The first, control measurement, seven months after the biological recultivation was carried out by measuring the biomass of sown crops (mixtures of grasses, clover, alfalfa and oilseed rape) compared to the control variant. Control variant, depending on location taking plant samples were plots where it is already made technical biological recultivation, or parcels on which has made only a basic fertilization.

Table 1 shows has yield (t/ha) freshly biomass crops, depending on the treatment. In all crops indicated an increase biomass in the variant where was carried out using these technologies. Increasing biomass ranges from 65.40 for grass to over 200% in oilseed rape. These values fully justify recultivation, technology since in the early years and intended only to produce biomass for plowing.

Table 1. Yield biomass diferent crops after 7 monts (t/ha)

R.br.	Culture and description		Treatment	Yield (t/ha)
01	Grass	Harvested more than 2 cm	Control	4.22
02		Harvested more than 2 cm	Experiment	6.98
03	*Alfalfa*	Lower plateau	*Control*	*3.55*
04		Lower plateau, the right from the road	Experiment	6.79
05		behind the nursery	Experiment	8.10
06	Clover	Upper plateau	Control	2.04
07		Upper plateau	Experiment	3.91
08	Oilseed rape	Area Technical recultivated	Control	6.21
09		Rapeseed upper plateau	Experiment	13.67

Figure 3 shows the effects of mentioned technologies after 7 months of growing grass seed mixtures including the period of vegetative rest, winter period.

Monitoring morphological changes in plants revealed that plants have grown in the experimental variants of better habitat to overhead and underground biomass. In all samples of plant material is determined the nutritional value of this biomass because mulching or plowing and because of use for animal feed.

Figure 3. Effects of applied technology on deposols of sand with grass cover

CONCLUSION

The new developed technology is a type of complex biological re-cultivation of soil on deposols that are characterized by low production properties (sandy mechanical composition, low organic matter content and macro and micro elements). Technology for all phases of verification justify the application of the morphological characteristics of the crops regardless of on initial adverse physical and chemical structure of soil. The technology can be applied on all types of deposols or flotation dump which in the Serbia has plenty of, over 20,000 ha which have directly threatened. In this way it is possible in the areas where missing or absent land recultivation material for the use, by this technology established the productivity of soil and prevent the negative effects of various forms of erosion.

REFERENCES

1. Werner, K., Einhorn W., Krummsdorf A. (1984): Technical and biological recultivation and development of exhausted open cast mines in the German Democratic Republic, GeoJournal 8.1, 075-079
2. Strzyszcz, Z. (1996): Recultivation and Land scaping in Areas after Brown-Coal Mining in the Middle-East European Countries, Water, air and Soil Poll. , 91, 1-2, pp. 145-157
3. Vujić S., i sar. (2006): Selektivno otkopavanje i odlaganje otkrivke u funkciji rekultivacije površinskih kopova uglja, 232, Srbija
4. Broll, G., et al., (2000): Rekultivierung in Bergbaufolgelandschaften: Bodenorganismen, bodenökologische Prozesse und Standortentwicklung, Rekultivierung in Bergbaufolgelandschaften, Springer-Verlag, pp. 1-306
5. Kuntze, H. (1986): Soil Reclamation, Improvement, Recultivation and Conservation in Germany, Zeitschrift für Pflanzenerährung und Bodenkunde, VCH, Weinheim, 149, 4, pp. 500-512

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WASTE MANAGEMENT IN THE LOCAL COMMUNITY ON THE EXAMPLE OF THE CITY OF LESKOVAC

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ABSTRACT

Waste Management presents a collection of activities, decisions and measures focused on the prevention of the creation of waste, as well as the decrease of the quantity of waste and its harmful effects on the environment. According to the Waste Management Act, the creation of the Waste Management Local Plan is the obligation of the local municipality.

In this work the most important solutions predicted by the Waste Management Local Plan in the area of the City of Leskovac will be shown, together with its primary goal of the establishment of the complete system of waste management. Starting with the analysis of the existing state of waste management, special attention is paid on the priorities and measures concerning waste management in the following ten years. A set of appropriate indicators is given for the purpose of the monitoring of the implementation of the Waste Management Local Plan and the decrease of the harmful influence of waste on the environment.

Key words: waste management, local municipality, Waste Management Local Plan

INTRODUCTION

According to the Waste Management Law, waste is each substance or object contained in the list consisting of the categories of waste (the Q list) that the owner intends to or has to discard [1]. Waste management presents the implementation of designed measures of managing waste during the gathering, transport and dispose of waste, including the supervision of these activities and care of waste fields after their closure. Waste management is performed in a way which secures the least risk for peoples' health and life and for the environment as well [2].

The legal framework of waste management in the Republic of Serbia

The normative framework of waste management in the Republic of Serbia is based on the Waste Management Act, The National Strategy for Waste Management [3], other valid legal norms and the European Union Legislation as well (the Council Directive 2008/98/EC concerning waste that replaces and complements Directive 75/442/EEC, 2006/12/EC). The Framework Directive on Waste plays the role of the umbrella directive setting definitions, principles, procedures, institutional setting for all waste management [4].

Waste Management in the local community on the example of the city of Leskovac

Legal norms of the Republic of Serbia imply that cities and municipalities in the Republic, as the instrument of waste management on the local level, have to establish the local plans for waste management. The creation of the Waste Management Local Plan of the city of Leskovac for the period between years 2010 and 2020, which is based on the National Strategy for Waste Management, presents a very important step for the purpose of the implementation of the integration system of waste management. The aim of the creation of the Waste Management Local Plan is the establishment of the complete system of waste management, the decrease of the harmful influence of waste on the environment, the development of the waste management information system integrated within the information system of the Republic of Serbia, followed by the establishment of the self-sustained system of finance reserved for waste management on the territory of the city of Leskovac. Some of the solutions encompassed by the previously-mentioned plan will be provided in the following.

CURRENT STATE OF WASTE MANAGEMENT IN THE CITY OF LESKOVAC

According to the available data considering the appearance, means of disposal and quantities of waste, there are 2,374,374 tons of waste gathered in the Republic on the annual level (year 2009) .[3]. Municipal waste is usually disposed of on disorganized wasteyards, and there is a great number of wild dumps due to the unconscientious conduct of the citizens, as well as the fact that 2,500,000 households are not encompassed within the organized waste collection [2].

Generating waste on the territory of the city of Leskovac has the following basic characteristics:

1. The daily amount of municipal waste (according to the questionnaire gathered for the preparation of the Regional Spatial Plan) measures 0.4 kg per citizen, which is less than the Republic`s average. Averagely, a citizen of Serbia generates 0.87 kg of waste a day (318 kg a year) [5]. The amount of waste generated by the citizens of the European Union varies from country to country, while the average amount for the 27 countries, members of the EU for 2008, is 524 kg a person per year [6].

2. The ratio between municipal and industrial waste is 75:25 in favor of municipal waste.

3. According to the questionnaire gathered for the preparation of the Regional Spatial Plan (82% of the gathered questionnaire) 20% of rural areas is not in the system of collective municipal waste disposal [7].

4. Municipal waste disposal started in accordance with the standards applied in this area with the establishment of the Regional sanitary wasteyard at the location "Zeljkovac" on October 9, 2009. In the sanitary wasteyard "Zeljkovac" municipal waste is disposed of from six municipalities of Jablanica County. Waste is currently disposed of without any previous pretreatment.

5. The system of gathering and transporting municipal waste in 2007 covered only the urbanized part of Leskovac and two settlements of Vucje and Grdelica, where 21,886 people were included, out of which 20,141 were households and 1,745 were corporate bodies. After signing a contract with strategic partner, the company *Porr Werner&Weber*, after a period of approximately two years, inclusively with December 31, 2009, PWW Leskovac d.o.o, with the services of collection and transport of waste in the territory of Leskovac, included 39,823 households and 2,493 corporate bodies, which led to increase in the coverage of households by 98% and 43% for corporate bodies.

PRIORITES CONSIDERING WASTE MANAGEMENT

Regarding the waste management and sustainable development, the European Commission Communication suggests integrating the basic objectives of the European Union waste hierarchy (preventing waste and promoting reuse, recycling and recovery – Figure 1) [8]. Priorities defined by Local Plan start with the principle of complete control of waste, starting with the place of its creation to the place of final treatment and disposal. Between the starting and ending points there is a series of measures that are in the process of implementing, are hierarchically subordinated to one another and include the following hierarchical options:

1. Avoidance of the creation of waste;
2. Reduction in the quantity and type of waste;
3. Reuse of waste for the same purpose, with processing;
4. Recycling of waste, making it usable and processing it;
5. Waste processing; and
6. Waste disposal.

The starting point of integrated waste management system signifies the request for reduction of waste, which largely depends on the behavior of individuals and society as a whole, with the definement of the categories and types of waste. When dealing with waste each category and type of waste has a specific course of treatment and disposal.

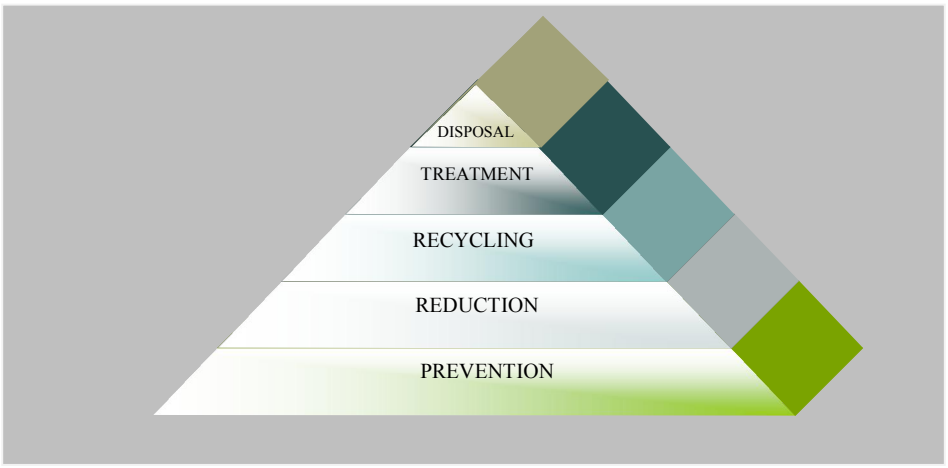

Figure 1. Priorities considering waste management [7]

THE SYSTEM OF INTEGRATED WASTE MANAGEMENT

The system of integrated waste management involves the implementation of a series of activities related to monitoring and treatment of waste from the place of origin to the place of final disposal.

The most important aspect in the implementation of integrated waste management system in the town of Leskovac is its implementation in the Spatial Plan of the city. This means that the complete infrastructure: sanitary wasteyard, and the future regional center for waste management, the Centers for separate collection of recyclable waste, etc., must find its place in the Regional plan.

Integrated waste management system in the town of Leskovac will be introduced in phases, through the following activities:

- separate collection of certain waste streams from households;
- the installation of necessary infrastructure (center for the collection of municipal waste, cntere for separate collection of recyclable waste, facilities for waste management, the regional sanitary wasteyards, etc.);
- a special collection of bulky waste (daily, periodical or on call);
- support of the public and all the participants to raise awareness of the need for waste management [7].

WASTE MANAGEMENT MEASURES IN THE CITY OF LESKOVAC

Waste management involves the implementation of measures for the prevention of and reduction of waste, without the use of procedures and practices that pose a risk to the environment, as well as measures to prevent harmful effects of waste on human health and the environment as follows:

- preventive measures that can avoid and reduce the amount of municipal waste: (development of a system of separate collection and recycling of waste; avoidance and reduction of waste generated in households with corporate bodies and individuals for the purpose of raising public awareness);

- waste management measures based on best available technology that doesn`t require excessive costs (biological treatment of separately collected biodegradable (green) waste from public areas and biodegradable waste from households; thermal processing of gas from the wasteyard, thermal treatment of the remaining waste; mechanical treatment of solid waste).

INDICATORS FOR MONITORING THE IMPLEMENTATION OF THE WASTE MANAGEMENT LOCAL PLAN

A set of indicators, shown in Table 1, are defined to monitor the implementation of the Waste Management Local Plan.

Table 1. Indicators for monitoring the generation and waste management [7]

	Indicators for monitoring waste	
1.	The total amount of generated waste	The total amount of annually generated waste (tons/year)
		The total amount of waste per resident generated annualy (kg/resident/year)
		Total waste generation in groups according to the Catalogue of waste per year (tons/group/year)
2.	The intensity of waste generation	The amount of waste per resident (kg/resident) according to BDP per resident (EUR/resident)

	Waste Management Indicators	
1.	The amount of recycled waste	The total quantity of recycled waste (tons/year)
		The total amount of recycled packaging waste (tons/year)
		The total amount of recycled packaging waste by type (tons/year)
2.	The amount of biodegradable waste	The total amount of biodegradable waste (tons/year)
3.	The amount of allocatedly collected waste	The total amount of allocatedly collected waste (tons/year)
		The total amount of allocatedly collected waste by type (tons/year)

CONCLUSION

Waste management in Serbia, at the local level, presents a significant problem for a number of local governments. The Waste Management Act and the national strategy define the objectives and courses of action, whose essence is the introduction of integrated waste management system. One of the most important tools for achieving this goal at the local level is a local waste management plan. This work shows the current situation in this area on the example of the city of Leskovac, where it was stated that there was a significant positive change in the period after engaging a strategic partner, the company *Porr Werner & Weber*. It points to the priorities to be implemented so that an integrated waste management system can be achieved. Based on the above it can be concluded that the major problems considering waste management are related to final

care, or disposal. For obtaining an integrated waste management system in the town of Leskovac in the regional sanitary wasteyard, the following steps should be performed: an organized recycling for the purpose of valorisation of raw materials, a facility for the separation of recyclable waste, facility for composting, for the collection of recyclable waste and to install the devices to control air and water pollution. At the same time, it is necessary to establish an appropriate information system and constantly work on raising awareness of the need for waste management.

REFERENCES

1. The Waste Management Law, The Public Voice of the Republic of Serbia, edition 36/09
2. The centre for cleaner Serbia, www.cpc-serbia.org/ 20. 04. 2011.
3. National solid waste management strategy for 2010-2019, Serbia, The Public Voice of the Republic of Serbia, edition 29/10
4. Kobus D., Practical Guidebook on Strategic Planning in Municipal Waste Management,World Bank, Bertelsmann Stiftung, Gütersloh,2003,www.citiesofchange.org
5. The new policy for developing consciousness about waste management at the local level – from understanding to necessity, The open school of Belgrade, www.bos.rs/imamplanzasvojgrad
6. EUROSTAT - Statistical Office of the European Communities: Data on Municipal waste generated 2009, http://epp.eurostat.ec.europa.eu/tgm/web/_download/Eurostat_Table_tsien130HTMLDesc.htm#
7. The Waste Management Local Plan in the city of Leskovac for the period between 2010 and 2020, The Public Voice of the City of Leskovac, edition 2/11
8. Commission of the European Communities. Green paper on Integrated Product Policy. COM (2001) 68 Communities; http://eur-x.europa.eu/LexUriServ/site/en/com/2001/com2001_0068en01.pdf.

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SOLVENT EXTRACTION OF EFFLUENT STREAMS FROM COPPER SULPHATE PLANT

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ABSTRACT

The main objective of this work is to study cathodic copper recovery from effluent streams of copper sulphate plant. Effluent stream was neutralized with copper hydroxide sludge obtained from Cerovo and underground mine waters with copper content of 0.38 g/L at pH 2.8. This mine solution was further treated by neutralization with sodium hydroxide at pH 5.5. The resulting solution contained 2.5 g/L copper at pH 1.8 presented as pregnant leach solution for solvent extraction and electrowinning.

On the basis of laboratory experiments, the solvent extraction/electrowinning procedure, followed by cathodic copper recovery, could be performed on a real quantity of high acid effluent streams and mine waters in the existing Bor tank house.

Key words: Effluent streams, mine waters, solvent extraction, cathodic copper

INTRODUCTION

In recent years, the RTB Bor Company has developed and carried out several test works for the removal and recovery of copper from acid solutions emanating from the mining and metallurgical activities. So far, it has been without much success. Test examples were as follows: Copper sulphate production from tank house bleed electrolyte, copper cementation from mine water on scrap iron, neutralization of mine water in flotation tailings pond and electrowinning of copper from low-grade acid solutions The results showed low efficiency and poor quality of copper, hence further re-smelting was needed which is not considered as ecologically and economically justified.

The objective of this work is in an attempt to prevent the problem of copper losses from copper sulphate recovery plant, while at the same time to improve copper recovery from mine water in order to improve revenue and decrease environmental hazards [1].

METHODOLOGY

Effluent streams and mine water samples

Effluent streams and two mine water samples from the underground mine in Bor and the open pit mine in Cerovo were selected. Details of the chemical compositions of the mine water are shown in **table 1.**

High acid effluent streams contained 400 g/L H_2SO_4 and 15 g/L Cu.

Table 1 Chemical composition of the mine waters

Element	Open pit mine water	Underground mine water	mixed solution
		g/dm3	
Cu	0.53	0.32	0.38
Fe2+	0.57	0.48	0.51
Fe3+	0.04	1.71	1.23
Fe(tot)	0.61	2.19	1.74
pH	4.5	2.5 – 3.8	3.8
Suspended solids		0.744	0.744

Removal iron and impurities

Figure 1 shows the complete flowsheet for effluent streams and mine water treatment and copper reovery (SX-EW) units. The samples were mixed together and the mixed solution was then pre-treated chemically**.** The first pre-treatment of the mixed mine water was carried out at the cementation plant situated near the two copper mines. Further stages of precipitation by neutralisation was carried out in the laboratory at the Institute for Mining and Metallurgy in Bor.

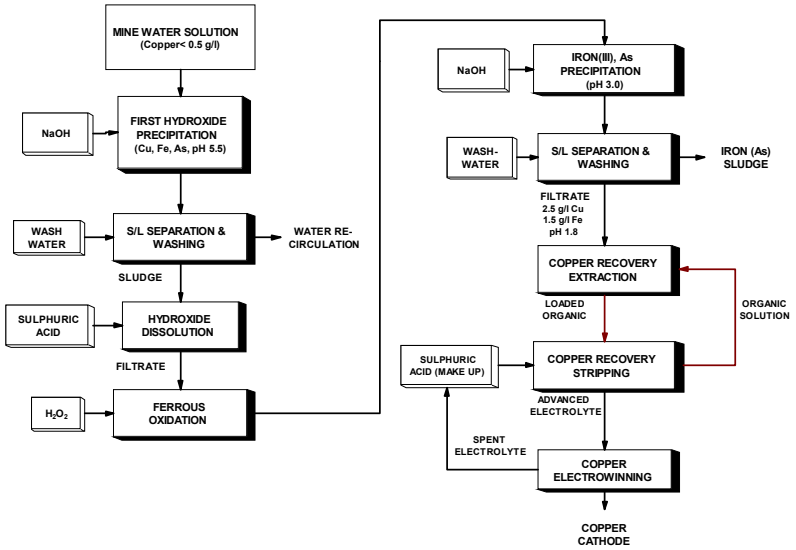

Figure 1 Process flowsheet for mine water treatment and copper recovery

SX-EW laboratory equipment

MEAB laboratory mixer-settler are traditionally designed pump mixer-settler units, with squared mixing chambers (mixers) and box-type settling compartments (settlers). The mixers are equipped with adjustable speed stirrers and the settlers with picket fences for the distribution of the dispersion over the whole cross-section of the settler. An adjustable jackleg for the outflow of the heavier solvent controls the phase boundary level at varying liquid densities. A heavier solvent recycle is integrated in the construction [2].

RESULTS AND DISCUSSION

Pre-treatment of mine water

The collected mine effluent streams and water samples of total volume 28 m^3 from the two copper mines were brought to the cementation plant with average concentration of 0.38 g/L copper and 1.7 g/L iron with pH 3.8, as listed in table 1. Neutralisation at pH 5.5, it yielded 141 kg collective wet hydroxide sludge (DS 83 %).

The dry sludge, containing 17 kg copper hydroxide, 86 kg iron hydroxide and 9 kg impurities in the form of hydroxides and insoluble substances, was further treated in the laboratory at Institute for Mining and Metallurgy in Bor. The hydroxide sludge was dissolved in sulphuric acid at pH 1.5. The resulting pregnant leach solution of 4.3 m^3 contained 2.5 g/L copper, 11.3 g/L iron and soluble impurities.

This solution was further treated by oxidation, neutralisation and precipitation. The resulting filtrate contained 2.5 g/L copper and 1.7 g/L iron at pH 1.8. It was then treated by solvent extraction and electrowinning. Copper from fine filtrate is precipitated again in the quantity of 16.5 kg as copper hydroxide

Solvent extraction - Copper separation and concentration

Basic technical and chemical data for the solvent extraction operation was investigated by tests in the laboratory. Extraction and stripping equilibrium values (isotherms) were obtained by vigorous mixing of actual aqueous and organic solutions at different phase ratios [3]. The slope of the working line in figure 2 indicate the ratio of organic (stripped organic) to aqueous solutions (pregnant leach solution) in the extraction stages, in this case O/A = 1.

The slope of the working line in figure 3 indicate the ratio of loaded organic to barren electrolyte in the stripping stage, in this case O/A = 8.7.

Predicted technical and chemical parameters for the solvent extraction laboratory experiments are shown in figure 4. In the two extraction stages, the copper content in the pregnant leach solution decrease from 2.5 to 0.2 g/L copper in the raffinate. This is equal to a transfer of 2.3 g/L copper to the stripped organic solution, resulting an increase of the copper concentration from 1.8 g/L to 4.1 g/L in the loaded organic. In the single stripping stage, the copper content in loaded organic decrease from 4.1 g/L to 1.8 g/L copper in the barren electrolyte.

Concentration of copper in the barren electrolyte changed from 30 to 32.3 g/L in the loaded electrolyte. The aqueous and organic flows are fairly equal as this gives the best operation conditions in the mixer-settlers. Through extraction and stripping

operation, 80.5 g/h copper is transferred from pre-treated mine water to electrowinning process.

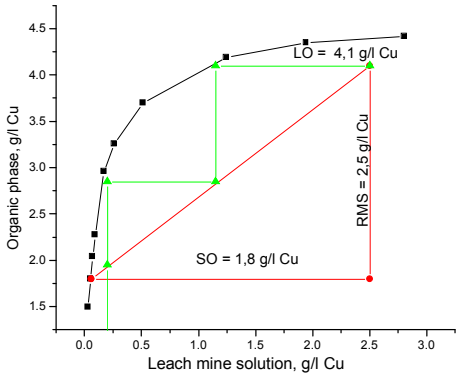

Figure 3 Extraction isotherm

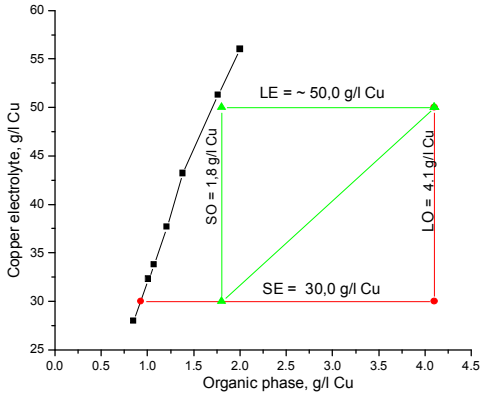

Figure 4 Stripping isotherm

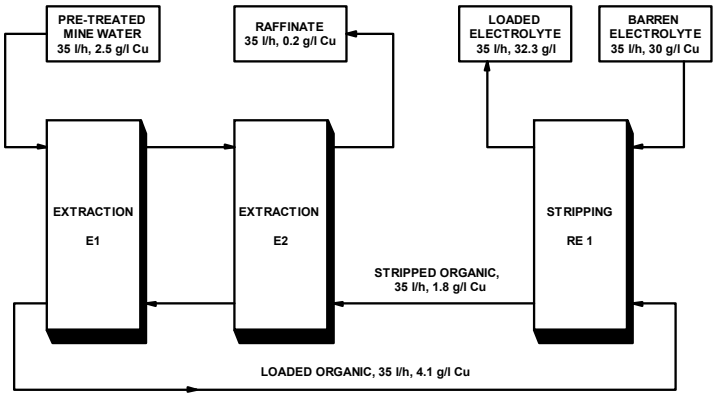

Figure 5 Performance data of extraction and stripping

Electrowinning - Copper metal production -

Electrowinning was performed in the electrolytic cell equipped with two dimension stable anodes (DSA) and one cathode of pure copper [4]. This electrowinning process is very similar to industrial conditions. Cathode current density-160 A/m^2, current efficiency-85%, temperature of electrolyte-55 ^{0}C, cathode period-5 days.

The weight of the resulting copper cathode was 10 kg. It was produced in a period of 5 days. This is in good agreement with the expression:

$$G_{Cu}=1.186\ g/Ah \times 0.5 \times 0.5\ m^2 \times 160\ A/m^2 \times 124\ h=10000\ g \quad (1)$$

Where:

electrochemical equivalent of coppe1.186 g/Ah, current efficiency 85 %, DS Anode dimension 0.5 m^2, current density 160 A/m^2, electrowinning period 124 h

Quality of produced copper cathode was LME A-grade, with copper content 99.99 wt.%, summary of Se, Te, Bi less than 3ppm, and total impurities less than 65 ppm

CONCLUSION

Two effluent streams and mine water samples, one from the underground mine in Bor and the other from an open pit in Cerovo were selected for this work. Various pre-treatment processes were carried out and the result from solvent extraction and electrowinning showed that high quality copper cathodes were produced and it was in line with BS 6017-1989 standard. It can be concluded that by using this process, copper can be recovered from effluent streams and mine water. Not only can it increase the revenue, but also reduce environmental hazards in the East Serbia area.

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REFERENCES

1. Cvetkovski, V. at.al. (2000) Metallurgical Waste Solution Purification, World of Metallurgy – ERZMETALL. 53 Nr 3. p. 176-182.
2. Dittrich, C. et al. (2009) Separation and Purification of Base Metals from Bio-leach Solutions by Solvent Extraction, World of Metallurgy – ERZMETALL 62, No. 6.
3. Kordosky,G, at al. (2006) Equilibrium Copper Strip Points as a Function of temperature and other Operating parameters: Implications for Commercial Copper Solvent Extraction Plants Tsinghua Science and Technology, Vol 11(2), pages 160-164.
4. Cooper, C. at al. (1985) Advances and future in copper electrowinning Journal of Applied Electrochemistry 15 p.789-805.

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ANODIC OXIDATION AS A METHOD FOR SYNTHESIS OF CUPROUS OXIDE, POTENTIAL ACTIVE MATERIAL FOR SOLAR CELLS

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ABSTRACT

Copper oxides, especially cuprous oxide, are of interest because of their applications in solar cell technology. Since the properties of cuprous oxide not only depend upon the nature of the material but also upon the way they are synthesized, different methods and results obtained on the synthesis of cuprous oxide are being investigated by various researchers. In this paper, the point is made on anodic oxidation as a promising method of synthesis of cuprous oxide because electrochemical techniques are particularly well suited for obtaining of metal oxides with thicknesses down to a few nm. The properties of the prepared cuprous oxide films related to surface morphology are presented too.

Key words: Cuprous oxide, Anodic oxidation, solar cells, photovoltaic effect, band gap

INTRODUCTION

Growing demand for energy sources that are cleaner and more economical led to intensive research on alternative energy sources such as rechargeable lithium batteries and solar cells, especially those in which the sun's energy is transformed into electrical or chemical. From the ecology point of view, using solar energy does not disturb the thermal balance of our planet, either being directly converted into heat in solar collectors or being transformed into electrical or chemical energy in solar cells and batteries. On the other hand, every kilowatt hour of energy thus obtained replaces a certain amount of fossil or nuclear fuel and mitigates any associated adverse effects known. Solar energy is considered to be one of the most sustainable energy resources for future energy supplies.

To make the energy of solar radiation converted into electricity, materials that behave as semiconductors are used. Semiconductive properties of copper sulfides and copper oxides, as well as compounds of chalcopyrite type have been extensively investigated [1,2]. One of the important design criteria in the development of an effective solar cell is to maximize its efficiency in converting sunlight to electricity. A photovoltaic cell consists of a light absorbing material which is connected to an external circuit in an asymmetric manner. Charge carriers are generated in the material by the

absorption of photons of light, and are driven towards one or other of the contacts by the built-in spatial asymmetry. This light driven charge separation establishes a photo voltage at open circuit, and generates a photocurrent at short circuit. When a load is connected to the external circuit, the cell produces both current and voltage and can do electrical work.

The high cost of silicon solar cells forces the development of new photovoltaic devices utilizing cheap and non-toxic materials prepared by energy-efficient processes. The Cu–O system has two stable oxides: cupric oxide (CuO) and cuprous oxide (Cu_2O). These two oxides are semiconductors with band gaps in the visible or near infrared regions. Copper and copper oxide (metal-semiconductor) are one of the first photovoltaic cells invented [3]

Cuprous oxide attracts the most interest because of its high optical absorption coefficient in the visible range and its reasonably good electrical properties (Musa et al., 1998). Its advantages are, in fact, relatively low cost and low toxicity. Except for a thin film that can be electrochemically formed on different substrates (steel, TiO_2), cuprous oxide can be obtained in the form of nano particles with all the benefits offered by nano-technology (Daltin et al., 2005; Zhou & Switzer, 1998). Nanomaterials exhibit novel physical properties and play an important role in fundamental research.

The unit cell of Cu_2O with a lattice constant of 0.427 nm is composed of a body centered cubic lattice of oxygen ions, in which each oxygen ion occupies the center of a tetrahedron formed by copper ions (Xue & Dieckmann, 1990). The Cu atoms arrange in a fcc sublattice, the O atoms in a bcc sublattice. The unit cell contains 4 Cu atoms and 2 O atoms. One sublattice is shifted by a quarter of the body diagonal. The space group is Pn3m, which includes the point group with full octahedral symmetry. This means particularly that parity is a good quantum number. Figure 1 shows the crystal lattice of Cu_2O. Molar mass of Cu_2O is 143.09 g/mol, density is 6.0 g/cm^3 and its melting and boiling points are 1235°C and 1800°C, respectively. Also, it is soluble in acid and insoluble in water.

METHODOLOGIES USED FOR THE SYNTHESIS OF CUPROUS OXIDE

The optical and electrical properties of absorber materials in solar cells are key parameters which determine the performance of solar cells. Hence, it is necessary to tune these properties properly for high efficient device. Electrical properties of Cu_2O, such as carrier mobility, carrier concentration, and resistivity are very dependent on preparation methods.

Cuprous oxide thin films have been prepared by various techniques like thermal oxidation [4,7,8], chemical vapor deposition [9-13], anodic oxidation [14,15], reactive sputtering [16], electrodeposition [5, 17-23], plasma evaporation [24], sol–gel-like dip technique [25,26] etc. Each of these methods has its own advantages and disadvantages. In most of these studies, a mixture of phases of Cu, CuO and Cu_2O is generally obtained and this is one of the nagging problems for non-utilizing Cu_2O as a semiconductor. Pure Cu_2O films can be obtained by oxidation of copper layers within a range of temperatures followed by annealing for a small period of time.

Results obtained using electrochemical methods, especially anodic oxidation are presented in next sections.

ELECTROCHEMICAL METHODS FOR THE SYNTHESIS OF CUPROUS OXIDE

Electrodeposition

Electrodeposition is a method for the synthesis of semiconductor thin films such as oxides. The electrodeposition techniques are particularly well suited for the deposition of single elements but it is also possible to carry out simultaneous depositions of several elements and syntheses of well-defined alternating layers of metals and oxides with thicknesses down to a few nm. This method provides a simple way to deposit thin Cu(I) oxide films onto large-area conducting substrates (Lincot, 2005). Thus, the study of the growth kinetics of these films is of considerable importance. Results of electrochemical deposition of cuprous oxide have been presented in some of our previous works [27,28].

Anodic oxidation

In spite of the simple equipment and easy process control, cathodic synthesis demands expensive chemicals as a big dissadventage. On the other hand, anodic oxidation of copper in alkaline solution is one of the standard methodologies for producing cuprous oxide powders used for marine paints and for plants preservation. Those powders are composed of particles of micrometer scale. However, solar sells, for their part, require particles or films of much smaller dimensions in order to achieve higher efficiency. Passive protecting layers formed on copper during anodic oxidation in alkaline solutions are widely investigated and described in electrochemical literature. The structure of those films formed on copper in neutral and alkaline solutions consists mainly of Cu_2O and CuO or $Cu(OH)_2$. Applying in situ electrochemical scanning tunneling microscopy (STM), Kunze et al. [29] found that in NaOH solutions, a Cu_2O layer is formed at $E > 0.58\text{-}0.059$ pH (V vs. SHE). A $Cu_2O/Cu(OH)_2$ duplex film is found for $E > 0.78\text{-}0.059$ pH (V vs. SHE). In borate buffer solutions, oxidation to Cu_2O leads to non-crystalline grain like structure, while a crystalline and epitaxial Cu_2O layer has been observed in 0.1 M NaOH indicating a strong anion and/or pH effect on the crystallinity of the anodic oxide film.

Stanković et al. [30,31] investigated the effect of different parameters such as temperature, pH and anodic current density on CuO powder preparation. The lowest value of average crystallite size was obtained at pH 7.5, whereas the highest value was obtained at pH 9.62. They found a strong dependence of grain size and cupric oxide purity on current density. The average srystallite size increased from 45 nm (at a current density of 500 Am^{-2}) to 400 nm (at a current density of 4000 Am^{-2}), other conditions being as follows: pH 7.5, temperature of 353 K and 1.5 M Na_2SO_4.

There have been a number of papers on anodic formation of thin Cu_2O layers (< 1 μm) using alkaline solutions, but some work has been done with slightly acidic solutions. For example, backwall Cu_2O/Cu photovoltaic cells have been prepared by Sears and Fortin [32] with the Cu_2O layer being about 1 μm thick. They used and compared two methods of oxidation – thermal and anodic. The condition of the

underlying copper surface is expected to influence the resulting parameters of thin solar cells, so they examined the influence of the surface preparation of the starting copper (i.e., polishing technique, thermal annealing). All this experience can help in researching the optimal way of production of nanostructured Cu_2O powders or films.

Recently, Singh et al. [15] reported synthesis of nanostructured Cu_2O by anodic oxidation of copper through a simple electrolysis process employing plain water as electrolyte. They found two different types of Cu_2O nanostructures. One of them belonged to particles collected from the bottom of the electrolytic cell, while the other type was located on the copper anode itself (Figure 1). The Cu_2O structures collected from the bottom consist of nanowires (length, ~ 600–1000 nm and diameter, ~ 10–25 nm). It may be mentioned that the total length of Cu_2O nanothread and nanowire is comprised of several segments. These were presumably formed due to interaction between nanothreads/nanowires forming the network in which the Cu_2O nanothread/nanowire configuration finally appears. When the electrolysis conditions were maintained at 10 V for 1 h, the representative TEM microstructure revealed the presence of dense Cu_2O nanowire network (length, ~ 1000 nm, diameter, ~ 10–25 nm). The X-ray diffraction pattern obtained from these nanomaterials, could be indexed to a cubic system with lattice parameter, a = 0.4269 ± 0.005 nm. This tally quite well with the lattice parameter of Cu_2O showing that the material formed under electrolysis conditions consists of cubic Cu_2O lattice structure.

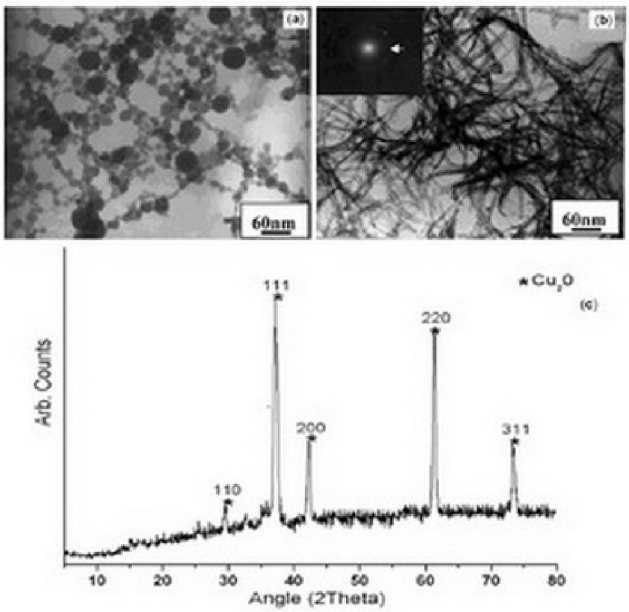

Figure 1. (a) Typical transmission electron micrograph of Cu_2O nanothreads embodying beads, as collected at the bottom of the cell after electrolysis at 2 V for 1 h, (b) is the representative TEM micrograph of dense Cu_2O network of nanowires, obtained after electrolysis at 6 and 10 V, respectively for 1 h and (c) is the X-ray diffraction of the as obtained materials at the bottom of the electrolytic cell after electrolysis at 6 V

In addition to the delaminated nanostructures, investigations of the copper anode, which were subjected to electrolysis runs, revealed the presence of another type of nanostructure of Cu_2O. Authors propose that the higher applied voltage (e.g. 8 V or 10 V) for electrolysis represents the optimum conditions for the formation of nanocubes. These nanocubes reflect the basic cubic unit cell of Cu_2O. The authors estimated the band gap of prepared Cu_2O nanothreads and nanowires to be 2.61 and 2.69 eV, which is larger than the direct band gap (2.17 eV) of bulk Cu_2O (Wong & Searson, 1999). The higher band gap can be attributed to size effect of the present nanostructures. Thus the increase of band gap as compared to the bulk can be understood on the basis of quantum size effect which arises due to very small size of nanothreads and nanowires in one-dimension.

Cu_2O is mainly a p-type semiconductor with a direct band gap of 2.0–2.2 eV (Grozdanov, 1994) which is suitable for photovoltaic conversion. Tang et al. (2005) found that the band gap of nanocrystalline Cu_2O thin films is 2.06 eV, while Siripala et al. (1996) found that the deposited cuprous oxide exhibits a direct band gap of 2.0 eV, and shows an n-type behavior when used in a liquid/solid junction. Han & Tao (2009) found that n-type Cu_2O deposited in a solution containing 0.01 M copper acetate and 0.1 M sodium acetate exhibits higher resistivity than p-type Cu_2O deposited at pH 13 by two orders of magnitude.

CONCLUSION

Solar technologies preserve the planetary energy balance. Cuprous oxide is a nontoxic and low cost semiconducting material that can be used for conversion of solar radiation into electricity. Nanotechnologies made again anodic oxidation of copper a promising method for synthesis of cuprous oxide for application as an active material in solar cells.

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REFERENCES

1. Rajčić-Vujasinović, M.; Stević, Z. & Djordjević, S. (1994). Application of Pulse Potential for Oxidation of Natural Mineral Covellite, Russian Journal of Applied Chemistry, Vol.67, No.4, pp. 594-597
2. Rajčić-Vujasinović, M.M.; Stanković, Z.D. & Stević, Z.M. (1999). The Consideration of the Analogue Electrical Circuit of the Metal or Semiconductor/Electrolyte Interfaces Based on the Time Transient Analysis. Russian Journal of Electrochemistry, Vol.35, No.3, pp. 347-354
3. Pollack, G.P. & Trivich, D. (1975). Photoelectric Properties of Cuprous Oxide. Journal of Applied Physics, Vol.46, No.1, (1975), pp. 163–172

4. Musa, A.O.; Akomolafe, T. and Carter, M.J., Production of cuprous oxide, a solar cell material, by thermal oxidation and a study of its physical and electrical properties, Solar Energy Materials and Solar Cells, 51 (1998) 305-316
5. Daltin, A-L.; Addad, A. and Chopart, J-P., Potentiostatic deposition and characterization of cuprous oxide films and nanowires, Journal of Crystal Growth, 282 (2005) 414-420.
6. Zhou, Y. & Switzer, J.A. (1998). Electrochemical Deposition and Microstructure of Copper (I) Oxide Films. Scripta Materialia, Vol.38, No.11, (May 1998), pp. 1731-1738,
7. Jayatissa, A.H.; Guo, K. and Jayasuriya, A.C., Fabrication of cuprous and cupric oxide thin films by heat treatment, Applied Surface Science, 255 (2009) 9474-9479.
8. Sears, W.M. and Fortin, E., Preparation and properties of Cu_2O/Cu photovoltaic cells, Solar Energy Materials, 10 (1984) 93-103.
9. Kobayashi**,** H.; Nakamura , T. and Takahash, N., Preparation of Cu_2O Films on MgO (110) substrate by means of halide chemical vapor deposition under atmospheric pressure, Materials Chemistry and Physics, 106 (2007) 292-295.
10. Maruyama, T., Copper oxide thin films prepared from copper dipivaloylmethanate and oxygen by chemical vapor deposition, Japanese Journal of Applied Physics, 37 (1998) 4099-4102.
11. Medina-Valtierra, J.; Ramırez-Ortiz, J.; Arroyo-Rojas, V.M.; Bosch, P. and De los Reyes, J.A., Chemical vapor deposition of 6CuO•Cu_2O films on fiberglass, Thin Solid Films,405(2002)23–28.
12. Ottosson, M.; Lu, J. and Carlsson, J-O., Chemical vapour deposition of Cu_2O on MgO(100) from CuI and N_20: Aspects of epitaxy, Journal of Crystal Growth, 151 (1995) 305-311.
13. Ottosson, M. and Carlsson, J-O., Chemical vapour deposition of Cu_2O and CuO from CuI and O_2 or N_2O, Surface and Coatings Technology, 78 (1996) 263-273.
14. Fortin, E. and Masson, D., Photovoltaic effects in Cu_2O-Cu solar cells grown by anodic oxidation, Solid-State Electronics, 25 (1982) 281-283.
15. Singh, D.P.; Singh, J.; Mishra, P.R.; Tiwari, R.S. and Srivastava, O.N., Synthesis, characterization and application of semiconducting oxide (Cu_2O and ZnO) nanostructures, Bulletin of Materials Science, 31 (2008) 319–325.
16. Ghosh, S.; Avasthi, D.K.; Shah, P.; Ganesan, V.; Gupta, A.; Sarangi, D.; Bhattacharya, R. and Assmann, W., Deposition of thin films of different oxides of copper by RF reactive sputtering and their characterization, Vacuum, 57 (2000) 377-385.
17. Briskman, R.N., A Study of electrodeposited cuprous oxide photovoltaic cells, Solar Energy Materials and Solar Cells, 27 (1992) 361–368.
18. Georgieva, V. and Ristov, M., Electrodeposited cuprous oxide on indium tin oxide for solar applications, Solar Energy Materials and Solar Cells, 73 (2002) 67–73.
19. Liu, Y.L.; Liu, Y.C.; Mu, R.; Yang, H.; Shao, C.L.; Zhang, J.Y.; Lu, Y.M.; Shen, D.Z. and Fan, X.W., The structural and optical properties of Cu_2O films

electrodeposited on different substrates, Semiconductor Science and Technology, 20 (2005) 44-49.

20. Mizuno, K.; Izaki, M.; Murase, K.; Shinagawa, T.; Chigane, M.; Inaba, M.; Tasaka, A. and Awakura, Y., Structural and electrical characterizations of electrodeposited p-type semiconductor Cu_2O films, Journal of The Electrochemical Society, 152 (2005) C179–C182.
21. Rakhshani, A.E.; Al-Jassar, A.A. and Varghese, J., Electrodeposition and characterization of cuprous oxide, Thin Solid Films, 148 (1987) 191-201.
22. Santra, K.; Chatterjee, P. and Sen Gupta, S.P., Powder profile studies in electrodeposited cuprous oxide films, Solar Energy Material and Solar Cells, 57 (1999) 345–358.
23. Tang, Y.; Chen, Z.; Jia, Z.; Zhang, L. and Li, J., Electrodeposition and characterization of nanocrystalline films cuprous oxide thin films on TiO_2, Materials Letters, 59 (2005) 434–438.
24. Santra, K., Sarkar, C.K.; Mukherjee, M.K and Ghosh, B., Copper oxide thin films grown by plasma evaporation method, Thin Solid Films, 213 (1992) 226-229.
25. Armelao, L.; Barreca, D.; Bertapelle, M.; Bottaro, G.; Sada, C. and Tondello, E., A sol–gel approach to nanophasic copper oxide thin films, Thin Solid Films, 442 (2003) 48–52.
26. Ray, S.C., Preparation of copper oxide thin film by the sol–gel-like dip technique and study of their structural and optical properties, Solar Energy Materials and Solar Cells, 68 (2001) 307-312.
27. Rajčić-Vujasinović M., Vujasinović D., Stević Z., Bugarinović S., Grekulović V., Elektrohemijska sinteza Cu_2O za primenu u solarnim ćelijama, Ekološka istina, Kladovo, (2009), Zbornik radova, 17-20
28. Bugarinović, S.J.; Grekulović, V.J.; Rajčić-Vujasinović, M.M.; Stević, Z.M. & Stanković, Z.D. (2009). Electrochemical Synthesis and Characterization of Copper(I) Oxide (in Serbian). Hemijska Industrija, Vol.63, No.3, (May-June 2009), pp. 201-207
29. Kunze, J.; Maurice, V.; Klein, L.H.; Strehblow, H.H. and Marcus, P., In Situ STM study of the effect of chlorides on the initial stages of anodic oxidation of Cu(111) in alkaline solutions, Electrochimica Acta, 48 (2003) 1157-1167.
30. Stanković, Z.; Rajčić-Vujasinović, M.; Vuković, M.; Krčobić, S. and Wragg, A.A., Electrochemical synthesis of cupric oxide powder. Part I: Influence of pH, Journal of Applied Electrochemistry, 28, (1998) 1405-1411.
31. Stanković, Z.; Rajčić-Vujasinović, M.; Vuković, M.; Krčobić, S. and Wragg, A.A., Electrochemical synthesis of cupric oxide powder. Part II: Process conditions, Journal of Applied Electrochemistry, 29 (1999) 81-85.
32. Sears, W.M. and Fortin, E., Preparation and properties of Cu_2O/Cu photovoltaic cells, Solar Energy Materials, 10 (1984) 93-103.

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SOLAR PHOTOVOLTAIC PUMPS FOR DRIP AND MINI SPRINKLER IRRIGATION

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ABSTRACT

Solar Photovoltaic (SPV) pumps act vital role in the irrigation field instead of conventional irrigation pumps for upcoming energy crisis. Water scarcity is widespread problem in the world. Therefore it is very important to manage water with high effective manner especially in irrigation sector. One of the best solutions for these two crises would be SPV drip and mini sprinkler irrigation systems. In this paper, a Solar Photovoltaic (SPV) pump operated drip irrigation system and mini sprinkler irrigation system have been analysed considering different land size and different water depths for citrus crop and cotton crop in Roorkee, India. Then analysis carried out for estimating investment cost, life cycle cost (LCC), Levelized cost of water, energy produced by the modules and theoretical used energy by the SPV pumps for each case. For the SPV drip irrigation system, 100 cases and 80 cases for SPV mini sprinkler irrigation system have been analysis.

Key words: Solar photovoltaic pump, drip irrigation, mini sprinkler irrigation, Micro irrigation, Levelized cost of water

INTRODUCTION

Today the process of producing food is very dependent on energy. The dependency on fossil fuels causes the cost of producing crops to increase as the price of fuel increase. Application of renewable energy especially solar energy can provide a solution to this energy crisis and up rising price of energy dependable foods. On the other hand, water scarcity is widespread in the world. Especially countries which are situated in Sunbelt, are suffering more. Most of countries focus on ground water for irrigation and drinking purpose.

The Wold bank says in their latest report that India is the largest groundwater user in the world, with an estimated usage of around 230 cubic kilometres per year, more than a quarter of the global total. With more than 60 percent of irrigated agriculture and 85 percent of drinking water supplies dependent on it [1]. The total number of irrigation pump sets in India during the year 2001 was 12.5 million. In the year 2002-03 the Annual power consumption was 118,059 GWh by agri-pump sets, based on this

information, the number of pump sets works out to 15.7412 Million. It was estimated that about 30 % to 40 % of electrical energy produced in India is consumed by motorized pump sets employed in agricultural sector [2].

Water use efficiency of conventional method of irrigation which is predominantly practice in Indian agriculture, is very low due to substantial conveyance and distribution losses. Recognizing the fast decline of irrigation water potential and increasing demand for water from different sectors, a number of management strategies and programmes have been introduced to save water and increase the existing water use. Micro irrigation (MI) including drip and mini sprinkler irrigation is one such effort. MI is proved to be an efficient method in saving water, increasing water use efficiency and productivity gains as compared to the conventional method of irrigation [3].

Among various renewable energy resources, India possesses a very large solar energy resource which is seen as having the highest potential for the future. Considering use of ground water and abundant solar energy in India, the connection between the high efficient irrigations system, especially drip and mini sprinkler irrigation, and SPV pumping system would be economically and environmentally efficient [4].

Present study is an effort to illustrate variation of energy and investment cost to lift ground water using solar powered pump system for the irrigation purposes. Two variables i.e. 'land size' and 'depth to water table' are taken into account in the analysis. Drip and sprinkler system have been analysed for citrus and cotton crop respectively. The study area considered is in Roorkee of Haridwar district in state of Uttarakhand, India.

FEASIBILITY ANALYSIS

Calculation of water requirement: For the analysis purpose metrological data of Roorkee (29^0 51' 0" N, 77^0 52' 48"E) from 1991-2010 was collected from Agro-meteorological observatory of the Department of Water Resources Development and Management, Indian Institute of Technology Roorkee. Two crops i.e. citrus crop and cotton crops have been considered for analysis. Water requirement for irrigation of these two crops have been estimated. The calculation of evapotranspiration (ET) is the first step of estimation Crop Water Requirement (CWR). CWR for the entire growth cycle, from sowing to harvest of both citrus and cotton were determined using CROPWAT 8.0. Maximum ET of both crops gave in the month May. Table 1 and 2 shows water demand for citrus crop and cotton crop in this month for different land sizes.

Table 1. Water requirement for citrus crops in the month of May

Land (ha)	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
m^3/day	4	9	13	18	22	26	31	35	40	44	49	53	57	62	66	71	75	79	84	88

Table 2. Water requirement for the cotton crops for the month of May

Land (ha)	0.25	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5	2.75	3	3.25	3.5	3.75	4
m^3/day	15	30	45	60	91	91	121	121	151	151	181	181	211	211	226	272

Drip and mini sprinkler irrigation system: In drip irrigation, water is applied frequently at low rate from a low pressure distribution system. Several studies have been demonstrating the design of the drip irrigation system, its advantages, and most suitable crops for use of this method. Also studied on the modelling and optimization of drip irrigation system for optimum capital and operating cost have been found in literature [5-8].

In the sprinkler method of irrigation, water is sprayed into the air and allowed to fall on the ground surface resembling rainfall. The spray is developed by the flow of water under pressure through small orifices or nozzles. Available literature demonstrates about sprinkler method's designing, implementation, maintenance and economy [9, 10]. For the analysis, 100 drip irrigation systems have been studied for the different land sizes from 0.5 ha to 10 ha and for different ground water depths i.e. 10 m, 20 m, 30 m, 40 m and 50 m. The analysis has been done for one month (Month of May) which gives high evapotraspiration. The energy required for lifting water for different sizes of citrus crop lands was obtained. The discharge in litre per hour is calculated using water requirement data (Table 1). The pump operating time is considered to be 5 hour for a day. Required energy in the case of 10 m ground water depth has been calculated using equation 2. The friction loss of main line and laterals was calculated using modified Hazen-William's formula given in equation1,

$$H_L = L * \left(\frac{Q}{C_R}\right)^{1.81} * \frac{1}{994.62 * d^{4.81}} \quad (1)$$

Where, Q is Discharge in m^3/day, C_R is Constant for different pipe materials and d is Pipe diameter in m.

$$required\ energy = \frac{Q * w * H * 0.28}{\eta} \quad (2)$$

Where, w is Unit weight of water in kN/m^3, H is Total water head in m and η is Pump efficiency (In the present case η is 0.4)

The mini sprinkler irrigation systems have been analysed for the different land size from 0.25 ha to 4 ha and for similar ground water depths as for drip irrigation system. The energy required for lifting water for different sizes of cotton crop lands was obtained for the month of May. Pump operating time considered here is 5.5 hours per day. 80 different types of cotton crops have been analysed. The required energy and static head in the case of 10 m ground water depth are calculated.

Solar pump and PV array system: It is assumed that the photovoltaic systems are mounted horizontally and do not incorporate any sun tracking. The topography of land is flat and appropriate for the crops. The ground water is suitable for irrigation and no need to use filtration methods. In the cost analysis, only SPV panel and pump system has been considered.

DC motors are preferable for the PV applications, because they can be directly coupled to the PV array output. The most common pump types are DC submersible pumpset, DC surface mounted centrifugal pumpset, DC floating pumpset [11]. According to the static head and required flow, the submersible pump which are available in the market, were selected for both drip and mini sprinkler irrigation.

PV modules capacity ranging from 10 W_p to 230 W_p, are commonly available in Indian market. In this study 230 W_p modules have been considered. Following equations are used to calculate the number of modules [12].

$$No.\ of\ Panels\ required = \frac{P_p}{\eta_s \times P_{pp} \times I_{av}}, \quad Where, P_{pp} = I_{mpp} V_{mpp} * [1 - 0.0031 * (T_c - T_{ref})]$$

Where, P_p is daily energy requirement to lift water; η_s is overall efficiency due to insolation times, wiring etc; I_{av} is average solar radiation in kWh/m^2/day; P_{pp} is power output per panel;

I_{mpp} is current at maximum peak power; V_{mpp} is voltage at maximum peak power; T_c is maximum temperature on panels and T_{ref} is reference temperature (25^{0}C). Value of I_{mpp}, V_{mpp}, T_{ref} are provided by the manufacturer for respective module. The serial numbers of panels out of total were calculated in accordance with pump operating voltage.

Life Cycle Cost analysis: In order to compare different systems offering the same output the life cycle costing approach is used. This approach allows systems to be compared on an equal basis by placing all future costs at their present values, which occur at different intervals of the systems life [13]. Total life cycle cost of pump system is the sum of capital cost, maintenance and replacements in life time. Levelized cost of water has been computed for all cases in both irrigation systems. The life cycle cost of a solar PV system requires the initial capital investment (C_0), the present value of operation and maintenance costs (OM_{pv})

$$LCC = C_0 + OM_{pv} + R_{pv}$$

Operation and maintenance costs includes if any taxes, insurance, maintenance, recurring costs, etc. It is generally specified as a fixed cost. Replacement cost includes only replacement of the pump with 10 year life time. The other parameters used in the economic evaluation are; 20 years life time; discount rate 10%; escalation rate 7.5%. Cost analysis of this study has been carried out based on complete SPV water pump set including all accessories. The results of calculations for the feasibility analysis for the case of 10 m ground water depth are shown in Table 3 and Table 4 respectively for Drip and Mini sprinkler irrigation system. The results of calculations for the feasibility analysis for the case of 10 m ground water depth are shown in Table 3 and Table 4 respectively for Drip and Mini sprinkler irrigation system. For the SPV drip irrigation system, total static head, and energy requirement has been calculated for 20 sizes of citrus crop lands having 10 m ground water depth. For mini sprinkler system the calculations have been done for 16 sizes of cotton crop lands for same ground water depth. The other calculations includes maximum energy required, no. of 230 W_p modules, the investment cost of the system, LCC, Levelized cost of water and percentage of used energy. It is observed that for both irrigation systems used energy do not exceed 50% of produced energy by the solar modules. Main reasons are; systems have been designed for maximum water demand and variation of water demand according to meteorological parameter of the location especially effect of rainfall. In monsoon season sufficient rainfall is available for the both crop. Pump operation is not required in monsoon season.

Table 3. Details of SPV pump system of drip irrigation for the 10 m to water depth

Land (ha)	Discharge (LPH)	Static head (m)	Required max. energy (Wh/day)	No of 230Wp panels (Round up)	Investment cost (Rs)	LCC (Rs)	Rs/m^3	Percentage of used energy
0.5	646	25.307	766.9	1	243,478.00	282,067.00	23.45	27.7
1.0	1292	25.633	1552.6	2	243,478.00	282,067.00	11.72	27.9
1.5	1937	25.974	2358.5	2	244,398.00	283,133.00	7.85	42.1
2.0	2583	26.389	3193.0	3	245,824.00	284,785.00	5.92	37.8
2.5	3229	26.818	4053.6	3	274,298.00	317,772.00	5.28	47.7
3.0	3874	27.304	4949.1	4	343,942.00	398,454.00	5.52	43.4
3.5	4520	27.89	5893.1	5	343,942.00	398,454.00	4.73	41.0
4.0	5166	28.782	6942.3	6	343,942.00	398,454.00	4.14	39.8
4.5	5807	28.049	7612.5	6	502,964.00	582,679.00	5.39	44.1
5.0	6453	28.442	8572.7	7	505,448.00	585,557.00	4.87	42.4
5.5	7098	28.854	9562.3	7	505,448.00	585,557.00	4.43	47.0
6.0	7744	29.286	10582.7	8	722,430.00	836,929.00	5.80	45.3
6.5	8390	29.739	11636.1	9	722,430.00	836,929.00	5.35	44.0
7.0	9036	30.284	12753.2	10	722,430.00	836,929.00	4.97	43.2
7.5	9681	30.913	13938.7	11	722,430.00	836,929.00	4.64	42.6
8.0	10327	31.49	15136.4	11	10,42,314.00	12,07,512.00	6.28	46.0
8.5	10973	31.983	16326.0	12	10,42,314.00	12,07,512.00	5.91	45.2
9.0	11614	32.612	17608.6	13	10,423,14.00	12,07,512.00	5.58	44.7
9.5	12260	33.255	18942.3	14	10,423,14.00	12,07,512.00	5.29	44.4
10.0	12905	33.957	20347.8	15	10,423,14.00	12,07,512.00	5.02	44.2

Table 4. Details of SPV pump system of sprinkler irrigation for the 10 m to water depth

Land (ha)	Discharge (LPH)	Static head (m)	Required max. energy (Wh/day)	No of 230Wp solar panels (Round up)	Investment cost (Rs)	LCC (Rs)	Rs/m3	Percentage of used energy
0.25	2743	30.387	2798.3	3	2,74,298.00	3,17,772.00	17.16	15.2
0.50	5486	31.071	5722.5	5	5,02,964.00	5,82,679.00	15.74	18.7
0.75	8229	32.180	8890.2	7	7,22,430.00	8,36,929.00	15.07	20.7
1.00	10972	32.919	12125.8	9	7,22,430.00	8,36,929.00	11.30	22.0
1.25	13715	32.183	14818.3	11	7,26,110.00	8,41,192.00	9.09	22.0
1.50	16458	32.857	18154.4	14	10,42,314.00	12,07,512.00	10.87	21.2
1.75	19201	33.631	21679.1	16	11,97,058.00	13,86,781.00	10.70	22.1
2.00	21944	34.514	25426.6	19	17,70,310.00	20,50,888.00	13.85	21.8
2.25	24687	34.140	28295.0	21	17,70,310.00	20,50,888.00	12.31	22.0
2.50	27430	34.839	32082.5	24	17,70,310.00	20,50,888.00	11.08	21.8
2.75	30173	35.597	36058.6	27	17,70,310.00	20,50888.00	10.07	21.8
3.00	32916	36.415	40240.6	30	17,70,310.00	20,50,888.00	9.23	21.9
3.25	35659	37.297	44649.9	33	22,60,946.00	26,19,286.00	10.88	22.1
3.50	38402	38.245	49306.7	36	22,60,946.00	26,19,286.00	10.10	22.4
3.75	41145	40.380	55777.7	41	22,62,786.00	26,21,417.00	9.44	22.2
4.00	43888	41.672	61399.9	45	22,62,786.00	26,21,417.00	8.85	22.3

RESULT AND DISCUSSION

Same calculation proceeds for the different water aquifer depth (i.e. 20 m, 30 m, 40 m and 50m) and to select the SPV pump system to match the requirements. Total investment cost for 20 sizes of land for different water depths are shown graphically in Figure 1. Variation of 'levelized cost of water' with 'variable land sizes' and 'different ground water depth' are shown in Figure 2. Same as for drip irrigation system, analysis was carried out for SPV mini sprinkler irrigation. Results are show in Figure 3 and Figure 4.

Many state governments in India provide subside for the farmers by 80% of scheme cost up to 10 lakh for the solar pumps [14]. Therefore, the capital cost of SPV pump system up to 10 lakh, is significant for the farmers. Figure 1 shows that if water table within 10 m, SPV pump system could supply sufficient water for 8.5 ha of citrus crop constraining 10 lakh of investment cost. Further if water table drawdown up to 20 m, 30 m, 40 m and 50 m cultivatable land size decrease up to 8 ha, 6.5 ha, 6 ha, and 4 ha respectively for the same amount of investment.

In the case of mini sprinkler irrigation system, if the irrigated land limited to 1.5 ha, 1 ha, 1 ha, 0.5 ha and 0.25 ha for the water depth of 10 m, 20 m, 30 m, 40 m, and 50m respectively then the investment cost could be kept within 10 lakh margin. The plot in Figure 2 demonstrates it. It can be observed that as compared to drip irrigation system, mini sprinkler system requires more investment.

Figure 3, shows that, when increasing the land size, the levelized cost of water decrease for drip irrigation system. Figure 4 again shows the similar decreasing trend for levelized cost of water with land size for Mini sprinkler system. It can be viewed that in the case of mini sprinkler irrigation system, decreasing rate is less compared to drip irrigation system.

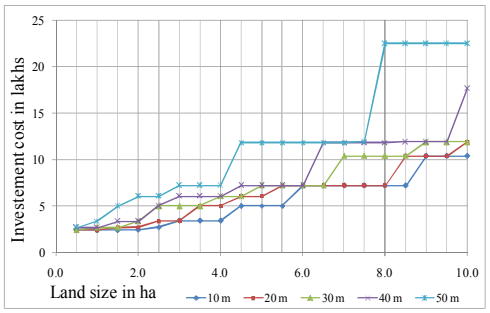

Figure 1. Investment cost for PVS pump system variation with land size and depth to water

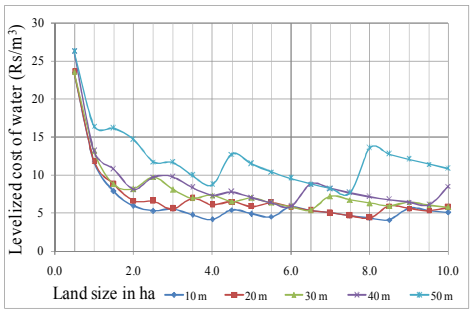

Figure 2. Levelized cost of water (Rs/m^3) variation with land size and depth to water for solar drip irrigation system

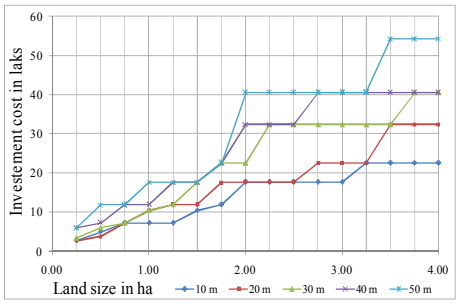

Figure 3. Investment cost for PVS pump variation with land size and depth to water

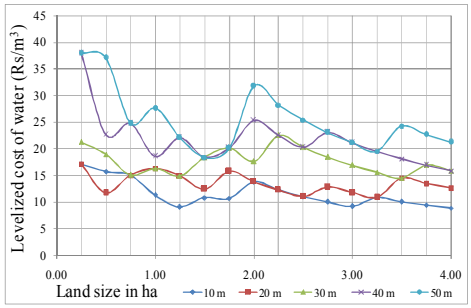

Figure 4. Levelized cost of water (Rs/m^3) variation with land size and depth to water for solar powered sprinkler irrigation.

CONCLUSION

In this paper, a feasibility analysis on solar Photovoltaic (SPV) pump operated drip irrigation system and mini sprinkler irrigation system have been presented. Different land size and different water depths for citrus crop and cotton crop have been considered in the analysis for the study area in Roorkee, (Uttarakhand) India. Keeping the fact in mind that Indian government provides a subside of 80 percent for an investment up to rupees 10 lakh for solar pump set system, the analysis provides conclusions for the farmers to apply these systems so that these systems prove to be economic for them. This paper has been studies economical feasibility for different size of land i.e. for drip irrigation system from 0.5 ha to 10 ha and mini sprinkler irrigation from 0.25 ha to 4.0 ha. The study concludes that SPV pumping system for drip irrigation system favours to 6.5 ha land size for citrus crops and 30 m maximum depth to water. For the mini sprinkler irrigation for cotton crops, favourable land size would be 1.0 ha to 1.5 ha for 10 m water depth. Excess energy of the system shows requirement of further study for use of excess energy to optimization of the system.

REFERENCES

1. World Bank, 2010 "Deep Wells and Prudence: Towards Pragmatic Action for Addressing Groundwater Overexploitation in India", pp ix, World Bank, Washington USA
2. European Commission, 2007 "India's Role in World Agriculture", Monitoring Agri-trade Policy (MAP) No. 03-07, pp 3.
3. Narayanamoorthy, "Potential for Drip and Sprinkler Irrigation in India" <http://nrlp.iwmi.org/PDocs/DReports/Phase_01/12.%20Water%20Savings%20Technologies%20-%20Narayanmoorthy.pdf> [accessed on 18.03.2011]
4. Leach C. Kelley, Eric Gilbertson, Anwar Sheikh, Steven D. Eppinger, Steven Dubowsky, 2010 "On the feasibility of solar-powered irrigation", Renewable and Sustainable Energy Reviews 14 (2010) pp 2669-2682, Elsevier Ltd,

5. A.M. Michael, 2009 "Irrigation Theory and Practice", Second edition, pp 611-660, Vikas Publishing House Pvt Ltd, New Delhi.
6. P. T. Wu, D. L. Zhu, J. Jin and W. P. Niu, 2010 "Design of drip irrigation lateral for optimum capital and operating cost" Water Science & Technology: Water Supply-WSTWS (10.6), 943-95, IWA publishing.
7. Hathoot, H. M., Amoud, A. I. & Mohammad, F. S., 1993 "Analysis and design of trickle- irrigation laterals", J. Irrig. Drain. Eng. ASCE 119(5), 756–767.
8. Numan Mizyed, 2002 "Numerical analysis to solve the hydraulics of trickle irrigation units", Irrigation and Drainage Systems 16, pp53–68.
9. A.M. Michael, 2009 "Irrigation Theory and Practice", Second edition, pp 578-610, Vikas Publishing House Pvt Ltd, New Delhi.
10. Indian National Committee on Irrigation and Drainage, 1998 "Sprinkler irrigation in India",pp. 51-76, WAPCOP (India) Limited, New Delhi.
11. R.K. Pachauri, 2008 "From Sunlight to Electricity", pp 75 Teri Pres, New Delhi
12. D. Uogi Goswami, Frank Kreith, Jan F. Kreider, 1999 "Principles of Solar Engineering", Second edition, pp 425-443, Taylor & Francis USA.
13. Ministry of Mines and Energy- Namibia, 2006 "Feasibility Assessment for the Replacement of Diesel Water Pumps with Solar Water Pumps", pp 14,
14. "Raj govt to roll out Rs 515 crore solar water pump project", <http://www.business-standard.com/india/news/raj-govt-to-roll-out-rs-515-cr-solar-water-pump-project/94396/on> [accessed on 18.03.2011]

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DEVELOPMENT OF ON-LINE SYSTEM TO CONTROL FACILITY FOR ACHIEVING ENERGY EFFICIENCY

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ABSTRACT

The rapid development and expansion of the global Internet computer network opens the possibility of use and implementation of measurement systems and systems for monitoring and control. This option becomes particularly attractive in the case of collection of measurement data from a large number of physically significantly remote measuring points. Modern information and communication technologies enable application of new approaches in the process of energy system of supervision and management. This paper presents concept and design of the on-line object monitoring. Observation of the object was conducted in laboratory conditions while online monitoring was performed using the software package, Active WebCam.

Key words: Energy efficiency, thermal imaging, Internet

INTRODUCTION

It is particularly important that using these technologies (eg, Web and mobile communications) in a quick and easy way, it can be accessed to important information during the monitoring of a plant or a facility. Web portals that integrate specialized services for displaying and analyzing data is one of the modern solution for monitoring and control of production and consumption. In addition to collecting data services should allow their analysis and visualization including the following the trends, as well as printing the appropriate reports. The thermal imaging surveillance systems are already widely used In developed European countries. In this way it is possible to implement remote reading (ie, acquisition) of all essential temperatures in the process of the observed object.

Objective monitoring and presentation of the structure is possible by analyzing the thermal imaging clip that provides full distribution of temperature field of tracked objects. Considering the system complexity mobile thermal imaging surveillance system has been developed, consisting of:

- Thermal Imager
- TV card
- PC or mobile (notebook) computer.

It is required to install some software for processing IR Snap View Pro and review of the video signal from the camera, On the acquisition computer in this case, allowing the transfer of thermal imaging camera images.

For the purpose of mobile surveillance systems, it is important that the camera has a video output NTSC / PAL composite video. A TV card is installed on the data acquisition computer (TV Tuner 7131RF, manufacturer Kworld Co..), with has a composite video input. Since the thermal imager has a video output, camera is connected to the acquisition computer through the aforementioned TV tuners by composite video cable. In this way the acquisition computer in real-time records video from the thermal imaging camera, figure 1.

The recording is in MPEG format, resolution 320 x 240 pixels. For this you need to use data acquisition computer with enough internal memory for storing a camera video recording, which can be the limit. Thus obtained video material can be recorded in an appropriate medium, archived and further processed.

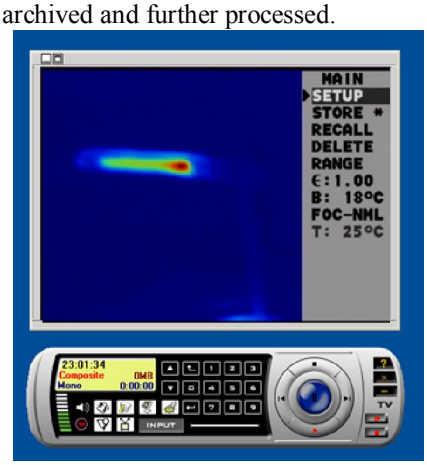

Figure 1. Sequence of video recording of the object

Computer-aided monitoring using the Internet data network enables instant determination of system condition and their working ability. On the Web site, formed by the user, with the help of browser, it is possible to monitor directly the condition of temperature, ie. follow thermal process using thermal imaging cameras, from any point and at any time. The simplest solution for transferring images to a server is via FTP *(File Transfer Protocol*) protocol.

Direct transmission of compressed video material causes delays of the video signal, of even 5 seconds during the transmission through the local network, and the picture from an infrared camera, using the *Active WebCam* making actived by *PY Software* remembers as a JPEG image and each second to sends server via aforementioned FTP protocol, [1]. The images from camera is displayed on a Web page as a static image, with the Web pages code set to be refreshed every second. User in his Web browser sees pictures that change on the page giving the impression of watching videos. This solution almost has no delay.

The given software provides a wide range of tools for image processing and further re-emission. Remote monitoring of a process whose temperature and heat are

measured and monitored using an infrared camera could be achieved in two ways. First, as mentioned, via Internet so it requires Web server and a dynamic Web page where the video material is to be shown. The data acquisition computer, with attached infrared camera should be connected to a central computer via a network infrastructure (wired or wireless) that would be running a Web server. Selecting computer linking to a large extent depends on the computer conditions and the distance between them. Access to the page can be made public or be limited to certain users. To be view requires fast Internet connection and monitoring is possible at any time and from any place, where you can access the Internet, simply by using a Web browser without any additional software.

Another way is based on the approach of using a computer acquisition of software for remote access. The idea is that review not to be public, but only used internally within the work organization in which the object is warming, or the process followed. This type of remote monitoring does not require central computer, but on each acquisition computer to install some software for remote access and server part, and on computers from which we want to access the computer acquisition the client software for remote access, using the *Active*WebCam. Similarly access here also is performed either via network infrastructure (wired or wireless) or through phone lines.

POSSIBILITY OF SOFTWARE PACKAGE ACTIVE WEBCAM

Active Webcam covers all uses of video cameras. It captures images at 30 frames per second, allowing users to watch streaming broadcast via FTP or Web server on the Internet. Web camera is required for the program operation. Video camera, used in this case is the thermal imager as well as corresponding card with video input. The software enables end-users to view video from the camera in any Web browser, archive formats such as AVI or MPEG remain in the acquisition computer [2].

In the case of monitoring facilities, analysiing images from a video camera, Active WebCam registers unmistakably every movement in the visual field, and can be programmed to sound an alarm, send e-mail alert message, continue recording or broadcast it on the Web server. There is an option to enter a date, time of recording on each picture, where you can add a short text (identification number of the camera, object, etc.)..

If the Web page with video material is set up emitting Active WebCam, the program can register everybody reviewing shot and registring its IP address. Demanding users are offered a programmed recording at specified intervals, the special channel to access the camera from the remote computer on the Internet, photo gallery of the important moments, possibility to restrict the number of users who have the right to watch clips, and support for working with multiple cameras.

After the program starting the display window appears offering to create camera *Create New Camera* (with the set parameters of the camera), if the program did not recognize the camera, there is an option *Cameras Search* that will find the currently connected camera, *Open All Channels Video Capture* window displays the video material of all connected cameras, *Open Session* openes some of the previous session that already contains all the settings. To create a Web page which will be show video material in real time there is the option *Create a Web Page,* Figure 2

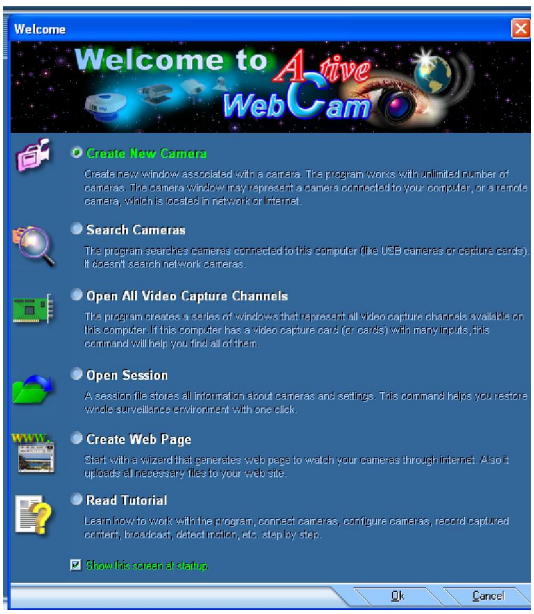

Figure 2. „Welcome" window

The most important adjustment is creation of new camera and setting its parameters. If there are more surveillance cameras each should be set and its signal appears in the main window. When thermal imager is connected on previously explained manner, its video display appears on the screen in the Preview section. Next step is to define ways to transfer video and audio camera signal between Internet users and users in the LAN.

After setting up cameras and signal transfer, it is to create a Web page that will allow users to monitor the Internet video cameras in real time. When you create a Web page you choose the way in which users can view the clip. The program can run a Web server on the acquisition computer and each user who access it can see the footage. Then the program can load a Web page on a web site via FTP, so you need a web hosting service with FTP access. The third option is to copy image to a folder on your computer, and then the image can be viewed.

To anable user to see video it is necessary to decide on ActiveX, JavaScript or Fire Still Image or to refrese static image while to determine the time interval that will be executed. After all the settings have been done on Figure 3 you can see the look of the generated Web site for continuous monitoring thermovision.

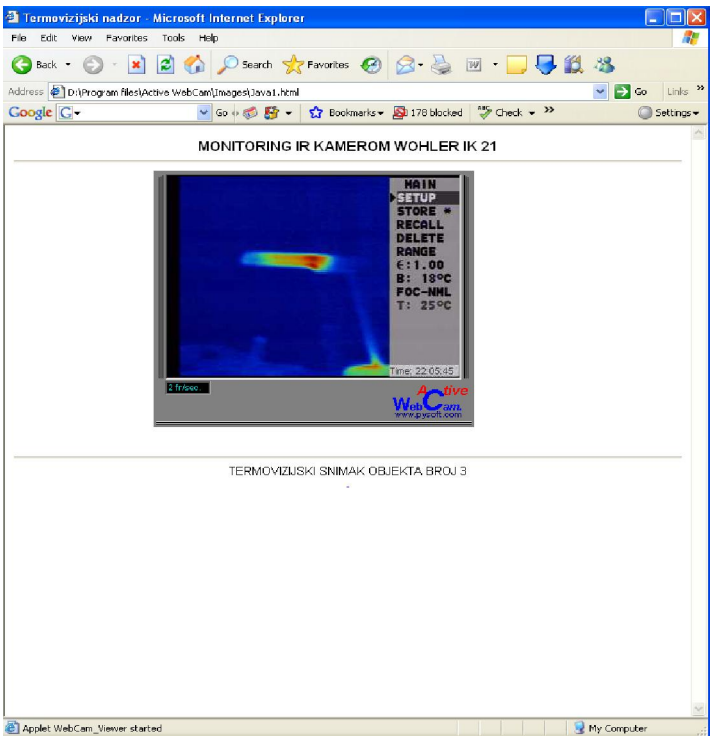

Figure 3. Website of continuous thermal imaging surveillance

If we have more cameras we can record video clips and photos. Intervals activities on a daily basis can be determined for each camera. By determining the areas where movement is expected it can be determined by motion detection (motion detection), with the possibility of sending an alarm buzzer, sending e-mail messages, record a video of a selected duration, taking photos, performing a specific program and the like.

Thermal imaging camera is controled by software package SnapView Pro sends a signal to camera to record an object in a certain period of time and switch to an earlier recording folder defined. All activities are monitored in real time on a Web page. Access to a certain camera may be limited to certain users or remote computers by defining passwords.

CONCLUSION

Using thermal imaging in preventive maintenance of facilities, maintenance becomes faster, easier and better, and therefore more economical. The possibility of contactless detection of damaged position is the major advantage over previous conventional methods that physically disrupt the structure of the object or damage it. The tested object can work undisturbed during the testing, since it required only visual contact. With the help of computer system received data can be easily processed.

The formation of thermal images and gathering information on the temperature nowadays looks very simple, but in fact, it is more complex than it appears. A person who uses an infrared camera has to understand how it operates, and to be familiar with examining the subject, to know how heat is transferred within and on the surface of the object and how to adjust the camera settings according to conditions prevailing in the environment to the details in the picture are precise as possible . Finally, he should prepare an accurate report for staff, who otherwise would not have to know anything about thermal imaging, and easy understandble. As with any method of non-destructive for interpreting collected information it is necessary adequate training and experience.

Computer-directed system wile thermovision opportunities, way of configuring and puting in to function presented in the paper, allows the introduction of new, very powerful technology for monitoring, diagnosing, preventive maintenance and operation of different processes. The presented system enables remote monitoring of temperature fields using data transmission over the Internet or remote access over an internal network (wired or wireless). On-line diagnostic facilities are still largely in the research stage and should be confirmed in practice. And when you confirm its application, its results and recommendations will be supporting tool for decision making on the implementation of further steps in the equipment maintenance, but it will not be the one to make decisions.

REFERENCES

1. Ranđić S., Mitrović N., Dostanić A., Dragićević S., Krneta R., Peulić A., Razvoj sistema termovizijskog nadgledanja, Zbornik radova, rad ML2.6., ETRAN 2007, Igalo
2. ActiveWebCam,PYsoft,UserManual, www.pysoft.com/activewebcammainpage.htm

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THERMOVISION ASSESSMENT OF ENERGY EFFICIENCY OF A SCHOOL BUILDING

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ABSTRACT

In a global economic crisis era, energy efficiency of public dwellings becomes a must. In overall schooling system in Serbia, material savings that could be achieved in heating through reducing thermal loss could, in a way improve school-children's health and decrease total illness rate during a winter season. Objective of this paper was to assess energy efficiency of a certain school building, by using a thermovision method. Results show that temperature measurements undergone in all classrooms were below the given norms. Critical spots at which thermal loss could be achieved were observed: loose window tightening, inadequate building insulation, insufficient finishing of internal and external wall surfaces, existing of thermal cold bridges. Conclusion: the building shows energy inefficiency, indicating need for further interventions according to legal standards and procedures.

Key words: thermovision, energy efficiency, school hygiene

INTRODUCTION

Global economic crisis together with limited state budget set an urgent need for energy saving in all huge public buildings, with a special accent on school facilities, due to enormous annual heating expenses. Knowing the fact about children's high vulnerability to thermal discomfort, it is necessary to obtain a sustainable thermal comfort zone in all working rooms (classrooms, gym, laboratories). Also, it is important to fulfill the transposition of all relevant EU Directive, due to the process of accession.

Three EU Directives are important for the building sector, in the field of thermal protection, energy saving and environmental protection: Construction Products Directive 89/106/EEC on levelling of adopted regulations and decisions of member states concerning construction products [1], Directive 93/76/EEC on limitting carbon dioxide emission by improving energy efficiency (CO_2) [2] and Directive 2002/91/EC

on the energy performance of buildings [3]. According to this Directive, looking from the energy status point of view, building counts as an energetic entity. It includes energetic characteristics of the building and architectural structure and elements, together with all indoor energy equipment of the facility (heating system, hot water preparation, lightening, cooling, ventilation etc.).

Within Serbial legal framework, improving energy efficiency is one of five priorities defined by the Programme on the Development of the National Strategy on Energy Efficiency until 2015 [4]. A By-law on Energy Efficiency of buildings in the process of addoption in 2011 will define the legal need for each building to obtain an Energy Efficiency Certificate - „energy passport". It is determined that half of the total CO_2 emissions is generated by the buildings, which is two-fold the concentration originated from vehicle and airplane exhaust. The way building has been built, insulated, existing heating & cooling system, as well as the fuel type are factors defining the CO_2 emission. „Energy-saving passport" indicates possible future improvements in energy efficiency, aiming to overall reduction of energy consumption. All public and state-owned buildings should obtain a „passport" of this type, while buildings with the surface beyond 1000 m^2 will have to point it out on a prominent spot.

Thermovision is one of the methods used for the building's energy efficiency assessment. It is ideal for quick and effective energy loss analysis for each heating system, as it is founded on the fact that each body emanates heat. The waves from infrared region of the electromagnetic spectrum are transposed to colours of the visible region by the thermovision camera, making them visible for the human eye. Due to its high temperature resolution, thermovision camera visualises in details insufficient insulation, thermal cold bridges, damages and badly condusted construction work, in the field of building construction [5].

Typical threats to energy efficiency in buildings are (Figure1):

Building structure: 1. energy loss via roof surface,
2. energy loss via windows,
3. outdoor wall insulation,
4. energy loss via basement's cieling and floor

Behaviour: 5. losses due to inconvenient ventilation

Heating system: 6. energy loss via heating system.

Figure 1. Weaknesses concerning energy efficiency

OBJECTIVES

The objective of the paper was to assess energy efficiency of the school building by using thermovision camera shooting of the building construction and architectural elements.

METHODS

On the demand of the director of Primary School „Sveti Sava" in Pancevo a energy efficiency thermovision control of the building was undertaken, during the heating season. He complained that classrooms stayed cold besides the good quality of the central heating system.

An infrared camera Wohler IK 21 has been used for the purpose. Software package SnapView Pro v.2.1 has been used for data [6]. A certified thermohygrometer was used to measure ambient air temperature and relative humidity, type TFA Dostmann/Wertheim V11ATX7N.

Statistical data processing was obtained in an SPSS, v.13.0 software.

Indoor and ambient air temperature and relative air humidity, together with wind direction and speed were monitored during the thermovision process. Meteorological data were taken from an automatic station of the Hydro-meteorological service, located in Pancevo.

Some 52 shots were taken of classrooms orientated to all globe directions. The same rooms were shot from both indoor and outdoor views. The shooting has taken place indoors in 5 rooms, as well as outdors from 12:30h to 15:20h.

RESULTS

The school examined was a one-story building. It was constructed in 1989. The external wall surfaces were made of brick facade siding, while in some classrooms the same material was used on inner walls, as well. Plastic tiles flooring was found in all classrooms. Corridors and sanitation facilities were paved with ceramic tiles. All classrooms had wooden window seals, highly wared-off. Cieling in two classrooms was partially furnished with wood panels.

Table 1. Meteo data for February 2nd 2011. Pancevo

time (h)	temp (^{0}C)	pressure (mb)	humidity (%)	wind speed (m/s)	wind direction
11:10:01	-7.6	1021.4	90.4	1.5	W
12:25:01	-7.8	1020.4	89.3	1.9	SW
13:25:01	-7.6	1019.4	88.8	1.9	W
14:20:01	-7.3	1019.9	88.9	0.9	S
15:20:01	-7.4	1020.1	89.7	1.3	N

Indoor temperature and relative humidity measurements were conducted on two spots: the first one was along the window, and the other one just opposite, siding the wall of the classroom. In all rooms radiators are located below the window.

Results indicate that room temperature ranged from minimal 16,0^{0}C to maximal 20.0^{0}C. The mean value of indoor air temperature along the window was 18,0±0,9 ^{0}C, while it was 18,1±1,7 ^{0}C at the opposite side (Table 1). In three rooms the measured temperature was lower opposite to the radiator and the window. Only at one of the spots temperature was in line with given legal norms (20^{0}C) [7], while it was lower than it shold be at other measuring spots.

Table 2. Indoor air temperature and relative humidity results

Sampling site	T_1	T_2	RH_1	RH_2
1	18.2	20.0	35	30
2	16.9	16.0	33	35
3	18.2	18.5	32	31
4	19.3	18.6	31	31
5	19.2	17.4	31	30
	T_{av}	T_{av}	RH_{av}	RH_{av}
	18.0±0.9	18.1±1.7	32.4±1.7	31.4±2.1

T_1 , RH_1 – temperature and relative humidity along the window
T_2 , RH_2 – temperature and relative humidity opposite to the window
T_{av}, RH_{av} – average temperature and relative humidity

The following critical points were spotted:

1. Loose window tightening – Figures 2 - 4.
2. Inability to conduct natural ventilation due to nailed window seals of numerous windows (Figure 5).
3. Indoor and outdoor wall furnishing – brick facade siding (Figure 6,7).

Figure 2. Window critical points

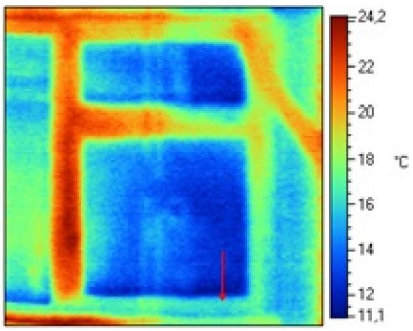
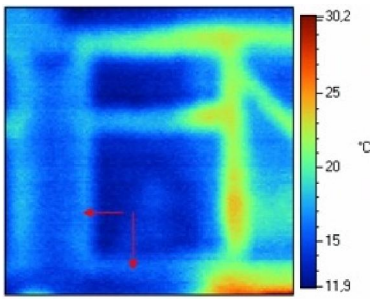
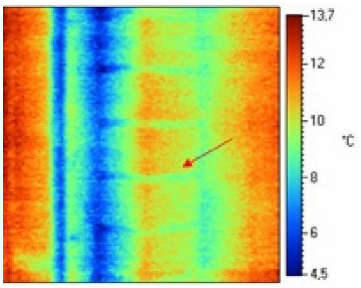


Figure 3. Loose window tightening



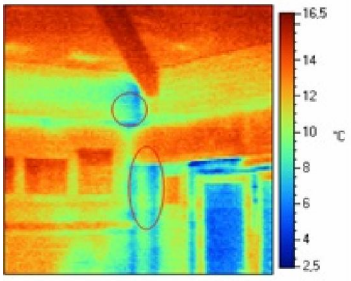
Picture 4. Large heat loss

Picture 5. Inability of window opening



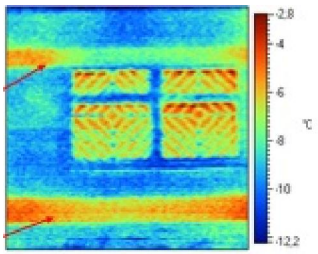
Picture 6. Heat loss through brick facade siding

Picture 7. Inner brick facade siding



Picture 8. Thermal cold bridges (indoor)

Picture 9. Thermal cold bridges (indoor)



Picture 10. Thermal cold bridges (outdoor)

Picture 11. Thermal cold bridges (outdoor)

DISCUSSION AND CONCLUSION

Large heat loss indicates energy inefficiency of the building. Indoor air classroom temperatures are below given legal norms. Heat loss occurs due to: wared-off window seals, loose window tightening and inadequate insulation of the building.

The problem could not be solved just with shutting the surface between glass and wood by a sillicone spread, as the wooden window seal is over-dried, and a number of windows could not be shut at all. On the other hand, natural ventilation is impossible due to nailing of the window seals. Large heat loss is measured in the rooms covered with inner facade brick siding, and in ones with cieling concrete rafters, as well.

Total window renovation of windows in the building is needed. Insulation improvement could be done through the following procedures: plaster the indoor walls, put additional insulation panels where concrete rafters are located.

REFERENCES

1. Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of the Member States relating to constructions product.
2. Council Directive 93/76EEC of 13 September 1993 to limit carbon dioxide emissions by improving energy efficiency (SAVE) (Official Journal L 237, 22/09/1993)
3. Directive 2002/91EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings (Official Journal L 001, 04/01/2003).
4. Strategy for the Development of Energy Sector in Serbia until 2015. http://www.mem.gov.rs/
5. Stević Z, Rajčić-Vujasinović M, Antić D. Applied Thermovision. Technical faculty in Bor, University of Belgrade: 2008.
6. Nikolovski D, Stevic Z, Konstantinović-Birovljev B. Infrared thermovision in public health screening. International scientific symposium „Infoteh-Jahorina 2008" BIH. Jahorina, 2008. Book of Abstracts http://www.infoteh.rs.ba/zbornik/2008/
7. By-law on the norms for school facility, equipment and training tools for primary schools (Official Gazette of Republic of Serbia N^{o} 4/90).

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TRENDS IN ELECTRICAL VEHICLES DEVELOPMENT

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ABSTRACT

Critical component in every hybrid or purely electrical vehicle is energy storing. Possible solutions are accumulators, supercapacitors, flying wheels, hydraulic devices and new special materials for hydrogen storing. It was already mentioned that accumulators have specific power problem. Flying wheels are still in development same as energy storing using hydrogen, so substantial technological improvements are needed before they can be put in use. Supercapacitors are only available technology today that can provide high power (over 1kW/kg) and great cycle numbers at acceptable price. Supercapacitors have other properties that makes them interesting in hybrid vehicles, and it's ability of complete regeneration of energy of braking (so called regenerative braking), which increases energy efficiency, no special maintenance needed, great utilization of electric energy, small toxicity and easy storage after use. In this paper theoretical base is presented, practical realization and use feasibility of supercapacitors in block of electrical vehicle power supply in combination with accumulator batteries or with fuel cells.

Key words: electrical vehicles, supercapacitors, ecology, regulation

INTRODUCTION

Electric drive vehicles present one of the most important technological advances having in mind spread of this kind of nature pollution. Lately there is increased world interest for so called hybrid vehicles that have reduced fuel consumption and much less pollutants emission than regular vehicles. Hybrid vehicles can in broadest sense be described as vehicles utilizing combination of production and storage of energy [1]. Good properties of conventional vehicles are combined (long range and acceleration, very good supply network) and electrical vehicles (zero emission, quiet operation, regenerative use of braking energy).

In next five years electrical and hybrid vehicles may became real alternative to classical vehicles in big cities, as shown by research done by consultant company „Mc Kinsey & Company". New York plans about 70.000 electrical vehicles in 2015 their number in new registered vehicles of 16 percent. Paris is planning for 60.000 and Sanghai 25.000 such vehicles.

Research showed that it is not required to build network of charging stations to increase sale of electrical vehicles, since users are ready to charge its vehicles batteries at home. As a next step could be a possibility of supermarkets, parking stalls and restaurants to offer their clients charging stations. Very good solution is exchange empty for charged accumulator batteries at the specialized stations.

Important factor to bring political decisions is a public opinion as well. So it is very important to raise global ecological awareness and wider public education in that sense. Goal of this paper is to bring closer to reader new drive technologies that are intended to environment and nature protection in all.

SUPERCAPACITORS vs. ACCUMULATOR BATTERIES AND FUEL CELLS

Supercapacitors are relatively new type of capacitors distinguished by phenomenon of electrochemical double-layer, diffusion and large effective area, which leads to extremely large capacitance per unit of geometrical area (in order of multiple times compared to conventional capacitors). They are taking place in the area in-between lead batteries and conventional capacitors. In terms of specific energy (accumulated energy per mass unity or volume) and in terms of specific power (power per mass unity or volume) they take place in the area that covers the order of several magnitudes. Supercapacitors fulfill a very wide area between accumulator batteries and conventional capacitors taking into account specific energy and specific power [2]. Batteries and fuel cells are typical devices of small specific power, while conventional capacitors can have specific power higher than 1MW/dm^3, but at a very low specific energy. Electrochemical capacitors improve batteries characteristics considering specific power or improve capacitors characteristics considering specific energy in combination with them. In relation to other capacitor types, supercapacitors offer much higher capacitance and specific energies, as illustrated in Figure 1.

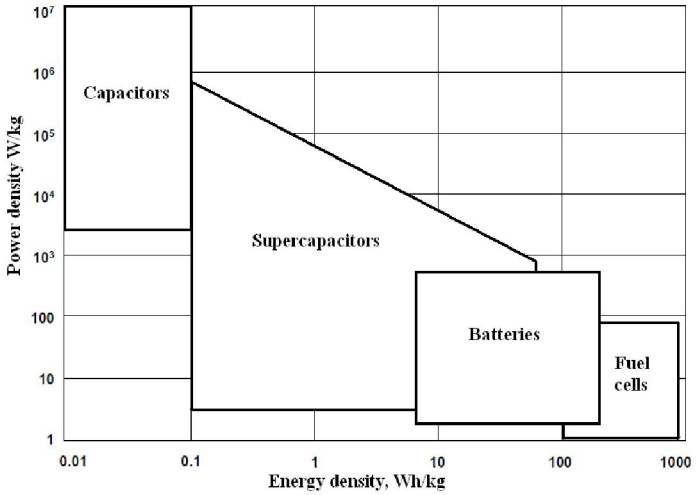

Figure 1. Area diagram for various energy storage systems

Accumulator batteries and low temperature fuel cells are typical devices with low specific power, where conventional capacitors may have specific power over 1MW/dm^3, but at very low specific energy. Electrochemical capacitor can improve characteristics of batteries in terms of specific power and improve properties of capacitors in terms of specific energy when they are combined with them [3].

The principal supercapacitor characteristic that makes it suitable for using in energy storage systems (ESS), is the possibility of fast charge and discharge without lost of efficiency, for thousands of cycles. This is because they store electrical energy directly. Supercapacitors can recharge in a very short time having a great facility to supply high and frequent power demand peaks [4].

Data given in Table 1 clearly show supercapacitor characteristics that make those devices adequate for purposes requiring great specific energy and great specific power combination or long lifetime denoted by charging and discharging number of cycles. In other words, capacitors have retained classical capacitors positive property to achieve almost unlimited charging and discharging number of cycles.

Table 1. Capacitor, supercapacitor and accumulator basic characteristics

Characteristic	Classical capacitor	Supercapacitor	Accumulator
Discharg. time	μs – ms	ms – weeks	min - months
Charging time	μs – ms	ms – minutes	hours
Specific energy	< 0,01 Wh/dm^3	0,5 – 5 Wh/dm^3	< 500 Wh/dm^3
Specific power	> 10^4 W/dm^3	(1-3) 10^3 W/dm^3	< 500 W/dm^3
Cycles number	10^6 - 10^8	10^6 - 10^8	200 - 1000

Literature offers data on two basic kinds of supercapacitors with different ways for energy storing [5]:

a) double layer capacitors
b) redox supercapacitors.

Capacitance of the first kind is electrostatic by its nature, taking into account that distance between quasi electrodes is extremely short, and electrode material has highly developed surface. Typical examples are Faraday inactive carbon powders including both assumptions.

In the case of redox capacitors, in the course of electricity pass, Faraday processes are occurring as at batteries and a new phenomenon, called pseudocapacitance is appearing [6]. That is the reason why this kind of supercapacitors has got the name pseudocapacitors. Typical representatives of the supercapacitors type are RuO_2, Co_3O_4, NiO_2 and IrO_2 in acid water solutions.

Investigations of behavior of copper sulphide minerals during their anodic polarization and modeling of these reactions were performed at Bor Technical faculty. On this occasion, it was established that equivalent electrical circuit must contain very high capacitances, indicating possibility of copper sulphide mineral use as potential material for electrochemical supercapacitor electrodes [7-13].

SUPERCAPACITORS AS A POWER SOURCE IN ELECTRICAL VEHICLES

Most strict requirements are related to supercapacitors applying in electric haulage, i.e. for vehicles of the future. Nowadays, batteries of several hundreds farad capacitance are with working voltage of several hundred volts have been produced. Beside great capacitance and relatively high working voltage, these capacitors must have great specific energy and power (because of limited space in vehicle). Considering their specific power, they have great advantage in relation to accumulator batteries, but, on the other side, they are incomparably weaker considering specific energy. Hence, ideal combination is parallel connection of accumulator and condenser batteries. In an established regime (normal drawing) vehicle engine is supplied from accu-battery, and in the case of rapidly speeding, from supercapacitor. Very important is the fact that in the case of abrupt breaking, complete mechanical energy could be taken back to system by converting into electrical energy only in presence of supercapacitor with great specific power.

In Figure 5 the scheme of an electrical drive vehicle in which supercapacitor is used for energy storage and so-called regenerative breaking is presented.

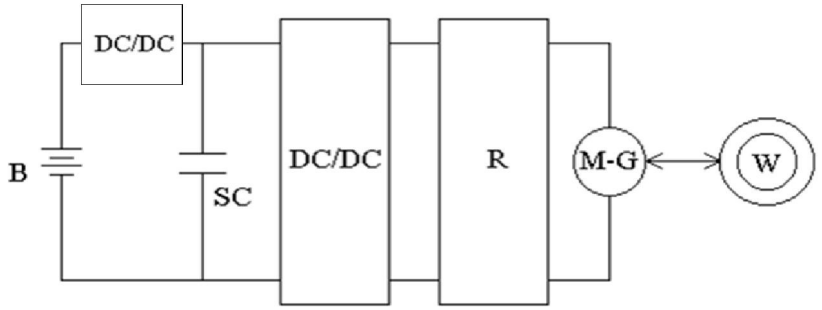

Figure 5. Scheme of electrical drive vehicle with supercapacitor with possibitlity for using breaking energy; B – one-way voltage source, SC – supercapacitor; DC/DC – direct voltage converter; R – regulator; M-G – engine – generator (depending on working regime; W – drive wheels

CONCLUSION

Electric drive vehicles are one of the most advanced taking in account contamination of environment. Lately there is an increased interest in the world for hybrid vehicles that have smaller fuel consumption and substantially less contamination emission footprint. Hybrid vehicles in most general terms can be described as vehicles comprising combination of energy producing and storing.

Supercapacitors are only available technology today that can provide high power (over 1kW/kg) and great cycle numbers at acceptable price. Supercapacitors have other properties that makes them interesting in hybrid vehicles, and it's ability of complete regeneration of energy of braking (so called regenerative braking), which

increases energy efficiency, no special maintenance needed, great utilization of electric energy, small toxicity and easy storage after use.

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REFERENCES

1. Van Voorden, A.M.; Ramirez Elizondo, L.M.; Paap, G.C.; Verboomen, J. & Van der Sluis, L. (2007). The Application of Super Capacitors to relieve Battery-storage systems in Autonomous Renewable Energy Systems. Power Tech, pp. 290-295.
2. Conway, B.E. (1999). Fundamentals of Electrochemical Capacitor Design and Operation. In: Electrochemical Supercapacitors: Scientific Fundamentals and Technological Applications, Kluwer Academic/Plenum Publishers, ISBN 0-306-45736-9, New York, USA.
3. Stević, Z. Supercapacitors based on copper sulfides, Ph.D. Thesis, University of Belgrade, 2001.
4. Kotz, R. & Carlen, M. (2000). Principles and applications of electrochemical capacitors. Electrochimica Acta, Vol.45, No15-16, (May 2000), pp. 2483-2498, ISSN 0013-4686.
5. Arbizzani, C.; Mastragostino, M. & Soavi, F. (2001). New trends in electrochemical supercapacitors. Journal of Power Sources, Vol.100, No1-2, (November 2001), pp. 164-170. ISSN 0378-7753
6. Ardizzone, S.; Fregonara, G. & Trasatti, S. (1990). »Inner« and »outer« active surface of RuO_2 electrodes. Electrochimica Acta, Vol.35, No1, (January 1990), pp. 263-267, ISSN 0013-4686.
7. Stević, Z.; Rajčić-Vujasinović, M. & Stanković, Z. (2003) Modelling of copper sulphide/electrolyte systems as a potential material for supercapacitors Proceedings of XXII International Mineral Processing Congress, pp.463, ISBN 0-9584663-4-3, Cape Town, South Africa, September 28 – October 3, 2003.
8. Rajčić-Vujasinović, M.; Stanković, Z. & Stević, Z. Consideration of the electrical circuit analogous to the copper or coppersulfide/electrolyte interfaces based on the time transient analysis. Russian Journal of Electrochemistry, Vol.35, No3, (March 1999), pp. 320- 327, ISSN 1023-1935
9. Bugarinović, S.; Rajčić-Vujasinović, M. & Stević, Z. Construction of double layer capacitors, Proceedings of 39th International October Conference on Mining and Metallurgy, pp. 470-476, ISBN 987-86-80987-52-1, Sokobanja, Serbia, October 7-10, 2007.
10. Stević, Z. & Rajčić-Vujasinović, M. (2006). Chalcocite as a potential material for supercapacitors. Journal of Power Sources, Vol.160, No2, (October 2006), pp. 1511-1517, ISSN 0378-7753.

11. Stević, Z.; Rajčić-Vujasinović, M.; Bugarinović, S. & Dekanski, A. (2010). Construction and Characterisation of Double Layer Capacitors**.** Acta Physica Polonica A, Vol.117, No1, (January, 2010), pp. 228-233, ISSN 0587-4246.
12. Stević, Z.; Rajčić-Vujasinović, M. & Stanković Z. (2002). Achievments and perspectives in supercapacitors development and applying, Proceedings of 34th International October Conference on Mining and Metallurgy, pp. 435-440, ISBN 86-80987-17-4, Bor Lake, Serbia, September 30 – October 3, 2002.
13. Stević, Z.; Rajčić-Vujasinović, M. & Stanković, Z. (2002). Galvanostatic investigations of copper sulfides as a potential electrode material for supercapacitors, PO 320, Book of Abstarcts 3rd International Conference of the Chemical Societies of the South-Eastern European Countries on Chemistry in the New Millennium – an Endless Frontier, Vol.II, pp. 97, Bucharest, Romania, September 22-25, 2002.

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INFORMATION SYSTEMS FOR ENVIRONMENT

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ABSTRACT

Intelligent control systems and software building systems in households can contribute to savings in heating and up to 30%, while energy savings can be up to 5%. Intelligent or smart house is a housethat has a built-in central control system. Such a system is able to integrate multiple systems (heating, hot water, cooling, lighting, security). One of the essential functions of this system and optimization of energy consumption in the home. The system can regulate the temperature in every room in the house in a givenmode, be it winter or on the fly, can control the lighting in some areas, on or offelectrical appliances, ventilation systems, exterior shutters and fire alarm system.

In this paper is given analysis and architecture for the Environment Information System (EnvIS) and Cisco® Connected Real Estate for inteligent or smart house.

Key words: Environment, Software system, Management technology, Environmental information system (EnvIS), Cisco® Connected Real Estate

INTRODUCTION

THE POWER OF TECHNOLOGY to transform societies is a cornerstone of our history. In the last 150 years, scientific exploration and invention led to huge technology infrastructures that transformed built environments and the way we use them. Technology led to metropolitan, then national and international infrastructures for power, water, transportation, and communications. These advances added value to real estate by creating environments that liberated human activities from site and climate, intensified space use, and facilitated urban development.

Information System (IS) is a set of activities for the processing of information . The new millennium marked a new Knowledge-Based Society (KBS) or shorter Knowledge Society (KS). The basis of the society mainly consists of non-material software and technology. Research in the field of environment is becoming more attractive with the increase of the number of inhabitants on Earth. Many services whic are being used at the moment represent a simple IS expansion of Web internet service [1,2].

Environmental management system (EMS) presents a decentralized system set up in the areas of pollution control, central and offshore ecology, bio-degradation of wastes and environment management, toxic chemicals, environmentally sound and appropriate technology, etc.

The scale of development concepts and technologies for Environmental Management System (EMS) and the application of ISO 14000 series of standards is shown on figure 1.

The system by that ensures environmental information collection, collation, storage, retrieval and dissemination to all concerned. EIS provides environmental information to decision makers, policy planners, scientists and engineers, research workers, etc.

Intelligent control systems and software building systems in households can contribute to savings in heating and up to 30%, while energy savings can be up to 5%.

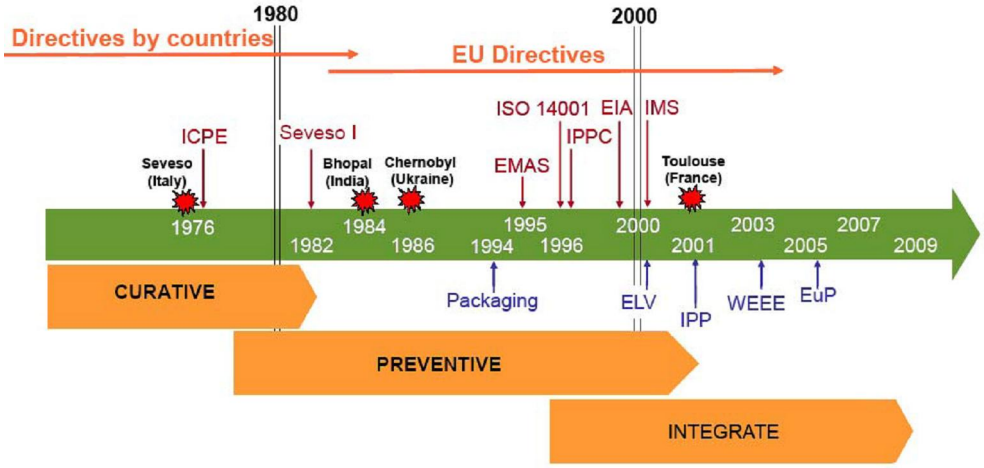

Figure 1. Environmental Management System (EMS) development

EMAS Eco-Management and Audit Scheme
EIA Environmental Impact Assessment
ELV End of Live Vehicles
EuP Energy-Using Products (EU Directive 2005/32/EC)
ICPE Installation Classée pour la Protection de l'Environnemen
IMS Integrated Management System
IPP Integrated Product Policy
IPPC Integrated Pollution Prevention and Control
(EU Directive 2008/1/EC, which replaces Directive 96/61/EC)
WEEE Waste Electrical and Electronic Equipment
(EU Directives 2002/96/EC, 2003/108/EC and 2008/34/EC)

ENVIRONMENT INFORMATION SYSTEMS (EnvIS)

Information System (IS) is a set of activities for the processing of information, together with associated organizational resources such as human, technical and financial, to provide and distribute information. Connections between objects and connection system with the environment, with information system, make the exchange of information. Each system consists of a database and a set of programs those different classes of users to

access data in the basis for their everyday business tasks. On the basis of the information system can be defined as a set of techniques and technologies, methods and procedures for the proper planning the collection, preparation, transmission, storage and processing of data based on the application of computers and the distribution and presentation of information to use for decision-making [8].

Classification of information systems is realized by different criteria. According to fields of application is developed a large number of different information systems. In field of environment of development is Environmental Information System (EnvIS), that is for India available on Web site:http://www.envis.nic.in/.

The essential purpose of environmental information system (EnvIS) is to facilitate and streamline the flow of environmental information from data sources to decision makers and to provide the necessary analyses that are required to give decision makers adequate information [9-17].

Presently, the EnvIS network consist of 76 EnvIS nodes apart from the focal point, out of which, 29 EnvIS nodes are on State Government Departments dealing with the Status of Environment and related issues of the concerned State Government and the remaining 47 have been set up on various environmental disciplines covering from air pollution, water pollution, noise pollution, biodiversity, solid waste management, ecology and ecosystems, environmental education, NGOs, media and even environmental parliament, coastal ecosystem, clean technology, etc.

On figure 2 is shown architecture environmental information system (EnvIS).

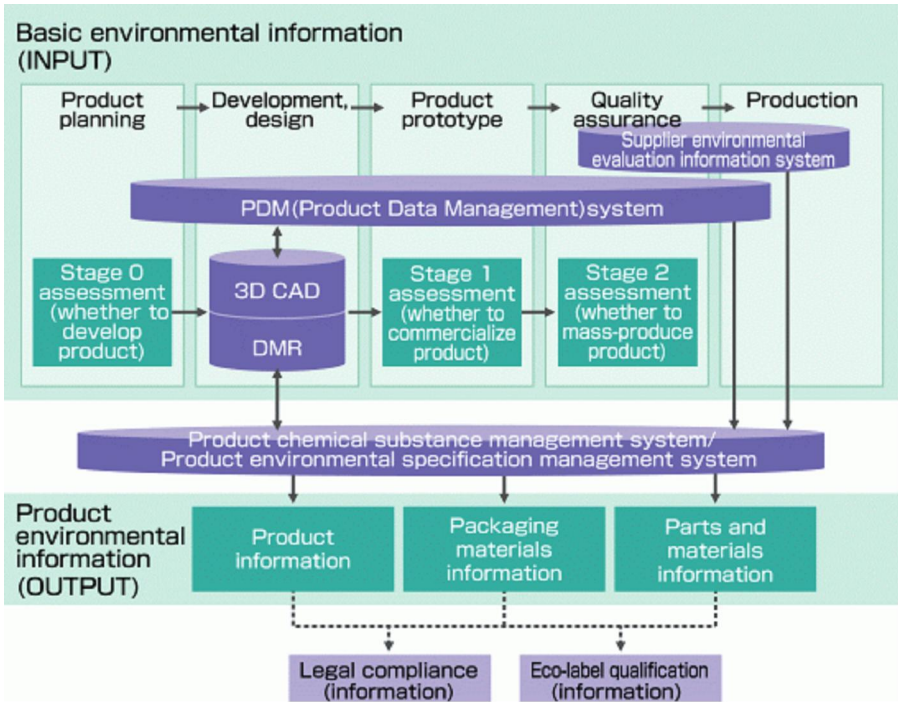

Figure 2: Environmental Information **S**ystem (EnvIS) architecture

Cisco® CONNECTED REAL ESTATE

IN THE 20TH CENTURY, new technologies in the form of the steel frame, curtain wall, elevator, electricity, and air conditioning led to buildings as we know them today. Here in the 21st century, digital technology continues to accelerate our ability to increase real estate values.

Technology is again changing how we design and construct buildings and the building fabrics themselves: both how we operate and maintain them as well as how their occupants experience and use them.

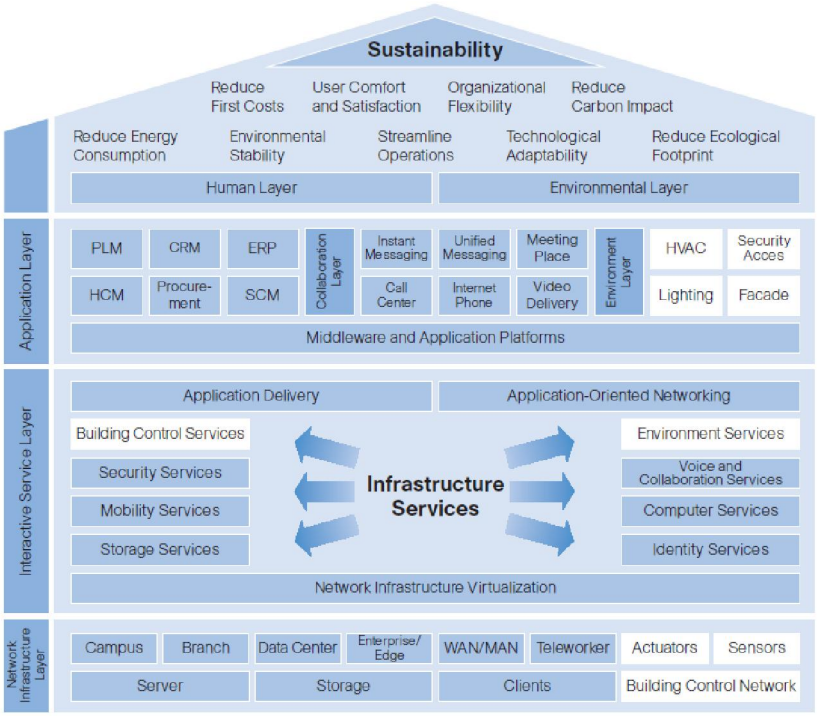

Figure 3: Integration of building systems (white) in the intelligent information network architecture

CRM = Customer Relationship Manager, ERP = Enterprise Resource Planning, HCM = Human Capital Management, HVAC = Heating, Lighting, Air Conditioning, PLM = Product Lifecycle Management, SCM = Supply Chain Management.

Critical to the success of Information Technology-Enabled Sustainability is the convergence of building systems and information technologies. This diagram illustrates the integration of building systems (white) in the intelligent information network architecture. The resulting networking benefits for humans and the environment are shown in the top triangle.Source: Carnegie Mellon University, 2006.

As the digital Building Information Model takes hold, we expect new ecosystems of partners to emerge that are better able to meet client demands. The detailed databases created during the design-build phases of the building lifecycle have additional value for the operations and maintenance phases. Handing off these databases to operational

organizations provides a strong, real-time knowledge base for day-today operations. It also assists them with simulating user requirements.

Future sensor and sensor network systems must successfully address the following factors:

- User needs and decision support to create comfortable, healthy, and productive settings .
- Organizational requirements for flexibility
- Technological adaptability to ensure easy introduction of new technology, and the removal of outdated technology, without waste
- Energy and environmental effectiveness in operation and maintenance throughout the building's lifecycle

Cisco Smart+Connected Real Estate Advisory Services (Figure 4)

Cisco adopts an end-to-end lifecycle approach to Cisco Smart+Connected Real Estate. It starts with initial advisory consulting, which covers understanding the vision and key value drivers, identifying key services that help realize the vision and targeted goals, creating business cases for the services, and specifying the underlying architecture to enable the desired services. Cisco advisors can continue by providing Master System Integrator (MSI) support and RFI/RFP selection, as well as additional aspects of implementation and testing, operations, and optimization.

Cisco Smart+Connected Real Estate solutions are the building blocks for the real estate of the future. The converged network becomes an intelligent building infrastructure and the foundation for change in any development project.

Cisco Smart+Connected Real Estate can increase profitability by providing additional revenue streams and enabling new, differentiated opportunities. It can provide end-customers with a superior standard of living while maintaining environmental sustainability[19].

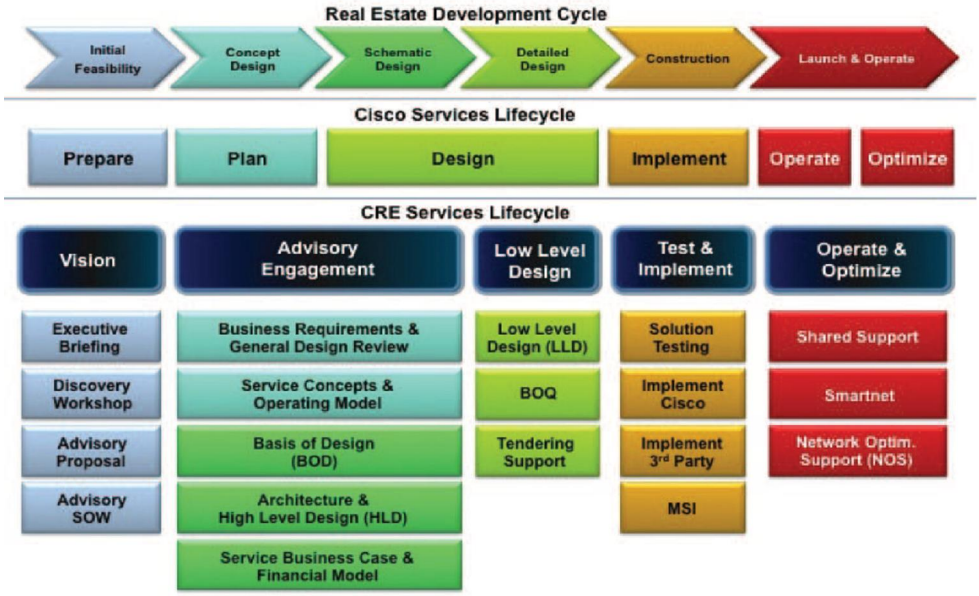

Figure 4: Roadmap for Success Cisco Smart+Connected Real Estate

CONCLUSION

Set of activities for the processing of information, together with associated organizational resources such as human, technical and financial, to provide and distribute information in field of environment, which is called the environmental information system (EnvIS).

Integrated design stands on the pillars of human needs for healthful, safe, and productive environments; on societal needs for energy, resources, and security; and on environmental needs for healthy and diverse ecological systems. To develop a new model for integrated design, new metrics for accurately assessing the cost effectiveness of alternative design scenarios for enhanced health and productivity in high-performance buildings must be developed, including cost-effective monitoring tools and control strategies that can be integrated into the next generation of automated building control systems.

Therefore in close cooperation with the industry, is developing ubiquitous, flexible, re-addressable, and wireless sensing systems, combined with advanced logic concepts. These systems have to be integrated with flexible, adaptable, and responsive building technologies, such as those that have been realized in the IW. These new sensing systems require advanced decision making processes that have distributed intelligence. The distributed intelligence aspect could then be a major gateway to advance the entire field of sensing systems.

This vision is now realizable with advances in IT infrastructures and software innovations. Every fixture in a workspace can be addressed: lights, air diffusers, radiators, blinds, window openers, PCs, printers, radios, and locks. The IW is pursuing this future vision as the Information Technology Enabled Sustainability Test bed (ITEST**).**

Intelligent control systems and software building systems in households can contribute to savings in heating and up to 30%, while energy savings can be up to 5%. Intelligent or smart house is a housethat has a built-in central control system.

REFERENCES

.

1. Z. Damjanović, D. Petrović, V. Nikolić , SERBIA M-BANKING NEW ECO-TEHNOLOGY, XVIII International Scientific and Professional Meeting, "ECOLOGICAL TRUTH" ECO-IST '10, 01 - 04 June 2010 Spa Junakovic, Apatin, SERBIA , ISBN 978-86-80987-79-1 COBISS.SR-ID 175499788 p. 474-483
2. Predrag Dašić, Valentin Nedeff, Georgous Petropoulos: SOFTWARE SYSTEMS AND MANAGEMENT TECHNOLOGY IN ENVIROMENT, 1st Internationa conference ECOLOGICAL SAFETY IN POST-MODERN ENVIRONMENT, 26-27.06.2009. Banjaluka, RS, BIH, Book 1, p.53-67
3. Bruno, P. & Katrien, P.: PRESCO work package 2: Inter-comparison and benchmarking of LCA-based environmental assessment and design tool. Final report. Lozenberg (Belgium): Practical Recommendations for Sustainable Construction (PRESCO), 2005. – 74 pp. Available on Web site: http://www.etnpresco.net/generalinfo/PRESCO_WP2_Report.pdf.

4. Ceccaroni L., OntoWEDSS: An ontology-base environmental decision-support system for the management of wastewater treatment plants. Ph.D. dissertation. Barcelona (Spain): Universitat Politècnica de Catalunya (UPC), 2001. – 262 pp. ISBN: 84-688-1569-1. Avaliable on Web site: http://www.lsi.upc.edu/~ia/tesis/Luigithesis.pdf.
5. Dašić, P.: 100.000 Technical and ICT Abbreviations and Acronyms. Vrnjačka Banja: SaTCIP Ltd., 2009. pp.1800. ISBN 978-86-6075-001-5.
6. Dašić, P.: Put ka društvu znanja i trendovi Evropske RTD misije. Časopis IMK-14 Istraživanje i razvoj, God. XII, br. (24-25) 1-2/2006 (2006), s. 77-92. ISSN 0354-6829.
7. Dašić, P.; Ječmenica, R. & Šerifi, V.: One classification example of decision support systems. Annals of the University of Petrosani, Electrical Engineering, Vol. 9 (XXXVI) (2007), pp. 385-391. ISSN 1454-8518.
8. Dašić, P.; Nedeff, V. & Petropoulos, G.: Internet resources and software tools for life cycle assessment. Plenary and Invitation paper. In: Proceedings on CD-ROM of 6th International Conference ″Research and Development in Mechanical Industy - RaDMI 2006″, Budva, Montenegro, 13-17. September 2006, pp. 68-87. ISBN-13 978-86-83803-21-7.
9. Frühbrodt, E.: LCA software review – An up-to-date overview of the European market. Workshop on life cycle data for assessment of environmental performance of EEE and EU funded RTD activities on EEE ecodesign. Brussels, 9 October 2002. Available on Web site: http://europe.eu.int/comm/enterprise/electr_equipment/eee/workshop9-10-02/present/lcasoftwarere.pdf.
10. Gibert, K.; Sanchez-Marre, M. & Rodrıguez-Roda, I.: GESCONDA: An intelligent data analysis system for knowledge discovery and management in environmental databases. Environmental Modelling & Software, Vol. 21 (2006), pp. 115-120. ISSN 1364-8152.
11. ISO 14040:1997 Environmental management -- Life cycle assessment -- Principles and framework. Geneve: International Organization for Standardizations (ISO).
12. ISO 14041:1998 Environmental management -- Life cycle assessment -- Goal and scope definition and inventory analysis. Geneve: International Organization for Standardizations (ISO).
13. ISO 14042:2000 Environmental management -- Life cycle assessment -- Life cycle impact assessment. Geneve: International Organization for Standardizations (ISO).
14. ISO 14043:2000 Environmental management -- Life cycle assessment -- Life cycle interpretation. Geneve: International Organization for Standardizations (ISO).
15. ISO/TR 14047:2003 Environmental management -- Life cycle impact assessment -- Examples of application of ISO 14042. Geneve: International Organization for Standardizations (ISO).
16. ISO/TS 14048:2002 Environmental management -- Life cycle assessment -- Data documentation format. Geneve: International Organization for Standardizations (ISO).

17. ISO/TR 14049:2000 Environmental management -- Life cycle assessment -- Examples of application of ISO 14041 to goal and scope definition and inventory analysis. Geneve: International Organization for Standardizations (ISO).
18. SimaPro 6 – Introduction to LCA with SimaPro. Amersfoort (Netherlands): Pré Consultants BV, 2004. – 71 pp. Available on Web site: http://www.pre.nl/download/manuals/UserManual.pdf
19. Kevin O'Donnell and Wolfgang Wagener, Connected Real Estate, Essays from innovators in real estate, design, and construction, Jun 2007, CISCO® 2007 Cisco Systems, Inc.ISBN 978-0-9551959-1-4

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ELECTRICAL ILLUMINATION SAVINGS AT AGRICULTURAL POPULATION IN THE TIMOK REGION

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ABSTRACT

The world faces problems of energy lack in all segments of work and life. The permanent deficit of energy causes various problems worldwide. The question of production of electrical energy is combined with the question of its saving. Both efforts lead to the most actual field – the protection of living environment through reduction of air pollution and the effect of the glass house. The Serbian agricultural population is certainly a strong factor in consumption of el. energy, however it is somehow conservative in use of power innovations, so still a lot of projects and actions can be done within home economics through introduction of new ways of energy efficiency. This paper treats one of them – possibility of el.energy saving through replacing classical Edison bulbs with modern fluorescent and LED illumination sets at rural households in the Timok region.

Key words: energegy efficiency, electrical illumination, classical Edison bulbs, fluorescent light, light emiting diode, household, family house, utility objects

DIVISION OF IMPACT FACTORS ON ELECTRICAL ENERGY CONSUMPTION

All factors of influence on energy consumption can be divided into natural and antropogenic.

Natural factors: outdoor temperature, atmospheric precipitation, air humidity, wind, day light etc

Antropogenic factors: construction characteristics (size of building object, windows, doors, construction materials, thermic insulation etc), heating/cooling, cooking, domestic activities, level of technological development and living standard etc, type and capacity of illumination etc.

ELECTRICAL ILUMINATION AT AGRICULTURAL HOUSEHOLDS IN SERBIA

Agricultural households differ in electrical illumination from urban homes in Serbia. There are several common characteristics appertained to majority of urban homes

in blocks of flats and the majority of agricultural households that cause considerably higher consumption of el. Energy for illumination. The factors of discrepancy are the following ones:

Size of homes in urban areas: The size of urban areas homes in Serbia is generally smaller of the size of the majority of rural homes built within last 50 years. This relation especially concerns flats in residential blocks. There is a direct proportion between the size of residential objects and number of illumination points, that means the bigger the home the bigger the number of lights. Taken that an average double room flat of 50 m² in towns usually has app. 6 – 8 illumination points with classical Edison bulbs – usually from 40 to 150 W, it can be calculated that the total power capacity of these bulbs per an average town flat in blocks of flats will be 600 – 700 W.

Size of homes in rural areas: The size of homes in rural areas usually concerns family houses built after 1960s, usually bigger than the flats in towns. Accordingly, bigger rural households with usual utility objects have considerably bigger number of illumination points indoors and outdoors.

Rural utility objects: A point difference between urban flats /family houses and rural households is in number of utility objects. While urban homes usually have one utility object – a garage, rural households, besides a family house have several accompanying or utility objects. An average rural households has more as family house, 1-2 garages for cars, and agro mechanization, stable, pigsty cowshed, etc. Besides, there are various storages, workshops etc that are not usually present in towns. Almost all rural households have el/ illumination mainly based on classical Edison bulbs.

OBLIGATIONS OF SERBIA AS A SIGNATORY OF THE KYOTO PROTOCOL

The most important event in the history of human ecology is certainly the Kyoto protocol based on OUN Convention on global climatic changes as the UN official document by which all signing countries are liable to reduce air pollution and overheating of the atmosphere. The protocol was signed by majority of the UN members in Japanese town Kyoto on 11th December 1997 and put in force on 16th February 2005. Since Serbia signed this declaration, it is obliged to take adequate measures in reduction of CO2 and other harmful gasses causing the effect of the glass house for 5% from 2008 to 2012 related to the year1999. In other words, this means that Serbia as all other countries according to their natural and technological capacities have to put maximal efforts to increase production of el. energy from renewable energy sources on one side and to conduct the national politics of energy efficiency or rational energy saving. In this sense, Serbia and its adequate institutions have developed an important document "The Strategy of long range development of power production of the Republic of Serbia until the year 2015". The purpose of the document is establishing and accepting basic goals of new energy politics, priority directions at power production sectors and allowing programs for deciding adequate legal instruments. Such politics means development and supporting of projects and other activities at all levels and ownership forms that conduct and support saving of el.energy in all possible and rational forms. Among such forms is replacing classical Edison bulbs with modern fluorescent and LED illumination sets.

SAVING OF ELECTRICAL ENERGY BY REPLACING CLASSICAL EDISON BULBS WITH MODERN FLUORESCENT OR LED BULBS / SETS

At such research it is required to pay attention to the following hints: number of illumination points /bulbs for entire household, their types, total power capacity (kW), power consumption in kWh, illumination capacity/m² (L - Lumen), price of a bulb/set per type and life time. According to types of electric light (bulb), a brief review of several most frequent in Serbia is presented.

Classical Edison bulbs: The oldest, with pleasant white-yellow light, produced from 15 to 300 W in several colors with standard E27 and narrow E14 mm. The main characteristics are:

- Easy handling due to simple turn screw installation.
- Wide offer of numerous power ratings E27: 15, 25, 40, 60, 75, 100, 150, 200, 250 and 300 W and for E14, 15, 25, 40 and 60 W.
- Low price for a bulb (20 – 300 RSD) depending on power, shape and color.
- Very brittle - easy breakable and weak tungsten fiber
- Only 5% of energy for illumination due to strong heat of tungsten spiral fiber (to 2000 ° C) dissipated
- Rather short life time (up to 1,000 hours – manufacturer's declaration) due to high power peak at the moment of turning the power on.

Standard fluorescent (neon) light: Based on discharging of electricity through diluted gas (argon) producing ultraviolet emission that turns into fluorescent light in glass tubes. In Serbia the tubes are manufactured in two sizes – 60 mm (20W) and 120 mm (40W). This type of light is mostly used for larger premises – mostly at sitting rooms at residential homes. The properties are:

- Strong cold white light
- 5 times higher degree of energy efficiency related to classical Edison due to low heat emission
- Life time app 5,000 hours
- Brittle long thin glass tubes
- Rather complicated installation due to additional equipment (housing, starters, buffers)
- Rather high price of a complete set (15 times higher comparing Edison equivalent)

Mercury bulb: Based on the principle of ionized discharge in mercury vapor. Its light is close to the sun light and rich with ultraviolet spectrum. It is mostly used outdoors and in heating rooms, stables or cowsheds. This type is mostly produced for bigger illumination capacity. There are sets of 125, 250 and 400 W on Serbian market.

The main features are:

- Similar to neon lights by strong white light and the life time.
- Rather high price from RSD 250 to 1,000 depending on power rating and the producer.

- Due to toxic mercury vapour, this type of bulbs is a subject of ecological procedures

Modern saving fluorescent bulbs: A subtype of fluorescent light sets are small narrow spiral or bent tubular bulbs. This type of illumination has the following advantages/disadvantages:

- Strong, mostly white light, although they are produced in some other colours (yellow, green etc)
- Easy installation due to classical E27 throat
- High degree of energy efficiency – 5 times lower power consumption due to cold light
- Higher price: 7 – 8 times higher price related to classical Edison bulbs
- Brittle – easy breakable bodies, due to thin glass wall of tubes.

Light emitting diode (LED) sets: This type of illumination is the youngest on the world market. It works on the principle of PN joint of silicon that emits light at certain conditions within voltage range 2.6 - 3.8 V and at electric currents from a few mm amperes (mlA) to 0.5 A. They are the only total source of cold light not emitting heat at all. Their light is absolutely monochromatic.

Due to rather high price and poorly covered market in Serbia and their extreme use flexibility, they are mostly used for various light effects (for light shows, light advertising, disco clubs etc).

The main characteristics of this type of illumination are:

- Strong light in several colors (white, yellow, red, blue, green)
- The highest degree of energy efficiency (only 1% of heat emitting) – 25 higher than Edison
- Easy installation due to E27 and E14 screw throats.
- The only type that can work at low voltage (5 – 12 V) and normal 220V/380hz power rating. This enables universal use anytime and anywhere even in nonstandard conditions.
- Extreme mechanical strength due to PVC walls or some other plastic material.
- Ecologically accepted due to clean technology and untoxic materials
- Wide illumination range from 50 mcd (mili candel) to 2000 mcd
- Flexible and multipurpose installation (screwing, sticking sinking in water) on various bases (wall, glass, wood, metal, liquids, trees etc)
- High price per a bulb/set from RSD 500 to 2.000 (15 times higher than Edison) at not adequate market

Besides listed types there are some other ones as halogen and infrared not considerably present-

Table 1: Main power and illumination ratings of light bulbs/sets at nominal 220 V/350 Hz

Power rating				Light flux				Lifetime hours, years				RSD price			
Edison	MFL	Neon	Mry	Edison	MFL	Neon	Mry	Edison	MFL	Neon	Mry	Edison	MFL	Neon	Mry
40	7			440	300			to1000h	< 5 y			30	300		
60	11				660	535		to1000h	< 5 y			35	300		
	13				642				< 5 y				300		
75	15				825	750		to1000h	< 5 y			40	330		
100	20	18		1100	900			to1000h	< 5 y	6000 h		40	30	100	
250	25		125		1230				< 5 y		5000 h		350		250
150	30			1650	1475			to1000h	< 5 y			90	400		
	35	36			1925				< 5 y	6000 h			400	120	
200				2200				to1000h				150			
250			250	2750				to1000h			5000 h	200			
300	65			3300	3185			to1000h	< 5 y						
			400								5000h	280	1400		1000

LED lights – separated from other lights due to non parallel ratings

El.current rating	Voltage range	Illum range	Life time	El. En. efficiency	RSD price
1 mlA - 0.5 mlA	5V – 220V	50 mcd – 2000 mcd	< 5 years	99 %	500 - 2000

According to table 1, classical Edison bulbs have the highest rate of power consumption, while LED lights-bulbs the lowest one, however their price is still rather high and the Serbian market still not well covered with all power ratings of this innovation in the field of illumination.

RESULTS OF THE RESEARCH IN THE VILLAGE MALI IZVOR

Mali Izvor, a village in Zajecar district was taken for the research . The village established in 19th century, is situated in the White Timok river valley, 18 km from the regional centre Zajecar , app. 500 residents. The village is known by fertile land thus main industry is land farming (wheat, corn, tobacco), gardening (usual vegetables), wine and fruit growing and cattle rising (cows, sheep, pigs and poultry). Some residents are engaged at forestry for timber and fire wood (white and copper beech, mountain oak, locust, poplar, ash-tree). The slight majority of residents live on agriculture while others work in Zajecar, Bor and Knjazevac. As the majority of the Timok valley villages
Mali Izvor has the same problem – too old population due to low birth rate and moving of young people to towns and abroad. For this research 5 average households were taken.

Table 2. Households, number of residents, employed and retired

Household no.	Residents no. (children, adults)			Employed/retired		F. house size in m²	No of levels	No. of household objects (solid mat)	Size of entire household in m² objects	land
1.	7	2	5	2	2	200	4	6 (1 + 5)	340	2100
2.	6	2	4	1	1	166	3	5 (1 + 4)	260	1600
3.	5	1	4	0	2	150	3	4 (1 + 3)	244	1320
4.	4	1	3	1	1	124	2	4 (1 + 3)	216	1450
5.	3	1	2	1	0	60	1	3 (1 + 2)	112	800

Note: Levels (cellar or basement, ground floor, first floor, second floor, loft or attic)

Constructional characteristics of the households

All the building objects of the households are based on solid materials (concrete foundations and pillars, construction steel, clay bricks, concrete blocks, standard clay roof tiles made and timber for roof construction. Two of the listed family houses are thermically insulated (polystyrene).

Electrical installation characteristics of households

All of the households are connected to 220/380 V local low voltage grid that is connected to high power grid after voltage reduction (from 110 kV to 35 kV to 10 kV) from Zajecar, managed by "Elektrotimok" Zajecar, public enterprise for power distribution.

Table 3. Electrical installation characteristics of the households

Household no.	Family house illumination points number	Total installed power of f.h. illum points in kW	Utility objects ilum points no.	Total installed power of ut.ob illum points in kW	Total installed power of illumin in kW
1.	27 (4 levels) (5, 9, 10, 3)	2.52 kW	6 (5 objs) (g, ws, cs, cst)	0.675 kW	3.200 kW 33 illumin points
2.	19 (3 levels) (2,10, 6, 3)	1.37 kW	5 (4 objs) (g, cs, p, cst	0.525 kW	1.900 kW 24 illumin points
3.	13 (3 levels) (1,7, 5,)	1.295 kW	4 (3 objs) (g, cs, cst)	0.45 kW	1,790 kW 21 illumin points
4.	10 (2 levels) (2, 8)	0.975 kW	5 (3 objs) (g, cs, cst)	0.5 kW	1.480 kW 15 illumin points
5.	8 (1 level)	0.875 kW	6 (3 objs) (g, ws, st, p)	0.6 kW	1,480 kW 14 illumin points
Note: 3 of 5 households are equipped with standard 3 phase electrical installation, while 2 of them with monophase					

RESEARCH ANALYSIS AND RESULTS

The research was carried out in March 2011, its main subject was achieving economic effects or reduction of costs for el energy by replacing classical Edison bulbs with modern fluorescent lights. LED lights were not taken due to inadequate market offer. At these 5 households it was calculated that considerable savings can be achieved from two reasons because of the following:

Table 4. Relation between classical Edison bulbs and modern fluorescent spyral/bent bulbs

Power in W and Edison / MFL	Light fluks Edison/MFL	Average annual loss in pcs month/year and Edison / MFL		RSD price per peace Edison / MFL		Declared lifetime Edison / MFL	Average daily work in hrs / household for both types
150 / 30	1400/1280	1 /12	0	80	400	1,000 hrs 5 yrs	8
100 / 20	1100/1000	1 / 12	0	40	350	1,000 hrs 5 yrs	8
75 / 15	825 / 750	1 / 12	0	40	300	1,000 hrs 5 yrs	8
60 / 11	660 / 535	1 / 10	0	30	300	1,000 hrs 5 yrs	4
40/ 7	440 /300	1 / 10	0	30	300	1,000 hrs 5 yrs	4

From table 3 it is evident that all 5 households use classical Edison bulbs, according to households calculations the cost, potential savings of this replacement are:

Table 5. Review of 5 household costs for electrical illumination and potential savings

No. Nousehold	Total bulbs	Total capacity	Yearly loss		Yearly power consumption	
	number	kW / kWh	Edison	MFL potent.	Edison	MFL potentially
1. Household 4,186 RSD	37 pcs	3.2 kW/25.6 kWh	370 pcs	0	41,861:2 = 20,931 RSD	20,931:5 =
2. Household 2,485 RSD	27 pcs	1.9 kW/15.2 kWh	270 pcs	0	24,855:2 = 12,426 RSD	12,426:5 =
3. Household 2,338 RSD	20 pcs	1.79 kW/14.3 kWh	200 pcs	0	23,383:2 = 11,692 RSD	11,692:5 =
4. Household 1,936 RSD	18 pcs	1.48 kW/11.84kWh	180 pcs	0	19,361:2 = 9680 RSD	9680 :5 =
5. Household 1,936 RSD	15 pcs	1.48 kW 11.84 kWh	150 pcs	0	19,361:2 = 9680 RSD	9680 :5 =

It is evident that this replacement yields two types of saving:
A) Short life time of classical Edison bulbs (10 pieces in a year) / long life time of MFL (< 5 years)
B) Too low en. efficiency of Edison bulbs (only 5%) that is too high power consumption / MFL
5 times higher energy efficiency or 5 times lower power consumption.

A) Classical Edison bulb's life time is app. 1000 hours / Modern fluorescent bulbs (E 27 screw throat) lifetime is 5 and 10 years. It mens that all 5 households will buy these bulbs only once in at least 5 years period of time instead of buying Edison bulbs almost every month.

Calculation

Edison 100W: 8 hrs work/day, RSD price 40/pc, life time 1000 hrs, yearly loss (purchase) 10
10pcs x 40 RSD = 400 RSD/year, for 3 years = 1,200 RSD.
MFL 20 W: 8 hrs work/day, RSD price 350, life time < 5, yearly loss (purchase) 0
1 x 350 RSD = 350RSD, for 3 years = 350 RSD
It means that a household with 10 classical Edison bulbs pays 4,000 RSD for one year and 12,000
RSD for three years, while for 10 modern fluorescent bulbs the calculation is 3,500 RSD for 1 year and the same amount for 3 years down to 7 - 8 years.

B) Classical Edison bulbs have only 5% of energetic efficiency, and therefore too high power consumption that generates very high costs for electrical energy. At the other side modern spyral or bent fluorescent E27 bulbs have 5 times higher energy efficiency or 5 times lower power consumption or 5 times lower costs for electrical energy.

Calculation

Edison 100W: 8 hrs work/day x 0.1 kWh = 0.8 kWh, 1kWh = 4.48 RSD
0.8kWh/day x 4.48 RSD=3.584 RSD/day. 3.584 RSD x 365=1,308.16 RSD x 3yrs =3,924.48RSD
MFL 20 W: 8 hrs work/day x 20W = 0.16 kWh, 1kWh = 4.48 RSD

0.16 kWh/day x 4.48 RSD=0.7168 RSD/day x 365 =261.632 RSD x 3 yrs = 784.896 RSD

It means that a household with 10 classical Edison bulbs pays 13,081.60 RSD for one year and
39,244.8 RSD for three years, while for 10 modern fluorescent bulbs the calculation is 3,500 RSD for 1 year and the same amount for 3 years, while for 10 modern fluorescent bulbs the calculation is 2,616.32 RSD for 1 year and 7,848.96 for 3 years. However in reality, it is recomendable to
divide final costs by 2, as it was done in the table 5 due to inquiry conducted at the above five households in Mali Izvor, where all five houselords recommended halving the results of calculation according to their power bills and long time experience.

CONCLUSION

Reduction of el.energy consumption in all segments of the human society is an imperative of today, it is not not only the question of finances or budgets in all levels but the question of urgent ecology and human existence. The time of energy wasting is behind all and ever, no one, whether government, enterprises, institutions or private persons can alow itself spending electrical energy without creating plans for its saving and consumption reduction. It is not enough to increase production of electrical energy from renewable sources, it is a „must" to reduce energy costs which is certainly considerably less expensive than building new capacities.

The Government of the Republic of Serbia, as the Kyoto protocol signatory has already taken certain steps to comply with this declaration demands, however it is far to be enough, because a lot of many actions and work have to be done. The advise of visionary and entrepreneurial agricultural producers of Serbia is not to relay too much on this or any other government, but to consider all existing possibilities for electrical energy saving, because, even a small amount saved today, as the aforementioned replacement, after several years becomes a good agricultural investment or even one step forward in considering possibilities of self producing electrical energy at micro hydro electrical power plants or wind generators. Cheers!

REFERENCES

1. Kyoto protocol - United Nations Framework Convention on Climate Change (NFCCC Secretariat Report,) www.kyotoprotocol.com
2. „Strategija dugoročnog razvoja energetike Republike Srbije do 2015. godine" (The Strategy of long range development of energetic of the Republic of Serbia) Government of the Republic of Serbia, Belgrade 2003
3. Report 2009, International Energy Agency (IEA) Washington, USA, (http://www.iea.org)
4. Renewable sources of energy, International Energy Agency (IEA) (http://www.iea.org)

5. Statistički izveštaj za 2009. godinu, Agencije SIEPA-e (Serbian Investment and Export Promotion Agency) Beograd 2009. www.siepa.annual report. 2009
6. Annual report 2009, Sandbag Climate Campaign, London, 2010 (www. Sandbag Climate.org
7. Zakon o energetici Republike Srbije, Ministarstvo za energetiku R. Srbije, Beograd 2009, Izveštaj za 2008. godinu, Agencija za energetiku Republike Srbije, Beograd 2009
8. Philips illumination production programs (www.philips.illumination)
9. Program za racionalnu upotrebu energije i povećanje energetske efikasnosti, Agencija za energetsku efikasnost Republike Srbije, Beograd 2003.
10. C. Mandil, IEA Energy stastistics manual, International Energy Agency, Paris 2009.
11. Elektroprivreda Timočke krajine, arhiva sajta Regionalne privredne komore Zaječar, 2010 (www.Regionalna privredna komora Zaječar).

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CALCULATION OF INDEX RISK THE PRESENCE OF PESTICIDES IN ENVIRONMENT

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ABSTRACT

In many literature a large number of methods is listed to assess the potential impact of pesticides on human health and the environment. These tools are called indexes and indicators of risk. Analysis of risk to the environment that I will show, will use several criteria in the selection index for defining risk to the environment. We analyzed indices of risk to the environment developed in three comparative studies [1], [2], [3]. The choice of indices of risk to the environment that I have presented are derived from existing indicators [4] and risk indicators developed by Norway [5], [6]. The main criteria that were used as technical feasibility, accuracy, data availability and the ability to generate indicators of risk to the environment.

Key words: pesticides, risk analysis, risk index and the risk to the environment

INTRODUCTION

The importance of these topics is great, because the Republic of Serbia has developed a system for analyzing the risks of pesticide use based on the index and risk indicators as a tool for decision makers in the process of risk management. Indices extracted from this kind of work may be used in the selection of pesticides that represent the least risk to human health and the environment.

Risk index of the presence of pesticides in the environment, developed by Norwegian version indicator of risk [5], [6] and indicators of risk in Canada. Indicators of risk from pesticides to the environment are taken into the calculate ecotoxicological - physical characteristics and properties of active ingredients, as well as some characteristics associated with the end use products.

MATEREIJAL AND METHODS

Risk of pesticides to the environment is calculated based on the risk index for the Environment (hereinafter ERI). This index is a potential risk of active ingredients as the ultimate use of it to treat. Selected organisms to calculate the index are those that are regularly used as a species for ecotoxicological risk assessment. ERI defines six parameters (variables) as follows:

ecotoxicological: T - effects on terrestrial invertebrates, O - the impact on birds, A - the impact on aquatic organisms, physicochemical: M – mobility, P - persistence in soil, B – bioaccumulation. The way in which to define each variable separately:

Impact on terrestrial invertebrates (T)

Impact on terrestrial invertebrates is represented by variable (T).

Terrestrial invertebrates that are chosen for the calculation of the earthworm and the bees. Possible rating given to the variable comes from two variables, T_{ew} (impact on earthworms) and / or T_{bee} (impact on bees).

a) Impact on earthworms (T_{ew})

Rating for T_{ew} variable is determined from the ratio of the toxicity / exposure (TER).

TER = Toxicity / $PIEC_{soil}$, where

Toxicity - 14 day exposure LC_{50} for earthworms,

$PIEC_{soil}$ - Predicted initial environmental concentration.

The $PIEC_{soil}$ is determined using the following equation [7]:

$PEIC_{soil}$ = SAD × (1-f_{int}) / (100× depth × density),

SAD - Standardized area dose (ml/ha or g/ha),

fint - Interception factor for plant cover (*table 1*),

Depth - Depth of penetration of the pesticide into the soil (default value of 5 cm),

Density - Soil density (default value of 1.2 g/cm^3) .

Table 1. Interception factor (**fint**) of the crop according to type of pesticide

Type of crop	Interception factor (fint)			
	Herbicide	insecticide/ fungicide	Growth regulator	Soil fumigant
Low level field crop (50 cm)	0,10	0,5	0,5	0
Bush (>50-200 cm)	0,20	0,5	0,5	0
Fruit tree (>200 cm)	0,25	0,4	0,4	0

Points for T_{ew} variable is determined by table 2 limit of 100 was set by the European and Mediterranean Plant Protection Organization [8] and the EC [9].

Table 2. T_{ew} value compared to the toxicity /exposure based on14 days of exposure LC_{50}[5], [6]

TER	T_{ew}
>100	0
>10-100	2
≤ 10	4

b) Impact on bees (T_{bee})

(T_{bee}) rating was established by the risk for oral exposure (Qho) or contact exposure (Qhc) the bee [9], (Table 3):

Qho or Qhc = SAD / Toxicity, where

SAD - Standardized area dose (ml/ha or g/ha),

Toxicity - Oral or contact LD_{50} (μg /bee).

Table 3. Coefficient for the bees (T_{bee}) based on oral exposure (Qho) or contact exposure (Qhc) [5], [6]

Qho= Qhc	T_{bee}
< 50	0
≥ 50-1000	2
≥ 1000	4

Impact on birds (O)

Potential impact on birds is determined by the criteria for acute toxicity (LD_{50}) for birds (wild duck and / or quail). These two types of bird species are cited in scientific literature. The (O) variable is determined by a toxicity/exposure ratio (TER).

TER = toxicity / ETE, where

toxicity - LD_{50} (mg/kg of body weight) of the mallard duck or the bobwhite quail,

ETE - Estimated daily intake (mg/kg of body weight).

The European guide for the evaluation of risks for birds and mammals [10] takes a multilevel approach to evaluate risk. For millet impact on the environment defines realistic worst case in order to quantify exposure to birds. Table 4 presents the distribution points for TER [9].

Table 4. Coefficient for the birds (A) the relative toxicity / exposure [5], [6]

TER	O
> 10	0
> 5-10	1
> 1-5	2
> 0,1-1	3
≤ 0,1	4

Effect on aquatic organisms (A)

Effect on aquatic organisms is variable in the calculation of ERI active ingredients. Ratio of the toxicity / exposure determines the score assigned to this variable (TER). TER = toxicity / PEC_{mah}toxicity - LC_{50} or EC_{50} for algae, aquatic plants, aquatic vertebrates and fish,

PEC_{mah} - the maximum anticipated concentration apparent after 4 days in the environment.

PEC_{mah} calculation method is explained in the EC Working Group [11]. Points assigned to variables are shown in table 5 which is based on limit values [10]. TER is calculated for fish and aquatic spine, as well as algae and aquatic plants and uses PEC_{mah}.

Table 5. The value of the toxicity / exposure [5], [6]

TER for fish and aquatic invertebrates	TER for algae and aquatic plants	A
> 100	> 10	0
> 10-100	> 1-10	1
> 1-10	> 0,1-1	2
> 0,1-1	> 0,01- 0,1	3
≤ 0,1	≤ 0,01	4

Mobility (M)

Mobility of active ingredients is variable (M) in the calculation of the ERI active substance and is determined on the basis of its potential leaks. GUS index *[12],* is used to assess the potential of pesticides to contaminate groundwater from leaks and infiltration of surface water through the drainage system.

GUS is based on two properties of active ingredients: organic adsorption coefficient (K_{oc}) and degradation in soil (TD_{50}). These properties are used in the following equation:

GUS = log (TD_{50} × (4-log (K_{oc})

GUS index is interpreted as follows:

GUS < 1,8 Low potential leak

GUS ≥ 1,8-2,8 Moderate potential leak

GUS ≥2,8 High potential for leakage

Standardized application area (SAD) dose is placed in relation to the GUS index to determine the potential risk of contamination through leakage or infiltration in the drainage systems (Table 6).

Table 6. the value of M according to the GUS index and rate of application of the product [5]

GUS	SAD (g ili ml a.s/ha)			
	< 100	≥ 100-1000	≥1000-2000	≥ 2000
< 1,8	0	0	0	0
≥1,8-2,8	1,25	1,5	1,75	2
≥2,8	2,5	3	3,5	4

Persistence in soil (P)

Persistence in soil is variable (P) in the calculation of ERI active ingredients. Degradation in soil (TD_{50}) and the standardized area dose (SAD) is used to determine the value of (P) (Table 7).

Table 7. value according to the time of stability in the soil and the rate of pesticide per hectare[5], [6]

TD_{50} (days)	SAD (g ili ml a.s/ha)			
	< 100	≥ 100-1000	≥1000-2000	≥ 2000
< 10	0	0	0	0
≥ 10-30	0	0	0,5	1
≥ 30-60	0,5	1	1,5	2
≥ 60-90	1,5	2	2,5	3
≥ 90-180	2,5	3	3,5	4
≥ 180	4	4	4	4

Bioaccumulation potential (B)

Bioaccumulation potential of a variable (B) in the ERI calculation for a given active substance. Degradation in soil (TD_{50}) and the logarithm of the octanol water partition coefficient (log P_{ow}) are used to determine ratings bioaccumulation potential (B) (Table 8).

Table 8. the value of B according to the time of degradation in soil and logarithm of distribution coefficient octanol / water log Pow [5], [6].

TD_{50}	SAD (g ili ml a.s/ha) ($\log P_{ow}$)		
	< 3	3 - 4	> 4
< 10	0	0	1
≥ 10-90	0	0	2
≥ 90-180	0	1	3
≥ 180	0	2	4

Calculate the risk index (ERI) for the Environment

Aggregate variables that have previously presented the corresponding index of risk of active substances contained in end-use products for the treatment of one preparation per hectare ($ERI_{active\ ingredient--w}$). In order to provide greater value and distribution in order to come to the fore at greater risk from pesticides, the sum variable was graded on the square, which in a larger scale allows to better distinguish the risk of pesticides in relation to each other. Terrestrial organisms are most directly affected by the application of pesticides that directly affect their environment, and therefore the T and A variables multiplied by a factor of 1.75.

General equation is as follows:

$$ERI_{active\ ingredient--w} = \mathbf{[1{,}75 \times (T + O) + A + M + P + B + 1]^2}$$

Pesticides used in greenhouses have limited effect, the active ingredients used also have limited impact on terrestrial invertebrates, birds, and aquatic organism bioaccumulation. However, given the potential for wastewater discharge, two variables must be considered when calculate ERI in relation to the environment: mobility and durability.

$$ERI_{active\ ingredient--w} = [M + P + 1]^2$$

Pesticides used in warehouses and microbial pesticides for small or limited use, as well as poor knowledge of microbiological characteristics of pesticides and their impact, given the score 1 for all products.

Pesticides are used in warehouses: $ERI_{active\ ingredient--w} = 1$

Microbial pesticides: $ERI_{active\ ingredient--w} = 1$

$ERI_{active\ ingredient--w}$ -risk index w corresponds to the active substance contained in a given end-use product for the treatment of a hectare. It is also possible to introduce an index by dividing the mass of pesticides with standardized doses of application areas (SAD), which was used in the calculation. This index (ERI / SAD) is a risk associated with the use of one kilogram of active ingredients.

ERI calculation of end-use products

ERI index for end-use products must be calculated taking into account all the active ingredients included in the treatment of crops.

$ERI_{end\text{-}use\ product} = \sum ERI_{active\ ingredient--w}$

Given all the risks of active substances present in the end use of the product, evaluation allows us to avoid the effects specific to all active ingredients separately.

RESULTS

Example calculations for the two active substance in the treatment of corn herbicides [13]:

Merlin 750 WG in plantations corn

$ERI_{active\ ingredient\text{--}1} = [1{,}75 \times (T + O) + A + M + P + B + 1]^2 = [1{,}75 \times (0 + 0) + 1 + 0 + 0 + 0 + 1]^2 = [2]^2 = 4$, thus the index of environmental impact on 4.

Stomp 330-E in plantations corn

$ERI_{active\ ingredient\text{--}1} = [1{,}75 \times (T + O) + A + M + P + B + 1]^2 = [1{,}75 \times (4 + 4) + 4 + 4 + 4 + 3 + 1]^2 = [44]^2 = 1936$, thus the index of environmental impact on 1936.

$\mathbf{ERI_{end\text{-}use\ product}} = \sum ERI_{active\ ingredient\text{--}w} = 4 + 1936 = 1940$, if corn is treated with both pesticides (Merlin 750 WG and Stomp 330-E).

CONCLUSION

Based on the results presented in this paper each farmer who is engaged in cultivation of various crops can be at the level of private farm (farm), calculate the numerical value of risks to the environment, for each product that is used to treat a crop, choose a product that has the smallest Index impact on the environment.

Based on result of research, farmer can calculate the overall risk to the environment of more products that are used during the year in a given crop ($ERI_{end\text{-}use\ product}$), as well as the predictable use of preparations for next year depending on the type of crop and to reduce exposure.

With this model they could for each active substance calculate the risk index for the environment, combined with data on the use of pesticides in one region the number of hectares of arable land and the amount of consumed products (index becomes an indicator of risk) and the total risk to the environment in this area-region.

In order to preserve and protect the environment this index allows us to compare the pesticides with each other to make a selection of pesticides that are least harmful to the environment, so we were able to make important decisions related to environmental protection.

REFERENCES

1. Day, E, 2002. Environmental Indicators Results. Report to the U.S. EPA. American Farmland Trust Center for Agriculture in the Environment.
2. Demers, I, 2001. Analyse et application d'outils de sélection environnementale de pesticides en usage à la ferme. Faculté des sciences, Université de Sherbrooke.

3. Reus, J. et al., 1999. Comparing Environmental Risk Indicators for Pesticides – Summary. Retrieved January 9, 2008 from http:// www.clm.nl /publicaties/data /capersum. pdf
4. Duchesne, R-M, M-H. April and D. Gingras, 2003. Inventaire des indicateurs de risques sur la santé et sur l'environnement pour les pesticides. Direction del'environnement et du développement durable, MAPAQ. Retrieved January 9, 2008 from_ www.agrireseau.qc.ca/agroenvironnement
5. Norwegian Agricultural Inspection Service (NAIS), 2000. Pesticide Risk Indicators for Health and Environment – Norway. Retrieved January 9, 2008 from_http://landbrukstilsynet.mattilsynet.no/dokument_eng.cfm?m_id=201&d_ id=1221 #Pesticide%20risk%20indicators
6. Norwegian Agricultural Inspection Service (NAIS), 2004. Pesticide Risk Indicators for Health and Environment – Norway
7. FOCUS, 1997. Soil Persistence Models and EU Registration. The Final Report of the Work of the Soil Modelling Work Group of FOCUS (Forum for the Co-ordination of Pesticide Fate Models and their Use).
8. European and Mediterranean Plant ProtectionOrganization (EPPO), 2003. Bulletin OEPP/EPPE Bulletin 33, pages 195-209. Retrieved January 9, 2008 from _ http://archives.eppo.org/EPPOStandards/PP3_ERA/pp3-07(2).pdf
9. European Commission (EC), 1994. Council Directive91/414/EEC of 15 July 1991 concerning the placing of plant protection products on the market.
10. European Commission (EC), 2002. Guidance Document on Risk Assessment for Birds and Mammals Under Council Directive 91/414/EEC.Sanco/4145/2000 – Final, 25 September 2002.
11. FOCUS, 2002. Surface Water Scenarios in the Evaluation Process under 91/414/EEC. Report prepared by the FOCUS Working Group on Surface Water Scenarios. Final Draft 06-06-02. Retrieved January 9, 2008 from_ http://viso.ei.jrc.it/focus/sw/index.html
12. Gustavson, D.I., 1989. Groundwater Ubiquity Score: A Simple Method for Assessing Pesticide Leachability. Environmental Toxicology and Chemistry, 8,339-357.
13. Mitić,N,2004. Pesticidi u poljoprivredi i šumarstvu u Srbiji i Crnoj Gori, petnaesto, izmenjeno i dopunjeno izdanje, Drustvo za zastitu bilja Srbije.

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ANALYSIS OF SOIL EROSION WITHIN TWO SMALL CATCHMENTS (WESTERN SERBIA)

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ABSTRACT

This study involves the evaluation of soil erosion within two small catchments classified as ravines and dry valleys within the Kamenica catchment, part of the Zapadna Morava catchment. All natural and anthropogenic factors of soil erosion were assessed, aiming at presenting their effect on erosion. The most vital effect is that of vegetation which contributed to a 2.47-fold increase in erosion intensity within the small catchment of the nameless brook 22 as compared to that within the nameless brook 20 catchment. This analysis enables adequate soil and water protective measures to be taken for the purpose of agricultural production in the area studied.

Key words: catchment, soil, rainfall, vegetation, erosion

INTRODUCTION

Soil is a natural non-renewable resource prone to changes caused by natural factors that are not easily affected by human activities, as well as by anthropogenic factors. The pressure on soil resources has been huge ever since the last century, in both global and local terms: the tendency of the world human population to increase in numbers, urban expansion, industrial and technological parks and infrastructure networks, at the expense of arable land. This problem can be partially mitigated by turning infertile soil into fertile arable land, but the problem of judicial soil utilisation still exists. Serbia has 5,110,000 ha of agricultural soil (0.68 ha per capita) i.e. 4,250,000 ha of arable soil and 0.56 ha per capita [6]. Water resources in Serbia are favourable but insufficiently exploited. There are 180,000 ha of irrigation systems, their current exploitation level being 50-60%. Hydrological systems are estimated to be used for just about 30,000 ha.

Inadequate soil utilisation enhances soil erosion, which is in itself a natural process, but when enhanced it can turn into a very serious irreversible process. Erosion causes huge damages. Serbia is among countries highly endangered by erosion, as evidenced by substantial soilless areas. Some 25,000 ha of soil is lost through erosion in Serbia and more than 50 million hectares worldwide on an annual basis. Erosion is a process involving loss of

arable landm, deterioration of soil physical and chemical properties and reduction of soil productivity. Huge amounts of fertile land are washed off into watercourses.

One of the severest environmental problems in the Republic of Macedonia is intensive soil erosion induced by anthropogenic factors in the last century. Natural factors highly favour the development of this erosion [4].

The struggle against water erosion is an important activity associated with the preservation of both the environment and the production capacities of agriculture as a major source of food. There are numerous ways to fight erosion. In order to take protective measures against soil erosion, catchment properties should be evaluated and defined, which is the objective of this study.

MATERIAL AND METHOD

This study involved the use of field methods including the method of evaluation of the overall configuration elements within the catchment comprising the subcatchments herewith presented, methods used to define the characteristics and effect of natural erosion factors, methods that enable erosion categorisation i.e. methods used to create the torrent cadastre.

Climate elements, rainfall and air temperatures for both catchment regions were determined by the interpolation method [1; 2].

Mean annual sediment volumes coming from the two small catchments and reaching the confluence were calculated [3].

RESULTS AND DISCUSSION

This study presents the results on soil erosion within two small catchments which are subcatchments of the Kamenica river, the left tributary of the Zapadna Morava, near Čačak (Western Serbia). The torrent cadastre for the Kamenica catchment identifies the two small catchments as nameless brook 20 and nameless brook 22 [7]. Both nameless brooks flow into the Kamenica at its left bank.

The nameless brook 20 is 0.53 km^2 in area, 3.57 km in circumference, and 1.02 km in length. Catchment shape is the factor determining the possibility of a sudden inflow concentration of flood waters coming from the entire catchment area, which induces enhanced soil erosion within the catchment. Total runoff, on the other hand, is dependent upon catchment size. According to size, catchments are classified into four types [5]. The shape of catchment 20 is classified as type II, indicating maximum development of the hydrografic network in the middle course of the river but not in the upper and lower courses which lack larger tributaries.

The nameless brook 22 is 0.75 km^2 in area, 4.67 km in circumference and 1.42 km in length. According to size, brook 22 is classified as type I as its bed branches mostly in the upper course. Soil and loose geological substrate are washed off this part of the catchment. The middle and lower course of such catchments have no tributaries and are hydrographically undeveloped.

Sediment production originating from nameless brooks 20 and 22 is part of the overall annual sediment volume of the Kamenica river. The causal agents of the overall sediment yield in the catchment include natural characteristics of the catchment and the

anthropogenic factor. The effect of natural factors of soil erosion is determined by major catchment relief parameters, geological substrate characteristics, soil characteristics, climate and percentage of cadastral land types, with the role of human activities being also exhibited.

All major relief parameters are more dominant in the catchment of nameless brook 20 than in that of nameless brook 22, Tab. 1.

The nameless brook 20 flows into the Kamenica river at the section that is more downstream than the confluence point of the nameless brook 22 and the Kamenica. The lowest point of the nameless brook 20 catchment is 400 m a.s.l., and that of the nameless brook 22 – 434 m a.s.l. The highest point of the main course of nameless brooks 20 and 22 is 515 m and 508 m, respectively. The highest point of the nameless 20 catchment (E)=580 m, and that of the nameless 22 catchment - 558 m. The average bed slope of the main watercourse 20 and 22 is 9.6% and 4.6%, respectively. Mean altitude of catchment 20 (A_m) is 508.40 m and that of catchment 22 - 498.29 m, whereas the mean altitudinal difference (D) of catchment 20 and 22 is 108.40 m and 64.29 m, respectively. The mean catchment slope of nameless brook 20 is higher (I_m=21.4%) as compared to catchment brook 22 (I_m=18.1%). The above relief parameter values resulted in the relief erosion energy coefficient (E_r) of catchment 20 (66.91 $m \cdot km^{-1/2}$) being higher than that of catchment 22 (42.18 $m \cdot km^{-1/2}$), Tab.1.

Table 1. Major relief parameters of the catchments of two nameless brooks (20 and 22)

Parameters	Unit of measurement	Value for nameless brooks	
		20	22
The lowest point of the main watercourse and catchment	m	400	434
The highest point of the main watercourse	m	515	508
The highest point of the catchment (E)	m	580	558
Average slope of the main watercourse in the catchment (I_a)	%	9.6	4.6
Mean altitude of the catchment (A_m)	m	508.40	498.29
Mean altitudinal difference of the catchment (D)	m	108.40	64.29
Mean slope of the catchment (I_m)	%	21.4	18.1
Coefficient of catchment relief erosion energy (E_r)	$m\ km^{-1/2}$	66.91	42.18

The geological substrate present in the catchment area is an indication of soils formed on it. In both catchments, soils are formed on diabase and lake sediments of Pleistocene clay and loam. These are poorly permeable geological substrates.

Table 2. Geological substrates, coefficient of their water permeability (S_1) and their erosion resistance within nameless brook (20 and 22) catchments

Parameters	Unit of measurement	Value for nameless brooks	
		20	22
F_{ip} – Impermeable rocks			
Diabase	km^2	0.15	0.18
	%	29.00	23.40
Tertiary clayey and loamy lake sediments	km^2	0.38	0.57
	%	71.00	76.60
Water permeability coefficient of the geological substrate (S_1)		1.00	1.00
Erosion resistance of geological substrate		Nonresistant	Nonresistant

Diabase accounts for 29.00% and 23.4% of nameless brook 20 and 22 catchments, respectively. Tertiary clayey and loamy lake sediments make up 71.00% of nameless brook 20 and 76.60% of nameless brook 22 catchment. Both parent substrates, i.e. diabase and Tertiary clayey and loamy lake sediments, within both catchments (20 and 22) are non-resistant to water. The water permeability coefficients (S_1) for each catchment are 1.00, Tab. 2. Consequently, the soils present in both catchments (20 and 22), skeletoid brown soil on diabase of the A_h-C profile type and eroded vertisol of the A_h-A_hC-C profile type, are prone to erosion.

Climate elements are an important soil erosion factor within the test catchments. Soil erosion is caused by water runoff. The total average annual rainfall (R) within the catchments is 752.5 mm for nameless brook 20 and 751.2 mm for nameless brook 22. The mean annual air temperature for both regions is 9.2^0C i.e. 9.3^0C, respectively.

Table 3. Cadastral land types and vegetation cover coefficient (S_2) of nameless brook (20 and 22) catchments

Design	Parameters	Unit of measurement	Value for nameless brooks	
			20	22
F_f	Forests and coppice of good crown closure	km^2	0.20	0.16
		%	37.74	21.33
F_g	Orchards	km^2	0.06	0.09
		%	11.32	12.00
	Meadows	km^2	0.01	0.20
		%	1.90	26.67
	Pastures and devastated forests and coppices	km^2	0.13	0.05
		%	24.52	6.67
$\sum f_g$		km^2	0.20	0.34
		%	37.74	45.34
F_b	Arable land	km^2	0.13	0.25
		%	24.52	33.33
	Infertile soil	km^2	0.00	0.00
		%	0.00	0.00
$\sum f_b$		km^2	0,13	0.25
		%	24.52	33.33
Vegetation cover coefficient (S_2)			0.77 Protected	0.83 Nonprotected

The vegetation cover coefficient (S_2) is dependent upon the percentage of cadastral land types in the catchment. The soil of catchment 20 is covered equally (37.74%) by forests and coppice of good crown closure as well as by grass vegetation (orchards, meadows, pastures, devastated forests and coppice). Arable land and infertile soils account for a total of 24.52%, Tab. 3. This relationship between vegetation and land without vegetation within the small catchment area of nameless brook 20 indicates that the soil is protected from erosion, S_2=0.77, Tab.3. The vegetation cover coefficient (S_2) of the catchment 22 soil is 0.83, which is due to the predominance of forests and coppice

of good crown closure (21.33%), orchards, meadows, pastures and devastated forests and coppice 45.34%, and arable land and infertile soil 33.33% (Tab. 3). This suggests that the small catchment 22 is not protected from erosion in terms of cadastral land, as compared to catchment 20, given the fact that catchment 22 has 8.81% more arable land and fewer forests and coppice of good crown closure (by 16.41%), regardless of the higher grass percentage in catchment 22 than in catchment 20.

The numerical value for the soil erosion coefficient in both catchments indicates the predominating type of erosion of particular intensity. The small catchment 20 has the following properties: erosion coefficient (Z) 0.19, class V of erosion category (K_c), very low intensity of erosion, erosion type – in traces. The properties of the small catchment 22 are as follows: coefficient of erosion (Z) – 0.39, erosion category IV, low intensity, deep-cutting type of erosion.

The torrent hydrographic class (H_c) index is used to determine torrent types according to classes. Both nameless brooks (20 and 22) belong to class F, including ravines and dry valleys.

Soil erosion intensity can be expressed both qualitatively (degree of erosion) and quantitatively. In quantitative terms, erosion intensity ($G_{yr\ sp}^{-1}$) in the small catchment of nameless brooks 20 and 22 is 43.91 $m^3\ km^{-2}\ yr^{-1}$ and 108.63 $m^3\ km^{-2}\ yr^{-1}$, respectively.

CONCLUSION

The evaluation of natural characteristics of the two small catchments suggests that major relief parameters of nameless brook 20 are more pronounced than those of nameless brook 22.

The geological substrates and soils occurring in the two nameless brook regions are non-resistant to the predominating type of erosion.

The total mean annual rainfall and air temperatures are identical for the two small catchments, as the catchments of the two nameless brooks (20 and 22) are separated only by a small catchment area.

The vegetation cover provides soil erosion protection in catchment 20, whereas catchment 22 is unprotected.

The characteristics of both small catchments evaluated in this study have resulted in erosion intensity of 43.91 $m^3\ km^{-2}\ yr^{-1}$ and 108.63 $m^3\ km^{-2}\ yr^{-1}$ within nameless brook 20 and 22, respectively. These results suggest a significant effect of vegetation factors on soil erosion.

REFERENCES

1. Bonacci, O.: Meteorološke i hidrološke podloge. Priručnik za hidrotehničke melioracije, 59-86, I kolo, knjiga 2, Tomić, F. (ed.), Zagreb, Hrvatska: Društvo za odvodnjavanje i navodnjavanje Hrvatske, 1984.
2. Dukić, D. (1984): Fizičko-geografski faktori rečnog režima. Hidrologija kopna, 172-190. Joković, D. (ed.), Beograd, Srbija: Naučna knjiga, 1984.

3. Gavrilović, S.: Tehničke dijagnoze erozionih procesa u bujičnim područjima. Inženjering o bujičnim tokovima i eroziji. Specijalno izdanje (0): 66-82, Marković, A., Jarić, M., Trbojević, B. (eds), Beograd, Srbija: Izgradnja, 1972.
4. Milevski, I.: Excess erosion and deposition in the catchments of Kamenichka and Radanjska river, Republic of Macedonia. Glasnik Srpskog geografskog društva, 89 (4): 109-120, 2009.
5. Orlov, P. B., Šćukin, S. I.: Voprosi eroziji i stoka. Moskva, 1962.
6. RZS: Podaci o površinama zemljišta. Beograd, Srbija, 2003.
7. Šekularac, G.: Odnos intenziteta erozije i stepena erodiranosti zemljišta sliva reke Kamenice. Doktorska disertacija. Agronomski fakultet, Čačak, 2000.

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EFFECT *AZOTOBACTER CHROOCOCCUM* UNDER GRADED LEVELS OF NITROGEN ON YIELD OF WHEAT

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ABSTRACT

An investigation has been organized to study the effect of wheat seed inoculation (the cultivars Renesansa, Pesma) with *A. chroococcum*, strain 86 (5x CFU 10^8 ml^{-1}). Experiments were conducted under field conditions, on a chernozem soil. The effectiveness of inoculation on wheat seed yield and 1000-grain weight was shown to depend on the amount of applied urea (50, 100 and 200 kg ha^{-1} and nonfertilized control) and wheat cultivar. *A. chroococcum* inoculation increased the yield of seed in the variant without urea application (by 16 to 26%) and in the case of the cultivar Pesma (from 20%, with 50 kg/ha urea, to 27%, with 100 kg/ha urea).

Key words: *Azotobacter chroococcum*, inoculation, seed, wheat

INTRODUCTION

Nitrogen is the most limiting nutrient for increasing crop productivity. Biological nitrogen fixation (BNF) plays an important role in maintaining soil fertility [1].

Azotobacter spp. is a free-living nitrogen-fixing bacterium, which is used as a biofertilizer in the cultivation of most crops. Inoculation with *Azotobacter* can increase yield by 5–28% [2, 3, 4, 5] as a result of BNF, and the production of antibacterial and antifungal compounds, growth regulators and siderophores [6].

Effect of wheat inoculation with *Azotobacter* varies in dependence of the species and strain of N-fixing bacteria, physico-chamical soil properties, N fertilizers applied, climatic conditions and wheat cultivar [7, 5]. According to Soliman et al. [8] and inoculation with *Azotobacter* replaced up to 50% of the urea-N for wheat in greenhouse trials under aseptic conditions.

The objectives of this study were to assess the effects of inoculation with *Azotobacter chroococcum* and quantity of urea on seed quality and grain yield of wheat.

MATERIALS AND METHODS

This study was undertaken in order to assess the effects of inoculation with *Azotobacter chroococcum* and urea application on yield of wheat cultivars Renesansa and Pesma.

Experiments were conducted under field conditions, on a chernozem soil. The field trial was established in a randomized block design with four ive replications. The chemical soil properties were: pH (in H_2O) 7.47; $CaCO_3$ 15.27%; humus 3.81 %; P_2O_5 32.70 mg/100g soil and K_2O 16.00 mg/100g soil. The size of experimental plots was 48x50 m.

Test variants:

1. control (without urea application);
2. 50 kg ha^{-1} urea;
3. 100 kg ha^{-1} urea;
4. 200 kg ha^{-1} urea, with and without inoculation with *A. chroococcum*.

Wheat seed was inoculated with *A. chroococcum*, strain 86 (72 hrs old, density about 10^8 cfu/ml). Subsequently, 1000-grain weight and grain yield were measured and shown per ha^{-1} of land. The presented results are 2-year averages (2003 and 2004).

RESULTS AND DISCUSSION

The global annual volume of BNF is estimated at about 175 million tons of nitrogen, 79% of which are being fixed in plant-soil systems. Inoculation with diazotrophs may have a positive effect on plant growth parametersm, which may but need not manifest itself on the yield of field crops. Namely, the effect of inoculation has been found to depend on cultural practices applied, plant species, hybrid, bacterial species and strain, inoculation technique and the method of application of bacterial preparations [5, 4].

Azotobacter spp. is free-living non –symbiotic aerobic nitrogen fixing bacteria found in rhizosphere zone of many plants. Azotobacter produces a variety of growth promoting substances like indole acetic acid (IAA), gibberellins (GA), vitamin B and antifungal substances. Another important characteristic of Azotobacter associate with cro improvement is excretion of ammonia in the rhizosphere in presence of root exudates [5]. It fixes approximately 20-60 kg of biological nitrogen per hector per season

A field experiment was conducted to study the effect of *Azotobacter chroococcum* and *Azospirillum brasilense* inoculation under graded levels of fertilizeer nitrogen (0, 30, 60, 90, 120 kg/ha) on wheat [2]. The results revealed that both the inolculants sigificnatly increased the growth parameters, tilles, dry-matter accumulation, grain yield and protein content of wheat gains. Maximum percent increase in grain yeidl with *Azotobacter* (19.2%) over uninoculated control was observed at 90 kg N/ha level. According to Burns [9], inoculation with *Azotobacter* may significantly affect plant germination and growth, *i.e.,* it may indirectly affect the yield.

Table 1. Effect of inoculation with *A. chroococcum* on 1000-grain weight (g)

Inoculation	Cultivar								LSD 5% 1.6673
	Renesansa				Pesma				
	Urea (kg ha^{-1})								
	0	50	100	200	0	50	100	200	
Uninoculated	31.00	33.00	36.00	34.00	30.00	33.00	34.00	32.00	
Inoculated	36.00	37.00	36.00	34.00	34.00	35.00	31.00	33.00	
Increase over uninoculated control (%)	16	12	-	-	13	6	-	3	

The effectiveness of inoculation and its effect on wheat seed yield and 1000-grain weight were shown to depend on the amount of applied urea (50, 100 and 200 kg ha^{-1} and nonfertilized control) and wheat cultivar (Tab. 1, 2)**.**

The largest increase in 1000-grin weight was obtained in the variant without N application and with 50 kg urea ha^{-1} (Table 1). According to Govedarica *et al*. [3] inoculation of wheat seed with diazotrophs increased the 1000-grain weight from 2 to 14% under conditions of a greenhouse. Average long-term results [7] have shown mostly positive effects of inoculation with *A. chroococcum* on wheat grain yield (up to 3%) and plant height (up to 6%). The later parameter may be important in wheat breeding for resistance to lodging.

A. chroococcum inoculation increased the yield of seed in the variant without urea application (by 16 to 26%) and in the case of the cultivar Pesma (from 20%, with 50 kg ha^{-1} urea, to 27% (Table 2). *Azotobacter* spp. increased the yield of wheat by 0.65 g per plant under conditions of a greenhouse [3].

Table 2. Effect of inoculation with *A. chroococcum* on grain yield (kg ha^{-1})

Inoculation	Cultivar								LSD 5% 2.5211
	Renesansa				Pesma				
	Urea (kg ha^{-1})								
	0	50	100	200	0	50	100	200	
Uninoculated	2291.67	2250.00	2333.33	3125.00	2333.33	1041.67	1666.67	2583.33	
Inoculated	2666.67	2502.00	2666.67	2708.00	2958.33	1250.00	2125.00	2458.33	
Increase over uninoculated control (%)	16	12	14	-	27	20	28	-	

Bacterial inoculant biofertilizers can, in principle, be used to supplement the use of urea-N. The estimated amount of BNF by wheat–bacterial associations was between 10 and 30 kg N ha^{-1} for the crop or about 10% of the total N requirement [2].

CONCLUSIONS

The effectiveness of bacterial inoculation on wheat seed yield and 1000-grain weight was shown to depend on the amount of applied urea and wheat cultivar.

Wheat seed inoculation with *A. chroococcum* affecte positively all parameters under study, especially in the variants without urea application and the lowest dose of urea.

Taking in consideration the ecological and economic importance of diazotroph application, the application of bifertilizers is a future imperative.

REFERENCES

1. Vance C. P. & Graham, P. H. (1995): Nitrogen fixation in agriculture: Applications and perspectives, In: Nitrogen Fixation: Fundamentals and Applications, (Tikhonovich I.A., Provorov N.A., Romanov V.I., Newton W.E., Eds), Current Plant Science and Biotechnology in Agriculture, Vol. 27, 77-86.
2. Zambre M. A, Konde B. K, Sonar K. R (1984): Effect of Azotobacter chroococcum and Azospirillum brasilense inoculation under graded levels of nitrogen on growth and yield of wheat. Plant and Soil, Vol 79, No 1, 61-67.
3. Govedarica M., Milošević N., Jarak M. (1995): Diazotrophs and their effect on wheat. Nitrogen Fixation Fundamentals and Applications, Proceeding of the 10th International Congres on Nitrogen Fixation, Sankt Peterburg, Russia, 758-759, May 28 - June 3, 1995.
4. Kennedy R.I., Choudhury A. T. M. A ., Kecskés L. M. (2004): Non-symbiotic bacterial diazotrophs in crop-farming systems: can their potential for plant growth promotion be better exploited? Soil Biology and biochemistry, 36, 8, 1229 - 1244.
5. Milošević N., Jarak M. (2005): Značaj azotofiksacije u snabdevanju biljaka azotom. U AZOT agrohemijski, agrotehnički, fiziološki i ekološki aspekti (Ur. R. Kastori), Naučni institut za ratarstvo i povrtarstvo, Novi Sad, 305-352
6. Pandey A., Kumar S. (1989): Potential of Azotobacters and Azospirilla as biofertilizers for upland agriculture: a review. Journal of Scientific and Industrial Research 48, 134–144.
7. Milošević N., Govedarica M. (2001): Mikrobni inokulanti – biofertilizatori kao zamena i/ili dopuna mineralnim đubrivima? 1st International Simposium, Food in the 21st Century, Book of Proceedings, Subotica, 216-223.
8. Soliman S., Seeda M.A., Aly S.S.M.,Gadalla A.M. (1995). Nitrogen fixation by wheat plants as affected by nitrogen fertilizer levels and non-symbiotic bacteria. Egyptian Journal of Soil Science 35, 401–413.
9. Burns R.G., (1995): Enumeration, Survival and Beneficial Activities of Microorganisms Introduced into Soil, In: Huang P.M. et al. (Eds) Environmental Impacts of Soil Component Interations, Metals, Other Inorganics and Microbial Activities, CRC Press. Inc., 154-164.

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LOGISTICS SUSTAINABILITY OF FOOD PRODUCT

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ABSTRACT

Agro-food chains and networks play an increasingly important role in providing access to markets for producers in developing countries. Globalization of trade and integration of supply chains lead to new demands regarding food quality and safety. Analytical approaches for addressing the role of logistics for development involve a mixture of disciplines that focus on issues of efficiency, organization and innovation as key dimensions of competitiveness.

Key words: logistics, sustainability, markets, development, food products

MATERIALS AND METHODS

Logistic in agri-food sustainable management

In order to govern globalization, countries need to reconcile natural resource management and concern for the environment with the need to have more growth and employment. This is particularly important in the case of food supply chain management, as environment pollution and climate change do threaten agriculture productivity.

Globalization, urbanization and agro-industrialization put increasing demands on the organization of agro-food chains and networks. Food and agribusiness supply chains and networks – once characterized by autonomy and independence of actors – are now swiftly moving toward globally interconnected systems with a large variety of complex relationships. This is also affecting the ways food is produced, processed and delivered at the market (Reardon and Barrett 2000; Van der Laan et al. 1999).

Perishable food products can nowadays be shipped from halfway around the world at fairly competitive prices. The market exerts a dual pressure on agro-food chains, forcing towards continuous innovation and agency coordination. Classical price and quality issues are more important than ever, since consumers can choose from an increasing number of products offered by competing chains.

Today, instead, several factors have pushed agriculture towards the adaptation of transformation industry requirements, as well as to the tastes and needs of the final

consumers, target of aggressive marketing campaigns, aimed only at increasing the final product sales.

Different causes have contributed to this change: the transport costs reduction, experienced until a few years ago, allowed a massive company delocalization and an increasing market internationalization; the consumption of organic products increased, on one hand, as well as fast foods diffusion, on the other; also new distribution systems, especially for major companies, were diffused. This evolution has happened regardless of environmental issues, following Fordism ideas, with no interests in sustainable development.

In this situation, a new and more sustainable approach to food production has been developing - organic food production.

Organic producers, due to their approach and organization, have both a social and environmental role of crucial importance, because:

1. They obtain healthy and taste appealing products, in an environmental friendly way;
2. They preserve vegetation and animal biodiversity, thanks to their ecological infrastructures;
3. They promote the landscape values of rural areas;
4. They have a direct effect in reducing greenhouse gas emissions, and in improving crop capability of carbon sequestration;
5. They could support energy production from renewable sources; water, wind, sun and natural gas;
6. They promote social agricultural systems, supporting the employment of disadvantaged categories
7. They apply and promote contractual relations shared by social parties, and based on ethical and social principles;
8. They promote local food, and don't generate subsidized over-production, increasing dumping behaviour in Developing Countries;
9. They promote a fair and sustainable economic system worldwide, a systems granting the food sovereignty of each people and community.

The experiences and results obtained by organic food producers constitute a useful reference and good practice for the whole food industry.

However, organic food production is not on its own enough to grant the whole food chain sustainability, which should be supported by integrated and efficient production systems, allowing the transformation of agricultural products and delivery to final consumers with a lower use of natural resources, and with lower pollution levels.

In this perspective, the concepts of local food and sustainable logistics become two key issues in assuring the sustainability of the whole food supply chain.

The concept of SUPPLY CHAIN is fundamental for the understanding of the food sector. The supply chain is a kind of route "from farm to fork": from the agriculture, throughout the agricultural products trading and transformation, up to the distribution (wholesaling or retailing). The supply chain indicates how economic activities are developed and integrated; usually it refers to sequential activities, one pre-ordered to the following, even if self-regulated.

Within a logistic process, it is possible to highlight some methods and organizational functions that could deliver a product to the final consumer, in the way, time and costs required. With regards to food products, the logistics activities are carried out by different operators (manufacturers, distributors, service suppliers, consumers), and could be grouped in seven categories:

1. Order Management (order receipt, elaboration, transmission, implementation and invoicing);
2. Management and stock control (definition of supply timing and quantity, inventory upload and download, products and packaging codification);
3. Warehousing (conservation of goods, qualitative and quantitative controls before shipment);
4. Shipment (activities related to product movement and shipment receipt);
5. Packaging (pallets);
6. Delivery (products delivery from the starting point, to the destination);
7. Sales returns management and waste disposal.

The lack of coordination in carrying out these activities could generate inefficiencies: the storing up of too much stock, the rise of lead times, out of time supplying, increasing costs and decrease of the service quality.

In the food sector, three different steps in the evolution of logistics services could be found.

In the first step, logistics was intended as a part of the production system.
In the second step, companies, in order to reduce costs, developed outsourcing strategies, also for logistic activities.

Recently, as a third step, companies are attempting to achieve a better competitive positioning, and give logistics a new strategic role, within cooperative strategies.

It is in this perspective that there could be an evaluation of the coordination and information spread efforts that try to create a stricter connection between production and sales activities, to satisfy the needs of customers interested in the food qualities and health, as well as in the environment.

A consolidation of contractual relationships, durable and able to satisfy commercial and logistic needs, is necessary in order to establish a new partnership, especially in the promotion of local food diffusion (even if this doesn't necessarily correspond to a shorter supply chain).

The possibility of giving a product value depends, quite often, on the efficiency of the supply chain and on the methods used to measure its performance.

The final stage in granting the pursuit of the service goal (the "perfect order") could only be an efficient Supply Chain Management, allowing the integration and the management of the supplies, the control of materials and information in a global perspective, aiming at granting value for the customer; this could be summarized as to obtain the right product, in the right quantity, at the right time.

In view of the next challenges posed by globalization and EU enlargement, the competitiveness of Italian companies should be maintained thanks to logistics

improvement processes, allowing the achievement of growth rate comparably good as in the past.

However, at present, the Italian logistic supply chain has to face a series of problems, which decreases its efficiency:

1. The extreme fragmentation of farms and transformation industries makes it difficult to reach a critical mass in logistics activities, as to set up a district logistics.

1 The Modern Distribution is more and more engaged in directly controlling and managing the whole food supply chain

2 The market doesn't offer logistic solutions able to satisfy the requirements of the food sector, especially for the management of the chill supply chain, and for Door to Door delivery.

3 The administrative fulfilments are several and rigid, while the delivery of fresh food requires a high efficiency.

4 Customer price for fresh products have been stagnant for many years, while distribution and logistic costs are increasing.

Nevertheless, there are several experiences and good practices that are to be spread in order to increase the efficiency of logistic activities and of the whole supply chain, with a potential costs reduction and the creation of new business opportunities on markets attracted to the "Italian Taste".

It is possible, thus, to start from the diffusion and good reception of Italian products on foreign markets, in particular for typical or DOP products. This property allows Italian export to grow regularly.

The chill supply chain is essential to grant food conservation. Technology could help food producers: railway or maritime transport operators are starting to suggest shipments on refrigerated mobile bulks, allowing for perfect product conservation without breaking the chill supply chain, and also simplifying, where rendered possible by health and duty authorities, administrative procedures.

For instance, Sicilian oranges are delivered from Sicily to the CeDi of COOP in Northern Italy on railways, using mobile bulk with passive refrigeration systems. At this moment the service involves three bulk delivery daily on Trenitalia trains, but if only 15% of all oranges delivered by road would use this service, 3 trains/day could be filled. Another example about how logistics could support food production comes from maritime transport: MAERSK has, for the first time, has delivered a refrigerated mobile bulk of Sicilian oranges to Japan, a rich market where Tarocco oranges cost 1€ a piece. In this winning case, logistics creates value for Italian agriculture.

Also, the CPR System experience, a Consortium managing reusable green boxes for fruits and vegetables transport, is important: this system has evident environmental advantages (more than 90 million disposable packages per year are avoided), and has also allowed a reduction of 2/3 in packaging costs. CPR System estimations state that 50% of fresh food price comes from logistic costs; thus, possible gains are huge, and advantages are connected to an improvement of the whole logistics chain, with benefits for all operators (producers, distributors and customers).

Therefore, some possible solutions to improve food logistics are available, regardless of all Italian production system weaknesses, caused by its fragmentation.
Logistic providers have to "invent" innovative and affordable solutions as to make demand and offer collide.

RESULTS AND DISCUSSION

Critical success factors for performance and sustainability

In times of globalization and change, the understanding of the dynamics in critical success factors for competitive performance and sustainability (Bisp et al., 1998) is of crucial importance in strategic management decision activities. It is the basis for any further discussion of research needs and challenges .
In principle, successful competitiveness and long-term sustainability depend on benefits exceeding costs where, in this context, benefits and costs represent general terms representing advantegous and disadvantegous effects of activities or developments. The indicators for their determination can vary in times of change as can the critical success factors for performance and sustainability. This reduces the competitive advantage of the established production and distribution organization. A current example is the emergence of competitive bio-energy production.

Any improvements in food chain activities build on the perceived anticipation of improvements in the balance of benefits over costs. However, there are different perceptions and priorities for society (policy) and for enterprises (Fritz & Schiefer, 2008). From a society's point of view, benefits may involve monetary and non-monetary elements. From an enterprise view the monetary profitability must be evident. This has consequences for sector developments and enterprise activities. In principle, enterprises have to focus on those critical success factors that improve their profitability. However, they cannot neglect the society's view on benefits and costs and the dynamics in society's performance indicators to remain sustainable in order to avoid regulations and other limitations on an enterprises' decision flexibility. The consideration of society's views is, therefore, one of the critical success factors for the sector's sustainability in a competitive environment (Krieger et al., 2007). New developments in sustainability communication between the retail sector and consumers like 'food miles' (Pretty et al., 2005), 'fair miles' (MacGregor & Vorley, 2006) and similar indicators reflect some of these developments . They may have wide-reaching effects on the sector's development direction in trade relationships, organization, etc. Furthermore, potential changes in the future scenarios (SCAR, 2007) due to environmental effects (climate change, depletion of resources, etc.), demographics, changes in diets or lifestyles, etc. but also due to unexpected events may ask the sector to develop flexible solutions in production, organization, sourcing or distribution to be able to easily adapt to changes in scenarios and to remain sustainable in the long run.

In determining their long term development paths, enterprises and chains need to find a balance between improvements in their monetary benefit-cost balance to assure general competitiveness in their markets, and the society's consideration of the benefit-cost balance to assure acceptance and sustainability. It will be essential to understand the

relevance and dynamic developments in those critical success factors and indicators that determine performance from the view point of enterprises, chains and the society (Aramyan et al., 2007; Gerbens-Leenes et al., 2003; Gunasekaran et al., 2001, 2004).
Comparative benchmarking studies within the food sector, as well as across sectors, are required to understand the complex interdependencies between chain organization alternatives and their performance in economic and non-economic (e.g. quality, environmental consequences, etc.) aspects. Benchmarking research does focus on the basic functions chain organization alternatives build on and identify 'best practice' reference models, the critical success factors for success in different dimensions of interest (quality, environment, etc.) and the related performance indicators for their evaluation (e.g., Hunkeler et al., 2003). Cross-sector benchmarking studies attempt to identify so-called 'best of class' examples for organizational functions irrespective of the products under consideration (Bisp et al., 1998; Gilmour, 1999; Togar et al., 2004).
Approaches derived from Life Cycle Assessment (LCA) and involving economic and social elements (e.g., SLCA, Social Life Cycle Analysis), from chain encompassing 'hot-spot-analysis' or from Balanced Scorecard (BSC) concepts (e.g., BSSC, Balanced Sustainability Scorecard) and others are being discussed for the necessary multi-dimensional analysis needs (Guinée, 1992; Hendrickson et al., 1998; Graedel, 1996; Heijungs, 1996; Hagelaar & Vorst, 2002; Schiefer, 2002; Mourad et al., 2007).
Results from benchmarking studies can be combined with modelling results and linked to performance indicators to produce performance maps, which support evaluation of alternatives and the decisions required for their realization.

CONCLUSION

The food sector as a whole is faced with major challenges that arise from changes in the sector's economic and non-economic environments, from changes in lifestyles, from global increases in food consumption, from a diminishing production base due to, e.g. the loss of arable land or its divergence for non-food production alternatives (see, a.o., CIAA, 2007), and, not the least, by changing attitudes of society towards the consequences of the food system's activities for environmental, social and economic issues, captured in the term of 'sustainability'.

As a consequence, Food Chain Management is a rather new research domain.

This paper discusses the background of future research needs and formulates priority challenges for managerial improvements towards an increased sustainability of the food sector.

REFERENCES

1. Rodney S. Tolley, 2003, "Sustainable transport: planning for walking and cycling in urban environments" WP
2. William Richard Black,Peter Nijkamp, 2002, "Social change and sustainable transport"
3. William Richard Black, 2010, "Sustainable Transportation: Problems and Solutions"

4. Piet Rietveld, Roger Stough, 2008 "Barriers to sustainable transport: institutions, regulation and sustainability"
5. C. Socco, C. Montaldo, L. Staricco, 2009, "Verso una strategia europea per una mobilità sostenibile: linee d'azione per gli enti locali", Franco Angeli.
6. Carlo Socco, 2009, "Il piano urbano di mobilità sostenibile: linee d'azione, indicatore e monitoraggio", Alinea Editrice.
7. Wolfgang Kersten u.a.,Wolfgang Kersten,Thorsten Blecker,Heike Flämig, 2008, "Global Logistics Management: Sustainability, Quality, Risks", ESV.
8. Thomas R. Leinbach,Cristina Capineri, 2007, "Globalized freight transport: intermodality, e-commerce, logistics and sustainability", EE.

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PROTECTION OF RESOURCES IN PRODUCING SAFE FOOD APPLICATION ALUMINOSILICATE RAW MATERIALS

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ABSTRACT

The paper presented the results of multiyear's research in ITNMS to use domestic raw mineral materials and to create new products as substitutes of imported components and and supplements for protection overall resources and the production of safe food to the competitive european market. It was pointed out that certain aluminosilicate raw mineral materials (zeolite, bentonite, apatite, diatomite,...) under the given conditions, in the natural or modified form, individually or in mixtures, are good adsorbents mycotoxins, heavy metals, radionuclides and other harmful substances present in different media. It was confirmed that aluminosilicate raw minerals materials have widely application to protect resources.

Key words: safe food, harmful matters, aluminosilicate raw mineral materials, resources

INTRODUCTION

Food manufacturers now are faced with several conflicting requirements: to produce enough food which need to be healthy, safe and cheap. Production of safe food limits and / or exclude the use of pesticides and fertilizers, antibiotics, hormones and other chemicals, which regulates the EU regulations (178/2002, 852/2004, 882/2004, 183/2005, etc.). On the other hand, human activities in industry, energy production, and exploitation of mineral deposits, agriculture, military activity, transportation and urbanization, continually generate primary and secondary organic, inorganic and radioactive pollutants which endanger the ecosystem, especially the resources to produce safe food (soil and water) with long-term harmful effects on biodiversity. In the EU are produced annually about 30 million tons for the health hazardous waste materials, from which 50-60% stays in the soil. In the world, every year, due to anthropogenic factors, lose about 7 million hectares of agricultural soil, from which in Serbia, about 6200 hectares. It is evidently that there is the higher content of radioactive uranium and toxic metals (Cr, Cd, Sr) in mineral fertilizers [1,2].

Application of mineral raw materials as adsorbents, based on the properties that alumosilicate minerals of zeolite, bentonite, diatomite on their active centers, by the

mechanism of ion exchange, on the surface and in grain structure, can adsorbed various toxic ligands: atoms, molecules, radicals and ions from waste water, contaminated gases, from degraded soils, animal feed, human and animal organisms. Chemical modification can be achieved in the process of changing some active centers (exchangeable cations) on the surface or in the structure of minerals, with organic or inorganiccations.

Natural aluminosilicate mineral raw materials, due to their physical-chemistry characteristics, under the given conditions, in the natural or modified form, can be good adsorbents of toxins, heavy metals, radionuclides, ammonia , carbon dioxide, organic pollutants. They are used as correctors of the pH of soil, for improving the chemical and physical-mechanical properties of soil, donors of the macro and micronutrients, modulators of nutrient base, means for plant protection and preservation of seed quality, carriers of the active ingredients in production the pesticides of biologically active substances, the reaction filters, means for binding the pellets in the animal feed industry and others.

The aim of this paper is to present the new knowledge about the possibilities of application the major domestic alumosilicate mineral raw materials as substitutes for expensive imported materials and often synthetic materials to protect resources and the production of safe food.

RESULTS OF INVESTIGATION OF APPLICATION THE ALUMINOSILICATE MINERAL RAW MATERIALS

Zeolite: Natural or modified zeolites because of their sorption, exchangeable cation, catalytic and other properties can be used as adsorbents of mycotoxins, radionuclides, toxic metals, ammonia in a variety of media, for adsorption of harmful gases with unpleasant smelt and moisture, as a means for improving the immunity of animals in livestock. Many studies have confirmed that the addition of zeolite to the corn silage influences on increase the pH of silage and reducing the number of molds and the presence of mycotoxins (zearalenone, T-2 toxin and DAS) [4]. Natural zeolite with a high percentage (80%) of clinoptilolite efficiently adsorbing (82-99%) aflatoxins B1, B2 and G2. On the other hand, zeolite whose surface is modified by the ammonium ion, besides the aflatoxin, adsorbed (83-94%), zearalenone, ochratoxin A and T-2 toxin (Table 1), [3].

Table 1. Adsorption index of major mycotoxins

Mikotoxin	nature zeolite	modificated zeolite
Aflatoxin B1	99%	99%
Aflatoxin B2	85%	-
Aflatoxin G2	82%	-
Zearalenone	33%	94%
Ohratoxine A	40%	96%
T-2 toxin	35%	83%

Animals that receive food which is contaminated with mycotoxins, with the addition of adsorbents, opposed to the animals which received the same food, but without the addition of adsorbents, achieves higher yields of meat, milk and eggs (3-7%),

have better reproductive performance, better immune status and health, and less residues of harmful substances in products. By inclusion of nature zeolite in the feeding mixture for fattening pigs (2g/kg of mixture) compared to the control group, influenced on increase in meat yield for 3.06 percentage points, the decrease of the content of free fat in the muscle *(M. semimembranosus)* by 0.66 percentage points, and the increase the content of proteins by 0.53 percentage points [3].

In applying for the adsorption of uranium ions, modified zeolite showed higher efficiency, in the range pH 3-8. Treatment of nature zeolite with cations ODA*, HDTMA* or OA* increases the index of adsorption of uranium ions from solution with 35% to the natural zeolite to more then 95% to the organic modified samples (Table 2), [4].

Table 2. The results of adsorption of uranium ions with organozeolites

Organozeolite	Organic phase mmol M^+/100g.	Adsorption index, %	C_{fil}, mg/dm3
Zeolite+ ODA	2	20,4	38,06
	5	24,1	36,25
	10	50,4	21,71
Zeolite+ HDTMA	2	29,8	33,50
	5	92,0	3,81
	10	98,0	0,95
Zeolite + OA	2	25,0	35,83
	5	50,5	23,65
	10	97,7	1,19

*M^+ - organic cation with which is activated zeolite; C_{fil} - no adsorbed concentration of uranium ions in the filtrate (initial is 49.2 mg/dm^3) ODA-octadecyl-dimethyl-benzyl; HDTMA-hexadecil-trimethyl ammonium ion; OA-octadecyl amin.

Especially are emphasized results of the efficiency of adsorption the uranyl ion by reaction mixtures with different mass participation of apatite and zeolite modified with quaternary ammonium ions, purposed for remediation of contaminated soil. It was confirmed that with the increasing of content of organozeolites in the mixtures, increase the adsorption index, too. Synergism of the mixture is reflected in the rapid binding of uranium by organic modified zeolite and formation of stable autunite phase in a long-term period of time using the apatite, which excludes the desorption effect of zeolite due to changes of conditions of the soil. The mixtures are recommended as a reactive permeable barrier, directly mixed with contaminated soil in combination with suitable agro-technical measures to correct acidity. In recent years are developed new integrated technologies of soil remediation the land contaminated by uranium, using the plants (phytoaccumulators), which have ability of adopting uranyl ions. By their use, in combination with mineral adsorbent zeolite and precipitator- apatite, emphasized more appropriate synergistic effects for more remediation methods. [5]

Because of the big affinity towards the radionuclide ^{137}Cs, zeolite is using to remove cesium from contaminated waters, soil, and like a radioprotector to alimentary radioactivity[6].

Zeolite has very successful in the technology of biological recultivation the

landfill and tailing with different mechanical and physical-chemical composition. Germination, growth and yield of grass-legume mixtures, alfalfa and canola on deposols is improved using natural and
modified zeolite [7].

The addition of natural and modified zeolite (0, 0.25, 1, and 2%) had a positive impact on the development of mushroom mycelium (*Agaricus blazei. Ganoderma lucidum, Lentinula edodus, Pleurotus ostreatus HK-35*), and the modified form gave better results with doses from 1- 2%. Modified zeolite (0.2% of the mass of wet substrate based on the wheat straw for nursing the mushroom *Pleurotus ostreatus* HK-35) contributed to the faster intergrowth of the mycelium, earlier fruiting and increasing the yield fruitful bodies of the fungus by 30%. Fruitful body of the fungus shows increasing the presence of minerals (Ca, P, Na, Mg, Fe,Cu), proteins, sugars and fibers. Addition of natural and modified zeolite to the cover for growing the mushroom *Agaricus biosporus*, contributed to increasing the yield up to 10% [8].

Bentonite: Due to its characteristics, similar to the zeolite, it can be used as adsorbent of certain mycotoxins. Bentonite added in the medium same as bovine gastric contents (1%), realized the adsorption of aflatoxin (B1, B2, G1 and G2) close to 100%. Application of 2% bentonite adsorption of aflatoxin M1 from milk was 89% By including of 0.5% Na-bentonite in the diet of pigs which contained 800 ppb of aflatoxin B1, is increased average daily gain and food consumption. Bentonite (1.1%) was added to the meal of lactating cows and had a positive influence on milk production and metabolism and also contributed to reduction the residues of aflatoxin M1 in milk, in a quantity of 64.6% [9]. Inclusion of 600 g / day of bentonite in the meals of cows resulted in a reduction of milk contamination with ^{137}Cs and 134Cs for 80% [10].

The latest results about using the bentonite (as a means for pelleting feed mixtures for calves indicates that the bentonite, besides its influence on increasing the quality of pellets, has positive impacted on growth, while it is not fortified its adverse impact on important biochemical parameters of bloods [11].

The bentonite can also be used as carriers for pesticides with the slower release of active components [12]. In recent investigations carried out in ITNMS, are examined the adsorption-desorption capacities of more minerals in the natural and modified (organic-mineral) form forwards the pesticide Fenitrothion. Like an organic component for the synthesis of organic-minerals was used quaternary ammonium with stearyl-dimethyl-benzyl ammonium chloride. Adsorption index ranged from 90-99% for organo-bentonite, 71-97% for organo-zeolite and 50-99% for organo-sepiolite. When as a carrier in the formulation is used organo-bentonite and organo-zeolite , it desorbed up to 10% and 20% fenitrothion, which indicates their stability in water.

Diatomite: Investigation of efficiency of adsorption the uranyl ions by diatomite, in comparison with natural and modified bentonite and zeolite, natural, mechanochemically activated apatite and phosphate concentrate with 34.95% P_2O_5 are presents in Table 3., [13].

Table 3. Immobilization of uranyl ions with different aluminosilicate materials at pH 5.5

reactive material	7 days% immobilization	15 days% immobilization
Nature apatite	32.44	44.74
Mechanochemistry active apatite 15'	77,04	81.60
Concentrate of phosphate	91.40	97.17
Diatomite	89.76	81.12
Nature bentonite	47.77	42.49
Organomodified bentonite	89.46	89.64
Natural zeolite	34.80	34.80
Organomodified zeolite	98.00	98.00

Binding speed for uranium ions follows the rule: **organomodif. zeolites> apatite concentrate> organomodif. bentonite> diatomite> mechanochemically activated apatite> natural bentonite> natural zeolite> natural apatite**. Using the adsorbents with faster action (diatomite, organomodif. zeolite and bentonite) with adsorbent of slower acting(natural phosphate), achieves a synergistic effect of mixtures of reactive materials like a permanent solution for the "in situ" stabilization of uranium ions in the remediation of soil contaminated.

Diatomite gave very good results as inert duster for suppress the development of insects in warehouses. The highest quality of duster is those with 80-90% SiO_2 with amorphous shape and pH ≤ 8.5, which diatomite has. Inert duster in protection the grain from storage insects are important because are not toxic to mammals. The beetles which are the most sensitive species, are beetles of the genus *Cryptolestes*, slightly less from the genus *Sitophilus and Oryzaephilus,* while the genus *Rhyzopertha* and *Tribolium* and least sensitive to this type of inert duster (Table 4) (14).

Table 4. Mortality of adult of insects Sitophilus oryzae and Tribolium castaneum,%

Duster	Duster, g/kg wheat	7. day	14.days
		Sitophilus oryzae	
Zeolite	0.50	66± 1.73	100
Organozeolite	0.50	40 ± 1.63	87 ± 2.06
Diatomite	0.15	69 ± 1.50	100
		Tribolium castaneum	
Zeolite	0.50	34 ± 3.70	95 ± 1.26
Organozeolite	0.50	23 ± 1.26	72 ± 3.16
Diatomite	0.30	83 ± 2.06	100

Apatite. In the latest researches [15], it is investigated the synergistic mixture of natural phosphate ores and modified zeolites in order to develop the production of natural phosphate fertilizers on the basis of domestic raw zeolite („Igroš" Kopaonik) and natural phosphate („Lisina", Bosilegrad). It was fortified that 15 days after the preparation of mixtures, modified zeolite (by ammoniumsulphate and urea as NH^{4+} ions carriers) by exchange of Ca^{2+} contributed to increase the solubility of phosphate ore and releasing of available phosphorus and then nitrogen and calcium necessary for

plant nutrition. Zeolite reduces the loss of weakly bonded ammonia from urea retention in its porous structure, which is released as needed and makes available to the plant.

CONCLUSION

Aluminosilicate mineral raw materials (zeolite, bentonite, apatite, diatomite) in natural or modified form, can adsorb or bind mycotoxins, radionuclides, toxic metals and others harmful substances. On that way, they simultaneously, contribute to the protection of resources for the production of safe food (soil, water and air flow) and contribute to the health of humans, plants and animals and the environment protection. Initiating local preparing capacities for getting the new products based on mineral raw materials, we would obtain immense economic and social effects on the national level.

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REFERENCES

1. Stevanović D., Kresović M.,Stojanović M., Grubišić M., Milojković J., Postojeći asortiman mineralnih djubriva u Srbiji, njihov kvalitet i problemi primene, XIV Savetovanje o Biotehnologiji sa medjunarodnim učešćem, Čačak, 9-17, (2009).
2. Stojanović M.,Mrdaković-Popić J.,Stevanović D.,Martinović Lj., Phosphorus Fertilizers As Source of Uranium In Serbian Soils, Agron. for Sustainable Development, 179-183, (2006).
3. Adamović M.,Tomašević-Čanović M., Milošević S., Daković A., Lemić J., The contribution of mineral adsorbent in the improvement of animal performance, health and quality of animal products. Bioteh. in animal hasbandry, 5-6, 383-395, (2003).
4. Matijasević S., Daković A.,Tomasević-Canović M., Stojanović M.,Ileš D., Uranium(VI) adsorption on surfactant modified heusoilites/clinoptilolite rich tuff, Journal of Serbian Chemical Society, J.Serb.Chem.Soc., 71(12), 1323-1331, (2006).
5. Stojanović M.,Milojković J.,Adamović M., Ileš D., Integrated management of uranium contaminated soils, XXI congress of Chemists and Technologists of Macedonija, September 23-26, Ohrid, p54, (2010).
6. Mitrović B., Vitorović G., Vitorović D., Daković A., Stojanović M., AFCF and clinoptilolite use in reduction of ^{137}Cs deposition in several days contaminated broiler chicks, Journal of Environmental Radioactivity, 95, 171-177, (2007).
7. Grubišić M., Vuković M., Savić N., Stojanović M.,Milojković J.,Stojković S.,Stanje, nove mere i tehnologije u biloškoj rekultivaciji zemljišta na spoljašnjem odlagalištu Drmno, Electra VI, 274-279, (2010).

8. Klaus A.,Grubišić M.,Nikšić M., Influence of some zeolits on the growth of mycelia of industrial fungi Agaricus biosporus, Ganoderma lucidum, Pleurotus ostreatus and Lentinus edodes. 1st South East European Congres of Chemical Enginering, 31-37, (2005).
9. Applebaum R., Marth E.H., Use of sulphate or bentonite to eliminate aflatoxin M1 from naturally contaminated raw whole milk. Z. Lebensm. Unters. Forsch., 174:303-305, 1982.
10. Piva G., Fusconi G., Stefanini L., Modenseni R., Fabri S., Lusardi E., Pacifici L., Effect of supplementing feeds with bentonite on transfer of ^{137}Cs and ^{134}Cs from forage to milk. Zootecnica e Nutrizione Animal, 14 (4) 307-313, (1988).
11. Stojanović B.,Grubić G., Adamović M., Radivojević M., Šamanc H., Effect of bentonite in pelleted concentrate for calves. 13. Međunarodni Simpozijumu tehnologije hrane za životinje "Tehnologija, kvalitet i bezbednost hrane za životinje" 153-159., Novi Sad, (2009).
12. Celis R., Facenda G., Hermosín M.C., Cornejo J., Assessing factors influencing the release of hexazinone from clay-based formulations. Inter. Jour. of Environm. Anal. Chemistry 85, 1153-1164, (2005).
13. Milojković J.,Stojanović M.,Ileš D.,Grubišić M., Bentonit i diatomejska zemlja kao sekvencijalni agensi za adsorpciju urana. XLVI Savetovanje srpskog hemijskog društva. Beograd, 131-135, (2009).
14. Kljajić P., Andrić G., Adamović M.,Bodroža-Solarov M., Perić I., Laboratory assessment of insecticidal effects of natural zeolite and a diatomaceous earth formulation against three stored-product beetle pests, J. of stored products research, doi:10.1016. (2009).
15. Stojanović M., Milojković J., Grubišić M., Stevanović D., Adamović M., Environmental friendly" alumosilikatna đubriva na bazi prirodnih fosfata i modifikovanih zeolita, XIV Savetovanje o Biotehnologiji sa medjunarodnim učešćem, Čačak, 905-911,(2010).

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THE USE OF AUTOCHTHONOUS PLANTS IN PREVENTION OF SPREADING OF INVASIVE PLANT SPECIES IN THE PROCESS OF URBAN LAND PLANTING

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ABSTRACT

This paper aims to introduce the principles and benefits of using autochthonous vegetation in the process of urban planting in the function of control and further prevention of spreading of invasive plants. The emphasis is primarily given to woody plant species.

Key words: invasive plants, control

INTRODUCTION

The most significant threats to sustainability, structure and functioning of ecosystems are located in habitat changes due to the influence of man, the effects of climate change, the spread of invasive species, excessive exploitation of resources, ecosystems and pollution. Scientific papers suggest that habitat destruction and invasive species are the two most important factors that threaten biodiversity at the global level.

In projects dealing with biological invasions, as well as in the literature concerning the same subject, it is emphasized that the majority of invasive plants belong to a group of horticultural plants [1]. The largest number of horticultural, ornamental plants entered the city by planting in public areas, private gardens, botanical gardens and other green spaces.

Therefore, the proper selection of species for the landscaping of urban green areas is the basic prerequisite for combating the spread of invasive plants. Planting primarily natural, autochthonous plant materials reduces this process to a minimum. This paper shows the use of autochthonous woody plant material as a means of preventing the spread of invasive plants on urban green areas.

MOST IMPORTANT INVASIVE WOODY PLANT SPECIES IN SERBIA AND THEIR BEHAVIORAL PATTERN

The term invasive species includes the species whose introduction or spread outside their natural range is threatening biodiversity. Invasive alien (non-native) species occur in all taxonomic groups, including animals, plants, fungi and microorganisms. All of them can affect all types of ecosystems.

One of the reasons why non-native plant species become invasive is that they are away from their natural enemies, herbivores and pathogens that keep the density of the population in their natural habitat under control. Other reasons derive mainly from insufficient control of the ecosystem in which the survival and expansion of all, including potentially invasive species, is influenced by man.

Invasive plant species have the ability to generally easily use the features of the altered habitats and to establish themselves and spread, because they can penetrate and take up residence in disturbed habitats around the urbanized territory more easily than in stable ecosystems, which are much more resistant to the establishment of new species.

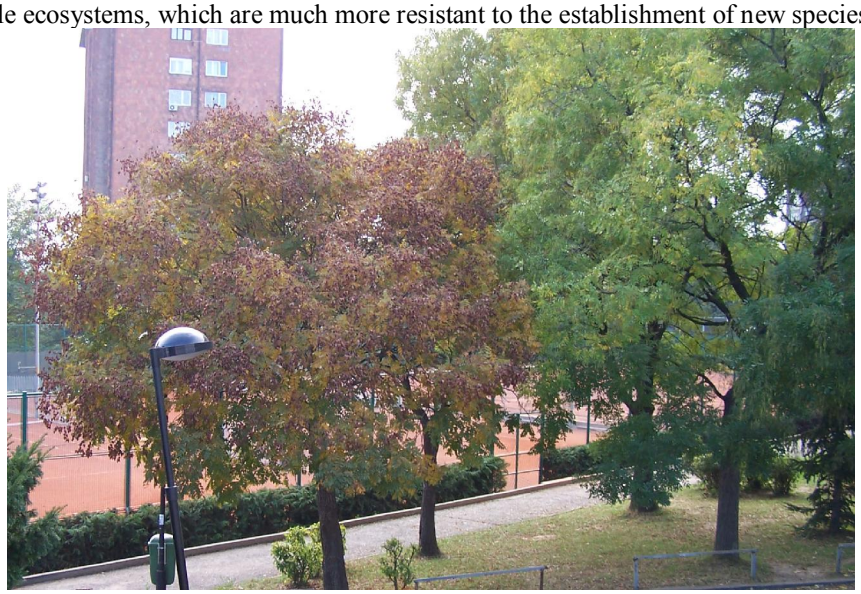

Figure 1. *Koelreuteria paniculata Laxm.,* invasive species planted in the green area of a sports centre in Belgrade

If the new environment is similar to the natural environment of the introduced species, the species may find it easy to survive in it and to breed. However, to be called invasive, i.e. to actually become invasive, it has to be successful in suppressing the local, autochthonous species successfully and visibly spreading to new areas, significantly increasing the density of population and to substantially harming the ecosystem in which it is introduced.

Figure 2. *Ailanthus altissima (Miller) Swingle,* an invasive species growing wild; Partizanski put, Belgrade

Common features of invasive non-indigenous species are rapid growth and intensive reproduction, a great power of dispersion, phenotypic plasticity and, for numerous individuals of the species, the capacity to survive in spite of different nutrients available and different environmental conditions. Invasive species are, especially in forestry, of high ecological and economic damage, and their negative impact has been exacerbated by climate change, pollution and degradation, as well as by the potential loss of habitat due to human interaction. Invasive species can lead to a homogenization of regional flora, therefore to the disturbance of biodiversity, and they can also change the structure and functioning of ecosystems, and cause socio-economic and health consequences for the man [1].

Susceptibility of an invasion of ecosystems depends on the characteristics not only of invasive species, but native species present. One plant species may be invasive if it has the same properties as native species and also if it has different properties from them. In the first case it may be more successful than domestic plants in the region and take up the available space, and in another it may be easier to take the empty spaces that local species avoid.

Figure 3: *Gleditsia triacanthos L.., invasive species used for the protective strip on the part of Zrenjanin road in Belgrade*

This paper deals with the most important group of ornamental plants used for urban planting - trees, which most efficiently covers the urban and suburban space and is most functional in it. Especially important are potentially invasive species from ornamental ie. horticultural plants, especially as, after a while, this kind can get out of hand of the controlled cultivation due to absence of certain measures to control the spread, and can very quickly spread in the environment in which they were introduced. Some of them can first take over just an urban habitat, but can later spread from them and be transferred to the surrounding countryside.

The Study: Ecology, Monitoring and technological methods to control invasive plants in the biotopes of Belgrade [1], has revealed significant invasive and potentially invasive woody species which threaten autochthonous flora of this very area. These are the following species: *Acer dasycarpum Ehrh. (fam: Aceraceae Juss.), Acer negundo L. (fam: Aceraceae Juss.), Ailanthus altissima (Mill.) Sw. (fam: Simarubaceae), Albizia julibrissin Dur. (fam: Mimosaceae R.Br.), Amorpha fruticosa L. (fam: Fabaceae Lindl.), Broussonetia papyrifera (L.) Vent. (fam: Moraceae Link.), Buddleja davidii Franch. (fam: Loganiaceae), Tecoma radicans (L.) (fam: Bignoniaceae Pers.), Catalpa bignonioides Walt. (fam: Bignoniaceae Pers.), Celts occidentalis L. (fam: Ulmaceae Mirb.) Diospyros lotus L. (Ebenaceae Vent.), Elaeagnus angustifolia L. (Eleagnaceae Lindl.), Fraxinus americana L. (fam: Oleaceae Hoffm. et Link), Fraxinus pennsylvanica Marsch. (fam: Oleaceae Hoffm. et Link), Gleditsia triacanthos L. (fam: Cesalpiniaceae R.Br.), Hibiscus syriacus L. (fam: Malvaceae Juss.), Juglans nigra L. (fam: Juglandaceae A.Rich.), Koelreuteria paniculata Laxm. (Sapindaceae Juss.), Maclura aurantiaca Nutt. (Moraceae Link.), Mahonia aquifolium (Pursh) Nutt. (fam: Berberidaceae Terr. Et Gr.), Morus alba L. (fam: Moraceae Link.), Morus nigra L. (fam: Moraceae Link.), Paulownia imperialis S. et Z. (fam: Scrophulariaceae Juss.), Populus ×*

canadensis Moench, Prunus serotina Ehrh (podfam: Prunoideae)., Quercus borealis Michx f., Rhus hirta (L.) Sudworth (fam: Fagaceae Dum.), Robinia pseudacacia L, (fam: Fabaceae Lindl.) Sophora japonica L. (fam: Fabaceae Lindl.), Ulmus pumila L. (fam: Ulmaceae Mirb.). It may be noted that this list contains almost all frequently used and popular woody species applied in the process of land planting in our towns and other urbanized areas, mines, industrial sites, transport complexes and resorts. It is therefore of great importance to determine the methods of reviewing their potential invasiveness and develop methods of fighting this phenomenon with the help of systematic selection of predominantly autochthonous ornamental woody material, which are plentiful, due to the natural resources of Serbia.

AUTOCHTHONOUS PLANT SPECIES AS A FACTOR IN INVASIVE PLANTS CONTROL

Functionality and lifespan of woody plants, the basic elements of green areas, varies significantly and depends on the characteristics of the species and on specific, and in a small area, very variable environmental conditions [2]. The conditions in which a species grows influence the dynamics of its growth and the achievement of certain developmental stages, and durability.

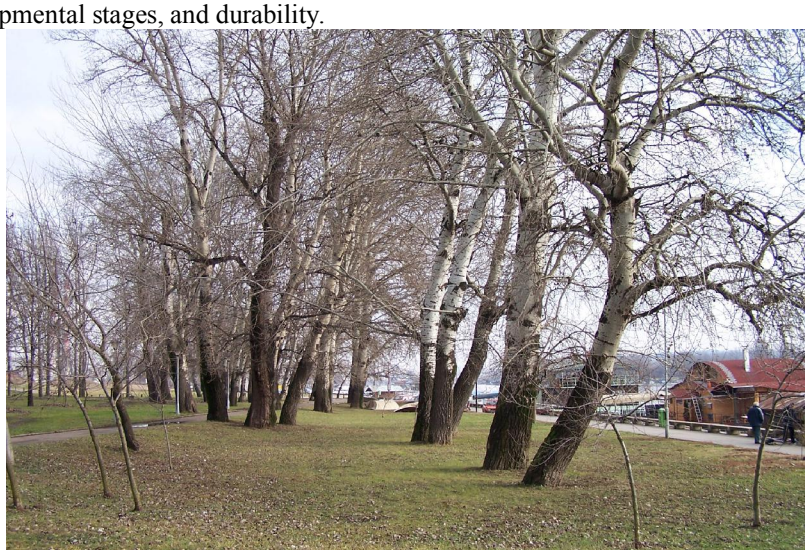

Figure 4. *Populus alba L.*, an autochthonous species, used in land planting of greenery along the riverbank in block 70 in New Belgrade

The intensity of physiological processes depends primarily on the process that creates a new plant mass [3]. Only during the course of an intensive process of photosynthesis, respiration and construction of new plant tissue, the wood organism achieves optimal ecological function, much-needed in almost every urban ecosystem. This means that the tree trunk, as a structural element of the green areas, will have even greater environmental impact if it achieves a more intensive growth, in height, as in

thickness. On the other hand, by the use of autochthonous plant species, and therefore potentially the most resistant and functionally important tree species, that are adapted to the microclimate conditions in this environment, this effect of the urban planting of allocated areas in cities is achieved to a greater extent.

Typically poor and difficult urban conditions resulting from the use of inert construction materials (concrete, metal, asphalt) during the construction of cities are manifested in terms of effects on woody plant individuals mainly indirectly, by minor or major modification of microclimate and health conditions in these areas.

Also, the effect of mostly dry and warm habitats, on which urban green areas are developed, often is very adverse for individuals of certain tree species, so much that some of them, even if they are autochthonous, native species, find it very difficult to survive and reach their full functionality.

In contrast, some of the harsh conditions of habitats are not too big a problem for the settlement of invasive species, and due to a lack of competition, they spread very easily and quickly. For this reason, when selecting species for landscaping of urban green areas where an area is introduced, a special attention should be paid to the analysis of the environmental conditions of the area itself, especially soil conditions, moisture, light, and therefore select, primarily, one local, autochthonous species which thrives in such conditions. This way, inter alia, the conservation of local biodiversity is directly supported.

Longevity, as well as resilience of the local, i.e. autochthonous plant species to various pollutants in the air and soil and modesty of most native species in demand for high value edaphic characteristics, which are usually difficult when it comes to urban conditions, are among the most important biological criteria for urban land planting.

With all this insight, it should be noted that the local woody species, properly selected, in addition to being a strong competitor to potentially invasive plants, due to the adaptation to microenvironmental conditions, which is a general characteristic of autochthonous plants, will be able to reach their full functionality.

Figure 5. *Cotinus coggygria Scop.* - common sumac, an autochthonous species used for green roads

The above facts suggest a systematic selection of autochthonous ornamental woody material when it comes to building and reconstruction of the green areas of Serbia. A wide choice that is allowed by a large plant wealth of the geographical space observed, facilitates the choice and makes it efficient in the ecological and the aesthetic way. By many of their most important features, the most important autochthonous woody plant species for landscaping in Serbia are: *Acer campestre L. (familija: Aceraceae Juss.)*, *Acer platanoides L. (familija: Aceraceae Juss.)*, *Acer pseudoplatanus L. (familija: Aceraceae Juss.)*, *Aesculus hippocastanum L. (familia: Hippocastanaceae DC.), Carpinus betulus L. (familija: Corylaceae Mirb.), Carpinus orientalis Mill. (familija: Corylaceae Mirb., Corylus colurna L. (familija: Corylaceae Mirb.), Cotinus coggygria Scop. (familija: Anacardiaceae Lindl.), Corylus avellana L. (familija: Corylaceae Mirb.)*, *Forsythia europaea Deg. Et Bald. (familija: Oleaceae Hoffmgg. Et Link)*, *Fraxinus ornus L. (familija: Oleaceae Hoffmgg. Et Link)*, *Syringa vulgaris L. (familija: Oleaceae Hoffmgg. Et Link)*, *Cornus mas L. (familija: Cornaceae Dum.), Crataegus oxyacantha L. (familija: Rosaceae Juss.)*, *Crataegus monogyna L. (familija: Rosaceae Juss.)*, *Prunus laurocerasus L. (familija: Rosaceae Juss.), Prunus spinosa L. (familija: Rosaceae Juss., Sambucus nigra L. (familija: Caprifoliaceae Juss., Tilia argentea DC. (familija: Tiliaceae Moench.)* and others. Therefore, it is quite evident that the potential choice in each case is relatively easy to make.

CONCLUSION

In addition to traditional technological methods to combat invasive plants that include physical methods: manual and mechanical control, use of controlled fires, controlled grazing, treatment with herbicides, etc., proper selection of species for planting primarily public green space is an additional mechanism and an important element in combating the spread of invasive plants.

Particular attention should be focused precisely on the planting of public green spaces that are under less intensive care (maintenance), and therefore under less control against a possible spread of invasive plants.

Primary woody species used for land planting of suburban greenery, and the ones in the green block, which is the most frequently used category of urban green space and trees and shrubs along roads and in the protection zones, should be selected from autochthonous species. This also contributes to the stability of local ecosystems to conserve biodiversity in general.

For the land planting of cities in general, and especially those parts of the city which are directly affected by invasive plants, or those areas of the city where the spread of invasive plants is expected, we should use ecologically appropriate species, and always choose the autochthonous species, because they are adapted to the local environment, they are abiogeneous, can easily be planted, cultivated and maintained in a functional state.

Finally, autochthonous plant species are the most important part of local natural ecosystems.

REFERENCES

1. Anastasijević N., Vučković M., Vratuša V. (1997): Funkcionalnost šumskog i ukrasnog drveća u gradskim zelenim površinama, Eko-konferencija, Ekološki pokret grada Novog Sada, Novi Sad 1997, str. 223-227
2. Anastasijević N., Vratuša V. (1997): Bioekološki kriterijumi izbora drvenastih biljaka za "Beogradske šume", Eko-konferencija, Ekološki pokret grada Novog Sada, Novi Sad 1997, str. 235-240
3. Grbić, M., Djukić, M., Skočajić, D., & Djunisijević-Bojović, D. (2007): Role of invasive plant species in landscapes of Serbia. 18th International Annual ECLAS Conference „Landscape Assesment – From Theory to Practice: Applications in Planning and Design" Proceedings, Belgrade: 219-28;
4. Grbić, M., Djukić, M., Skočajić, D., & Djunisijvić-Bojović, D., & Lakićević, M. (2008): Invasive plant species in urban landscapes. III International symposium of ecologists of the Republic of Montenegro. Book of abstracts, Bijela, Herceg Novi.
5. Grbić M. i dr. (2010): Ekologija, monitoring i tehnološki postupci za kontrolu invazivnih biljaka u biotopima Beograda, Studija.

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INFLUENCE OF MAINTENANCE TECHNIQUES OF GREEN AREAS ON PREVENTION OF SPREADING OF THE INVASIVE PLANTS IN TOWNS

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ABSTRACT

Spreading of invasive plants, in part, is enabled by irregular or inadequate maintenance measures of green spaces that are used in cities. This paper aims to present the most important maintenance measures of plants on green spaces that are aimed at prevention of spreading of invasive plants in the cities.

Key words: invasive plants, maintenance measures of green areas

INTRODUCTION

Nowadays, the expansion of invasive plants represents one of the major problems in the fight to preserve biodiversity. The main focus of their expansion are the cities, urban and suburban parts of the planet, mostly because those areas are disturbed (changed), therefore many invasive plants are easily and quickly settled. This way, invasive plants receive priority to the overall self-created urban flora.

The uncontrolled introduction of foreign, non-indigenous species in the construction and renovation of green spaces largely contributes to the spread of unwanted and unattractive plants, especially in cities.

Some of these introduced species, especially herbaceous, due to their high resistance to unfavorable environmental conditions, may become changing elements of the plants in green spaces and their surroundings.

Some of them may spread on the terrain due to occasional microclimate and weather changes, causing compromised state and level of resistance of the native species, which is common in normal conditions.

Finally, some of the favourite species from certain regions, within their native range, and introduced out of control, following the models of other countries, often prove to be invasive or potentially invasive in our country. These plants can become a serious factor for expansion of unwanted plant content, and in the actual sense of the word, can reduce native biodiversity and natural landscape.

When it comes to suburban areas of small and especially large towns, this process is often unintentionally aided by irregular or inadequate maintenance measures of green spaces in these areas.

Due to all this, the choice of accurate and appropriate maintenance measures of green spaces, especially when they are located in marginal urban areas, is one of the important elements of control of the unwanted suffocation of biodiversity by expansion of invasive and withdrawal of native plant species.

MAINTENANCE MEASURES OF GREEN AREAS RELEVANT TO THE PREVENTION OF SPREADING OF INVASIVE PLANTS

Plants are living organisms, with all the features that characterise the living world: they grow, increase their size, changing the environment and ecological relationships that govern it - in a word, plants have an active attitude towards the environment in spatial (visual), temporal and biological sense [1]. Plants, as the main component of green areas, permanently changing the volume, take up more and more space, and their functionality for many decades (or longer in trees) continuously increases.

In order to meet all their functions, life processes of plants in the green areas must be precisely and accurately regulated by engineers, to the possible extent. This is implemented through various interventions on plants such as adding nutrients and water, removing parts of the foliage that are dead, broken, or too sick, providing enough space and light, and through measures that are carried out on the land. This series of measures, commonly known as measures of nurturing of green areas, is beginning to be implemented, with varying intensity, immediately after establishing the green areas, i.e. immediately after planting.

Maintenance measures of green areas should be aimed at preservation of such composition and structure of green areas that is considered optimal, as it was at the time of their creation. Even when all these measures are carried out regularly, the original plants fail to preserve their integrity without certain changes. In particular, it is often due to the absence of regular maintenance measures of green areas, the occurrence of weeds, undesirable plants, among which are, almost regularly, some invasive plants.

The most important maintenance measures of green areas concerning the removal of the unwanted plants and prevention of their spreading are regular professional control and monitoring of the situation on green areas, proper measures aimed at soil protect, which is very effectively carried out by mechanical treatment of soil and / or its covering - mulching. Finally, the extreme measure taken to suppress undesirable plants from green spaces, weeding or removal of entire plants is used. In the process of prevention of the spreading of invasive plants, an important maintenance measure of the green areas is the chemical treatment of invasive and undesirable plants.

1. Protection against invasive plants through regular professional control

Regular technical control of green areas is perhaps the most important procedure for preventing the spread of invasive plants on green areas in towns. Regular

control of the plant material in green areas, especially those that are less tended, systematic recording and evaluation of existing plant material can greatly contribute to the early detection of potential hot spots, from which we can sometimes expect a very rapid and irreversible spreading.

During professional control, special attention should be paid to those green spaces that have been intentionally planted, because of their appearance or other characteristics, plants from invasive or potentially invasive groups. Their follow-up should be regular, and their growth, fruiting and reproduction must be kept under constant supervision.

2. Soil protection against invasive plants colonisation

Protection of land on the green areas against the colonization of invasive plants can be carried out by measures of mechanical tillage - regular hoeing and raking of the soil, and through mulching process.

These measures are necessary for many plants on green areas, because only on condition that they are carried out regularly, some sensitive species in the lots may survive to the desired extent. They are necessary to landscape practice because poor land conditions do not allow roots to develop normally to depth and width, and prevent the penetration of the required amount of water, air and nutrients to the deeper layers of soil.

Mechanical tillage - hoeing is of special importance to young trees. While young, woody plants develop root system far more intensively, and special attention should be given to soil after planting. Raking of the top layer of soil has a positive effect on root penetration to depth, and also stops the establishment of capillary pores to soil, thus reducing evaporation, increasing infiltration of water and providing the necessary amount of air. Good rooting provides, on the other hand, easier access to water and dissolved nutrients by the plant, which undoubtedly positively affect its vitality and longevity.

Regular hoeing - in addition to being a positive influence on the vitality and functionality of the plant itself - allows permanent removal of any unwanted seedlings of herbaceous and woody species.

Tillage around the trees is necessary immediately after planting and during one year three hoeings should be done: in spring, summer and autumn. Tillage around the trees may be suspended after ten years. When hoeing stops in parks and other green areas, herbs and plants used as ground covers should be planted. We should never leave bare soil on the green areas, as they are ideal for the infestation of weeds and invasive plants. This is normally one of the most important principles of park maintenance in modern landscape architecture.

Raking of soil or soil aeration is aimed at breaking the earth's crust on the surface of the soil and the enrichment of soil with additional amounts of air. Along with raking, weeding (removal) of unwanted plants is often performed. Seeds of unwanted plants that came into the root zone are brought to the surface by raking, and are exposed to dry out.

Mulching is a maintenance measure of green areas which: prevents heating of the surface area of the soil and its over-cooling and water evaporation, keeps the soil in a

loose state, and also provides supplementary feeding of surrounding plant material. Mulch prevents direct contact of seeds of invasive plants with superficial soil, and prevents these seeds and seedlings of weeds and undesirable plants from receiving the necessary sunlight for survival and growth, even if they reached the ground and began their development.

Mulch can be organic or inorganic. The organic mulch includes peat, moss, grass clippings, compost, fine humus, shredded bark, sawdust, etc. Stone rubble, coloured river pebbles, small white or coloured stones, coloured gravel etc. can be used as inorganic mulch. (Figure 1)

Figure 1. Mulching on green areas, different types of organic and inorganic mulches

Mulching as a process is supplementary to mechanical processing of soil around the plants, and in some cases can entirely replace it. Direct physical positive impact of covering the area around trees with organic material increases and extends the positive effect that is achieved with hoeing, and to some extent, organic mulch is an additional (and sometimes more than sufficient) source of nutrients. In practice this may exclude supplemental feeding as a maintenance measure. It is clear that mulching has a positive impact on prolonging the life of plants in the city.

Introduction of mulch is best done in spring after the hoeing and watering of the soil. However, mulching can not prevent the spread of some perennial weeds because their long roots enable them to grow even through the mulch.

3. Protection by removing invasive plants form green areas

Removal of undesirable plants can be performed mechanically – by weeding, mowing and removing of entire plants by their extraction.

Removing unwanted plant by mechanical means - weeding, pulling out or cutting down can be done in case of herbaceous plants or seedlings of woody plants and provided they are present in relatively small areas. In order for the results to be effective, procedure should be repeated several times. Weeding on green areas is generally performed with appropriate tools. Mechanization is utilised only in specific cases.

Figure 2. Manual removal of undesirable plants by weeding

Weeding is useless when applied to perennial weeds with deep roots or underground stems, as they are successfully reconstructed from remaining parts in the soil. In this case, herbicides should be applied.

Weeding is the simplest way of eliminating undesirable vegetation, and is often the best way to control small infested areas, for example when an invasive plant is first noted in a given area. As a maintenance measure it has a high ecological value because it does not introduce harmful substances into the soil and, when performed manually, does not expose it to physically negative influences. Weeding should remove as many unwanted plants with the smallest possible measure of deterioration of soil surface. Pulling out is not effective for plants with roots that easily break, and which have the power to regenerate from roots [2].

Most of the tools for weeding are designed to cover the stem and provide the power needed to pull out the roots of plants. Tools vary to size, weight, as well as how big a plant can take out.

Figure 3. Tools for removing unwanted plants on green areas

Mowing the lawn on green areas is a regular maintenance measure. When mowing a lawn, the unwanted plants in the grass are also cut down. Mowing can reduce seed production and growth of certain undesirable plants, especially when it is done prior to annual plants flowering and fruiting. However, some will give even more shoots when cut, replacing one or few stems with large number of new stems that can readily be flowering and fruiting. Therefore, the cutting in some cases can be considered only a conditional maintenance measure to prevent the spread of invasive plants.

Removal of entire plants by extraction is most frequently used in young trees. The procedure consists of extraction of the whole plants from the green area if they represent a risk for spreading of undesirable species. Extraction of whole plants from green areas will be applied only to extreme cases, when it deems it is necessary, as the spread of unwanted species is otherwise quite efficiently done by the control of seedlings. If green trees or shrubs that belong to the group of invasive or potentially invasive are found, and in addition to that, these specimens (individuals) are characterized by a high degree of vitality and decoration, and are visually distinctive and valuable feature of an area, such individuals should not be removed. It would be a principled mistake, similar to removing highly functional specimens of wild trees of alien species that grow for decades in the centre of our largest cities. Therefore, in these cases precautions need to be made in terms of preventing their further spread, or dissemination.

4. Protection by herbicides treatment of invasive plants in green areas

Removal of invasive plants from green spaces can be done using different herbicide types, with different properties, purposes and uses (acting only on certain species). Caution dictates that the use of herbicides is first checked on a small area in order to protect those species that are most often subject to damage. Application of herbicides by special machines (quite close to the surface of the ground) provides a greater or lesser degree of protection of ornamental plants.

Figure 4. Treatment of unwanted plants with herbicides, if a small number of undesirable plants appears, the treatment is individual, if they occur over large areas, special equipment is used for the treatment

Prior to herbicide application one must be well aware of the consequences of their excessive use on the unwanted plants and other plants in the immediate vicinity. It is often not entirely possible only on the basis of the instructions for use, but requires more detailed study of the efficiency of specific herbicides. You should always give the reason for the application of herbicides in each case, and why it was preferred over other methods.

CONCLUSION

Regular and adequate maintenance measures of green areas can influence in many ways the prevention of expansion of invasive plants in the cities.

The most important procedures to be implemented within the regular maintenance of green areas aimed to prevent the spread of invasive plants in the cities are:

- permanent and regular professional control, recording and evaluation of existing plant material on the green areas.
- protection of land on the green areas form the introduction of undesirable species by regular tillage of the land, especially by regular mechanical processing of soil –by hoeing, raking and soil covering - mulching
- protection of green and urban areas against the colonization of invasive plants by removing them with weeding techniques, cutting or removing entire plants if necessary. If plants belonging to the group of invasive or potentially invasive are discovered on green areas, and which at the same time show a remarkable degree of vitality and decoration, representing the dominant or characteristic of an area or part of a group of old and valuable trees, such plants should not be

removed. It is necessary to introduce additional control measures to prevent its further spread.

– protection by use of herbicides

Using regular maintenance measures on green areas extends their horticultural life and total functionality. All the plants become more vital and powerful and therefore more resistant to adverse environmental conditions, among other things, to the impact of invasive plants.

REFERENCES

1. Anastasijevic N., Vratuša V., Ojdanic M. (1996): Autochthonous trees of Belgrade green areas – the significant indicator of high dendrologic diversity in urban regions, Proceedings of the Balkan Scientific Conference "National parks and their Role in biodiversity Protection of Balkan Peninsula" Ohrid, Macedonia, 1996, 283-288
2. Anastasijevic N., Vuckovic M., Vratuša V. (1997): Funkcionalnost šumskog i ukrasnog drveca u gradskim zelenim površinama, Eko-konferencija, Ekološki pokret grada Novog Sada, Novi Sad 1997, str. 223-227
3. Anastasijevic N. (2007): Podizanje i negovanje zelenih površina, Šumarski fakultet, Beograd
4. Grbic, M., Djukic, M., Skocajic, D., & Djunisijevic-Bojovic, D. (2007): Role of invasive plant species in landscapes of Serbia. 18th International Annual ECLAS Conference „Landscape Assessment – From Theory to Practice: Applications in Planning and Design" Proceedings, Belgrade: 219-28;
5. Grbic, M., Djukic, M., Skocajic, D., & Djunisijvic-Bojovic, D., & Lakicevic, M. (2008): Invasive plant species in urban landscapes. III International symposium of ecologists of the Republic of Montenegro. Book of abstracts, Bijela, Herceg Novi.
6. Grbic M. i dr. (2010): Ekologija, monitoring i tehnološki postupci za kontrolu invazivnih biljaka u biotopima Beograda, Studija
7. Krussmann G. (1968): Die Baume Europas, Verlag Paul Parey, Berlin und Hamburg
8. McHoy P. (1999): Vrtlarski prirucnik, Rjeka
9. N. Stojanovic, M. Mešicek V. Anastasijevic (2010): Native Vegetation As A Basic For Successful Landscaped Roads, Ekoistina 2010, XVIII Naucno-strucni skup o prirodnim vrednostima i zaštiti životne sredine, Apatin 2010, 133-139.

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THE ROOF GARDENS DRAINAGE AND IRIGATION

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ABSTRACT

Convenience of living in an urban environment is highly dependent on the presence of vegetation, which is missing in the city. For these reasons there is a need for greening available spaces in the city, even those that were previously unusable in this respect, thus enriched the urban area to a greater extent. The architecture of flat roofs on large buildings is the opportunity to create a specific area greened with plants. Roof garden, a green roof or eco-roof basic terms relating to the roofs covered with plants. The growth and existence of plants on roofs cannot be imagined without the installation of complex systems. This work represents the most significant installations that are used in roof gardens construction.

Key words: roof garden, drainage, irrigation, greenery

INTRODUCTION

Unlike the other buildings greened roofs are a product of natural forms and materials and with support of nature are dynamic living systems. Plants as their basic building blocks, are living organisms, with all the features that characterize the living world: they grow, increase their size, changing the face of environmental and ecological relationships that govern it - in a word, plants have an active attitude towards the environment in spatial (visual), time and in biological sense.

Construction of traditional buildings ends with, as known, with road opening, putting the bridge for traffic, immigration of the building. Bridge, building or road, suffer gradual changes (material), under the influence of atmospheric phenomena and tear of certain component parts, but during the entire existence are occupying the same space. Their total observed functional decline over time. However, the basic elements of green spaces, plants on them, permanently changing the volume, taking up more and more space, and their functionality over time more and more increases [1]. This fact, therefore is of crucial influence on the way to build (increase) and maintenance (nurturing) the roof gardens in urban areas.

For plants as living elements, to survive in such difficult conditions, such as roofs is necessary to build a series of installations that will provide them with favorable conditions for growth and development. Here primarily refers to the supply of water

available to plants and removal of excess water from the root zone. Accordingly, the drainage systems (drainage systems) and irrigation system (irrigation systems) are most important installations of roof gardens.

DRAINAGE SYSTEMS

Good carried out drainage is the crucial element in the functioning of the roof garden. Blockage of the drainage system can lead to decay of plants and water infiltration in surrounding structures, requiring costly repairs.

Drainage system of a roof garden consists of drainage and surface drainage systems and drain pipes that carry water to most sewage or sanitation in general building and through drainage water flows to the city sewage or retentions.

In addition to surface drainage second element of roof drainage, sewers and drains are collecting water on the roof. They can be of different materials: plastic or metal (brass or cast iron), and distinguish between several types:

Circular drain (sink) has on its upper surface the grid, and on the sides the perforation (Figure 1 and 2). These drains have the option of regulating the height and the ability to take water to the surface, and drainage below the surface of the substrate through the perforations. This type of sink is applied to paved surfaces, which are located near the planting area.

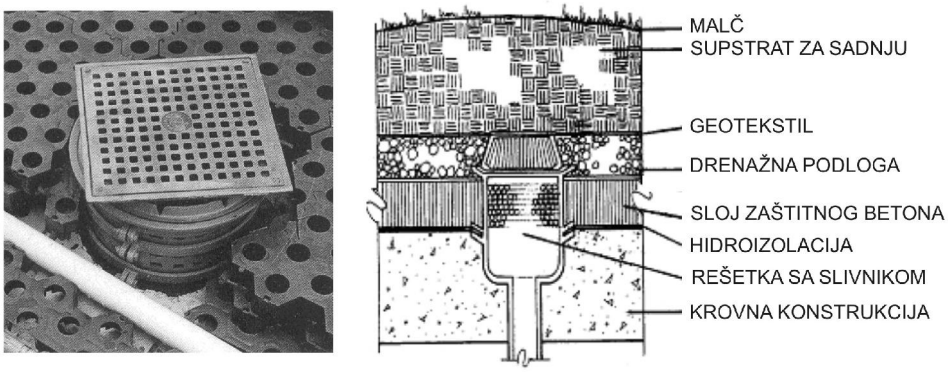

Figure 1. has a circular drainage holes at the top and sides. Good for surface and subsurface drainage (left) Cross section of the roof garden with circular sink (right)

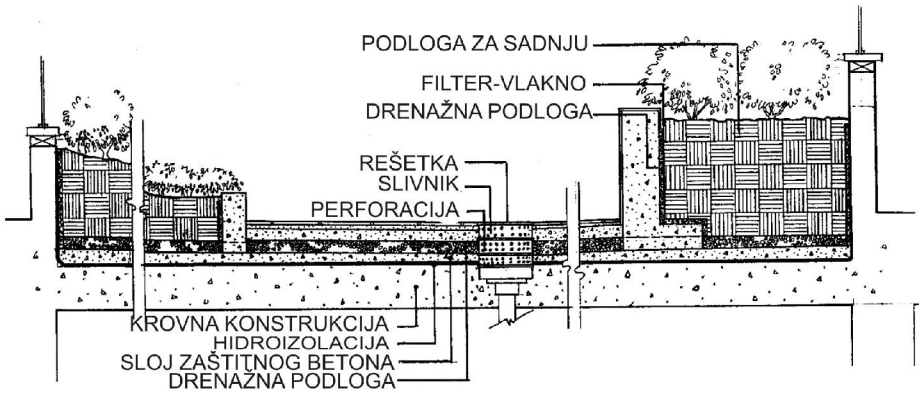

Figure 2. the circular sink can also be used for drainage of paved or planted area adjacent

Conical sink has a conical-shaped perforated surface (cap) that rises above the surrounding area, which can easily clog up with leaves and other debris (Fig. 3a). This type of drain is not recommended for paved surfaces, and is usually placed below the drainage base.

Flat sink (Fig. 3b) is placed in the same plane with the surrounding area. This drain is placed on paved surfaces, and drainage below the surface

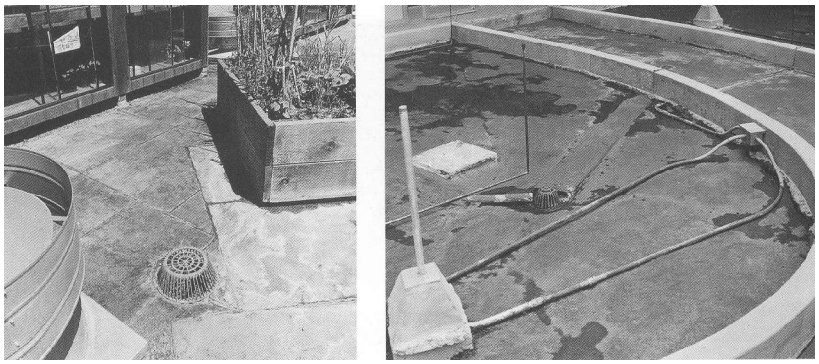

Figure 3. a) Conical sink is effective, but interferes with hikers when installed above ground. b) On the building of a Pacific Bell in Sacramento, water from the external drain pipe leading to the side to drain the central cone.

Side, channel drain, Canaletto and gutters are placed on paved surfaces, for short flows. They are made in cast iron; steel or plastic (Figure 4). The grid is flush with the pavement and can be removed for cleaning.

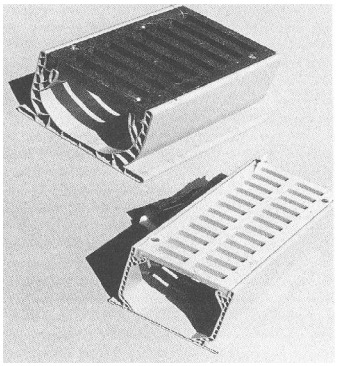

Figure 4. Side-channel or gutter used on paved surfaces.
The grid is set to drain can be removed for cleaning.

IRRIGATION SYSTEMS

Shallow substrate, well drained and low water holding capacity in which the growth of plants on roof gardens require intensive irrigation. Classic underground irrigation system (sprinkler system), are used for irrigation on roof gardens, which disperse the water into the air above the green surface and capillary irrigation systems of water to each plant through capillary lead, immersed the substrate. Roof gardens can be irrigated by a combination of these two systems (such as, for watering the lawn can be used capillary irrigation systems for watering large woody plants underground irrigation system - sprinklers).

Irrigation system should be invisible for aesthetic reasons. Main and lateral pipes are installed above the insulation. Irrigation systems sprinklers are controlled with electrical signals, so the exact release prescribed amounts of water at certain times of the day, according to weather conditions. Also, these systems themselves have moisture sensors that automatically signal the control system when the humidity level in the land falls below the given limits. The basic element of capillary irrigation system is the water tank, which is connected to the drainage base, on one hand, and a system of pipes, the other (Fig. 5).

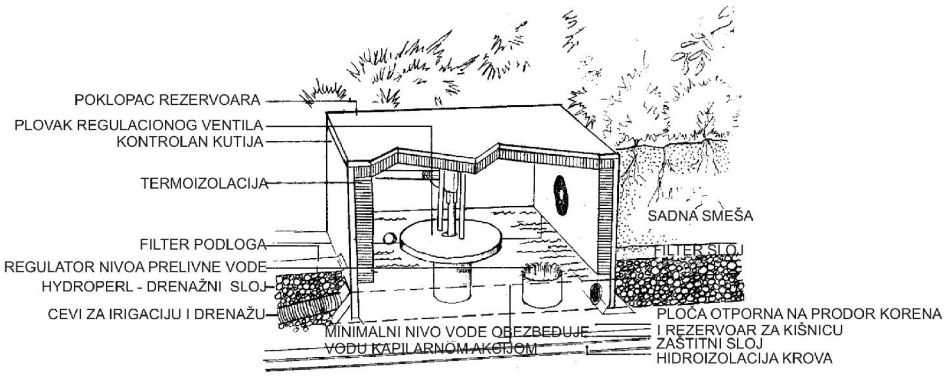

Figure 5. The water reservoir capillary irrigation system, which maintains a constant level of water through the inlet and outlet valves

The water level in the reservoir is maintained at a constant level. For the purposes of irrigation water from the reservoir is released into the drainage surface, where it climbs through the capillary to the plants. If the water level in the tank drops due to drought and excessive absorption of plant, floating valve signals and pulls water from the building water pipe line. Also, the valve automatically closes, after reaching the prescribed level of water. This system also performs drainage when excess water from the drainage layer is draining back into the tank with water, and feeding if the water is injected with liquid fertilizer.

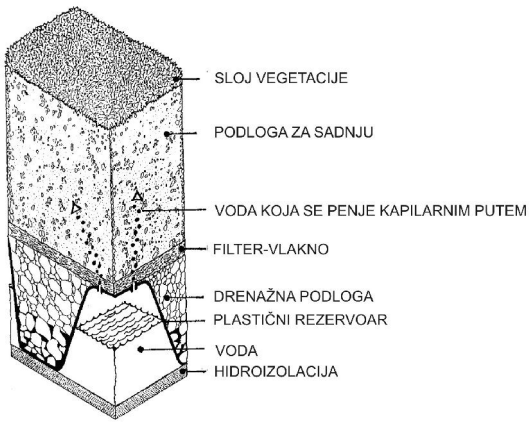

Figure 6. Cross section of the roof garden with irrigation components Floradrain

The second type of capillary irrigation system has a drain-watering layer that delivers and sets in the form of profiled panels, on the market known by the name Floradrain (Fig. 6). Highly profiled panels Floradrain are made from recycled polyethylene. This system provides water supplies that are located in a plastic reservoir at the bottom of each Floradrain-a. Floradrain panels are equipped with system of channel openings that allow the excess water to drain from the system. Special-fiber filter that covers the surface drainage, prevent soil washing into it. Land mixtures made in this case are an integral part of the system, and are set directly on the filter fiber. This mixture consists of a mixture of minerals and organic matter and includes an established ratio of water, air and nutrients, and thus makes the whole system easier [2].

ROOF GARDENS BUILDING SYSTEMS

Many global manufacturers have developed various systems to build the roof gardens. Some manufacturers have entered substantial innovations even producing systems that include the construction of the roof and the garden together. One of the world's well known system for the construction of roof gardens is Bauder system.

Essence of the Bauder system is that the roof and a garden on it are shipped and placed in a common profile form (Fig. 7).

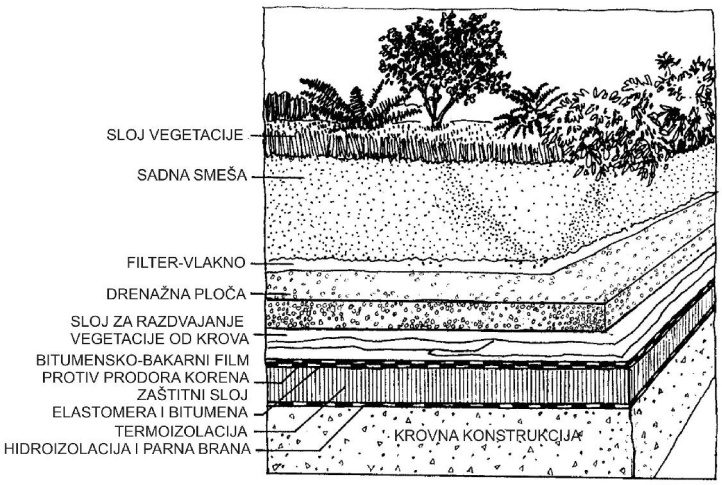

Figure 7. System Components Bauder roof and garden design

The primary coating makes cold, bituminized fluid that fits directly on the surface of the roof structure. The main function of this layer is to connect the roof structure and the next layer that protects it from condensation. Vapor barrier is a 4 mm thick layer made of elastic, modified bitumen with the base layers of aluminum and fiberglass.

This dam has a function to prevent condensation of warm and moist air from the building, and wetting the insulation. Waterproofing is done in two layers. Bottom, 5 cm thick with a base of bitumen, it is very flexible and resistant of cracking. The upper layer of waterproofing is the same thickness, with a base of bitumen and copper coating that protects against penetration of roots. On waterproofing goes double layer separating the roof from the roof garden.

This connection of roof structure and roof garden is not completely fixed, which allows the top layer to be taken off if needed (due to possible damage). Standard Bauder drainage layer consists of polystyrene; it is lightweight and durable, resistant to root penetration and high water pressure. Water holding capacity of the drainage layer is 30% of its total volume. Reservoir that holds water can be attached in this drainage system, so the system becomes and irrigation.

Fiber filter is placed on the drainage layer to prevent ingress of soil into it, it is chemically neutral and resistant to decay, and has the ability to absorb water from the lower water holding layer. Depending on the type of plants Bauder made different substrates too.

Another world-famous system is a *Sopranature* system that is used to raise extensive roof gardens.

EXTENSIVE ROOF GARDENS COMPONENTS

The construction of extensive roof gardens is shown through Sopranature system for the construction of roof gardens. The system is designed in France, and is used to raise extensive roof gardens on flat or slightly sloping roofs. Plants that are recommended for planting are only annuals, succulents Perene and low growth.

Sopranature system is shown in Figure 8 and consists of a layer of insulation and water holding layer, *Sopralene Flam Jardin*, placed over the roof tiles. Through these layers a drainage layer is placed, consisting of a cell polystyrene or drainage geotextile, depending on the degree of slope of the roof. Drainage material is protected by *Sopra*-synthetic geotextile filter. At the top is set *Sopraflor* substrate that has a feature to retain water for a long time, and it is very resistant to erosion.

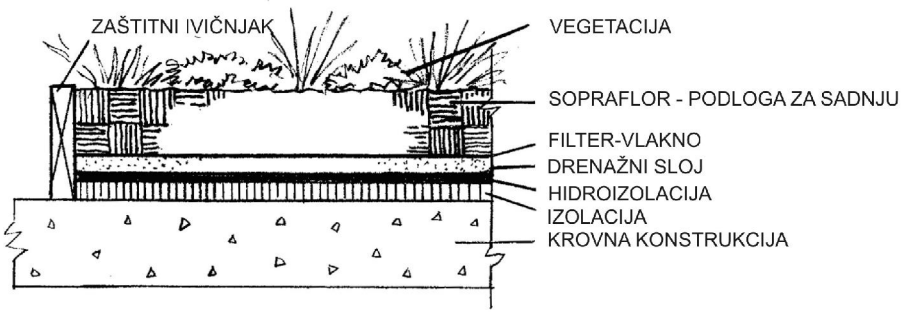

Figure 8. Sopranature system components

CONCLUSION

The selection of species and taxon of the plants is crucial to the longevity of the roof greenery. When selecting plants for roofs planting should be primarily used heliofile species that almost always stronger insulation exposure of the roofs Because of difficult conditions in which the plants develop at the roof exceptionally quality planting material must be used, and planting only be applied to the punch even with the small plants. The procedure of rising the roof gardens have their own specific operations to be followed in order, roof garden, to exercise its functions for as long time as possible. Regular cropping of plants is necessary to maintain the roof garden. Basic measures of care, which survival of the roof plants cannot imagine without, are watering, fertilizing, and removal of excess water. For these measures to be successfully implemented, it is necessary to pre-designed system of the roof, which necessary components are installation of drainage and irrigation systems.

REFERENCES

1. Anastasijević N.(2007): Podizanje i negovanje zelenih površina, Šumarski fakultet, Beograd
2. Osmundson, T. H. (1999): Roof Gardens: History, Design and Construction, W.W.Norton
3. Landphair C. H., Klatt, F. (1988): Landscape Architecture Construction, Elsevier, New York - Amsterdam - Oxford.
4. Harris Ch. W., Dines N. T. (1988): Time - Saver Standards for Landscape Architecture, McGraw-Hill Book Company, USA.
5. Vujković Lj. (1995): Pejzažna arhitektura – planiranje i projektovanje, Šumarski fakultet, Beograd.

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THE ROOF GARDENS CONSTRUCTION

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ABSTRACT

Cities today are densely developed structures with evident lack of free living space. Urban land price is too high and usually oriented for other purposes. For these reasons, a need appears that every free space available is better to be green and refined. Especially interesting opportunities that can provide this are roofs. This paper is an account of techniques and modern technologies of construction of roof gardens in the city.

Key words: roof garden, construction, greenery

INTRODUCTION

Lack of space is the basic problem of big cities. This lack is manifested in terms of green areas of the city. Today, more rarely in urban planning can find large urban green areas intended. Modern Urban Concepts resolve this problem with other forms of greenery, including the construction of roof gardens. While any multi-storey building today in the contemporary city has to solve the parking problem by building underground garages, so too every multistory needs for free, and recreational areas solves the construction of roof gardens. Many authors believe that the roof gardens are gardens of the future.

The successful construction of a roof garden, in the first place, provides a good choice of location for its performance. The choice of location for the construction of the garden depends on: environmental conditions, type of roof construction of the building and purpose of the building.

Since environmental conditions are most sunlight, wind and precipitation. Sunlight and warmth are important for plants and for visitors to the roof garden. The ideal location is where the garden-oriented south, west or east. Most negative is the northern orientation of the garden. If too sunny, may also be uncomfortable because it creates a reflection that can be alleviated by placing an adequate pavement or turf establishment.

Wind is also a limiting factor in selecting sites for construction of roof gardens. Strong wind is not favorable for plants (especially because wind bulge), but might also

compromise security of the people on the roof. The intensity of rainfall is another important environmental factor in the construction of roof gardens. For roof construction is very important excess of water as soon as possible to take in the drainage system.

In locations with substantial amounts of rainfall drainage system is critical for the functioning of the roof garden. Roof gardens on the sites that have lots of snow in its pavement should have systems for snow melting, which also can raise low temperatures.

Roof Garden should be built only in structures that are strong enough to carry the garden, as a rule, the buildings have a steel roof or reinforced concrete roof. Roof gardens can be built on the buildings of different purposes of which are attractive: the underground garage, office buildings, hotels, apartment buildings, hospitals, universities and other buildings.

Depending on the application of space roof garden is divided into extensive and intensive roof gardens [1].

Intense interlude of greenery roof gardens include roof surface designed for intensive use. This type of roof garden may contain a water surface, seating areas, paths, lawn areas, intensely green areas shrubs and trees. They can be for public or private use.

In contrast to the intensive, extensive roof gardens interlude of greenery is not intended for direct use. Their function is primarily ecological and aesthetic. The extensive roofs no higher plants are used only: moss, succulents, grasses, weeds and crawling shrubs. These species are characterized by low demand in relation to moisture, and possess the ability to regenerate underground rhizomes or self under sowing. Construction cost of these gardens is low.

CONSTRUCTION OF INTENSE INTERLUDE OF GREENERY ROOF GARDENS

Intense interlude of greenery roof gardens construction is made of: reinforced concrete and steel roof structure, a layer of insulation, protection board, insulation, protective layer of concrete, surface drainage, geotextile (filter-fiber), a substrate for growing plants and a layer of mulch (Fig. 1).

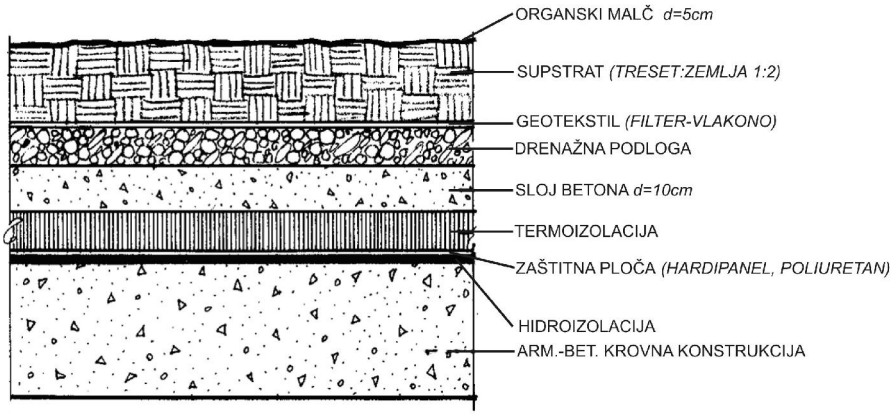

Figure 1. Standard design roof garden

The roof structure may be constructed of different materials, but it is best when made of steel or reinforced concrete. If the roof garden was designed in pre-construction of the building in the statistical calculation, roof load of the roof garden should be included, on the basis of the main roof garden landscaping project. If the building is created a roof garden is subsequently built on the flat roof, then, after the detailed design of the roof garden, an additional statistical calculation is needed, that will confirm whether the existing roof structure can accommodate the additional load that is provided for the construction of a roof garden.

WATERPROOFING is the layer that goes over the roof. Its function is to prevent leaks in the roof structure below, and basic characteristics are: resistance to mechanical damage, resistance to penetration of the roots of plants, and longevity, because replacement of waterproofing means temporarily removing the entire roof of the garden from the roof. Depending on the types of position on the roof distinguish between three types of insulation:

- Waterproofing is an integral part of the roof structure and consists of interlocking joints felt impregnated with asphalt, which is placed between two layers of hot, asphalt bitumen. Felt used to be made from cellulose fibers, and today is made from fiberglass which is more resistant to penetration. The famous roof gardens Derry and Thoms in London, Rockefeller Center in New York, Union Square in San Francisco, exists already sixty years and have such a system of waterproofing, which proved to be effective because these gardens have never had a problem with the insulation failure. Disadvantages of such waterproofing are that the bitumen is organic material that can easily collapse under the influence of water, sun and temperature changes. Some plant roots penetrate into the organic layer, feeding from it and making such a crack in the waterproofing. So this kind of waterproofing are overflowed with concrete coating thickness of 10 cm to extending their shelf life.
- Insulation that can be used when building roof gardens, consisting of inorganic plastic or synthetic rubber material (e.g. neoprene). Available in rolls and the roof is installed by overlapping joints and their digestion (FIR) at high temperature. They are resistant to root penetration, because the inorganic origin, but from the mechanical damage and ultraviolet rays need to be protected by covering with a layer of metal, stainless steel or copper. Critical point in installing this type of insulation are compounds themselves, as well as compounds with other materials, which is the main disadvantage of this type of insulation.
- Waterproofing the roof that is applied as a liquid in a hot or cold phase with spray or paint. The advantage of this type of insulation is that with its outpouring the problem of critical points of compounds is eliminated.

Whatever the material to be used for waterproofing, before proceed further with setting up the next layer of structures it is necessary to perform its testing for leakage of

water and it will do so all the drains and the roof is closed and filled with water that stands a full 48 hours, i.e. two days.

If roof insulation keep water for 48 hours it is possible to move forward with placing layers of the roof garden. If the insulation fails, it has to be removed and re-done.

PROTECTIVE PLATES are placed on the waterproofing for her protection during work on the construction and mechanical damage caused by garden tools. Today different materials are available, such as: hard panel, polyurethane and others.

THERMAL INSULATION is placed on the protective plate, to retain heat. Commonly used solid polystyrene foam board similar to Styrofoam.

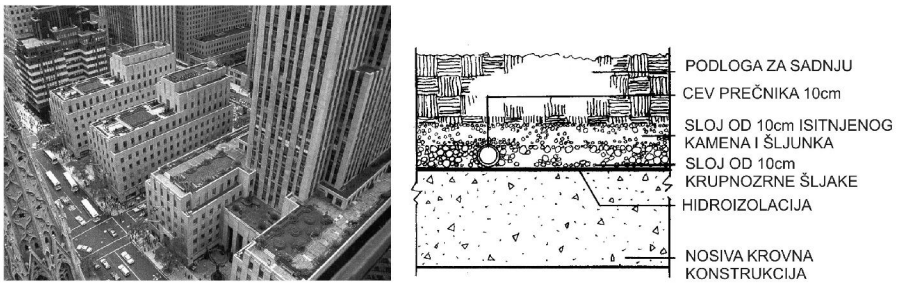

Figure 2. Cross section of the drainage system of the roof garden at Rockefeller Center

CONCRETE PROTECTION LAYER is poured on the spot in a layer of 10 cm. The upper surface of this layer is gently sloped, so the water can drip from it down the sink. It protects the layers below it from large temperature changes, mechanical damage, and ultraviolet rays.

DRAINAGE BASE is a layer that is placed directly on a layer of protective concrete. The basic function of drainage surface is to carry water to the main roof drains.

The first drainage materials that were used are: gravel, crushed stone and clinker (pieces of baked bricks) as an example. In the construction of roof gardens Derry and Thoms and Rockefeller Center (Figure 2). These materials have proven very effective, but the downside to them is overweight.

In the late 1970s products for the growth of grass in parking lots were designed. One of them is the Grass - Cel, which is made from high compact plastic, shapes of connected hexagons that are deepened and hollow in the middle (like honeycomb). Square in shape, size 50x50cm, and only 5 cm thick (Fig. 3a). The designers of roof gardens were turning the squares on the bottom (as opposed to their originally intended position) and so get the perfect drainage layer (Fig. 3b). Figure 3c shows the cross section of the roof garden that uses of Grass - Cel as a drainage layer.

Later in Germany, two more products with the same function are produced: Enkadrain and Geotech. Both are made of plastic and when installed should be protected from ultra-violet rays. Enkadrain is made of strong and loose plastic threads.

Supplied in rolls of 30 m in length (Figure 4a). Geotech is made of expanded polystyrene reservoir connected by asphalt adhesive (Fig. 4b). Sold in plates of dimensions 1.2x1.2m with various thicknesses. Both products can be attached with polypropylene fiber filter on top. These products are accompanied by many other (Figure

4c and 4d). Are made of long lasting plastic, so it is necessary to protect them from direct exposure to sunlight [1].

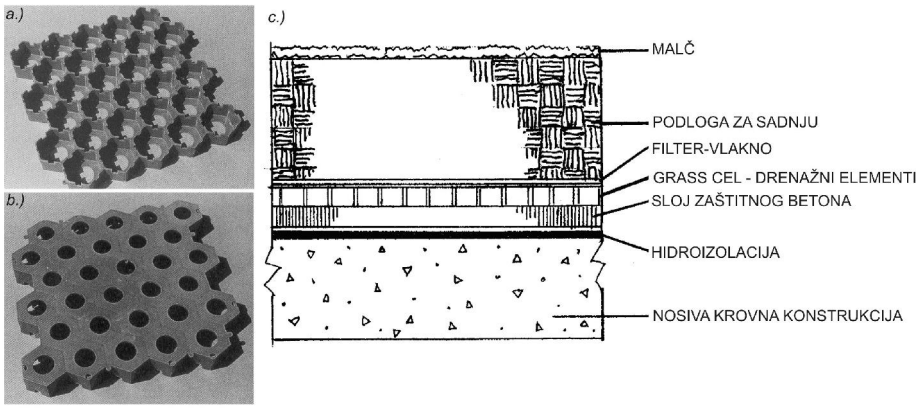

Figure 3. Grass-Cel-Elements as drainage elements of the roof gardens a) real look Grass-Cel-elements as they are placed in parking lots to keep grass b) Grass-Cel-elements turned upside down to allow water through the holes to enter the cell, while the lateral cells aloud excess water flowing over the protective layer of concrete and drainage c) Cross section of the drainage system of Grass-Cel as a drainage material

Geotextile (Filter-fibers). The water that passes through the substrate for planting comes to drainage systems, and it can carry larger particles of soil, mulch and plant requirements. If this water is not filtered it takes away nutritious particles from the substrate, and also may reduce the drain. The product which was used as an insulator, a Q-fiberglass, was also the first material used as a filter fiber. Although it gave satisfactory results, it was cumbersome and difficult to set.

Soon it was found other material, which is made up of polypropylene fibers, felt similarly. This filter-fiber is made in various thicknesses and fully meets all the requirements of the roof garden (Figure 5a, 5b). Today geotextile is in the use (Figure 5c).

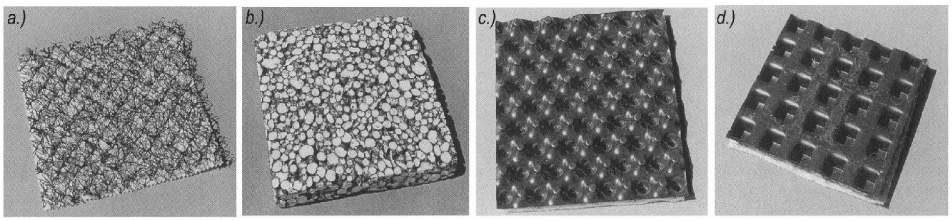

Figure 4. Drainage materials a) Enkadrain b) Geotech, drainage material, c) and d) Various plastic materials can also serve as drainage. They may have different profiles.

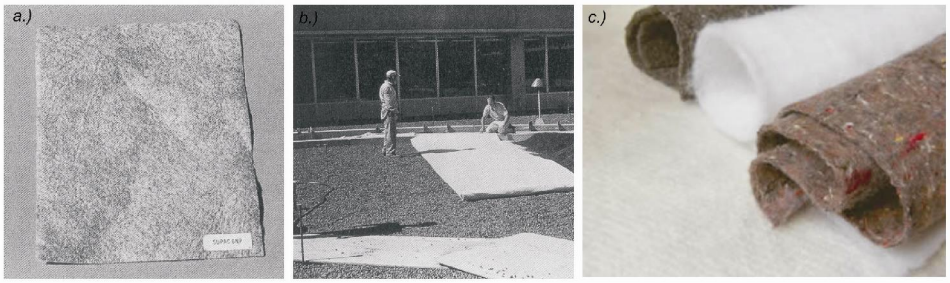

Figure 5. a) fiber filter made of polypropylene fiber is placed over the drainage layer, b) Before the discovery of polypropylene fibers, was used fiberglass insulation c) geotextile as a filter layer in the construction of roof gardens

SUBSTRATE FOR PLANTING must be a low specific weight, that is well supplied with nutrients (and has the ability to keep them), and easy and well drained. Mixtures consisting of: sand, perlite, peat and high quality land, meet these requests.

Sand gives a mixture looseness and porosity, but does not retain nutrients and water in the soil.

Perlite is lightweight and has a great ability to absorb (creates favorable structural and textural properties of the soil), which is also used in addition to these mixtures. The uses of peat, which is also lightweight and has great absorption capacity, improve the chemical properties. Substrate for plants growing in the construction of a roof garden should include sand, peat and high quality land in comparation 1:1:1.

The characteristics of this mixture are: density of absolutely dry soil 0.86-0.93 g / cm 3, density of soil saturated with water 1:33 to 1:40 g / cm 3, the capillary water capacity of 46-47%, 61-65% of total porosity, air capacity 31 -35% (Osmundson, 1999). Percentage value of air and water capacity of this land classifies this land to the group of land with suitable water-air properties. The bulk density of soil saturated with water due to capillary water capacity is much smaller than the density of most of the natural soil (1.70-2.20 g / cm 3).

Peat in this compound is present in more than 30%, which makes this substrate rich with nutrients. If the peat in this mixture, good acidity (pH = 6.5), sand could be replaced with perlite (Fig. 6) resulting in a considerably lighter blends.

MULCH is a layer that is placed on the surface of the substrate and the thickness is 2.5-5cm, and also represents the final layer. Organic mulch has the function of preventing excessive heat or freezing of roots, slows weed growth and prevents the evaporation of moisture from the soil. Its gradual decomposition compensates the land organic matter.

Longest lasting organic mulch is made of evergreen tree parts (cedars, fir or pine bark). Inorganic mulch (e.g. gravel) in this case is not used because it cannot compensate the loss of nutrients that intense here.

Figure 6. Perlite as part of a substrate for plant growth

CONCLUSION

Due to growing urbanization and a lack of available space in the urban environment needs for building roof gardens is growing. Construction of roof gardens offers an innovative use of roof, providing space for recreation, relaxation, enjoyment and entertainment.

The biggest problems that accompany the construction of roof gardens are: breakdown and damage of insulation, overload of structures, washing soil into drainage system and many others. Therefore, many designers and contractors rarely make decisions for designing and construction of roof gardens.

Construction of roof gardens requires highly skilled team work, knowledge of modern materials and technology of the construction and permanent maintenance.

Continuous improvement of systems for the construction of roof gardens that lead that these gardens, rightly can be called, urban area future gardens.

REFERENCES

1. Landphair C. H., Klatt, F. (1988): Landscape Architecture Construction, Elsevier, New York - Amsterdam - Oxford.
2. Osmundson, T. H. (1999): Roof Gardens: History, Design and Construction, W.W.Norton
3. Anastasijević N.(2007): Podizanje i negovanje zelenih površina, Šumarski fakultet, Beograd
4. Harris Ch. W., Dines N. T. (1988): Time - Saver Standards for Landscape Architecture, McGraw-Hill Book Company, USA & Company, Singapure
5. Vujković Lj. (1995): Pejzažna arhitektura – planiranje i projektovanje, Šumarski fakultet, Beograd.

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THE POSITION OF THE PRUNING CUT OF BROADLEAF TREES

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ABSTRACT

Application of incorrect pruning methods often causes healthy plants within green areas of cities to be weakened or deformed. In contrast, the proper use of pruning techniques, especially broadleaf trees, improves fitness and longevity of plants and therefore the functionality of green areas in general. This paper reviews the most important techniques of pruning of broadleaf trees within green areas of cities.

Key words: pruning, broadleaf trees, green areas

INTRODUCTION

Pruning of broadleaf trees is one of the most important plant maintenance measure in the green areas. Pruning is primarily used to improve the condition of the tree itself, enhance its aesthetic value and to retain the crown within the planned area. By cutting down branches and twigs representing the excess part, either because they are damaged, or because they have a bad position and spoil the look and shape of the foliage, the tree is freed from undue burden with the help of man, thus the total energy of face growth is directed to those parts with higher functionality, which naturally increases the functionality of the plant as a whole [1]. Pruning of mature trees within urban green areas and especially individual trees (tree alleys, squares, green areas in front of public buildings, etc.) is also known as dendrosurgery and is performed within urban landscaping practices throughout the plant life, starting from the first years of its existence on the selected location [2].

In order to fulfill its task pruning must be carried out correctly and professionally. Improper pruning can firstly lead to a reduction of fitness of the tree, affect its visual quality and natural look of its habitus. Within the technique of pruning of broadleaf trees special attention is paid to proper positioning of the cut when removing branches, especially the big ones.

In addition to proper positioning of the cut the success of pruning depends on the selection of proper tools. With the application of inappropriate tools cuts we make on the branches will not be clean and smooth, which may cause moisture retention and

appearance of pathogenic organisms. Secondly, rot and infection of the cut may occur, which consequently reduces the health condition of the tree. It is important to coat each section with preservatives, inspect the preservatives used from time to time and replace them if necessary.

CUT POSITIONING

Pruning is a process that occurs spontaneously in nature in the form of natural decay and falling-off of the branches. Usually the lower branches are in the shadow of the higher branches, where due to the lack of light they become unproductive and the plant wants to rid itself of them. In this situation, a ring (branch collar) is formed where branch and trunk meet, whose role is to prevent further flow of minerals and water into the branch that the plant wants to rid itself of. The branches which have a ring formed in their base are retained throughout the winter and gradually dry out. When the wind blows, or during the storm these branches fall off (Figure 1).

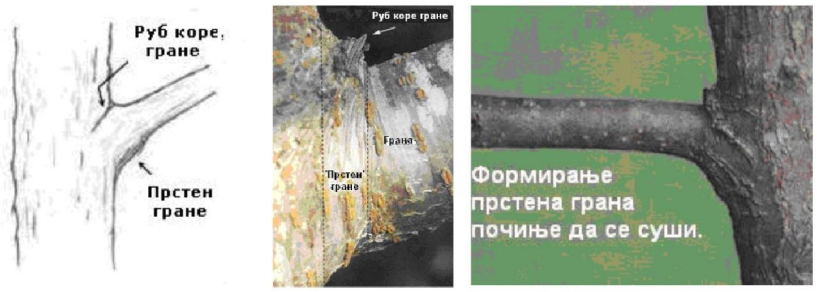

Figure 1. Falling-off of branches by creation of a ring (left); The edge of the branch bark and the ring (right)

Cut positioning techniques for pruning of broadleaf trees are applied in accordance with the natural process of elimination of excessive branches. Branches that we want to remove are cut to the point of growth or the bud that will take over further growth. Before pruning takes place we should take a close look and pin point the ring and the edge of the branch bark (Figure 1).

The branch collar is a lump-swelling at the base of a branch where it meets, i.e. touches the trunk. It represents the part which will heal the wound that remains after pruning. Correct pruning leaves the branch collar intact. The branch collar varies from tree to tree and from species to species. Some are big and clearly visible others are smaller and less visible. The edge of the branch bark is a slightly raised bark between the branch and trunk and stretches in the form of a line on both sides of the trunk. When it is hard to notice the ring of a branch, the edge of the branch bark can help us decide where to make a cut. With pruning the cut is never made behind the edge of the branch bark. The branch collar should always be left intact. The cut itself should start from the top of the branch collar and end at its bottom.

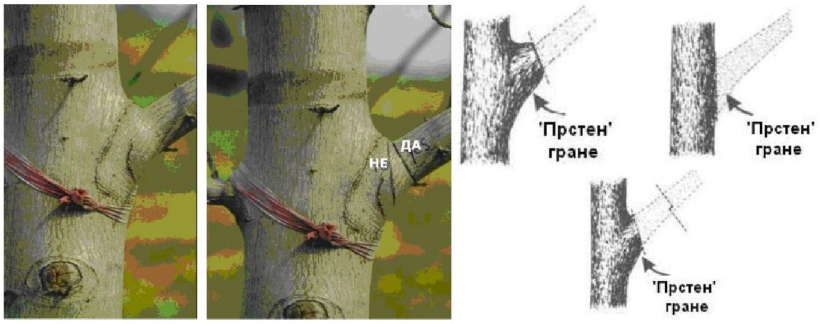

Figure 2. An example of where to position the cut (left); The final cut is made properly at the end of the branch collar (top right); The final cut is incorrectly positioned in line with the trunk (top right); The final cut is made through the branch collar (bottom right).

If the branch collar in a tree is flat and close to the trunk, so it's hard to distinguish it, the cut is made so as to draw the imaginary line from the top of the branch ring to where the branch touches the trunk. Then we observe the angle that the edge of branch bark makes with the imaginary line and copy it as a mirror image to the other side of the imaginary line. The cut is made on the other side of the imaginary line, at the copied angle. This way the branch ring will remain intact [1].

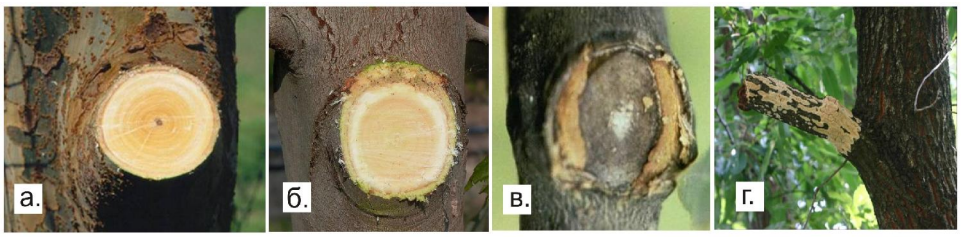

Figure 3. a.) Clean and tidy cut, b) Bad and untidy cut made through the branch ring; v.) Wound of the cut is formed irregularly, g.) A piece of a branch that is soon exposed to infection

CHOOSING THE CUT POSITION

The cut position should be chosen very carefully (Figure 4). It is very important to ensure that the living tissue is kept in the region of the cut for current and future growth and so that the habitus of trees is not impaired by the process of pruning. If the cuts are made improperly large wounds will be created, which will expose the tree to diseases and pests.

If a dead - dry tree is pruned, the cut must be made in a sound, i. e. intact tissue because only healthy tissue can heal. It is important to make the cut at the point nearest to the branch or bud. If the cut is made further from the point of growth, the branch or bud, a piece – a stump is created i.e. a part of the branch which is later exposed to diseases and pests (Figure 3g).

The position of the cut should not be only above the bud or the branch, but the most suitable position should be chosen (Figure 4a and 4b). When making the cut if we want the crown to spread in width the cut should be made in such a way so that there is a bud that faces the outer edge of the crown. Otherwise, if we want to get thick foliage we choose a bud that faces the interior of the crown.

The angle of the cut also depends on the nature, thickness and mechanics of the main trunk. Apart from the importance of making a cut near the branch (the trunk), the wound should be as small as possible. There are two types of cuts with pruning: the cut by which we reduce the branch or tree - shorten the length of the tree by cutting to the smaller branch and the cut by which we remove the branch – prune the branch to the trunk or parent branch (Fig. 4v and 4g).

When pruning trees, attention should be paid not to tear the bark or part of the tree while removing the branch (Fig. 5).

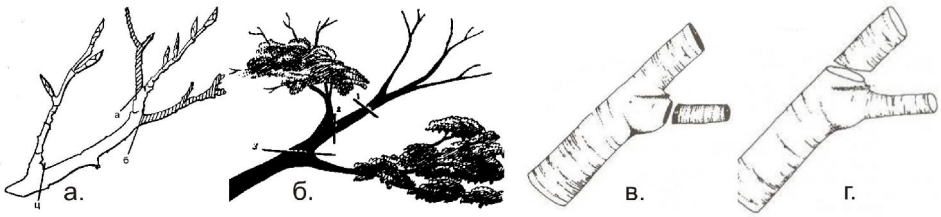

Figure 4. a.) The right choice of the cutting position (a and b: the twig shows the ideal position for removal of the piece of the branch c- displays a better position of the cut as the pieces of the branch are infected, and the lower parts show excellent condition; b.) Pruning of dry or dead branches. (1. a very bad position of the cut, a dried piece of branch is left, 2. a good position of the cut for a given part of the branch, but bad on the whole, for parts that are below show symptoms of infection, 3. a good position of the cut concerning a healthy branch that remains) v.) the cut by which the branch is removed, g.) the cut by which we reduce the branch or the tree;

As important as the angle of cut is it is essential to avoid tearing of the bark or a part of the tree when removing the branches. As a result of the removal of a large branch a big tear can occur which consequently leads to a higher risk of pests to the large exposed area, and the circle of cambium surrounding the clean wound being interrupted in the region of the tear. Thus the healing process is slowed down. With a big tear it is possible that a part of the pith is also torn. This often leaves the base of the tear in a very untidy condition, so a lot of work concerning the cleaning of the wound is left to be done. Pockets or sharp uneven surfaces should never be left behind so that moisture does not form. The tear will be visible, which is undesirable. Properly done work (by professionals) and a good finish are very important.

Large heavy branches are removed by cutting them piece by piece, which includes several cuts by using equipment such as ropes to secure safe landing of the branches (Fig. 5). When making any of the cuts, it is important to first make the bottom cut, before cutting thick branches from the above. This is necessary if we do not want to cause tearing of the branch collar and the bark of the trunk. The lower cut is made at 1 /

6 to 1 / 3 of the diameter of the branch. The upper cut which is made through the entire diameter of the branch should be near the lower cut (5 - 7 cm distance).

Figure 5. Pruning of large branches by means of piece by piece technique in order to prevent tearing of the branch; a.) Tearing the bark of the trunk when pruning b.) The bottom of the cut should be 30-60cm away from the branch collar c.) The second cut is made from the top to the end of the branch, up to 5-7cm from the first cut, g.) The final cut should be just behind the branch collar to avoid tearing the bark of the trunk.

The surface of the wounds after pruning remains healthy and intact only if protected from water, air, pests and other harmful organisms. For this reason it is essential to apply protective coating as quickly as possible. All cuts of over 25mm in diameter must be treated, and when it comes to young specimens (plants) even minor wounds should be coated and treated.

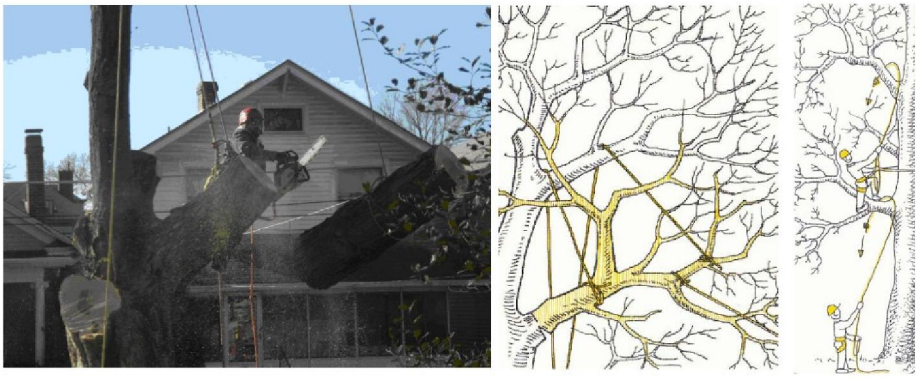

Figure 6. Reducing the weight of a large branch high in the tree by using ropes

The agents used must be water resistant with an active and long-lasting fungal protection. It is necessary to check the wound at least once a year and if necessary repeat the coating of the wounds.

Healing of the cut varies and greatly depends on the size of the wound, plant age, fitness and vitality of the tree and on its species or variety. Small wounds especially on young plants heal quickly. The wounds of similar size on older trees can heal for several years.

Before applying protective coating on the wound, it is necessary to rub out the wound. This is also true for small cuts in which the outer tissue and the substrate itself

may be uneven and untidy. While in larger wounds only edges and outer tissue should be to rubbed out.

Figure 7. The use of machinery and various tools for pruning trees

Large areas within the wound should not be touched until they are in good condition. The protective agents that are mainly used are sticky masses which adhere well and therefore the surfaces should be rough, i.e. uneven.

Pruning high in the tree is also done by means of ropes and specialized equipment for high altitude work (climbing and caving equipment) and by using trucks with cranes (Fig. 6). When the weight of a branch is reduced, the final cut at the end of the stump should be done from top to bottom to ensure that the surface of the wound is neat and even.

When pruning large and heavy branches different methods are used to connect branches for their safe landing. When working on tall trees trucks with cranes are also used (Figure 7).

CONCLUSION

Pruning of broadleaf trees on the green areas is of utmost importance for growth and development of plants, and if properly and professionally performed provides trees with high level fitness, excellent aesthetic and sanitary function.

Pruning of a crown is also an intervention in the tree that significantly affects the extension of horticultural life of the plant itself.

Being familiar with the essence of pruning and the implementation of this measure in biologically and technically correct manner is an extremely efficient assistance to trees, just as the patterned, wrong and routine pruning of some parts of the

crown significantly accelerates the decay of trees on the green areas and greatly reduces their aesthetic value.

Pruning may also be subject to the desire for specific effects (topiary effects) which are achieved by forming special shapes of crowns, otherwise unusual for particular species.

REFERENCES

1. Anastasijević, N., Vratuša, V. (2000): On the main sources of Belgrade trees' decline. In: International Symposium on Plant Health in Urban Horticulture. Mitteilungen aus der Biologischen Bundesanstalt fur Land - und Forstwirtschaft. Berlin, Heft 370, 69-74
2. Anastasijević N, Vratuša V. (1999): Bezbedno orezivanje velikog drveća u gradskom pejzažu, Zbornik radova Ekološka istina, Zaječar, 80-84.
3. Brown E. G. (1972): The Pruning of Trees, Shrubs and Conifers**,** Faber and Faber Limited
4. Siewniak M.,Kusche D. (1984): Baumpflege heute, Hannover 1984

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PRINCIPLES OF BROADLEAF TREE PRUNING

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ABSTRACT

Pruning is one of the most important maintenance measures of physiologically mature broadleaf trees in green areas. It is a technique that regulates and controls the growth of trees, their flowering, fruiting, and with all this gives a regular and balanced form of trees. The absence of plant pruning will affect their irregular growth, so they can become unproductive, immense and unpresentable. This paper provides an overview of the key principles of pruning of broadleaf trees.

Key words: pruning, broadleaf trees

INTRODUCTION

Pruning is one of the most important maintenance measures of plants in green areas. It is a technique used to regulate and control the growth of plants, their blooming and fruiting. By pruning plants their form and appearance of the habitus is defined.

The goal of pruning of tree crowns is the removal of those parts that interfere with or slow the proper development of a tree in a biological or aesthetic sense [1].

Everything that is sick, dead or overgrown is pruned. If plants are not pruned, they grow improperly and become unproductive and immense, i.e. unpresentable. Proper pruning of plants increases their longevity and purpose in the landscape. Pruning of tree crowns is one of the most important maintenance measures, and if properly and professionally performed provides trees with high level fitness, excellent aesthetic and sanitary function. The way proper pruning enhances the beauty of almost every tree, improper pruning can ruin or greatly destroy the landscaping potential of a tree.

During maintenance of green areas pruning techniques are implemented both in broadleaf and coniferous trees. By its nature coniferous tree species are much less intensively pruned due to the nature of their growth and habitus formation. Pruning of coniferous trees mainly implies removing the lower dry branches, and broken and diseased branches and twigs. Pruning of tall broadleaf trees is of much greater significance within the techniques of tree pruning.

BIOLOGICAL CHARACTERISTICS OF BROADLEAF TREES

Tree (arbor) is a plant on whose aboveground part of the stem (usually higher than 5m) we differ a trunk (unbranched part) and a crown (branched part) or leaf rosettes as in palm trees. General appearance (habitus) of woody plants is largely constant for particular species, so based on the 'tree architecture' and general outline a determination can be performed even from a distance. Each woody species has a typical form of the crown which implies the one that a particular species achieves at its middle age. The shape of a crown in woody plants varies and is the result of both hereditary factors and the influences of environmental factors. The crown can be regular and irregular. Regular crown can be developed vertically and horizontally. If a crown develops vertically branches are directed towards the top of the tree or the ground in which case a pyramidal, cone-shaped and "drooping" crown are formed. If a crown develops horizontally a rounded, elliptical, egg-shaped, umbrella-like and other forms of crown are formed. Irregular crown does not have the axis of symmetry and is formed in such a way that branching occurs at different heights on one and then the other side.

With the majority of woody tree species there are lower systematic categories in which a crown is completely different from the typical one for that species. The most prevalent forms of crown of woody species that can be properly used on different categories of green areas are: pyramidal (*pyramidalis, fastigiata, stricta*), cylindrical (*columnaris*), round (*globosa, spheroidea*), umbrella-like (*umbraculifera*), drooping (*pendula*), leaning (*prostrata*), and climbing crown (*reptans*). According to the height of trees three groups can be formed: first group - tall trees, which reach a height of over 25 meters, then the second group which includes medium-height trees which reach a height of 12m to 25m and the third group which includes small trees that reach a height of 5m to 12m (Figure 1).

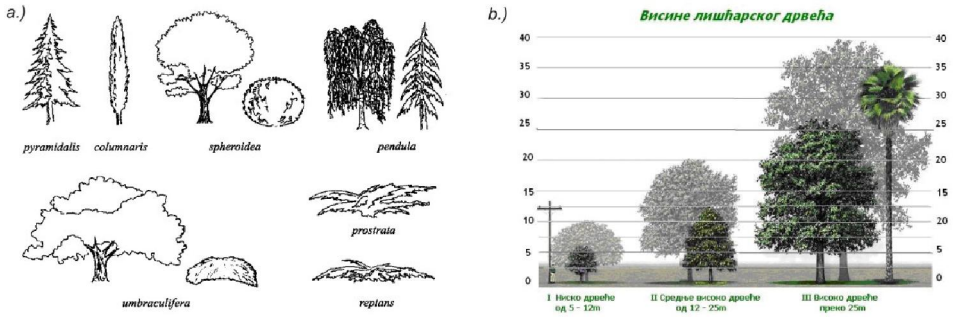

Figure 1. Biological characteristics of trees: a.) Appearance of tree crowns; b.) Categorization of broadleaf trees according to height

PRUNING OF BROADLEAF TREES

A frequently asked question is why trees need pruning. From man's point of view a tree that grows in nature does not have a good habitus. Growth may be typical for the species, but under natural conditions plants often find themselves in environments within which they are in direct competition with other plants, especially those that are larger and older than they are. Bigger plants are superior to smaller ones and unless

smaller or younger plants adapt to adverse conditions, especially sunlight exposure, deterioration and eventually withering occur (Figure 2.).

This type of competition among plants planted on green areas occurs to a much lesser extent, because the growth and development of plants is man-controlled, especially with pruning techniques. Pruning does not allow plants to outgrow the optimal size for a given area or to significantly threaten the neighboring plants (Figure 3.).

The main objective of tree crown pruning is to remove those green parts that hinder or slow down the healthy development of plants in a biological or aesthetic sense. Branches and twigs representing the excess part, whether damaged or being in a bad position, thus spoiling the appearance and shape of the crown are cut off. This way the tree is freed of unnecessary ballast with human assistance, thus the total energy of "growth" focuses on those parts that have more functionality, so that functionality of the plant grows as a whole. Proper pruning enables maintaining a form of plants in the planned limits for a particular position.

Figure 2. A display of vertical forest stratification

The first pruning when planting on green areas is carried out before the start of the planting. Then the root of the plant is pruned first, when the lateral roots and root hairs that were damaged during the extraction and packing in the nursery and during the transport of the plant itself are removed. Any pruning of the root of the plant must be accompanied by appropriate removal of the part of the crown, since it is very important to establish proper relationship between the aboveground and underground parts of the plant. Too small a root mass cannot supply the nutrients to a much greater crown mass, which can consequently lead to drying and shedding of leaves and the death of a part of the crown. For this reason, after root pruning and the planting the corresponding part of the crown of the tree is removed.

Figure 3. Relationship between big and small trees in green areas

Approximately the same mass of root and crown should be achieved by pruning because this way a balance between the underground and aboveground parts of the tree is created, thus enhancing the proper development of the crown. During the first year after planting the green areas so-called initial plant maintenance is carried out, where pruning is one of the most important maintenance measures. Further pruning is carried out every three to five years, depending on the species of plants and rate of its growth, in order to maintain the trees within the planned space, reduce and regulate their growth and maintain the good condition of the plant. Broadleaf tree pruning is also implemented to eliminate any possible damage caused by nutrient shortages, damage caused by storm or insect infestation and plant diseases.

Any pruning of broadleaf trees should be accompanied and defined by a good plan. Before pruning one should know exactly why pruning should be carried out and what the purpose or objective of pruning is.

Proper planning of pruning stages after a certain period of time results in a desired appearance of the crown (Figure 4).

Figure 4. Appearance of the tree before crown pruning; A display of the tree five years after crown pruning; Dry branches in the crow

When pruning broadleaf trees dead, diseased and broken branches are removed first, starting from large branches to the branches of smaller dimensions, by cutting them to the point of growth or the buds that will take over further growth of branches (Figure 5). Then branches that grow irregularly, crossed branches and water shoots are removed.

After completion of the so-called sanitary phase of pruning the second phase of pruning – the so-called crown thinning ensues. This is necessary in order to develop a desired shape of the crown and fit the tree into the available space. There is an additional i.e. corrective pruning that is done to eliminate/remove the competitive central branches when two or more occur at a time (Figure 6).

When these cuts are made one should move away from the tree and take a look at the whole crown. It should be assess whether it is necessary to conduct anther corrective pruning. If a large mass of the crown is removed further pruning should be postponed for the following year (Figure 7).

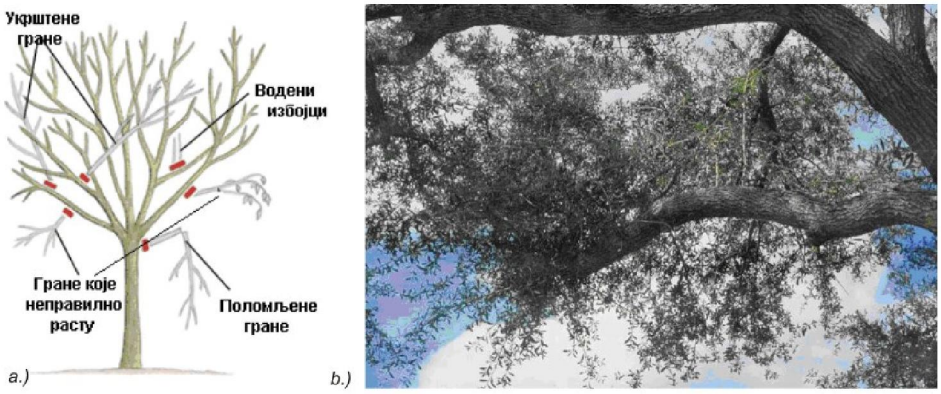

Figure 5 Broadleaf tree pruning: a.) Pruning of broken and problematic branches in a tree; b.) Water shoots on a big branch

Many plants around the age of maturity accumulate a large number of dry twigs and branches, which should be removed because they violate the appearance of the plant, threaten its growth and can become a source for a variety of plant diseases and pests (Figure 8).

Pruning can be done at any time of the year, however, depending on the species of the plant pruning time can vary. Pruning done at the wrong time, i.e. the wrong time of the year will not kill the plant, but if a plant is continually pruned improperly it will lead to damaging or weakening of physical condition of the plant.

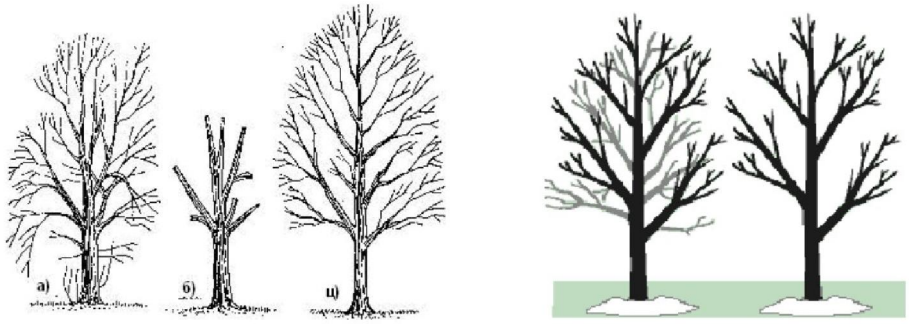

Figure 6. Left: Pruning of trees with dry, broken and damaged branches: a) Appearance of a tree with diseased, broken and problematic branches; b) Pruned tree; c) Appearance of a tree after pruning and recovery; Right: Pruning of lateral branches.

Figure 7. Tree crown out of balance. Balanced tree crown after pruning. Corrective pruning is left for the following year due to the removal of a large mass of the crown.

Figure 8. A mature broadleaf tree before pruning of dry branches in the crown (left) and after pruning (right).

Generally, the best time for pruning is late winter or early spring before the growing season starts. There are exceptions to this rule and they apply to species that are characterized by strong secretion of juices such as maple, birch, etc.

The most unfavorable time for pruning is immediately after the growing season started, i.e. when the buds have developed in the spring. This occurs because the large amount of reserve nutrients from the roots and trunk is used for the formation of new foliage. Should the foliage be removed before the formation of new reserve nutrients, a lack of nutrients would occur and the plant would be stunted. It is also recommended that the volume of pruning in late summer be limited while on some plants shoots are still formed. These young shoots may not have enough time to harden before the onset of cold winter, which will result in damages from frost.

Plants damaged by lightning, storms or vandalism should be pruned as soon as possible in order to avoid the possibility of occurrence of plant diseases and pests.

Pruning of old trees, depending on the species, is carried out every three to five or ten years. With pruning all those green parts that interfere with or delay the proper development of plants are removed. The branches and twigs representing the excess part, whether damaged or having a bad position and "spoil" the look and shape of the crown, are cut off.

By proper pruning a tree is relieved of unnecessary ballast with the help of man, thus the total energy of the "growth" focuses on those parts that have more functionality, which increases the functionality of the plant as a whole. By pruning the shape of the plant in the planned limits for a particular position is maintained.

CONCLUSION

Pruning represents the most important plant maintenance measure, and thus the green area maintenance measure. Pruning is applied primarily to improve the condition of the tree, enhance its aesthetic value and maintain the crown within the limits of the planned area.

In order to fulfill its task pruning must be carried out properly and professionally. Improper pruning can, above all, lead to reduction of the condition of the tree, impair its visual quality and the natural appearance of its habitus.

The need for pruning can be reduced or eliminated by selecting plants that are appropriate for a particular site. Some plants are too large for the designated area so that they can interfere with traffic, threaten street infrastructure, private homes, etc.

Typically, a great need for pruning arises due to the fact that during the design of green areas enough attention is not paid to the choice of species for certain positions. Should designers and contractors pay more attention to the selection of species, pruning could be reduced to a minimum.

Careful selection of plants during the process of designing and planting represents one of the key moments for further maintenance of green areas.

Operatives who carry out pruning should, above all, be familiar with the biology, ecology and nature of tree species they prune, basic principles and techniques of pruning, as well as the tools used for this purpose.

REFERENCES

1. Anastasijević N, Vratuša V. (1999): Bezbedno orezivanje velikog drveća u gradskom pejzažu, Zbornik radova Ekološka istina, Zaječar, 80-84.
2. Anastasijević N. (2007): Podizanje i negovanje zelenih površina**,** Šumarski fakultet, Beograd.
3. Brown E. G. (1972): The Pruning of Trees, Shrubs and Conifers**,** Faber and Faber Limited.
4. Siewniak M.,Kusche D. (1984): Baumpflege heute, Hannover 1984.

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ECOLOGICAL SAFETY PRODUCTS FOR CHILDREN - GREEN TOYS

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ABSTRACT

Toys are an important factor in proper psycho-physical development and socialization of children. Toys should be eco-friendly in order to develop environmental awareness and concern for the environment in the perid of childhood. The paper analyzes legal provisions of safety and health safety of toys, use of new eco-friendly materials for their production and precautions in choosing them.

Key words: Ecological safety, health safety, green toys

INTRODUCTION

The toy represents material element of the children game, which affects to its flow and contents. It dated from the time when our ancestor began to leave his marks on cave walls, and made minor copies of his tools and weapons. Such items can be found in museums around the world and it is difficult to separate the cult and game function, presenting a proof of the time and culture when they were created, as well as the universality of play activities. Toys were made of bone, wood, leather, wax, clay and later of lead and bronze. [1]

Researches on the development of toys show that toys are rarely mentioned in historical reviews but that does not mean there were no things used for playing. Children were playing with mud, twigs and stones and made replicas of houses and cattle. Toys were initially related to religious ceremonies and adults. Toys were not concerned as part of growing up and education in the community. Gradually in the 17th and then during 18th century, some scholars recognized children's play and toys as a suitable means for education. By that time the term „toy“ was used to indicate the item without the higher values.

The development of today's concept of the toy began between 1550 and 1750, when the new idea of industrial machinery began to change the image of the world, hence in the 18th century production of the first toys began. A more serious approach to the didactic toys and games, such as maps for learning geography, history and astronomy occurred in the late 18th century. In the next century, the development of the

international toy market started, and the main producers were located in England and Germany.

The early 20th century, especially its second half, was characterized by technological progress that reflected on toys industry [2].

The famous researcher E. Seguena recognized the huge importance of toys for the psycho-physical development „Books can not teach child what toys can, nations with more toys are the one with more individuality, idealism and heroism, and if you tell what kind of toys your children use for playing then it is possible to predict what kind of person they will be tomorrow" [3]. There is no other object in the world, that is so atractive to children and which is able to fill their emotional world, as a toy. With the help of toy child develop senses and muscles, learn to socialize. Toy contributes the development of intelligence and helps in learning. It develops creative spirit, and contributes the development of communication.

Classification of children's toys can be made according to various parameters, but the general classification could be according to: original creation time of the toy, age, sex of the child, the season of creation or playing, play area (indoor or outdoor), place of creation (village , city, region), material of which the toy is made.

SAFETY CONTROL OF TOYS

Offer of children's toys in our market in the registered stores, is mostly satisfied by import from different countries, mostly from China and less extent by domestic production. The mark CE should be a guarantee in terms of regularity, but the toy should be enclosed health certificate from the exporting country.

Inspector gives import approval based on the health certificate of the exporting country, other documents and laboratory safety tests on importation, which are carried out by authorized laboratories in our country. If toys are manufactured in our country, they have to have certificates of laboratory testing in health safety by authorized laboratory. The irregular children's toy on the market imply the lack of approval import, i.e. related to certificates of the safety and inspection puts such toys out of trade.

On an annual basis around 3% of defective toys was found imported. In more than 90% of cases, the reasons for failure were colors instability and falling dolls hair. Sanitary inspectors in the process of children's toys control determine their safety and health safety, controlling the following [4]:

1. The children's toys are from materials meeting the following requirements:
   - They do not contain ingredients harmful to health,
   - The material is completely clean with no mechanical pollution,
   - It can be maintained hygienically
2. The toys are made of material previously used (the reason for an absolute ban on the import and transport)
3. The hair on children's toys and dolls must not fall off when shaking, combing, drawing or in another procedure
4. The age group the toys are designed for and the following are to be controlled:
   - the toys for infants are made of materials that can be disinfected or boiled, and toy in these proceedings does not change the quality,

- toys must be made in the way that children can not swallow them or put into the nose or ear,
- toys for infants must not be less than 7cm. If they are infants made up of several parts that can be easily dismantled, their smallest part must not be less than 7 cm

5. Children's toys in terms of construction meet the following requirements:
   - not to be pointed,
   - not to have sharp or jagged edges which may injure infants and toddlers,
   - to be well polished and coated with varnish or lacquer-color that are not toxic (wooden toys),
   - the voltage in electricity powered toys is not higher than 24 V.

These requirements are assessed, in accordance with the recommendation and restrictions given by the manufacturer, and according the age level for wich the toy is intended.

6. It is forbidden to manufacture children's toys of glass, porcelain, pottery or clay, except marbles and decorations for Christmas trees and figures, because they have trouble breaking
7. In the case of pyrotechnic materials should not be used for making children's toys as the children can be injured by them
8. Air rifle, air gun and starter pistol is not considered children's toys.

RAPEX is the EU system for the rapid exchange of information on dangerous products and their reports are also valid in our country, because the Serbian market, mainly available the same toys with wich children in EU play, are present on the Serbian market. One of the latest RAPEX report states that whenever possible toys made of PVC should be avoided because of they contain hazardous additives. PVC can be dangerous if it does not contain softeners, because if a child swallowed a small, sharp piece of PVC there is the risk of injury of the digestive tract because gastric acid may harden it Vinyl is an integral part of rubber products such as bags, balls, bracelets, and it is very dangerous because of its toxic properties. European Union through the RAPEX finds unsafe products in all member states.

According to information obtained from the RAPEX 1340 unsafe products, of which 543 were unsafe toys (about 40.5%) were withdrawn from the EU market in 2007. In the first six months of 2008. a total of 659 unsafe products, of which 204 toys (31%) was withdrawn. Most of the toys were withdrawn from the market due to the presence of unacceptable levels of chemicals, because in that group of toys, the potential danger is not obvious as with a toy with small parts, sharp edges. The information is submitted to the competent state authorities (inspections), commercial inspections conducted control of the situation in the Serbian market, and consumers have begun to pay attention when purchasing [5].

Example of a RAPEX report:

Informing country:Slovenia

Category: Toys

Product: Doll „Dolci Bebè"
Brand: Tobia's Giochi
Type / No.model:.207 186
Description: Doll - baby dark skin, the blue trousers.
Country of Origin:China
Threat: Chemical threat

Product poses a chemical risk because the plastic head contains 12% of mass percentage of Di (2-ethylhexyl) phthalate (DEHP) and 0.32% of mass percentage of Di – „isononyl" phthalate (DINP). Plastic hands contain 13% of mass percentage of Di (2-ethylhexyl) phthalate (DEHP) and 0.29% of mass percentage of di-isononyl phthalate (DINP).

REACH Regulation on dangerous chemicals, bans the use of phthalates DEHP, DBP and BBP in toys and products for children, while phthalates DINP, DIDP and DNOP are banned for use in toys which children can be put in the mouth [6].

The measures adopted by the country to give notice: Distributor Voluntary recalls from consumers.

DANGEROUS SUBSTANCES IN TOYS

When purchasing toys should consider the following:

Declarations- means any written marks, trade mark, brand name and / or trademark, name and address of the manufacturer and / or legal entities or individuals that puts product in the market, the name and address of the headquarters of the importer, country of origin if the product is being imported, prescribed toxicological and environmental labels, instructions for use when necessary for proper use. When buying plastic toys should be noted if there is a label marking the product is PVC FREE or NON TOXIC. The labels on painted toys should mark the use of non-toxic and safe colors.

Mark-aged children toys on the market, on declaration must be permanently marked with visible warning of possible dangers, especially when it comes on toys for children up to three years and in words and / or image, shown internationally valid character. Parents should buy toys appropriate to children age, because all others can be potentially dangerous.

CE-mark CE is an acronym for French words „Conformité Européen" (European conformity). CE mark indicates that the product meets the requirements of safety, health and life, property protection, environmental protection, protection of public interest, required by European Union directives. The product marked with CE and accompanied by a statement of compliance has free access and movement throughout the European Union market. CE mark on the product is put by the manufacturer or his authorized representative based in the EU. The market has frequently toys with the false CE labels. The most common scam is the CE mark with two letters almost glued together or elongated. The original tags two letters are away and both letters actually represent half of the imaginary perfect circle. The CE mark is for authorities to monitor the market, but does not indicate the quality of the product and not a guarantee that the product is safe. However, toys that do not have the CE mark have a greater risk to the safety of the child.

GS-sign presents „verified safety". This label does not represent an obligation for producers. It is placed if the toy tested in one of the verified independent institute for checking and testing. It is important to note that the obtained mark must be renewed regularly.
Dangerous substances that can be found in toys are:

Cadmium

Toys must be painted with non-toxic paints. Toxic cadmium can be found in costumes with jewelry, and it can be found in combination with lead and toxic pigments in colorful plastic.

Lead

The colors of the toys, especially red and green contain lead. If the product contains less than 0.09% lead, it is a safe toy, greater contents are dangerous. Ingestion of lead in the course of longer period of time through biting toys can lead to permanent brain damage.

Bisphenol

Perhaps the greatest threat are plastic bottles for milk, which have a synthetic female hormone bisphenol, which can lead to cancer and disorders of endocrinology system, and serves making hard polycarbonate plastic.

Nitrosamine

Nitrosamine is cancerous and can be found in rubber objects. Inflatable balloons can contain it, because the package must have a warning if the level of nitrosamine is high and it is recommended to inflate ballons with a pump.

Phthalates

The substance that softens plastic, can be found on soft toys made of PVC or vinyl. These substances affect the hormonal system of people of all ages, especially developing children. This can lead to infertility, and affects the work of other hormones, such as those that regulate the thyroid gland etc.

THE TERM OF „GREEN" TOYS

„Green" toys are kind of toys made from recycled plastic and other environmentally friendly materials, helping reduce use of fossil fuels and reduce greenhouse gas emissions. The toys are designed for environmentally conscious consumers who want to improve the overall health by purchasing them and also provide entertainment for children.

These products may look similar to other toys of the same type, they are made with a key difference. An important innovation of these manufactures is to re-think the flow of the design process. Rather than creating a toy design and then considering the materials that could be used to realize it. They first performed research of the greenest and safest available materials, and then determine what toys may be made of these materials. Initially, green criteria included biodegradability, recycled materials recyclability, and energy efficiency. Safe criteria included avoidance of lead, phthalates, bisphenol A (BPA), or other additives that could leach out of plastic and pose a health hazard to consumers.

Green toys can be made of wood, paper and vegetable raw materials such as corn, nuts, dried vegetables and fruits, seeds and similar edible food. So you can make edible crayons, when color depends on the type of fruit or vegetable powder. Grain corn are processing into raw substances. This is the producing natural toys, a kind of Lego in color -

painted colors that are also used for food production (eg Happy Mais toys). When children wet dice from corn, they create various shapes and play without boundaries. Assortment of these toys is broad, topics diverse. And most importantly, there is no chemical hazard and no risk of suffocation because the raw material melts in the mouth with help saliva.

CONCLUSION

As a state whose one of the goals is entering the European Union, Serbia will have to make a series of institutional changes and a series of social changes and cultural forms that will inevitably lead to changes in the way of life of its citizens. One such area is environmental protection. Apart from the adoption of ecological principles at the institutional level, it is necessary to strengthen the environmental awareness of citizens and not only to EU accession, but also to adopt such values that will enable sustainable survival of our society as a whole. Citizens, as individuals, every day make decisions that have direct or indirect impact on the environment.

As Serbia has not yet accessed to the European Union, it is not obliged to apply European laws, and therefore the implementation of information from the RAPEX. However, based on Article 16 Law on objects of general use [7], which was adopted in 2009, the Government is obliged, within 20 days after receiving information from the RAPEX implement measures to maintain and withdraw products from the market of Serbia, or to give instructions to the competent inspection bodies and the customs.

In addition, the problem is that our country has no rules regulating the maximum amount of a chemical substance that can be found in toys. That basically means that the authorities are powerless to ban the sale of chemical hazardous toys.

By the end of the year Ministry of Health should establish propasal for general use and regulation of health safety of toys in accordance with EU directives in this area. The aim is harmonize of Serbian legal regulations relating to specific products, with European achievements.

The right to healthy environment undoubtedly belongs to the category of basic human rights.

REFERENCES

1. Fleber.F, Pedagoška enciklopedija, knjiga1., Zavod za izdavanje udžbenika, Beograd, 1989.godina.
2. Jekić S., Golubović D., Razvoj dečjih igračaka kroz istoriju, Tehničko obrazovanje u Srbiji, Čačak, 2006. godine
3. Eljkonin D.B., Psihologija dečije igre, Izdavački zavod za udžbenike i nastavna sredstva, Beograd, 1981. godine,
4. http://www.zdravlje.gov.rs/showelement.php?id=2287
5. http://ec.europa.eu/consumers/dyna/rapex/rapex_archives_en.cfm
6. Zakon_o_hemikalijama,www.ekoplan.gov.rs/shema/cir/prez/files/Zakon_o_hemikalijama-S.R..pdf
7. Zakon o opštoj bezbednostiproizvoda, http://www.retailserbia.com/20090614344/zakoni-republika-srbija/zakon-o-opstoj-bezbednosti-proizvoda-republika-srbija.html

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OPEN SPACES BARRIERS THAT INFLUENCE ON REDUCED MOBILITY OF USERS

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ABSTRACT

In six locations in the center of Belgrade and Uzice, open space barriers that influence on reduced mobility of users were identified. Every location with barriers is presented on the photo, then, the category of people which those barriers present the obstacle in movement was determined, and at the end, the evaluation of accessibility of these locations was carried out. It was determined that analyzed spaces are partially accessible. In the conclusion it was point out that the continuum in movement was not achieved because standards in accessibility are only partially being used.

Key words: accessible environment, barriers, people with disabilities

INTRODUCTION

By careful planing and designing open spaces it is possible to achieve one of the most importan human needs - the right to move free, without the obsticles and barriers. Frendly enviroment, arranged with respect for diferences among people, enables everyone, esspecially disabled persons, to have active, pleasent and quality participation in arranged enviroment and also its' better use. The arrangement and the design of the spaces should be done in accordance with the principles of universal design, and it is also necessary to adapt and reconstruct the existing facilities and their surroundings to make them accessible for everyone [1]. There are numerous barriers in environment that influence on reduced mobility, which disable performances of basic needs. It is necessary to point out that adaptable environment is not a necessity only for disabled people but also for others. Every person in some point of life has reduced ability to move - parents with children, injured people, people with luggage, obese people, pregnant women and older people. Accessible environment is not something that is exclusively applied on minority, it is necessary for everyone.

The goal of this work is to point out problems of accessibility - open spaces barriers, to show commonest obstacles by analyzing examples and locations and to give

sugestions to solve and circumvent problems which interfere with normal everyday lives of disabled people as well as the rest of people with reduced mobility.

METHOD

In this work, several methods have been applied depending of the task and stage of research.

In the first phase, collecting, analyze and research of all accessible data was conducted.

In the next phase, imporatnt points in Belgrade and Uzice were analyzed. They were chosen by: attractivity of location, frequency of use, functionality. All the elements in space that influence on accessibility and free movement has been analized. Open space barriers were identified and every possible solutions for their circumvention were presented. Also, every location with barriers is presented on a photo. Categories of people which are influenced by these barriers are identified. At the end, accessibility evaluation of location was conducted. Three evaluation categories were persented: accessible, partially accessible and inaccessible [2]. The collected data were analyzed in terms of to the requirements set forth by the Book of regulations about the requirements for the planning and designing of buildings that deal with the unobstructed mobility of children, the elderly, the handicapped and the disabled („Official Gazette RS, No. 18/97). The results are presented by text and by graphic representation.

In the last phase, by synthesis of collected data the conclusions were conducted and systematized.

Table 1. Legend for graphic part of analysis

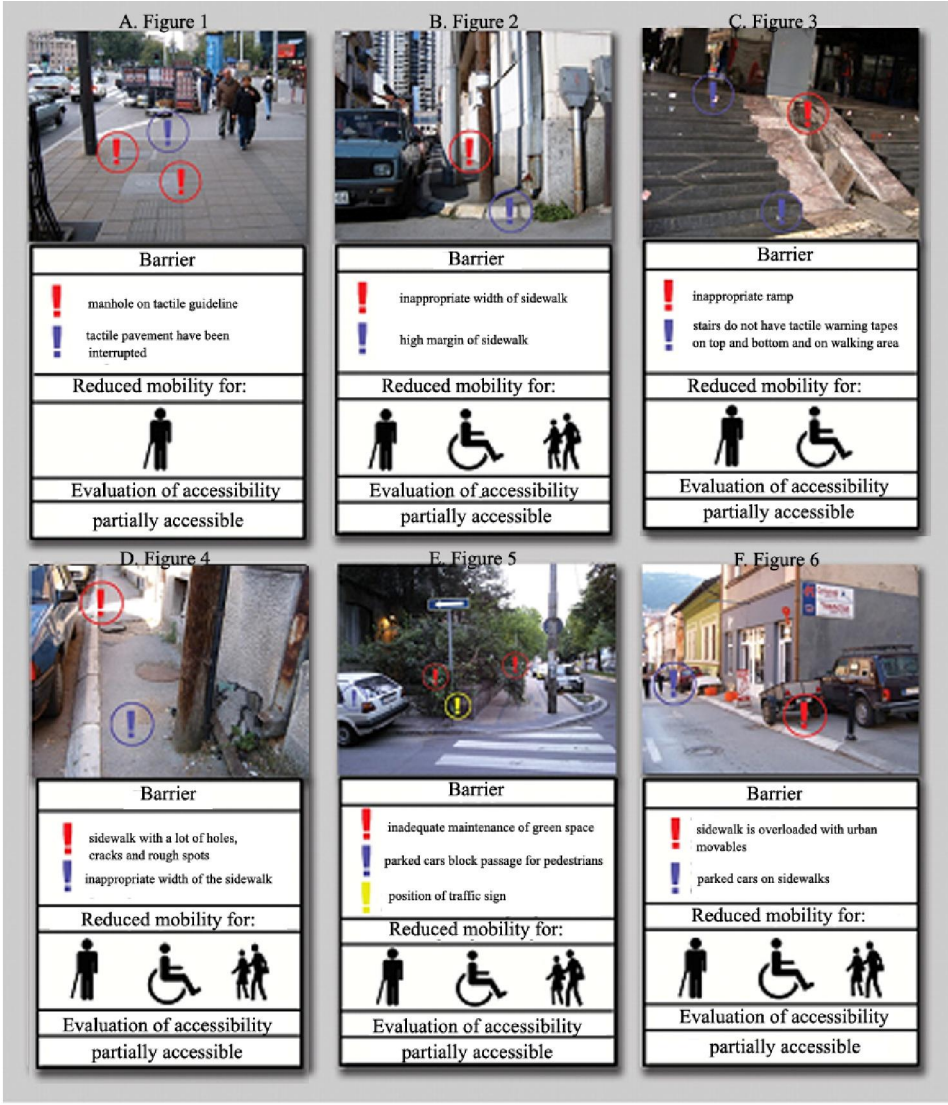
Mark of barrier	Barrier 1	Barrier 2	Barrier 3
	!	!	!
Mark for users with difficult access	Visually impaired people	Wheelchair users	Person who move with helping device aid
			

RESULTS

Analysis of location 1 - Square of Republic in Belgrade (Figure 1), it has been determined that the path from tactile pavement have been suddenly interrupted which makes it difficult for visually impaired people to continue walking. It also has been noticed that tactile guideline is interrupted by manhole, which can provide inadequate information for blind person. In these cases it is recommended to design continual path for visually impaired people who will direct them through space.

Analysis of location 2 - The street of Momcilo Tesic in Uzice (Figure 2), it has been determined that the width of sidewalk does not satisfy standards for comfortable

walking. Street lights are placed on walking directions, narrowing the predicted space for comfortable movement of people. Besides, high margin of sidewalk disables movement for people in wheelchair.



Phototable 1.

A. Figure 1. Analysis of location 1- Square of Republic, Belgrade; B. Figure 2. Analysis of location 2 - Momcilo Tesic Street, Uzice; C. Figure 3. Анализа локације 3 – Square in front of Faculty of Philosophy, Belgrade; D. Figure 4. Analysis of location 4 - Momcilo Tesic Street, Uzice; E. Figure 5. Analysis of location 5 - Krunska Street, Belgrade; F. Figure 6. Analysis of location 6 - Momcilo Tesic Street, Uzice

Analysis of location 3 – Square in front of Faculty of Philosophy in Belgrade (Figure 3), it has been determined that the existing ramp is not width enough, with high slope, made of poor material, without protection and handrails. Therefore it represents danger for users. The stairs do not have tactile warning tapes on top and bottom and on walking area as well. In this situation it is necessary to adapt the existing ramp in accordance to given standards.

Analysis of location 4 – The street of Momcilo Tesic in Uzice (Figure 4), it has been determined that the sidewalk is not width enough with a lot of holes, cracks and rough spots. These conditions predispose to possible injuries of users.

Analysis of location 5 – The Krunska street in Belgrade (Figure 5), it has been determined that inadequate maintenance of green space which expands across the sidewalk represents obstacle for visually impaired people and people in wheelchair. Regarding that blind people cannot detect obstacle (tree branches, bushes, etc.) this represents danger for them and they can be badly injured. Also, people in wheelchair have difficulty in moving (plants beside the sidewalk compromise space predicted for pedestrians). Next obstacle - inappropriate parked cars which block passage for pedestrians. The position of traffic sign on sidewalk is irregular because of inadequate width of sidewalk.

Analysis of location 6 – The street of Momcilo Tesic in Uzice (Figure 6), it has been determined that the space predicted for pedestrians is overloaded with different elements such as: flowerpots, columns, advertising tables, trailers. Illegally parked cars on sidewalks are also a problem.

DISCUSSION

Comparing collected data of accessibility from six locations in Belgrade and Uzice, with conditions from the Book of regulations, open spaces barriers have been identified.

- Insufficient width of pedestrian communications. According to the Book of regulations, the article 4 states that width of sidewalks and pedestrian paths should not be less than180см, extremely 120см, while width of passage between immobile obstacles should not be less than 90см (3). This conditions are not accomplished in location 2, 4 и 5. The width of pedestrian communications is significantly narrow.
- Inadequate maintenance of sidewalk. According to the Book of regulations, the article 4 states that surface of sidewalk should be clean, flat and slide proof. These conditions are not accomplished in location 4.
- Inadequate marking of main pedestrian communications. According to the Book of regulations, the article 4 states that it is necessary to provide hallmarks of main courses and directions in squares and other large pedestrian surfaces by applying the predicted paints and material. These conditions were not fulfilled in location 1.
- Inadequate position of street signs. According to the Book of regulations, the article 5 states that is forbidden to place columns, advertising tables or any other obstacles in area of pedestrian movement and that present obstacles should be marked appropriate. These conditions are not accomplished in location 6.
- Inadequate maintenance of green spaces. According to the Book of regulations, the article 5 states that lower parts of tree (lower branches) which are near the sidewalk should be at least 250 cm apart from sidewalk. These conditions are not accomplished in location 5.

- High margin of sidewalk. According to the Book of regulations, the article 6 states that in order to circumvent the altitude differences of sidewalk and road one should use oblique margins. These conditions are not accomplished in location 2.
- Irregular build ramps. According to the Book of regulations, the article 10 states that ramp slope should not be more than 1:20 (rarely 1:12 for short paths); smallest clean surface of ramp for one direction passage is 90 cm; ramps should be equipped on both sides with two level handrails on high of 70 cm and 90 cm; surface of ramp should be clean, flat and slide proof; if ramps are predicted for frequent use for visually impaired people, surface of ramps could be in light, strong colors to provide good contrast. These conditions are not accomplished in location 3.
- Impractical stairs. According to the Book of regulations, the article 11 states that surface of upper side of stairs should be in contrast color in regarding to ford, that between resting place and stairs should be color contrast as well as on top and bottom of the stairs. Surface of ground should be 50 cm apart from the beginning of descending leg of stairs and should have different tactile and visual proprieties than ground. These conditions are not accomplished in location 3.

CONCLUSION

There are numerous problems surrounding the constructed areas that influence reduced mobility for people with disability. To improve current situation it is necessary to undertake following steps:

a. Conducting regulations and technical standards for designing accessible environment;
b. To introduce obligatory subjects in faculties regarding construction and arrangement of environment;
c. Multidsciplinary aproach – colaboration of all profesions that are responsible for solving these problems; colaboration with relevant assotiations all over the world that could provide experience and present examples of good practice;
d. Colaboration with assotiations of disabled people in inplementation principles of accessibility;
e. Raising awareness among citisans regarding significanse of accessibility of environmet without obstacles and barriers.

REFERENCES

1. Gačić A. The analysis of the exterior design of the Zemun Medical Centre in terms of its physical accessibility for the people with reduced mobility, Ecological Truth – Ecoist '10, str. 188-94, Apatin, 2010.
2. Gačić A. Dizajn otvorenih prostora prilagođen osobama sa invaliditetom na primeru škole za učenike oštećenog vida „Veljko Ramadanović" u Zemunu, master rad, str.82, Univerzitet u Beogradu – Šumarski fakultet, Beograd, 2009.
3. Pravilnik o uslovima za planiranje i projektovanje objekata u vezi sa nesmetanim kretanjem dece, starih, hendikepiranih i invalidnih lica, Beograd, („Sl. Glasnik RS", br. 18/97), 1997.

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ECONOMIC INSTRUMENTS IN PRACTICE - EXPERIENCE WITH THE TRANSFERABLE PERMIT SYSTEM

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ABSTRACT

The interests in the problem of global warming has been followed by the forts in the field of economic theory regarding harmonizing of trade and ecological interests and finding out adequate instruments for stimulated sustainable development as well. Transferable permits can be a good basis for efficient solving of global warning problem. The main advantage of transferable permit is based on the fact that they are cost-effective instrument. Furthermore, permits might be stored for later use and also the permit specifies the amount of pollution reduction that will be reached. Finally, this method of distribution provides a much higher degree of political control, making it easier to create a majority coalition.

Key words: transferable permit, economical instruments, Kyoto protocol

INTRODUCTION

Theoretical model of transferable permit system is developed in the early seventies of the twentieth century thanks to the initiative of the Environmental Protection Agency, EPA, with the aim of finding solutions for the control of localized air pollutants. Transferable permit system from 1980 was used as a method for reducing the utilization of leaded gasoline and carbon compounds (CFC) that damaged the ozone layer [1]. Property rights, as instrument for pollution control, was introduce by the Canadian economist J. Dales, while the first program of trading property rights used in USA was after adoption of the Clean Air Act in 1990. After that, the USA has implemented several projects based on this instrument, so we could say that this country has the most experience in applying transferable permit. The idea: that this instrument could be effective in solving the problem of global warming, through certain modifications, was first initiated by the 1997 (Kyoto Protocol) [1].

DISCUSSION

The most successful utilization of transferable permit was in the acid rain control, which is regulated by the Fourth Amendment of the Clean Air Act (1990).

Adoption of this Act which is based on the use of transferable permit for emission of CO_2 could be explained by several factors. There was a need to find a cost effective solutions. By the 1990 the costs of pollution control in the USA have reached an annual value of $125 billion, which represented almost three times the value of the real costs in 1972 [2]. In the case of SO_2 emission control, for technological differentiation, emitters were faced with very different marginal cost of pollution reduction, so they wanted to use different kinds for pollution reduction. EPA estimates that the program of transferable permit reduced cost about 50% by the end of the eighties [3]. The prediction has shown that the annual value of costs exceeded $6 billion with the further use of traditional instruments. The decisive factor perhaps is the fact that this program of transferable permit for SO_2 was not only cost effective, but it was primarily intended for reduction of SO_2 emissions in USA. The great advantage of market instruments is that we can achieve environmental improvements that otherwise would be neither politically nor economically feasible. Economists, who have been involved in this program, accepted the reduction of SO_2 emissions by 10 million tons also as a political goal. It is important to note that the problem of acid rain by the 1990 and adoption of Clean Air Act was not regulated at all.

Clean Air Act of 1990 is program designed for trade of transferable permits for SO_2 which are introduced in order to reduce overall emissions of SO_2 in the USA by 50% compared to levels in 1980. The first phase of the program was successfully completed 1995, and second in 2000. The first phase identified 263 largest emitters of SO_2, and 110 of them were power plants and each of them were assigned an initial number of permits by participating in pollution in the period 1985-1987. Subsequently, emitters were able to obtain more permits, but under certain conditions. In the next phase, emitters were able to emit SO_2 only to the borders which are determined by the number of owned permits. Contempt of the certain borders was followed by a fine of $2000 for every ton of emissions over the permissible level and also obligation to neutralize these transitions in the next year. By the early 2000, almost all power stations in USA which using fossil fuels were included in this system [1].

The main advantage of transferable permits is based on the fact that they are cost-effective instrument. Cost efficiency is achieved because the permit holders have the option of exchanging them. Emitters who fail to reduce emissions at minimum cost have a strong incentive to sell their permits to those who have more expenses to reduce pollution. Also, permits might be stored for later use. The expected result is that the marginal costs of pollution reduction among emitters equalize by the time and lead the cost of pollution reduction to the minimum [4].

In addition to private market for trading permits on a bilateral basis, EPA has organized the annual auctions of permits which revenues are distributed between the emitters on the basis of the initial distribution of permits [3]. The program is designed so the emitters can trade permits also on the annual auction organized by the Government. Initial distribution of permits has always been free, and permits are initially always unconditionally distributed, although it turned out that a public auction were economically efficient.

On the demand side, existing firms favor the unconditional granting of permits, because that way there are no transferred obligations under the annuity for them.

Moreover, the free distributions of permits (as opposed to the distribution of licenses by auction or taxes) prevent the entry of new companies, because new companies have to buy permits from existing holders. In this way rents are transferred to the private sector, while through the unconditional distribution licenses are sustainable. On the other hand, groups that advocate for the protection of the environment are encouraged to avoid instruments that make visible the costs of environmental protection for consumers and voters, and taxes make those costs explicit than permits [5]. Also, the permit specifies the amount of pollution reduction that will be reached in relation to the indirect effects of environmental taxes. Freely allocated permits are easier to implement than taxes or licenses that are shared through the auction because they making the cost less visible and less impact [5]. Finally, this method of distribution provides a much higher degree of political control, making it easier to create a majority coalition.

The program of SO_2 permit trade has been successfully implemented. Target levels of emission reductions are achieved even surpassed. In fact, for overcoming the expectations in terms of reducing pollution in the period 1995-1996 (and for additional permits distributed by the government) emitters have created so-called "bank of permits" of over 6 million tons of SO_2. One of the peculiarities of the transferable permit system in the USA is actually the possibility of their use of delayed and futures operations.

Total costs of pollution reduction were significantly lower than they would be in the absence of trade permits. According to EPA data, during the program period the number of transactions in the market grew, so in 1996 more than 4 million tons of transfer of permits between economically unrelated parties were registered. Price of permits on the open market was falling, from the initial 300 $/t (1992), to only 70 $/t (1996), and the average was about 100 $/t of emitted SO_2 [6]. This has resulted in annual savings of $1 billion [6]. This example shows that the transferable permits are more efficient than traditional legal and administrative measures, and also have great potential for solving pollution problems at the global level.

Experiences with trade permits to emit CO_2, as well as some earlier programs of trade permits for emissions of lead and CFCs, provide a starting point for further planning and development mechanisms, which are [7]:

1) SO_2 trade permits are specific because the costs of reducing pollution differ between different sources.
2) The higher the level of mixing of different pollutants, the more attractive is the system of transferable permits, relative to the conventional uniform standards. Therefore, market instruments, whether environmental taxes or transferable permits, can lead to the localization of hot spots with relatively high levels of environmental pollution. This leads to the key issue - the distribution. In fact, some countries that have experienced the problem of acid rains have tried to prevent the trade of permits because it would increase the concentration within their borders. However, if there is the nonlinear nature of damage relative to the concentration of pollution, this points to the question of efficiency.
3) Efficiency of transferable permits will depend on the distribution of costs and benefits. Weitzman indicates that if there is a significant degree of uncertainty regarding the marginal cost of reducing pollution, and the marginal benefit of pollution reduction decreases relatively quickly, then the quantitative

instruments (permits) will be more efficient than the pricing instruments (taxes). When there is a significant degree of uncertainty about marginal benefits, which are positively correlated with marginal costs, then there will be an additional argument for the relative efficiency of quantitative instruments.

4) use of transferable permits gives the best results when transaction costs are low, and experiment with SO_2 indicates that if the program is designed, private markets will tend to have low transaction cost [7].

Many previous experiences with the transferable permit system could be applied and improved in the case of reducing CO_2 emissions, which, as one of the six greenhouse gases, is contributing to global climate change.

The number and diversity of sources of CO_2 emissions compared to SO_2 is immeasurably greater, primarily as one of the biggest causes of this gas emission is the use of fossil fuels. What is important is that any program to control pollution has to face the possibility of an outflow of emissions from regulated to unregulated sources. This can be a problem not only in meeting national targets to reduce CO_2 emissions, but in the case of international agreements when emissions have a tendency to increase in non-party countries. This issue is regulated by one of the provisions of the Kyoto Protocol where the industrialized countries are determined to participate in Cap and Trade program, while for developing countries there are not binding provisions, they are given the option to access the system based on individual project as an approach known as the Joint Implementation (JI) [4].

In order to serve as a successful model in the case of global climate change, there are some facts about previous trade programs that have to be pointed out. Thus, for example, there is an interesting conclusion reached by applying transferable permit system in the U.S. in order to reduce the use of leaded gasoline. In this case, the unit of measure of the emission is not the emission of lead oxide from motor vehicles, but the lead content in gasoline. This case could also be used when creating a mechanism for preventing global warming. Great savings in the cost of monitoring and implementation of the entire mechanism could be achieved with trade permits for inputs (carbon content of fossil fuels). This is acceptable in the case the heating because unlike SO_2, CO_2 emissions are roughly proportional to the content of carbon in fossil fuels. On the other hand, the natural separation of CO_2 from the atmosphere by increasing the forest area is possible at an affordable cost and explicitly aligned with the goals of the Kyoto Protocol. Therefore, it is very important to combine a program of trade licenses of CO_2 (or taxes) with measures of sequestration (prohibition) of CO_2 [8].

Of reliable methods of distribution of permits to emission of CO_2, CO_2 permit auction would have the advantage because the income could be used to finance reductions of taxes. While the free distribution of CO_2 permits may encounter political resistance, it could still increase costs so that efficiency would be shifted from positive to negative net benefits.

Previous experience with the transferable permit system is related to pollution which is uniformly distributed in space and that is perfectly mixed. For CO_2 is specific that time and place of emission doing not affect the amount of damage. In practice, emission of local character is far more likely to happen, concentrated around the source.

Actually, it is expressed as a reservoir so that the more we move away from sources of pollution, the lower is damage.

CONCLUSION

Application of the transferable permit in the domain of global climate change would certainly bring a whole new set of economic, political and institutional challenges, particularly in terms of implementation. Not only that some of the major sources of CO_2 are decentralized (the use of fossil fuels in the household) and mobile (e.g. motor vehicles) so it is harder to control them, but also the question of initial allocation of permits can cause serious political disagreements. The level of caused damage depends, beside on geographical location, also on the physical environment characteristics (dynamic range of pollution, the time dimension, time of day and frequency of transmission), the cultural and environmental characteristics of the environment in which pollution is emitted (e.g. whether a source is close to the densely populated neighborhood or nature reserves).

All this should be taken into account when designing mechanisms that should be operational at the global level. Diversity of sources of CO_2 emissions and magnitude of the potential costs of pollution reduction clearly indicates that the only commercial instrument - a form of carbon trade emission permits (carbon rights trading) or a tax on CO_2 emissions – could achieve national objectives that might result from international agreements. However, it is necessary to insist on the international character of any action that is taken towards reducing global warming, which in turn hampers its implementation.

REFERENCES

1. Böhringer, C., Vogt, C., Economic and Environmental Impacts of the Kyoto Protocol, The Canadian Journal of Economics 2 (36), pp 475-495, 2003.
2. Munitlak-Ivanović, O., Penezić, N. D., Ekonomski instrumenti u funkciji eksternih efekata, Životna sredina ka Evropi 23, p 230, 2006.
3. www.epa.gov
4. Hahn, R. W., Stavins, R. N., What has Kyoto Protocol Wrought? The Real Architecture of International Tradable Permit Markets, American Enterprise Institute for Public Policy Research, 1999.
5. Ilić-Popov, G., Ekološki porezi, 160-171, Pravni fakultet u Beograd, 2000.
6. European Bank for reconstruction and Development, Transition Report 2000.
7. UNEP i UNCTAD, An emerging market for the environment, A Guide to Emissins Trading, 2002.
8. Filipović, S., Međunarodne institucije i mehanizmi za rešavanje problema globalnog zagrevanja, pp 44-50, Ekonomski fakultet u Beogradu, 2003.

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ELEMENTS OF FLORA AND VEGETATION OF ZRENJANIN'S PESKARA

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ABSTRACT

In early July of last year on the artificial formation complex of stagnant water near Zrenjanin called Peskara performed a preliminary analysis of vegetation and its classification. This paper provides a list of species which then were identified. This natural environment has anthropogenic origin, as a result of sand exploatation and it is currently under selfrenovation. As it is close to a Nature reserve Carska bara for some time already, birds typical for Carska bara nesting here. As a remarkably beautiful landscape Peskara should be managed on the principles of sustainability and eventually put into a particular category of protection

Key words: artificial formation, analysis of vegetation, landscape, sustainable development

PESKARA - PART OF NATURAL HERITAGE OF VOJVODINA

Natural heritage of Vojvodina is rich and diverse, characterized by distinct ecosystemes, species and genetic diversity. On the loess plateau, whose origin dates back to the time of the last ice age, extraordinary landscape units were formed. Over 120 000 ha, or 5.5% of the province, were placed under the regime of protection (data from 2005)[1]. That is far below the European standards, which state that 11% of total area should be put under the protection regime. In Zrenjanin was initiated an action in order to protect Peskara from local devastating influences, especially from proximity of the local inert waste, and guiding it in the spirit of sustainable development, knowing that well organized network of protected structures at regional-local level provides global, overall biodiversity and this approach is present in almost all projects of biodiversity conservation in Europe today[2].

LOCATION AND GEOGRAPHIC PROPETIES

Peskara is located in the rural area called Muzlja 5km southwest of Zrenjanin. It lies on the alluvial terrace of river Tisa, 76-78 metres high. It's artificial formation developed by sand mining which previous where marsh and wetland habitats of standing waters and moorland and steppe habitats bouth mostly destroyed by sand mining. Rate of

exploitation was greatly reduced in 1989 and today it only partially takes place in some localities. Artificial lakes are filled by infiltration of water through atmospheric precipitation and underground inflow of water that lies on the first watertight layer, which also depends on the amount of precipitation.

Today on this site, and the surrounding area, lies fragments of old natural habitat restoration and also habitat caused by anthropogenic influence. At the lakeshore has been formed contact vegetation characteristic for stagnant and slow-water surfaces, sand and soil sections and areas where sand was disposed in forme of artificially sand dunes. There is natural fouling phytocenoses of various associations, from initial stages to those rich in species. Besides the native species also can be found fragments of human impact and established plantations of trees.

Figure 1. View of Pescara (Foto: N. Ranđelović)

Since the location is in the relative vicinity of few areas of great importance for birds such as the Carska bara, Okanj and Rusanda and flood zone of the river Tisa, and since from the ecological point of view these properties by origin and structure have no differences and represent a unique ecological whole, rather quickly were inhabited by various species of birds. Ornithologist Dimitrije Jovičić - a member of Ecological Society Joseph Pančić from Novi Sad – made a study about spicies that nests and found living conditions in this area.

WORK ON FIELD

The analasis has been made to identify the presence of vegetation. On that occasion, we identified the following types of plants:

1. Achilea millefolium	51. Lotus corniculatus
2. Agrimonia eupatoria	52. Lycopus europaeus
3. Allium vineale	53. Malva sylvestris
4. Ambrosia artemisifolia	54. Matricaria inodora
5. Anchusa officinalis	55. Medicago prostrata
6. Arctium lappa	56. Melandrium album

7. Balota nigra	57. Melilotus albus
8. Bilderdyckia dumetorum	58. Melilotus officinalis
9. Bromus sterilis	59. Mentha aquatica
10. Calamagrostis epigeios	60. Minuartia glomerata
11. Calystegia sepium	61. Odontites serotina
12. Carex vulpina	62. Oenothera bienis
13. Centaurea jaccea	63. Ononis spinosa
14. Centaurea micranthos	64. Ononis spinosa var. mirjanae N.Ranđ.2011White spiny restharrow
15. Centaurea sedleriana	65. Onopordon acanthium
16. Cephalaria transsilvanica	66. Pastinaca sativa
17. Cerastium caespitosum	67. Petrorhagia prolifera
18. Myriophyllum spicatum	68. Phalaris arundinacea
19. Chenopodium album	69. Phragmites sp.
20. Chenopodium urbanicum	70. Plantago lanceolata
21. Conium maculatum	71. Poa pratensis
22. Convolvulus arvensis	72. Polygonum aviculare
23. Coronilla varia	73. Potamogeton sp.
24. Crepis caespitosa	74. Prunella vulgaris
25. Cirsium arvensae	75. Raphanus raphanistrum
26. Datura stramonium	76. Salix fragilis
27. Daucus carota	77. Salix purpurea
28. Dactylis glomerata	78. Sambucus ebulus
29. Dipsacus laciniatus	79. Setaria glauca
30. Epilobium hirsutum	80. Setaria viridis
31. Epilobium lanceolatum	81. Sisymbrium sophia
32. Equisetum arvense	82. Solanum nigrum
33. Erigeron canadensis	83. Sonchus arvensis
34. Eupatorium cannabinum	84. Stachys palustris
35. Festuca pratensis	85. Stenactis annua
36. Galega officinalis	86. Tragopogon orientalis
37. Galium verum	87. Trifolium campestre
38. Glechoma chederacea	88. Trifolium fragiferum
39. Hordeum leporinum	89. Tripholium pratensae
40. Innula germanica	90. Typha angustifolia
41. Juncus filiformis	91. Urtica dioica
42. Juncus articulatus	92. Verbascum banaticum
43. Juncus tabernemontani	93. Verbascum phlomoides
44. Lactuca perenis	94. Veronica spicata
45. Lathyrus hirsutus	95. Vicia villosa
46. Lathyrus tuberosus	96. Xanthium strumarium
47. Leonorus cardiaca	
48. Lycopus europaeus	
49. Lythrum hyssopifolia	
50. Lythrum salicaria	
51. Linaria vulgarus	
52. Lolium perenne	

Figure 2. Ononis spinosa – Spiny restharrow - unusualy white instead of pink flower coulor (Foto: N. Ranđelović)

ANALYSIS OF RESULTS FROM THE FIELD

On the studied territory around the lake in Pescara, there are elements of **water**, **marsh** and **weed** vegetation.

Aquatic vegetations in the lakes has the initial stages of following vegetation

1. ***Lemnion minoris*** that includes elements of free floating duckweed;
2. ***Potamion eurosibiricum*** elements of the submerged vegetation and floating resin and hornwort
3. ***Nympheion albae*** elements of community water lilies and water nut (Trapa sp.).

On the **shores of the lake** and in the **contact zone** grows well-developed vegetation

Phragmition communis **-**community of fens

It is a community with folowing representatives: *Phragmites communis* (rush), *Typha angustifolia* (reed), *Juncus tabernemontani* (dust shot). These hydro-heliophytes are typical for wetland habitats. Since only a few kilometers from the Pescara is Carska bara, in this contact zone habitats are found wading birds that are otherwise normally nest at the Carska bara.

Around the lake there are elements of **weed vegetation** following bound:

Arction lappae- el. of the association of black wormwood

Onopordion acanthii- el. of the association of thistle, stinging nettle, black elderberry and hortortum

Polygono-Chenopodion- el. of the association of prostrate knotweed and lambsquarter

Polygonion avicularis - el. of the association of prostrate knotweed and narrowleaf plantain

Convolvulo-Agropyrion - el. of the association of field bindweed and couch-grass

Convolvulion sepii- el. of the association of larger bindweed (Calystegia sepium),

Centauretalia cyani - el. of the association of garden cornflower and royal knight's-spur

Eragrostion - - el. of the association of yellow foxtail.

This vegetation is starting its development in early May and during June and July reaching its optimum which is why during our fild work (that was done in early July), was most numerous. At Peskara this tipe of vegetation is located along the edges of dirt roads that have beaten by movement of local people, at the empty surfaces that were once intensively fertilized with organic waste, and alluvial substrate (loamy sand) which contains larg amount of humus and available forms of nitrogen compounds.

Weed vegetation of Peskara considered as ruderal, since developed within human settlements. Its origin, development, distribution and dynamics are anthropogenic dependent. This tipe of weed vegetation, for the difference of agricultural crops, developed at the sites affected by man, but not to create agricultural complexes wich are organized, but oposit – made spontaneously[3].

On the part of an area near the lake Peskara it is possible that there are **salt-tolerant fitocenosis** but thay can be seen only in August when the ponds get dry because the vegetation of salt soile only then make out well.

Figure 3. Arcium lappa and Onopordon acanthii beside the edge of the dirt road (Foto: N. Ranđelović**)**

CONCLUSION

Peskara space is in the stage fouling. In contact partes of stagnant water and soil there is vegetation of hidroheliofites, and at the other partes- ruderal weed vegetation. It is maybe possible to finde salt soil vegetation restoration, but in the period when the analysis was done we could not see it. It should be emphasized that we have found a very new variety of Ononis spinosa whose flowers are white. Most of the reported plants are generally pioneer species that are used later in different successive stages of establishing stable living conditions. Peskara was subjected to the devestation waste disposal done by the local population. Plantes present in areas where was a certain type of pollution appears as accumulators of harmful pollutants (ash, soot, heavy metals) and can have recovery efect[4].

REFERENCES

1. Provincial Secretariat for Environmental Protection and Sustainable Development
2. Vladimir Stevanović, Assessment of biodiversity- from interpretation to conservation - example of the endemic vascular flora of the Balkan Peninsula
3. Radmila Stanković-Kalezić, S. Jovanović, Lj. Radivojević, V. Janjić, Phytogeographical analysis of the ruderal flora at the area of Pančevački rit
4. Stevanović, Janković, Vascular plants as indicators and hyperaccumulative heavy metals in soil, 2001

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SOME OF THE CHARACTERISTICS OF DEVASTATED AREAS' RECLAMATION

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ABSTRACT

In surface exploitation of coal degrades huge areas, which must restore to prior purpose in the process of technical and biological reclamation, after finishing the coal extruding. After done technical reclamation, there chooses cultures that will be grown in the purpose of biological reclamation. Those can be the areas meant for forests, orchards or vineyards and for crop-vegetable production. If soil is intended for crop-vegetable production, than determines a technology of these cultures growing, in order to improve productive capacity of soil and microorganisms' activity stimulation.

Key words: open pit, biological reclamation, productive character of deposol

INTRODUCTION

In last few decades, on the global level has been more expressed a battle for soil preservation. Major areas which are favourable for agricultural production have already been used, or turned into non-agricultural land, especially in developed countries. It presumes that in next hundred years all reserves of potentially agricultural land will be used, and in this same period, around 800 million ha will be lost from agriculture on the world level [10]. Therefore numerous countries have conducted and legally defined national strategies of environment protection and biodiversity[7]. Harmful effect of mining activities reflects in degradation of huge areas (open pits), disposition of hard waste materials (mine cover, barren soil and flotation barren soil). Disposition of big quantities of barren soil is especially characteristic for copper exploitation from sulphate ores t [4], degradation of areas by disposition of barren soil in surface exploitation of coal also represents a great problem.

Due to tendencies in change of utilization structure and a problem of agricultural land degradation, the strategic goals have to be directed to repression of further loss of land, preservation of its capabilities for agricultural production, especially in the fields where are represented industrial, energetic and mining activities.

The agricultural land in Serbia represents an important natural wealth in relation to many surrounding countries, not only for its size (more than 5 million ha), but also for its regional position. The combination of natural conditions (climate and relief) in this region enables making various productions in the field of agriculture. However, owing to enlargement of city settlements, industrial facilities, infrastructure, as well as for enlargement of open pits, communal (public) waste dump, the significant areas of agricultural land are lost.

In order to provide applied utilization, i.e. transformation of agricultural land in other purposes, it is forbidden by the law to use arable land from I to V cadastral class (ploughs, gardens, orchards, vineyards and meadows) in non-agricultural purposes. For areas which use in coal open pits, extruding of pebble and sand, disposition of barren soil, dross and other materials, it is necessary to provide an approval by the Ministry of Agriculture, which implies that the land used in mentioned purposes must rehabilitate by reclamation for agricultural production.

PRINCIPLES OF DEVASTATED AREAS RECLAMATION

There are many open pits, quarries, clay pits and similar areas, which significantly influence on degradation of, not only agricultural land, but also whole area where they are located. Electro-energetic facilities in Serbia, such as open pits for coal exploitation, other minerals exploitation, thermal power stations etc are located mostly on agricultural land, and their negative effect is much wider. Mining basin "Kolubara" is the biggest producer of coal in Electric Power Industry of Serbia. It develops its main activity on lignite reserves in Kolubara coal basin, which is located 60 km south-west from Belgrade and occupies 600 km^2. The open pits effect mainly to the change of relief due to notable land movements.

In order to avoid harmful consequences of open pits, after exploitation ending, that degraded land, should be reclamated. The concept of reclamation can be defined as a complex of mining-technical, engineering, melioration and forest works which have been done in certain period, directed to the transformation of industrially degraded land into a state favourable for use in agricultural and forest purposes, recreation, different ways of using water accumulations, capital and housing construction t [8]. The concept of degraded land reclamation by disposition of barren soil is the concept of land adhibition to a culture.

In Kolubara open pits have been degraded around 8.500 ha, and in Kostolac mines open pits – around 2.500 ha. Operations on the reclamation are negligible, because it is necessary to uncover big quantity of barren soil and put off in order to get to the coal. In surface coal exploitation huge areas degrade (about 1.800 ha per annum), which should be rehabilitated for various purposes in the process of technical and biological reclamation.

In the field B of Kolubara mining basin was raised an experimental orchard with 14 cultures (apple, pear, quince, plum, apricot, sour cherry, peach, hazel, almond, nut, domestic chestnut, strawberry, blackberry, raspberry) and grape vine. Many of these cultures have shown that they can grow successfully. In places where the barren soil's point of disposal was raised up to a top height there was not technically possible to

prepare the area for some kind of agricultural production, except for forest plantations. Therefore was reclamated around 1.200 ha in Kolubara open pits' point of disposal by forest plantations 870 ha and 300 ha under fruits. Besides these areas, there are also areas where technical reclamation was done and on which was possible to grow crop and vegetable cultures. With utilization of crop cultures in biological reclamation, it is necessary to raise a level of organic matter in, as short time as it is possible, by which increases productive capability of soil. The increase of productive capabilities of soil is possible to achieve by applying series of measures in technology of crop cultures growing (cultivation, fertilization, sowing method), by which would influence to improvement of soil structure, physical-chemical characteristics of soil, especially on porosity, air-thermal and feeding regime and therefore to micro-biological activity in the soil. The activity and mass of microorganisms in the soil is very important, while microbes participate actively in many processes, such as decomposition of fresh organic matter in a synthesis of specific organic compounds which participate in production of humus.

RESULTS OF SOIL CHARACTERISTICS ANALYSIS

The area where technical reclamation was done is located on the territory of the municipality Lazarevac, in the location – the field D Tamnava, with mild micro-depressions on altitude of 189-222 m. In the process of technical reclamation by mixing barren soil, surface humus layer and primary soil, which was not kept in natural form, has been made a new substrate – so called deposol or technogenic soil. The deposol has pedological characteristics of perturbated soil. Those are the soils, which, according to pedological profile, do not have differentiated horizons, but the profile consists of different contents layers. They are of very heterogenous granulometric content. The most represented is a fraction of small sand, while the fractions of silt and clay are equally represented, but lesser than the sand. Therefore can be said that the deposol is of sandy-clayey content. It is of medium compactness, i.e. more lax and of medium humidity, due to higher content of sand. The clay is yellow, laxly and water-permeable.

Agro-chemical characteristics of soil are important indicator of soil's condition and, among physical characteristics, one of the main pre-conditions for number and enzymatic activity of microbes. According to the results in table 1 can be seen that the soil is of mildly-acidic reaction. The level of basic fertility parameters (humus and total nitrogen) is on the bottom line of optimal values.

Table 1. Basic agro-chemical characteristics of soil prepared for reclamation

pH		**Humus**	**Total N**	**C/N**	**NH_4+-N**	**NO_3--N**	**Ca**	**Mg**	**P_2O_5**	**K_2O**
H_2O	KCl	%	%		mg.kg^{-1}		mg.kg^{-1}		mg.100g^{-1}	
7.56	6.70	1.21	0.14	5/1	12.6	10.2	4800	76.2	5.41	65.2
Optimal basic agro-chemical characteristics of arable land										
8.00	7.00	1-5	0.1-0.3	10/1	-	-	-	-	15-25	15-30

Source: official report of Eco-lab on analyzed soil

The content of phosphorus and potassium in the soil should be on the optimal availability level which is 15-25 mg.100g^{-1} for phosphorus and 15-30 mg.100g^{-1} for potassium. However, in the samples are determined quantities P_2O_5 5.41 mg/100 g of

soil, which are low and can be concluded that the soil is poorly available with this element. Such low amounts of P can be the result of potassium lack, which lack in soil solution can effect to low solubility of this element.

The content of heavy metals is illustrated in table 2, and in table 3 are illustrated their top allowed amounts, which can be found in soils in Serbia, defined in the Rule book on allowed amounts of dangerous and harmful matters in the soil (Official Gazette RS 23/1994). According to the results has been determined that the amounts of nickel were above top allowed, while the amounts of other heavy metals under top allowed ones. Determined amounts of nickel were 62.1 $mg.kg^{-1}$ which is for 12.1 $mg.kg^{-1}$ more than allowed (table 2).

The nickel in the soil can origin from master substrate, but also by anthropogenic way. Significant source of soil contamination is coal combustion, inserting waste mud. High concentration of nickel can be in some coals up to 70 mg/kg. However, the solubility of nickel and increased concentration in soil solution is a cause of increased soil acidity, i.e. lack of calcium. The assumption is that the nickel mobility in this part of soil is increased exactly by pH decrease and decrease of capacity for ion modification, because there is small amount of organic matter. The content of Ni in the soil can be very toxic for some groups of micro organisms. In accordance to the research t [5] Ni has inhibited in concentration of 2.0 $mg.kg^{-1}$ most of microbiological parameters, except *Azotobacter sp*.

Table 2. Content of dangerous and harmful matters in soil prepared for reclamation ($mg.kg^{-1}$)

Cr	Cd	Pb	Ni	As	Hg
37.3	0.51	37.3	62.1	2.6	<0.1

Table 3. Maximum allowed amounts of heavy metals according to the Rule book on allowed quantities of dangerous and harmful matters in soil and water for irrigation and their analysis methods (Official Gazette of RS 23/1994) ($mg.kg^{-1}$)

Cd	Pb	Hg	As	Cr	Ni	Fe	Cu	Zn	B
3	100	2	25	100	50	300	100	300	50

Figure 1. View of soil surface ready for setting up the experiment

The soil micro organisms give informative evaluation of toxicity and soil degradation. According to dynamics of their number modification, as well as enzymatic activity, can be given the evaluations on soil condition, about its fertility t [3]. Presence of some physiological and systematic groups of micro organisms in the soil is important, while they take part in herbicides dissolution, as well as capability for accumulation of heavy metals in their cells, by which they effect to decrease of dangerous matters amounts in the soil[6]. There are also important the measure by which increases their number and enzymatic activity, because it influences to increase of total nitrogen and balance of humus in the soil. The micro organisms make from 0,1 to 5% of whole organic matter of soil. Biomass of microbiological origin in formed soils amounts, in average, up to 5 t/ha[1]. The microorganisms participate in formation of soil, they participate in circulation of biogenic elements, do translocation and dissolution of fresh organic matter and take part in the processes of forming humus matters. The number and enzymatic activity in the soil depend on ecological factors of chemical and physical characteristics of soil, application of organic and mineral fertilizers, content of organic matter in the soil. Low number of some micro organisms groups and oxide-reduction processes, rendered as dehydrogenise enzyme activity, reflect decreased biological activity and thereby soil fertility, too.

Microbiological characteristic of soil were determined in accordance to some systematic and physiological groups of micro organisms, which have been determined on selective nutritious grounds (tab. 3). The basic parameters of soil biogenic, as well as enzymatic activity of soil, according to total oxide-reduction processes, which lead to organic matter mineralization level (dehydrogenise activity determined by Lenhard method (1956), modified by Thalmann) [9], which bases on measurement of 3-phenyl formasan (TTF) extensions, made by reduction of 235-5-phenyl tetrazoliumchloride (TTS). Due to number of some groups we can say that microbiological activity of soil was very low.

Table 3. Basic microbiological characteristics of soil prepared for reclamation

Type of soil	Total number ($x10^7$g zemlj)	Mushrooms ($x10^3$g zemlj)	*Actinomicetes* ($x10^3$g zemlj)	DHA μгTPFg^{-1} земљ.
Deposol 1	202.12	12.82	2.89	36
Deposol 2	252.17	8.76	1.02	108

Determined parameter of microbiological activity is in correlation with the content of humus and nitrogen in the soil. It is understandable, because most of micro organisms that live in the soil require organic sources of nutritive elements and energy for their needs, so the general rule is that the soils with more organic matter also contain more micro organisms and *vice versa t* [2].

CONCLUSION

According to got results can be concluded the following:

- Parameters defining fertility are on the bottom of optimal values margin,
- For reclamation of this land is necessary to conduct some measures in correcting certain characteristics,

- It is recommendable that in sowing technology would be represented leguminous sorts,
- It is necessary to determine carefully the sorts and fertilizers quantity, which would be used in technology of selected plants growing,
- Surely the organic fertilizers such as manure, compost, greens fertilizers with application of microbe inoculates with nitrogen-fixers must be represented.

Experiences acquired in similar environments are not possible to apply by simple reproduction of applied methods, while the conditions in most of mine activities are specific and the best approach is looked for, adjusted to each concrete case.

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REFERENCES

1. Alexsander M (1990): Introducion to Soil Microbiology, Krieger Pub Co
2. Bo L. Gumpertz M.L. Shuijun, H., Ristaino J. B. (2007): Long-term effects of organic and syntetic soil fertility amendments on soil microbial communites and the development of southerm blight Soil biology biochemistry Vol. 39, No9. 2302-2316
3. Doran, J.W., Safley, M. (1997): Defening and assessing soil helth and sustainable productivity. In: Pankhurst C E (ed.) Biological Indicators of Soil Health, CAB International New York, 1-28
4. Dožić S., Đukić M., Bogdanović G., Stanojlović R., Lukić S., Đunisijević-Bojović D., Bjedov I. 2010. New approach to the reclamation of the old flotation tailings in Bor. Bulletin of the Faculty of Forestry Гласник шумарског факултета, Београд, 2010, бр. 101, стр. 35-48 BiblID: 0353-4537, (2010), 101, UDK 630.233:630.114.449.8(479.11 Bor) DOI 10.2298/GSF1001035D pp 35-48
5. Miloševi, N., Govedarica, M., Kastori, R., Petrović, N. (2002): Effect of Nickel on wheat plants, soil microorganisms and enzymes. Biologia 47: str. 177-181
6. Milošević Nada, Petar Sekulić, Gorica Cvijanović (2010):Mikroorganizmi kao bioindikatori zagađujućih materija u zemljištu, Ratastvo i povrtarstvo Institu za ratarstvo, ISN 1821-3944, UDK: 631/635(051) 2010:47 (1) str 49-55
7. Nielsen, M.N., Winding, A. (2002):Microorganisms as indicators of soil health, National Enviromental Research Institute. Tehnical report, N0 388 1-86, Denmark
8. Моторина И.В. (1975): Опит рекултивации наручвених промисленич чландшафтовв СССР и зарубежнич странач, Обзорнаја информациа, Москва
9. Thalmann A. (1968): Zur Methodik des Bestimmung der Dehydrogenase Activat in Boden Mittles Triphenyltetazoliumhlorid (TTC). London. Forch 21, 249-258,
10. Vučić, N. (1995): Higijena zemljišta, Vojvođanska akdemija nauka i umetnosti, Novi sad , Knjiga 6 YU ISBN86-81125-12-5

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PROBLEMS OF RURAL DEVELOPMENT FINANCING IN SERBIA

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ABSTRACT

Serbia is one of the most agrarian European countries. About 80% of its territory is made up of rural territories in which half of the population lives. In Serbia, nearly 40% of rural households are very poor. State of the economy and social infrastructure in many rural areas in Serbia is bad. Opportunities for employment and development of entrepreneurship are limited. Poverty is a significant and persistent problem. Financing of agricultural production is a major problem of agricultural policy. The funds allocated from budget are insufficient and the bank loans are unfavorable for the further development of rural Serbia.

Key words: rural development, agriculture, economy, financing, loans

INTRODUCTION

The concept of rural development can be found in the theory of economics and economic practice over several previous decades. Rural development originated as a response to the problems connected with intra and inter regional inequalities in the degree of economic development and it has served as a (suitable) concept for a more complex analysis of development potential within rural areas.

By definition, the Organization for Economic Cooperation and Development (OECD), rural areas cover 85% of the total territory (population density below 150 inhabitants per km2), and 10% of the territory is occupied by more than half of the population (55%) of Serbia. According to this definition, 130 municipalities can be defined as rural, and they cover 3904 villages. In rural areas the most concentrated natural resources come from the rich ecosystems and biodiversity, significant human resources, economic activity and cultural heritage. Deep changes have occurred in all the spheres of life in rural regions of the Republic of Serbia. "Extinction of villages" represents the most visible and most dangerous sign of changes in a long-term sense. It is the matter of demographic emptying, in particular, when it comes to villages, that are at larger distances from urban centres, namely those that are poorly connected with such centres as regards communication. In such villages, as a rule, only the oldest remain, and they are insufficiently motivated for innovations and modernisation. They are not capable of designing the future. There are about 4800 villages in Serbia today [1].

The EU has recently developed two sets of baseline indicators: the Context Related Baseline Indicators and the Objective Related Baseline Indicators (DG-Agri, 2006a). These are founded on a comprehensive understanding of the international research in this area and seek to capture the structure and functioning of rural areas through the monitoring and evaluation of key social, economic and demographic data. The baselines incorporate data pertaining to nine broad dimensions including demography, geographical characteristics, economic structures, employment patterns, human capital, agriculture, tourism and infrastructure. These data do not constitute a typology in themselves, but stem from the need to develop more effective and efficient programmes and measures through evidence based planning. Development of the baseline indicators assists in this as it facilitates comparative assessment of the challenges confronting sustainable rural development at sub-national levels [2]. Ranked very low in rural life, which includes 85% of Serbia's territory and 55% of the population in general is bad, but far more bearable in the north compared to the west, and especially Southeast Serbia are reduced to the status of "rural Cinderella". Serbia recorded a long tradition of policy failures in regional and rural development, in which the dominance of structural and sectoral spatial criteria led to the irrational distribution of the regional economy and population and the large polarization in the level of development between different regions, municipalities and rural areas in their surroundings.
In Serbian villages, 37.8% of households have incomes below the poverty line, and the risk of poverty is greater in households whose existence is related solely to agriculture, according to a research made by NGO Group for Development initiative SeConS. GDP per capita in rural areas is 74% of the national average and significantly below the GDP per capita in urban areas. The rural population faces a high degree of poverty; approximately one million people in rural areas live below the poverty line with a 2$ / day [3] .

IMPORTANCE OF AGRICULTURE FOR DEVELOPMENT OF SERBIA

Agriculture and food industry of Serbia is the backbone of economic activity and is the only economic area, in addition to the military industry, which generates a surplus in foreign trade. All other economic areas realize the trade deficit and cause the increase in debt levels.Last year was marked by high liquidity, and agriculture requires a different approach to funding. According to statistics, the situation was slightly better than in 2009, but when you look at the reality, it shows that we are still in deep crisis that was generated by not applying measures of economic development in the medium and long term. This is the time when there is need to carry out substantial reforms that have been delayed because there are no insoluble problems. For us, there is a long overdue in this work. In all of this, the important link is agriculture, which requires a different approach to funding. It is a branch of a surplus, and therefore it is necessary to have better access to financing system and a different attitude by adopting laws on cooperatives, which would include minor holdings and fragmented production. Agricultural activity has significant natural and human resources [4].

The share of agriculture in the realization of GDP of Serbia is more then 40 percent of the country's GDP. However, the industry is facing many problems.

Insolvency is somewhat alleviated by government action credits, but there are still delays in payment, billing customers and suppliers, and public companies and large retail chains slow to pay firms from 120 to 180 days [5].

When it comes to agriculture in 2010, according to data of the Statistical Office, the gross value of agricultural production is estimated at 5.13 billion dollars, which is 0.56 percent less than realized in the last year. At the same time, the net realized value of agricultural production from the amount of $ 4.1 billion decreased by 1.62 percent compared to 2009. However, that is the thing that agropolicy makers do not understand. Agriculture is a sector that has a surplus with the world, and it is the fastest in returning the money, and every penny invested in agriculture brings five new ones. For this, the government remained deaf.

FINANCING, THE PROBLEM OF AGRICULTURE

Financing of agriculture at the moment is the most important issue of agricultural policy. So far the state has proved to be a decisive factor in the creation of monetary and credit policies and was the main factor in the financing policies of Serbian agriculture. However, this impact is still not enough.

The investment policy priority should be to have programs that provide cost-effective production, profitability, as well as to meet the criteria to eliminate the countries deficit, to participate in the increase of export and the revival of the village. These are three criteria that should be the basis for priorities determination. In addition, we need a Serbian Development Bank, and new agricultural bank, so that agriculture can participate in the overall manufacturing investment with at least 20 percent. Today it is only 0.7 percent. With existing loans in agricultural production, mortgage loans should also be used, which with no doubt would increase the volume of investments and would contribute to greater accountability for the appropriate use of funds. In addition, the cooperative must be established so that in addition to equity investment in their establishment the guarantee is provided, thus creating greater security in financing agriculture [6].

In addition, the dependence of other factors on agricultural finance is the result of inadequate agricultural policies in the past, because this sector of the economy had been put in a difficult situation. The absence of measures of development policy for agriculture and the tendency toward European integration, however require systematic approach to state intervention in order to remedy this situation.

The issue of agricultural financing can be almost equal to the issue of financing of rural development in our country. Namely, if one bears in mind that agriculture is the dominant activity in rural areas, then this fact is a confirmation of earlier testimony.

As a significant problem in the financing issue that requires a complex solving approach is the ownership structure fragmentation in our agriculture, because it diables the use of modern agricultural technology, low productivity and competitiveness are oresent, and how income lags behind that of the economy, there is a village and agriculture abandoning.

Our agriculture uses loans, not just in manufacturing but also for keeping inventory which further increases the price of its products, because it extends the setting

time of funding. Practically, in agriculture, goods are placed in stocks and they are distributed throughout the year. This means that we should also fund supplies, and they last until next year, until a new cycle of production is finished. With financing of crop production this process takes up to two years, in animal husbandry is longer, and it is especially a long period in fruit plantations.

Analysis of the funding sources in agricultural production

Loans for productive agricultural activities can be obtained using any of the three sources of credit:

1. loans of the Ministry of Agriculture, Forestry and Water Management (MAFW) - as top source of farm loans because the interest rates on these loans are more favorable compared to other interest rates. In order to attain the credit of the Ministry of Agriculture, Government of the Republic of Serbia adopted a Decree on establishing the program of measures for the financing of agricultural production in 2009. Regulation allows registered farms to reach short and long-term loans from the budget on favorable terms, but also stimulate commercial banks to engage in the financing of primary agricultural production. Last year (2010) Serbian Ministry of Agriculture has signed contracts with 20 banks on short and long-term loans for agricultural production;

2. bank loans - are unfavorable, as they have high market interest rates, strict selection borrower, high requirements for securing loans, the low priority given to agriculture in its business and credit policies, high cost of supporting activities in the loan approval procedure. However, provision of favorable credit conditions is a key precondition for dynamic restructuring of agriculture and improvement of overall rural economy. The main problems in the use of loans for agricultural sector are:

- Farmers do not trust the banks,
- Lack of experience and expertise of farmers in developing business plans,
- Interest rates are too high and mostly indexed in euros,
- Farmers can not provide credit guarantees - incomplete cadastre, the lack of credit history of farmers,
- The uncertainty of the agricultural market is a major obstacle for wider bank's support to farm manufacturers,
- Non-harmonized legislation and an underdeveloped market of agricultural futures contributed to the fact that securities for agricultural products can not serve as a guarantor for loans,
- Banks have high fixed costs of approving and monitoring loan repayments,
- Lack of expertise and experience of banking staff in dealing with farmers,
- In the evaluation of agricultural business plan, banks are focused on large enterprises and farms, while their interest in cooperating with small producers is negligible,
- Establish better cooperation between banking sector and farmers,
- Establishing an efficient financial market tranquility of the needs of the agricultural sector is a process that requires further institutional and organizational adjustments;

3. loans from local self-government bodies - are also intended to registered farms, and credit conditions are identical with the conditions of long-term loans of the Ministry of Agriculture. Local governments in many municipalities in Serbia set aside part of its budgetary resources for agriculture development, and the funds are distributed to public tenders or direct allocation based on defined criteria [7].

Starting from 2004, MAFW in collaboration with the Ministry of Finance tried to improve credit conditions for farmers by giving them credits from "agricultural budget". Currently, financial markets in agriculture includes the following sources:

1. The agricultural budget support,
2. Loans by commercial banks on the basis of guarantees (mortgages, guarantees)
3. MAFW loans,
4. Leasing companies that allow the replacement of old farm machinery,
5. Development funds
    a. the Development Fund of the Republic of Serbia
    b. the Guarantee Fund of the Republic of Serbia
    c. the Development Fund of Vojvodina
6. Budgets and funds LG (Local Government) [8].

MEASURES FOR RECOVERING SERBIAN AGRICULTURE

Some of the important measures to be taken by the state for the recovery of agriculture are:

- the agricultural budget needs to be10 percent of the total budget, because it participates directly or indirectly, to 40 percent in the creation of budget,
- the establishment of specialized agricultural banks,
- providing premiums for those who produce and deliver products and
- adoption of the Law on Cooperatives [9].

We must have better access to financing system in Serbian agriculture and a different attitude by adopting laws on cooperatives, which would include minor holdings and fragmented production. That was proposed by Serbian Chamber of Commerce at the request of food manufacturers. That this was done everyone would feel better. Doing this will take some time to prosperity. A food manufacturers have a huge untapped potential in almost all agricultural sectors. Striking fact is that in Serbia there is an increasing number of unsown areas (in 2009 there were about 600,000 hectares). Speaking about the measures to stabilize food prices, which represent only a consequence of poor economic policies, we strongly believe that the cause is in the inappropriate agricultural budget for 2010. This is why even harder time is waiting for us in 2011 with a budget that will be only 22 billion dinars [10].

Agricultural budget has been selective, and only registered private households had a right to state incentives, and economic entities which are legal entities did not have this right. And with the fewer and fewer registered farms, there is little incentive for greater production. A promise has been made that in future all food producers should be

equal. Republican budget was restrictive to the agricultural budget, and Serbian agriculture could not be competitive in the region. Investment in agriculture in recent years per capita was $ 29, which in the EU amounted to six times more!

When we are talking about the disappearance of the Serbian village, because of 4600 villages (excluding Kosovo) every fourth is disappearing, and 86 percent of their population declines, we must point out that the return to the village creates a chance of getting a job in and around agriculture. Especially for those with estates, but who have no job and got severance pay.

Return to the village should contribute to the development of underdeveloped areas and bring them closer to the developed countries. In recent years the ratio was 1:22. Commenting on a new level of agricultural budget for 2011, we must conclude that this budget is not developing and that agriculture remains in the very low ranks. Association of the economy continue to believe that the agricultural budget should number to 10 percent. We expected five percent to be accepted immediately, and that the other five percent raises each year by two percent to the percentage reached by 2015. However, it is obvious that, even this time, agroeconomical policy makers did not want to hear the voice of food producers, peasants who for the first time in the last 20 years are absent from the Serbian parliament.

CONCLUSION

In recent years the amount of funds to support farms in the so-called "agricultural budget" noted a decreasing trend (in 2004 it was 4%, and in 2010 it was 2.3% of the national budget). Starting from 2011 it is necessary to ensure a level of so-called "agricultural budget" in the amount of 5% of the national budget with an annual increase of shares from 20% to achieving a level of 10% of national budget expenditures in 2015.

In terms of nominal and real decline of the agricultural budget, a large number of agricultural holdings in the status of individuals (estimated to be approximately 400,000 households) is already on the edge of existence and the question is how to establish production in the next production year.

The number of land owners who will experience their fate in the coming years is difficult to predict. All this represents an extraordinary risk for a country that fails to absorb shocks in the transition to agriculture and the countryside. A new socially vulnerable group of farmers is created, a group that will continue to put pressure on social funds, since the missing of their working capital. Those who were once indebted and did not specifically allocated funds or had adverse climatic year, will no longer be able to repay loans that are already one or more times reprogrammed. It is followed by seizure and sale of the farmers' property for nothing.

By theirs nature, rural areas are remote and poorly connected with the world, and also less populated – which rises a price of infrastructure. If rural areas provide opportunities for employment in other areas, except in traditional agriculture, they will become an important segment of the market economy. This requires investment in roads, electricity, water, sewer, ambulance, schools. These investments will link rural areas with major urban centers. This may initially lead to the retention of young people in rural

areas. However, in the long run real effects in this area may be provided for new forms of rural employment. However, this does not mean that in rural areas we can provide conditions like in big cities. Moment requires an attempt to create atmosphere and encourage people to invest in local society.

REFERENCES

1. Nacrt strategije ruralnog razvoja 2010–2013, Ministarstvo poljoprivrede, šumarstva i vodoprivrede, (avgust, 2009), Republika Srbija,
2. Bogdanov N. (2007): „Mala ruralna domacinstva u Srbiji i ruralna nepoljoprivredna ekonomija" UNDP, Beograd
3. Ministarstvo za socijalna pitanja, Svetska banka - WB (2002/2003): Strategija za smanjenje siromaštva u Srbiji, (strategija za smanjivanje ruralnog siromaštva), Beograd
4. Plan strategije ruralnog razvoja 2009–2013, Ministarstvo poljoprivrede, šumarstva i vodoprivrede, (januar, 2009), Republika Srbija,
5. Bogdanov N. and Z. Stojanovic (2006), "The methodology of rural determination and identification of rural Serbia", in: Agriculture and rural development of Serbia in transition period, DAES, Belgrade
6. Janković D. (2005): Perspektive ruralnog razvoja u Srbiji, zbornik„Multifunkcionalna poljoprivreda i ruralni razvoj". Institut za ekonomiku poljoprivrede, Beograd
7. Stojiljković D. "Ruralna razvijenost i mogućnosti njenog merenja sa posebnim osvrtom na Ap Vojvodinu", doktorska disertacija, (2010), Novi Sad.
8. Stamatović M. and Vemić M. "(2009), The potential role of private investors in financing rural entrepreneurship and SMEs in Serbia", Novi Sad
9. Njegovan, Z. (2006): Održivo planiranje i upravljanje lokalnim razvojem, Ekonomski fakultet, Beograd i Institut za arhitekturu i urbanizam, Beograd
10. Koen De Rijck & Erg Boris, (2006): "High Nature Value farming in the Western Balkans: Final report of Workshop on High Nature Value farming in the Western Balkans", 2-3 February 2006, Belgrade.

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ORGANIC MATTER AND ARSENIC IN DRINKING WATER IN WEST COUNTY IN RELATION TO THE DEPTH OF WELLS

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ABSTRACT

Dinking water in West Backa District, Vojvodina, is drawn from the first and second aquifer. The waters are rich in organic matter and arsenic in which about 60% water has a concentration significantly higher than the norm. What is the source depth, the greater the concentration of both organic substances and arsenic and to move towards the Danube. Organic matter impede disinfection of water due to the formation of carcinogenic trihalomethanes. If we add arsenic and carcinogenic, and great potential for hazardous compounds between arsenic and humic substances, the inhabitants of Vojvodina were exposed to dangerous matter from drinking water which makes the need for solving this problem urgent.

Key words: drinking water, arsenic, organic substances, source depth

INTRODUCTION

Based on the content of organic matter, groundwater quality in the Republic of Serbia is uneven, ranging from those who are free to those in which the organic matter in large quantities. The quality depends on the source, or from wells and hydrogeological structure. The presence of humic substances is of great technological and medical importance because of the difficult process of disinfection and water treatment. Organic matter with chlorine build hundreds of products from which a number has not yet been identified. High pH values in particular enable the creation of carcinogenic trihalomethanes, which are created in waterwork, all while having residual chlorine. (Kringstad et al. 1985). In the waters of certain parts of the district Pliocene age, high consumption of $KMnO_4$ values. Natural organic matter, or humic acids, have a complicated structure and it is accepted that the lignin of plant tissues, which remains the longest not taken apart and the basis for the formation of humus. NOM (natural organic matter) are a combination of macromolecules that are long established and consists of a stable skeleton for which the associated variable number of inorganic and organic ligands. Defined as the product of heteropolycondensation of carbohydrates, proteins, fatty acids, lignins, tannins, etc.. Some geological formations containing naturally

formed inorganic arsenic compounds, which pollute ground water aquifers in high enough concentrations, can cause serious risks to public health.

First periodic inspections of drinking water since 2001. Arsenic has become topical in the area of West Backa District. Analyses that involve a number of parameters, when the new procedure (drilling of new wells) in the mid 90., were detected in higher values of arsenic, were confirmed in subsequent analysis in 10 different laboratories. Not uncommon for the pathology of drinking water in West district consists of complex organic matter and arsenic (R. Krstur, small breads, Lalic, other places Odžaci ....). It turned out that it is not easy to remove iron from the organic matter from drinking water, and their presence complicates the technology of removing of arsenic. Do you can count on in the waters that contain higher amounts of humic substances, we can expect a higher concentration of arsenic? It is known that humic substances may on different mechanisms to bind tightly but other organic and inorganic matter. Thus, humic substances can absorb pesticides which is then partially hydrolyzed under the influence of acidity of humic acid. (Perdue, 1983) We also know that there is incorporation of various phenols in soil humic acids. There are various types of interactions and various results of that in aqueous medium, to form a different association of different structure and stability (Peter Pfendt, 2002). Humic substances with polyaromatic hydrocarbons in partial oxidation of PAH produce esters. Some studies concerning the association of zinc with n-alkanes and it is believed that the correlation between zinc and alkanes result of the anaerobic digestion of biomass oxygen carrying the zinc, rather than the current association and the like. Ion exchange in water, is one of the fastest natural processes. Imitation in technological terms, we can reduce the presence of certain metals. (Miodragović et al. 1989) Organic matter with some cations, eg. Copper, build a huge number of different types of complex structure and stability which makes the interaction of humic substances, especially metal ions, is extremely complex. The result can be changes in properties of metals and their reduced toxicity. (Saar and Weber, 1982, Hering and Morel, 1988). High affinity for organic matter with ions of heavy metals, alkaline earth and alkali metals at the end.

OBJECTIVE

Objective of this paper is to establish a correlation between organic matter and arsenic in drinking water, to basic analysis of the account value $KMnO_4$ consumption, could assume the movement of arsenic? To a question what is the relationship between organic matter and arsenic in drinking water, with considering on biogeochemical cycles of elements and compounds? To what extent can move product toxicity, drinking water, rich in arsenic and organic matter? Or, if organic matter reduce arsenic toxicity?

METHOD

We used the results of analyses laboratory for the sanitary chemical Toxicology Institute of Public Health of Sombor which controls the quality of drinking water in West Backa district, and, according to the rulebook of hygienic quality of drinking water FRY Official Gazette no. 42/98 and 44/99). Method of determining arsenic by AAS, atomic

absorption spectrometry-hydride generation. Scoring is done using the calibration right. Atomic absorption spectrophotometer has the option of automatic reading of concentration from a previously saved data for calibration. MAC is 10 μg/L. Although based on the consumption of $KMnO_4$ can not fully determine the content of organic matter, it is possible to predict the organic load in the permanganate number. Legislation has used the consumption of $KMnO_4$ as a summary threshold organic load of drinking water and water stream categorization. According to the Regulations on sanitary quality of drinking water, water consumption of $KMnO_4$ can have up to 8 mg/L. According to this regulation shall be seemed that the water right in the event that the measurements are not consecutive in the year, and 20% of the value of $KMnO_4$ consumption reaches 12 mg/L. The values of the EU recommendation of 03.11.1998. year is 5 mg O_2/L (calculated from permanaganatnog number, which represents 19.7 mg $KMnO_4$/L).

RESULTS AND DISCUSSION

In the West Backa District has a total of 39 central waterworks or spring water and performed the installation, waterworks. Of them, seven legal personality, others manage the local community. According to the strategy Province since 2009. year, the plan is to organize the inter-municipal water supply and regional water supply systems, using existing sources and legal entities.

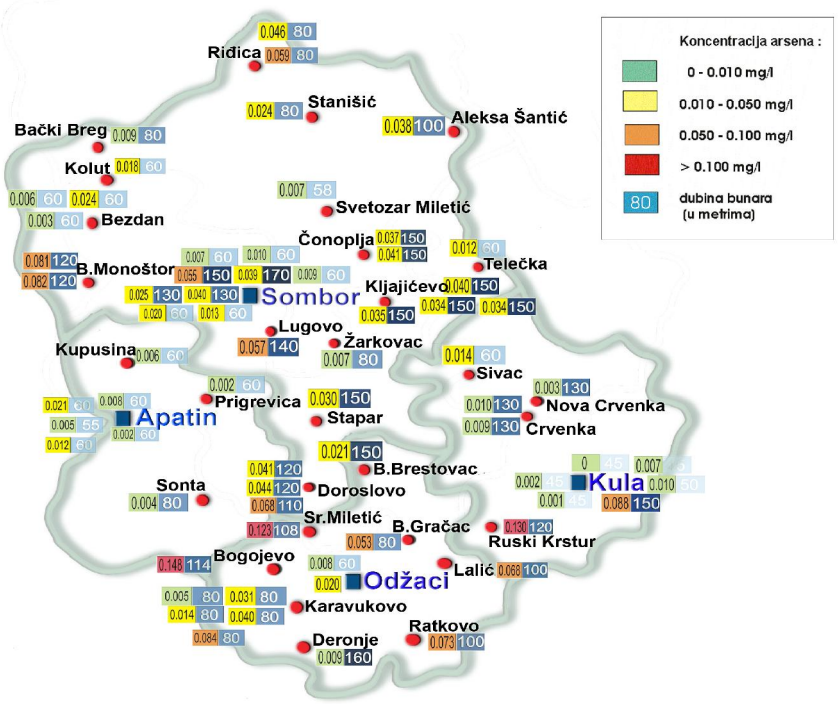

Figure 1. Site layout of individual water supply in ZBO with depth source

At Figure 1 we see that the deeper wells, second source aquifer deployed mostly along the Danube, stretching Odžaci and partly municipal Kula, in places that gravitate towards the river.

Table 1. $KMnO_4$ consumption values in mg/L and arsenic in μg/L for individual water supplies in ZBO

Place	$KmnO_4$	As	The depth of wells
1. Aleksa Šantić	5,66	**37,9**	**100**
2. Apatin	9,77	11,9	60
3. Bački Breg	7,86	9,5	84
4.Bački Brestovac	26,34	20,4	**150**
5. Bački Gračac	**13,78**	**53,2**	80
6. Bački Monoštor	**16,20**	**81,2**	**92**
7. Bezdan	10,73	23,6	60
8. Bogojevo	**22,18**	**148,0**	**114**
9. Crvenka	4,95	10,0	**130**
10. Čonoplja	3,85	**40,7**	**150**
11. Deronje	47,68	8,7	**160**
12. Doroslovo	**48,13**	**68,0**	**120**
13. gakovo	8,58	2,1	68
14. Karavukovo	**16,04**	**87,3**	80
15. Kljajićevo	4,26	**39,6**	**150**
16. Kolut	5,27	17,6	86
17. kruščić	7,52	**82,4**	**120**
18. Kula	4,65	10,3	45
19. Kupusina	21,66	5,6	60
20. Lalić	**10,59**	**67,6**	**100**
21. Lipar	4,55		**60**
22. Lugovo	**14,84**	**56,6**	**140**
23. Nova Crvenka	5,50	3,2	60
24. Odžaci	6,57	19,5	60
25. rastina	8,07	1,3	80
26. Ratkovo	**15,42**	**73,4**	**100**
27. Ridica	9,43	58,4	80
28. Ruski Krstur	**14,73**	**129,7**	**150**
29. Sivac	4,61	14,4	60
30. Sombor	8,74	10,3	60
31. Sonta	9,53	3,7	80
32. Srpski Miletić	**33,48**	**123,0**	**108**
33. Stanišić	6,3	23,9	80
34. Stapar	**19,78**	**29,5**	**150**
35. Svetozar Miletić	4,51	6,9	58
36. Svilojevo	10,1		60
37. Telečka	6,77	12,0	60
38. Žarkovac	18,45	7,1	80

On the table 1. have been presented results of consumption $KMnO_4$ in the mg/L, or concentrations of arsenics in the μg/L, as well as depths of single wells. Underground springs, are drilled wells, find on depth of 45 (Kula) to 160 (Deronje) meters, which means that in West Backa District taking the drinking water from first and second underground water-bearing beds.

In shallower wells, or first water-bearing bed is smaller concentrations of organic substances, of 3,85 the mg/L of consumption $KMnO_4$ (Čonoplja) and subsequent, second water-bearing bed is rich humic substances, 48,13 the mg/L (Doroslovo). Depth of well follows the concentration of arsenics which also has in the larger concentration in deeper wells, to 146 µg/L (Bogojevo) or 2,1 the µg/L (Gakovo) in shallower wells.

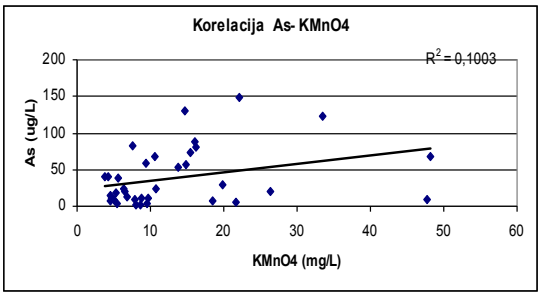

Figure 2.. Relation between $KMnO_4$ and arsenic

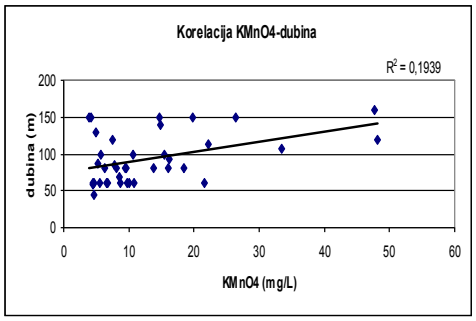

Figure 3. Relation between $KMnO_4$ and depth of well

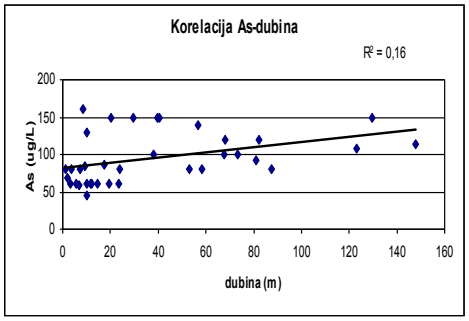

Figure 4. Relation between arsenic and depth of well

Relationship between arsenics and $KMnO_4$ is in the positive correlation, or organic substances writes to with the arsenic (Fig.2.). In waters enriches humic substances, with the right can expect and arsenics which makes difficult their pathology and makes complex processing technology these waters. What all chemical compounds can yet to expect with respect to their interactions, can that confirms the only high sophysticated analytics. Concentrations of arsenics and consumptions $KMnO_4$, or organic substances in the correlation is with the depth of well. In deeper wells expect larger concentrations of arsenics and organic substances (the Fig.3. and 4.).

Do not forget that in our country practically has been prohibited the first water-bearing bed for the use as drinking water because of the potential microbiological contamination, as well as because of limited the capacity. This means that is the population of Vojvodina, around 60 %, is refered to second water-bearing bed which therefore, abounds in humic substances, arsenic and their chemical compounds.

The just such condition speaks about urgencies solving problems of qualities of water potable in this our region whereon last years seriously works and with the aid Agencies for the reconstruction EU.

CONCLUSION

Drinking water in waterworks of West Backa administrative division whose springs at second bearing bed, contains in some waterworks significantly larger concentration of organic substances and arsenic.

Amounts of arsenic and organic substances correlates with the depth of well. The many world research speaks about the reaction and possibilities of creations of complex chemical compounds between organic substances and inorganic, by the fact itself and arsenics.

In waters in which has the increased consumption $KMnO_4$, with the right can that expect and the increased amount of arsenic.

Pathologies of drinking water of Vojvodina are complicated, water is risky on the health of population and the problem must be solved, as soon as possible.

REFERENCES

1. B. Dalmatia, I. Ivančev Tumbas, Natural organic matter in water, University of Novi Sad, Faculty of Natural, Department of Chemistry, Novi Sad, 2002.
2. B. Dalmatia, control of water quality in the Quality Management, University of Novi Sad, Faculty of Science, Institute of Chemistry, Novi Sad, 2000.
3. B. Dalmatia, T. Knezevic, Z. Cukic et al., Quality of drinking water-recommended standards and norms, the Federal Office for Protection and Promotion of Health, 1996.
4. Hering JG, Morel, FMM, Kinetics 0f Trace metal complexation: Role of Alkaline-Earth Metals. Ibidem, 22 (12), 1988.
5. Kingstad, KP, de Souss, F., Stromberg, LM, Studies on the Chlorination of Humic Acid and Chlorolignins. Ibidem, 19 (5), 1985.
6. Ljiljana Sokolova Djokic, Arsenic in groundwater and the impact on the environment, the master's thesis, Pine, 2006.
7. Miodragović, Z., P. Polic, Pfendt, P., Methanol-Soluble Fractions of Organic Matter Alluvial. Correlations with Zinc J. Serb. Soc. 54 (6), 1989.
8. Perdue, EM, Rodicck, FA and Snow, R., Removal of dissolved organic compounds in fixed-bed columns: evaluation of jow-rank coal adsorbents, Water Researsch, 35 (12), 2001.
9. Pfendt, PA, Vucelic, D., Begovic, B., Spasojevic, M., Jankovic, B., Influence of Polycarboxylate PC-5 on Cooper and Zinc Distribution on Activated Sludge Aerobic. I. Regional Symposium "Chemistry and the Environment", Vrnjacka Banja, Proceedings 1, 1995.
10. Saar RA, Weber, JH Lead (II)-Fulvic Acid Complexes. Conditional Stability Constnts, solubility, and Implications for Lead (II) Mobility, Ibiden, 14 (7), 1980.
11. Regulation on the hygiene of drinking water, Fig. FRY no. 42/98.

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PROJECT SOLUTION OF WASTE WATER TREATMENT PROCESS IN TECHNOLOGY OF MILK PROCESSING

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ABSTRACT

Technological process of milk processing has resulted in the creation of the various components that may end up in wastewater. Wastewater quality depends on their origin. Each of the generating units of the technological process produces its waste waters, which differ from others according to their quality. Therefore, it should be noted that any problem in this area must be specifically processed and tested in order to determine the specific conditions of collective wastewater treatment. In this sense, the paper presents the project solution of the plant for pretreatment of collective waste water from the technological process of preparation and processing of milk.

Key words: milk processing, waste water treatment

INTRODUCTION

The structure of technological processing of milk can involve the following:

- units for preparation, pasteurization and milk packaging;
- units for cheese production;
- units for the production of butter and kaymak (creamy diary product);
- units for the production of milk powder.

Also, the technological process of milk may contain other plants, depending on specific conditions, demands and opportunities of particular industries.

Each of the above mentioned generating units produces its wastewater which is different from others by its quality. From the units for pasteurization of clean milk, we can obtain only washing water which corresponds to diluted milk. It is important to emphasize that there are periods when this kind of water is extremely acidic or alkaline, due to the use of nitric acid and soda for pasteurizer washing and other appliances. After the processing of milk into butter or cheese, the rest of it is whey (milk plasma) - it is waste water with traces of casein, lactose, protein and fat. The plants for the production of cheese and casein also produce a serum which contains much lactose, but little albumin.

Whey and milk serum contain high concentrations of biodegradable organic pollutants. Biochemical oxygen consumption ($_{20°C}BPK_5$) ranges from 20000 mg/l to 40,000 mg/l. Whey and milk serum are mostly recuperated and are typically used as animal feed, while and only water from washing is transferred to the industrial purification process. Otherwise, if whey and milk serum would proceed with waste water, a more complex and expensive plant should be applied. A plant would include a process of controlled anaerobic decay, and aerobic processes as well (bio-aeration pool or bio-filter). One of the particularly undesirable components that may occur in waste water of milk processing technology is lactose.

If wastewater does not contain enough oxygen that would allow aerobic decomposition, lactose is transformed into lactic acid. In this case the waste water becomes sufficiently acidic, the casein got deposited and as a result of excessive acidity, it begins create very strong and unpleasant odours. This points to very different quality of waste water from the plant for milk processing, which should certainly be considered when choosing the technological scheme for treatment of plants.

EXPERIMENTAL PART

Organic pollution from $_{20°C}BPK_5$ created by a technology of milk processing, can be approx:

- all the devices for the preparation and processing of milk: 150g $_{20°C}BPK_5$ to 100 l of processed milk per day;
- plants for the production of butter imately estimated as follows:
- and cheese: > 5 kg $_{20°C}BPK_5$ per 100 kg of produced butter or cheese
- plants for condensed milk: 500 g $_{20°C}BPK_5$ per 100 kg of condensed milk.

Basic qualitative and quantitative characteristics of typical waste water from various facilities for the milk preparation and processing are given in Table 1.

Table 1. Basic qualitative- quantitative characteristics of waste water from the unit for milk preparation and processing

Qualitative-quantitative characteristics	**Type of drive (unit)**					
	Pasteurization	Bottle packaging	Cheese production	Butter production	Buttermilk production	Milk powder
Quantity of waste water in litres per 1000 pounds* of processed milk	795,1	1136	909	500	681,5	681,5
Total solid matters (mg/l)	1141	1483	1528	2422	2793	2407
Suspended soilds105^{O}C (mg/l)	-	536	751	664	754	-
$_{20°C}BPK_5$ (mgO2/l)	509	567	998	1246	1291	485
pH - value	-	5,3	7,0	7,7	7,8	-
Composition of waste water	milk, water from milk washing	milk, water from milk washing	whey, casein, water from milk washing	processed milk residues and water from milk washing	rotten milk, water from milk washing	rotten milk, water from milk washing

** 1 pounds = 453,590 kg*

The amount of water for washing the equipment for milk preparation and processing is about 6 liters of water per 1 liters of milk processing. The organic load for $_{20°C}BPK_5$ per each 1000 liters of milk to be processed corresponds to 30 ES.

In addition to these characteristics of waste water of milk industry (biodegradable organic pollution - $_{20°C}BPK_5$, suspended matter at 105^oC, precipitated solid matter per 2 h by Inhoff and pH value), there are significant concentrations of the ammonium ion, oil and grease and total organic pollution (TOP). Biodegradation of total organic pollution (the ratio is $_{20°C}BPK_5$/TOP) in wastewater of dairy industry is large, often 70% or more, which refers to the use of biochemical aerobic purification, including the recuperation of whey and milk serum.

Technological schemes of plants for collective waste water treatment from the technological process of milk processing (including the recovery of whey and milk serum) usually contains the previous (sifter, equalization pool), primary (flotation, coagulation and flocculation with sedimentation) and secondary (bio-filtration with sedimentation) treatment.

Fine filter (sifter) is used for straining of water which involves the removal of raw materials from the production technology and protective equipment (flow meter, pump, etc.) in the plant.

Equalization pool is used for the equalization of qualitative and quantitative characteristics of waste water from different units of a diary plant. Since suspended solids and anaerobic processes cannot be deposited in the equalization pool, the system of stirring must provide sufficient quantities and great power of stirring.

Intensive physical-chemical treatment contains air flotation reactor with coagulation with the help of $FeCl_3$ i $Ca(OH)_2$ and primary sedimentation which takes about 1.5 hours in the primary cylindrical conical tank. The ratio of optimal amounts of chemicals for precipitation and the amount of waste water is as follows: 1 liter of 0.01% whitewash and 1 liter of 0.003% of ferric chloride solution are added to 4 liters of waste water. The efficiency of removing organic pollutants from $_{20°C}BPK_5$ is 90% or more, which can fully satisfy the criteria for draining the waste in the city sewage system (pretreatment) or in the rivers with minor ecological requirements (Class 3 and class 4 rivers).

Figure 1 shows the technological scheme of the plant for pre-treatment of collective waste waters from milk preparation and milk processing industry.

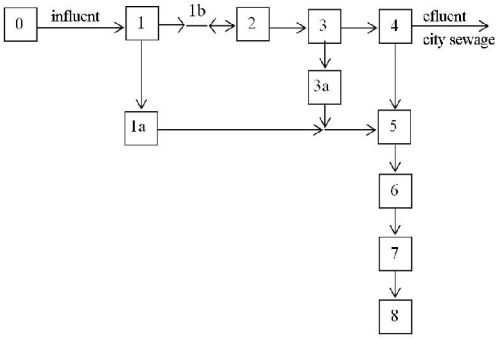

Figure 1. Shows the technological scheme of the plant for pre-treatment of collective waste waters from milk preparation and milk processing industry

Water lines:

0 - technological process for the treatment and processing of milk (polluter); influent - raw waste waters from the technological process of milk preparation and processing

1 - Fine filter (sifter) for removing the material from the technological process and safety of the equipment in the plant (flow meter, pump, etc.)

1a - the container for the material was removed by the sifter which has been processed on a mud line;

1b flow meter;

2 - equalization pool for the equalization of qualitative - quantitative characteristics of aggregate waste water; equalization pool containing equipment for mixing, ie. blowing enough air to avoid the deposition of suspended solids and anaerobic processes;

3 - reactor for intensive physical - chemical treatment where air flotation is performed, with the addition of $Ca(OH)_2$ i $FeCl_3$ for coagulation and sedimentation;

3a - container for flotation treated material that is processed on a mud line;

4 - primary cylindrical - conical clarifier made of steel, and effluent - purified wastewater from the technological process of preparation and milk processing, which are being is discharged into the city sewers..

Sludge Line:

5 - sludge thickener;

6 - conditioning of sludge with $FeCl_3$ and organic polyelectrolytes;

7 - stabilizing sludge with whitewash ($Ca(OH)_2$) and

8 - disposal of stabilized sludge to the landfill.

Figure 2 shows the technological scheme of the plant for full treatment of collective waste water from the dairy industry with bio-filtration as the main process.

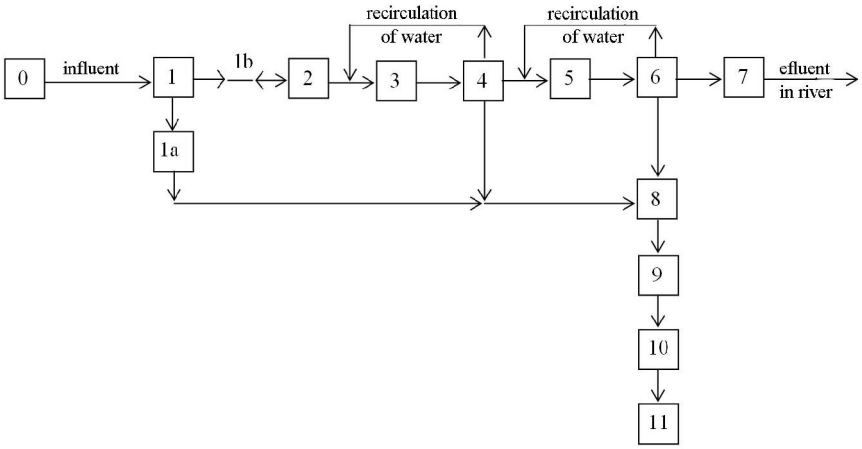

Figure 2. Technological scheme of the plant for full treatment of collective wastewaters from milk industry with biofiltration process

Water lines:

0 - technological process of preparation and processing of milk (polluter),

Influent water – raw water from a treatment plant for milk preparing and processing

1 - Fine filter (sifter) for removing the material from the technological process and safety of the equipment in the plant (flow meter, pump, etc.);

1a - the container for the material was removed by the sifter which has been processed on a mud line;

1b flow meter;

2 - equalization pool for the equalization of qualitative - quantitative characteristics of aggregate waste water; equalization pool containing equipment for mixing, ie. blowing enough air to avoid the deposition of suspended solids and anaerobic processes;

3 - primary biofilter with slag filling;

4 - primary sludge tank with a pump used to re-circulate water for re-treatment in the primary biofilter, since the sludge is processed in the mud line;

5 - secondary biofilter filled with slag;

6 - secondary sedimentation tank from which it is using a pump of the water re-circulated for re-treatment in the secondary biofilter, while the sludge processed and leads to the mud line;

7 - pool for waste water chlorination and effluent - purified wastewater from the technological process of preparation and processing of milk, omitted into the natural recipient (the river).

Sludge Line:

8 - sludge thickener;

9 - sludge digester (anaerobic composting and biogas as a final product);

10 - field for drying stabilized sludge;

11 - disposal of sludge (the use of stabilized sludge in agriculture).

RESULTS AND DISCUSSION

Project solution for the pretreatment of collective wastewater from the technological process of milk processing is satisfying, which enables intensive chemical treatment. However, due to the use of chemical agents ($Al_2(SO_4)_3$, $Ca(OH)_2$) and the lack of active sludge biomass, the obtained sludge cannot be fully valorized into biogas. Stabilization with whitewash allows the increase of pH value, which prevents decay of the sludge and the development of pathogenic microorganisms. Such product can be applied in the construction industry.

Biological filters with recirculation of certain amount of waste water while installing double biofiltration are used in the project solution for wastewater treatment in technological milk processing. In this way, intensive physical-chemical treatment is not applied directly in the plant, while chemicals for deposition and energy required for air flotation are saved.

Biological filters with moving nozzle are used often, although filters with fixed nozzles are usually applied in smaller devices. However, especially in the plants for milk preparation and processing, bio-filters with movable nozzle proved to be more suitable.

The efficiency of a bio-filter on the basis of $_{20°C}BPK_5$ depends on the medium (fill), or the type of material (gravel, spiral rings, stone, quartz sand, etc.) ranges from 80% to 90%. Research with different filter - media showed that the best efficiency for removing is $_{20°C}BPK_5$ obtained by slag, which allows the removal of $_{20°C}BPK_5$ is up to 99%. All other materials provided $_{20°C}BPK_5$ decrease about 90%.

Of course, before using the filter, a certain amount of sewage sludge must be added (it should be sludge from a nearby plant for waste water treatment with mostly organic pollution, so that the culture of bacteria should be developed into a new filter. Those bacteria will form the appropriate biological environment necessary for effective treatment. Filter maturation lasts for two or three weeks, after which the filter is capable for effective treatment.

CONCLUSION

Respecting science and profession, and in line with contemporary trends of treatment of waste water from milk processing industry, this paper provides a comprehensive characterization and project solutions to the level of being discharged into the city sewage system (pretreatment) and complete treatment that allows recycling of organic pollution with a tendency to use safe technologies. Significant biodegradable organic pollution ($_{20°C}BPK_5$) has been determined after the deposition was transformed into the mud. Sludge treatment by anaerobic processes produces a bio-gas which is the environmentally friendly fuel, and a stabilized sludge which is used in agriculture as a fertilizer.

REFERENCES

1. Stanisaljević M., Technologies for waste water and industrial hazardous waste treatment, p.p. 531-538, High Technical School of Professional Studies, Požarevac, 2010
2. Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, p.p. 1112-1126, McGraw-Hill: New York, San Francisco, St. Louis, International Edition, 2003
3. Mohseni-Bandpi A., Bazari H., Biological Treatment of Dairy Wastewater by Sequencing Batch Reactor, pp.65-69, Iranian J Env Health Sci Eng, Vol.1, No.2, 2004

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ECO-CHEMICAL STATUS OF THE BARJE RESERVOIR IN TERMS OF WATER QUALITY INDEX PARAMETERS

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ABSTRACT

The protection of the environment and sustainable use of water resources is a primary task that implies constant monitoring of the quality status and evaluation of eco-chemical status of the water. On the example of Barje reservoir, this paper presents a calculation of all-inclusive water quality by the SWQI method and assessment of eco-chemical status of water within the parameters of water quality index for the year of 2009.

The starting point of the monitoring of quality and eco-status of Barje reservoir is the Data Fund of the RHMZ of Serbia for the year 2009 and the selection of the quality parameters for the index method. The results show that the overall quality of the Barje reservoirs water corresponds to the descriptive index of "*good*" water. According to the *Council Directive 75/440/EEC*, the evaluation of the eco-status corresponds to A1 Category of the surface water quality intended for abstraction for drinking water supplies in member states.

Key words: Eco-chemical status, Barje reservoir, SWQI

INTRODUCTION

The evaluation of the quality and eco-chemical status of surface water intended for abstraction for drinking water, the pollution problem and environmental protection must be given special attention. Commitment to the use of surface water resources for the supply of drinking water depends primarily on the quality of raw water, a distance of industrial and other pollutants, the risk of accidental pollution, the capacity of the source and duration of transport treated water to consumers.

The accumulation lake Barje, with the total raw water volume of $41x10^6$ m^3, was designed to meet the current and future water supply requirements for the city of Leskovac. Identification of raw water quality features in the accumulation lake Barje is a pre-requirement for the adoption of an optimal procedure for drinking water purification which would meet quality standards, at the Gorina-Leskovac plant [1].

Lakes vary in physical, chemical and biological characteristics. Physically, they vary in terms of light levels, temperature and water currents; chemically, in terms of nutrients, major ions and contaminants; and biologically, in terms of structure and function. There is a great deal of spatial heterogeneity in all these variables, as well as temporal variability on the scales of minutes, hours, diel (day/night), seasons, decades and geological time [2].

In practice, water quality is determined by measuring parameters that are relevant to a particular target, especially in the surface waters where the classification is based on an integrated system requires that provides relative stability of the ecosystem and also the requirements for the abstraction of drinking water [3]. The descriptive water quality indicator and the calculated SWQI number define the state of surface water and realistically assess sustainability of its exploitation for drinking water production [4]. Comparison and compliance of current Serbian legislation with the acknowledged European surface water quality standards is a necessity for any improvement in water supply. The protection and improvement of environment were supported by data on the monitoring of surface water quality status and the changes of eco-chemical status [5].

METHODOLOGY

In the Environment Protection Agency of the Ministry of Environment and Spatial Planning of the Republic of Serbia, developed was an environmental index for the water intended for reporting to public and experts on the water quality status. The indicator is based on the Water Quality Index method [6] whereby ten selected parameters (oxygen saturation, E. Coli, BOD-5, pH value, total nitrogen oxides, orthophosphates, suspended matter, ammonium, temperature and conductivity) by their characteristics represent the surface waters characteristics by a single index number. The share of any of ten selected parameters does not have the same relative significance for the total water quality; therefore, each of them was allocated a specific number according to their part in the menace to the water quality. By summing their products ($q_i \times w_i$) index 100 is obtained as the ideal sum of all parameters. Depending on the number of points of individual parameters achieved, given water will be allocated a number of index points ranging from 0 to 100. In case of missing data for an individual parameter, the value of arithmetically determined WQI is corrected by multiplying the index value by 1/x, where x is the sum of arithmetically measured weights of available parameters [7].

Determination of water quality, using a single index number, is the simpler approach of comparing the measured individual indicators of water quality parameters with reference values [8]. The adopted classification criteria of the descriptive quality indicator and determination of the surface water class based on the calculated value of SWQI index number are given in Table 1 [9].

Table 1. Classification of surface waters by the Serbian Water Quality Index method

WQI		**WQI**	**WQI**	**WQI**
85 - 84		74 - 69	56 - 44	51 - 35
100 - 90	89 - 84	83 -72	71 - 39	38-0
Excellent	**Very good**	**Good**	**Poor**	**Very poor**
Serbian Water Quality Index (SWQI)				

Quality indicators of the surface waters are classified, in compatibility with the existing classification, according to their purpose and the purity level:

- Excellent – water that in the natural state, with filtration and disinfection, can be used to supply water to settlements and food industry, and surface water that can be used for cultivation of precious fish species;
- Very good and good – waters that in their natural state can be used for swimming and recreation, water sports, for breeding of other fish species, or those that with modern purification methods can be used for water supply systems and for food industry;
- Poor – water that can be used for irrigation and that, after having been treated by modern methods, can be used for industries other than food industry;
- Very poor – waters that have an adverse effect on the environment and can only be used after special treatment (purification) methods.

Water Framework Directive EU/WFD – 2000/60/EC is the most important legal instrument in the water domain and a precondition for successful realization of the concept of integrated environment management. The primary aim of the Framework Directive is bringing all natural waters into "good status", i.e., providing good hydrological, chemical and ecological status of water bodies [10].

As regards the determination of the surface waters quality from the aspect of its suitability for water supply, SWQI method is comparable to the *Council Directive 75/440/EEC*, which refers to the required quality of surface water intended for human consumption in Member States [11]. According to this Directive, Annex I, with respect to the limit values of the quality parameters, the surface waters are categorized into three categories with suggested standard treatment methods for transforming surface water into drinking water:

A1 – Simple physical treatment and disinfection, e.g. rapid filtration and disinfection.

A2 – Normal physical treatment, chemical treatment and disinfection, e.g. pre-chlorination, coagulation, flocculation, decantation, filtration, disinfection (final chlorination).

A3 – Intensive physical and chemical treatment, extended treatment and disinfection, e.g. chlorination to break-point, coagulation, flocculation, decantation, filtration, adsorption (activated carbon), disinfection (ozone, final chlorination).

These groups correspond to different surface water qualities according to their physical, chemical and microbiological characteristics set out in the table given in Annex II. Surface water having physical, chemical and microbiological characteristics falling short of the mandatory limiting values corresponding to treatment type A3 may not be used for the abstraction of drinking eater. However, such lower quality water may, in exceptional circumstances, be utilized provided suitable processes – including blending – are used to bring the quality characteristics of the water up to the level of the quality standards for drinking water [11].

RESULTS AND DISCUSSION

The investigation of quality and eco-status of the Barje accumulation water uses data fund of the RHMZ of Serbia for the year 2009 and the selection of the quality parameters for the index method. According to RHMS program, testing water quality storage is done at three locations: near a dam, in the middle of the lake and at the beginning of the lake. Reservoir sampling was conducted at three depths (surface, middle and bottom of the vertical) as follows: A1 = 0.5m, A2 = 15m, A3 = 28m, B1 = 0.5m, B2 = 8m, B3 = 15m and V1 = 0.5m, V2 = 1m, V3 = 1.5m, respectively, at selected locations of the lake.

For the purposes of budget studies were done averaging the individual indicators of water quality according to the instructions Eurowaternet - Lakes Aggregation of station data [12] and calculated the quality expressed by the appropriate SWQI index number (see Table 2).

The evaluation of the eco-chemical status is based on a comparative analysis of the results, i.e., the minimum, maximum and median value of the array of the selected parameter indices for water quality, with standard parameter values defined by the Council Directive 75/440/EEC as the required quality for the surface water intended for abstraction of drinking water in Member states (Table 2).

Table 2. *Parameters and values of the Barje accumulation at selected locations*

Para-meters / Values	Temperature (°C)	pH	Conductivity (µS/cm)	Oxygen saturation (%)	BOD-5 (mg/l)	Suspended matter (mg/l)	Total N (mg/l)	Orthophosphate (mg/l)	Ammonium (mg/l)	E. coli (n/1l)
Barje – Location A* (A1, A2, A3)										
min	16.8	7.0	214	53	2.0	3	0.102	0.014	0.01	1000
max	24.0	8.3	222	102	3.1	8	0.305	0.016	0.06	2100
median	19.6	7.5	218.3	74.7	2.5	6	0.203	0.015	0.03	1433
Barje – Location B (B1, B2, B3)**										
min	15.1	7.1	218	69	2.0	4	0.302	<0.010	0.02	2400
Max	24.1	8.4	223	100	2.5	12	0.404	0.015	0.05	2700
median	19	7.6	220.3	82.3	2.2	9.3	0.373	0.012	0.037	2500
Barje – Location V* (V1, V2, V3)**										
min	24.0	8.2	232	100	1.7	7	0.205	0.017	0.07	>2400
max	24.3	8.4	235	107	2.0	9	0.306	0.023	0.08	>2400
median	24.1	8.3	233.7	103.3	1.9	8	0.275	0.019	0.08	>2400
Eurowaternet – Lakes Aggregation of station data										
median	20.74	7.72	224.2	86.18	2.2	8.12	0.285	0.016	0.59	1466
SWQI	**82**									
Council Directive 75/440/EEC concerning the quality required of surface water										
A1	22	6.5-8.5	1000	>70	<3	25	1	0.4	0.05	20
A2	22	5.5-9	1000	>50	<5	-	2	0.7	1	2 000
A3	22	5.5-9	1000	>30	<7	-	3	0.7	2	20 000

* Location – near dam; ** Location – center of the lake; *** Location – begining of the lake

The Barje reservoir's water temperature in winter-summer period ranges from 15,1 ^{0}C to 24,3 ^{0}C, which does not represent extreme changes of this parameter as a condition of maintaining water life, so that the average value is lower than prescribed for A1 category of river water as given by the Council Directive 75/440/EEC. (see Table 2). Barje accumulation, with an average pH = 8.1 weak acid character, indicates a low level of organic pollution that adversely affects the organisms in aquatic ecosystems and is within the permissible value category A1. The values for conductivity show a low concentration of ions in the water, ranging from 214 μS/cm (min near dam) to 235 μS/cm (max center of the lake) and they are less than allowed for the surface water of A1 category.

The low level of oxygen saturation of water is a sign of possible pollution only in the dam, while the value at the beginning and middle of the lake is significantly higher than 70% as a threshold of the category A1 and the maintenance of life in the water. The results of BOD-5 determination define low level of pollution of lake water with organic compounds and classify the water into the A1 category (see Table 2). Content of suspended matter include organic and inorganic pollutants in water with values significantly lower than the allowed limits for categories A1. The values of total oxides of nitrogen and orthophosphate are mutually consistent excluding presence of chemical industry pollution in the water reservoir Barje, classifying it in the best quality class A1. Phosphorus is considered to be the most critical growth factor in the water bodies because the dissolved phosphate are absorbed by the plants and passed on to animals in the food chain. The measured concentrations in all localities of the lake does not show an increase in phosphate levels above naturally present that would lead to eutrophication which is compromising the structure of natural aquatic ecosystems and biodiversity loss. Ammonium ion slightly deviates from the boundaries of permissible concentration values of category A1, but the slightly acidic nature of water reservoirs Barje remains under the category A2. Present coliform bacteria (E. Coli) are an indicator of anthropogenic impact, sanitary contamination which, including the effect of self-cleansing water, comes down to values in the range of categories A1 and A2.

In general, the quality of water reservoirs Barje with index number SWQI = 82, corresponds to a descriptive indicator of "good water", category A1 of the Council Directive 75/440/EEC and meets the criteria of surface water intended for water supply.

CONCLUSIONS

Water resources are considered the most important segment of the environment and the protection of the natural ambient cannot be imagined without the adequate protection of water, which implies monitoring, water categorization and establishing water quality standards.The Agency for Environment Protection of the Ministry of Environment and Spatial Planning of the Republic of Serbia develops and coordinates the environment protection system. Part of the information system referring to waters, *Serbian Water Quality Index,* is based on the information on the surface waters in accordance with the program of the Hydrometeorological Service of the Republic of Serbia. This investigations show that by use of SWQI method and a comparison with the standard values defined by the Council Directive 75/440/EEC as the required surface

water quality intended for abstraction for drinking water distribution in Member states, a comprehensive evaluation of the water quality and eco-chemical status of the Barje reservoir can be obtained. The overall water quality of the accumulation corresponds to the descriptive indicator "good" water and meets the requirements of A1 category of the Council Directive 75/440/EEC for the observed one-year period.

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REFERENCES

1. Water Purification Facility Gorina – Leskovac, Energoprojekt-Hidroinženjering DD, Beograd, 1992.
2. http://www.waterontheweb.org/under/lakeecology/03_lakevariability.html (accessed March 26, 2011).
3. Dalmacija B., What determines the water quality, II International Congress "Engineering, Ecology and Materials in the Processing Industry", Jahorina, March 9th to 11th, 2011.
4. Takić Lj., Ranđelović Lj., Krstić I., Water quality of the Barje reservoir analyzed by the Serbian Water Quality Index – SWQI, Vodoprivreda, 42 (2010) 246-248 p.251-256
5. Banerjee T. and Rajeev, K.S., Application of water quality index for assessment of surface water quality surrounding inregrated industrial estate-Pantnager, Water Science and Tehnology, 60 (8) 2041-2053., 2009.
6. *Development of a Water Quality Index* (1976), Scottish Development Department, Engineering Division, Ediniburhg, 1976.
7. Water Research Center, B.F. Environmental Consultants Inc. http://www.water-research.net/watrqualindex/index.htm (accessed 10 December 2010).
8. Boyacioglu H., Development of a water quality index based on a European classification scheme, Water SA Manuscript, 33 (1) 101-106, 2007.
9. Agency for Environmental Protection, Republic of Serbia, The Ministry of Environment and Spatial Planning, http://www.sepa.gov.rs (accessed 10 December 2010).
10. Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 Establishing a framework for Community action in the field of water policy
11. EEC Council Directive 75/440 of 16 june 1975 concerning the quality required of surface water intended for the abstraction of drinking water in Member States (www.csribd.com/doc/8264383/Directive-75440EEC-Drinking-water-treatment-classes)
12. http://www.eea.europa.eu/data-and-maps/data/waterbase-lakes (accessed March 5, 2011).

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POSSIBILITIES OF SOLIDIFICATION/STABILIZATION OF SLUDGE FROM WASTEWATER TREATMENT PLANT IN TIR BOR WITH FLY ASH

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ABSTRACT

Within RTB Bor Copper Smelter–Acid Plant Modernization Project in Bor, Serbia construction of Wastewater Treatment Plant (WWTP) is planned. The aim of this study was optimization of solidification/stabilization (S/S) process for wastewater treatment sludge bearing high amount of heavy metals and arsenic from future WWTP with fly ash (FA). Experiments were conducted on synthetic sludge which phisically and chemically corresponded to sludge that would be obtained in WWTP process. S/S proces was verified by compressive strength tests and EN 12457-4 leaching tests. Best results in fixation of heavy metals and arsenic were obtained with 20% FA.

Key words: wastewater treatment sludge, S/S process, fly ash, heavy metals, arsenic

INTRODUCTION

Mining and pyrometallurgical processing of copper bearing ore in Bor, Serbia started in early 20th century when one of the largest copper ore deposits in Europe was discovered in this region. A hundred years of mining and an outdated copper extraction technology (oxidation roasting – smelting in reverberatory furnace – converting), still present in the Bor Copper Smelter (TIR), left extensive environmental problems of polluted air, water and soil, not only for local community but for Danube basin and whole Balkan region. Metallurgical wastewaters from technological processes in TIR are currently released without previous treatment. This water carries great quantities of copper, arsenic and heavy metals causing serious pollution of water and soil [1]. In the course of RTB Bor Copper Smelter – Acid Plant Modernization Project, construction of The Wastewater Treatment Plant (WWTP) is planned, for treatment of contaminated process flows from the copper smelter and converter gas cleaning and cooling operations [2]. After wastewater treatment process, treated water would be collected in polishing pond and sludge, generated during wastewater treatment, bearing significant amount of heavy metals and arsenic, should be solidified and stabilized.

Solidification/stabilization (S/S) method is widely applied technology for treatment of industrial waste and contaminated material prior to disposal. It involves mixing a binding reagent with contaminated media or waste, changing the chemical and physical properties of hazardous constituents in waste to make it non-hazardous [3]. The most used binding reagents are cement-based materials like ordinary Portland cement (OCP) [4] and its mixtures with pozzolanic-based materials (cement kiln dust, fly ash, lime, blast furnace slag) as additives [5, 6] which can be successfully used in fixation of heavy metals ions in waste. Nowadays, OPC is replaced with fly ash (FA) as binder in waste S/S processes due to its excellent stabilization behavior that could be explained by surface complexation – electrostatic adsorption – hydrolysis mechanism [7]. FA is also a waste material produced during coal combustion in thermal power plants and is available in large quantities. It is primary used as only binder [7-9] or in two types of mixtures [10, 11]: Portland cement + fly ash or lime + fly ash. Addition of OPC is necessary for strength development in S/S system and the addition of hydrated lime for acceleration the hydration process of FA [10]. Main role in solidification/stabilization treatment has pH value of the waste + binder mixture that has to be kept in the range of heavy metals lowest solubility [8, 9].

Various studies have shown that industrial waste containing As could be also successfully treated by S/S technology using OPC [12, 13], fly ash [14] and lime, or their combination as binders and additives [15-17]. Optimal addition for simultaneously reducing the leachabilities of arsenic and heavy metals has to be determined based on the composition of the waste [18]. Three possible mechanisms may be responsible for the immobilization of As and heavy metals: precipitation due to the formation of insoluble precipitates, inclusion (either by physical encapsulation or chemical inclusion) and sorption on products from pozzolanic reaction [14].

The aim of presented study is to investigate solidification/stabilization process of sludge from future WWTP. Experiments were performed on synthetic sludge in order to optimize the parameters of S/S process with FA. Results were verified by following the development of compressive strength and metals leachability after curing period of 28 days.

EXPERIMENTAL PART

Wastewater treatment (WWT) simulation

Simulation of wastewater treatment is done in software package for chemical processes simulation based on modified HighDensitySludge (HDS) process, which leads to acid neutralization and precipitation of heavy metals ions, in order to obtain the chemical composition of WWT sludge. Wastewater, generated during the treatment of waste gases, contains up to 20% sulfuric acid and significant amounts of dissolved heavy metals (Bi, Cu, Fe, Zn, As, also Ni, Pb, Sb and Hg in traces), certain amounts of non-metal oxides and sulfides. According to the designed acid content, pH of wastewater has a negative value, and the temperature is around 66^{o}C. It is planned that the process occurs in a two cascade reactors with in flow of $Ca(OH)_2$ as precipitation agents. The first reactor is designed for acid neutralization, also iron precipitation in the form of $Fe_2(OH)_3$ and As coprecipitation at pH 7.2. The second reactor is designed for

precipitation of other metals in the form of hydroxide at pH value of 9.5 to 10. The clarifier is designed for separation of treated water from wastewater treatment sludge which contains up to 50% of water [2, 19]. Process scheme for simulation is presented in Figure 1.

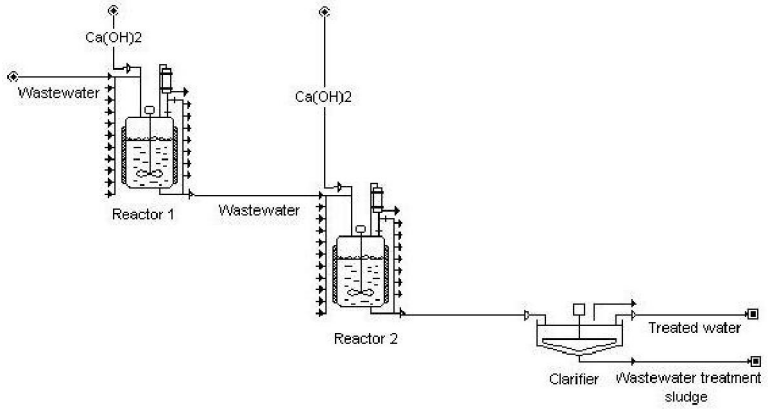

Figure 1. Wastewater treatment process scheme for simulation in SuperProDesigner

Materials

The synthesis of the sludge was conducted in laboratory conditions; the aim was to generate sludge that would physically and chemically correspond to wastewater treatment sludge obtained by simulation, i.e. designed sludge from WWTP. Dusts from reactor and convertor electrofilters from TIR were used for this synthesis with addition of suitable metal salts, p.a. quality. The dusts-salts mixture was mixed with 50 vol.% technical sulfuric acid in ratio 1:1 to generated acidic sludge. The acidic sludge was neutralized with 25% $Ca(OH)_2$ solution according to simulation. Obtained sludge had pH value 9.65, water content 50.67% and density 1.55 kg/l, which corresponded to designed process condition. Chemical composition of dried sludge is presented in Table 1.

Table 1. The chemical composition of dried synthesized sludge

Element	%	Element	%
SiO_2	16.44	Pb	0.94
SO_4	32.47	Bi	0.02
Al_2O_3	0.82	CaO	16.66
Fe	13.07	Ca	11.90
Cu	5.36	As	0.67
Ni	0.08	Sb	0.38

Fly ash from coal burning in Bor heating plant was used as the banding agent in the S/S process of synthetic sludge. This coal fly ash was class F fly ash by its chemical composition (SiO_2 60.29%, Al_2O_3 17.53%, CaO 6.21%) [20], and also contained 21.68% of water, due to the conditions of storage and transport.

Preparation of specimens

Influence of FA as binding agents was analyzed by addition of agent in quantities of 5, 10, 15, 20 and 25% to synthetic sludge. For S/S process FA was previously dried for 24h at 105^{o}C and used -100 μm fraction. The sludge and fly ash were thoroughly mixed into one homogeneous paste. This paste was cast in two portions into plastic molds dimensions 5×5×5 cm and vibrated in order to remove excess water and air. The specimens were cured according to ASTM C 109-2001 [21].

Properties of stabilized specimens

Quality of the stabilized waste was determined by compressive strength testing after 7, 14 and 28 days and long-term effects of leaching through the standardized European test EN 12457-4. Leachability of metals was determined by inductively coupled plasma (ICP) analysis.

Compressive strength test provides basic information on material stabilization. There are several recommendations for the required minimum compressive strength which is sufficient for the safe disposal of stabilized waste in landfills. That is 0.35 MPa according to U.S. Environmental Protection Agency (EPA) [22] and 0.30 MPa according to Resource Conservation and Recovery Act's (RCRA) [11]. Compressive strength of stabilized waste material specimens was tested using a servo hydraulic testing machine type ISTRON 1332 retrofitted Fast track 8800 with a maximum load of 5 kN.

EN 12457-4 test method is standardized by the EU and also adopted in Serbian laws, which are used to determine the mobility of both organic and inorganic substances present in liquid, solid and multiphase wastes. This is one stage batch test at a liquid to solid ratio of 10 l/kg for materials with particle size below 10mm (without or with size reduction) with deionized water [23].

RESULTS AND DISCUSSION

Compressive strength

Results for compressive strength testing after 7, 14 and 28 days for 5, 10, 15, 20 and 25% FA are presented in Figure 2.

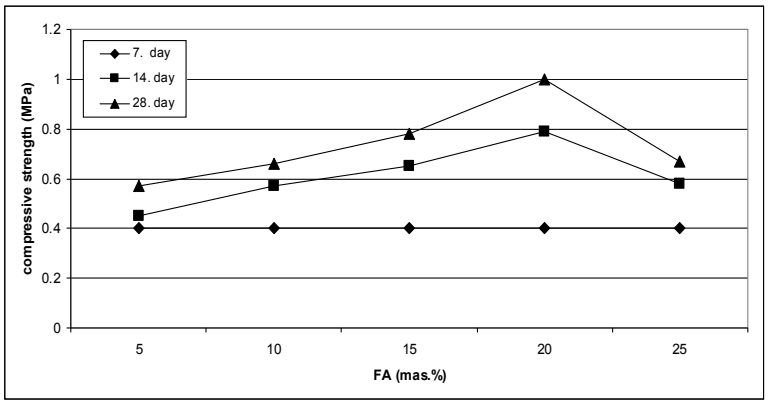

Figure 2. Development of compressive strength for different percentage of FA

All stabilized specimens with different amounts of FA exceed the required compressive strength value even after first seven days. During the first period there was no significant difference in the compressive strength between different ratio sludge/FA. After this time, the value of strength increased sharply for the composition of 20% FA and by the end of the 28th day this composition reaches the maximum value of 1.00 MPa. Values increased with the increase of ash amount from 5% to 20%, but for 25% FA fell and was close to the values of 10% of FA. This can be attributed to the decrease of water content in sample. Insufficient amount of water (as is the case with 25% additives) results in a low value of strength, while a larger amount of water (5% additive) results in slower drying of samples and leads to the formation of cracks in the samples during drying.

Leaching test

EN 12457-4 leaching tests were conducted after curing for 28 days. Bi, Cu, Fe, Ni and Pb were not detected in leachates. Concentrations of As and Sb in leachates are presented in Table 3 with comparison to national legislative. The concentrations were lower than national legislative for concentration limits of leachates for non-hazardous waste landfills for Sb and for inert waste landfills for As [24].

Table 2. EN 12457-4 leaching test results of As and Sb

Element	FA, %					National legislative	
	5	10	15	20	25	Inert waste	Non-hazardous waste
As, mg/l	0.11	0.18	0.17	0.15	0.13	0.5	2
Sb, mg/l	0.12	0.16	0.19	0.24	0.29	0.06	0.7

Sb concentration increase could be attributed to the increase of FA content which carries significant amounts of antimony [25].

CONCLUSION

Presented results show that all specimens had compressive strength greater than regulated 0.35 MPa even after first 7 days. Bi, Cu, Fe, Ni and Pb were not detected in leachates. The concentrations of Sb were lower than national legislative for concentration limits of leachates for non-hazardous waste landfills and As concentration for inert waste landfills. Best results were obtained for S/S samples with 20% FA regarding compressive strength (1 MPa) and arsenic leachability (0.15 mg/l). According to presented, S/S sludge from WWTP is suitable for disposal at non-hazardous waste landfills. Future experiments will include binder combinations (FA+lime+OPC) in order to further improvement of S/S process for this type of waste.

Acknowledgments

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REFERENCES

1. Local Environmental Action Plan (LEAP) Municipality Bor, 2003
2. Environmental impact assessment, New Smelter and Sulfuric Acid Plant, http://www.rtb. rs/media/dokumenti/nt/EIA_Volume_1.pdf
3. U.S. EPA (United States Environmental Protection Agency), Solidification/ Stabilization Resource Guide. EPA/542-B-99-002, Washington, USA, (1999)
4. Diet J. N., Moszkowicz P., Sorrentino D., Behavior of ordinary Portland cement during the stabilization/solidification of synthetic heavy metal sludge: macroscopic and microscopic aspects, Waste Management, 17-24, (1998)
5. Ruiz M. C., Andres A., Irabien A., Environmental assessment of cement/foundry sludge products, Environmental Technology, 589 – 596, (2003)
6. Zain M. F. M., Islam M. N., Radin S. S., Yap S. G., Cement-based solidification for the safe disposal of blasted copper slag, Cement and Concrete Composites, 845-851, (2004)
7. Polat M., Guler E., Lederman E., Cohen H., Neutralization of an extremely acidic sludge and stabilization of heavy metals in flyash aggregates, Waste Management, 482-489, (2007)
8. Pereira C. F., Rodríguez-Piñero M., Vale J., Solidification/stabilization of electric arc furnace dust using coal fly ash: Analysis of the stabilization process, Journal of Hazardous Materials, 183-195, (2001)
9. Camacho L. M., Munson-McGee S. H., Anomalous transient leaching behavior of metals solidified/stabilized by pozzolanic fly ash, Journal of Hazardous Materials, 144-151, (2006)
10. Qiao X.C., Poon C.S., Cheeseman C., Use of flue gas desulphurisation (FGD) waste and rejected fly ash in waste stabilization/solidification systems, Waste Management, 141-149, (2006)
11. Qian G., Cao Y., Chui P., Tay J., Utilization of MSWI fly ash for stabilization/solidification of industrial waste sludge, Journal of Hazardous Materials, 274-281, (2006)
12. Choi W. H., Lee S. R., Park J. Y., Cement based solidification/stabilization of arsenic-contaminated mine tailings, Waste Management, 1766-1771, (2009)
13. Voglar G. E., Leštan D., Solidification/stabilisation of metals contaminated industrial soil from former Zn smelter in Celje, Slovenia, using cement as a hydraulic binder, Journal of Hazardous Materials, 926-933, (2010)
14. Moon D. H., Dermatas D., Arsenic and lead release from fly ash stabilized/solidified soils under modified semi-dynamic leaching conditions, Journal of Hazardous Materials, 388-394, (2007)
15. Shih C. J., Lin C. F., Arsenic contaminated site at an abandoned copper smelter plant: waste characterization and solidification/stabilization treatment, Chemosphere, 691-703, (2003)
16. Vandecasteele C., Van den Broeck K., Dutré V., ICP–MS, hydride generation-ICP–MS, and CZE for the study (analysis and speciation) of

solidification/stabilisation of industrial waste containing arsenic, Waste Management, 211-216, (2000)
17. Singh T. S., Pant K.K., Solidification/stabilization of arsenic containing solid wastes using portland cement, fly ash and polymeric materials, Journal of Hazardous Materials, 29-36, (2006)
18. Sullivan C., Tyrer M., Cheeseman C. R., Graham N. J. D., Disposal of water treatment wastes containing arsenic — A review, Science of The Total Environment, 1770-1778, (2010)
19. Pavlović J., M.Sc., Faculty of Technology and Metallurgy, University of Beograd, (2006) (in Serbian)
20. Komljenović M., Baščarević Z., Bradić V., Mechanical and microstructural properties of alkali-activated fly ash geopolymers, Journal of Hazardous Materials, 35-42, (2010)
21. ASTM C 109, Standard test method for compressive strength of hydraulic cement mortars (using 2-in. or [50-mm] cube specimens), Annual Book of ASTM Standards, 83-88, (2001)
22. Malviya R., Chaudhary R., Factors affecting hazardous waste solidification/stabilization: A review, Journal of Hazardous Materials, 267-276, (2006)
23. EN-12457-4, Characterization of waste, Leaching–compliance test for leaching of granular waste materials and sludges. Part 4, (2003)
24. Regulation on categories, study and classification of waste (Official Gazette of the Republic of Serbia no. 56/10), Appendix 10 (in Serbian)
25. Narukawa T., Takatsu A., Chiba K., Riley K. W., French D. H., Investigation on chemical species of arsenic, selenium and antimony in fly ash from coal fuel thermal power stations, Journal of Environmental Monitoring, 1342-1348, (2005)

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IMPACT OF URBAN SETTLEMENTS ON MICROBIOLOGICAL QUALITY OF WATER OF THE RIVER TISA IN SERBIA

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ABSTRACT

Microbiological river water quality, obligatory for use-related aspects such as drinking water production, irrigation and recreation, was evaluated by applying the routine procedure for testing the microbiological indicators of sanitary correctness and faecal indicators. To evaluate presence state of water quality, samples of water and sediment taken from 3 sites on River Tisa were analyzed. By applying standard procedures for sanitary correctness and organic load assessment, total of 16 parameters were analyzed. Results of analyses indicated that quality of water is at unsatisfactory level at most of the sampling locations.

Key words: Microbiological quality, sanitary pollution, River Tisa

INTRODUCTION

Microbiological examination of river water is obligatory for use-related purposes such as drinking water production, irrigation and recreation. Quality of sediment, as dynamic and integral component of aquatic ecosystems, has become of increasing interest for river water quality evaluation. The basin of River Tisa is extended over 5 countries. The total length of the river is 1.358 km. The Serbian reach of the Tisa extends a distance of 168 km that covers middle and lower waterway. Tisa flows through numerous industrial and urban centers and receives significant amount of urban and industrial wastes leading to serious debasement of water quality. This typical low-land river flows through region of intense agriculture (over 470.000 ha) whose efluents degrade water quality due to high concentrations of nitrogen and phosphorus. Thus, detailed knowledge on the extent and the origin of microbial faecal pollution is crucial for watershed management activities in order to maintain safe waters according to their quality targets [1].

With experience in the field of microbiology [2-9], we have undertaken this study to evaluate the anthropogenic impact of wastewaters originated from large urban settlements, such as Senta, Bečej and Zrenjanin and the present state of water quality of River Tisa in Serbia. The study includes analysis of sanitary correctness of water and sediments sampled from sites during spring and autumn seasons in 2010. Ecological aspect of microbiological analyses included monitoring of dinamics of bacterial populations during seasons, isolation of bacteria resistent to mercury and organic load assasment.

Physical and chemical parameters were observed to give proper assessment of quality and prognosis of the situation. Only integrated approach gives a complete picture of the present state of the water ecosystems.

MATERIAL AND METHODS

The samples for analysis were collected during spring and autumn 2010. from tree sites of River Tisa (Table 1.). The sites were determined by Republic Hydrometeorological Service of Serbia within routine water quality monitoring. The Ada site receives effluents from domestic sewage of upstream located town Senta (25.000 inhabitants), this site is also under impact of sugar industry ¨TE-TO¨, and fermentation industry ¨Alteh Fermin¨ of town Senta. The Novi Bečej site is located downstream town Bečej (40.000 inhabitants) recievng great amount of urban wastewaters. The Titel site is chosen to measure effects of Tisas tributary River Begej on water quality. This site is under impact of urban wastewaters of town Zrenjanin (33.000 inhabitants). The coordinates of the sampling sites were measured by GPS ("Garmin Etrex") and charted by using ArcView software (map 1:300,000, system WGS_1984).

Table 1. Sampling sites along the River Tisa

River	Locality	Latitude	Longitude	Above sea (m)
Tisa	Ada	45° 47' 36, 2"	20° 08' 49,3"	148
	Novi Bečej	45° 35, 447'	20° 08,063'	90.7
	Titel	45° 11,960'	20° 18,672	90.2

All samples were processed in the laboratory within 12 hours from sampling and total of 16 parameters were processed. Microbiolgical indicators of sanitary correctness and indicators for organic contamination assesment were analysed using standard procedures according to Law of Water of Republic of Serbia (''Official Gazzete of RS'' number 46/91, 53/93. 67/93. 48/94. 54/ 96) and EU-Bathing water quality directive 2006/7/EEC. For the assessment of recent fecal pollution and the potential presence of pathogenic bacteria, total coliforms, fecal coliforms and intestinal enterococci were monitored by using membrane filtration methode. Faecal indicator bacteria like total coliforms, faecal coliforms (thermotolerant coliforms), *E. coli* and intestinal enterococci (faecal streptococci) are excreted by humans and warm-blooded animals, pass sewage treatment plants to a great amount and survive for a certain time in the aquatic environment [10]. Faecal coliforms to *Enterococci* ratio was used to indicate origin of pollution. Ratio lower than 1.5 should indicate pollution by waterfowl, while ratios higher than 4 should be typical for anthropogenic pollution [11]. Identification of

isolated coliform bacteria was performed using API 20e identification kit (bioMerieux) [**Error! Reference source not found.**2]. Presence of potential pathogen species was observed by cultivation on meat peptone agar (MPA). To fullfill sanitary analyses, presence of *Proteus* sp., sulphitereducting clostridia, *Pseudomonas aeruginosa* and *Bacillus sp.* was also determined.

For providing information about overloading of water with organic compounds, the presence of the main physiological groups of bacteria (heterotrophic, oligotrophic) and phosphatase activity index [13] were monitored.

Microbiological analyses of sediment included quantification of coliform bacteria (membrane filtration), identification of isolated coliforms (API 20e), isolation of bacteria resistent to mercury and presence monitoring of potential pathogens.

We also studied physical and chemical characteristics: temperature, pH, turbidity, specific conductivity, dissolved oxygen, oxygen saturation, NH_4^+ (mg/l), NO_3^- (mg/l), PO_4^- (mg/l) (Table 2).

Table 2. Physical and chaemical characteristics of River Tisa

Site	**Ada**		**Novi Bečej**		**Titel**	
season	**S**	**A**	**S**	**A**	**S**	**A**
t (C^o)	**12.3**	**16.8**	**12**	**17.3**	**11.8**	**17.5**
Conductivity (µS/cm)	**401**	**-**	**424**	**-**	**412**	**-**
Oxygen mg/l	**8.05**	**7.28**	**7.48**	**7.48**	**10.2**	**7.24**
Oxygen %	75	**75.8**	**77.5**	**76.8**	**94.2**	**75.2**
pH	**7.9**	**7.8**	**8.32**	**7.8**	**8.37**	**7.8**
NH_4^+ (mg/l)	**0.13**	**0.08**	**0,05**	**0.11**	**0.07**	**0.06**
NO_3^- (mg/l)	**2.3**	**1.4**	**2.6**	**1.3**	**2.6**	**8.3**
PO_4^- (mg/l)	**8.3**	**2.2**	**1.4**	**1.6**	**1.4**	**2.1**

RESULTS AND DISCUSSION

The sanitary analyzes indicated a critical to strong faecal contamination at the majority of the sampling sites (EU Bathing Water Directive 2006/7/EEC) [14]. Faecal coliform numbers ranged from 10^3 to 1.7 x 10^4 CFU/100ml. Strong faecal pollution (> 10000 cfu/100ml) was found at locality Novi Bečej in autumn and at locality Titel in Spring. At all sampling locations, number of faecal coliforms was more than 4 times higher than number of Enterococci indicating a great impact of human urban pollution (Fig. 1.). Mercury resistant bacteria were detected in all water samples indicating potential pollution of these localities with mercury [15].

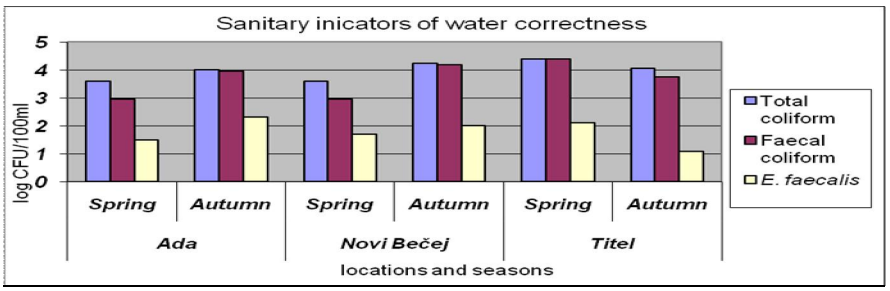

Figure 1. Sanitary indicators of water samples taken from River Tisa during spring and autumn season, results are shown as log CFU/100ml.

Index of phosphatase activity was applied to evaluate organic pollution of water of River Tisa. Analyses of the results indicated a satisfactory purity (class IIA) at the Novi Bečej and light (class III) pollution at the majority of the sampling sites (Fig. 2.).

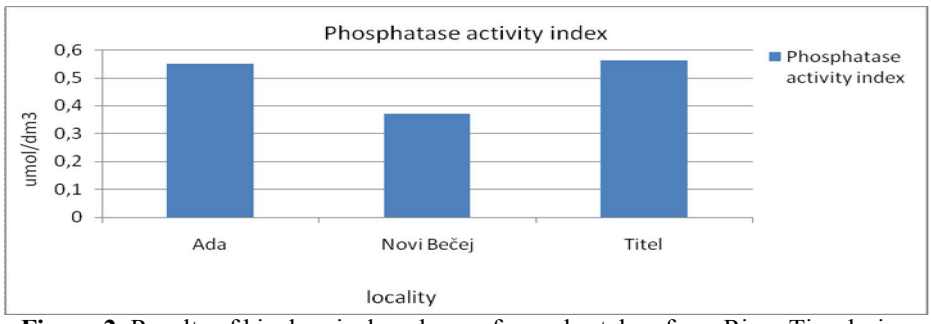

Figure 2. Results of biochemical analyses of samples taken from River Tisa during spring season, results are shown as μmol/dm^3

Organic load assessment was also performed by using oligotrophs to heterotrophs ratio. Domination of oligotrophs in almost all water samples indicated satisfactory level of self purification (Fig. 3.).

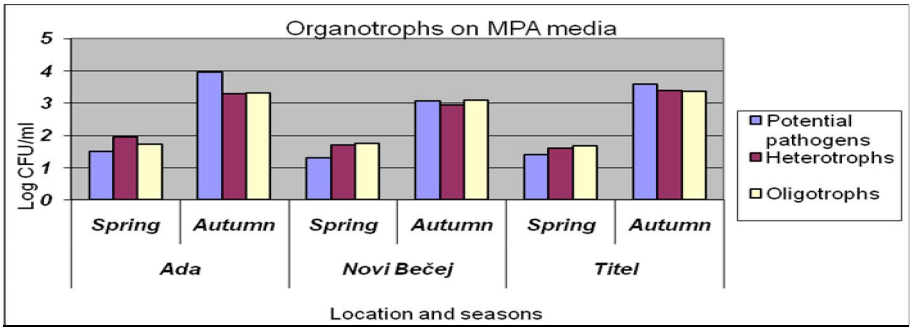

Figure 3. Number of organotrophic bacteria isolated from water samples from River Tisa during spring and autumn seasons, results are shown as log CFU/ml.

Microbiological parameters of sanitary correctness of sediment varied in correlation of sampling location. Total coliform numbers ranged from 1.2 x 10^3 to 1.3 x 10^5 CFU per gram of sediment. The highest pollution values were recorded at location Ada during autumn season. Mercury resistant bacteria were isolated from all sediment samples during autumn season (Fig. 4.).

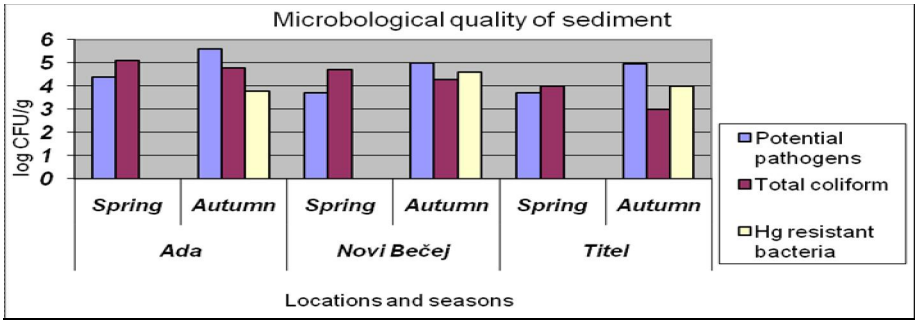

Figure 4. Microbiological parameters from sediment samples taken from River Tisa during spring and autumn seasons, results are shown as log CFU/g.

CONCLUSSIONS

Obtained results indicated that the quality of water is unsatisfactory and knowledge on microbial pollution in aquatic environments appears essential in order to take appropriate measures which result in acceptable river water quality and compliance with national and international quality standards and directives. Sanitary pollution detected at selected sites can be mainly attributed to great amount of raw or not properly treated urban wastewaters, while increased agricultural activity in this area during sampling period has probably contributed to detected organic pollution.

REFERENCES

1. Farnleitner A.H., Kirschner, A.K.T., Zechmeister, G. Kavka, T.C., Mach, R.L. (2001), Austrian Association of Water and Waste Management, Book of Abstracts, 150
2. Kolarević, S., Gačić Z., Paunović M., Knežević-Vukčević, J., Vuković-Gačić, B., (2010), Microbiological water quality of the rivers Danube, Sava, Morava and Tisa, 7th Congress of Serbian Microbiologists, Belgrade, Serbia, Book of Abstracts on CD
3. Nikolić, Z., S. Stanković, B. Vuković-Gačić**,** J. Knežević-Vukčević, D. Simić, (1997), The influence of settlements along the Topčider river on microbiological quality of water (in Serbian), Donji Milanovac, Serbia, Conf Proceedings, 140-145.
4. Stanković, S., Vuković-Gačić, B., Knežević-Vukčević, J., Anćelković, M., Simić, D., (1995), Monitoring of environmental pollution with genotoxic agents-

genotoxic monitoring (In Serbian), Int. Conf. Preventive Engineering and Living Environment Proceedings, C20 1-4.

5. Stanković, S., Z. Nikolić, Vuković-Gačić, B**.,** J. Knežević-Vukčević, D. Simić, (1997), Bacteriological analysis of Dubašnica springs (In Serbian), Niš, Serbia, Conf. Proceedings, 285-287.
6. Stanković, S., Knežević-Vukčević, J., Vuković-Gačić, B., Simić, D. (1996), Microbiological water quality of the River Kolubara (In Serbian), V Kongres ekologa, Belgrade, Serbia, Book of Abstracts, 101.
7. Stanković, S., Mitić, D., Vuković-Gačić, B., Knežević-Vukčević, J., Simić, D., (1997), Microbiological water quality of the River Jablanica (In Serbian), 31 Dani preventivne medicine, Niš, Serbia, Book of Abstracts, 115.
8. Simić, D., Knežević-Vukčević, J., Vuković-Gačić, B., Mitić, Berić, T., Nikolić, B., Stanojević, J., Stanković, S, (2001), Genotoxic effects of environmental pollutants genotoxic monitoring and detection of antigenotoxic effects, ENRY 2001, Belgrade, Serbia, Book of Abstracts, 123-125.
9. Zlatković, S., Šabić, D., Milinčić, M., Knežević-Vukčević, Stanković, S., (2010), Geographical and biological analysis of the water quality of Bovan lake, Serbia, Arch. Biol. Sci., 62 (4), 1083-1087.
10. Kavka G.& Poetsch E., (2002), Microbiology. In: Joint Danube Survey – Technical report of the International Commission for the Protection of the Danube River,:138-150.
11. Geldreich, E. E., and B. A. Kenner. (1969), Concepts of faecal streptococci in stream pollution. J. Water Pollut. Control Fed. 41:R336-R352.
12. Biomerieux, (1995), API 20 E-Analitical Profile Index, 3rd edition, France
13. Matavulj M, O Petrovic, B Dalmacia, S Gajin & S Stojilkovic, (1983), Phosphatase activity as an indicator of a wastewater purification process (Serbian, English summary). Vodoprivreda 15: 165-172.
14. EU-Bathing water quality directive 2006/7/EEC
15. Viti C. Giobannetti, (2001), The impact of chromium contamination on soil heterotrophic and photosyntetic microorganisms. Annals of Microbiology 51, 201-213.

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MICROBIOLOGICAL ANALYSIS OF TIMOK'S WATER BASIN COMPOSITION FROM ZAJEČAR TO ITS CONFLUENCE WITH THE DANUBE

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ABSTRACT

This paper presents the results of microbiological analysis of water samples taken from nine measuring spots at Timok's water basin composition from Zaječar to its confluence with the Danube. The tests were performed during autumn of the year 2010.

Key words: microbiological analysis, water quality, river Timok

INTRODUCTION

Processes that occur in the natural water ecosystem, including self / cleansing processes, and biological processes of wastewater treatment, which are designed by the man himself are based on the acting and metabolic activity of microorganisms. Investigation of these processes is an essential part of the overall study of water in the environment, but also very interesting modern trend [1,2].

Microbiological characteristics of water are an important indicator of water quality, and most important group of microorganisms that can be found in surface water and waste waters are: bacteria, protozoans, microscopic plants and animals, and viruses. Most of these microorganisms, especially certain bacteria and protozoa, are essential for biological treatment, and some pathogenic bacteria, protozoa and viruses are undesirable because they are harmful to health. Pathogenic microorganisms are commonly found in sanitary sewage, which includes coliform bacteria, Proteus species, Clostridium and Streptococcus.

One of the most important microbiological parameters which was essential to establish, that affects the classification of water in a particular category is the total number of coliform bacteria in 1 liter of water (MPN). According to current regulations

in the Republic of Serbia [3], this number for the category of streams and class shouldn't exceed 2,000, for the category of class II it must be <100 000, water of class III must have <200,000, while the water of class IV contains over 200,000 coliform bacteria. As a contribution to better understanding of the characteristics of Timok, this paper presents the results of microbiological tests of the water basin from Zaječar to its confluence with the Danube.

The literature contains data about microbiological and other characteristics of Timok [4-7]. Timok [8] is the right tributary of the Danube, in which it flows at the border with Bulgaria, or the border connecting Serbia-Bulgaria-Romania, and it belongs to the Black sea basin. The last 15km, Timok runs along the state border with Bulgaria and presents the border river. The river Timok's basin is characterized by high fluctuations in the flow during the year - the average water flow is 24 m^3 / s, but in rainy autumn or in conditions of rapid melting of snow in spring it can grow to 120 m^3 / s, so in the summer and early autumn period the flow would drop to 3 m^3 / s. Otherwise, the Timok is 203 km away from the most distant sources, and from the junction of White and Black Timok near Zaječar it is 85 km long, with an average inclination of about 1% [9].

The main goal of this work is the report of the results of microbiological analysis of water Timok in 2010 compared to the previous period of tests. Beside testing water quality, it is necessary to determine locations and origin of pollutants of the river Timok from Zaječar to its confluence with the Danube.

EXPERIMENTAL PART

Experimental tests, presented in this paper include collecting samples at Timok's river basin from Zaječar to the mouth of the Danube and their microbiological examinations based on the content of MPN (total number of coliform bacteria), conducted at the Department of Public Health Timok Zajecar, according to standard operating procedures for sampling of surface waters and waste waters. Water samples were taken three times (in September, October and November of the year 2010) at the six measuring points, as follows: after the merger of White and Black Timok near Zaječar (M3), before the flow of the Bor's river and landfill Halovo (M5), downstream of landfill Halovo (M6), near the village of Tamnič (M7), after the flow of Sikolska river (M8), before flowing into the Danube (M9), and further, to better visualize the impact of White and Black Timok and Bor's river, three more measuring points - Black Timok before the merger with White Timok (M1), White Timok before the merger with the Black Timok (M2) and Bor's River before flowing into the Great Timok (M4). The above measuring locations are shown on the map - Figure 1 and the process of sampling in one of the measuring points in Figure 2. During the preparation of this work the results of mounthly testing done by Republic Hydrometeorological Service of Serbia.

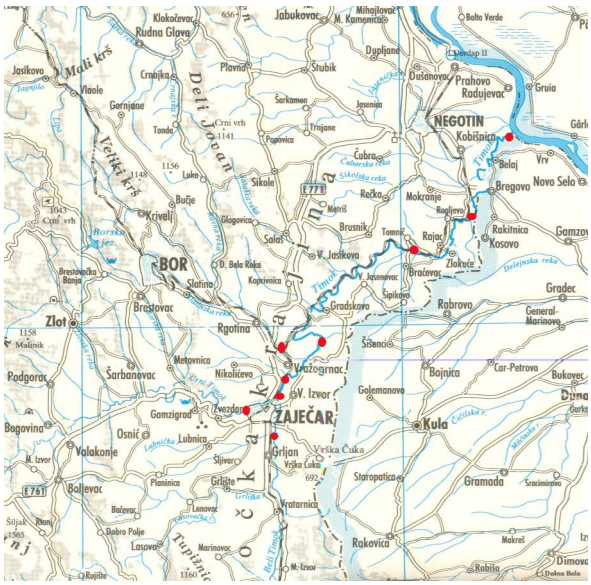

Figure 1. Measuring locations where water samples were taken

Figure 2. Sampling at the measuring location M7 – Timok near the Tamnič village

RESULTS AND DISCUTION ABOUT THE MICROBIOLOGICAL ANALYSIS OF THE RIVER TIMOK'S BASIN

Microbiological analysis showed that the most probable number of total coliform bacteria in 1 dm^3 of water (MPN) in 2008 was quite uneven and varied from 2,000 to 240,000. The value of MPN of Timok in June and August corresponded to the second and third class quality, respectively. However, the value of MPN of Bor river in April and October was > 240,000, which is a sign of the total degradation of streams in terms of sanitation and extreme faecal pollution. This pollution is present sometimes, considering that in June and August, the parameter MPN has a very low value that corresponds to waters of the first and second class. The situation is similar to White and Black Timok - quite uneven fecal pollution and discharge of untreated sanitary

wastewater and sewage treatment plants of small craft. Specifically, the pollution of the White Timok in June was very high (MPN beyond any class quality), while in April, August and October, the value of the MPN corresponded to I and II class. In that period, the water of the Black Timok was extremely polluted by fecal contamination only in April.

Microbiological analysis from the year 2010 showed that the situation was similar as in the year of 2008, that the occasional extreme fecal contamination happened due to uneven discharge of untreated sanitary wastewater in Timok and in Black Timok in June and October. However, in the water of White Timok and Bor's river the most likely number of total coliform bacteria in 1 dm^3 of water (MPN) during the year was very low and corresponding to I and II class.

Measured values of the above parameters of MPN, for all the above measuring points per month in the basin of the river Timok from Zaječar to the mouth of the Danube, are given in Table 1 and shown in Figure 3.

It may be noticed that the microbiological indicators of Timok's water are within the limits of prescribed values except at the measuring point M1 (Black Timok before the merger with White Timok), where the measured value is 4 times higher then the prescribed level. Since the measured values of the MPN don't vary significantly, it can be explained by the uniformity of sanitary waste water from the town Zaječar and waste waters from the existing mini-farm, as well as the absence of seasonal variability taking into account the research period (September-November 2010.).

Table 1. Overview of measured values of the MPN at all measuring points in the period September-November 2010.

Measuring point	**Water class**	**Prescribed value**	**Measured value**		
		MPN, no. in 1000ml	**IX 2010.**	**X 2010.**	**XI 2010.**
M1	IIa	60000	**>240000**	**>240000**	**>240000**
M2	IIa	60000	12000	<2000	2100
M3	IIb	100000	**>240000**	38000	100000
M4	IV	>200000	<2000	<2000	<2000
M5	IIb	100000	27000	38000	**240000**
M6	III	<200000	<2000	8800	5000
M7	III	<200000	<2000	<2000	38000
M8	III	<200000	2200	<2000	<2000
M9	III	<200000	2200	2200	2200

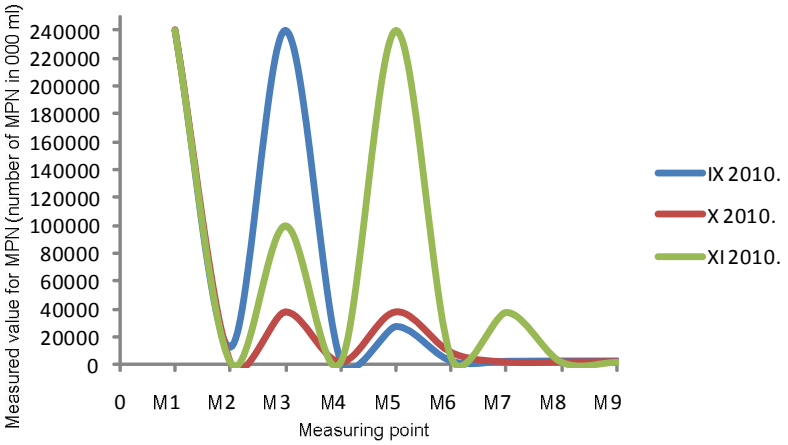

Figure 3. Overview of measured values of MPN at all measuring points in the period September - October 2010.

The only deviation from the prescribed value at the measuring point M1 can be attributed to the fact that Black Timok passes by a number of farms in the village Zvezdan before the merger with White Timok, which don't have adequate sanitary and utility solutions.

Therefore, the fact that shouldn't be neglected is that Bor's river (IV class) flows in Timok by the village Vražogrnac, and that itself is a remarkable ecological problem related to acceptance of waste water from RTB Bor, but the category of Timok remains at the level of III class until it flows into the Danube, which confirms specific self/cleaning power and influence of precipitation on the quality of these waters.

CONCLUSION

State of the Black Timok waters can probably be repaired without major investment, respecting the legal framework considering purification of waste water from Zaječar and the work of mini-farms in villages along its route. The variations in water quality of Bor's river are evident, and the river's impact on water Timok is noticeable, not only microbiologicaly but also physicaly and chemicaly, so it is necessary to solve Bor's river as a separate aquifer. Increased inspections and implementation of legislation soon would become ineffective, and the quality of these waters could be brought to the level IIa, or to be stood up at the level IIb.

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REFERENCES

1. Kovačić, A., Tripković, I., Galov, A., Žitko, T., Distribution of microbiological indicators of fecal pollution in the riverine substrates, (2011) Environmental Monitoring and Assessment, 172 (1-4), pp. 623-630.
2. Passerat, J., Ouattara, N.K., Mouchel, J.-M., Vincent Rocher, Servais, P., Impact of an intense combined sewer overflow event on the microbiological water quality of the Seine River, (2011) Water Research, 45 (2), pp. 893-903.
3. Regulation on water classification, Fig. Gazette of the Republic of Serbia, 53/1987.
4. Simić, S., Pantović, N., Observations on the rare alga Thorea hispid a (Thore) Desvaux (Rhodophyta) from Serbia, (2010) Cryptogamie, Algologie, 31 (3), pp. 343-353.
5. Petrovic, D., Todorovic, M., Manojlovic, D., Krsmanovic, V.D., Speciations of trace metals in the accumulation Bogovina on the Crni Timok river, (2009) Polish Journal of Environmental Studies, 18 (5), pp. 873-884.
6. Marković, A., Dinić, A., Djelic, G., Žikić, R., The influence of deposits from copper mining and smelting combine Bor on the vegetation of riverside of the River Timok (Eastern Serbia), (2008) Biotechnology and Biotechnological Equipment, 22 (1), pp. 566-571.
7. Polic, P., Grzetic, I., Jovancicevic, B., Oxygen saturation variability in River Timok (Serbia/Bulgaria), (1994) Fresenius Environmental Bulletin, 3 (7), pp. 433-438.
8. http://sh.wikipedia.org/wiki/Timok
9. Water resource base of Serbia, Institute for Water Resources Jaroslav Černi, 2001, pp. 88, Tab. 1.1.2. , Capacity of existing sources of groundwater and surface water.

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FEASIBILITY OF SOLAR ENERGY IN DISINFECTION OF WATER SOURCE FOR AN INDIAN VILLAGE –A CASE STUDY

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ABSTRACT

Water with good quality and sufficient quantity is essential for life. The solar disinfection of water (SODIS) is a technique used to inactivate microbes by sunlight. Energy from the sun is available abundantly in tropical country like India. The main objectives of this study: (1) to determine the efficiency of radiation intensity rate on the inactivation rate (2) to determine SODIS inactivation kinetics of Total Coliform. The result of the experiment shows that there is a reduction in Total coliform by 79.2%, Turbidity (66.67), TDS (41.03) and EC (40.67) after exposing the sample for 8 hours on sunlight.

Key words: Solar radiation, Microbes, Disinfection, SODIS, low budget water purification

INTRODUCTION

Water treatment can be done in a number of ways such as chemical flocculation, sand filtering and chlorination are the most widely methods used for water disinfection. Chloride is used in gas or diluted, acting efficiently against viruses and bacteria. However it has a residual by product which is toxic to human beings. In addition to its toxic effect it requires skilled laboratory technician or skilled manpower, mixing and laboratory equipment, storage, transport and handling of chemicals. On contrary solar energy which is the main sources of solar disinfection is available in most part of the world freely and it requires neither skilled personnel nor storage for treatment process. SODIS method is recommended for treating drinking water at house level since microbiological contamination is not visible. The criteria to be used to assess the quality of water may be: (a) frequency of water borne diseases (b) physical proximity of groundwater sources to polluting sources (latrine, animal dung, drainage water etc) [1] . Moreover disinfection water by SODIS is free from any hazard caused to users due to it is being free from toxic element by nature. Like any other water treatment methods solar disinfection has also its own advantages and limitation.

Common limitations of solar disinfection systems are: lack of sunlight during night and non sun days for disinfection, difficulties in treating highly turbid water and the availability of simple methods for reducing the turbidity of water before solar treatment, user objections to the technology due to it takes long time to get treated water and possible objectionable tastes and odours leached into the water from the plastic bottles. At a water temperature of 30^0c, faecal coli form can able to recover and grow at night [2]. Despite all these limitations, solar disinfection in clear plastic bottles is one of the most promising and extensively tested methods for disinfection of household water stored in a container.

The water requires several hours of exposure to strong sunlight to obtain the advantageous synergy between UV dosage and temperature rise [3]

UV-A (320-405nm) irradiance in watt/m^2on a horizontal plane was measured weather multi parameter sensor exhibiting an optimal response at 375nm, $5.98*10^{-8}$A $(Wm^2)^{-1}$ and 16.71A $(Wm^{-2})^{-1}$ conversion constant. The sensor was placed on roof of Environmental Engineering laboratory in an open area, free from interferences such as shade, reflection or diffusion. The solar radiation intensities were measured every one hour and the value converted and stored in a data logger using the ASCII code. The irradiance also known as flux was converted according Simpson's rule for numeric interaction into dose values (Wh/m^2)

According to [4] the inactivation kinetics are applied for the real activation process to single exponential decay law is a suitable approximation

$$N(t) = N_0 e^{-kF(t)} \quad (1)$$

Where, N_0 is the initial bacterial load and N(t) is the bacterial load after an irradiation period of length t [s]; F (t) is the fluence, or accumulated radiation dose up to time t,[Whm^{-2}] or [kJm^{-2}]; and k [m^2 kJ^{-2}] or [m^2Wh^{-2}] is the inactivation rate, which is characteristic for an organism under a determined disinfection process in consideration of the environment, settings and device. Equation (2) is obtained by taking logarithms and considering differences in order to obtain rates of change,

$$[\log (N(t+\Delta t)) - \log (N(t))]/\Delta t = -k[F(t+\Delta t) - F(t)]/\Delta t = -kI(t) \quad (2)$$

This equation relates the rate of bacterial inactivation, expressed in logarithms, to the intensity I of the irradiation. We will find evidence that the inactivation becomes independent of the irradiation intensity if the intensity exceeds some threshold. In this case, the right hand side of Equation (2) is replaced by a constant inactivation rate 2k. For practical applications, it is useful to consider the time until the number N is reduced to a fraction of 1og, with, say. This time is simply obtained as

$$T_p = p \log (10)/kI \quad (3)$$

Where, I is a mean radiation intensity. Some organisms can tolerate a certain amount of irradiation before they start decaying. This leads to an initial period with little change, after which the inactivation process can often be modelled again by the above

exponential law. If a and 2k are the intercept and slope of a straight line through the points of the decay phase, thetime Tp is calculated as

$$Tp = [p \log(10) + \infty - \log(N_0)J/=kI \quad (4)$$

Wegelin [5]) and Kowalski [6] summarize the inactivation kinetics commonly used in UV inactivation research.

Painting one side of the bottle, which to be putdowns in opposite to sunlight exposure improve the heat gain from the absorption of thermal radiation, and the bottle can be laid on a dark side on a roof to further increase the potential temperature rise in the water. Shaking a ¾ litre filled bottle to aerate the water before filling helps in aeration and had been found to give a faster pathogen kill rate.

Specific research study was initiated by prof. AftimAcra at the American University of Beirut, Lebanon, in the late 1970's. The main reported by [3] for bacteria inactivation by radiation was:

1. E.coli strains are slightly more resistant to the lethal effects of sunlight the other bacteria. E.coli strains therefore serve as indicators to assess the effect of sunlight intestinal bacteria
2. The effective component of solar radiation involved in microbial destruction seems to be the near ultraviolet A band (320-400 nm) and to a lesser extent to the visible band of violet and blue light (400-490nm).

AftimAcra carried out additional field research in 1986/1987 using continuous flow solar disinfection units and reactors volumes of 5-18 L. These experiments were run at constant flow conditions with exposure times 8- 66 minutes. The test resulted [3,4] can be summarized as:

1. Compared with E.coli and califorms, Str. faecalis were slightly resistant to solar radiation and required a UV-A
2. High bacteria concentrations showed a lower sensitivity to solar radiation compared with those of low or moderate density. In order to avoid prolonged exposure times, the tests were carried out with relatively low concentrations (2-6000 CFU/mL for E.coli in contrast to the bacterial density range of 10^6-10^8 cells /mL
3. Solar water disinfection can exerts a germicidal effect on bacterially contaminated water
4. Results of experiments involving the use of a pure E.coli culture differ from those using sewage as sources for water contamination by coliforms and *str. faecalis.* The use of sewer contaminated for solar radiation tests.

The Integrated Rural Energy System Association (INRESA), an associated program of the United Nations' University initiated a network project in 1985 to encourage different local research institutes to conduct research on solar disinfection and to transfer and disseminate the new technology. The field research was carried out in

research institutes of five research institution located in Peru, Colombia, Nigeria, Sri Lanka and Egypt were presented and reviewed in 1988. However, due to the lack of standardized research, results were inconclusive and guidelines for design of operation of solar water disinfection were not developed. The main findings and recommendation of the network project [3] were:

1. Acra's laboratory confirmed qualitatively by field tests. Solar radiation inactivates bacterially contaminated water.
2. Solar radiation can be applied effectively if a solar radiation intensity of at least 500W/m^2 is available for a period of about 5 hours if the concentration of the raw water to be treated does not exceed1000 faecal coliforms/100ml.
3. Temperature (lower than 50 ^{0}C does not seem to play a significant role in the activation of bacteria.

The Swiss Federal Institute for Environmental Science and Technology and SANDEC, EAWAG's Department of Water and Sanitation in Developing Countries, started to do laboratory research on solar radiation as a water disinfection system in the year of 1991. The main objective of the studies conduct by SANDEC was to assess the potential of this new method to inactivate microorganisms, mainly bacteria and viruses, and to promote and disseminate the technology after testing. Experiments were conducted both in laboratory and field [6]. Drinking water must be free from disease causing organisms called pathogen such as viruses and bacteria, coliforms bacteria, which are harmful to human being. Water treatment at household level like boiling, exposing water to sunlight to treat water by sun radiation is a long practice by human beings for long time.

MATERIALS AND METHODS

The study area is located in Roorkee, in south part of Hardiwar district in India located at 29.85^0 latitude and 77.88^0 longitude at an elevation of 255 m. above the sea level. Roorkee has an extreme and erratic continental climate. Summers start in late March and go on until early July, with average temperatures around 28^{0}C (83^{0}F). The monsoon season starts in July and goes on up to October, with torrential rainfall, due to the blocking of the monsoon clouds by the Himalayas. The post monsoon season starts in October and goes on until late November, with average temperatures sliding from 21^{o}C (70^{o}F) to 15^{o}C (58^{o}F). Winters start in December. The total annual rainfall in the area is about 2600 mm (102 inches).

The experiments were conduct with new local purchased smooth surface PET bottles 1 lit. in size. The transmission properties of the bottles PET plastic are similar to the results published [4]. The bottles were reused as long as they did not exhibit scratches which scattered and reflect the radiation. Prior to their reuse the bottles were disinfected with a hypochlorite (NaOCl) solution and washed with detergent. Thereafter they were rinsed twice with double distilled water, sterile water and twice with the water used for the experiment.

The water sample is conducted from a hand pump located at the right bank of Ganga canal which is about 3m away from the right bank of canal downstream of old Roorkee bridge. Raw water sample is filled to ¾ lit. and shaking for about 30 seconds then exposing to full sunlight for 8 hours (9.00 A.M. to 5 P.M.) continuously taken two hours interval and analysed MPN method [7],Turbidity(HACH/2100Q),EC and TDS (HACH/HQ40d multi parameter)in Environmental Engineering (Civil Engineering.) lab. (I.I.T.Roorkee)

RESULTS AND DISCUSSIONS

The result obtained from laboratory test shows the reduction in percentage of microbe increases with the exposure time as shown in table 1. The percentage (%) of reduction of Total coliform is about 79.2 as shown in fig1.

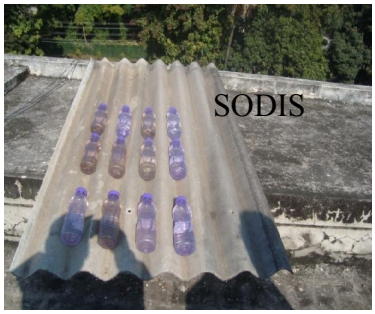

Table 1. SODIS Treatment

Time (hr)	SR (w/m^2)	Total coli form(/100ml)			Turbidity(NTU)			EC(µs/m)			TDS(mg/l)		
		RW	TW	% red	RW	TW	% red	RW	TW	% red	RW	TW	% red
0	603	120		0	12	0	0	300	0	0	144.3	0	0
2	885	90	30	25	11	1	8.3	223	77	25.7	106	38.3	26.5
4	895	65	55	45.8	9	3	25	227	73	24.3	108	36.3	25.2
6	635	40	80	66. 7	7	5	41.6	232	68	22.7	111.3	33	23
8	500	25	95	79.2	4	8	66.7	178	122	40.6	85.1	59.2	41.

SR=solar Radiation, RW= Raw water, TW= Treated Water, %red= percentage of reduction

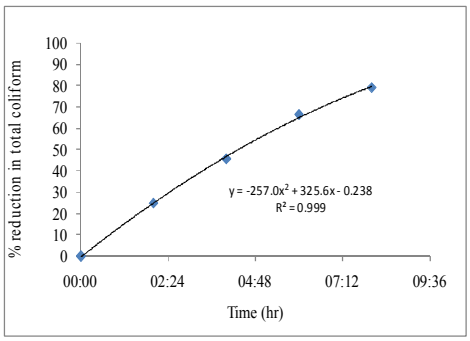

Figure 1. Percentage in reduction of Total coliform

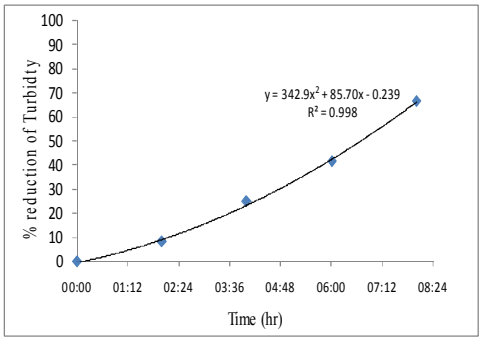

Figure 2. Percentage in reduction of turbidity

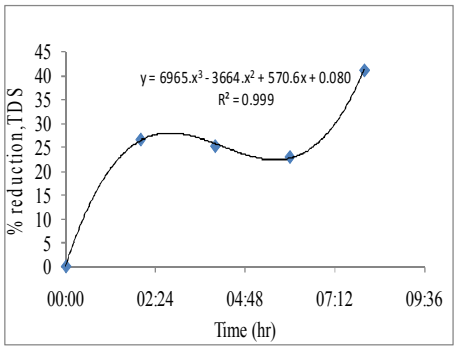

Figure 3. Percentage in reduction of TDS

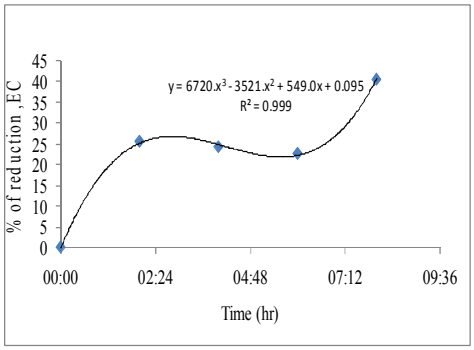

Figure 4. Percentage in reduction of EC

Raw water (hand pump) and gang canal water quality may be similar, when we treated with solar radiation in 2 hrs, 4hrs, 6hrs and 8hrs continuous exposure then the gradually water quality enhance up to pure drinking standard [8] Fig.1 shows the total coliform bacteria were inactivated in corresponding to solar radiation dose and temperature increase. But below 500 W/m^{2}solar radiation could not inactivate the bacteria [9]. In fig.2, 3, and 4 shows the SODIS treatment is also beneficial for removal of other water contaminant like EC, TDS and Turbidity etc. we recommend to rural and other residential place where water purification facility is not available this technology is eco-friendly and low cost budget purification of water .

CONCLUSION

SODIS disinfection is effective and simple methods to kill microbiological organisms. The inactivation of microbes depends on the length of exposure time, solar radiation and climatic condition under which the sample is exposed to sunlight. The overall efficiency of the SODIS under this study reduces the concentration of total coliform from high risk concentration to low risk concentration.

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REFERENCES

1. Gurung P.et.al (2009), Dissemination the SODIS Method: Which approach is more effective? Waterline, vol.28. 2. Practical action publishing.
2. Sommer B. et.al (1997), an Emerging water treatment process, J water SRT – Aqua vol.46, 3. Pp127-137
3. Acra A., M. Jurdi, H. Mu'allem, Y. Karahagopian, and Z. Raffoul, (1989).Water Disinfection by Solar Radiation Assessment and Application, Ottawa, Ont., IDRC.

4. Simon Dejum,(2007), Effect of Solar water distribution on Modern microorganisms under improved and field SODIS conditions, Journal of Water supplt Research and technology, pp 245-256
5. Wegelin, M., S. Canonica, K. Mechsner, T. Fleischmann, F. Pesaro and A. Metzler,(1994), Solar water disinfection: scope of the process and analysis of radiation experiments. J. Water SRT
6. Kowalski, W. J., Bahnfleth, W. P., Witham, D. L., Severin, B. F. &Whittam, T. S. 2002 Mathematical modelling of ultraviolet germicidal irradiation for air disinfection. Quantitative, Microbiol. 2, 249–270
7. APHA, AWWA, WEF(2005). Standard Methods for the Examination of Water and Wastewater, 21th edition. APHA, AWWA, WEF, Washington DC, USA.
8. WHO(2010),Drinking Water Quality available on line www.who.int/**water**_sanitation_health/dwq/guidelines/en
9. SANDEC(2002), Solar Water Disinfection; a guide for the application of SODIS ,available on line www.sodis.ch

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SUSPENDED MATTERS IN THE RIVER JUZNA MORAVA BASIN

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ABSTRACT

This paper analyses suspended matter in the river Juzna Morava as well as in its main tributaries, during the ten year period (2000. – 2009.), considering the human as well as natural impact to this occurrence and propagation of suspended matters.

Key words: suspended matters, river basin

INTRODUCTION

The river Juzna Morava is the shorter tributary of the river Velika Morava. It derives in Macedonia, flows through Kosovo and Serbia. Its average discharge is 100 m^3/s at its junction and so it is not compatible for river transport. Juzna Morava flows through a numerous gorges and valleys, and through and beside settlements of which some represent a significant source of pollution. As the result of enormous erosion in its basin, the river Juzna Morava is highly loaded with matter that precipitates and so causes floods in area around.

Juzna Morava has 157 tributaries. Some of the main tributaries, here analyzed, are Vlasina, Veternica, Pusta reka, Toplica, Nisava (the longest tributary). Each of them seasonally in different way impacts the main stream with the quantity of water and suspended matter content [1]. The content of suspended matter reflects to the river quality and sometimes can cause unusual water appearance.

MATERIAL AND METHODS OF WORK

In this paper there were used data published by the Republic Hydro meteorological Service in annual reports [2] and here were analyzed 9 measure points of the river Juzna Morava basin. Four of these measure stations are installed at the main stream of Juzna Morava (measure stations: Vladicin han, Grdelica, Aleksinac, Mojsinje) and the rest profiles are placed on its tributaries – Vlasina, Veternica, Jablanica, Toplica and Nisava (measure stations: Vlasotince, Leskovac, Pukovac, Doljevac, Nis).

Here are analyzed data about suspended matter content at these profiles during the ten year period (2000. – 2009.) including in consideration data about river flow and season.

RESULTS AND DISCUSSION

Suspended matters unlike other water quality parameters are determined quite often.

Maximal allowed concentration (MAC) of suspended matter for Juzna Morava, according to the established legislative [3] is 40 mg/l at the measure stations Vladicin Han (MS1) and Grdelica (MS2) and 30 mg/l at the measure stations Aleksinac (MS3) and Mojsinje (MS4). More than 20% of analyzed samples of water taken from MS1 and MS2, as well as more than 30% of analyzed samples of water taken from MS3 and MS4, had the content of suspended matter over MAC for this parameter.

For the main stream of Juzna Morava and its quality at the analyzed 4 profiles, March and April are typical for occurrence of maximal values of suspended matters during the year. Suspended matter concentrations at the measure profiles Aleksinac and Mojsinje often excess the MAC also in November and December.

Since the suspended matter concentration determination is not continual and that there are periods of a few months when this parameter wasn't determined at all, there is reasonable assumption that excess in suspended matter content is even more often, which causes that the river much more often aren't in accordance with required water quality. Suspended matter concentrations for each measure station (MS1, MS2, MS3 and MS4) for the analyzed 10 year period are presented at graphs bellow (Fig. 1,2).

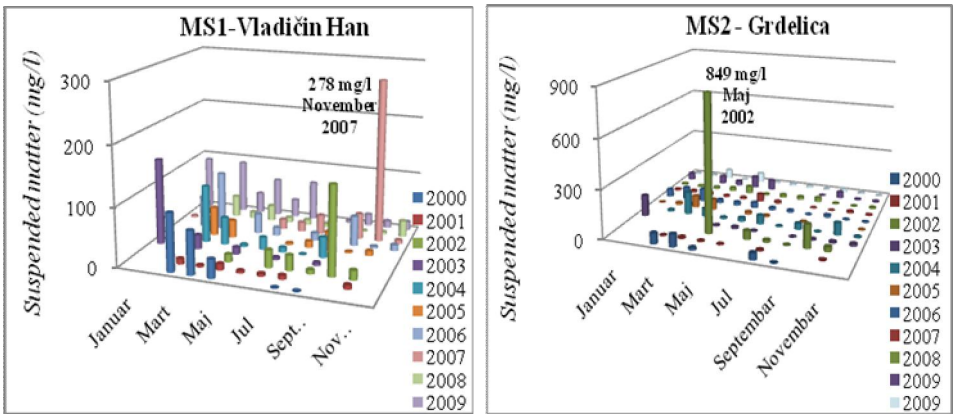

Figure 1. Graph 1. Suspended matter concentration (mg/l) in water samples from the MS1-Vladicin Han, during months in period 2000. – 2009.
Graph 2. Suspended matter concentration (mg/l) in water samples from the MS2-Grdelica Han, during months in period 2000. – 2009.

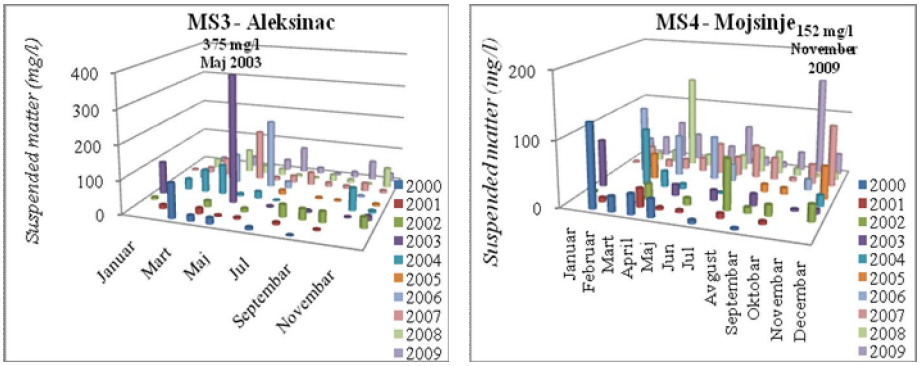

Figure 2. Graph 3. Suspended matter concentration (mg/l) in water samples from the MS3-Aleksinac, during months in period 2000. – 2009.
Graph 4. Suspended matter concentration (mg/l) in water samples from the MS4-Mojsinje, during months in period 2000. – 2009.

During the analyzed period the highest registered concentration of suspended mater at the above mentioned profiles were 152 mg/l at MS4 (Novembre 2009.), 278 mg/l at MS1 (Novembre 2007.), 375 mg/l at MS3 (Maj 2003.) and even 849 mg/l at MS2 (Maj 2002.). Minimal concentrations are characteristical for autumn (period september - novembre).

Propagation of suspended mater along the main stream of Juzna Morava, for each month of characteristic years are presented at the following graphs (Graph 5–8, Fig. 3,4).

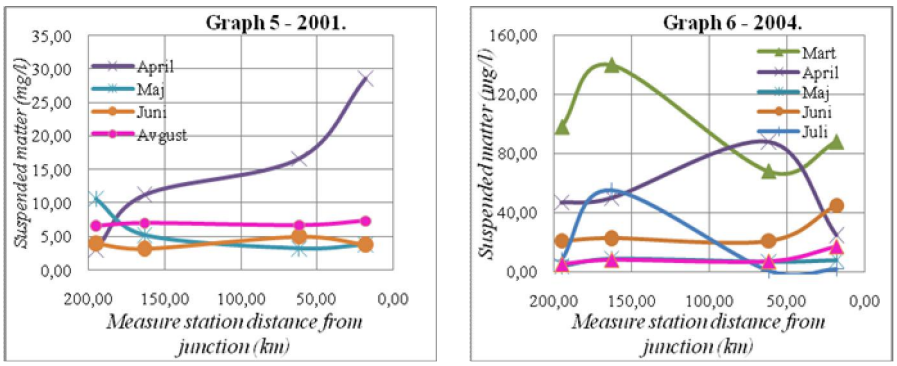

Figure 3. *Graph 5 and Graph 6. Suspended matters propagation along the main stream of Juzna Morava in 2001. and 2004. year: MS1 at 195 km from junction, MS2 at 163 km from junction, MS3 at 61,8 km from junction and MS4 at 18,1 km from junction*

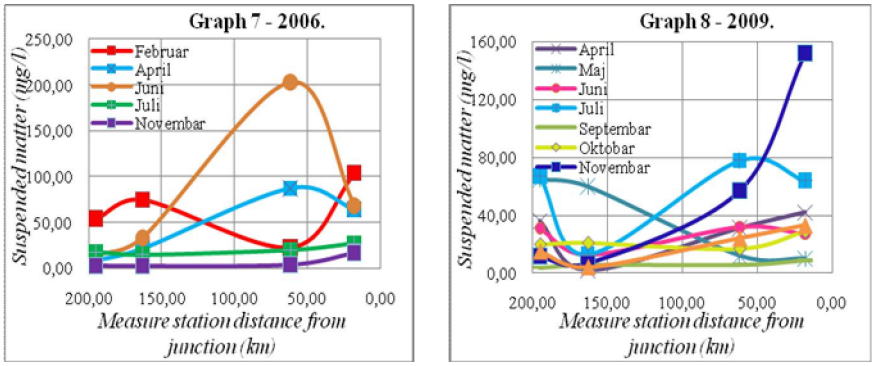

Figure 4. *Graph 7 and Graph 8. Suspended matters propagation along the main stream of Juzna Morava in 2006. and 2009. year: MS1 at 195 km from junction, MS2 at 163 km from junction, MS3 at 61,8 km from junction and MS4 at 18,1 km from junction*

According to the analyzed data, there is not possible to determine and predict the way of suspended matter concentration change along the main stream of Juzna Morava. Comparing the extreme values of suspended matters in water samples at the first two (Vladicin Han, Grdelica) and the last two (Aleksinac, Mojsinje) measure stations, in percentage there are more samples with excesses MAC for suspended matter at MS3 and MS4, than at MS1 and MS2.

For measure stations at the Juzna Morava tributaries Vlasina, Veternica, Jablanica, Toplica and Nisava (MS5 – Vlasotince, MS6 – Leskovac, MS7 – Pukovac, MS8 – Doljevac, MS9 - Nis) there is hard to determine eventual seasonal regularity of maximal concentrations of suspended matter occurrence. Nevertheless, it is indicative that the minimal number of suspended matter concentration higher than MAC is characteristic for September and October. Since in the most cases the suspended matter concentration at MS3 (Aleksinac) is higher than at MS2 (Grdelica), tributaries contribution to this water quality parameter value should be taken in consideration. Tributary water samples there were less cases of suspended matter concentration over MAC than in the main stream of Juzna Morava.

To what extent Juzna Morava's tributaries – Vlasina, Veternica, Jablanica, Toplica and Nišava load the main stream with suspended mater, it is presented at the following graphs (Graph 9-12, Fig. 5,6) for year 2001., 2004., 2006. and 2009.

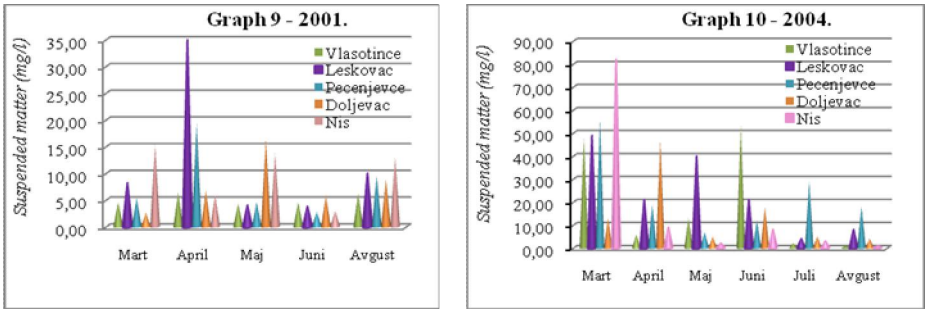

Figure 5. Graph 9 and Graph 10. Suspended matter concentration at MS5 – MS9 in 2001. and 2004.

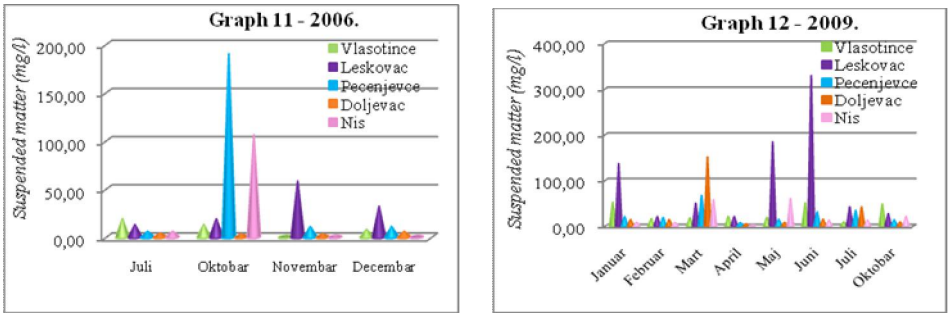

Figure 6. Graph 11 and Graph 12. Suspended matter concentration at MS5 – MS9 in 2006. and 2009.

Taking in consideration the tributaries as one, conjoint source of suspended matter, and comparing the suspended matter concentration at MS2 and MS3, in more than 77% of analyzed samples the sum of suspended matter that comes into the main stream from the tributaries is higher than this parameter value at single measure stations MS2 and MS3. 40% of cases are those when suspended matter concentration at MS2 is higher than at MS3. Hence, there is reasonably to conclude that the tributaries even though have great impact to suspended matter concentration increase in the main stream, summarily contribute to the main stream dilution thanks to their flow quantity.

The following Graph 13 (a, b) and Graph 14 (a, b) (Fig.7) present how the analyzed tributaries of Juzna Morava impact the main stream with water quantity and suspended matter concentration, in 2004. and 2009. year.

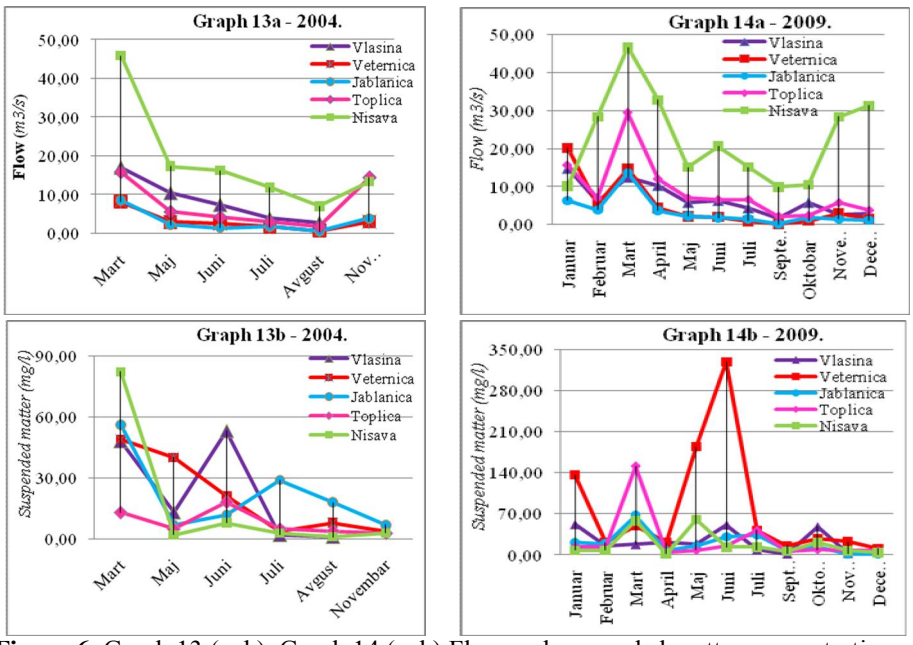

Figure 6. Graph 13 (a, b), Graph 14 (a, b) Flow and suspended matter concentration at MS5 – MS9 at rivers Vlasina, Veternica, Jablanica, Toplica i Nisava in 2004. i 2009.

CONCLUSION

Concentrations of suspended matter in the river Juzna Morava basin vary during the analyzed period and it is hard to determine eventual seasonal occurrence regularity of these concentrations values over the determined MAC for the required water category. The main stream is highly loaded with suspended matter as the result of highly expressed erosion in the river basin.

Tributaries also have significant impact to suspended matter concentration in the main stream, but this aspect is decreased since the tributaries contribute the main stream flow increase and so the water dilution. According to presented data, Nišava as the main tributary contributes to the main stream water quantity with the greatest ammount of water and on the other hand very rarely impact the main stream with high concentration of suspended mater.

Suspended mater is one of the parameter taken in account in water category as well as in water quality index determination and so should be determined more frequently at the measure stations in the river basin of Juzna Morava, since the previously provided data indicate very often high values of this parameter that exceed MAC for the required water quality.

REFERENCES

1. www.wikipedia.org
2. Republicki hidometeoroloski zavod Srbije, Hidroloski godisnjaci – Kvalitet voda 2000. – 2009
3. Uredba o klasifikaciji voda („Službeni list Srbije" br. 5/68)

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NEW TECHNOLOGY OF BIODEGRADATION OF PAH/s/ IN SLUDGE

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ABSTRACT

The objective of the work was a laboratory examination of biodegradation of sewage sludge from the Central Wastewater Treatment Plant (ÚČOV) in Ostrava, which had undergone physical pre-treatment by means of a spark discharge or UV radiation. The laboratory tests made use of a bacterial mixture of *Rhodococcus sp.* and *Pseudomonas putida*.

Key words: Biodegradation, polyaromatic hydrocarbons, *Pseudomonas putida, Rhodococcus sp.*, sewage sludge

INTRODUCTION

As soon as man started to think, they began transforming and using the nature to their advantage. The first negative impacts were almost minimal compared with the present ones, when the developing industry burdens the environment with a wide range of wastes. Fortunately, today the environmental protection is of a higher priority than in the past. Yet, the majority of methods are influenced by the extent of required investment. Therefore, some methods are not applicable despite their high efficiency. A method which appears as a both relatively inexpensive and effective alternative is biodegradation, which is used to eliminate contaminants by microorganisms.

Biodegradation (biological decontamination) is based on the ability of certain bacterial strains to use hydrocarbons as the source of carbon and energy for their growth, which results in the degradation of contaminants all the way to harmless products – carbon dioxide and water [1].

The ability of microorganisms to degrade hydrocarbons has been known since 1895 when Miyoshi described the growth of yeasts on paraffin for the first time and shortly, an ability of bacteria to make use of methane as the source of carbon was discovered. It was gradually proved that they can degrade practically all constituents of crude oil and many other hydrocarbons. Currently, more than 200 species of microorganisms capable of hydrocarbon degradation have been described.

BIODEGRADATION METHODS

Several approaches are used to eliminate hydrocarbons, where the most applied one is a use of microorganism strains isolated from different sites with precisely defined characteristics and a known spectrum of substance they are able to degrade. The strains are used in mixtures, which are prepared according to the type of pollution, type of locality and conditions of degradation. The strains or their mixtures are applied repeatedly, and thus they only need to be multiplied and activated [2].

A general principle of biological degradation of contaminants is a bacterial action at a sufficient supply of oxygen (aerobic conditions), which leads to a conversion of pollutants to carbon dioxide, water and biomass [15]. A great number of the aerobic microorganisms have been described, among which there are the representatives of the genera of *Pseudomonas, Acinetobacter, Corynebacterium, Rhodococcus, Alcaligenes, Achromobacter, Arthrobacter, Nocardia, Bacillus* and others [1].

In anaerobic conditions pollutants are converted by metabolic processes into methane and a limited amount of carbon dioxide and hydrogen [8]. Only very few anaerobic bacteria have been isolated so far. The most frequently these are microorganisms participating in the biodegradation of highly chlorinated compounds, and they rank among the genera of *Desulfomonile, Clostridium, Desulfitobacterium,* etc. [1]. Potential intermediate products formed during the process of biodegradation are less toxic, equally toxic or even more toxic than the original contaminant [7].

Decontamination methods are classified according to a number of aspects:

1. **According to the aim**, when the contaminated rock environment is either isolated inserting a mechanical or hydraulic barrier, and thus the spread of contamination in the unsaturated zone or ground water into the clean environment is prevented, or complete or partial decontamination of the rock environment should be accomplished. A partial decontamination only ensures isolation and decontamination of the centre of contamination.
2. **According to the technological function**, when the contaminated material is removed extracting the rocks, venting the soil air or pumping the contaminated water; next, the contaminated material may be degraded by means of biological or physical-chemical processes or the contaminant may be fixed by physical or physical-chemical methods into the soil or other matrix (solidification).
3. **According to the point of remediation.** These are in-situ methods, when the decontamination takes place directly in the rock environment. In the unsaturated zone the most common method is biodegradation, venting and bioventing, or washing. Another possibility are ex-situ methods, when remediation takes place on the ground surface. The contaminated material is supplied into a suitable cleaning device. The ex-situ methods are further divided into "on-site" and "off-site" methods.The last methods are auxiliary methods which are used to improve the permeability of the environment, to pump, vent or, on the contrary, to supply the decontamination solutions into sites difficult to access.
4. **According to the establishment,** the technologies divide into verified, which are well-established and time tested technologies, where the technological procedure, efficiency as well as possible drawbacks and limitations are known in detail.

Another group includes incipient technologies, which are well known but have not been tested on a long term basis.

The last group are experimental technologies [1].

POLYCYCLIC AROMATIC HYDROCARBONS

Polycyclic aromatic hydrocarbons (PAHs) are substances whose two (or more) benzene nuclei (aromatic rings) are connected in a way that two atoms are common for both the rings [11]. These are organic compounds formed by two or more condensed aromatic nuclei in a linear, angular or cluster arrangement [9]. The group of substances is represented by 280 basic hydrocarbons, but the number increases due to the quantity of isomers [8].

Among the most known PAHs, according to US EPA, there are the 16 compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, fenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3,c,d)pyrene, dibenz(a,h)anthracene and benzo(g,h,i)perylene [11].

CHARACTERISTICS OF PAHS

PAHs are crystalline substances, mostly white or colourless, but they also may be whitish or greenish. PAHs and their derivatives intensely absorb light in the visible and near ultraviolet region of the spectrum. Some even fluoresce.

In general, the physical and chemical characteristics of PAHs change with the molecular mass. Along with a rise in the molecular mass, there is a decrease in water solubility and vapour tension, an increase in the fusion point (roughly from 80 °C) and the boiling point (approximately from 200 °C). Under certain conditions some PAHs are soluble in water (e.g. chrysene, 1,12-benzoperylene), they succumb to photooxidation (fenanthrene) or biochemical degradation [3]. They are capable of long term persistence in the environment, they are toxic, carcinogenic and mutagenic. Thanks to their characteristics, they are considered as typical representatives of persistent organic pollutants (POPs). They can combine with solid sorbents or particles (dust), as well as live organisms (capacity of bioaccumulation).

A significant capacity of PAHs is to create further compounds which may be even more carcinogenic [6].

BACTERIA OF *Pseudomonas* GENUS

Pseudomonas bacteria are gram-negative, chemoorganotrophic, obligate aerobe microorganisms with aerobically respiratory metabolisms. Some species are facultatively chemolithotrophic.

They are straight or curved rods (Figure 1) of dimensions between 0.5 and 1.0 μm x 1.5 – 4.0 μm. They move by means of one or more polar-located flagella. They are arranged mainly individually or in small clusters or chains. They grow under strictly aerobic conditions in common culture media, on which they form irregularly large colonies producing water-soluble exopigments of pyocyanine and fluoresceine, which diffuse into the environment and dye it yellow or blue-green. Older cultures dye dark brown.

The temperature range for their growth is 0 – 42 °C; the optimum temperature is 35°C. The enzymatic activity is dependent on ecological conditions out of which the individual strains were isolated. They make use of some sugars, out of which they form acids. The majority of strains reduce nitrates to nitrites. They mostly live saprophytically in the soil and water. Some species appear as potential pathogens.

Figure 1. *Pseudomonas putida* [12].

BACTERIA OF *Rhodococcus* GENUS

The bacteria of *Rhodococcus* genus are gram-positive, strictly aerobic, non-sporulating rods (Figure 2) with a morphological cycle rod – coccus. The colonies may be rough, smooth or mucoid, with a whole colour range of pigments. They are partially acidoresistant, positive catalase, negative arylsulphatase, sensitive to lysosome, unable to degrade casein, cellulose, elastin or xylan [5]. The size of the cells fluctuates between 0.5 and 3.5 μm. The optimal temperature for their growth ranges between 25 and 35 °C. In the nature, they occur as saprophytes [4].

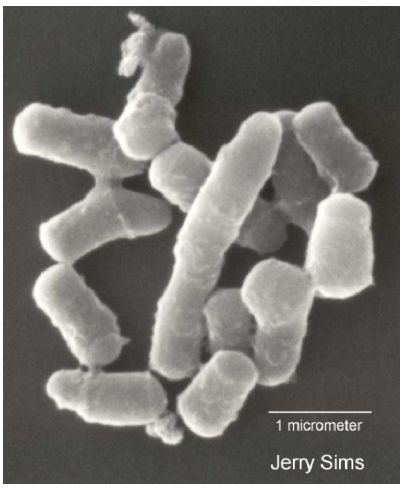

Figure 2. *Rhodococcus sp.* [10].

METHODS OF LABORATORY BIODEGRADATION

The samples of unlimed sludge were drawn from the premises of the Central Wastewater Treatment Plant (ÚČOV) in Ostrava-Přívoz by the staff of the Water Research Institute of T.G. Masaryk (VUV T.G.M.) in Ostrava. The samples underwent laboratory biodegradation in the laboratories of the Institute of Environmental Engineering at VŠB – TU Ostrava. The physical pre-treatment and chemical analyses were carried out in the laboratories of VUV T.G.M.

A bacterial mixture of *Pseudomonas putida* and *Rhodococcus sp.* in1:1 proportion was used for the biodegradation of sludge. The bacteria had been obtained from the Czech Collection of Microorganisms at the Faculty of Natural Science of the Masaryk University in Brno.

The nutrients for cultivation were supplied via nutrition solutions - culture media - M1 for *Pseudomonas putida* and medium M96 for *Rhodococcus sp.* Five-litre beakers were used as a "bioreactors". Aerobic conditions were ensured by aquarium compressors. This set was placed into a hood. In the individual "bioreactors" 300 g of the sample, 750 ml of medium M1, 750 ml of medium M96, 150 ml of bacterial solution *Pseudomonas putida*, 150 ml of bacterial solution *Rhodococcus sp.* were prepared for the degradation.

Prior to the biodegradation the samples underwent physical pre-treatment, which was grounded in the action of a spark discharge or UV radiation. The own biodegradation lasted for 28 days. Next, the samples were filtered, dried and sent for analyses in VUV T.G.M. The obtained results are summarized in Table 1 and evaluated in Figure 3.

Table 1. Concentration of PAHs in mg/kg in the sludge post biodegradation combined with physical pre-treatment.

Sample designation	Unlimed sludge, feed	Unlimed sludge, spark	Unlimed sludge, UV	Feed post biodegrad.	UV post biodegrad.	Spark post biodegrad.	Feed check	UV check	Spark check
Solids, %	27,6	27,9	28,3	28,1	33,9	24,9	66,9	66,4	61,5
Naphthalene	2,9	1,5	2,0	0,73	0,63	0,68	1,1	1,1	0,92
Acenaphthene	48,7	47,1	48,7	3,87	4,02	3,46	3,3	3,26	2,67
Fluorene	22,0	22,0	22,0	7,2	7,6	6,8	5,8	5,5	4,8
Fenanthrene	20,0	19,0	19,0	2,3	2,3	1,7	2,2	2,2	2,0
Anthracene	1,5	1,5	1,3	0,045	0,048	0,018	0,052	0,053	0,054
Fluoranthene	5,6	5,3	3,1	4,3	3,9	3,8	5,0	5,8	5,2
Pyrene	3,4	2,9	2,5	4,0	2,7	2,9	4,0	4,6	4,1
Benzo(a)anthracene	5,9	5,9	5,9	4,9	4,8	4,7	4,5	4,3	3,6
Chrysene	4,3	4,2	4,3	4,6	4,7	3,9	3,3	3,2	2,7
Benzo(b)fluoranthene	7,7	7,6	7,6	7,6	7,9	7,5	9,9	9,7	8,4
Benzo(k)fluoranthene	4,6	4,6	4,5	4,9	4,4	4,3	6,0	4,5	4,1
Benzo(a)pyrene	7,1	7,0	6,7	7,8	6,4	6,3	9,0	8,7	7,6
Benzo(g,h,i)perylene	5,9	5,7	5,7	5,5	4,9	5,0	6,5	6,8	6,2
Dibenzo(a,h)anthracene	1,3	1,2	1,1	1,1	1,2	1,2	1,4	1,4	1,3
Indeno(1,2,3,c,d)pyrene	5,8	5,6	5,4	5,7	5,3	4,5	5,7	5,8	5,6
SUM of PAHs (15)	**147**	**141**	**140**	**64,5**	**60,8**	**56,8**	**67,8**	**66,9**	**59,4**

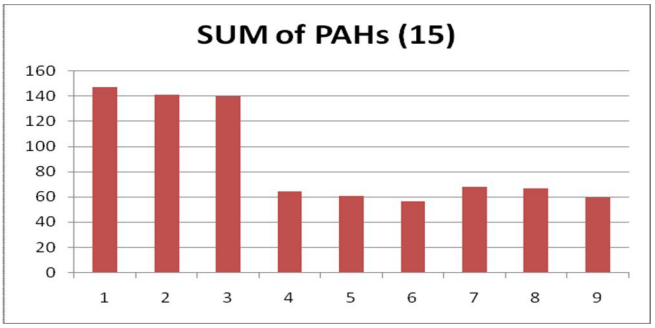

Figure 3. Graphic overview of PAH results.

CONCLUSION

The objective of the work was to examine the laboratory biodegradation of unlimed sewage sludge from ÚČOV in Ostrava which had been physically pre-treated by a spark discharge and UV radiation. The tests were implemented using a bacterial culture mixture of *Pseudomonas putida* and *Rhodococcus sp.* in 1 : 1 proportion. In total, 15 PAH compounds were analyzed.

The results imply that the action of the mixed bacterial culture succeeded in the elimination of 56,12 % of the sum of 15 PAHs in the feed sludge sample. When compared with the results of the samples which had been physically pre-treated, better results were acquired with the sludge sample which had been exposed to the spark discharge before the biodegradation process – 59,72 % of the sum of 15 PAHs were removed. In the sample which had been exposed to UV radiation and consequently biodegraded the value of removed PAHs is 56,57 %.

As proved by the input sample analysis, they were contaminated materials. Having carried out laboratory experiments and evaluated the obtained results, it is clear that the sludge biodegradation, or the contained pollutants, is possible. The potential incorporation of the biodegradation process to decontaminate sewage sludge from ÚČOV in Ostrava is conditioned by the process optimization. Naturally, time plays an important role there and considering the biodegradation output values after 28 days, it may be stated that prolonging the time horizon, much better results will be obtained.

Acknowledgment

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REFERENCES

1. Biodegradace a biodeteriorace [online]. 2004, 3. dubna 2008 [cit. 2007-11-03]. Dostupný z www: <http://www.vscht.cz/kch/kestazeni/sylaby/biodegbiodet.pdf>.

2. Fečko, P. et al. Environmentální biotechnologie. Ostrava: Ediční středisko VŠB-TU Ostrava, 2004. 180 s. ISBN 80-248-0700-9.
3. Herza, T.: Sledování jakosti vod [online]. [2003], 6. listopadu 2003 [cit. 2008-02-10]. Dostupný z WWW: <http://voda.chmi.cz/ojv2/default.htm>.
4. Lyčková G. et al.: Biodegradace PAU, PCB a NEL ve vzorku sedimentů Černého potoka (Česká republika). In Fečko, Peter; Čablík, Vladimír (ed). Možnosti zpracování odpadů po důlní a metalurgické činnosti: 1.12. – 2.12.2005, VŠB-TU Ostrava. Ostrava: VŠB-Technická univerzita Ostrava, 2005. s. 69-72. ISBN 80-248-0949-4.
5. Marine Pollution Bulletin, Volume 48, Issues 3-4, February 2004, Pages 341-350.
6. Petrlík, J.: Budoucnost bez jedů [online]. 2005, 18. července 2005 [cit. 2008-01-14]. Dostupný z www: <http://bezjedu.arnika.org/chemicka-latka.shtml?x=319920>.
7. Pokorná, T.: Polychlorované bifenyly. Waste [online]. [online]. 2004 [cit. 2008-01-13]. Dostupný z www: <http://www.waste.cz/waste.php?clanek=03-04/PCBuvod.htm>.
8. Raclavský, K., Raclavská H., Matýsek, D.: Ochrana půd [CD-rom]. Ostrava: VŠB – Technická univerzita Ostrava, 2002.
9. Salava, P. et al.: Výzkum a pilotní ověřování nových sanačních technologií a [online]. c2005-2006, 23. dubna 2006 [cit. 2008-01-11]. Dostupný z www: <http://www.ekosystem.cz/vav/x/2.htm>.
10. Sezima, T.: Biodegradace vybraných škodlivin v půdách a vodách. Ostrava, 2003. 153 s. Vysoká škola báňská-Technická univerzita Ostrava.
11. Štursa, P.: Aromatické sloučeniny. [s.l.], 2003. 80 s. Katedra organické chemie Přírodovědecké fakulty Masarykovy univerzity. Diplomová práce. Dostupný z www: <http://koch.chemi.muni.cz/vyuka/aromaty/index.htm#predmluva>.
12. Visuals unlimited [online]. [2005], 6. dubna 2008 [cit. 2008-02-12]. Dostupný z www: <http://www.visualsunlimited.com/>.

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THE PROBLEM OF AIR POLLUTION AND REGULATIONS OF THE REPUBLIC OF SERBIA

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ABSTRACT

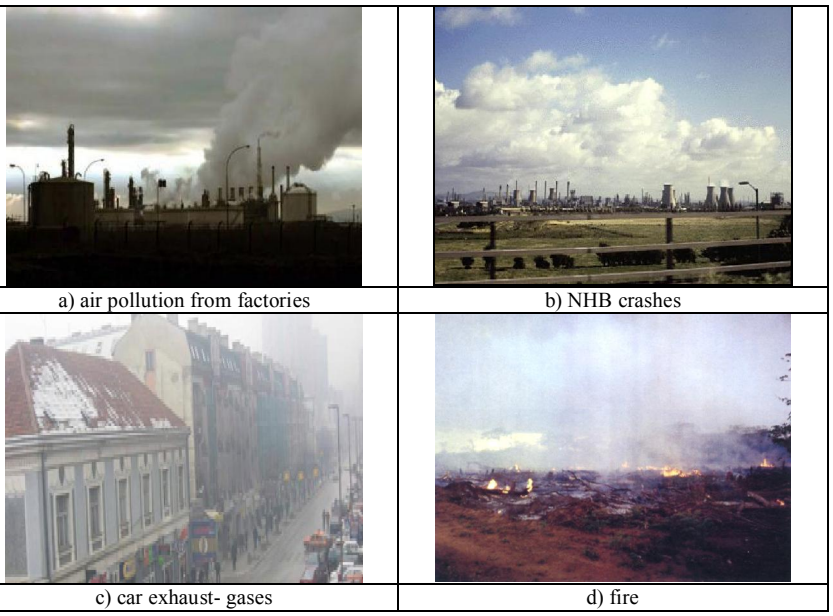
Environmental pollution has become more intensive process which cannot be stopped, but which we can consciously act on. Basic and the most frequent pollution sources of urban environments are: technological industrial processes, traffic, factories, institutes and hospitals, thermal and heating plants and chimneys, solid and liquid waste, pesticides and other sprayers, fires, natural catastrophes. Lately air pollution is taking proportions that require special attention in the sense of taking the protective measures. Necessary protection of air pollution provides the quality of live in the settlements and industrial centers and the protection of ecological potential of natural environment is emerging as one of the imperatives of the development. The overall objective of the legislation, relating the quality of air, is to reduce harmful emissions into the atmosphere and ensure the quality of air which is acceptable from the standpoint of protecting human health and environmental protection. Legislation regulates the standards for air quality, maximum emissions from different sources.

Key words: air pollution, smog, fuel, traffic, concentration, regulations

INTRODUCTION

Air pollution implies presence of one or more undesirable solid, liquid or gaseous substance in the air, in a certain amount, of certain properties and in a certain time period, which causes threats for man, flora and fauna preventing in some way a comfortable life and enjoyment in the environment. Industrial revolution is one of main reasons for increase of air pollution which has been recorded in the last three centuries, Fig. 1. Under certain conditions, smoke and sulfur dioxide appear by burning coal, they can conjugate with fog producing industrial smog (winter smog). In high concentrations smog can be extremely toxic, both for humans and other living organisms. Nowadays, creation of industrial smog has been significantly reduced owing to use of other kinds of fuels. However, burning of liquid fossil fuels, such as petrol, new air pollutants may

occur, which can cause a new problem, known as photochemical smog (summer smog). Basic and most common sources of pollution in urban environment are: technological processes in industry, transportation (internal combustion engine), companies, institutes and hospitals, power plants and chimneys, solid and liquid waste, pesticides and other sprayers, facilities (with noise and vibration), NHB crashes and fires, natural disasters, war destructions, NHB terrorism, table 1.



a) air pollution from factories | b) NHB crashes

c) car exhaust- gases | d) fire

Figure 1. Air pollution

Table 1. Main air pollutants in urban areas

Pollutions	Main Sources	Mean Annual Concentration ($\mu g/m^3$)	Influence on environment and human health
Solid particles (dust, ash)	Burning of fuels	0.04-0.4	Reducing of solar insolation and visibility, increasing cloudiness, appearance of fog. Possible lowering of the temperature of the Earth.
Sulphur-dioxide	Burning of fuels	0.5-1	Chronic disease of plants, reducing yields in agriculture, deforestation. Respiratory disease.
Nitrogen oxides	Oxidation of atmospheric nitrogen and nitrogen from fuels at high temperature	0.05-0.2	Absorption of sunlight, creation of photochemical fog-smog. Destruction of a number of materials, reducing yields, deforestation. Reducing the content of hemoglobin in the blood.
Carbon monoxide	Incomplete combustion	1-50	Reducing the content of hemoglobin in the blood.
Soluble hydrocarbons	Incomplete combustion of fuels	to 3	Disease of plants with higher concentrations of 0.2 $\mu g/m^3$. Exasperating effect on the eyes.

Even when the air looks clean, when there are no forms of dust and smoke, the air can be polluted with tiny invisible particles of aerosols. The emission of particles in industrial zones depends on the kind of industry (particles of cement, coke, metal oxides etc.). If the particles mix with remains of oil and solvent, they create sticky mixture difficult for washing off. In the atmosphere heavy metals appear in the form of particles and gases. The time of keeping of aerosols in the air depends on the size of particles. Short staying time is characteristic for most particles of industrial origin. In the waste emissions of metal into the atmosphere lead is most frequent. Measurements of heavy metals in tissues of plants show dependency of heavy metal content from the distance of the contamination source in the sense of establishing decreasing gradualism. Serbia has many cities where pollution exceeds limits.

EUROPEAN UNION REGULATIONS IN THE FIELD OF AIR POLLUTION

The European Union harmonizes ecological legislation throughout Europe and thus ensures a high level of environmental quality, especially in member countries, but also for other European citizens in the parts of Europe, and so far beyond the EU borders. Candidate countries are required to adopt, by the date of accession to the EU, the legislation in the field of environment and complete its application within about 10 years of post-accession (source UNDP study, Bratislava, 2004).

The Directive of the Council 96/62 EC in assessing and managing air quality is a general legislative framework in this area. The objectives of the Directive are as follows: define and set objectives for ambient air quality and make this information available to the public. This Directive has established a group of atmospheric pollutants, which are supposed to define specific standards on air quality, within special directives-sisters. This list includes CO_2, HO_2, particular particles, lead, ozone, cadmium, arsenic, nickel and mercury. Member countries are obliged to identify areas where air quality is to be estimated, changing the measurement or modeling. For areas where the actual level of any one or more pollutants exceed the maximum value or limit of tolerance, they are obliged to adopt and implement an action plan to achieve the maximum values in given time. The plan is given to the public and should contain information defined in the Directive, including the origin and nature of pollution, its spatial and temporal distribution and detailed information about the activities and projects aimed at reducing pollution. In areas where pollution levels do not exceed maximum value, member countries are obliged to maintain air quality.

REVIEW OF SERBIAN REGULATIONS ON THE CONTROL OF THE POLLUTERS' EMISSION INTO THE AIR

Law regulations and normative activity in the field of atmosphere protection includes a group of measures, obligations and conditions for preserving natural values and protection of human health and quality of living environment from consequences of air pollution. In our legislation norms for emission are being covered by the following republic laws and regulations:

- The Law on the environmental protection (Official register RS 135/04)
- The book of regulations on the border emission values, the way and deadlines for measuring and data recording (Official register RS 30/97 and 35/90).

The Law on the environmental protection (Official register RS 135/04) defines basic regulations of law, obligations and interests that are directed towards preserving quality of air. The book of regulations on the border emission values, the way and deadlines for measuring and data recording (Official register RS 30/97) defines border emission values (BEV), that is regulates the highest allowed level of quantities and concentrations of harmful and dangerous substances on the place of the pollution resource, while the level, quantity and concentrations of harmful and dangerous substances is determined by measuring.

Border emission values (BEV), according to the book of regulations on the border emission values, the way and deadlines for measuring and data recording (Official register RS 30/97 and 35/90), article 3, can be presented through the following:

1. Mass concentrations (mg/m^3 or g/m^3) – as the mass of emitted substances in relation to the unit of volume of smoke gas with no humidity at 0ºC, the pressure of $101,3x10^3$ Pa and submitted volume part of oxygen;
2. Mass flow (mg/h or g/h) – as the mass of emitted substances in relation to the time unit;
3. Emission factors (g/t or kg/t) – as the mass of emitted substances in relation to the mass of produces, that is the plant for burning in relation to the mass of burned fuel;
4. Emission degree (%) – as the relation of emitted quantity and the quantity of the same substance that enters the process.

Article 5**.** (Official register RS 30/97 and 35/90) processes types of carcinogenic substances, their class, border emission value and the value of mass flow for the given substances and according to it, border values are:

- for cadmium and its compounds (Cd): class 1, BEV is 0,1 mg/m^3 with mass flow of 500 mg/h and higher
- for lead and its compounds (Pb): class 2, BEV is 1 mg/m^3 with mass flow of 5 g/h and higher,
- for total mass concentrations of all carcinogenic substances from class 1 and 2 that are present in the waste gas at the same time, BEV 1 mg/m^3.

Article 10. (Official register RS 30/97 and 35/90) according to which mass concentration of harmful and dangerous substances in waste gas is expressed in the unit of volume of dry waste gas at the temperature of 0 ºC and under pressure of $101,3 \times 10^3$ Pa.

STRATEGY OF AIR POLLUTION

Pollution prevention, remediation of already polluted air, and return the environment to its original natural state requires a range of activities, the appropriate knowledge about the state of environment, emission of pollutants, pollutants distribution in the atmosphere, their reactions and climatic conditions and it is necessary to develop

appropriate strategies and protection. This strategy must include local, regional and global solution.

The strategy of air protection is based on two facts:

- everything that is produced provides certain benefits,
- the impact of production on the environment is damaging (dangerous).

The strategy of air protection should be directed so that it does not affect the manufacture but that the negative impact of production on the environment is reduced to a minimum, that the production has a positive impact on the environment. The real goal of production is satisfaction of human needs and thus improvement of its environment. Within the social planning it is necessary to plan such activities which will resolve problems of pollution of the environment – either by reducing emissions of pollutants or by their complete elimination. This could be activated by: introduction of so-called "pure" rather than "dirty" technologies, rational use of energy (thus reducing consumption of fossil fuels and the emission of pollutants), the appropriate geographical distribution of sources of pollutants, using devices to reduce emissions of pollutants, etc. Spatial plants of inner or wider areas (such as the Republic space plans) must contain requirements of the quality of the environment. It is therefore necessary to develop: kadastre of pollutants emission into the atmosphere, survey of meteorological parameters which influence the distribution of emitted pollutants, kadastre of air quality, and the assessment of pollutant effects on environment.

The emission of pollutants is the basis for spatial planning because it contains spatial arrangement of pollutant emitters, the size of the emission, the causes of emission (fuel, technological process, etc.), the size of emission by economic branches etc. On the basis of the mentioned data, with the aim of protecting the environment, it is possible to perform the appropriate arrangement of new sources of emission, select technologies and types of fuels that will be used.

CONCLUSION

Air pollution damage many parts of nature that are visible, and the consequences affect the general climate, because destruction of vegetation reduces the possibility of restoration of oxygen. Damage of air, as the basic condition of life, threatens human health and life, as well as the whole above-ground bioceonosis (forests and many plants). The consequence of air pollution on living organisms in biosphere and on the material goods, and it can easily be determined when the presence of a larger pollutant with well-known and easily measurable pollutants materials is evident.

Republic of Serbia in its process of integration into the family of the European Union must harmonize the regulations in the field of ecology. As it is necessary to harmonize the regulations it is also necessary to direct the population to develop awareness of the protection of the environment in which they live. It has already been common practice in the European Union, but unfortunately not in Serbia. The citizen must be well-informed mostly over the Strategy and national policy. The state must regulate, through the system of education, basic introduction into ecology, environment, human share in the pollution and the ways to prevent it all. Only the timely education and informing with consequences and the ways of their prevention can develop

awareness of man – his attitude towards the environment. For breach of the rules is still necessary to introduce a system of punitive measures.

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REFERENCES

1. Welburn A.: Air pollution and Acid Rain, Longam Scentifik and Technical, 2000.
2. Ljiljana Trumbulović-Bujić, Zagorka Aćimović-Pavlović, Ljubiša Andrić, Ilija Belić, Vladan Milošević: ''Management of Plastic Waste'', XIII International Scientific and Professional Meeting Ecological Truth (Ecoist'10), 01-04 June 2010, Spa Junakovic, Apatin, Serbia, ISBN 978-86-80987-79-1, p.286-292
3. R. Naiman, R. Bilby: River Ecology and Menagement, Springer, 2000.
4. The Technical Paper on Climate Change, Science, April 2008.
5. Ljiljana Trumbulović Bujić, Snežana Aksentijević, Vesna Vasović: Emission of harmful and waste gases, 8 th International Conference ″Research and Development in Mechanical Industry″, RaDMI 2008, 14-17. September 2008, Užice, Serbia
6. Dragan Nikolić: Protection of environment, Faculty of Mining, Kosovska Mitrovica, 2002.
7. Aksentijevic, S., Kiurski, J.,Vucinic Vasic,M., (2011) Arsenic Distribution in Water/Sediment System of Sevojno, Environmental Monitoring and Assessment, (acepted for press), 2011.
8. Kiurski, J,, Vučinić-Vasić, M., Aksentijević, S**.,** Kozmidis-Luburić, U., Vojinović-Miloradov, M.,: Metals Distribution and Particle Size Analysis in Water and Sediment of the Djetinja River and Dragića Spring (Serbia), Chemical Industry and Chemical Engineering Quarterly, Vol.16, No. 4, pp. 363-372, (2010): ISSN 1451-9372.
9. www.europa.int
10. Aksentijević S., Jocić N., Andrić M.,: Of Particular Devices for Purification of Gas Flows in The Plants For Cement Production, 1st International Conference "Science and Higher Education in Function of Sustainable Development", SED 2008, Užice, Srbija, 17-18. 9. 2008.
11. Aksentijević S., Kiurski J., Marjanović V.,:"Arsenic in Water/Sediment System", 3rd International Conference " Science and Higher Education in Function of Sustainable Development", SED 2010, 7-8 October 2010, Uzice, pp.69, ISBN: 978-86-83573-18-9
12. A. Gačić, N. Stavretović: Importance and influence of school yards green spaces on children development, Ecological truth, 2008. Sokobanja, Proeceedings, pp.305-308, 2008.

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NATURAL RESOURCE MANAGEMENT AS A FUNCTION OF ENVIRONMENTAL CONSERVATION

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ABSTRACT

The protection and preservation of a healthy environment is an imperative of any modern society. It is a wide range of duties that relate to large number of subjects, from citizens through business entities (companies, enterprises, entrepreneurs) to local governments and the highest social bodies and institutions.

Business activities greatly endanger the living environment. Most affected are benefits of the earth - air, water, forests, flora and fauna. This leads even to the question of survival of all living beings on earth.

Conflict relations between economy and ecology can be reconciled only with adequate management of natural resources. Namely, using the resources of nature must not endanger the living environment and resulting environmental damage must be repaired. In addition, exploitation of renewable natural resources should be in line with the process of their regeneration, and the use of nonrenewable resources must be conducted in an extremely rational manner, with maximal representation of substitutes and the recycling process.

Key words: environment, natural resourses management, renewable energy

INTRODUCTION

One of the basic principles of sustainable development is, of course, improvement of environmental quality. Unfortunately there was no adequate attention paid to this matter.Serious debates on this issue started during seventies of last century within the consideration of limits to economic growth.

Otherwise, the World is now faced with serious environmental problems of planetary importance, such as:

- "Ozone holes"- damaging the ozone layer that protects all living things on Earth from harmful ultraviolet rays of the sun;
- "Greenhouse effect"- continual warming of the planet that could lead to melting of eternal snow and ice, and thus to increase water levels of seas and oceans;
- "Harvesting" Amazonian rainforest - considered to be the lungs of the planet, thereby directly threatening the world climate.
- "Increased pollution"- as a result of rapid economic development [1].

For this reason, the exploitation and use of natural resources must not undermine the capacity of the living environment. The mankind must pay more attention to natural values as air, water, soil, forests, geological resources, flora and fauna. In this sense, natural resource management is gaining in importance.

TERM, DISTRIBUTION AND SIGNIFICANCE OF NATURAL RESOURCES

There is a considerable number of definitions of natural resources in economic theory. Every their author has his/her view and points out their character, their significance and the role in economic development, however, among these definitions there are no substantial results. We will point out some of them.

According to Komar, the resources mean energy that is used in the production process in accordance with the development of productive forces. According to Branko Djeric, natural resources constitute a special segment of manageable nature that is a part of nature that is used in the economic development and can be economically valorized. Further, for Blagoje Zarkovic, natural resources are different types of natural wealth which are the basis of human life and its basic activities. Finally, a rather complete and comprehensive definition of natural resources was given by professor Gojko Rikalovic. According to him, 'the natural resources" are specific forms of natural conditions in that stage of economic development involved in the reproduction process and are directly exploited in the production or processing. What elements of nature will appear as natural resources depend on the achievements in the development of technology, the economic possibilities and appropriateness of use and the level of exploitation"[2].

From all the aforementioned it comes out that natural resources are only one part of the natural conditions, that is a gift of nature, which is used in the process of reproduction to create new useful values.

Otherwise, the resources in nature, depending on the criteria that are used in this field, are classified in different ways. One of the most common classifications is according to the degree of depletion. According to this division, all natural resources are classified as:

- Depletable, and
- Undepletable.

Depletable natural resources are reduced or depleted during use. Besides, it is especially important whether these resources are reproduced or regenerated by their use. Accordingly, depletetable resources are divided into:

- Renewable energy, and
- Non-renewable

Natural resources as soil, flora and fauna and some mineral resources that renew or regenerate at exploiting belong to this group. In contrast to renewable, non-renewable natural resources reduce or deplete by use. Such characteristics have energy mineral resources as well as metals and nonmetals.

On the other hand, a particular group is made by undepletable natural resources. They are in the space frames considered final, but from the point of use are unlimited or abundant. The first group of natural resources include: solar energy, air, wind, water, seas and oceans, tides, geo energy etc. It should be pointed out that between depletable and undepletable natural resources there is no strictly established difference, however such division can be considered conditional.

In economic theories, in addition to this, there are also many other divisions of natural resources. Here are some of them:

According to the possibility of exploitation:

- Potential natural resources that will be used in the far future;
- Natural resources that are to be considered in the near future, and
- Natural resources, that can be used now.

According to the possibility of compensation:

- Recoverable, and
- Irreplaceable natural resources

According to the possibility of replacement – substitution:

- Replaceable, and
- Irreplaceable natural resources

According to the degree of exploration:

- Available, and
- Unavailable natural resources.

It is interesting to mention that the S. Milenkovic classifies all natural resources into 19 groups and N. Rainer in as many as 74 units.

Economic resources represent an important factor of economic development. Although their importance somehow decline due to continued advances of science, engineering and technology, knowledge, skills and craftsmanship in their work, they will still be an essential factor in defining the economic structure and economic development in general, especially in underdeveloped countries. Also, they play an important role in maintaining a healthy environment. Their exploitation should be conducted in conformity with prescribed standards without endangering living environment and human health.

MANAGEMENT OF ECONOMIC RESOURCES

Rapid economic development with environmental protection justifies the need to control economic resources. This is the wide public interest.

Otherwise, under the management of economic resources means a set of measures, methods and activities that provide the optimum level of exploitation of these resources to the achievement of desired economic and social objectives. Basically, these activities are based on the principles and assumptions of the concept of sustainable development. In addition, the sustainable development means the harmonized system of

technical, technological, economic and social activities in the overall development in which natural and real values of the Republic of Serbia are used on the principles of economy and ratio in order to preserve and enhance environmental quality for present and future generations" [10].

Management of natural resources includes three segments:

- Strategic planning,
- Realization of the strategic settings, and
- Controlling the execution of strategic goals.

Management of natural resources begins with strategic planning. This is the first stage at which goals and objectives and the means and methods to achieve them are established. Relevant documents define the level of exploration of natural resources by type, spatial distribution, diversity, volume and quality, then, the balance sheet categories (spatial and temporal features, quantity, quality, vulnerability, reproducibility, strategic reserves) and the foreseen trends of change and way of evaluating the conditions for sustainable economic use of resources and goods. Then, for each individual economic resource and the good, through plans, programs and principles the ways of utilization and protection are carefully elaborated.

The next stage is the realization of goals and objectives stipulated by the strategic documents and plans, programs, and foundations. Legal entities and individuals use the natural resources on the basis of the offered projects and approval of the competent state authorities. In addition, economic and other entities are obliged when use natural resources to follow the appropriate legislative and other prescribed standards in this field.

Use and protection of natural resources and goods are subject of control of appropriate authorities. According to applicable legislation, the control of these activities is performed by authorities and organizations of the Republic of Serbia, the Autonomous Province of Vojvodina and local authorities.

In the past, the pursuit of a rapid economic development, caused a high degree of depletion of natural resources both renewable and non-renewable, which led to some disruption of balance in nature and threats to the environment. Here are a few examples:

In the second half of 20th century due to poor processing methods about 550 million hectares, or one third of arable land all over the world was degraded. Such tendencies are still in progress;

Reduction of the forest area. It is estimated that the annual cut down is about 30 million hectares of forest. It has an unfavorable impact on the ecosystem, given that forests absorb large amounts of harmful carbon dioxide while producing necessary oxygen.

Besides, other resources as water, flora and fauna, air and living environment in general are endangered. In some areas the situation is alarming. Something similar is the situation of non-renewable resources.

In such circumstances, the question arises: how to harmonize relations between economy and ecology? The answer is to be found in the strict application of the concept of sustainable development.

MANAGEMENT OF RENEWABLE NATURAL

Renewable resources, as noted above, represent a special group of depletable resources. They are spent at use, but at the same time restore, or regenerate. The essence of management of these resources is reflected in harmonizing the relationship between the degree of depletion and the degree of regeneration.

Bearing in mind that the flora and fauna are the most important segment of renewable resources, the greatest attention is paid to management of these resources. Every year an annual plan of production (growth) is made for each species of plants and animals

as well as for the scope of use (depletion), then, the way of the plan realization, and ultimately the control of execution of planned objectives.

Accordingly, the annual volumetric increase of timber in the year 2007 in the forests of Serbia is 9,079,772 m², while the volume of forest cut amounts 2,247,000 m² which is several times smaller than the increment. To this fact the resulting damage to forests as for example natural drying and a certain amount of uncontrolled timber cut that is not recorded should be added to this calculation.

Special attention is given to the wild flora and fauna. By appropriate regulation issued by the Government of the Republic of Serbia, various species of flora, fauna and mushrooms are considered as a protected species and under what level of control can be collected from natural habitats, use and trade. The main objective of oversight of the collection, use and trade of protected species is based on ensuring their sustainable use, preventing the collection of these species from natural habitats in amounts and ways that would threaten their survival in the future, the structure and stability of such living communities.

Based on the estimated status of species in their natural habitats, every year the annual quantities of protected species that may be collected for commercial purposes are established. In addition, for each protected species the conditions and manner of collection are regulated. So, for example, collecting endangered species of flora, depending on which parts or developmental stages are used, are under condition that such species are collected in the optimal stage of vegetative development for use. It is also regulated at what species where underground organs are used, a part of the underground organ is to be left in the soil together with vegetative bud.

According to a prescribed contingent of wild plant species, and the advertised announcement, the competent ministry shall grant license to interested legal entities and entrepreneurs for the collection, use and trade of wild flora. For this purpose, an adequate compensation will be paid.

The species and quantities of wild plants that can be collected in the year 2011. are shown in the table below.

Table 1. Contingents of wild flora and mushrooms that can be collected in the 2011 (Selected species with larger quantities)

No. Latin name	Traditional English name (for existing) plants	Quantity in kg
A. PLANT SPECIES		
1. *Achilla millefolium L.*	1. Milfoil, Verbena	140,000
2. *Allium L. ursinum*	2. Cremosa, Bear garlic	500,000
3. *Althaea officinalis L.*	3. Marshmallow, Sweet Mallow	230,000
4. *Betula pendula Roth*	4. Birch	160,000
5. *Centaurium umbelatum Gilib*	5. Brush, stave, Grass of fever	25,000
6. *Cornus mas L.*	6. Cornel berry	200,000
7. *Corylus avellana L.*	7. Hazel, hazelnut	50,000
8. *Crataegus monogyna Jacq.*	8. White hawthorn, hawthorn	260,000
9. *Crataegus L. oxycantlia*	9. Red hawthorn	100,000
10. *Equisetum arvense L.*	10. Hosetail, Moor panicles	200,000
11. *Fragaria vesca L.*	11. Wild Strawberry, Strawberry	330,000
12. *Galium verum L.*	12. Lady's flowers, St John's grass	50,000
13. *Geranium robertianum L.*	13. Mercury grass, Needle	80,000
14. *Hedera helix L.*	14. Ivy	300,000
15. *Hypericum perforatum*	15. St. John's Wort, Virgin's grass	250,000
16. *Juniperus cemunis*	16. Juniper, Cade	2,000,000
17. *Juniperus communis L. Ssp. nana Syme*	17. Low Juniper	100,000
18. *Mililotus officinalis L. Pa llas*	18. Melilot	120,000
19. *Ononis spinosa L.*	19. Rabbit thorn, Wolf thorn	100,000
20. *Origanum vulgare L.*	20. Oregano	100,000
21. *Petasites hybridus L.*	21. Cocklebur	150,000
22. *Prinus spinosa L.*	22. Blackthorn	180,000
23. *Rosa canina L.*	23. Wild Rose, Hip rose	5,000,000
24. *Rubus fruticosus L.*	24. Blackberry	2,200,000
25. *Rubus idaeus L.*	25. Raspberry	110,000
26. *Sambucus nigra L,*	26. Elder blossom and berry	1,200,000
27. *Symphytum officinale L.*	27. Black comfrey, comfrey	300,000
28. *Teuorium chemaedrys L.*	28. No traditional name	50,000
29. *Thymus serpyllum*	29. Thyme	300,000
30. *Tilia tomentosa Moench*	30. White lime, Silver linden	80,000
31. *Vaccinium myrtillus L.*	31. Blueberry	3,100,000
B. MUSHROOMS		
1. *Boletus edulis Bull. Fr*	1. Summer, autumn porcini	5,000,000
2. *Cantharelluss cibarius L.Fr.*	2. Chanterelle	1,800,000
3. *Craterelluss cornucopiodes Pers.*	3. Brown trumpet	500,000
4. *Lactarius deliciosus LSFGray*	4. No traditional name	150,000
5. *Marasmius oreades Fr.*	5. Oread	50,000

A similar procedure is carried out for wildlife fauna is concerned. For example, collecting of protected species of snails can be done from 1 June to 1 October, frogs from 1 June to 1 August and fish (beluga) from 1 June of 31 March of the next year. It is forbidden to collect, use and trade the following sizes of protected species – snails with shells width less than 3 cm, frogs weighing less than 50 grams and bigger ones of more

than 120 grams, or length of less than 9 and bigger than 15 cm, more than 50 individuals of horned viper at the site of collection and whose length is less than 50 cm and males at the site collection and whose length is less than 50 cm, and beluga male, whose length is less than 180 cm in length and females less than 210 cm.

The species and quantities of animal species that can be collected in the year 2011 are given in the table below.

Table 2. Contingents of fauna that can be collected in the year 2011.

No.	No. Latin Name	Traditional english name	Quantity in kg
1.	Hirudo medicinalis	Medical leech	500
2.	Pelophylax kl. esculenta	Edible frog	5,000
3.	Pelophylax ridibunus	Frog	5,000
4.	Pelopylax lessonae	Little Frog	5,000
5.	Helix aspersa	Garden snail	200,000
6.	Helix leuceru	Forest gray snail	200,000
7.	Helix pomatia	Vineyard snail	200,000

Depending on the assessment of the situation in the field, the Ministry may provisionally prohibit the collection of certain endangered species of flora and fauna in certain areas, or on the other hand, in the entire state. In this way it protects the survival of some species and prevents disturbance of the structure and stability of living communities.

However, it should be noted that many failures occur in this field. There is no adequate assessment of the situation in the field, so it happens that much larger contingents of objectively possible are approved for collecting and trading. This can greatly endanger the continued survival of some species, especially flora. Such is the case with the following species of wild flora: Alchemilla sp., Centraurium umbelatum Gilib, incana Lam., Lamium albumh., Marrubium vulgare L., Polygonum bistorta L., Potentilla erecta (L) Rauschel, Primula elatior (L) Hill, Primula veris L., Primula vulgaris Hudson etc.

Besides the aforementioned, it is important to add to the state of the hunting game. In this field every year a draft plan containing the state of hunting game and akllowed shooting possibility. This plan applies to the Republic of Serbia and hunting areas - regions. In doing so, one must take into account the sustainable use, in order not to jeopardize the survival of certain species.

The following explanations present some examples of management of renewable natural resources. Similar approach is applied in other areas when these resources are concerned.

MANAGING NON-REWENABLE NATURAL

Unlike the previous group of resources, management of non-renewable natural resources is much more complicated and complex. These resources permanently reduce by their utilization. This group includes mineral resources.

Mineral resources, because of their specificity, require adequate management, primarily of strategic character, in order to achieve desired goal by their exploitation, above all, the optimum level of efficiency and effectiveness.

The basic approach in the management of non-renewable natural resources (minimal resources) reflects a high degree of rationality in their use. This is achieved by intensive exploitation whose main goal is to achieve maximum utility with the minimal possible natural resources.

By strategic management of mineral resources at one side, their quasi-use, should be provided and on the other side, the planned economic growth. In other words, the management of these resources has to ensure achievement of sustainable development.

When it comes to managing of non-renewable resources, the question of substitution and recycling is unavoidable. This is one of the ways of their conservation and rational use. Development of science and technology opens the way for the application of various forms of substitution. This particularly applies to the replacement of non-renewable resources, and finding suitable substitutes for nonrenewable natural resources.

The other area, also of importance for the management of natural resources is recycling. The advantages of recycling are numerous: protection and conservation of natural resources, ensuring quality and low cost of raw materials for processing industry, maintaining a healthy environment etc.

Exploitation of mineral resources can greatly undermine the quality of the living environment. This usually leads to land degradation, destruction of flora, pollution of the environment - air, water, to the endangerment of human health.

The essence of management of mineral resources in these circumstances is reflected in the effort to reduce the damage to the natural environment, as well as their proper removal. Environmental costs borne by entities that led to their creation. They are counted in the cost and further transferred to selling prices of products.

In this respect the principle of prevention and precaution provides that "any activity must be planned and implemented so as to: cause the least possible change in the living environment, is the least risk to the environment and human health, reduce the load space and the consumption of raw materials and energy in building , production, distribution and utilisation, include the possibility of recycling, prevent or limit environmental impact at the very source of pollution.

The precautionary principle is realized by assessment of environmental impact and using the best available technology and achieved technology, know-how and equipment'[10].

CONCLUSION

Natural resources are an essential factor of economic development and preserving a healthy environment all over the world. Although their importance is somehow declining in terms of economic development, because other factors of development get more and more important role (technology, know-how and especially knowledge), thus their role in the ecological sense is growing.

Economy and ecology ones from two conflict areas have become complementary ones. Permanent technical and technological progress allows business activities without any major damage to the environment at one side, while a healthy natural environment contributes to the preservation of natural values and human health, on the other side. This provides both economic growth and conservation of the living environment.

The realization of such complex goals can be achieved only with adequate management of natural resources. It is a complex and responsible but inevitable process in contemporary business activities. Only by sustainable use of natural resources (renewable and non-renewable) economics and ecological stability all this can be achieved with the goal of economic development and increase of overall human welfare.

REFERENCES

1. R. Nikolić, Ekonomija prirodnih resursa, Kompjter centar, Bor, 2010.
2. G. Rikalović, Ekonomika prirodnih resursa, Biblioteka ''Dr Djordje Natošević'', Indjija, 1999.
3. T.S. Hačutarov, Ekonomika pripodopljozvania, Nauka, Moskva, 1987.
4. J. Bluden, Mineral Resources and their Management, Longman, London, 1985.
5. B. Skinner, Marth Resources, Yale, University, 1989.
6. Grupa autora, Ekonomija prirodnog kapitala, Institut ekonomskih nauka, Beograd, 1998.
7. Pearce, D.W., R.K. Turner, Economics of natural resources and the environment, New York et al, 1990.
8. B. Milenković, Ekološka ekonomija, Fakultet zaštite na radu, Niš, 2000.
9. S. Milenković, Resursi u ekonomiji, Ekonomski fakultet, Kragujevac, 2000.
10. Zakon o zaštiti životne sredine, ''Sl. glasnik RS'', br. 135/04.

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NATIONAL RED LISTS OF HOVERFLIES (DIPTERA: SYRPHIDAE)

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ABSTRACT

Red data lists are catalogues of species that are recognised as threatened, at either a national or international level. Hoverflies (Diptera: Syrphidae) have an important role as pollinators and biological control agents and are protected taxa on many National Red lists.

National Red list of hoverflies of Germany has 212 estimated species, in the Danish Red List invertebrates there is a list of hoverflies with 280 species while in Czech Republic there are 120 species in the list. In the list of proposed species for Strictly protected and Protected species of Serbia there are 77 species of hoverflies.

Key words: National Red lists, hoverflies, endangered

INTRODUCTION

The World Conservation Union (IUCN) criteria for classifying threatened species in Red Lists were constructed to be applied primarily on a global scale. Nonetheless, many nature conservation efforts are conducted at national levels and there is consequently a demand for Red Lists at subglobal scales [1].

Sub-global Red Lists now exist in many countries and regions. On the one hand, they are important for national legislation, and sometimes include better information than those on the global list [2]. On the other hand, the list may be limited by strong cautious approach to the process of classification, sometimes inconsistent use of criteria and / or lack sufficiently transparent documentation to ensure proper process of classifying species according to IUCN's criteria and categories [3].

In order to support regional listing efforts, IUCN has produced extensive guidelines for their application at the regional level and appointed a *National Red List Working Group* to encourage best practice in national Red Listing efforts [1].

Experience in the use of the proposed guide for National Red Lists, particularly from Sweden and Finland, shows that the system is suitable for a wide range of taxa and geographical areas, although there are some concerns to be solved [1].

Red List of Threatened Species is the inventory of the conservation status of plant and animal species, and its importance is reflected particularly in the promotion of taxa that are a priority for protection.

Family Syrphidae (Diptera) combines a large and diverse group of flies, different in size and shape. They are very important as pollinators of many plant species, regulators pest insects, decomposers *(*decaying organic matter of both plant and animal origin), but also as pests in agrobiocenosis because larvae of some species develop in bulbs of cultivated plants [4].

DISCUSSION

Some of the countries in Europe which have national Red lists of hoverflies are Czech Republic, Denmark, the Netherlands, Spain and Germany.

Czech Republic In the territory of Czech Republic live 381 species of family Syrphidae. Faunistic data on this family are found in several hundred works, but a monograph has not yet been published with new data on distribution and the impact of hoverflies in Czech Republic. In the Red list of invertebrates of Czech Republic, there is a sublist of hoverflies with their endangered status (Regionally Extinct, Critically Endangered, Endangered and Vulnerable). Ordo Cheilosia Meigen, 1822 is excluded from the list because it is still not well understood in the territory of this country. A total of 120 (31.5%) species are listed here, of which seven species are assessed as Regionally Extinct, 14 species are considered Critically Endangered, 34 species are Endangered and 65 species belongs to the category of Vulnerable species [5].

Denmark In the Danish Red List invertebrates, there is a list of hoverflies with 280 species. Endangered are 53 species (18.9%), of which 4 species are assessed as Critically Endangered, 15 species have the status of Endangered species and 34 species belong to the category of Vulnerable species. Five species are concidered as Regionally extinct, 24 Near Threatened, 182 species belong to the category of Least concern, 3 species have a status without sufficient data, and 13 species belong to the category Not Evaluated [6].

The Netherlands In the Netherlands there are 328 species of hoverflies. Species were classified into four categories: Critically Endangered, Endangered, Vulnerable and Near Threatened. Each category includes between 5 and 10% of all known species and 22 species belong to the category of Critically Endangered, 31 species are Endangered, 21 species in the category of Vulnerable species and 16 species are identified as Near Threatened.

Spain In the Spanish Red List invertebrates, there are only three species of hoverflies: *Caliprobola speciosa* (Rossi, 1790) with the status of Endangered species and *Mallota dusmeti* Andreu, 1926 and *Meligramma cingulata* (Egger, 1860) with the status of Vulnerable species [8]. *Caliprobola speciosa* lives in forest areas in Western Europe, but it is also recorded in Asia and Siberia, which makes Spanish individuals as the westernmost individuals. However, in Spain, this species was seen only once in the forest area of the province of Leon (Gorge las Konhas, Prior, Leon). Despite numerous studies, this is so far the only known locality. A major factor of vulnerability is the loss of habitat for two reasons: cutting older trees and trees disease- grafioza [8].

Meligramma cingulata was usually being found in the Alpine area of Central and Southern Europe, while data from the Mediterranean basin are rare and scattered. In Spain only two studies have been reported the presence of *Meligramma cingulata* in the

Sierra de Grasalema (Kaddish). Despite numerous studies conducted since 1980 at various high mountains of Iberian peninsula, so far the only known population is located in the Sierra Pinspar (Grasalem). Factors that threaten this species are loss of habitats (*Abies pinsapo* forests) and non-selective treatment of pesticides in agriculture and forestry against aphids that directly affects the population of this species [8].

Mallota dusmeti so far is observed only in the central part of Spain and Tunisia. In Spain, has been found in some localities: Cortes (Burgos), Los Membriljares (Caceres), El Pardo, El Escorial, Viljavisiosa de Odon, Aranjuez and Rivas (Madrid), Topas, Castillo del Buen Amor de los Viljaseka Gamitos (Salamanca). Factor of vulnerability is cutting of old trees (Fraxinus angustifolius and Quercus faginea) in which the development of larvae of this species occurs [8].

Germany In Germany there are 428 species of hoverflies. Many scientists are assessing the degree of threat hoverflies, so Germany, in addition to national, has several regional Red List hoverflies. National Red list of hoverflies of Germany has 212 estimated species. Categories that were used are: 0 (Extinct), a (Near Extinction), 2 (Very Vulnerable), 3 (Endangered), R (rare), G (accepted as endangered, but unknown category), V (Vulnerable), D (Without enough data). Eight species are considered Extinct, 16 species Near Extinction, 25 species are Very Endangered, 50 species are in the category of Endangered species. If we take into account the number of species that are in the category of 0-3 (99), and the category G (50), it can be concluded that 34.8% of species of hoverflies in Germany are endangered [9].

1) Baden-Virtemberg For the first time created a detailed list of hoverflies, which serves as the base for the Red Book in Baden-Wurtemburgu. As 366 species have been indentified, 30.3% of them are classified as Endangered, and another 5.7% were declared as Threatened. The most Endangered species (category 1 - 4.6% of the total number of hoverflies) are species that inhabit exothermal habitats with phytophagous maggots (Eumerus Meigen, 1822, Merodon Meigen, 1803) or aphydophagus maggots (Paragus Latreille, 1804), and on the other hand, the kind of hoverflies whose habitats associated with dead trees (Chalcosyrphus Curran, 1925, Criorhina Meigen, 1822). For category 2 (Threatened species-9.3%) is mainly associated with the third environmental group-species with aquatic maggots that feed on decaying organic matter [10].

2) Saksonija On the territory of Saxony was identified 283 species of hoverflies. 34.4% of them is Endangered (categories 0-3), and 12% is considered Potentially Endangered. It is estimated that 17 species are Extinct (6%), Near Extinction is 19 (6.7%), the category of Critically Endangered species includes 25 species (8.8%) and the status of Endangered species has 37 hoverflies (13.1%).

3) Saksonija-Anhalt Territory of this federal German states settled 290 species of hoverflies, 83 species (28.7%) is Endangered. It is estimated that 19 (6.6%) species are Extinct and as much are Near Extinction, 22 species (7.6%) are in the category of Critically Endangered and 23 species (7.9%) are Endangered [10].

4) Donja Saksonija i Bremen Out of 317 known species of Lower Saxony and Bremen, 67 (21%) species are Endangered (categories 0-3). The remaining 250 species are not endangered or whose status is unknown / unpriced. 14 species (4%) are classified as Extinct, six species (2%) are Near Extinction, 23 species are Critically Endangered (7%), and 24 species (8%) are in the category of Endangered Species [11].

5) Tiringija On the territory of this federal states lives 320 species of hoverfiles, and 67 (21%) of them are Endangered (categories 0-3). 17 species (5.3%) are in the category Extinct, 14 species (4.4%) are Near Extinction, 10 species (3.1%) is evaluate as a Threatened species and 24 species (7.5%) are Endangered species [10].

Serbia As for Serbia, based on field research and analysis of materials from the collections of the registered species there are identified four risk categories: Critically Endangered species, Endangered species, Vulnerable species and Non-endangered species (All data are referred to the types of subfamily Eristalinae (Syrphidae)). There is a large percentage of endangered species (35.14%) and those recorded only on two or five sites. Nearly a third of these species are endemic relicts and those whose center of range is in a remote area (e.g. Northern Europe, Mediterranean). For more than half reported endangered species maggot development is not known, indicating the specificity of their development cycle. Among them was also a significant number of terrestrial saprophags (20 or 23.8%) occurring in well-preserved forests, with old trees, which indicates a high degree of possible damage to these ecosystems in Serbia. Nearly a third of recorded species in Serbia (71 or 29.7%) belongs to Non-endangered taxa. The lowest number of recorded species belong to the category of Critically endangered - 35 (14.64%), while the number of Vulnerable species slightly larger (49 or 20.50%) [4].

On the list of proposed species for Strictly protected and Protected species of Serbia is 77 species of hoverflies, 33 are proposed to be Strictly protected (these are Critically Endangered and Endangered species, local endemic species and relicts), and 44 species of protected (Vulnerable species and endemic species). By comparison, 26 species (34%) from this list are also in the German Red List and 20 species (26%) in the Danish Red List.

Importance of knowing the degree of endangerment and species diversity of hoverflies is showed by the fact that some sites, which are home to rare and endemic species of hoverflies, are protected as strict nature reserves in 2004.

In fact, during the development of Spatial Plan of National Park Fruška gora, five locations are chosen based on the analysis of data on registered hoverflies. One of them is the Rokovs stream on the Glavica. This area has been designated as a Strict nature reserve, and source valley of Rokovs stream on the Glavica was put on the first level of protection order, just on the basis of faunistic research of hoverflies of Fruška gora [12]. This way, for the first time in Europe, a habitat is protected on the basis of diversity of hoverflies.

CONCLUSION

National Red List hoverflies show that habitat loss, pollution and many other direct and indirect effects of anthropogenic activities affect also this insect group and many species are threatened or face extinction. Importance of knowing the degree of endangerment and species diversity of hoverflies is showed by the fact that, for example, some sites in Serbia, which are home to rare and endemic species of hoverflies, are protected based on the analysis of data on registered hoverflies.

REFERENCES

1. Gärdenfors, U. (2001): Classifying threatened species at national versus global levels, Trends in Ecology & Evolution 16.
2. Rodrigues, A.S.L. et al (2008): The value of the IUCN Red List for conservation, Trends in Ecology and Evolution 2.
3. Hilton-Taylor, C. (2000): 2000 IUCN Red List of Threatened Species, IUCN Gland, Switzerland and Cambridge, UK.
4. Radenković, S. (2008): Fauna podfamilije Eristalinae (Diptera: Syrphidae) u Srbiji, Doktorska disertacija, PMF, Novi Sad.
5. Farkač J., Král D. & Škorpík M. (2005): Červený seznam ohrožených druhů České republiky. Bezobratlí. Red list of threatened species in the Czech Republic. Invertebrates, Agentura ochrany přírody a krajiny ČR, Praha, 760 pp.
6. www.dmu.da
7. Verdú, J.R. Galante, E. (2005): Libro Rojo de los Invertebrados de España. Dirección General de Conservación de la Naturaleza, Madrid
8. Ssymank, A., Doczkal, D. (1998): Rote Liste der Schwefliegen (Diptera : Syphidae). In: Binot, M., Bless, R., Boye, P., Gruttke, H., Pretscher, P. (1998): Rote Liste gefährdeter Tiere Deutschlands. Bonn-Bad Godesberg. 65-72
9. Doczkal, D, Schmid, U., Ssymank, A., Stuke, J.H. et al. (1993): Rote Liste der Schwebfliegen (Diptera: Syrphidae) Baden-Württembergs. Natur und Landschaft 68 (12): 608-617.
10. Stuke, J.H., Wolff, D., Malec, F. (1997): Rote Liste der in Niedersachsen und Bremen gefährdeten Schwebfliegen (Diptera: Syrphidae). Inform. d. Naturschutz Niedersachs 18: 1-16.
11. Pil, N., Vujić, A. (2004): The importance of wetland habitats of Fruška Gora Mt. for existance of rare and endemic hoverflies (Diptera: Syrphidae). Internat. Assoc. Danube Res. 35: 13-19.

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LESS AIR POLLUTION WITH TRANSPORT SOLUTION

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ABSTRACT

Herein, we discuss the project idea, which is to find a way how to connect South Italy to South East Europe/Balkan Peninsula countries in the most suitable way with less air pollution, more traffic safety and reduction of road congestion.

Creation of a new intermodal/combined transport corridor could reduce CO_2 emission with enormous advantage on the environment, reduction of GHG emission, not only due to reduction of number of kilometers, which a new corridor permits, but also because we are focusing on creation of railways joined practice between all Balkan countries with interoperability and interconnection operations and management.

Key words: environment, Balkan, intermodal, transportation, European Union

ENVIRONMENT, CLIMATE CHANGE AND TRANSPORTATION

In the decade up to 2008, greenhouse gas emission (GHG) in the EU27 decreased by 2,4%. The areas where emissions decreased were: energy use, waste, manufacturing and construction and agriculture. At the same time however, emissions from energy industries, industrial processes and transport were growing. [1]

Today and in the future climate change is essentially a social problem. It is the production, transportation and eventually the consumption of the goods that produce emission. These emission give rise to climate change with social costs in the form of diseases, cost that do not have to be carried by the actual polluter. The green house gas emission in EU have been reduced in most sectors over the last 15 years, on the other hand, transportation has shown a 25% increase [2]. In order to come to terms with this, many governments in Europe have to decide to take legislative action. The level of greenhouse gas emission is to be reduced by 40% by 2020 and by 2030 the Swedish vehicle fleet is to be fully independent on fossil fuels. The number of economic measures are suggested. The social cost will have to be internalized and to achieve this carbon taxes and emissions trading schemes will be utilizes. [3]

In order to achieve a reduction, a firm may chose between a number of measures. One measure commonly suggested is a shift in transport mode, from faster, more polluting mode such as road and air transport to slower and less polluting modes

such as rail or sea transport. A particularly interesting solution is an intermodal road-rail-short sea shipping solution. In this way, the flexibility and availability of truck transport is combined with low cost, CO2 efficient , rail transport for the longer part of the journey. Research has shown that, with this type of mode shift, CO2 emission can be reduced by 20-50% or more depending on how the electricity for the train part is produced. [4]

Climate change, as well known, is a major threat to sustainable development. Under the international Kyoto Protocol the EU15 has a collective target of 8% of reduction below levels chosen in base year (mostly 1990). By 2008, the EU15 had decreased its emissions by 6,9%. Furthermore, the EU27 has set a 20% reduction target by 2020.

With a share of 19,5% of total emissions in 2008, transport is the second largest source of emissions in the EU and it is the sector that has exhibited continuously growing emissions. Beside GHG emissions, transport is also responsible for other negative externalities such as air pollution, particulate matters and noise.

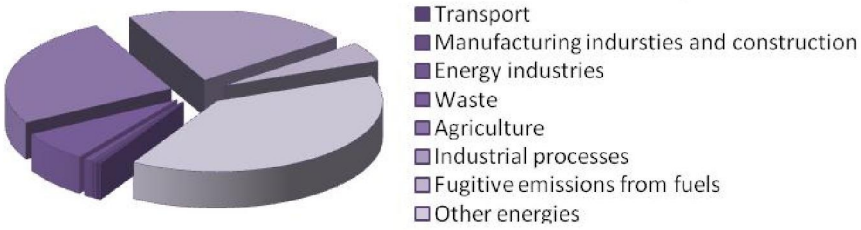

Figure 1. EU -27 greenhouse gas emissions by sector, 2008

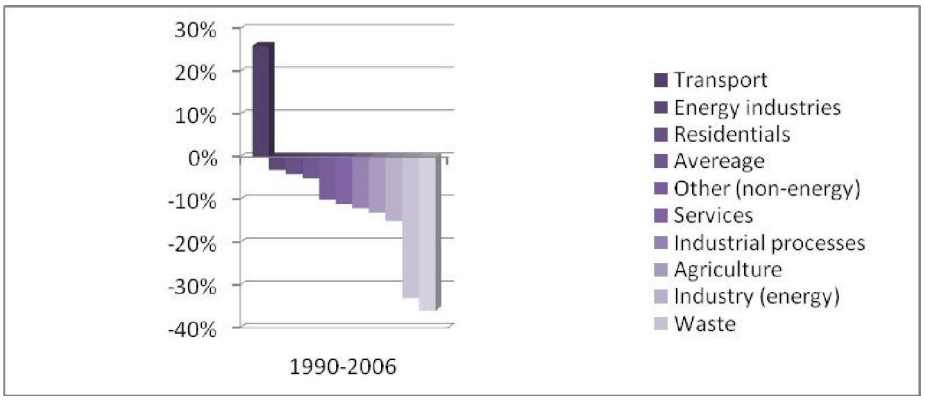

Figure 2. CO2 emissions from transportation EU-25 [2]

The effects of transport infrastructures on the nature, landscape and biodiversity are also adverse but at the same time is essential for society and for individuals.

One of the main goals of the EU Sustainable Development Strategy is to achieve a balanced shift towards environmentally friendly transport modes to bring about a sustainable transport and mobility system. This shift would certainly bring down GHG emissions as well.

Achieving sustainable transport and lower emissions requires infrastructural development in modes with lower environmental impact. There has been a shift in investment towards environmentally friendly transport modes. Total investment in transport infrastructure, including new construction, extension, reconstruction and major repairs, reached about €95 bilion euro in 2008. During a period between 1999-2008 investments in rail, maritime and inland waterways slightly decreased but road infrastructure investment remained dominant.[6]

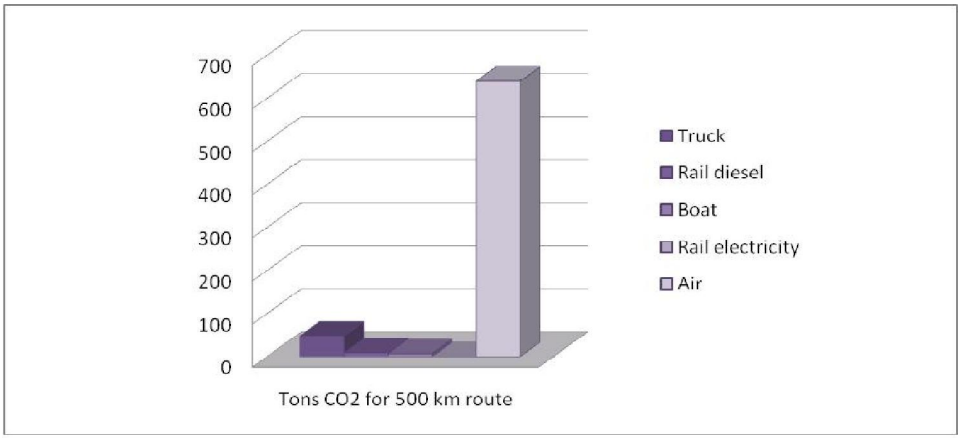

Figure 3. Ton CO2 for 500 km route [5]

EUROPEAN UNION PLANS FOR THE REGION

EU plans for the Region are distinguished in hard and soft measures. The hard is related to infrastructures and soft measures are harmonization and reforms (technical standards and border crossing procedures). The soft projects indicate that the rail and ports are considerably affected by " regionalization", which could be solved by setting up Intergovernmental Working Group on Railway and Intermodal Policy. One of the main job of the Working Group is to make an inventory of rail reforms and further recommend measures that ensure the regional integration and harmonization of the reforms for every country and to open access to transport infrastructure. Unfortunately, States have usually denied railways enterprises the freedom of a commercial business and this has to be changed. Different options are possibly: some railways may focus entirely on their core business of operating trains. Other may choose to enter into partnership for example with road haulers or logistics companies and offer door to door intermodal services. Some may operate across Europe, while others may concentrate on local services. One thing in common of all railways in Region is that they must focus on what their customers want and how they can satisfy these needs. It is important to establish common traffic management which will focus on planning, monitoring and control or influence of traffic. The principal aim should be to maximize the effectiveness of the use of existing infrastructure, ensure reliable and safe operation of transport, address environmental goals and ensure fair allocation of infrastructure space (road space, rail slots etc.) among competing users [7].

Concerning seaports intention is to identify which regional port (out of total number of seven ports in the regional core network) provides the best long-term solution for Adriatic shipping.

The core network was defined by the "REBIS" study and includes the mail rail and road connections between the five capitals of the region, as well as the cities of Banja Luka, Podgorica and Pristina; the linking of these cities with the capitals of the neighboring countries and to the ports of the Adriatic Sea and the river Danube.[8]

SOCIAL IMPACT ASSESSMENTS

In the case of the Trans European Transport Network in last years, European Union found out that transport has a determinant impact on regional development and regional cohesion. South-East Europe countries should be more sensitive because facing more or less critical levels of socio-economic, stability and having a rich history of ethno-political developments.

Most countries in the region have very high (30%) rate of unemployment . They reached these high level over the years as a result for transiting, the Balkan conflicts etc. For example: a sector as railway transport where 50% of labor force has left their jobs within last ten years. The current plans to liberalize rail transport in the region will have a further impact on jobs – and, this time, with no chance of resorting to voluntary departures or early retirement schemes. The key questions are:

What are the job opportunities for the people who leave the transport industry?

What are the measures to retain the active population in the labor market-training and job opportunities?

The trade unions should be involved as a social partners in the process of reform and some other aspects must be pointed out: South-East Europe countries have young democracies and so less transparency and social dialogue,

Assistance of European Union on South-East Europe countries also as a pressure to implement social dialogue, consultation and information mechanisms.

International financial institutions – often a barrier for the reform process because of "chain of blame" social dialogue at national level Consultation of trade union on the European Union regional transport policy for south-east Europe [9].

ENVIRONMENTAL ASPECT

ERTRAC The European Road Transport Research Advisory Council [10] identified the following research targets in the areas of environment, energy and resources:

- Improvements in vehicle efficiency should deliver as much as a 40% reduction in CO2 emissions for cars and 10% for heavy vehicles for the new vehicle fleet in 2020
- Fuel consumption and CO2 emissions should fall by at least 10% for cars and 5% for heavy vehicles as a result of better vehicle maintenance and driving for fuel efficiency

- Further reductions in fuel consumption of 10-20% should result from improvements to road infrastructure, better use of transport modes, IT systems, higher car occupancy rates and freight loading factors
- Further reduction of carbon emissions associated with fuel production should be achieved
- By 2020, fuel cell vehicles and low carbon or hydrogen fuels should start contributing to carbon reduction, provided sustained research efforts are begun now
- By 2020, Euro 5 and 6 vehicles should be well established in the vehicle fleet
- Transport noise should be reduced by up to 10 dB(A) through a system approach including better indicators and improvements to vehicle and infrastructure [11]
- Sustainable use of resources and recycling of vehicles and road infrastructure materials should contribute to the preservations of the environment [10].

European policy implication and its key impacts regarding environment are resource use, climate change, waste, local air pollutants, noise and land take. Resource use- fuel reserves remains uncertain what makes costs increasment and also insecurity of the market. Governments need to stimulate greater energy efficiency and encourage the uptake of those alternative fuel technologies which can be shown to be less damaging the environment. This could be done by providing incentives for development of alternative fuels, opening projects and adoption of alternative vehicles for government fleets [12].

Research has been conducted and here are some measures included which have environmental impact of transports: regulations on the use of vehicles and the effective enforcement of those regulations; demand management approaches which reduce the need to travel or the use of less sustainable modes: pricing measures; soft options such as travel plans and informational and behavior change campaigns and land use planning [13].

PROJECT IDEA

The project idea is to create unaccompanied combined transport chain of intermodal transport units in South East Europe between Bari Logistic Center and Logistic Railways Terminals in Bosnia and Herzegovina, Serbia, Romania, Montenegro, Croatia and Bulgaria avoiding the road traffic and reduction of CO_2 using short sea shipping by Ro/Ro vessels and block trains. The European Commission has developed policy measures to shift the balance between transport modes with special focus on promoting intermodal transport. The type of transport has been strongly advocated because of environmental concerns and safety reasons to avoid road congestions.

The first step is to organize railways practice in Bosnia and Herzegovina, Serbia, Romania, Montenegro, Croatia and Bulgaria mixing private and public consortium which will be able to move merchandise from/ to Southern Europe to/from Eastern Europe. To start up a common railways practice it is necessary to create a Intergovernmental Working Group on Railways- new railway management model able to take care of the opportunities given by all existing European Programs on intermodal transport sector - which will include all countries interested in a project start up. The aim of European Union policy has been to reduce and in the future to eliminate technical and operational differences among national railway systems and achieve harmonization in terms of

technical specifications for infrastructure, signaling, telecommunications and rolling stock as well as certain operational rules [14,15]. The above mentioned group should create common intermodal policy.

CONCLUSIONS

Climate change is essentially a social problem and because of that it needs integral and coherent transport policy. The social implications of the transport need to be constantly and carefully monitored.

The starting point is to find sustainable transport and welcome the development of infrastructure changing as a policy instrument to contain and reduce congestion and reduce environmental impacts. It is well reported by Kreutzberger [16] that the environmental performance of intermodal transport is substantially better than that of unimodal road transport when looking at every use and GHG emission and this is even more outspoken when also local emissions, accidents, congestion and noise are integrated. As regards of the automatic link between economic growth and growth in freight transport, the solution is not in reduction of transport but in redistribution between modes. This is a main reason and strength of a project idea which could bring a success. Furthermore, in this case we are not only talking about redistribution between modes [17] of transport but also we are implementing a new corridor. Fair and efficient pricing, better investments and some of policy tools that can help to achieve this. Enlargement of the European Union is set to trigger larger exchanges of goods and so need for additional investments in transport infrastructures. It's well known south-east Europe transport system distinguishes itself by extremely fragmented transport. Italy, especially South Italy, with its geographical position, cultural, political, humanitarian and historical connections could have prestige and favorable role between European Union and Balkans. Finally, implementation of legal regulations under supervision could produce different positive consequences on transport, environment, climate, production, crime control, protection and defense etc. The European Commission is supporting the idea that transport costs should reflect the true impact on environment and society and is relentlessly pushing towards the so called internalization of external costs as a policy instrument in order to establish fair and efficient pricing of different transport modes.

REFERENCES

1. Eurostat 2008, " Greenhouse gas emission by sector", http://ec.europa.eu/eurostat/product?code=tsdcc210&language=en&mode=view) , Accessed: 2011-04-13
2. Eurostat 2006"Greenhouse gas emissions by sector" , http//epp.eurostat.ec.europa.eu Accessed: 2009-03-20
3. Regeringen 2009, Enhallbar energy-och klimatpolitik foor miljo, konkurrnskraft och trygghert, Regeringskansliet, Stockholm
4. IFEU & Sgkv 2009 " Comparative analysis of energy consumption and CO2 emission of road transport and combined transport road/rail , IRU, Geneva

5. Fedrik Eng Larsson, David Kollberg "Overcoming the obstacles of intermodal transport- a shipper perspective on the effects of modalshift" Master Thesis conducted at Engineering Logistics, Lund University 2009
6. Eurostat 2011 "Climate change-driving forces" http//epp.eurostat.ec.europa.eu/statistics_explained/indexphp?title=Climatechange Accessed: 2011-04-13
7. The World Bank document "Railway Reform in the western Balkans", December2005 http://ec.europa.eu/.../rail/.../005_world_bank_western_balkans_railways_report.
8. www.seerecon.org/infrastructure/sectors/transport/documents/REBIS/Rebis_FR_Final.pdf Accessed :2010-02-01
9. ETRAC "European road transport 2020:a vision and strategic research agenda", Sixth Framework Programme Research Advisory Council. www.ertrac.org, 2010
10. W. Schade, "Noise :a challenge for sustainable mobility" UNESCO International Social Science Journal 179, p279-294, 2003
11. Commission of the European Communities (CEC) "Towards a new culture for urban mobility": DG TREN , Brussels, 2007
12. European Environmental Agency (EEA) Term report indicators, Luxembourg: Office for Official Publications of the European Communities, 2003
13. D. Banister and R. Hickman, "How to design a more sustainable and fairer built environment" IEEE Proceedings of the Intelligent Transport System 153(4). 276-291, 2006
14. Commission of the European Communities (CEC), "White paper: European transport policy for 2010: time to decide" Luxemburg: Office for Official Publications of the European Communities, 2001
15. Commission of the European Communities (CEC), "Keep Europe Moving-Sustainable Mobility for Our Continent, Mid-term review of the European Commission's 2001 Transport White Paper" Luxemburg; Office for Offical Publications of the European Communities, 2006
16. E. Kreutzberger, C. Macharis, L. Vereecken, L. Woxenius, "Is intermodal freight transport more environmental friendly than all-road freight transport?" A review in:7th Nectar Conference "A New Millennium. Are things the Same? Umea Sweden 13-14 June 2003
17. Ogorelc, " European Union Common Transport Policy "; Nase more" 50. 5-6, 2003

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"ECOLOGICAL TRUTH" ECO-IST'11
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ENVIRONMENTAL ACCOUNTING, WITH PHYSICAL FLOW ANALYSIS TOOL: PIOTS (PHYSICAL INPUT - OUTPUT TABLES)

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ABSTRACT

Nature has set her operation on a series of closed loops, with industrialization and the development of technology, the regulatory processes of nature have been put at risk. Natural resources, taken sometimes at no cost, after processing and at the end of their use, return in altered form to the environment. The traditional economic models are closed and disregard of the economy - environment interactions. In reality, the economy is an open and circular system, which can operate only with the support of its ecological basis (Tarner 2003) (Kapp 1991). The objective of reducing the use of natural resources is a necessary but not sufficient condition to ensure sustainability, the question to understand is what exactly reduce(Istat 2009). The PIOTs are a tool to define the interactions between economy and environment, and develop new indicators to focus the strategy required to give breath to the environmental policies, linking the defense of ecosystems to economic growth.

Key words: input-output, PIOTs, material flow, sustainable development, environmental accounting

INTRODUTION

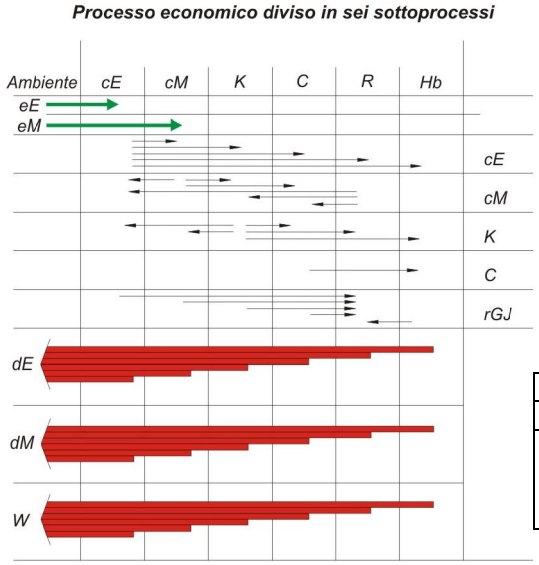
The choices of consumers, business planners, men of government and bank investors, depend on market mechanisms. The market directs traders on decisions to be based on accurate information. Why the market to function without distortions is crucial that the facts are known the real prices of the products you buy. But the market provides only partial information, market failures, and sometimes even the failure of public intervention in the market inevitably leads to bad behavior. The market does not incorporate the "hidden costs" of commodity production: negative externalities, and the GDP (gross domestic product) is not a welfare indicator does not consider natural capital as a factor of production (Hawken, Lovins & Lovinzs 1999). The management of natural capital is needed, so it's inevitable move from a traditional accounting in part, based on an analysis of financial indicators alone, and balances to a complete set of accounts that takes into account the flows of matter, in order to obtain an information tool ensuring control of the environmental variable and also leading the development of environmental indicators and indices (Giljum et al. 2009) (Suh, Kagaua 2009). A 'government agency need new indicators to apply an environmental policy, and a' business needs of environmental indicators to calculate its efficiency in the management

of natural capital, were born to this a number of tools for collecting and analyzing physical data, one of these instruments is discussed in this article: the PIOTs.

MATERIAL AND METHODS OF WORK

Origins of PIOTs

Over the years there have been a number of approaches to accounting which takes into account the flows of matter, starting from the middle of the eighteenth century (1694-1774) Francois Quesnay, in his Tableau économique described the movement of goods, with a model based on 'analogy with the blood system in humans (Quesnay 1756-1758). In 1906 W. Leontief, based on patterns of accumulation of enlarged Marx, drawn from the theories of Quesnay and the Physiocrats, developed the analytical forms of accounts, which later became the elements of modern input-output analysis in monetary units. (Leontief 1970, Leontief et al. 1977). RUAyres in 1969 introduced the principle of matter-energy balance, quantifying the amount of waste and seeks to develop a "matrix of waste" (Ayres and Knesse 1969). In 1971 the statesman Nicholas Georgescu - Roegen published his essays on the bio-economic theory. The theory was incompatible with neoclassical economics by proposing new methods of study of production processes and consumer choices, systems derived from observation of nature and its laws, the study of natural cycles and the times in which they do . (Georgescu - Roegen 2003) Considering the laws of thermodynamics came to a very simplified model of the global circulation of flows between the environment and the economic process (Fig.1).



Legend fig. 1	
inflow	outflow
eE = energy eM = material	dE = energy dissipated dM = material dissipated W = waste rGJ = material for reuse

Figure 1. Diagram of the global circulation of the flows Between the environment, and it is Divided into six sub-economic process, into the primary flows, output flows end of the process. (Source: Georgescu-Roegen 1971).

The model shows that no economic system can continue to exist unless it receives energy and matter from the outside, even if we could recycle all the waste, an amount of matter has now been lost, and this prevents the stock of natural capital to remain constant . The methodology for the analysis of material flows (MFA), was born from the concept, the subject matter is transformed continuously from low entropy to high entropy matter and the process is irreversible (Ayres and Ayres 1999, Lagioia 2006).

Construction of the table PIOTs

The scientific debate has led, therefore, the definition of an accounting tool such as I / O table in physical units: the PIOTs. The construction of the tables is provided on the basis of mass balances considering the principle of conservation of mass of the first law of thermodynamics. We define the processes, a set of activities, through the use of technology to transform materials and energy, commodities or finished products, thus making a qualitative transformation and at the end of a process, all the matter in entry must find output. A simplified diagram of a representation in physical units of material flows within the biosphere is shown in Table 1.

The table is divided into four areas:

I : exchanges between the sectors of the biosphere, air, water, soil, living organisms, X (*i,i*);
II: the flows of material transferred from areas of the biosphere *i* to the fields of technosphere *j* X *(i,j);*
III: the flows of material transferred between the various sectors of the technosphere X *(j,j);*
IV: The flows of waste generated by sectors of the technosphere *j* and receivers placed in the bodies of the biosphere, X *(j, i)*.

Table 1. Simplified schematic of a cross table in physical units of material flows between biosphere and technosphere

	NATURAL AREAS	*ECONOMICS SECTORS*
NATURAL AREAS	I X (i,i)	II X (i,j)
ECONOMICS SECTORS	IV X (j,i)	III X (j,j)

(Source: Daly, 1968)

Then the board is divided into more sectors, in the biosphere: air, water, soil, natural stocks and the sector of economic activities: production and consumption activities, reflecting the NACE (statistical classification of economic activities), based on which are cross-compiled tables for the construction of economic indicators according to the 'European Union.

RESULTS AND DISCUSSION OF RESULTS

It analyzes the table Italian economy in 2000 (Table 2) constructed by prof. G. Nebbia. Boxes of the first four rows (1,2,3,4) contain the masses of air, water, soil and natural stocks used as input in the various sectors of economic activities, while the data of the boxes of the first four columns (1,2,3,4) indicate the masses of the same components of the biosphere that come from the output from various human activities and return to nature. The table (Table 3) include the total mass input and output areas of the biosphere extrapolated from the table (Table 2). Analysis of the data we observe that

the areas of the biosphere have altered quantitative and qualitative 's air (Fig. 2 n sector 1) is returned in the biosphere with a mass greater than 29%, as it contains a number of new substances pollutants (CO2, CO, NOx, PAH, SOx, CH4, H2S, Dioxins, etc..) are recognized as carbon dioxide and methane, as part of greenhouse gases, and then with appropriate calculations can be detected on their weight problem of global warming of our planet, and even go back to the more industrial architects of their education. In the Italian case, these are the areas of energy production, domestic consumption, the transport system and livestock. Nitrogen oxides are guilty of the "ozone hole", again making an accurate analysis is possible to obtain very useful information to be used for reducing their production. With regard to water (Fig. 2 n field 2), its quantification is especially complex because of the effect evaporation, the water output in the state begins its steam cycle, and recondensation in other areas of the earth in the form precipitation.

Table 2. Cross table in physical units of the Italian economy in 2000

		Air	Water	Soil	Natural Stocks	Agriculture	Livestock	Energy, Water	Metallic ores and metals	Non metallic mineral and products	Chemical products	Metal products	Machinery	Transport equipments	Food, beverages	Textiles, Leather products	Paper Woods products	Rubber and plastics	Other manufactured products	Building and construction	Waste treatment	Trade services	Transport services	Services	Households	Stocks	Imports	Total inputs
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Air	1					186	51	208	6	10	51	15	10	12	18	3	10	10	14	10	32	13	146	10	135			950
Waters	2						180	7	5		21	7			16	8	15		10	22	4			8	51			354
Soil	3					104																						104
Natural Stocks	4							59	8	457	31	10			12				5		7							589
Agriculture	5	86		32		3	91	1							93		2				5						6	319
Livestock	6	103	12	143																	61						1	361
Energy, Water	7	279		1		3		179		3	7	24	4	6	5	1	1	1	2	3	2	7	41	2	30		26	627
Metallic ores and metals	8	2	2	2					2	2		20									8							36
Non metallic minerals and products	9	15	1	2				5		6	15	6			3				5	403	20						5	486
Chemical products	10	50	5	2		11	5	1	1	1	45	1	1	2	8	2	2	15	10	2	12	8					3	12	199
Metal products	11	48	7	9								50	10	5						20	1	1						7	158
Machinery	12	15																									10	3	28
Transport equipments	13	8	2					4													5	2					17	5	39
Food, Beverages	14	52	25	12			32								103		1		4		32	74						5	340
Textiles, Leather products	15	5	5											1		8					3	5						6	33
Paper, Wood products	16	8	2												2		10			3	4	8					10	6	53
Rubber and plastics	17	12									4			3	2			8		5	6	5					4	1	50
Othe manufactured products	18	10									5			2	5	1	1	1	2	15		5					10	15	72
Building and construction	19	35	13	5																	5	9					413	12	492
Waste treatment	20	74	35	76		10		5				15				2	4	3	5		10						69		308
Trade services	21	5				2								2	10	1	1	2	5		5	5		11	86	20		155
Transport services	22	187																										187
Services	23	21	5	2																	3							31
Households	24	209	22	11																	55						5		302
Stocks	25																				26						5		31
Imports	26						2	162	16	7	20	10	1	6	22	7	6	10	10	9	2	13				35		340
Total inputs	27	1224	136	297		319	361	627	38	486	199	158	28	39	340	33	53	50	72	492	308	155	187	31	302	601	110	6046

(Source: Nebbia 2003).

Table 3. The total mass input and output areas of the biosphere in Mt PIOT Italian economy in 2000 (data processing personnel on Nebbia 2003).

	INPUT Mt	OUTPUT Mt
AIR	950	1224
WATERS	354	136
SOIL	104	297
NATURAL STOCKS	589	------

To the soil (Fig. 2 No sector 3), there is an increase of 180% by mass, as in this case has been enriched by toxic substances: material unusable as sewage sludge, waste water, etc.. The value of natural stocks in output is equal to zero since (Fig. 2 n sector 4), 589 Mt have been in the technosphere. You can make a calculation of the material assets in infrastructure, machinery, vehicles, cargo still circulating in the technosphere. The formula considers the total stock of cheap materials and removes the material taken from such stock (PIOT data in the table 2):

MATERIAL IMMOBILIZED =X(n,25) - X(25,n) = 601 Mt - 31 Mt = 570 Mt.

CONCLUSION

The largest gap in one PIOTs is the count of physical flows in a single unit. The count of the air is made by considering only the portion used directly in processes, such as combustion and excludes the part which has the role of carrier gas for other substances (Fog 2003). There are difficulties in accounting for the amount of water in agricultural and livestock products, as the quantitative content is varied (from 10% to 85%) and is subject to evaporation in the boxes is counted only the process water, by 'restrictive approach suggested by Ayres and Ayres (1998), and Gravgard Vadmond (1998), Nebbia (2000) is excluded, the water flowing through the activities of production and consumption as a passive carrier of heat or solvent, to avoid that 'total amount of all the materials to be dominated by the amount of water (Strassert 2000). Duplication of streams is a further problem, in different situations is counted twice for the same material as found in the anthropogenic input in different processes related to each other (De Marco et al. 2009).

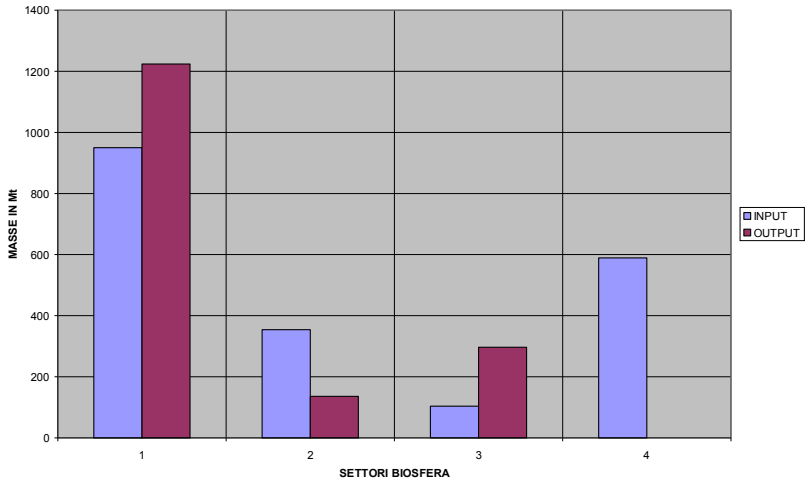


Figure 2. Graph representing the variation of the total mass from input to output, sectors of the biosphere, air (1), water (2), soil (3), natural stocks (4) (data processing personnel on Nebbia 2003).

Another limitation is the data retrieval. The data from statistical agencies are not always accessible for the secret to keeping on industrial production and trade Even if they are revealed difficulties in the construction of PIOTs, we can say that: they are a suitable tool to see what we consume " natural capital "and especially at that speed. Prove therefore to be an excellent tool to be used for a complete set of accounts, and if they refer to what happens in one country can be compared with the national accounts data in monetary units. One of the advantages of PIOTs is to have the ability to integrate into one framework the various sources of data obtained from: accounts for energy, waste accounts, production statistics, statistics for recycling and emissions, and international trade statistics(Hoekstra et al. 2006). An analysis of these data we seen helps identify priority areas to carry out strategies for natural resource management, and compatibility between PIOT and MIOT(I/O tables in monetary units) leads to obtain a direct relation ship between indicators derived from physical flows and indicators economy. The resulting indicators are useful for monitoring the processes of splitting the use of natural resources from economic growth and moving towards their more sustainable use (WRI 2000). It is necessary that economy invests in dematerialization, protection of natural capital, creating systems of production and distribution of democracy, considering all types of capital: financial, product, natural, cultural and ethical, and note that therefore, the human needs and not by the market.

REFERENCES

1. Ayres, R.U., Knesse, A.V. (1969), Production Consumption and Externalities American Economic Review, 59, (3), 282-297, una traduzione italiana in Cannata, G. (1974), Saggi di economia dell'ambiente, Giuffrè, Milano.
2. Ayres, R.U., Ayres, L.W. (1998), Accounting for Resources: 1. Economy-wide Applications of Mass-Balance Principles to Materials and Waste, Edward Elgar, Cheltenham UK.
3. Ayres, R., Ayres, L., 1998, Eco-Thermodynamics:Econonimics and the Second Law,in ecological economics, 26,2 .
4. Ayres, R.U., Ayres, L.W. (1999), Accounting for Resources 2, The life Cycle of Materials, Edward Elgar, Cheltenham- UK.
5. Daly, H.E. (1968), On Economics as a life science, Journal of Political Economy, 76 (33) 391-406; una traduzione italiana in, Girone G., Lagioia G., Tricase C. (1992), Sulle analogie fra fatti economici e fatti biologici, e un dimenticato saggio di H. Daly, Annuali della Facoltà di Economia e Commercio, Bari, N.S., Vol. 30 pp. 227-251.
6. De Marco O., Lagioia G., Amicarelli V., Sgaramella A. (2009), Physical Input-Output Accounting and Material Flow Analysis. Bottom-up case studies. In: SHU S. (Ed.), Handbook on Input-Output Economics for Industrial Ecology. vol. 23, Springer Verlag.
7. Gravgaard Pedersen, O. (1999) Physical Input-Output Tables for Denmark. Products and materials 1990. Air emissions 1990-92 Statistics Denmark, Kopenhagen.

8. Georgescu-Roegen, N.,1972, The Entropy Law and the Economic Problem, in The Ecologist", 2, 7, pp.13-8.
9. Georgescu -Roegen, N. (2003), Bioeconomia, verso un'atra economia ecologicamente e socialmente sostenibile, Bollari Boringhieri, Milano.
10. Hawken P. A. Lovins e L.H. Lovins (1999), Capitalismo naturale .La prossima rivoluzione industriale, Edizioni Ambiente, Milano.
11. Hoekstra, R., Van Den Bergh, C.J.M., 2007, Constructing physical input-output tables for environmental modelling and accounting: framework and illustrations, Ecological Economics 59, 375-393.
12. Giljum, S., Hubacek, K., 2009, Conceptual Foundations and Applicationsof Physical Input-output Tables, Handbook of Input-Output Economics in IndustriaI EcoIogy Edited by Sangwon Suh University of Minnesota, Departmento f Bioproductsa nd BiosysternsE ngineering, Saint Paul, U.S.A. , Springer.
13. ISTAT, 2009, Costantino C., Femia A.,Tudini A., ," Contabilità ambientale e pressioni sull'ambiente naturale: dagli schemi alle realizzazioni", Annali di statistica, Anno 138 Serie XI - vol. 2
14. Kneese, A. V. Ayres, R.U. & d'Arge, R. C. , 1970, Economics and the environment: A material balance approach. Baltimore, MD/London: John Hopkins.
15. Kratterl, A., Kratena, K. (1990), Reale Input-Output Tabelle und ökologischer Kreislauf, Physica-Verlag, Heidelberg.
16. Lagioia, G., Amicarelli, V., De Marco O. (2006), On the utility of combining two analytical methodologies: Material Flow Analysis(MFA) and Input Output Accounting (IOA), Lecture Series on Computer and Computational Sciences, Volume 7, pp.690-694.
17. Leontief, W. (1970), Environmental repercussions and the economic structure, The review of Economics and Statistics, 52, (3), 262 -171.
18. Leontieff , W., Carter, A., Pedri, P. (1977), The Future of Word Economy, New York.
19. Nebbia G. (2000), Contabilità monetaria e contabilità ambientale, Economia pubblica, 30, (6), 5-33
20. Nebbia, G. (2003), " Il prodotto interno materiale lordo dell'Italia nel 2000", Statistica, anno LXIII, n.2.
21. Quesnay, F.(1756-1758) "Tableu economique", in K. Mark " Capitale" vol.1, p.215-230; cap.XVIII, II libro
22. Stahmer,C., «The Magic Triangle of Input Output tables», in 13th International Conference in Input-Output Techniques, 21- 25 August 2000, Macerata, Italy, http://policy.rutgers.edu/cupr/iioa/StahmerMagicTriangle.pdf
23. Strassert, G. (2000), Physical input-output accounting and analysis: new perspectives, 13th International Conference on Input-Output Techniques, Macerata, Italy.
24. Suh, S., and Kagawa S., (2009), Industrial Ecology and Input-Output Economics: A Brief History, Handbook of Input-Output Economics in IndustriaI EcoIogy Edited by Sangwon Suh University of Minnesota, Departmento f Bioproductsa nd BiosysternsE ngineering, Saint Paul, U.S.A. , Springer.
25. WRI (World Resources Institute), 2000. Weight of Nations: Material Outflows from Industrial Economies. World Resources Institute, Washington DC.

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INDUSTRIAL PRODUCTION OF BRICKS- APPLICATION OF LEGISLATION ACORDING WATER LAW

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ABSTRACT

Legal basis: Water Law (Official Gazette RS" No.30/10), prescribes that in order to ensure uniform water regimes and water management, water acts issued for the construction of new or rehabilitation of existing buildings and other works that may permanently, occasionally or temporarily affect water regime, or threaten the environmental objectives. Water Act are issued for the production of planning documents for spatial planning and forest management, also.

The theme of this abstract is an attempt to show the connection between the issue of water acts in accordance with the Water Law, determination and classification underground water reserves and integrated license in accordance with the Integrated Prevention and Control of Environmental Pollution Law (Official Gazette RS "No. 135/04).

Key words: industrial production, groundwater reserves and the IPPC permit

INTRODUCTION

First of all, we have to clarify the way that investors have to prepare needed documents to be submitted in the process of issuing water management regulations. The Water Law (Official Gazette of the Republic of Serbia N^{o} 30/11). regulate the water protection, protection from the floods, the exploitation of the water and the water management… This law regulates the legal status of water contains 228 Articles (Art. 150-195 begun to apply from 01.January 2011)

Water Law contents: **I** -Basic provisions, **II** -Water goods, **III** -Water facilities . **IV** -Integrated Water Management**, V**-Water papers and Water Documentation, **VI**-Prohibition, limitation of rights and obligations of owners and users of water land and water facilities, **VII**-Other entities for water management **, VIII**-Information and Water Information System, **IX**- Financing of water management, **X** – Supervision, **XI**-Penalty provisions, **XII**-Final provisions.

JURISDICTION

Water documents are issued by the Ministry for Agriculture, Trade, Forestry and Water Management –Republic directorate for Water.

In the territory of the Autonomous Province of Vojvodina, Water documents are issued by Secretary for Agriculture, Forestry and Water

In the region of Belgrade, Water documents are issued by Secretary-Water directorate in Belgrade

In the territory of local self-government municipality, the documents are issued by themselves (for some activities) defined by article 117.

Before any usage, investors have to fulfill the preconditions issued by Authority and have to respect the procedure.

Water papers and Water documentation:

Water papers:
-Water management conditions,
-Water management agreement
-Water management permit
-Water order

Water documentation comprises: the water book, regulatory statutes on function and exploitation regime of water systems, water registries and registries of technical documentation. Example:

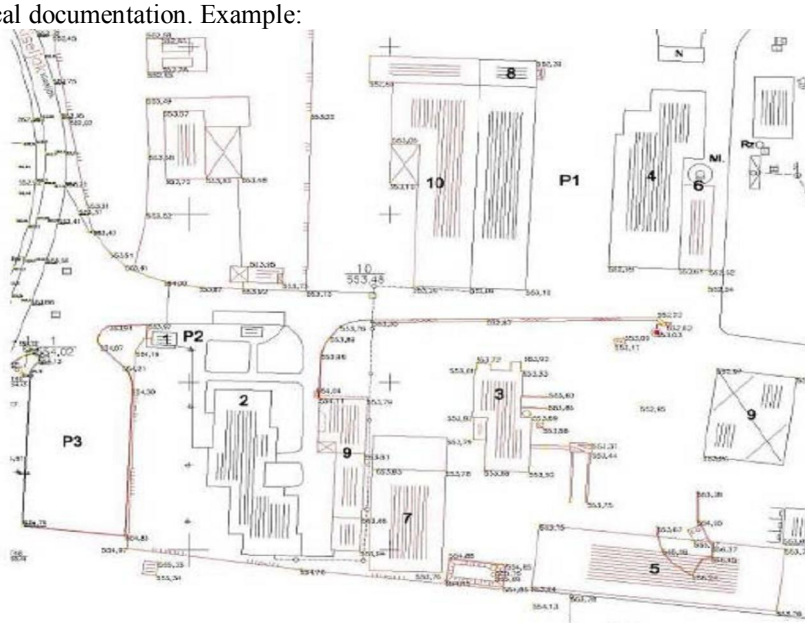


Figure 1. Lay out of complex for brick product

Legend of figure 1: P1 - complex for brick product, 10-production facilities and dryer, 8-administrative building and offices, 4-storage of final product, Pr-internal gas station, 6-well, N-oil separator

It is important to point out that the brick production plant division for that facility, and it is the subject to an integrated permission. In addition to other foreseen by law requirements for this facility it is primarily necessary to obtain Water management permit.

To make an object eligible for the issuance of water, it is necessary to solve the following activities:

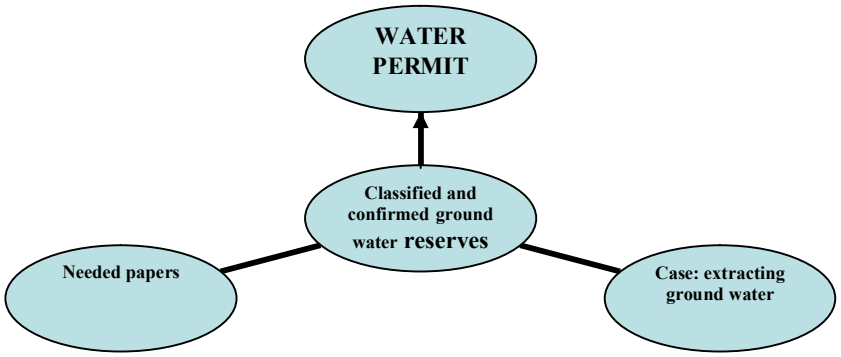
a. **supplying water** (abstraction from surface flow, **groundwater abstraction** and connection to public water supply)
b. **discharge** of sanitary sewage wastewater into public sewers or treatment and release to another recipient,
c. treatment and discharge **production wastewater** into public sewers and other recipients,
d. **oily water** from the terraces, manipulative areas, parking lots, is necessary to scrub first in oil separator and after then discharged into the sewer or other recipients.

In part **a)** it is underlined the **groundwater abstraction.** Why? It is important to point out that the groundwater can not be used casually.

Groundwaters that match the quality of drinking water can be used exclusively for water supply of population and food industry.

Groundwater that does not match the quality of drinking water may be plagued by the needs of industry, for the technological needs, for the hydrant network...

If we took the example of water supply brick production plant extracting ground water, we come to the connection between the issuance of water permits and graduated underground water reserves. Water permits can not be issued unless it is issued to the appropriate decision on classified and confirmed reserves of groundwater.



It is important to note that the water permit has validity. In accordance with the Water Law, the water permit is issued for a limited period of time, maximum for 15 years. After that period, the expiry of the water permit, fulfilling the given conditions of the water requirements permit, the investor submits an application for renewal.

REFERENCES

1. Water Law (Official Gazette of the Republic of Serbia N^{o} 30/11).

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POSSIBILITIES REGARDING ECOTOURISM DEVELOPMENT IN THE NERA DELTA, CARAŞ -SEVERIN COUNTY, ROMANIA

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ABSTRACT

Polluting the environment has had as response the encouragement of the emergence and development of sustainable tourism. One of its forms, ecotourism is good for protected areas since it supports environment conservation and the involvement of the local population in order to raise the living standard.

One can find great tourist resources in protected areas, resources that have a well-known value at a national and at an international level.

The Nera Delta is an ecosystem situated in Romania and in Serbia. They say that it is Europe's newest delta. Tourism development in this area can be beneficial both for the habitat and for the inhabitants of the region.

Key words: ecotourism, protected area, wetland, Nera Delta

INTRODUCTION

Ecotourism is one of the forms of sustainable tourism that can develop in protected areas and elsewhere.

The definition of ecotourism has been a preoccupation of the specialists ever since 1988 when the Belize Programme, initiated by Rio Bravo Conservation & Management Area, was implemented, even though the term was first used in 1965 by Claus-Dieter (Nick) Hetzer, an academician and adventurer from the International Forum in Berkley CA who initiated the first eco-tours in Yucatan at the beginning of the '70s.

The International Ecotourism Society (TIES) preferred a concise definition of ecotourism, that is "responsible travel to natural areas that conserves the environment and improves the well-being of local people." (1990)

According to the International Union for Conservation of Nature (1996) "ecotourism is environmentally responsible travel and visitation to relatively undisturbed natural areas, in order to enjoy and appreciate nature (and any accompanying cultural features - both past and present) that promotes conservation, has low negative visitor impact, and provides for beneficially active socio-economic involvement of local populations."

The main conditions necessary to ecotourism are:

- conservation and protection of nature;
- using human local resources;
- educational character, raising awareness of tourists and local communities;
- minimum negative impact on the natural, cultural and social environment.

The following principles were outlined within the Australian accreditation programme NEAP - Nature and Ecotourism Accreditation Program:

- natural area focus (develops within nature);
- interpretation of eco-tourist product;
- environmental sustainability;
- contribution to natural areas conservation;
- contribution to local communities development;
- cultural sensitivity;
- customer satisfaction;
- responsible marketing.

Tourists attracted by this type of tourism love nature, history, different cultures, they like participating in various open-air activities, they search for new experiences to enrich their life. They prefer medium, even basic accommodation facilities such as: tent, chalet, motel, pension or inn.

The International Union for Conservation of Nature defined the protected area as "a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values." (Resolution 19.4 of the 19th Session of the Assembly of IUCN, Buenos Aires January 1994).

Also, a classification system for protected areas, noted from I to VII, was developed in order to provide international standards for comparing the protected areas in different countries. The seven Protected Area Management Categories that define protected areas are:

- Strict Nature Reserve;
- Wilderness Area;
- National Park;
- Natural Monument of Feature;
- Habitat/Species Management Area;
- Protected Landscape/ Seascape
- Protected area with sustainable use of natural resources.

For a good management of protected areas these were divided into functional areas. The following main areas resulted:

- full protection areas or strictly protected areas - they are obligatorily protected and represent little disturbing samples, representative of natural ecosystems, terrestrial and aquatic. Therefore they include the most valuable assets of the natural heritage within the protected area;

- buffer areas or areas of sustainable management – they are set around strictly protected areas making the transition to economic areas;
- Economic or development areas of human activities - including human settlements;
- Ecological restoration areas – they are delimited only where necessary.

Wetlands present a growing interest for tourism being primary locations that can encourage recreational activities. They are characterized by the presence of both land and water in most of the year.

MATERIALS AND METHODS

A distinct wetland is the cross-border natural reservation the Nera Pond – Danube - Labudovo Okno (RNT BND & LO) placed on the territory of Romania and Serbia, at the confluence of the Nera and Danube rivers. This area forms a unitary ecosystem of the Nera river delta that was born after the emergence of the storage reservoir of the Iron Gates hydroelectric power plant.

The Nera Delta is a miniature of the Danube Delta, a paradise of fishermen, bird species and nature lovers.

On Romanian territory, the natural reservation the Nera Pond – Danube is part of the Iron Gates Natural Park, being considered a protected natural area, set by Law no. 5/2000 regarding the approval of the Development map of national territory – Section III Protected Areas.

The natural reservation the Nera Pond – Danube lies in Caraş - Severin County, and has a surface of 10 hectares on the territory of the Socol village.

One can access the area as follows:

- from Moldova Nouă on Pojejena – Socol DN (National Road);
- from Oraviţa on Naidăş – Socol DJ (County Road);
- on the Danube with own vessel.

The geological sub-layer of the reservation is made of sediments, gley and pseudo-gley soils and is aqueous.

The Nera Pond is made of a reduced proportion of swamps with dead sweet water that, during dry summers, reduce their level, sometimes leaving waterless surfaces. The small delta is formed at the inflow of the Nera in the Danube.

The climate is mild continental with Mediterranean influences and an average annual temperature between 6 and 8^0C, characterized by early springs with high temperatures, dry hot summers, and mild winters with little snow.

The vegetation of the area is hydrophilic and hygrophilic, specific to humid areas. Among the species met in this area we mention the: white willow *(Salix alba),* white poplar *(Populus alba),* black alder *(Alnus glutinosa),* narrow-leafed ash *(Fraxinus angustifolia),* sweet cherry *(Cerasus avium),* dog rose *(Rosa canina),* bastard indigobush *(Amorpha fruticosa),* sedge *(Carex sp.),* bulrush *(Holoschoenus vulgaris),* common reed *(Phragmites comunis),* and dwarf bulrush *(Typha minima),* wild grape *(Vitis sylvestris)* and hop *(Humulus lupus),* field horsetail *(Equisetum arvense),* yellow iris *(Iris*

pseudacorus) and common duckweed *(Lemna minor),* grass lily (*Oornithogalum umbellatum),* water chickweed *(Cerastium semidecandrum),* marsh seedbox *(Ludwigia palustris*), gibbous duckweed *(Lemna gibba).*

The fauna is rich adapted to the climate and vegetation of the area. Thus, they identified reptiles such as the common wall lizard *(lacerta muralis),* the European green lizard *(lacerta viridis)*, the Greek tortoise *(testudo graeca).* The fish present in the area are the: chub *(leuciscus cephalus)*, burbot *(lota lota),* roach *(rutilus rutilus carpathorossicus),* common bleak *(alburnus alburnus),* perch *(perca fluviatilis),* common bream *(abramis brama),* crucian carp *(carassius carassius),* common rudd *(scardinius erythrophthalmus),* pike *(esox lucius),* tench *(tinca tinca).* From the varied species of birds we can mention the: great cormorant *(phalacrocorax carbo),* pygmy cormorant *(phalacrocorax pygmaeus),* great crested grebe *(podiceps cristatus*), red-necked grebe *(podiceps grideigena),* mallard *(anas platyrhynchos),* garganey *(anas querquedula),* European herring gull *(larus argentatus),* black-headed gull *(larus ridibundus),* great bittern *(botaurus stellaris),* little bittern *(ixobrychus minutus),* grey heron *(ardea cinerea),* little egret *(egreta garzeta),* cirl bunting *(emberiza cirlus),* glossy ibis *(plegadis falcinellus),* sand martin *(riparia riparia),* chaffinch *(fringilla coelebs),* goldfinch *(carduelis carduelis)* and greenfinch *(carduelis chloris).*

The following activities are allowed within this reservation:

- scientific and educational;
- eco-tourist, that do not need constructions or investment;
- rational usage of pastures;
- localization and fire blow-out;
- intervention activities for the removal of negative factors for the habitats and the species in the area.

Besides permitted activities, there are also forbidden activities that refer to:

- exploitation, usage of natural resources and land;
- execution of constructions-investment.

As I have already mentioned, the reservation is located on the territory of the Socol village that has under its administration the villages: Baziaş, Cîmpia, Pârneaura and Zlatiţa.

The population of the village is of 2055 inhabitants, the majority being Serbians (1450 persons) and Romanians (810 persons), the rest being Czech (146 persons), gypsies (20 persons), Hungarians (14 persons), Germans and Ukrainians (8 persons each).

The main activities in the village are agriculture and fishing.

The anthropic tourist resources of the village are also important in order to develop ecotourism. We refer to the Serbian orthodox churches from:

- Baziaş, built in 1225, whose patron saint is the Ascension;
- Zlatiţa whose patron saints are Saint Simion and Saint Sava, located on the right bank of the Nera river; it is supposed to date back to the XIIIth century, being built by Saint Sava Nemanici, the missionary of Serbian culture;
- Cusici whose construction date is unknown.

The traditional crafts are those of bricklayer, carpenter, blacksmith, cartwright and sheepskin coat maker.

The traditional cuisine has known dishes: beans in sauce, cheese pie, pumpkin pie, pancakes with yeast addition.

Ecotourism is one of the development alternatives of the Natural Reservation Area the Nera Pond – Danube that can be further developed in the near future.

RESULTS AND DISCUSSIONS

Following a monitoring from GEC (Ecological Collaboration Group) on the Nera river in June 2010 within the protected area, disturbances of the nesting places were detected, because of a big quantity of plastic packages and wood waste products, unpleasant smells of used waters, sewerage up to 5 metres from the banks, trails of fuel and fats. Pollution is a reality that nature confronts with daily; many of the plastic packages are brought from upstream by the Danube, and at the moment only volunteers clean the waters.

In order to develop ecotourism in the Natural reservation the Nera Pond – Danube the authorities should:

- clean – put out plastic packages and wood waste products;
- replace the information board at the entrance in the reservation;
- set up certified camping sites;
- build pavilions for bird watching.

I have tried to establish a tree-objective (specific to the Logical Framework Approach) regarding ecotourism development and related activities in this protected area on the basis of the presented data.

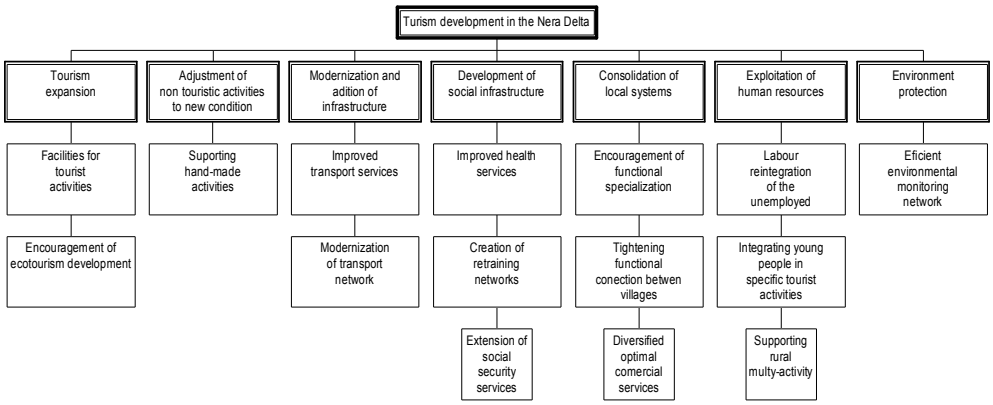

Figure 1. Tree-objective regarding ecotourism development and related activities in this protected area Adapted after Ianoş, I., Territorial systems, Tehnical Publishing House, Bucharest, 2000, page 165

The funds necessary for the implementation of a development plan for ecotourism in the Natural Reservation the Nera Pond – Danube could come from the European Union through POS Environment Priority Axis 2 – Development of integrated systems of waste management and rehabilitation of contaminated sites (for cleaning), POR Priority Axis 5 – Sustainable development and tourism promotion and PNDR Axis 3.1.3. – Encouraging tourist activities.

CONCLUSIONS

Ecotourism is the type of tourism that develops in protected areas, brings benefits to the neighbouring population, conserves the environment and helps people to become familiar with nature and local culture.

The reservation Nera Pond – Danube does not stretch on a very big surface, but includes enough natural resources to sustain ecotourism development. Due to its position, a collaboration between Romania and Serbia on a joint development programme of ecotourism would be quite beneficial for both parts.

At a European level there are funds to support such activities, thus the development of ecotourism in the Nera Delta is not an unfeasible objective.

REFERENCES

1. BĂLĂŞOIU,V., 2003, Tourism and the concept of sustainable development in tourism, sustainable ecotourism (2nd part) CNND, Bucharest;
2. IANOŞ, I., 2000, Territorial systems, Technical Publishing House, Bucharest;
3. NEACŞU, N.,1999, Tourism and sustainable development, Expert Publishing House, Bucharest;
4. NISTOREANU, P., (coordinator), 2003, Ecotourism and rural tourism, ASE Publishing House, Bucharest;
5. RUCKELSHAUSS, W.D., 1989, September, Toward a Sustainable World, Scientific American;
6. SAVA CIPRIANA, 2007, Development strategies of the tourism activity, Aprilia Print Publishing House, Timişoara;
7. GEC Nera, April - June 2010, Environmental alternative monitoring report for parks and reservations in Southern Banat;
8. Law no. 5/6.03.2000, regarding the approval of the Development map of national territory – Section III Protected Areas, Official Journal of Romania, no. 152 from 15.04.2000;
9. R.N.P. Romsilva – Administration of the Iron Gates Natural Park R.A.

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CONTRIBUTION OF THE DIGITAL FILM TO THE DEVELOPMENT OF ECOLOGICAL EDUCATION AND UPBRINGING OF LEARNERS

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ABSTRACT

Modern teaching implies use of modern teaching means and methods. In the teaching process various documentary and teaching-science films could be shown as a part of the materials about the protection and improvement of the social environment. Their usage in the teaching of ecological issues enables the teacher to demonstrate higher level of imagination and creativity. A digital film with ecological tone could be given at the beginning, in the main part, as well as in the final part of the lesson. When choosing a digital film the age and psycho-physiological abilities of the learners should be taken into consideration.

Key words: ecological education and upbringing, ecological contents, digital film

INTRODUCTION

Traditional teaching with frontal form of the work and class-lesson system slowly gives up its place to the new organization of the educational system of informatics era. Modern teaching process implies use of modern teaching means and methods. Among the abundance of modern teaching means which enhance audio-visual perception of learners and realize the didactic principle of evidence, the leading role definitely has the digital film. Use of digital films in teaching provides broad possibilities and their role in the teaching process is multiple. Their implementation in the teaching of ecological contents enables the teacher to demonstrate higher level of imagination and creativity. Besides, digital films represent an ideal way of active involvement of learners themselves in the teaching process and development of partner-relations between learners and a teacher.

POSSIBILITIES OF THE USE OF DIGITAL FILM

Digital films with ecological content put new demands in front of the teacher. Successful presentation of the film in the teaching process must be preceded by detailed preparation of the teacher and learners [1]. Teacher must not present a film if he/she does not watch it and analyze its possibilities for teaching process himself. When the teacher

chooses the film he will use, he must make a plan of his presentation. Good educational film with ecological content shown at the appropriate time has a huge ecological educational and upbringing value; it enriches and puts the teaching process in the contents, makes it interesting and various, as well as gained knowledge of the students more permanent. In the teaching process when the contents about improvement and protection of the environment are realized, different documentary and teaching-science films could be presented. "If the teacher's presentation is illustrated by film every child will have a clear thought of what the glacier looks like. All the changes in the nature and production which happen too fast or too slow (growth of the plant, for example) could be presented by film which is prepared for the school needs under the guidance of the pedagogue. Important details and eye-invisible particles are shot by suitable didactic media (electronic microscope, for example) and by simultaneous projection are presented to learners" [2].

Before the presentation of the film it is necessary to prepare learners for that. Every comment of the teacher during the film can distract learners. Because of that it is necessary before the start of the film to stress to the learners what to pay special attention to. Sometimes it is suitable to present the film to the learners many times.

It is very important that a teacher according to that concrete situation makes an appropriate choice, natural and logical combination of the teaching methods in tune with which he/she presents the film in the appropriate context. Digital film with ecological content could be presented in the introductory part of the lesson as a preparation of the learners for a new educational topic or unit. In that case film should not last for more than 5 minutes. In the main part of the lesson digital films could be the main or supporting teaching mean. When they represent the main mean their length is about 15 to 20 minutes. In the main part of the lesson a digital film could represent supporting teaching mean as a direct representation of a test or a situation and it lasts a several minutes. In the last part of the lesson a digital film could be presented as a recapitulation of that topic or unit.

Many authors have conveyed a survey in order to determine the efficiency of the use of teaching film depending on time articulation of the lesson, a moment and the way of its use. The percentage of acquired knowledge when the learners watched the film without an organized preparation was a bit under the 30 per cent on the test that is done immediately after the projection of the film. Far better results are accomplished when the learner watched the film after being prepared, when the per cent reached 50. The third version (result 60%) was that the learners watched the film after being prepared and then they are given tasks in relation to that material which were followed by test too.

The individualization could be done too from the digital film thanks to the fact that it is reproduced on home pc and it is easy to be coped in comparison to the classic film. Various films could be chosen for different levels of knowledge and different interests of learners, so they could be given the opportunity to watch them in school or at home.

In order to approach as successful as possible use of the digital film in the educational process a few things should be done. At first, the existing documentary and science-popular films should be classified according to the appropriate subject they

could be used for. For every film dedicated to the use in the teaching process a short content and photos should be prepared and printed on the covers of the digital films.

When digital films are being chosen the age and psycho-physiological abilities of the learners should be taken into consideration. Younger learners should be presented the films with less details and effects. If the chosen film is not adapted to the age of the learners it will not have a full ecological educational function.

APPLIANCE OF THE DIGITAL FILM AS A TAECHING MEAN IN THE REALISATION OF THE ECOLOGICAL CONTENTS

The main maxim of eco education is in the demand that ecological education is not just information about the eco facts and the knowledge that the learners acquire is not at the level of information but that the whole life in the educational institutions is in tune with the ecological requests [4].

Use of digital films in the teaching process should have these goals:

- Increase of the motivation of learners for learning and development of interests for the educational process by presentation of the films adapted to the topic of the lesson, pre-knowledge, interests and the age of the learners. By presentation of the digital multi-media film it is provided at the same time an easy acquirement of the presented thesis for the learners with the different styles of the learning. Abetment of a learner to notice and understand relations and situations which he/she watched in the film (recognition and analyze of the situation)
- Abetment of a learner to acquire and use data and principles that are exposed to him/her. Connection of the topics to realistic situations by presentation of carefully chosen films (contextualization of the knowledge).
- Abetment of learners to value, criticize and present their attitude about the thing they watch in a film (formation of the personal opinion, argumentation and discussion).
- Development of the imagination and interest of the learners; a learner is abetted to evaluate, classify, suppose and guess it (development of critical and abstract opinion).
- Training of learners to reformulate, summarize and synthesize cognitions gained by film watching. Training of learners to independently build and apply their knowledge according to film, for example through independent film projects.

The sources of films for educational process are different – it could be educational film which is bought and dedicated to that topic within plan and program of the educational process, appropriate film material legally taken from the cable TV, TV or Internet or could be even made by a teacher or learners in cooperation with teachers or film material which is shot or and turned into film by teachers and learners themselves. Film downloaded from Internet could be presented whole, just part of it or it could be assembled from different parts by teachers. For film presentation in the lesson only computer with video beam and sound for the frontal educational process is needed, while

for the individual educational process every learner should have its own computer with monitor and headphones.

There are many ways to include a digital film in the educational process:

- For the educational process of elementary and high school films which present realistic and hypothetical life situations could be made and presented. Discussion of learners is organized after film watching.
- It is possible to present a film from which a part is cut out. Learners are divided into groups and every group creates a script for the missing part of the film. Learners could be given the task to shoot that missing part or to discuss and choose the most logical one. At the end the original film is shown, which could also lead to following exercises: comparison, discussion and conclusion.
- Abetment of the principle of evidence could even be applied for some dangerous experiments or those for which there is not appropriate equipment or conditions in schools for carrying them out. These experiments could be shot in schools and faculties where there is appropriate equipment or digital films shot in special laboratories could be downloaded from Internet.
- Photos, objects, social and natural happenings as well as flora and fauna presented by film represent the reality that every learner understands in their own way.
- In the teaching of nature and community in lower grades of elementary school projects that provide content about the positive effect of man towards the environment are useful. It is also necessary to present the contents about the bad influence of man towards the environment so that learners could notice mistakes we make towards the environment.
- In biology teaching films about mutual harmonious relation of flora and fauna in nature could be presented. Those are films about natural beauties of the area (mountains, woods, mountain lawns, shores of rivers, lakes...); endemic species of plants and animals in the homeland. It is also necessary to present films with content which presents some negative impact of man to the environment (pollution of water, land, air, food). Films with content about measures which people take to protect the nature and to moderate negative effects they caused themselves in the nature.
- In geography teaching a digital film about the panorama of the area where the school is could be made and according to made snapshots a map of the territory, an interpretation regarded geographical maps and satellite shots could be done. Shots of different areas (national parks, river nets, geo-morphologic features of areas…).

PROJECT TEACHING PROCESS AND A DIGITAL FILM MAKING

Project teaching is the most complex form of practical sensible and intensive acquirement of knowledge through integral activities, that is, problem wholes and areas of cognition, a transfer and presentation, use and appliance of concrete knowledge [7]. Digital film making upon a chosen topic as a project task, together with a leadership of a

teacher, in a group or independently, is a modern approach to project learning which became achievable by use of IT technologies.

Learners make a film with the help of teachers through the project of knowledge accepting; that is active learning that has a huge pedagogic value and where technical quality of the film made by learners does not have a huge role. It is good that a role of every learner in a team is known in advanced and precisely determined and learners could also choose roles themselves according to their pre knowledge and predispositions. It is important that a task is clearly assigned to learners that they are given roles in a team that is time schedule of activities made and that they are explained how and where they could find additional material for project preparation. Some of learners could research digital film recourses, some of them could write a script, some could act, and others could shoot a video or voice or put up film scenes… When working in groups it is necessary to harmonize work of learners according to time and content and together with learners a list of activities and results (that every group and a learner should have during the work) should be made. Topic of the work should be in harmony with age, interests and previous knowledge.

In order to make a good teaching film an idea for shooting must exist. Before learners start making a film they should be instructed basic techniques of video material shooting and they should be helped when putting up a film.

Ideas for making project of learners could be suggested by learners themselves or in agreement with a teacher. Here are some examples:

- Learners could in a glass lay in a plant (wheat or beans for example) and record by a camera its development. Every day it is necessary to shoot a photo or a few seconds video sequence that shows development of a plant and at the end all those videos should be put together and speeded up. In that way a great film about plant development which could be titled with explanations about the growth speed and phases of development. Learners could be given to observe and shoot different plants or the same ones in the different growth conditions and consequently according to those films made by learners an analysis of morphologic differences and the difference in growth speed, influence of the light, humidity and the other factors on the plant growth.
- While going on excursion in their area or traveling abroad learners could shoot flora and fauna that is characteristic for that area and then they could make from the film virtual atlas of the area with task for an additional investigation (what flora and fauna is typical for that area precisely and why, where else similar one exists, and so on).
- For animals shooting it is not possible to make a script in advance but it is possible to cut them afterwards and put in the whole. It is good to have close shots of landscape, geographic maps and video of satellite shot of the area, which could be found on the internet and could be nicely fitted into the video.
- When visiting farms and fields learners could shoot objects where animals live, relationship of a man towards flora and fauna, work in a field, wine yard, mutual dependence of plants, animals and a man.
- Instead of a classic herbarium learners could make a virtual one: they shoot a plant in the natural environment and then make shots of a root, stem, leaf,

flower/offspring (when it disappears) and the appearance of the whole plant in different seasons.

- Going to woods or a park offers a possibility to shoot plants in their natural environment form different corners. Size of a plant could be presented in comparison to a learner or a wooden meter brought by a learner. Photos or video sequences of the leaf and its place on the plant, flower and offspring should be done and in the school photos of taken leaves, flowers, off springs and roots of a cut plant. In schools very good microscope shots of characteristic parts of a plant could be made by simple putting a camera slide on a microscope.
- Zoo visiting could be an ideal opportunity for shooting a film about animals, their behavior and physical characteristics, which is especially interesting for younger learners.

CONCLUSION

Digital film is a valuable didactic material which together with other didactic media, an appropriate choice of a film and its professional use offers a possibility of improvement of teaching and learning of ecological contents.

One of the most important tasks of education that arises in near future is formation and a building of ecological consciousness of children and youth. Nowadays almost there is not an area that is not presented in the film and in that way available to the broad masses, to find out more and increase their ecological consciousness.

Digital films use in a teaching process should have next goals:

- Increase of motivation of learners for learning and developing interest for lesson Presenting a digital multimedia film it is at the same time given an opportunity to learners with different learning styles to easily acquire presented thesis.
- Stimulation of learners to observe, notice, understand relations and situations they saw in the film (Recognition and analyzes of a situation)
- Stimulation of learners to acquire and use data principles that were presented to them.
- Stimulation of learners to value, criticize and present their opinion about what they see in a film (formation of personal opinion, argumentation and discussion)
- Development of imagination and interest of learners
- Qualification of learners to reformulate, summarize and synthesize knowledge acquired by watching of a film.
- Qualification of learners to individually build and apply their knowledge according to a film, for instance: Need of protection and preservation of their environment.

It would be suitable to build a bibliography card file for films used in teaching process which should have an appropriate description of material that is necessary for teachers. It would be good if a ministry of education, science and culture organizes distribution of digital films with ecological content to schools in order to develop ecological consciousness of learners.

REFERENCES

1. Mijanović, Nikola: Obrazovna tehnologija, "Pobjeda", Podgorica, 2002.
2. Mandić Danimir: Metodika informatičkog obrazovanja. Beograd: Mediagraf, Filozofski fakultet u Banjoj Luci, 2003.
3. Mandić Danimir: Informaciona tehnologija u obrazovanju, Filizofski fakultet u Srpskom Sarajevu, 2001.
4. Šehović, S., Marjanović, R., Biočanin, R. : Ekološko obrazovanje u funkciji zaštite i unapređenja životne sredine, Konferencija Tehnika i informatika u obrazovanju, TIO'08. Čačak, 2008.
5. Vukanović, Aleksandar: Ekološko vaspitanje i obrazovanje u funkciji zaštite biljnog svijeta na prostoru opštine Trebinje, Prva naučno-stručna konferencija sa međunarodnim učešćem „Rizici i eko-bezbjednost u postmodernom ambijentu", Novi Pazar, 2010.
6. Vukanović, Aleksandar: Doprinos škole i njene okoline u razvijanju ekološke svijesti učenika, Treći međunarodni kongres „Ekologija, zdravlje, rad, sport", Banja Luka, 2009.
7. Đorđević, Vesna: Inovativni modeli nastave, „Obrazovna tehnologija br. 4/2007, Beograd, 2007.

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THE INFLUENCE OF THE BOLOGNA PROCESS ON THE DEVELOPMENT OF ENVIRONMENTAL EDUCATION IN THE NATURAL SCIENCES

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ABSTRACT

In this paper examines the study of physics about the effects of noise, global warming and radiation as potential pollutants. There were curriculum examined, improving environmental education in 2009/2010 compared to 2003/2004 when the curriculum was not yet included the Bologna process. Environmental program, students were involved with the study of physics course: physics professor, teaching course, physicist researcher, meteorologist and medical physicist. This report lists the specific teaching content related to the three pollutants (noise, global warming and radiation) before and after the introduction of the Bologna process. Aim of this paper was to demonstrate the advantage of the Bologna process in the teaching of ecology in the study group of Physics at the Faculty of Natural Sciences in Novi Sad. The method of research was the analysis of archives of the Department of Physics.

Key words: Bologna Process, Environmental Education, Physics, Natural Sciences

INTRODUCTION

Education in the largest sense is any act or experience that has a formative effect on the mind, character or physical ability of an individual. In its technical sense, education is the process by which society deliberately transmits its accumulated knowledge, skills and values from one generation to another. A right to education has been created and recognized by some jurisdictions: since 1952, Article 2 of the first Protocol to the European Convention on Human Rights obliges all signatory parties to guarantee the right to education. At world level, the United Nations' International Covenant on Economic, Social and Cultural Rights of 1966 guarantees this right under its Article 13.

Environmental education (EE) refers to organized efforts to teach about how natural environments function and, particularly, how human beings can manage their behavior and ecosystems in order to live sustainably [1]. October 13–22, 1975 - The Belgrade Charter was the outcome of the International Workshop on Environmental Education held in Belgrade, Yugoslavia. The Belgrade Charter was built upon the Stockholm Declaration and adds goals, objectives, and guiding principles of environmental education programs. It defines an audience for environmental education, which includes the general public. Environmental education is a learning process that increases people's knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address the challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action (UNESCO, Tbilisi Declaration, 1978).

The purpose of the **Bologna Process** (or **Bologna Accords**) is the creation of the European Higher Education Area by making academic degree standards and quality assurance standards more comparable and compatible throughout Europe, in particular under the Lisbon Recognition Convention. It is named after the place it was proposed, the University of Bologna, with the signing in 1999 of the Bologna declaration by Education Ministers from 29 European countries and Serbia from 2003. It was opened up to other countries signatory to the European Cultural Convention of the Council of Europe; further governmental meetings have been held in Prague (2001), Berlin (2003), Bergen (2005), London (2007), and Leuven (2009). The **Bologna declaration** is the main guiding document of the Bologna process. It proposed a European Higher Education Area in which students and graduates could move freely between countries, using prior qualifications in one country as acceptable entry requirements for further study in another. The principal aims agreed were: „adoption of a system of easily readable and comparable degrees". and „adoption of a system essentially based on two main cycles, undergraduate and graduate. Access to the second cycle requires successful completion of first cycle studies, lasting a minimum of three years. The degree awarded after the first cycle is also relevant to the European labour market as an appropriate level of qualification. The second cycle should lead to the master and/or doctorate degree as in many European countries". The Bologna declaration has later been followed up a series of meetings between EU ministers. Each meeting has produced a communiqué based on their deliberations [2].

NOISE POLLUTION

Noise pollution is a type of energy pollution in which distracting, irritating, or damaging sounds are freely audible. As with other forms of energy pollution (such as heat and light pollution), noise pollution contaminants are not physical particles, but rather waves that interfere with naturally-occurring waves of a similar type in the same environment. Noise is defined as unwanted sound that involves harmful effects on humans. Sound protection is a set of measures that ensures that the sound (noise) during the transmission from the source to the receiving site, ie, the object from one space to another, be weakened.

Table 1 shows the cases in which it encourages students knowledge in the field of environmental education for both curricula. Students enrolled on curriculum in 2009/10. the year, but the first year of undergraduate studies in physics first serious encounter with

the basic concepts wich effect their environmental education within the course mechanics, which is mandatory for all courses of Physics. One area in which environmental education is to promoted is the Oscillations where the Sound wave and how it spreads.

Table 1. Overview of the subjects of ecology, which includes the topic of noise pollution

Subject	Curriculum from 2003/04			Curriculum from 2009/10			
	year	Item Status	Classes	Year	Item Status	Classes	ESPB
Mechanics	I	Obligatory course eccept for courses of astronomija	5+6	I	Obligatory course	3+3	8
Oscilaion and waves	-	-	-	I	Obligatory course	2+2	4
Acustics	-	-	-	I	Elective course	3+2	6
Anatomy of human body, introduction	II i III	Obligatory course only for one modul	2+2	II	Obligatory course only for one modul	2+1	3
Physiology and cell biology, introduction	II i III	Obligatory course only for one modul	2+2	II	Obligatory course only for one modul	3+2	4
Biophysics of human body	II i III	Obligatory course	2+0	III	Obligatory course only for one modul	3+2	7
Environmental protection	II	Obligatory course/ Elective course	2+2	III	Elective course	3+2	6
Noise pollution protection	-	-	-	III	Elective course	3+2	6
Biophysics	-	-	-	III	Elective course	3+2	

To that closely linked the second-year courses of study: Basic anatomy of the human body and Fundamental physiology and Biology of cells, with the objectives: to provide knowledge about Anatomy of the human body, and Function of cells, in the Biomechanical, Thermodynamic, Bioelectrical, Bioacoustic and Optical processes in the human body or at the cell level. On the next academic year, modul to Physics of the human body, developed a basis for understanding the functioning of human senses and understanding of Bioacoustics as a part of physics. In the same year are also held elective courses: Environmental protection, Noise protection and Biophysics.

In the frame of the Environmental protection modul students of courses could learn about basic concepts and principles of the environment, causes and consequences of pollution, (definition, significance, tasks). The subject of protection from noise, aims to introduce to students: objective and subjective characteristics of sound waves, the structure and functioning of the organs of hearing, norming harmful effects of noise, spatial acoustics, administrative organizational, educational and medical protective measures from the community noise, which is fundamental to the understanding of pollution and noise protection. Syllabus of Biophysics introduced with sound waves and radioactivity, the interaction of ionizing radiation with living and inanimate matter, dosimetry and protection from harmful radiation. In this case this combination of two very important parts that influence the awareness of students about ecology and protection of pollution brought about by modern society.

Unlike the previously mentioned, students who enrolled with the curriculum from 2003-04. years had a higher number of subjects in mechanics, but in the same syllabust: Oscillations, Waves and Acoustics, there were no predicted the basic

characteristics of sound waves. Furthermore, the differences being observed in sullabus Physics of the human body that the students in the program that was valid in 2003/04. attended two terms with less teaching hours per week than students who attended the same subject by the program from 2009/10. when it was just one semester classes with a larger number of classes.

Based on the type of classes we can see the difference that students under the earlier system of education does not have an organized practical training in that subject. Another difference is in the cases of Noise protection and Biophysics, which according to previous plan and program were not provided. On this basis, we see that in this case, students who enrolled the study curriculum in 2009/10. have more knowledge in the field of ecology.

GLOBAL WARMING

Global warming is the name of the increase in average temperature of the atmosphere and oceans, especially in recent times. How ecological „time bomb" ticking away, it must be to develop awareness among all citizens that as monitoring climate change is very important and that the climate change is a long-term problem what our planet faces. Therefore, students as a crucial link in our society, must be familiar with this global problem, which is a product of the modern society. Introducing physics students, enrolled in the curriculum from 2009/10. years, with global warming and its consequences begins from the first year of undergraduate studies (Table 2).

Table 2. Overviev of classes „Environmental education - Global warming"

Subject	Curriculum from 2003/04			Curriculum from 2009/10			
	Year	Item Status	Classes	Year	Item Status	Classes	ESPB
Introduction to Meteorology I	I	Obligated for one course	2+1 2+1	I	Obligated for one course	3+3	8
Introduction to Meteorology II				I	Obligated for one course	3+3	8
Dinamics meteorology I	III	Obligated for one course	4+4	II	Obligated for one course	2+2	4
Radiation in atmospherei	II i III	Obligated for one course	3+3 1+1	II	Elective	3+2	6
Meteorological observation and datas analysis	I	Obligated for one course	3+2	II	Obligated for one course	2+2	4
Timing analysis	III	Obligated for one course	3+3	III	Obligated for one course	2+1	4
Micrometeorology	IV	Obligated for one course	4+2	III	Obligated for one course	2+2	5
Modelling of airpollution transport	III i IV (Moddelling of atmosfere I i II)	Obligated for one course	4+4 4+4	III	Elective	3+2	6
Dinamics meteorology II	IV	Obligated for one course	4+4	III	Obligated for one course	2+1	4

Already in the first year of study within the subject-oriented to a study group, An Introduction to Meteorology I studied the areas that students directly acquainted with the basics of global warming. The introduction begins with studying the atmosphere over the distribution of solar radiation at Earth's surface in the absence of the atmosphere and the

weakening of the same in the atmosphere to global warming. On the basis of only a few areas within the subject shows that the subject itself provides a good theoretical knowledge in the field of environmental education. The following semester to the same study group, organized a compulsory subject, Introduction to Meteorology II, for students to study climate, human influence on to climate, global pollution and pollution spreading.

Also, was valid with the latest models for the transport of pollution, such as Euler's approach and Lagrange's approach, and the technique of measuring the concentration of pollutants. The study group also has Dynamic Meteorology II. In this course, students study the wave motion in a homogeneous atmosphere and instability in the atmosphere. The forther research includes: modeling global change and transfer of radiation through the atmosphere, which are electives.

The difference between the plan and program from 2003/04. and 2009/10. is that in the Introduction to Meteorology, increased the number of hours of both theoretical and practical training (Table 2). Subject of Dynamic Meteorology previously studied in the third year of study with a much larger teaching hours per week than in recent studies curriculum for second year [2].

The subject of radiation in the atmosphere previously has been studied for two semesters, and a syllabus from 2009/10. is scheduled only for one semester. Micrometeorology, Modelling of pollution transport in the atmosphere and Dynamic meteorology II reduced and changed the year of study. To rationalised programme is due to the increase of the fund for common subjects for all modules taught in course of Physics [4].

RADIOACTIVE CONTAMINATION

Radioactivity is a spontaneous process in which the nucleus transformed into other core. This process takes place with the emission of one or more particles or electromagnetic radiation quantums.

Table 3. Overview of items environmental education - radioactive pollution

Subject	Curriculum from 2003/04		
	Academic year	Item Status	classes
Fundaments of Electonics Industrial Electronics Medical Electronics	II	obliged for three groups	2+3 (2+4 i 2+4) (2+4 i 2+2)
Fundaments of Atomic Physics	III	obliged for one group	3+4
Fundaments of Nuclear Physics	III	obliged for one group	3+4
Nuclear radiation and Environmental protection	III	obliged for one group	3+3
Fundamental and Applied Nuclear Physics	IV	obliged for one group	3+4 3+4
Physics of Elementary Particles	IV	obliged for one group	2+2
Nuclear Physics	IV	obliged for one group	3+4 3+4

Knowledge of radioactivity, as an essential element of environmental education begins by introducing of knowledge about of charged particles and EMP (Electric Motor Power) in the frame of Fundamentals of Electronics (3+3) for students in the Second year. On this builded up the Contemporary Physiscs I (3+4), within which students are

intorduced the detailed atomic structure the atomic and the scattering spectras of α particles. This item is intended for students of III year. Then, the subject of Modern Experimental Physics III (3+4), which is obliged for students of third year aimed at acquiring knowledge about the interaction of radiation with matter, detection of nuclear radiation and radioactive decay. On this builded up the subject Protection from ionizing radiation and dosimetry (3+2) ensuring that students of all groups have the opportunity to deep their knowledge in the field of radioactivity. The master studies are continuing studies in this field on the topic, beginning with the subject of Atomic physics (3 +4), which is obliged for all directions. In this course, students learn about the atomic structure and the properties of electron. Build upon this theme: excitation and deexcitation of energy levels, lifetime of excited states, emission and absorption of radiation, spectroscopy, and others (Table 3).

CONCLUSION

Changes in higher education system that followed the acceptance of the Bologna processes caused different consequences. Specifically, changes have led to increased number of elective courses and in this way in an issue may include students who do not closely related to the profession, but, on the other hand, their theoretical training classes reduced what means that more students could attend the lectures. For students which like to search some part of subject, there is enough time to work at home. Content analysis in physics studies of dealing with environmental education finds that students who enrolled in the study curriculum in 2009/10. They have a broader knowledge of environmental education than students who were enrolled long before them, in 2003-04.

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REFERENCES

1. Halaši T.J., Kalamković S.S, Halaši R.J., 2008: Istorijat zagađivanja vazduha i kvaliteta vazduha, Kvalitet zaštite vazduha 2008, Zbornik radova, Privredna komora Srbije, Urednik Lj. Tanasijević, Beograd, 20-21. Oktobar 2008. str. 3-10.
2. Miljanović T., Drakulić V., 2010: Nove akreditovane studije biologije i ekologije na univerzitetima u Srbiji, Evropske dimenzije promena obrazovnog sistema u Srbiji, Zbornik radova, knjiga 6. Urednik O. Gajić, Univerzitet u Novom Sadu, 2010, str. 171-190.
3. Tomić P., (urednik), 2003: Informator za školsku 2003/04., Departman za fiziku, Univerzitet u Novom Sadu, Prirodno-matematički fakultet, Novi Sad, (2. poglavlje).
4. Mimica Dukić N. (urednik), 2010: Informator za školsku 2009/10., Departman za Fiziku, Univerzitet u Novom Sadu, Prirodno-matematički fakultet, Novi Sad, str. 71-98.

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ENERGY - AWARE DATA ROUTING TOWARDS A SUSTAINABLE AND GREENER INTERNET

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ABSTRACT

Can we harness the innovations of the global digital technology industry to save our planet? We believe the technologies of the computing and Internet revolutions will be critical in the efforts to prevent climate change.**Whether you're in a corporation wanting to learn about green IT best practices or an entrepreneur looking for your next venture in green, you should read about how some of the smart devices , software technologies and algorithms can make our world and planet a little more green.**

Key words: Internet, Web, Ecology,Green Computing,Energy eficiency,energy savings, green internet, internet routing, green data centers, CO2 reduction, energy protocols

INTRODUCTION

Internet provides us the luxury of unprecedented digital connection, but at the same time the amount of energy needed to keep millions of websites, servers and data centres up and running is enormous. Many people do not realise that the internet has become one of today's major polluters, already responsible for as much CO2 emission as the entire aviation industry. And with the continued demand on our internet infrastructure the problem is not going to get easier. But together we can make a difference to our environment.

Energy costs for data centers are a significant part of the overall expenses for their operation. With a reduction of these and associated costs, huge savings can be achieved. This paper describes a way to reduce the energy costs for data centers. The general idea behind our solution is very simple. Instead of routing the information required for any service interaction to and from the data center with the best latency performance or least utilization we rather propose that instead the one with the current cheapest energy costs should be used. We consider implications of our method to user performance and latency efficiency. Thereafter, we present methods which can be used to implement a general idea and discuss potential problems and benefits. The approaches described in can all be integrated into the IP protocol and require therefore no modifications of the network topology, the used hardware or used protocols.

'CO2 neutral' or 'carbon neutral' means that CO2 emission caused by the use of energy generated by fossil fuels is being compensated by

- Removing CO2 out of the atmosphere
- Reducing CO2 emission by using sustainable and renewable energy

CO2 is taken out of the atmosphere by plants and trees that grow and store the CO2 in their tissue in the form of carbon. A tree is actually a huge storage facility of carbon. In addition, trees also give us oxygen (O2) as a 'by-product' of this storage process. By planting sufficient numbers of new trees the extra emission of CO2 can be compensated for. CO2 emission can also be prevented - by using sustainable energy. There is no emission of greenhouse gasses involved in the production of energy generated by wind, water or sunlight.

A Greener Internet with Energy-Aware Data Routing Algorithms

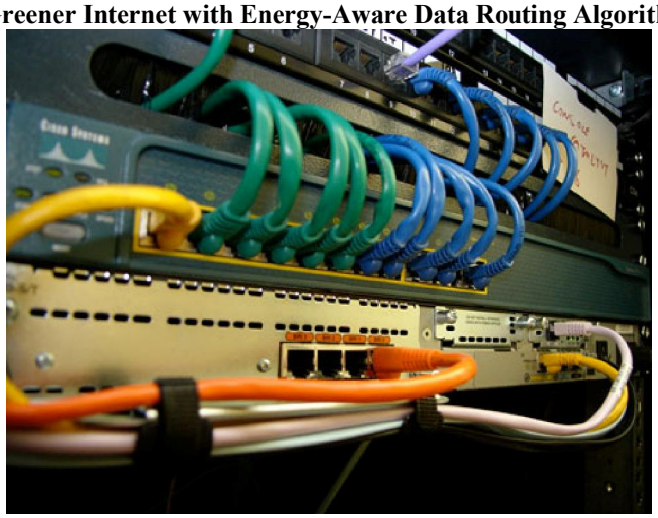


Photo: Flickr, CC

Energy Cost Savings Could Turn Into CO2 Reductions. Researchers at MIT, Carnegie Mellon University, and the internet caching companyAkamai released a study that shows how large internet companies with many power-hungry data centers could save a significant amount of money by using an algorithm that would track electricity prices and switch traffic to data centers where the cost is lowest.

Researchers have come up with a new way to route Internet traffic that could save big Internet companies like Google millions on their electricity bills. Researchers from MIT, Carnegie Mellon University, and the networking company Akamai recently published results from a study that suggest big Internet companies could save up to 40 percent on their electricity bills by using an algorithm to send Internet traffic to data centers where electricity is less expensive

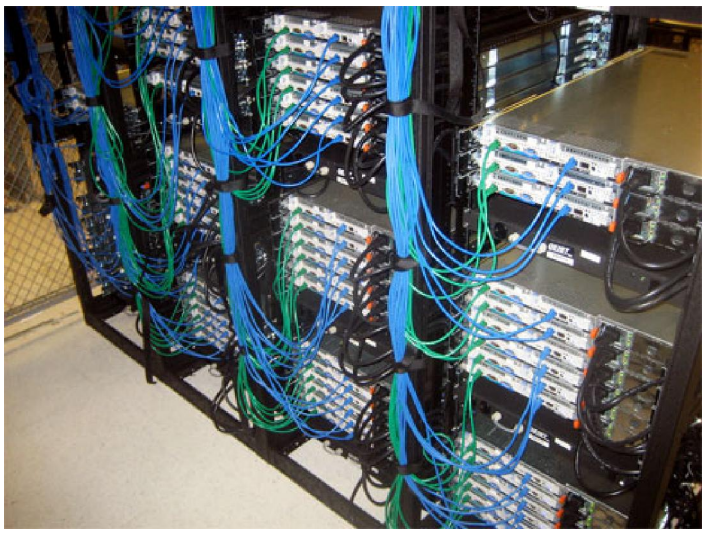


Photo: Flickr, CC

The team then devised a routing scheme designed to take advantage of daily and hourly fluctuations in electricity costs across the country. **The resulting algorithm weighs up the physical distance needed to route information--because it's more expensive to move data further--against the likely cost savings from reduced energy use**. Data collected from nine servers, covering 24 days of activity, provided a way to test the routing scheme using real-world data. The team found that, **in the best scenario--one in which energy use is proportional to computing--a company could slash its energy consumption by 40 percent**.

Data centers consume a lot of energy, which costs operators like Google and Amazon millions of dollars to run each year. And now as more digital information is "virtualized" and accessed in the cloud, centralized data centers are getting even bigger and are consuming even more energy.

In fact, data center energy usage is expected to quadruple during the next decade in the absence of efforts to improve efficiency, according to the article, which referenced a report from McKinsey & Company and the Uptime Institute published in July 2008. The article also estimated that today, some large Internet companies spend more than $30 million a year on energy costs.

But now there could be a way for these companies to lower their energy costs. Using an algorithm developed and tested by researchers at MIT, Carnegie Mellon, and Akamai, these companies can track electricity prices that fluctuate by location and time of day. It then calculates the best option depending on the price of electricity and the distance that data must travel to get to a particular location, to provide the most cost-effective route for data based on energy costs.

There is mounting pressure for big Internet companies to reduce their energy usage. Not only is it expensive, but these companies face pressure from governments and others concerned with the environment to reduce their carbon footprints.

The algorithm developed by these researchers doesn't necessarily cut the use of energy. It merely helps companies better manage their energy costs. But researchers argue it could also be used to direct traffic to facilities where greener forms of energy are being used.

The example usedis a Google data center in Belgium that relies on ambient cooling to keep its facilities under a certain temperature instead of firing up expensive air-conditioning systems. On days when the weather is too warm, the servers in the data center simply shut down. One researcher working on the project said that the energy-routing algorithm is an extension of this idea.

The problem with this is that the cheapest energy is often coal. So the problem with this kind of algorithm is that it could actually make the internet more coal-powered.

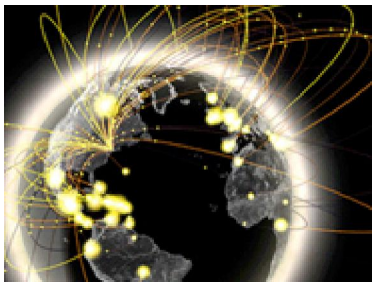
Green Internet Routing

A green version of this routing program might take into account electric costs and latency requirements, but also how clean the source of that electricity is and how much surplus of it there is at the moment.

For example, a company with many datacenters might have some buildings in an area where there is lots of solar power available on sunny days, and some in an area where there is lots of wind power available on windy days. On a sunny day it could redirect traffic to the former, while on a windy day it could redirect to the latter. On a day when there isn't much clean energy available (dark and windless), it could redirect to wherever the energy's cheapest (hopefully hydro and not coal).

Not all traffic could be redirected that way because sometimes you need the lowest latency, but any traffic moved from a "dirtier" datacenter to a "cleaner" one would be an improvement, at least until the day when 100% of the electricity on the grid is coming from clean sources.

But before that can happen, we'll probably need a higher price on carbon and/or cheaper renewables (both solar and wind are making progress, and should pick up the pace when financing for big projects becomes available again).



Managing energy and its costs is likely to be big business in the coming years for technology companies. Cisco Systems, the largest networking company in the world, recently said it sees a $100 billion market in helping power utilities better manage their electrical grids using communication technology.

Other high-tech companies, including IBM, Intel, and several start-ups, are also ramping up to develop sensors and other technology that alert power companies and their customers about energy usage in an effort to balance usage and reduce costs.

The idea of the "smart grid" is to modernize the electricity industry by overlaying digital communications onto the grid. For example, smart meters in a person's home can communicate energy usage to utilities, allowing these companies to more efficiently manage the electricity supply and potentially allow a consumer to take advantage of cheaper rates.

Some utilities are already testing technology from Cisco that will help its routers and switches more efficiently manage the flow of electricity and prevent outages in grid distribution equipment. Cisco also released new software earlier this year called EnergyWise, which allows more efficient use of energy in office buildings. The software is a free upgrade to Cisco Catalyst switches that can monitor and manage how energy is used on IP-connected devices, including phones and wireless routers. Using the software, companies can set policies on energy use, allowing PCs or networking equipment to go into sleep mode after work hours, for example.

Saving Energy in Data Centers with Smart Sensors and Algorithms

We're now firmly in an interconnected and digital world, and that means lots and lots of servers. The EPA wrote a report for the US Congress about it in 2006, and they estimated that servers and data centers represented about 1.5% of total electricity usage in the country for that year. That's 61 billion (with a 'b') kilowatt-hours, and that's for 2006, It's probably more now.

Of course, lots of power means lots of money, so there's clearly an incentive to become more energy efficient. Microsoft Research's Networked Embedded Computing group is working on a very promising concept: A combination of physical sensors in the server room and software algorithms to make individual computers sleep or wake up depending on demand.

How this Technology Works to Make Server Rooms more Energy Efficient

The sensors monitor the servers to make sure they're not being overcooled (a common problem in data centers, he says, since people often set the cooling system conservatively, to protect the equipment). In addition, the sensor system watches for hot spots, which can make the air-conditioning system work inefficiently. This information is then used by the load-skewing algorithms. Knowing that you want to shut down 400 servers is one thing. The sensor helps determine which ones to shut down.

So when demand is lower, the algorithms know that they can power down a certain number of servers. There's a lot of savings right there. But it's the sensors that make the system smart enough to power down the right servers to maximize savings, making the air conditioning work more efficiently (about half of the energy used by a data center is for cooling).

The Future of Data Centers. If the past is any indication, we'll find new uses for all that computing and storage that technology is bringing us, and the number of servers required (especially as developing countries come online) will keep growing. Many strategies will need to be used to make them as clean as possible; cleaning up the power grid is the most obvious way.A combination of renewables and efficiency will bring the best results.

CONCLUSION

Various estimates of Internet traffic yield different predictions, yet everyone seems to agree that the importance of data communications and the volume of traffic will continue to grow. This growth will likely vary from a linear to an exponential curve, depending on the country and economic conditions. Still, we can reliably conclude that individual consumers and businesses will increasingly rely on data networks worldwide. Does this mean that networking equipment will be responsible for a global increase in energy consumption? Not necessarily. Indeed, modern networks are frequently growing faster than Moore's law, which is the main reason for the absolute increase in energy consumption However, much of this growth is offset by reductions in other areas like commuting, offline shopping, offline banking, and goods manufacturing. The social phenomenon of a "Net-centric World" is transforming our planet for a better quality of living with less material footprint.

As we are moving towards an information-driven society, human activity increasingly shifts into online domain, and efforts to build sustainable and environmentally-friendly equipment will stay high on the priority list. Demand for noticeable and verifiable energy efficiency will only continue to rise. The two much-needed steps are an industry effort to standardize telecom network efficiency, and the rise of sustainable network technologies.

REFERENCES

1. http://www.treehugger.com/files/2008/05/servers-data-centers-energy-efficiency-saving-sensors.php
2. http://www.treehugger.com/files/2009/08/green-internet-energy-aware-data-routing-algorithm.php
3. http://cleanbits.net/about%20us
4. http://www.blackle.com/
5. http://en.wikipedia.org/wiki/Green_computing
6. http://staff.polito.it/mario.baldi/publications/
7. Juniper Networks, Inc. - WHITE PAPER - Energy Efficiency for the Network Equipment: Two Steps Beyond Greenwashing
8. Barroso, Luiz. 2008. Luiz Barroso on Energy Proportional Computing. O'Reilly Media Inc.Ceuppens, Luc, Daniel Kharitonov, and Alan Sardella. 2008. Proceedings of IEEE Symposium on Applications and the Internet: "Power Saving Strategies and Technologies in Network Equipment Opportunities and Challenges, Risk and Rewards"
9. Juniper Networks. 2009. Network and Telecom Equipment - Energy and Performance Assessment, Test Procedure and Measurement Methodology Draft, version 1.0.6.
10. Juniper Networks. 2009. Energy Efficiency - Penguin-friendly Networking in Design.

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IPV4 ADDRESS DEPLETION AND TRANSITION TO IPV6 DIFFICULTIES

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ABSTRACT

The gradual transition to IPv6, or Internet Protocol version 6, has officially begun, with the distribution of the last five remaining IPv4 address blocks to each regional organization overseeing the net-address assignments. The Internet's growth has created a need for more addresses than IPv4 is capable of. IPv6 allows for vastly more numerical addresses, but switching from IPv4 to IPv6 may be a difficult process.

Key words: Internet, IP, Internet Protocol, IPv4, Ipv6,infrastructure, internet addresses

INTRODUCTION

As most people know by now, your IP address is a unique identifier that differentiates your computer ,tablet, smart phone,router, IP camera or any other device that's connected to the Internet from all the other Internet-connected devices in the world.

IP address blocks are assigned to regional Internet registrars by IANA (the Internet Assigned Numbers Authority). Those registrars then assign address blocks to Internet Service Providers (ISPs) and large organizations. ISPs assign their allocated addresses to their customers - companies and individuals - either on a permanent (static) basis or as dynamic addresses that can change if you disconnect from and reconnect to the Internet

PUBLIC AND PRIVATE ADDRESSING& NAT

There are actually two different types of IP addresses: public and private. The public addresses are the ones that your ISP assigns to you, and each one has to be unique. Only one device on the entire Internet can use it. Your public IP address represents you to the whole world.

Private addresses are only "seen" within your local network. That means private addresses don't have to be unique world-wide, just within the local network. So your computer could have the same private IP address on your network as your next door neighbor's computer has on his network. You can assign your computer a private address by entering it manually in the TCP/IP properties of your network interface card (NIC) or

a DHCP (Dynamic Host Configuration Protocol) server on your local network (such as the one that's built into your Internet router) can assign a private address to your computer. Computers with private IP addresses can't connect directly to the Internet. They have to connect to the Internet through some type of gateway. That is usually a Network Address Translation (NAT) device such as the router your cable company or phone company gives you to attach to the point where their network comes into your home or office. NAT became popular as a way to extend the lifespan of the IPv4 address space. Without NAT, we would have run out of IPv4 addresses a long time ago.

QUICK HISTORY OF THE INTERNET PROTOCOL

IP version	IPv4	IPv6
Deployed	1981	1999
Address Size	32-bit number	128-bit number
Address Format	Dotted Decimal Notation: 192.0.2.76	Hexadecimal Notation: 2001:0DB8:0234:AB00: 0123:4567:8901:ABCD
Number of Addresses	2^{32} = 4,294,967,296	2^{128} = 340,282,366,920,938,463, 463,374,607,431,768,211,456
Examples of Prefix Notation	192.0.2.0/24 10/8 (a "/8" block = 1/256th of total IPv4 address space = 2^{24} = 16,777,216 addresses)	2001:0DB8:0234::/48 2600:0000::/12

Internet Protocol version 4 (IPv4, or just "IP")

- First developed for the original Internet (ARPANET) in spring 1978
- Deployed globally with growth of the Internet
- Total of 4 billion IP addresses available
- Well entrenched and used by every ISP and hosting company to connect customers to the Internet
- Allocated based on documented need

Internet Protocol version 6 (IPv6)

- Design started in 1993 when IETF forecasts showed IPv4 depletion between 2010 and 2017
- Completed, tested, and available for production since 1999
- Total of 340,282,366,920,938,463,463,374,607,431,768,211,456 IP addresses available
- Used and managed similar to IPv4

IPV6 DEFINITION

Internet Protocol version 6 (**IPv6**) is a version of the Internet Protocol (IP) that is designed to succeed Internet Protocol version 4 (IPv4). The Internet operates by transferring data in small packets that are independently routed across networks as specified by an international communications protocol known as the Internet Protocol. Each data packet contains two numeric addresses that are the packet's origin and destination devices. Since 1981, IPv4 has been the publicly used version of the Internet Protocol, and it is currently the foundation for most Internet communications. The Internet's growth has created a need for more addresses than IPv4 is capable of. IPv6 allows for vastly more numerical addresses, but switching from IPv4 to IPv6may be a difficult process.

IPv6 was developed by the Internet Engineering Task Force (IETF) to deal with the long-anticipated IPv4 address exhaustion, and is described in Internet standard document RFC 2460. Like IPv4, IPv6 is an Internet Layer protocol for packet-switched internetworking and provides end-to-end datagram transmission across multiple IP networks. While IPv4 allows 32 bits for an Internet Protocol address, and can therefore support 2^{32} (4,294,967,296) addresses, IPv6 uses 128-bit addresses, so the new address space supports 2^{128} (approximately 340 undecillion or 3.4×1038) addresses. This expansion allows for many more devices and users on the internet as well as extra flexibility in allocating addresses and efficiency for routing traffic. It also eliminates the primary need for network address translation (NAT), which gained widespread deployment as an effort to alleviate IPv4 address exhaustion.

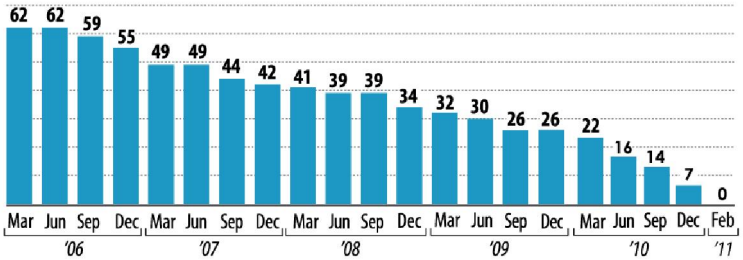
IPv6 implements additional features not present in IPv4. It simplifies aspects of address assignment (stateless address autoconfiguration) and network renumbering (prefix and router announcements) when changing Internet connectivity providers. The IPv6 subnet size has been standardized by fixing the size of the host identifier portion of an address to 64 bits to facilitate an automatic mechanism for forming the host identifier from link layer media addressing information (MAC address). Network security is also integrated into the design of the IPv6 architecture, and the IPv6 specification mandates support for IPsec as a fundamental interoperability requirement.

IPV4 DEPLETION

NAT was only a "bandaid" that delayed the inevitable, though. Now it's time to bite the bullet and implement a better solution. That solution has existed for many years; it's the next generation of IP, IPv6. The IPv6 address space is vastly larger than that of IPv4 - whereas IPv4 supported "only" a little over 4.2 billion addresses, IPv6 allows for approximately 340 undecillion of them

*as of 3 February 2011 **Available IPv4 Space in /8s**

The last top level (/8) block of free IPv4 addresses was assigned in February 2011, although many free addresses still remain in most assigned blocks and will continue to be allocated for some three to six months from then. After that, only 1024 addresses are made available from APNIC for each LIR. While IPv6 is supported on all major operating systems in use in commercial, business, and home consumer environments, IPv6 does not implement interoperability features with IPv4, and creates essentially a parallel, independent network. Exchanging traffic between the two networks requires special translator gateways, but modern computer operating systems implement dual-protocol software for transparent access to both networks using 'tunneling'. In December 2010, despite marking its 12th anniversary as a Standards Track protocol, IPv6 was only in its infancy in terms of general worldwide deployment. A 2008 study by Google Inc. indicated that penetration was still less than one percent of Internet-enabled hosts in any country at that time.



IPV4 DEPLETION SITUATION REPORT

- Each RIR received its last /8 from IANA on 3 February 2011.
- The IANA free pool of IPv4 addresses has reached 0%.
- While each RIR currently has IPv4 addresses to allocate, it is impossible to predict when each RIR will run out.
- ARIN publishes an inventory of available IPv4 addresses, updated daily, at www.arin.net.

IPV4 & IPV6 - THE BOTTOM LINE

- We're running out of IPv4 address space.
- IPv6 must be adopted for continued Internet growth.
- IPv6 is not backwards compatible with IPv4.
- We must maintain IPv4 and IPv6 simultaneously for many years.
- IPv6 deployment has begun.

RIRs have been allocating IPv6 address space since 1999.

Thousands of organizations have received an IPv6 allocation to date.

ARIN has IPv6 distribution policies for service providers, community networks, and end-user organizations.

DUAL STACK NETWORK

IPv4 & IPv6 Coexistence .Today, the Internet is predominantly based on IPv4.For the foreseeable future, the Internet must run both IP versions (IPv4 & IPv6) at the same time. (When done on a single device, this is called the "dual-stack" approach.)

The evolution of the Internet to IPv6 will directly affect enterprise customers because they will have to communicate with their customers, partners, and suppliers over an IPv6 network.

In order to ensure business continuity and future growth, all organizations need to carefully plan for coexistence between IPv4 and IPv6.

Also, as IPv6 propagates, early adopters can deliver innovative platforms, applications, and services that take advantage of the technical possibilities of IPv6

A combination of both native IPv4 and IPv6, better known as dual stack, is the recommended coexistence strategy for enterprise networks

Who Needs Dual Stack Support?

- Companies that need or want to deploy IPv6 on their internal network infrastructure
- Enterprises with IPv6-enabled, employee-provided, or guest devices on their network
- Enterprises getting started with IPv6 with pilot deployment or lab trials

What Is It?

Dual stack means that devices are able to run IPv4 and IPv6 in parallel. It allows hosts to simultaneously reach IPv4 and IPv6 content, so it offers a very flexible coexistence strategy.

Benefits

- Native dual stack does not require any tunneling mechanisms on internal networks
- Both IPv4 and IPv6 run independent of each other
- Dual stack supports gradual migration of endpoints, networks, and applications

What does this mean for:

- Broadband Access Providers?
- Internet Service Providers?
- Internet Content Providers?

- Enterprise Customers?
    - Equipment Vendors?
    - Government Organizations?

- Your customers want access to the entire Internet, and this means IPv4 and IPv6 websites.
- Offering full access requires running IPv4/IPv6 transition services and is a significant engineering project.
- Multiple transition technologies are available, and each provider needs to make its own architectural decisions.
- Plan out how to connect businesses via IPv6-only and IPv4/IPv6 in addition to IPv4-only.
- Businesses are beginning to ask for IPv6 over their existing Internet connections and for their co-located servers.
- Communicate with your peers and vendors about IPv6, and confirm their timelines for production IPv6 services.
- Content must be reachable to newer Internet customers.
- Content served only via IPv4 will be accessed by IPv6 customers via transition solutions run by access providers.
- Plan on serving content via IPv6 in addition to IPv4 as soon as possible
- Mail, web, and application servers must be reachable via IPv6 in addition to IPv4.
- Open a dialogue with your Internet Service Provider about providing IPv6 services.
- Each organization must decide on timelines, and investment level will vary.
- There was probably limited demand for IPv6 in the past.
- Demand for IPv6 support will become mandatory very, very quickly.
- Introduce IPv6 support into your product cycle as soon as possible.
- Coordinate with industry to support and promote awareness and educational activities.
- Adopt regulatory and economic incentives to encourage IPv6 adoption.
- Require IPv6 compatibility in procurement procedures.
- Officially adopt IPv6 within your government agencies.

IPV6 ADOPTION NEEDS

- IPv6 address space
- IPv6 connectivity (native or tunneled)
- Operating systems, software, and network management tool upgrades
- Router, firewall, and other hardware upgrades
- IT staff and customer service training

CONCLUSION

Although the IPv4 address exhaustion was long anticipated, it marked the end of certain kind to the existing system. The transition is a generational change. The previous generation won't go away, and it will still have a lot to contribute, but the future is IPv6. Bottom line: IPv6 is coming, but it's not exactly coming at lightning speed. Eventually we'll need to upgrade our routers, switches and other network devices to support it, if they don't already. Meanwhile, the IPv4 Internet still works fine.

A World IPv6 Day is being planned for 8 June that will give governments, companies and others the chance to test out the technology.

REFERENCES

1. www.arin.net
2. www.getipv6.info
3. www.TeamARIN.net
4. IPv4 IANA Free Pool Depletion https://www.arin.net/resources/request/ipv4_depletion.html
5. Community Use Slide Deck
6. IPv6 Wiki
7. Information Page at www.arin.net/knowledge/v4-v6.html
8. Outreach Microsite:www.TeamARIN.net
9. Social Media at ARIN www.arin.net/social.html
10. ARIN Board Resolution - Letter to CEOs
11. www.wikipedia.org
12. http://www.eweek.com/c/a/IT-Infrastructure/IPv4-Address-Depletion-Adds-Momentum-to-IPv6-Transition-875751/
13. http://www.ipv4countdown.net/
14. http://www.getipv6.info/index.php/Main_Page

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EDUCATION FOR SUSTAINABLE DEVELOPMENT INSTEAD OF ENVIRONMENTAL EDUCATION

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ABSTRACT

Orientation from „environmental education" to "education for sustainability" is a decline in terms of education. While self-criticism of ecological education, which was led until the end of 90's, wanted to find perspectives in the field of political education and in anthropologically motivated self-research, the concept of "education for sustainability" is based on political and rhetorical platitude. Main goal of „sustainability" has softened the education to educational and political consensus machine. Education, which, having in mind the frequent world's socio-economic crises, looks for calm waters of educational and political deals, is systematically successful when teaching practice makes it all understandable: the reasons are found in structures, and sometimes in personal desires of a specific individual. The thing in which environmental education has failed, „education for sustainability" will then be overcome, when it gets rid of empty metaphors of sustainability.

Key words: environmental education, education for sustainability, sustainability

INTRODUCTION

In the early 90's in education system, there was a new discourse that is oriented on political concept of the „sustainability" programme. The new utopia „education for sustainability", which has become obsolete overnight. Environmental education is in the background. To what extent does this replacement of terms express the replacement of paradigms? Terms function in the same way as objects. Replacing an old object with a new one dos not occur for no reason. Precisely because of the costs, we should keep the verified until the reasons worth reorienting and moving from one idea to another appear. For that reasons, we should put pedagogical efforts concerning environmental education in a new context. In case of encouraging the idea of sustainability, is it about a rhetorical or educational-rhetorical programme-progressive development of environmental education based on the relationship between man and the nature?

Scientific discourses are not free like the wind. They are subject to the rules, formal language rules, logical argumentation rules, scientific and ethical rules of

legitimacy, as well as moral rules of legitimacy and, finally, the rules of cultural acceptability. Scientific disciplines, though, control „their" discourses, but it is not followed by direct regulations for „acceptable" statements, i.e. production of particular meanings. We start from the fact that the turn from *environmental education* to *education for sustainability* is a discourse toy in a new environmental and educational-political positive; therefore, it is not a paradigm replacement.

SUSTAINABILITY AS A PROGRAMME

Although the term of sustainability appears in 18th century, it gets a striking attention by Declaration of Rio de Janeiro (1992) [1]. It is formulated in 27 points, it is generally a *revolutionary* agreement because all 178 countries-participants at the United Nations Conference on Environment and Sustainable Development requires a categorical change in all social fields, in order to ensure life conditions for the life in future. Declaration gives the impression as if there is a forthcoming revolutionary „change of course" in the relationship between man and nature, as if the manner of doing business and living by the motto of *sustainability* could result in a new organization of the world economy. Without a detailed revision of the rules of capitalist regulation of economy, the goals of Declaration cannot be reached. As long as their significance remains undisputed, the formulated principles cannot overcome the symbolism.

Rio Declaration is a *political* declaration and it primarily has a *symbolical* function and communicative use value. It has illusive and mythical character that governs a complex relation between real and utopian circumstances. The side of real relations is characterized by man-nature metabolism, full of dilemmas, which is again characterized by various contradictions of the system. Utopian side is characterized by a desire of all the people to close the gap between the hope of increasing the living standard and knowledge about the price of it – acceleration of excessive exploitation of nature – for the sake of reconciliation. Having in mind the expectations of the modernization of poor countries and energy consumption related to the acceleration of industrialization, it is understood, without saying, that the difference between reality and desire does not get any smaller, but bigger. The current example of industrial development in National Republic of China announces what is coming in the following decades and in other parts of the world – the so-called Third World. The contradiction between practical destruction of nature and desire for reconciliation with nature result in the fact that Rio Declaration has a status of a myth. In the secularized world, it takes the place of religious mythologies, which have lost their significance.

As a secularized system of beliefs, Rio Declaration generates mythical knowledge, which can be „stocked" through political institutions in conceivable social subsystems, including the educational systems. For educational systems and a number of university disciplines, *sustainability* programme was very attractive (critically-distant analysis of the idea of *sustainability* is found in Bauer 2005)[2]. There, the myth of the salvation of the world fills the vacuum, which was created by death of Grand Narratives [3]. Postmodern myths are no longer related to God, creation of a universal instance of justice that governs everything. They come into the world in a very profane way – in the forms of *prose* that is (seemingly) understandable to everyone.

EDUCATION FOR SUSTAINABILITY AS A PROGRAMME

In developed countries, which have, unlike our country, a longer tradition of environmental education in schools, environmental education was criticized for the results of various pedagogical and sociological studies back in the 80's. It was shown that the relationship between what is learned and its application in practice is so small that the question *why* didn't environmental education achieve the goals set becomes inevitable. When we look at the enormous efforts of environmental education, which was implemented since the 70's in developed countries, i.e. in their state schools, extra-curricular educational activities, environmental associations and organizations, the consumer habits of a significant number of people, who (today) are aged up to 40, come to the fore. Transfer of environmental knowledge into relevant fields of interest occurred in marginal areas, in the best case. Engineers who construct powerful engines in automotive industry today, who consume a lot fuel; they learned how to think about disadvantages of such activities when they were at school. It is too obvious that in everyday activities, in the way of life and behaviour during leisure, there have been very few structural changes in dealing with nature. Cheap air-lines should *particularly* thank the younger, environmentally educated generations for their gigantic success in the market. In the critical evaluation of environmental education, in the very beginning it was clear that „the bill was made without the innkeeper". Responsible behaviour towards the environment could not and it cannot be neither consolidated at the rationalistic level of understanding, nor can a stable orientation of personal identity in moral media of „education" be developed. Identity cannot escape the shadow of its institutional coercion. People do not do what they *should* – except if they are threatened by drastic punishments. They do what they *want* – as long as it does not result in some personal damage.

Within pedagogy (including didactics) during the 80's and 90's, a critical discourse was developed, which aimed at ending the indicated weaknesses of environmental education through a new conceptual orientation and, in addition, the following points were determined:

- In case of relations between man and nature, Gerold Scholz considers „that environmental problems of our society are political and economical problems" [4]. The implementation of this criticism would have a structural change of all subjects' curricula as a consequence. Special political, didactic, especially cultural-bureaucratic interests were stronger, so that the idea of enlightened citizenship about *professional,* and not political, curricula could – without great legitimacy efforts – sustain within environmental education.
- Wilfried Manke said that main problems of environmental education can be found in basic issues of power and the system [5].From this criticism, curricular consequences for the structuring of educational content might also arise, as well as the mediation of qualifications for system's analysis. But that would also make the revision of requirements for individual education necessary, in other words de-idealization, de-individualization and politicization of environmental education. General dilemma of environmental education has become clear: about the shades of environmentally responsible actions we can decide almost exclusively in (individual) fields, while political and economic structures are

disposed with in remote (non-intimate) fields – with a consequence that individual options of actions can be completely resolved through the changed global economic relations.

- From the unsolvable situation of environmental education, Hartmut Köhler has reached the second, but not less consequent conclusion: the school needs to „leave the hopeless training to master the reality and to retry to interpret the Real"[6]. This author concludes: „the students need as widely as possible, comprehensive, logical, general education, our students do not need environmental education." In the place of strenghtening political education, we are here talking about the restriction of environmental education, and the argument was anthropologically accented.
- Out of pedagogical discourse about environmental education, Eugen Drewermann criticizes that from Christian teaching, a non-holistic image of a man comes, which isolates the reason and feelings from each other [7]. By this criticism of culture, a task of critical revision of categorical preconditions of teaching and learning is set to educational system, and it is about a necessity of stronger integration of emotional components in the model of human actions. The existing consequences were not included here, because the school under mechanical evaluation of PISA's knowledge destroys humanistic education, as an institution of Nuremberg funnel (German. *Nürnberger Trichter*: teaching method in whic the student does not have to strain at all, since the teaching material more or less flows mechanically to him.).
- Klaus Michael Meyer-Abich complains about the fact that debate on ecology takes the anthropocentric image of man as a basis, which expresses „human chauvinism"[8]. At educational-philosophical level, there could appear some discussions that are not until today led with deserved attention, the task of self-definition of man not *against*, but *in* nature hasn't begun yet.

The criticism whose aim was to constructively develop environmental education was also present. All of this pointed out to the openness of pedagogy to assume the Rio Declaration in its programme and to soften environmental education by new utopia of *sustainability* in postmodern story about sustainability, because the new idea is adapted in an independent way to *all* subjects and curricular structures. By this, the „threat" for environmental education to flow into the field of transdisciplinary *political* education, but also to turn to anthropological aesthetics. By the aspect of general education turned towards knowledge and open to *unspecified* situations, superficial and insignificant, but entertaining spectacles under the motto „learning with all senses" are by far more competent for integration. The strength of new idea is recognized by unsurpassed weaknesses of the old idea.

In other words: the strength of the idea of sustainability lies in the fact that sustainability programme, except for rhetorical gestures and symbolic intents, does not say anything and does not want anything.

Gerhard de Haan indicates the *normative* content of Rio Declaration as a personal issue of education. Utopia of integrative linking of economic, social and environmental procedures becomes the focus. Education should contribute to the creation of a more just

world: „Basically, an equal amount of resources should be available to all people, all the people should have equal chances for a social and human life" [9]. Condition for accomplishing this goal is the development of „the competence of shaping", which is so widely formulated that all goals of general education are basically covered (Ibid). Widely formulated political programme of sustainability is related to widely formulated pedagogical programme.

The idea *Education for sustainable development* functions as educational-political machine for consensuses, whose discursive products hide categorial differences in opinions that affect the global process of the exploitation of nature (and its acceleration depends on globalization). Education, which in the situation of frequent socio-economical crises looks for calm waters of educational-political agreement, strives to notice (teaching) themes that are hidden in these conflicts only at one aseptic level of inoffensive analyses. Such a „theory" of education is successful when the teaching makes contradictory relations „understandable" by studying that the reasons for the structures are found in the structures themselves and never in personal desires and vital wishes of specific individuals.

Because of its comprehensive nature, the *education for sustainability* can also include the things that are not only related to environmental and social learning, but to the things that contradict it as well. In that way, by the motto *education for sustainability:* „a well-organized, capable individual, able to lead his own life, is required" [10]. Here, the education of one developed personality gets into the focus of attention. In the place where de Haan attempts to reach „the ability for solidarity with the poor, the weak, the oppressed..." [11] for the field of the social, the operationalization of Immler's goal would imply the opposite – to successfully (socially-in a Darwinist way) overcome all the others in one new global competition according to the rules that are not explicitly prohibited.
It was demonstrated that theoretical reconstruction of the debate on sustainability at the level of enlightened reason leads nowhere and that the change of paradigms through *rational* categories of discourse is not understandable.

CONCLUSION

Central problem of environmental education was found in the difference between the acquired knowledge and specific individual activities. That relation appeared to be contradictory. It was shown – and it still is – that the people do not follow the rationality of the acquired (recognizable and normative) school knowledge, but the vital life logic. The principle good mood-bad mood, desire and spontaneous desire are stronger than safe („better") knowledge. In remote fields of pedagogical imaginary world, the individuals *„act"* by rationally satisfactory „action plan". According to that (at least not officially) the principle of *subjectivity* and *vividness* is not valid, but the principle of *rationalistic self-distance*. It is held for the treatment of scientists with themselves [12], it is projected onto the situation of teaching at universities and in school. At that time, the following rule comes to the scene: scientific knowledge can succeed only if it gives up (its own) subjectiveness.

A specific individual is not a mechanical, but a vital being. It is involved in its biographic story that does not follow any *rationalistic* plan, but it has one quite free flow.

Rationalistic image of a man sees learning as introspective relating of the different that is not given in a *situationally* wholesome way, but in a *constellation* individual way [13]. Image of the man, which is conditioned by educational-theoretic discourse on sustainability, closely related to environmental education and the expectations that the education could – through the knowledge – have a permanent effect on the formation of identity, basically, keeps failing.

REFERENCES

1. Savezno ministarstvo za životnu sredinu (1992) Napori ujedinjenih nacija za bolju životnu sredinu 21. veka, Rezultati Svetskog samita u Rio de Žaneiru, Brazil; Beograd.
2. Bauer, S., (2005) Leitbild der Nachhaltigen Entwicklung. In: Informationen zur politischen Bildung 287, str. 16-20.
3. Lyotard, J.F., (1986) Das postmoderne Wissen. Wien.
4. Scholz, G., (1992) Umwelt als Thema. In: Grundschulzeitschrift 53. str. 6- 7.
5. Manke, W., (1986) Ökologie und kritische Erziehungswissenschaft. In: Öko Päd 1. str: 40-44.
6. Köhler, H., (1984) Über den Hochmut der Umwelterziehung. In: Öko Päd 4. str. 27 -31.
7. Drewermann, E., (1996) Mehr Menschlichkeit mit tieren. Plädoyer für eine neue Ethik, die den menschen nicht zum Maβ aller Dinge erhebt. In: Die Zeit, Nr.32, str. 38.
8. Meyer-Abich, K.M., (1993) Die natürliche Mitwelt in uns. In: Universitas 5. str. 414.
9. De Haan, G., (2001) Was meint 'Bildung für nachhaltige Entwicklung' und was können eine globale Perspektive und neue Kommunikationsmöglichkeiten zur Weiterentwicklung beitragen? In: Herz,O., Seybold, H., Strobl, G., (Hrsg.) Bildung für nachhaltige Entwicklung. Globale Perspektiven und neue Kommunikationsmedien. Opladen. str.30.
10. Immler, H., (2001) Nachhaltigkeit und Bildung. Vorwort zu: Moegling, K., Peter, H., (2011) Nachhaltiges Lernen in der politischen Bildung. Lernen für die Gesellschaft der Zukunft. Opladen. str. 11.
11. De Haan, G., (2001) Was meint 'Bildung für nachhaltige Entwicklung' und was können eine globale Perspektive und neue Kommunikationsmöglichkeiten zur Weiterentwicklung beitragen? In: Herz,O., Seybold, H., Strobl, G., (Hrsg.) Bildung für nachhaltige Entwicklung. Globale Perspektiven und neue Kommunikationsmedien. Opladen. str.39.
12. Erdheim, M.,(1994)Psychoanalyse und Unbewusstheit in der Kultur.Erstveröffentlichung. Frankfurt am Mein str.67.
13. Schmitz, H., (2005) Situationen und Konstellationen.Neue Phänomenologie, Band 1. Freiburg, München. S.18-32.

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IMPROVING THE QUALITY OF ENVIRONMENTAL EDUCATION THROUGH TRAINING OF TEACHERS FOR IMPLEMENTATION OF ICT IN THE PROCESSING OF SIGNIFICANT ENVIRONMENTAL DATES

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ABSTRACT

This paper presents concept, aim and significance of innovative training on teachers for implementation of information and communications technologies in environmental education in the processing of significant environmental dates. Special attention has been given to identification of local needs and potentials in terms of selection of significant environmental dates, as well as promotion of this activities on international level through appropriate information and communications technologies.

Key words: significant environmental dates, information and communications technologies, teachers training, local community

INTRODUCTION

In recent years, United Nations agencies and other international organizations have developed a number of informational, educational, promotional, scientific and other materials, programs and projects based on modern information and communications technologies (ICT) within the process of promotion of important environmental dates. Only few schools and individual teachers, cooperating with partners in the wider community, managed to take advantage of these opportunities by linking them with the needs of their environment and thus to improve school programs, especially by improving the fields of environmental education and the application of information technology in teaching process.

In the frame of current Decade of Education for Sustainable Development [1] and the environmental education as its pervasive component, it is very important to train as many teachers as possible (especially those whose teaching subjects are possessing a strong environmental component) to be able to find the common available educational materials, refine them and use them in the teaching process, connecting them with the situation and needs of local communities, therefore motivating the pupils and engage them in innovative training methods that are available.

A need to present the results of educational and training activities of schools in Serbia on international web sites that follow the promotion and celebration of important environmental dates, as well as on the school web sites, is not of the less importance, increasing the visibility and impact of such events outside the local community. Therefore, the educational institutions are getting the opportunity to join the international network of organizations whose activities promote and support the current trends in environmental information dissemination, environmental education and upbringing activities.

CONCEPT OF PROMOTING THE SIGNIFICANT ENVIRONMENTAL DATES WITHIN THE ENVIRONMENTAL EDUCATION PROCESS

Significant environmental dates are promoted and celebrated around the world in order to highlight the vulnerability of the environment and nature on the Planet and the importance of its preservation for current and future generations to the general world public [2]. Diversity of environmental issues that are covered by the significant environmental dates is enlarging day by day (World Water Day, Forest Day, Earth Day, World Biodiversity Day, International Day of Climate Action, Earth Hour, International Mountains Day, Clean Up the World Day, World Habitat Day, etc.) which enables that the inclusion of significant environmental dates in the environmental education covers its most important contents.

The requirement for inclusion of significant environmental dates in environmental education process is to stress it's educational, rather then manifestation component, and to ensure that these dates are not supported by sporadic but by continuous educational activities. The processing of educational content within the celebration of significant environmental dates should be varied or multimedia, should involved different scientific and educational disciplines and methods, and be adapted to pupils of different ages. It should also provide links to schools across the local and social environment, with a wide range of other institutions and partners involved in environmental education and development of environmental awareness (environmental NGO's, local authorities, media etc.) [7].

These conditions can be provided in the best terms if the significant environmental dates in local community are processed by the complex program, which combines a number of the most important environmental dates and environmental issues, and is a part of a wider process of solving local environmental problems, such as is the Local Environmental Action Plan (LEAP) and Local Strategy for Sustainable Development.

Structured program of promoting selected significant environmental dates named "Ecological days of Bor" was developed in 2003. as a part of LEAP process in Bor and was developed on basis of annual environmental events of non-governmental organization Young Researchers of Bor, who began with the promotion of significant international environmental dates in order to raise environmental awareness among youth and other citizens of Bor. Based on this previous experiences, a complex program has been design that initially included 15 significant environmental dates whose contents are

estimated as tightly associated with the LEAP process and are responding to the need for improvement of knowledge and awareness of the citizens of Bor on their environment.

During coming years this program has expanded with new dates and environmental issues so that now it encompasses over twenty significant environmental dates. Implementation of specified programs regarding targeted environmental dates nowadays involves a number of institutions - educational and cultural institutions, public and state enterprises, media organizations, NGOs, local authorities and local administration [3, 4].

SIGNIFICANCE AND OBJECTIVES OF TEACHERS TRAINING FOR THE APPLICATION OF ICT IN ENVIRONMENTAL EDUCATION THROUGH THE PROCESSING OF SIGNIFICANT ENVIRONMENTAL DATES

Connection of local environmental needs and issues with global environmental issues, includes the complex of informational, educational and promotional activities, based on available information and educational materials that have been developed by the appropriate agencies of United Nations to mark and promote thematic dates related to nature, water, health, biodiversity, environmental protection, wildlife animals, food, mountains etc. The most important participants on this topic are actually educational institutions, because they are able to effectively and creatively implement ecological and environmental principle in teaching through this program.

Main problem for school's larger participation in these programs during the past was mostly the lack of IT equipment, lack of teacher's knowledge on IT topic, as well as a reduction of environmental education to only a few teaching subjects and forms of extracurricular activities. Project "Digital schools", whose primary aim is to provide computer equipment in Serbian schools, as well as the expanding of environmental education principles application to all school facilities and types of extracurricular activities is giving the preconditions to start with the implementation of environmental dates concept, but the problem of teacher's and collaborator's skills for using modern ICT for environmental education improvement in their schools remains.

In order to solve this problem a specific program for professional training named 'Application of information and communication technologies in the implementation of environmental education through the processing of significant environmental dates' [6] has been developed an accredited, being founded on previous experiences and cooperation of Computer Center Bor and Association of Young Researchers of Bor. Implementation of this training program enables the processing of significant environmental dates through integrated use of ICT, as well as other ideas and techniques, in order for this to become the common practice in schools and local communities in Serbia.

The overall objective of this program is to gain trained teachers and professors who are able to implement innovative methods of ICT in environmental education.

Specific objectives of this program are:

- acquisition of appropriate knowledge and skills in ICT, especially the use of Internet and specified programs for electronic communication and presentation;
- identification of reliable Internet resources about key environmental issues that are processed on the occasion of significant environmental dates;
- download, customize and implement the educational and informational materials produced by the relevant UN agencies;
- motivation of students, parents and local communities for environmental education through the use of modern ICT;
- promotion and propagation of key environmental issues and opportunities for applying ICT in environmental education;
- promotion of school's environmental education activities on their web sites, web sites of local communities, national web sites and especially the official portal of the UN organizations that are conducting the celebration of significant environmental dates.

Effects of program that is designed to improve the quality of teaching are predominantly new competencies for the implementation of ICT in environmental education, enriched content and methods of environmental education in schools and local communities, greater motivation of pupils and parents to actively participate in environmental education, as well as the promotion and propagation of key environmental issues and opportunities of ICT in environmental education.

Development of ICT sector, applied kowledge and science enabled these fields to become a dominant factor in modern economy and education almost all over the world. The special role of the ICT application in environmental education is development of skills for searching, analyzing and transmitting information, with their usage in raising environmental awareness, protection and preservation of nature and environment, and environmental ethics. Role of ICT in environmental education and following environmental issues has been also stressed in Strategy of Information Society of Serbia [11].

For the implementation of environmental education through processing the significant environmental issues IT knowledge is essential, and it primarily includes knowledge of Internet communications, the most important search engines and web services, portals and other Internet resources, communication via social networks, electronic publishing, setting up web sites, blogs etc [5].

Sustainability of this program is provided by experiences of individual communities in the implementation of long-term processing of key environmental issues through the application of ICT, expressed interest and motivation of teachers and pupils to use modern ICT tools in environmental education, project of providing computer equipment for schools organized as IT classrooms and other ICT resources, more extensive Internet resources and new computer programs specialized for environmental education.

EXPERIENCES FROM PRACTICE

Educational training for teachers and collaborators named "Application of information and communication technologies in the implementation of environmental education through the processing of significant environmental dates" was carried out during 2010. and 2011. through seminars in elementary schools in Bor, Dragash and Priboj Spa. This program is accredited as training for professional development in education again for period of the year 2011. and 2012. Through practical exercises the participants of this program have defined specific activities for environmental education through processing of certain significant environmental dates.

Selected topics have been connected to a local environmental problems and needs and preferably linked to existing strategic documents relating to the environment at the local level (such as Local Strategy for Sustainable Development, Local Environmental Action Plan, etc..) , which enabled a school activities to be associated with a specific situation in each local community. This has resulted with creation of several project ideas for promotion of environmental dates such as: World Green Consumer Day [9] , International Mountain Day [8,9], World Day for Physical Activity [9,10], World Environment Day, World Environment Day [9,10] etc., which were then published on hosted free internet blog service [8,9,10]. Advantage of blog as one of ICT components is it`s interactive format and the ability to be maintained by an individual with regular entries of commentary, descriptions of events, or other material (Figure 1.). A typical blog combines text, images, and links to other blogs, web pages, and other media related to its topic.

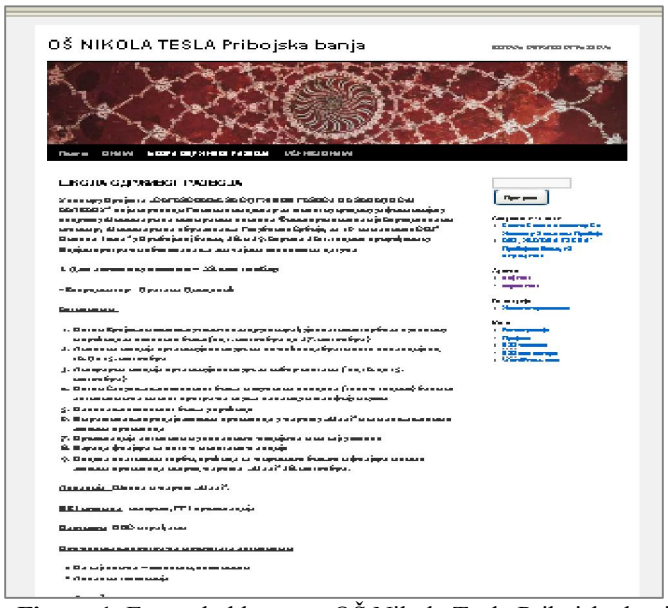

Figure 1. Example blog post OŠ Nikola Tesla Pribojska banja

CONCLUSION

Connection of recent trends in ICT in education and existence of new stakeholders in environmental education at the international level (UN agencies and other international organizations who organize and promote significant environmental dates) provides schools with necessary tools for improving the quality of environmental education. At the same time, by linking the contents of environmental education with key local and global environmental issues, the school also associates with environment issues and contributes on raising awareness and solving environmental problems in a broader context.

Important role in this process is those of teachers and school collaborators that can be more successfully achieved if they are in continuous vocational training. Professional development programs based on the experiences of individual communities and modern principles can contribute immensely to advanced role of teachers and their education quality as a whole.

REFERENCES

1. UN Decade for education of sustainable development 2005 – 2014, http://www.desd.org/About%20ESD.htm
2. Ekološki kalendar, http://www.ocistimosrbiju.rs/src/Zeleni-kalendar-868-c67-content.htm
3. Program „Ekološki dani Bora 2008", http://www.mibor.rs/aktivnosti/Eko%20dani/Eko%20dani%202008/index.asp
4. Program „Ekološki dani Bora 2011", http://www.forum.mibor.rs/teme.asp?TOPIC_ID=1280
5. Vodič za Internet, Savet Evrope, www.mingl.org/it_vodic
6. Randjelović, D., Damnjanović, Z.: Katalog programa stalnog stručnog usavršavanja nastavnika, vaspitača, stručnih saradnika i direktora za školsku 2010/2011 , program br. 173., http://www.zuov.gov.rs/m-cpr-katalog , 2010.
7. Randjelović, D., Randjelović, D. : Environmental Education of Adults and Role of NGO in It, Zbornik radova XV naučno stručnog skupa "Ekološka istina", Tehnički fakultet Bor I dr., Sokobanja, 2007.
8. http://ekogora.wordpress.com/
9. http://ecopribojskabanja.wordpress.com/
10. http://borskenovine.wordpress.com/
11. http://www.nauka.gov.rs/cir/images/stories/inform_drustvo/nauka_strategija_id.pdf

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CULTURAL DIMENSSIONS FOR MANAGEMENT OF SUSTAINABLE DEVELOPMENT PROJECTS

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ABSTRACT

Sustainable Development is a comprehensive concept that encompasses no less than social, economic, political, and environmental goals. As a general rule, despite the progress in increasing public awareness to the issue of sustainability, the measures employed are inadequate for preventing deleterious cycles.

In Serbia, there is still a general lack of knowledge about sustainability at all levels, and inadequate coordination among possible implementing subjects at governmental and local level. There is also a considerable gap between long-term plans and the short-term project management. This study is designed to explore certain dimensions of national culture in correlation with the optimal selection of organizational structure and culture.

Key words: sustainable development, organizational culture, cultural dimensions, project implementation

INTRODUCTION

Cross cultural management method

The widespread resistance to adopting sustainable habits, in spite of the apparent environmental crisis, suggests that there are persisting epistemological substrates that inexorably hinder the adoption of sustainable development models .This apparent deficiency can be ascribed to two main factors: insufficient efforts to finding viable and visible alternatives and the failure to thoroughly re-examine dominant cultural paradigms [1].

One of the recognized definitions of culture is that culture is the learned programming of the mind, which differentiates one group from another [2]. It could be identified by observing the external manifestations of culture, the values, perceptions, behaviors, and attitudes of the individuals who make up that group. Cross-cultural analyses are important to show that what may work in one culture, may not be appropriated in another [3]. People from different cultures may have different values,

perceive situations differently, act differently in the same situation, and approach life in different ways, so the attempts to transport Western practices to other nations where the culture is incompatible with the practices, are likely to fail [4]. As such, culture is conceptualized and measured through different value dimensions identified and measured by numerous scholars [5, 6]

Although many different cultural dimensions have been identified over the years, one of the most significant and perhaps the most replicated are Hofstede's four dimensions.. Based on surveying attitudes of 116,000 employees within subsidiaries of IBM in 40 countries and 3 regions Hofstede (1980) described four basic cultural dimensions, largely independent of each other: (1) Individualism vs. Collectivism, (2) Power Distance, (3) Uncertainty Avoidance, and (4) Masculinity vs. Femininity. Hofstede identified the degree that a society accepts inequality and distribution of power within that society in the dimension power distance - PD ; the degree to which a culture feels comfortable in unstructured or ambiguous situations -uncertainty avoidance UA; the degree to which individuals in a culture define themselves as individuals or according to their place in groups - individualism/collectivism IDV [7, 8] ; and masculinity/feminism -the degree to which a culture demonstrates certain characteristics considered to be masculine (for example, valuing achievement) or feminine (such as valuing relationships.

Collectivism is measured by the Individualism Index (IDV) ranging from 0 (low Individualism, high Collectivism) to 100 (high Individualism).Power Distance is measured by the Power Distance Index (PDI) ranging from 0 (small PD) to 100 (large PD). Uncertainty Avoidance is measured by the Uncertainty Avoidance Index (UAI) ranging from 8 (lowest UA country) to 112 (highest UA country). Masculinity vs. Femininity is measured by the Masculinity Index (MAS) ranging from 0 (low Masculinity) to 100 (high Masculinity).

In 1988 one additional dimension was described by Bond and was named- Confucian dynamism [3], to be renamed later to long-term versus short-term orientation. Number of newer and older findings by Asian and European researchers suggest the need for expanding the dominant five-factor model of personality traits, known as the "Big Five," with a sixth factor, Dependence on Others, in order to keep the model culturally universal.

The original research conducted by Hofstede included surveys handed out by IBM to its employees in 1967 and 1971-1973; the one exception to this was in Yugoslavia, where surveys were handed out to an independent company which worked closely with IBM [5]. This company was based in Ljubljana (Slovenia), with branch offices in Zagreb (Croatia) and Belgrade (Serbia). After the dissolution of Yugoslavia in 1991, Hofstede revisited the original Yugoslav samples in order obtain cultural dimension scores for three former Yugoslav republics: Slovenia, Croatia, and Serbia. In the second edition of Culture's Consequences [2] Serbian national culture is characterized by high Power Distance PDI - 86, high Uncertainty Avoidance UA - 92, Collectivism – low Individualism (IDV)- 25, and high to medium Femininity – low to medium Masculinity (MAS)- 43.

Organizational culture

Cultures have an important impact on management approaches, so the cultural differences call for differences in management practices [9]. The appropriate design of an organization depends upon many factors, but Hofstede (1983) has argued that organizational system work best when their design is consistent with the underlying values and culture of the society in which they function. For organizational culture to function effectively as a part of managerial mechanism, the organizational culture and the formal organizational structure must be harmoniously interrelated [10]. Thus, the structure and culture of an organization must be aligned with the demands and predispositions of the national culture in which the organization is embedded [11].

RESEARCH METHODOLOGY

Research objective

The main goal of this research was to test general hypothesis that certain problems in implementation of sustainable development programs in Serbia are organizational in their origin and correlate with dominant national culture. To understand these problems we have made an attempt to analyze a number of organizational characteristics and correlate them with certain cultural dimensions in order to explore optimal organizational design for projects aligned with the predominant national culture. The nature of the successful design of an organization depends upon the values of the society it serves, and a single solution to the issue does not fit all situations. Our hypothesis was that for Serbia with high PDI (86), high UAI (92), and Collectivism – low Individualism (IDV- 25) successful organizational design of sustainable development projects has to be strongly supported by leadership, but with dominant collectivistic character.

Study design

This study included 32 employees, (17 female, 15 male) with mostly higher education (27 with higher education), and work experience (as a rule over 5 years). They are all presently engaged in implementation of the development programs in regional and local agencies in Serbia.

Investigation was conducted by questionnaires and unstructured interviews to assess participant's views on optimal organizational design in reference to implementation of sustainable development projects.

Participants in the survey were asked to grade on a scale from 1 to 5 (1- not important; 5 - very important) particular organizational characteristics. Subsequently they were asked to assign the rank from 1-10 (1- the most important….) to the same set of characteristics. These organizational characteristics were found in the literature to correlate with organizational culture and structure [12].

RESULTS

The results of investigation of organizational characteristics are presented in the Table 1 and the Graph (Fig.1).
Average mark (5 maximum), average rank (1 as the best) for each investigated characteristic are presented numerically in Table 1.

Table 1. Average mark and average rank

	Organizational characteristic	Average Mark (1-5)	Rank (1-10)
1	Support from superiors	4.6	4.0
2	Involvement of superiors	3.4	7.1
3	Clear instructions from superiors	4.4	4.8
4	Independence in choosing own work style	4.4	5.1
5	Decision making in own line of work	4.3	5.1
6	Good working relations with colleagues	4.8	4.7
7	Good communication with superiors	4.3	4.7
8	Acknowledge of individual performance through salary	4.4	6.9
9	Career advancement through individual performance	4.3	6.0
10	Support for continuing education	4.5	5.9

Presentation of pooled values for organizational characteristics associated with PDI (1, 3) COL (6,7), IND (8, 9) is in the Graph (Fig.1). .

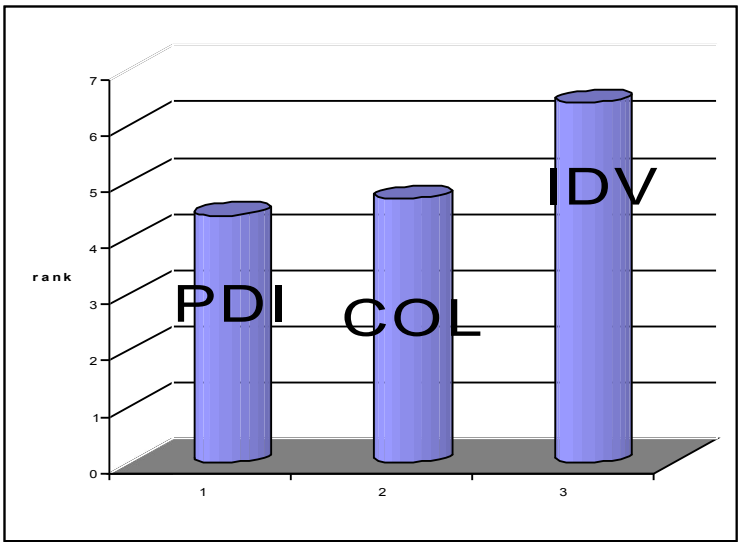

Figure 1. Pooled values for PDI (1, 3) COL (6,7), IND (8, 9).

DISCUSSION

For Serbia, the principles of good governance in municipalities, including effective and efficient use of resources, are the most critical for the sustainable advancement. One of the great challenges in this process is the lack of professional and organizational knowledge of internationally recognized campaigns for the sustainable development of cities and towns, particularly the Local Agenda 21 campaign (LA21). Although strategies of sustainable development have been successfully presented at government level, in local municipalities there is still a general lack of awareness about sustainability at all levels, and inadequate coordination among possible implementing subjects including general public, municipal officers, NGOs, professional association and, more importantly, among legislators and key-decision makers [13].

Participants in this study represent employees engaged in development projects in Serbia. We have analyzed their opinions and views on optimal organizational design of the projects they are involved in.

As the most important organizational characteristic participants have recognized communication between colleagues and superiors support from superiors and clear instructions from superiors. Acknowledgement of individual performance and independence in choosing their way of working was found less important. The least important for the participants was the actual involvement of the leadership. It correlated with our hypothesis that organization of the project has to be strongly supported by leadership - high PDI (but participants emphasized that they should not be directly involved), with dominant collectivistic conduct (very important working relations with colleagues and good communication with superiors, clear instructions from superiors), and minor individualistic performance (acknowledge of individual performance through salary, career advancement through individual performance). Nevertheless, some of the characteristics that could be associated with individualism (independence in choosing own work style and decision making in own line of work) were ranked high.

We have already published corresponding studies on implementation of information technology projects in Health Care [14], [15]. In both studies participants have delineated interdependence and team work along with acknowledgement of individual performance, and highlighted clear instructions from superiors, acknowledge of individual performance and independence in choosing their way of working. The least important for the participants, as a rule, was the involvement from the leadership. Once again, we have found Serbian organizational culture in investigated organizations to be "somewhere in between" ("West –East orientation").

Bangert and Doktor [12] exploring selected organizational categories with US IT professionals, have found involvement and strong leadership, and acknowledgement of individual performance as the most important , while support for continuing education and new things were ranked as the least important. In the same study, IT professionals from South Korea have ranked as the most important to have clear rules to follow and loyal fellowship.

If we are to have some assumptions about the design of sustainable development project organization in Serbia depicted from this study we could articulate : there should be compelling leadership support for the project (without actual involvement of superiors

but with good communication and clear instructions from them) with the strong emphasis on harmonious team work and achievement, (but with the opportunity to make decisions about the own line of work) and support for continuing education

Critics of Hofstede's work believe that he takes too simplistic a view of the multifaceted, complex dimensions which comprise the notion of culture. Although his work has been criticized by various authors [16], [17], the usefulness of the categories he developed remains very popular and is utilized by scholars in a variety of fields. Nevertheless, most studies have been developed using a limited range of nations. That is natural since researchers are particularly able to study phenomena that are culturally familiar. We find it important that this research has been performed in a country which has not been studied frequently [18, 19]. To quote Professor Hofstede: "Understudied parts of the world have the potential to provide a basis for new concepts and innovative theory [8].

REFERENCES

1. Gambini, B. 2006 Cultural assumptions against sustainability: An international survey, Journal of Geography in Higher Education, 30, p. 263-279
2. Hofstede, G. (2001), Culture's Consequence, Thousand Oaks, CA: Sage Publications.
3. Hofstede, G. and M.H. Bond (1988), "The Confucius connection: From cultural roots to economic growth", Organizational Dynamics, 16, 4-21.
4. Gomez-Mejia, L.R. and L.E. Palich 1997, Cultural Diversity and the Performance of Multinational Firms. Journal of International Business Studies, Vol 28, No 2, 309-335.
5. Hofstede, G. 1980 "Motivation, Leadership and Organization: do American Theories Apply Abroad?", Organizational Dynamics, Summer, 42-46.
6. Trompenaars, F. and C. Hampden-Turner 1998, Riding the waves of culture: Understanding cultural diversity in global business, 2nd edition, New York: McGraw-Hill
7. Hofstede, G. (1983), "The cultural relativity of organizational practices and theories", Journal of International Business Studies, Fall, 75-89.
8. Hofstede, G. 2007. Asian management in the 21st century Asia Pacific J Manage (2007) 24:411–420
9. Newman, K. L. and S.D. Nollen 1996, Culture and Congruence: The Fit between Management Practices and National Culture, Journal of International Business Studies, 27(4), 753-779
10. Worley CG, Hitchin DE, Ross WL 1996. Integrated Strategic Change: How OD Builds Competitive Advantage. New York, NY: Addison-Wesley Publishing Company
11. Trompenaars, F. and C. Hampden-Turner 2004, Managing People Across Cultures. Capstone Publishing.
12. Doktor R, Bangert D, Valdez M, 2005 Organizational Learning and Culture in the Managerial Implementation of Clinical e-Health Systems : An International Perspective, Proceedings of the 38th Hawaii International Conference on System Sciences - (HICSS'05) – , Track 6

13. Paunkovic J, N. Paunkovic , S. Milutinovic, S. Zikic: , 2007 Education for sustainable development, October Annual of the University of Mining and Geology "St. Ivan Rilski", volume 50
14. Paunkovic J, Stojkovic I, Stojkovic Z, Zikic S Awareness of organizational culture is important for sustainable implementation of e- health International Scientific Conference Management of Technology – Step to Sustainable Productio June 2010, Rovinj, Croatia ISBN 978-953-7738-09-9.
15. Paunković J., Jovanović R, Stojković Z. and Stojković I. 2010. Sustainable implementation of information and communication Technology in health care. Case study of organizational and cultural factors. Sibiu Alma Mater University Journals. Series A. Economic Sciences, 3(3), September 2010, 1–8.
16. Sondergaard, M. (1994), "Research Note: Hofstede's Consequences: A Study of Reviews, Citations and Replications",Organization Studies, 15(3), 447-456.
17. Gerhart, B. and M. Fang, 2005 "National Culture and Human Resource Management: Assumptions and Evidence", International Journal of Human Resource Management, June, 971-986.
18. Jovanovic M, Interkulturni menadzment , Megatrend, Beograd, 2005
19. Bogićević Milikić, B. 2009 The influence of culture on human resource management processes and practices:the propositions for Serbia , Economic annals, Volume LIV, No. 181, April – June

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ROMANIA BETWEEN THE OSCAR FOR SUSTAINABLE TOURISM AND THE CRUEL REALITY

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ABSTRACT

Romania received the "Golden Apple" Prize for three tourist destinations or for entities which activate in the tourist field in September 2009 as a world premier. Marginimea Sibiului is one of these destinations where the "Oscars" of tourism shall be awarded. For almost four decades, the prizes "Golden Apple", "La Pomme d'Or" or "Marul de Aur", reward the efforts in the promotion and increase of the tourism level internationally. They are awarded by the International Federation of Tourism Journalists and Writers, and, in 1975, Romania entered the books of experts. Then, in 1975, Romania received the "Golden Apple" for Moldovita Monastery. 2009 marked a new premier: Romania became the first country to whom three prizes were awarded in one year for the tourist destinations or for entities which work in the tourism field: The Danube Delta Biosphere Reservation, Marginimea Sibiului and the Blue Air Airline Company. The evaluation took place during the visit of the Council Manager of FIJET in May 2009 in Romania.

Key words: destination, tourism, trophy, evaluation, region

INTRODUCTION

As Romania progresses very slowly, the analysts announce us (so as not to have useless hopes) that the future of Romanian tourism does not look too good, even if we would like to paint it in pink. It is estimated that Romania could reach the standards of the developed countries in 40 years and this if we ask those countries to wait for us, not to make progresses, to be easily reached. There is a report that explains very clearly that the Romanian institutions are at the level of Morocco, in terms of efficiency. Than, let's not forget that Romania holds the first place regarding the smallest minimum wage from Europe. While, in Luxembourg, the street sweepers earn a salary of EUR 1,500, in Romania, an engineer barely makes EUR 153 per month, with more expenses on utilities, food and taxes. So … everything goes from bad to worse.

Well, Romania received the "Green Apple", the Oscar for tourism, which is given to a destination or a personality who contributed substantially to the development of tourism. We fully deserve this prize, especially from a moral point of view, as an encouragement… because, in reality, the Romanian tourism operates "perfectly", "the

Romanians are happy with the services offered by the Romanian tourism in proportion of 99%, the good prices, accessible to all the social categories, ideal conditions" etc. It is correct that the inverted comas prove that it is a joke which shall become a promotional slogan. The truth is only one, the Romanian tourism does not go so well, and the resorts offer you the same conditions they offered thirty years ago. Also, Romania received this prize not because our tourism deserves a 10, but probably because someone smooth talked someone else, given the fact that the prize is awarded to the "personalities" who contributed to the development of tourism, lobbied, created an image etc. In the end, one thing is good and another one is bad. The good thing is that the foreigner has more reasons to look for Romania on the map and visit the country after this story (and the one with the promotion advertisement). The bad thing is the holiday spent in our country shall disappoint the foreign tourist because the advertisement tricked him/her, presenting one thing about Romania and the reality being another. Who loses in all this? We all lose because we steal our own hats, we trick ourselves, trying to sell the image of a fabulous Romanian tourism, with a leaf / brand, surprisingly losing the ones who come to visit our country, tricked by the advertisement which looks charming, but it is nothing else by a leaf …

The foreign visitor comes, leaves, but becomes at his/her turn, after visiting Romania, a promoter of the ones seen around here… If we talk about personalities, companies, airline companies which have the full merit for the image of Romania abroad, then I think we find ourselves in a big error and we stumble in our own feet. This story about the Oscar offered to Romania for tourism seems to me more of a promotion of the image of some "personalities" not of the image of Romania. If we believe that from now on the Romanian tourism has reached the level of the ones abroad, then we are strongly mistaken, risking to get drunk with cold water.

After Sharm el Sheikh, Dubrovnik or Turku, Romania as received the "Golden Apple", the equivalent of the Oscar for tourism, awarded to a destination or a personality substantially contributing to the development of tourism.

The trophy awarded by **FIJET** (Fédération Internationale des Journalistes et Ecrivains du Tourisme) marks a world premier, because it is for the first time when it is awarded, in the same year to three tourist destinations/personalities of the same country:

- Marginimea Sibiului, the most romantic ecotourism area in the world
- The Danube Delta Biosphere Reservation
- The Blue Air Airline Company (the company with the most dynamic development in Eastern Europe)have won three prestigious trophies for Romania.

The Balkan 3 from 1 is very curious! It is not easily understood how a remarkable airline company could be evaluated as a tourist destination?

The Danube Delta, of course, is the largest reservation with humid areas from Europe and one of the best preserved European deltas. The paradise of flora and fauna, the Danube Delta stretches along the three branches which flow into the Black Sea. "The youngest land of Europe" was named Biosphere reservation by UNESCO in 1990 with the purpose of protecting it from the negative effects of industrialisation.

Marginimea Sibiului is one of the centres of Romanian ethnography, a place were the local traditions are honoured among the inhabitants. The closeness to the 2007 European Cultural Capital, Sibiu, favours the development of the tourism phenomenon from this area made of 18 villages, with the centre in Salistea.

The three prizes were awarded to Romania within a visit of the Executive Committee of FIJET. The Minister of Tourism, Elena Udrea, took part in the awarding ceremony, organised in Salistea, on 6 September. The representatives of the International Federation of Journalists and Writers from Tourism shall visit other tourist objectives like Alba Iulia Fortress, Poiana Brasov, The Mud Volcanoes or Sarata Monteoru.

Romania received a "Golden Apple" in 1975 for Moldovita Monastery. The prize is located in the museum of the monastery at the moment.

The FIJET association was founded in 1954, being considered the oldest professional association of writers and journalists of tourism in the world. At the moment, the number of members of the organisation exceeds 800 persons coming from over 40 countries on all the continents. FIJET is an apolitical and non-governmental federation which promotes destinations or personalities which contribute to the development of tourism at an international level.

It is interesting to mention that each "Golden Apple" is manually manufactured. The story of their creation starts in Mexico, where their bases are cut from a marble quarry. They are polished and assembled in the USA by an artist with more that 40 years of experience. Inside the crystal "apples" there is "gold" floating in a special liquid, so that it would not lose the sparkle or change its colour.

Due to winning the four "Golden Apples", Romania ranks the first in the world list, together with Belgium and Spain. Sicily (Italy), Estergone (Hungary), Rothenburg (Germany), Turku (Finland), Antalya (Turkey), Cracovia (Poland), South Sinai (Egypt), Santiago de Cuba, Sharm el Sheikh (Egypt) are other several destinations awarded the Golden Apple.

How is it possible that a town like Saliste to receive a Golden Apple when not only the asphalted roads, but also the sewerage is missing? When one travels by car to Jina, one stops in nice places and sees plastic bottles all over the places, one cannot find a parking space or a public toilet, people have to go into the woods or the fields nearby. From there we received the bio products, straight on the table. If these are the norms based on which the Golden Apple is awarded, than it is serious or very well that we shall receive other too… The merit for receiving these prizes belongs to the **Tourism Press Club – PressTour FIJET Romania.** After a hard work to promote the Romanian tourist attractions through the media each member was part of, they managed to convince the Evaluation Committee that the proposed destinations fulfil all the necessary criteria that Romania was selected for the award of the international prestigious trophy "Pomme d'Or" or "Golden Apple", the equivalent of the Oscar for Tourism.

The present trophy marks a world premier, because it is for the first time when it is awarded, in the same year, for 3 tourists destinations/personalities of one country. **The Romanian tourism triangle**, from now on golden too, is formed of the following sides:

- **the eco-tourist area Marginimea Sibiului**
- **the Danube Delta Biosphere Reservation**
- **The Blue Air Airline Company**

The Club of the Tourism Press – PressTour FIJET Romania is honoured to be the Romanian official affiliated to the **Fédération Internationale des Journalistes et Ecrivains du Tourisme (FIJET).**

PressTour is formed of professional journalists from the written press, radio and television who understand the needs and the requirements of the association members and their colleagues.

Recently awarded prizes, Romania enjoys the privilege to have tourist objectives which might ensure the success of a holiday, but it has also large infrastructure and services problems.

For the hikers, maybe some of the most beautiful landscapes from the country are in Retezat National Park, which reached the semi-final of **New 7 Wonders** this year as well.

For the mountainous area, the two biosphere reservations (from Pietrosu Rodnei and Retezat) sum up 3,600 protected hectares. We add to these the 385,000 hectares from the 12 national parks, among which we include Apuseni, Bucegi or Piatra Craiului mountains.

Although it has a lot of resorts on the Black Sea coast, which could satisfy all the tastes, from the ones looking for the comfort of the most expensive hotel, in an all-inclusive stay in Mamaia, to the ones who prefer camping in 2 Mai, Romania does not manage to have services and infrastructure to please the clients. It has only 230 kilometres of highway built, below Bulgaria, a country with 330 kilometres of highway, but with a surface which is twice smaller.

Another problem of the Romanian tourism is the services, because the personnel from the hotels is not well trained and needs specialty training courses. The Danube Delta, having 580,000 hectares, designated a biosphere reservation by UNESCO in 1991, confronts with the poverty of the inhabitants and the famous problem of the garbage randomly deposited. Moreover, there is no organised tourism, which offers the tourist a complete package, which included transportation, accommodation and walks on the Danube branches. The tourists have to look for a boat themselves or they have to ask the local people if they want to see the Delta.

Maybe the tourism sector that is the worst in Romania at the moment is the balneal tourism, although Elena Udrea declared that this was one of her priorities. Recently, the Minister of Tourism inaugurated a balneal treatment unit in Turda Salt Mine, but it was not functional yet, so after the inauguration, all the patients were sent home.

Although it has an enormous potential regarding the spas, their majority was left to ruin after 1990. The investments were rarely made, and only when they could bring immediate winnings, like the case of the swimming pool in Baile Felix, which was renovated, while the rest of the resort did not attract any investments. A visit to the monasteries from Moldova, to the castles hidden in the mountains or to the wooden churches of Maramures may be the perfect holiday for the ones who love cultural tourism. Even Bucharest has cultural potential, but, unfortunately, there are no organised tours to include the major objectives from the Capital, from the museums to the ruins of the medieval inns.

For 2009, the Minister of Tourism had a budge of 352.6 million lei, which represent 0.06% of PIB. Until 17 July 2010, when the institutions presented its balance sheet for six months, only 10.21% of the money was spent because, according to the ministry, the local authorities were still in the stage of organising tenders for the tourist infrastructure worked.

In many fields, the activities are in a beginning stage. It is the case of the tourist promotion of Bucharest, where a protocol has been signed between the City Hall and the ministry, or the activity of street marking all the tourist objectives, which has been started recently. And costing a lot of money…

From the total sum, a percentage of 73% should be invested in infrastructure, and 12% in actions of tourism promotion. Over 13 million lei have been spent on promotion so far, approximately 3 million EUR, and the advertisements which proposed to attract new visitors in the country are broadcasted in the period August-December 2009 on Eurosport and CNN, during the campaign "Romania, land of choice". Let's not remind about the leaf scandal, related to plagiarism, destroyed image and Chinese people dressed like Steven the Great…

Regarding the European funds for tourism development in Romania, only two contracts between the ministry and the local authorities have been signed so far. The fortunate areas which shall benefit from the European money are Rasnov, with 5 European projects (with a total amount of 4.97 million EUR in 2010) and Bucegi Mountains.

CONCLUSIONS

The focus and the size of the efforts to change the Romanian tourism and to subscribe it on the orbit of sustainability and quality depend on the local conditions, including the resources, the political activity, and the remarkable features of the community.

Maybe more connected activities, doubled by professionalism, would do us even better and would bring recognition on the global market. It would really promote us without being hindered by the mean interests of the politics and accessing the ancient values which have made us famous: hospitality, culture, unique traditions, exceptional tourist potential.

REFERENCES

1. Baker S., Bradley, P., Huyton, J., (2002). The Principles of the Operations at the Hotel Reception, ALL Beck Publishing House, Bucharest.
2. Bavoux, J., Bavoux, D., (1998). Géographie humaines des littoraux maritimes, A. Collin.
3. Ioncică, M., (200). The Economy of services, Uranus Publishing House, Bucharest.
4. Lupu, N., (2003). The Hotel – Economy and management, the 4th edition, All Beck Publishing House, Bucharest.

5. Minciu, R., (2000). The Economy of tourism, Uranus Publishing House, Bucharest.
6. Niţă, I., Niţă, C., (2000). The Tourism market of Romania, Ecran Magazin Publishing House, Braşov.
7. Mitroi M., (2000). The Predictions of the World Organization of Tourism: 2000 – 2010", Tribuna Economică Magazine, Bucharest, no. 27.
8. Mazilu M., (2004). Ecotourism and tourist arrangements, Scrisul Românesc Publishing House, Craiova.
9. Mazilu M., (2007). Tourist Geography, Didactical and Pedagogical Publishing House, Bucharest.
10. Mazilu M., (2007). Le tourisme roumain dans le contexte du tourisme europeen, Universitaria Publishing House, Craiova.
11. Mazilu M., Marinescu R., (2008). The Globalisation Impact on the Romanian Tourism, article defended and published on the site of the IASK Conference (International Association for the Scientific Knowledge)- Advances in Tourism Research, Portugal, 26-28 May, http://www.iask-web.org/atr08/programme.html, and www.iask-web-org/publications.html
12. Mazilu Mirela Elena**,** Marinescu Roxana, (2008). Sustainable Tourism in Protected Areas – Case Study of the Iron Gates Natural Park, Rural Futures Conference, organized by University of Plymouth and School of Geography**,** 2-4 April, Plymouth, the Great Britain, ISBN: 978-1-84102-185-0, p.1-7.
13. Mazilu Mirela Elena**,** Marinescu Roxana, (2008). Perceiving Romania as a Sustainable Tourism Destination, published in vol. Proceedings Book of the 4th World Conference for Graduate Research in Tourism, Hospitality and Leisure, organized by Anatolia Journal: An International Journal of Tourism and Hospitality Research, 22-27 April, Antalya, Turkey, ISBN 978-975-96260-4-4, page. 320-330.
14. Snak, O., Services and Quality Management, Romanian Academy of Management, Bucharest, 2000.
15. Stăncioiu A.F., Mazilu M, Căescu Şt. C, Constantinescu M., (2006). Considerations regarding the strategic thinking in the marketing of the regional identity, article published in, Economica" magazine, year XIV no.4 (December) (56), ASEM, Chişinău, ISSN 1810-9136.
16. Stăncioiu A.F., Arsene O., Teodorescu N., Mazilu M., (2008). The SWOT Analysis of the tourist destination – conceptual aspects – methodology. Case Study: Northern Oltenia or Oltenia at the bottom of the Mountain- published in the vol. The International conference Competitiveness and stability in Knowledge – Based Economy, 30-31 May, Craiova, ISBN 978-606-510-162-3, pg. 600-607, Universitaria Publishing House, Craiova.
17. Stănciulescu G., (2004). The Sustainable Tourism Management in the Urban Centres, the Economic Publishing House, Bucharest.
18. Vellas F., (1998). Tourism – tendencies and predictions, Walforth Publishing House, Bucharest
19. The National Institute of Statistics - 2006-2011.

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ECOTOURISM IN AN ASPECT OF SUSTAINABLE DEVELOPMENT

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ABSTRACT

Rapid economic growth and irrational use of natural resources at the end of the XX and at the beginning of the XXI century, have influenced the changes in the environmental sphere by increasing pollution of the environment. These environmental problems can be solved by applying the concept of sustainable growth and development and raising awareness about the necessity of implementation of basic environmental standards in business. Tourism is becoming one of the most growing world's industries nowadays and an important source of growth and development for many countries. While it can contribute in a positive influence to socio-economic development and environmental protection, uncontrolled tourism growth can also cause a various environmental problems, on the other hand. Ecotourism is a growing segment of the global tourism that is making important positive contributions to the environmental, social, cultural and economic well-being of destinations and local communities all over the world. Ecotourism is an inalienable part of nature, contained in rare forms of flora and fauna, landscape and environmental scarcity.

Key words: changes, development, environment, sustainable tourism, ecotourism

INTRODUCTION

Business environment at the end of the XX and at the beginning of the XXI century was characterised with the influence of different, dynamic and complex changes caused by technological, economic, political and social factors. Companies and national economy were focused on achieving growth in the volume of production whose result was the increase in profits, so their success was measured by the quantity produced and sold products and services. "Ecomomy of scale", on the other hand, have coused the changes in the environmental sphere and to specific environmental problems. "Extremely unfavourable prognoses for the world's future have created new development objectives in market economies, where once an unimaginable concept of a „sustainable development" appeared, which implies a certain level of orientation and limitation along with the responsibility to act preventively, to minimize negative development effects and to direct international cooperation." [1]

SUSTAINABLE DEVELOPMENT

Rapid economic growth and irrational use of natural resources in the 1970s., have influenced the emergence of global structural crisis in energy and raw materials. These processes have also influenced the changes in the environmental sphere and to specific environmental problems. Emerging problems of the entire human society can be solved by applying the concept of sustainable growth and development and raising awareness about the necessity of implementation of basic environmental standards in business. [2]

According to these global social and economic changes, at the beginning of the XXI century, the question of national economy development become quite different, so instead development theory based on „natural restruction" in achieving high development rate in the long term, today dominant role has theory of sustainable development.

Sustainable development has been defined in many different ways, but all definitions require a systematic and holistic approaches which will alow us to undestand the entire world as a complex system. However, the most frequently used definition is taken from report "Our Common Future", well known as the Brundtland Report:

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:

- the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and
- the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs." [3]

Sustainable development ties together concern for the carrying capacity of natural systems with the social challenges facing humanity. According to professor Milutinović, the basic focuss of the sustainable development is society and it's need for involving care for environment while social and economics changes are anticipating and planning. Sustainable development could be consider as a „roof concept" which including many different ideas. [4]

"The bridge between ecology and economy is sustainable growth and development. The essence of sustainable development is responsible for development or development that meets the current needs a way to rationally use natural resources to ensure meeting the needs of future generations."[5]

SUSTAINABLE TOURISM AND ECOTOURISM

Nowadays tourism is becoming one of the most growing world's industries and an important source of foreign exchange and employment for many countries. Tourism that focuses on natural environments is a large and growing part of the tourism industry.

While it can contribute in a positive manner to socio-economic development and environmental protection, uncontrolled tourism growth can also cause a various environmental problems. Achieving sustainable tourism is a continuous process and it

requires constant monitoring of impacts, introducing the necessary preventive and/or corrective measures whenever necessary. Sustainable tourism should also maintain a high level of tourist satisfaction and ensure a meaningful experience to the tourists, raising their awareness about sustainability issues and promoting sustainable tourism practices amongst them. [Sourse, UNWTO, 2004]

"Today the most attractive tourist destinations are those which have preserved physical-geographic environment, protected nature and anthropogenesis tourist motifs that attract tourists. Those destinations that do not have opportunities to offer such a tourist product are faced with a decreasing number of tourists, and thus with other negative effects reflecting in smaller foreign currency inflow, employment decrease. Sustainable development implies three main principles, which are: ecological, socio-cultural and economic. "[6]

The term ecotourism was coined by Hector Ceballos-Lascurain in 1983, and was used to describe nature-based travel to relatively undisturbed areas with an emphasis oneducation [7].

Terms like ecotourism, sustainable tourism and responsible tourism are rooted in the concept of sustainable development. Sustainable tourism was defined in the 1992 Agenda 21 for the Travel and Tourism Industry as tourism that "meets the needs of present tourists and host regions while protecting and enhancing opportunities for the future." Ecotourism is a growing segment of the global tourism that is making important positive contributions to the environmental, social, cultural and economic well-being of destinations and local communities all over the world. Ecotourism is a form of tourism that involves visiting natural areas - in the remote wilderness or urban environments.[7]
According to the definition and principles of ecotourism established by The International Ecotourism Society (TIES) in 1990, ecotourism is "Responsible travel to natural areas that conserves the environment and improves the well-being of local people." (TIES, 1990). As Martha Honey points out, there are seven characteristics of ecotourism, which are:

- involves travel to natural destinations
- minimizes impact
- builds environmental awareness
- provides direct financial benefits for conservation
- provides financial benefits and empowerment for local people
- respects local culture
- supports human rights and democratic movements. [7]

Ecotourism is an inalienable part of nature, contained in rare forms of flora and fauna, landscape and environmental scarcity. It is a protective role, which ecotourism has in natural areas, that allows the maintenance of the natural balance. It is often considered as tourism of human's living environment.
Studying ecotourism from the perspective of both theory and its practical applications, we must first differentiate whether it is a pure natural base category, or specific ecological-economic. Modification of the concept of ecotourism in recent period emerged from the need to reconcile differences between the products of ecotourism and the environment, especially when it comes to that part of what the basic are, and what

complementary sources of that product are. In determining the elements of ecotourism, as a system, are considered his best quality, but the most sensitive parts. As a scheme it would be possible to present in this way:

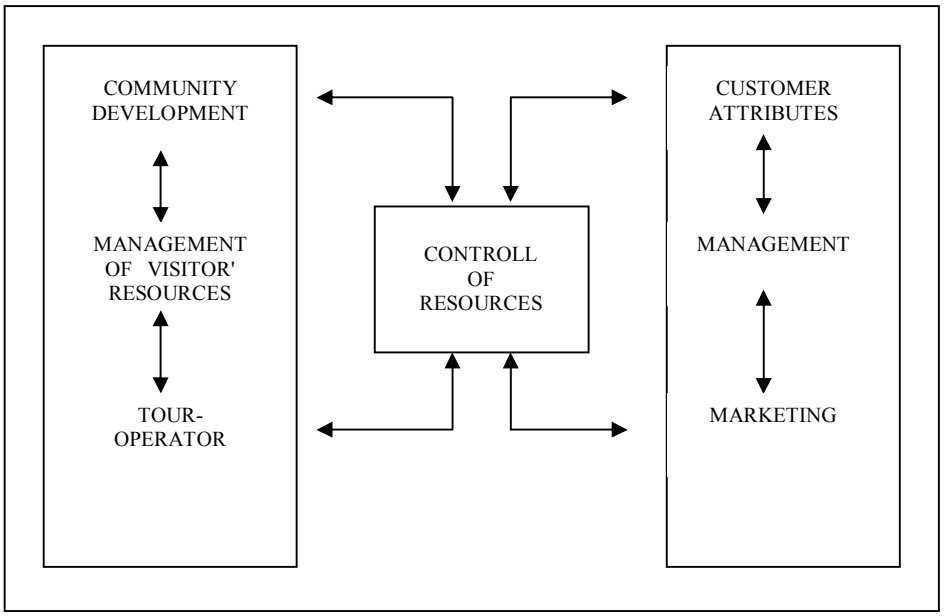

Figure 1. Integral parts of ecotourism [8]

Ecotourism focuses on local cultures, wilderness adventures, volunteering, personal growth and learning new ways to live on our vulnerable planet. It is typically defined as travel to destinations where the flora, fauna, and cultural heritage are the primary attractions. Responsible ecotourism includes programs that minimize the adverse effects of traditional tourism on the natural environment, and enhance the cultural integrity of local people. Therefore, in addition to evaluating environmental and cultural factors, initiatives by hospitality providers to promote recycling, energy efficiency, water re-use, and the creation of economic opportunities for local communities are an integral part of ecotourism. [9]

Different approaching to the usage of elements of the environment requires a different management of its resources and the separation of consumption and non-consumption evaluation forms. Today on the tourism market is much more prevalent consumption of non-consumption form and in relation 70% to 30% in favor of the consumption. Consumption shape provides benefits to many, because there are required regulated facilities, the construction of specific touristic facilities, manufacturing of equipment for hunting and fishing, trained hunt keepers and guides and such like.

Ecotourism only works when it yields economic benefits to local people, supports conservation and reduces the human impact of travel. It requires the active and

educated participation of tourists and the travel industry alike, and it involves everyone from the visitor to the tour operator and airline, the hotelier and the local labor force to agriculturists to individual conservationists.

On formation of eco-touristic motives influence numerous factors such as: length of travel and stay in protected areas, country where the tourists come from, their purchasing power, a form of tourism offer, the size and position of destination, content of staying and forms of consumption, type and quality of accommodation etc.

Table 1. The most important eco-touristic motives in rural are of Serbia [10]

Motivation	**average**	**t-value**	**rang**
Wild and unexplored nature	3,94	-23,40	1
Lakes and Streams	3,68	-16,46	2
Phisical Activity	3,39	-16,07	3
Mountains	3,32	-14,56	4
National and local parks	3,41	-14,33	5
Experience new lifestyle	2,89	-13,22	6
Specificity of rural areas	3,18	-12,59	7
Coastal bodies of water in rural Serbia	3,32	-12,34	8
Meeting people with similar interests	3,33	-12,17	9
A simpler lifestyle	2,79	-12,01	10
Visits to historic sites in the rural area and its gravitational zones	2,79	-11,85	11
External activities (impact of economic policy in rural area of Serbia)	3,12	-11,00	12
To be brave and adventurer	2,51	-10,61	13
Cultural activities (related to the cultural characteristics of rural areas)	2,71	-10,44	14
See the maximum in the time available	3,24	-9,95	15
Describing himself in conjunction with nature	2,47	-7,95	16
Escape from a stressful job	3,06	-8,81	17
Local crafts	2,66	-8,83	18
Historic sites and parks of rural area in Serbia	2,79	-8,25	19
Low cost service in ecotourism of rural areas in Serbia	2,47	-7,95	20
The enthusiasm and excitement	2,55	-7,01	21
Museums and art galleries (mostly naive artists)	2,42	-6,59	22
Accommodation in budget hotels and private country houses, pastures, basie, farms, etc.	2,62	-5,68	23
Escape from life's demands	2,52	-5,32	24
Recreation in eco-rural area	1,91	-5,30	25
Tasting new foods	2,18	-5,27	26
Lot of fun	2,92	-5,09	27
Detailed tours of different villages	2,56	-4,53	28

Ecotourism is considered the fastest growing market in the tourism industry, according to the World Tourism Organization with an annual growth rate of 5% worldwide and representing 6% of the world gross domestic product, 11.4% of all consumer spending - not a market to be taken lightly.

Direct income from ecotourism is flowing in from the payments of tourists, various donations, sale of handicrafts, souvenirs and the like. And they represent assets of the touristic balance sheet. Indirect revenues from ecotourism come from state subsidies and incentives and investments from different donors. On the other hand, the costs of eco-tourism are related to the costs of the organization of touristic offer itself, the costs caused by competitive touristic destinations and all other non-competitive costs, which are representing liabilities of touristic balance sheet.

CONCLUSION

Increase the physical volume of production in response to the growing needs of consumers and society, caused a disturbance of the environment by increasing pollution of the environment, but also increasing awareness of environmental protection.

The challenges of the contemporary development of science, technology and economy affect all relevant factors to development of modern tourism. The search for „a sustainable level of interaction between nature and man, nature and tourism, as well as man and tourism" should be a guideline in tourism development planning with the function to preserve the environment and to satisfy tourist needs. [1]

Ecotourism is an inalienable part of nature, contained in rare forms of flora and fauna, landscape and environmental scarcity and also the fastest growing market in the modern tourism industry. It is a protective role, which ecotourism has in natural areas, that allows the maintenance of the natural balance. That is the reason why ecotourism is often considered as tourism of human's living environment. Complacency with cumulative motives of touristic activities causes new needs for finding different, more dynamic, but stable and secure tourist motives and spatial touristic parts.

REFERENCES

1. Štetić S., Šimčević D., How to develope sustainable tourism in rural destinations in Serbia, Bulletin of the Serbian Geographical Society, N. 4, p 21, 2008.
2. Premović J., Drašković S., Strategic aspects of the ecological management**,** Proceeding XVIII International Scientific and Professional Meeting „EcoIst'10", p. 457, Spa Junaković-Apatin, Serbia, 01-04 June 2010.
3. World Commission on Environment and Development (WCED), Our Common Future, p. 43, Oxford: Oxford University Press, 1987.
4. Milutinović S., Politics of sustainable development, pp. 161-162, University of Niš-Faculty of occupational safety, 2009.
5. Boljević A., Sustainable development in an aspect of environment protection, p.16, The Annals of the Faculty of Economics Subotica, 2008.
6. Štetić S., Šimčević D., pp. 22-23.
7. www.wikipedia/ecotourism
8. Milenković S., Mutual relations between tourism and enviroment, p. 273, University of Kragujevac-Faculty of Economy, Kragujevac, 2006.
9. www.gdre.org/uem/eco-tourism
10. Milenković S., pp. 274-275.

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THE IMPORTANCE OF FOREST ECOSYSTEMS AND THEIR RESOURCES TO THE DEVELOPMENT OF ECOTOURISM IN SERBIA

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ABSTRACT

Forest ecosystems are the most important ecological potential and aesthetic-decorative element of the landscape, and as a result of their resources and numerous functions are of a great significance to human life. In recent years, great attention has been paid to the preserved and protected nature and food that fulfils health and safety requirements worldwide, and the areas which meet these criteria are of particular significance in the regard of tourism as ecoregions. Forest areas and their spatial distribution in Serbia in addition to other natural characteristics and created values are the important tourist potential for the development of ecotourism. In the entire area of Serbia it is possible to revive a wide range of the attractive sites, aimed at enriching the tourist offer of Serbia, enliving every visitor and offering them the unrepeatable experience. This paper will present the conceptual project of the tourist program called „Forest Heaven" - chain of the tourist sites „Forest House", which would fit in the concept of ecotourism.

Key words: forest ecosystems, forest resources, ecotourism, ecoregions

INTRODUCTION

Ecotourism is the ecologically responsible voyage and visit to the relativelly preserved areas, in the aim of enjoying nature (and accompanied cultural features - both from the past and from the present), which implies the improvement of the environmental protection, few adverse effects of the visitors and beneficial active impact on the local population [1]. Ecotourism often implies the sub-category of the sustainable tourism or the segment of the wider tourism market oriented towards the destinations in nature, which includes the business of the smaller range, emphasises the local ownership, and refers particularly to the rural population. Forest ecosystems are the ideal potential for the development of this type of tourism in Serbia [2].

The nature characteristics and peculiarities of the forest areas in Serbia, among other, created values, are the great tourist potential, which can be subject to the valorisation by different criteria. Forest have a positive impact on the air, water, soil, climate, plant and animal world, and area in general, they protect settlements, facilities, traffic lines and agricultural land from erosion, torrents, floods, avalanches, rockslides, wind, noise, etc. They reduce the noise and radioactive radiation, and due to the

increasing human needs for rest and recreation, particularly in the environment, recreation-health and tourist functions of forests are increasingly significant. Along with the numerous natural values, forest ecosystems in Serbia offer the possibility of using the potentials, such as big and small game, forest fruits (wild blackberry, wild strawberry bilberry, European cornel, etc.), edible fungi (penny bun, chanterelle, etc), medicinal and aromatic plants, which can leave their mark and make some sites recognisable [3]. Great profits, with suitable investment, can be made by developing eco and hunting tourism, large-scale rest, recreation and rehabilitation of the population in nature. In the entire area of Serbia it is possible to revive a wide range of the attractive sites, aimed at enriching the tourist offer of Serbia, enliving every visitor and offering them the unrepeatable experience.

GUIDELINES TO THE DEVELOPMENT OF ECOTOURISM IN SERBIA

The Spatial Plan of the Republic of Serbia for the period 2010-2020 [4] anticipates the construction of the spatial-functional units of the mountain, spa, urban, transitional and water tourism, which will integrally include rural, ecological, hunting and other forms of the commercial tourism. The priority in the tourist offer of Serbia is given to the units which have been already formed or initiated and the centres of the complex tourism offer. Given the strategic national interests (particularly the revival of the depopulated local units) and creation of the wider bases for the inclusion of the market participants, new tourist areas, in which the so-called ecosites, characterized by the preserved and protected nature and food that fulfils health and safety requirements, have the special role, are also included in the priorities.

Serbia has diverse and significant potentials for the development of ecotourism, the small part of which is used. The improvement of the current tourist offer and organization of this type of tourism in Serbia implies the better use of the resources, unification and presentation of all elements of tourist offer. The available tourist potentials are mainly valuable ecological resources and cultural-historical heritage.

In the Table 1 the tourist zones and regions in Serbia and their characteristics important to the development of different types of tourist activities are presented and decribed.

The main aims of the development of ecotourism and use of the tourist areas of Serbia are:

- intensification of the tourist activities and promotion of the tourist attractions;
- activation of new tourist areas, mainly the ones with the best natural potentials for the development of ecotourism;
- primary financing of the programs and projects which are the base of the tourist activities: infrastructure, public services, protection of natural and cultural heritage; increased participation of the local community in the activation of the tourist resources.

Some of the main factors for the development of ecotourism in Serbia are the preservation of ecological-tourist potentials, increased financing investment and improvement of the organization and promotion of ecotourist offer of Serbia.

Table 1. Tourist zones and regions in Serbia

Tourist zones			Tourist regions			Characteristics of zones and regions		
Class	***Symbol***	***Designation and Description***	***Sublevel***	***Symbol***	***Designation and Description***	***Rank***	***Main tourist activities***	***Other tourist activities***
I	**E**	**Eastern zone** – with high mountain regions E.1 and E.2	**I.1**	**E.1**	Stara planina	International and national	Alpine skiing	Summer recreation, hunting, village
				E.2	Krajište and Vlasina		Tour and alpine skiing	Summer recreation, lake, village
	C	**Central I zone** – with high mountain regions CI-1 and CI-2	**I.2**	**CI-1**	Kopaonik			Summer recreation, spa, hunting, village
				CI-2	Golija		Summer recreation and winter sports	Cultural heritage, hunting, village
	S	**Southern zone** – with high mountain regions S.1 and S.2	**I.1**	**S.1**	Šar planina		Alpine skiing	Summer recreation, cultural heritage, hunting
				S.2	Prokletije			
II	**W**	**Western zone –** with medium-sized mountain subregions of regions W.1	**II.1**	**W.1**	Tara-Zlatibor-Zlatar	National	Summer recreation	Transit, lake, village
	CII	**Central II zone –** with Peripannonian regions CII-1 to CII-5		**CII-1**	Valjevske planine			Excursions, spa, hunting, village
			II.2	**CII-2**	Šumadijske planine			
			II.1	**CII-3**	Kučajske planine			Excursions, cultural heritage, hunting
				CII-4	Đerdap			Excursions, nautical, cultural heritage
			II.2	**CII-5**	Deliblatska peščara			Excursions, nautical
	N	**Northern zone –** with Pannonian regionis N.1 to N.4	**II.1**	**N.1**	Fruška Gora			Excursions, nautical, cultural heritage
				N.2	Upper Danube river basin			Nautical, hunting
				N.3	Upper Tisa river			Nautical, spa, hunting, village
			II.2	**N.4**	Lower Tisa river			Excursions, nautical, hunting

Source: [5]

POTENTIALS OF FOREST ECOSYSTEMS FOR DEVELOPMENT OF ECOTOURISM

Forest ecosystems are among the most significant bioecological facilities on earth and can be viewed from several perspectives, both individually and coupled with other natural resources, ecological, social and economic indicators, by means of so-called „correlation of sustainability". In the aim of the sustainable development it is necessary to link economic and social policy with the policy of protection and improvement of the environment, at all levels of social communities, which implies the respect of the internationally adopted conventions and declarations.

By extending and enriching the tourist offer by including forest ecosystems, the tourist potentials of Serbia would be used to a much greater extent and the economic effects would be improved. Undoubtedly, it implies the need for the organizational strengthing and business connection of the leaders of all segments of tourism. Such a concept is based on the contemporary world practice of the environmental protection and biodiversity, principles of the integral use and "sustainable development".

The significant segment of the development of ecotourism is the production and placement of the food that fulfils health and safety requirements, which has been in great demand in recent years. The forest ecosystems in Serbia offer the possibility of using the auxiliary forest products, such as game meat, fish, forest fruits (forest blackberry, forest strawberry, bilberry, cornelian cherry, etc.), edible fungi (penny bun, chanterelle), medicinal and aromatic plants and other products, which can leave their mark and make some sites recognisable. Some households within the forest areas in Serbia collect these fruits, make different authentic specialties, and enrich the offer, particularly to a guest who comes from abroad, so many villages can be very attractive for tourism. During the procession of forest and agricultural products, monitoring, high quality, preservation of the peculiar characteristics and suitable marking system should be guaranteed. The mark should point to their geographical origion, the way in which they are produced, and main characteristics of the products.

CONCEPTUAL PROJECT „FOREST PARADISE" – CHAIN OF TOURIST SITES „FOREST HOUSE"

In the scope of ecotourism, the tourist accommodation should meet the following criteria:

- protect natural and cultural components of its environment;
- have a minimal influence on the enviroment during the construction;
- fit in the specific context of the environment;
- use the alternative, sustainable means in the water consumption;
- guarantee the careful treatment of waste material and waste water;
- involve the local population;
- apply the programs of the ecological education and upbringing, of both employees and tourists and
- contribute to the sustainable develoment of the local communities by conducting research programs.

The project *„Forest Heaven" – chain of the tourist sites „Forest House"* is a macro model, made of several local centres that consitute the chain of forest houses, and which would have to meet the above criteria. Around each forest house a special tourist program and product, by which the original peculiarities and characteristics of each site would be emphasized individually, would be created. In the entire area of Serbia a wide range of the attractive sites aimed at enriching the tourist offer of Serbia, enliving every visitor and offering them the unrepeatable experience, would be revived. Nature, culture, creative work, local features, and program contents, would guarantee the peculiarity and quality of the undertaking.

The aims of the project are multiple, complex and complementary. Some of the main aims are:

- attractive tourist concept,
- valorisation of important sites,
- tourist program which valorises the local potentialities,
- originality of the offer,
- ecologically correct project,
- contents which are in accord with the main concept,
- complementary contents,
- program which creates the prestigious image of the site,
- project adapted to the main image of the investors,
- concept which enriches the tourist offer of Serbia,
- higher employment rate of the local population.

The main principles of the project are:

- rational and controlled use of natural resources,
- valorisation of forest potentials and forest areas,
- ecological consistency of the project,
- protected typical elements of exterior and interior,
- the concepts are based on the local tradition.

The materialisation of the adopted concepts by segments and monitoring of the achieved results imply:

1. *Analysis of the development strategy* within which it is important to make cooperation with the experts from the different domains, representatives of the local administration and leading businessmen.
2. *Business reliability* - within which the proposed and adopted conception is subject to the strict econometrics and market analyses.
3. *Image creation* - public presentations, web presentations, promotions of the registrated trade mark of the project, advertisement support (publication of the common catalogue in which by advertising one tourist site all others are promoted as well, etc.).
4. *Projection and definition* of all common parameters and establishment of the model of functioning for all sites which are included and fall under the registrated trade mark „Forest Heaven".
5. *Theme programs* - excursions, educations (collection of fruits, teas, identification of fungi), learning the customs of the local population, etc.
6. *Cooperation with the local population* as the foundation of the project and its integral force.
7. *Joint investments* – clearly defined, critically analyzed.
8. *Monitoring* – the last important task within which the results can be publicly monitored and presented in the media and to the businessmen. This task implies the following activities: selection of the form, promotion of product, campaign of the market placement, advertising, sale and contact with the public.

The concept devised in such a way makes the tasks regarding to the investing, maintainance and sale of the products and services easier. Given the character and importance of the project in general, it is needed to form the competent team of experts from different domains and support the materialisation of this project. During the construction and implementation of the strategies of using natural resources, the concept of the sustainable development, which emphasises the harmony between the economic, technological, social and cultural development and preservation, rehabilitation and improvement of the environment, protection of the natural heritage and original ecosystems, should not be neglected.

CONCLUSION

Tourism as an activity is mostly and most successfully developed in the areas characterized by the attractive and preserved nature and the best recreation possibilities. In recent years ecotourism has become the most popular form of rest worldwide. While the tourism aimed at the destinations in nature is basically the simple voyage in the areas with nice nature, ecotourism is beneficial to the local population in the regard of ecology, culture and economy (for instance, an ecotourist hires the local guides, stays in a local lodging facilities, etc. and in this way contributes to the local economy). The increase in the number of visits to the protected areas and strengthening of the ecological concept of the importance of the health environment should stimulate the authorised persons in the countries worldwide to take the responsibility for the mass expension of the system of the protected nature areas.

The forest and everything which is located in it is the integral part of nature and one of the main preconditions for the survival and life. As the natural resource, forests are important productive-economic and ecological potential of the Republic of Serbia, and as the area of the common interest, they have a multifunctional character, which is reflected in the productive, protective-regulative (ecologic) and socio-cultural functions. The relation of tourism to the environment and use of the natural resources determines their mutual conditionality and interdependence, which implies the necessity of the comprehensive analysis of the use of natural resources, ecological problems with which nature is faced up, and the development of tourism in Serbia. In order to materialise the conceptual project „Forest heaven" – chain of the tourist sites „Forest house", it is necessary to clearly define the spatial and climate potentials of each region, town and site in Serbia, follow the tradition of people live in these areas, etc. The essence of the whole task is a very accurate definition of the micro tourist offer of Serbia on the on hand, and on the other, the acquaintance of every visitor with the level of service at each site.

REFERENCES

1. Ceballos-Lascurén H.: Tourism, ecotourism and protected areas: The state of nature-based tourism around the world and guidelines for its development, p.p. 20, IUCN, Gland, Switzerland, and Cambidge, UK, 1996.
2. Brašanac, Lj.: Forest resources of Serbia and their importance for the development of tourism, p.p. 121-126, Proceedings of scientific papers,

International conference on „Natural resources – Basis of Tourism", Ecologica, N°11, Belgrade, 2006.
3. Velašević, V., Đorović, M.: The Impact of Forest Ecosystems on the Environment, The Faculty of Forestry in Belgrade, Belgrade - Novi Sad, 1998.
4. Spatial Plan of the Republic of Serbia until 2020 – Draft Plan, Republic Agency for Spatial Planning, Belgrade, 2010.
5. Spatial Plan of the Republic of Serbia, Institute of Arhitecture and Town Planning of Serbia, Belgrade, Prometej, Novi Sad, 1997.
6. Brasanac, Lj., Cirkovic, T.: Sustainable development of forest ecosystems in Serbia, p.p. 71-75, Proceedings, International conference on „Environment and sustainable development", Ecologica No.14, Belgrade, 2007.
7. Brasanac-Bosanac, Lj., Cirkovic-Mitrovic, T.: Globalization influence on forest resources in Serbia, p.p. 181-186, Proceedings, International Scientific Conference on „Globalization and environment", Ecologica No.54, Belgrade, 2009.
8. Dinić, B. J.: Natural Potential of Serbia, Economic-Geographical Analysis and Appraisal, pp. 174-182, University of Belgrade, Faculty of Economics, Belgrade, 1997.
9. Nevenic, R., Drazic, D., Brasanac, Lj., Bojovic, S.: Conservation and Enhancement of Natural resources in Serbia, - Adjustment of legislation with international agreements of Environmental protection, p.p. 1-27, International Scientific Conference Forests „Integral protection of Forests – Scientific-Technological Platform", Plenary lectures, Proceedings, Institute of Forestry, Belgrade, 2007.
10. Nikolić, S. : Nature and Tourism of Serbia, pp. 55-72, Eco-center Belgrade, Institute for Nature Conservation of Serbia, Belgrade, 1998.

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TOURISM VERSUS MINING ACTIVITY IN JIU VALLEY

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ABSTRACT

The social-economic environment of Jiu Valley, a mono-industrial area the main activity of which has always been coal mining and processing, was strongly affected by the economic transformation and rehabilitation of mining activity. The region deals with the out of 54.000 employees of the National Coal Company had in 1997, only 8.600 remained nowadays; the labour market in the area was seriously disturbed by the labour force removed from the mining activity, economic alternatives being almost inexistent, because everything related to the economy in the area was adjacent to mining.

There is a possibility for the quality tourism to be the only solution for an economic recovery, it meaning not only investors and profit as well as the development of many adjacent activities.

Based on the results of a sociological research, the opinion of local population about touring development is presented.

Key words: tourism, sustainable development, project, opinion

INTRODUCTION

The social-economic environment of Jiu Valley, a mono-industrial area the main activity of which has always been coal mining and processing, was strongly affected by the economic transformation and reorganisation of mining activity. In 2011, considering that the Jiu Valley coal basin contains the most important coal reserve in Romania and the industrial coal reserve is estimated to be around a billion tons (Fodor, Baican, 2001), the region deals with the following situation:

- Out of 54.000 employees of the National Coal Company had in 1997 (before the first massive staff lay-offs), only 8.600 remained nowadays, meanwhile the staff reorganisation process continues;
- Narrowing down or stopping the productive activity of some mines, putting them into preservation and preparing them for being closed;
- The labour market in the area was seriously disturbed by the labour force removed from the mining activity, seriously disturbed the labour market in the area, economic alternatives being almost inexistent, because everything related to the economy in the area was adjacent to mining;
- The lack of interest of local or central authorities and investors lead to the migration of the labour force on one hand and to rising social tension on the other

hand, state assistance of the unemployed preventing the interest towards professional reconversion and searching for solutions on the labour market;

- The lack of long term social development and the lack of social policies adequate to the time and place continue to maintain the economic downhill and poverty of the area, adding as well as a decreased level of population training, lack of necessary funds for the implementation of new programmes, excessive bureaucratisation of private investment ideas, generalised corruption and not the least a mentality of the kind 'the state is compelled to ensure the a working place and good working conditions'.

SOLUTIONS FOR A SUSTAINABLE DEVELOPMENT OF JIU VALLEY AREA

Almost all the studies and researches realised in Jiu Valley during the past 15 years have tried to identify real and viable development alternatives outside the area of mining with different solutions such as: tourism, agro-tourism, infrastructure development, source water abstraction and bottle, etc. Each inhabitant and possible foreign investor is aware of the fact that tourism is always the first choice among the economic straightening solutions, and it cannot be realised without a solid new or at least modernised infrastructure. The mountainous environment in Jiu Valley is wonderful and suitable for touristic activities all year long, being a rival to the most known tourist areas in Romania. Unfortunately, even if in the past 20 years there have been private initiatives for the construction of new holyday houses and mountain hotels, this activity has also suffered due to several limitations:

- The development of the two mountain resorts (Parâng and Straja Vulcan) was not based on a systematic plan well thought from the beginning, the main reason for the agglomeration of chalets, cramped places, built only considering the proximity to water sources of access ways;
- The majority of these locations were built for the private use of investors, and only recently the idea of renting them during winter time had appeared, especially during the winter holyday season; renting is therefore made without any official touristic approval;
- A seasonal tourism is practiced in both resorts, being opened to the entire public especially during winter, while during the rest of the year tourists risk not finding any water source, not mentioning accommodation;
- The lack of infrastructure (access roads, water and energy connections) makes the area unattractive, although during the ski season the number of tourists seems large in comparison to the facilities. Choosing the winter holyday area is motivated by the price which is lower than in other famous resorts, and there is always the spatial proximity criterion.

RECENT ACHIEVMENTS IN TOURISM DEVELOPMENT

Presently, there is an increased interest of developing tourism, mainly because the continuous mining reorganisation process, a reason for which massive investments have been realised for two major projects:

1. The Pasul Vâlcan ski resort, where in February 2011 the firs cabin lift was inaugurated, project implemented during 9 months with a price of 7 million euro out of a total of 26 million euro given for the construction of two cabin lifts which will ensure the connection to Straja resort. In Pasul Vâlcan ski resort there are two private ski slopes (600 m each) and maximum 100 accommodation places;
2. For the Parâng ski resort, there is a project for the construction of a cabin lift to connect the Municipality of Petrosani to the mountainous resort and the construction of 17 slopes all with snow machines, 7 ski lifts, chalets and restaurants construction, etc.

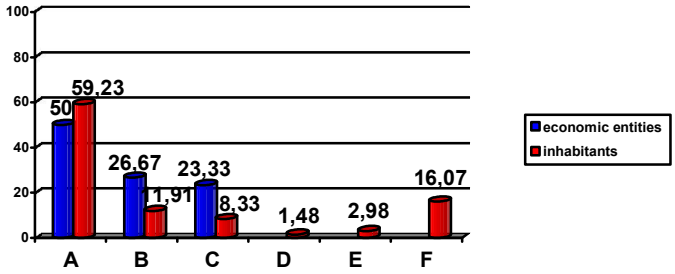
During this period when the economic crisis affects more and more the perception on people, where, due to an extremely corrupt politic system almost every development plan or programme seems to hide interest groups and the opinions on these major projects are quite different. Most of the inhabitants of the region think that these projects are not a positive thing, will not have the wanted effect on the economy of the area, and these opinions are most of the times supported by people of the mass-media who do not know the whole thing but a series of aspects of the construction phases and therefore influence the public opinion contrary to that implied by the project. For instance, in April 2011 a TV show subjectively presented the case of the "cabin lift" in Petroşani as an enclosed business, following its own profit, the population being fooled as a reporter filmed an interview with a group of skiers saying they preferred the Austrian ski resorts to the local ones and that they are being sceptical regarding the future of this resort. The differences between the local resorts and the resorts abroad are obvious, but the questioned people accused the lack of modern ski slopes, corresponding accommodation, leisure possibilities, aspects which have already been foreseen by the major project.

THE OPINION OF LOCAL POPULATION ABOUT TOURING ACTIVITY

In July 2010 an project development impact assessment was made considering the population of the Municipality of Petroşani, assessment materialised through 2 sociological surveys, one having considered the opinion of the inhabitants (336 interviewed people) and another survey which considered the opinions of the economical entities (60 companies from all the domains, i.e. different goods production, banks, health units, educational units, tourism companies, insurance companies, supermarkets, real estate agencies, public notaries, gas and electric companies, auto services). Contrary to a lot of affirmations appeared before and after the finalisation of the survey it seems that the population of Jiu Valley acknowledges that efforts must be made in order for the

economy of the region to take another direction than mining. Here are some of the conclusions of these two surveys:

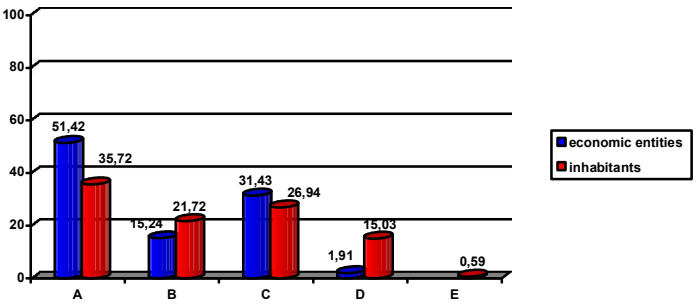
1. There is no doubt in the opportunity of the development project of Parang ski resort, being appreciated by 90 % of the subjects (100 % by economic entities and 80 % by inhabitants);
2. 74 % of the subjects are convinced that the project will be realised in 3 years' time (90 % economic entities, 71 % inhabitants);
3. Half of the people interviewed (78 % economic entities and 45 % inhabitants) consider that the project will be the benefit of the entire population;
4. Project expectancies (objective confirmation) are appreciated to be real by 83 % of the subjects (92 % economic entities and 81 % inhabitants);
5. The positive effects following the project are considered to be the creation of new jobs, re-building the infrastructure and economic re-launch (Figure 1).



A- Jobs
B- Infrastructure
C- Intense economic life
D- Population health
E- Leisure possibilities
F- Others

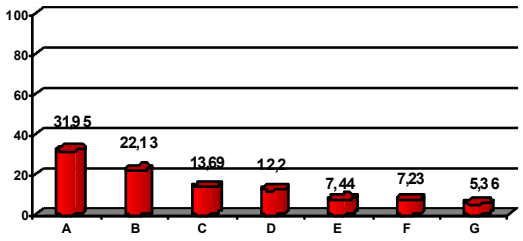
Figure 1. (%) Positive effects of the project

6. The main risks of the project are financial ones (financial adjustment, financial block), delays in implementation, risks involving political-judicial instability (Figure 2).
7. 92 % of the economic entities manifest their desire to take part in the project, the most powerful desire being expressed by non-commercial services units;
8. 47 % of the economic entities appreciate they will be always involved in the project, in the preparation stages as well as in the implementation and usage stages;
9. Acknowledging the need of the project comes from the fact that the inhabitants think that the greatest problems of the resort are the access and accommodation (Figure 3).
10. The main objective to be realised would be the construction of the cabin lift followed by the modernisation of ski slopes (Figure 4).



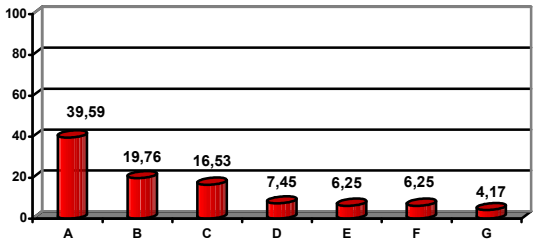
A– Financial
B- Implementation delays
C- Political-judicial risks
D- Flawed estimations
E- Others

Figure 2. (%) Project risks



A- Access roads
B- Corresponding accommodation
C- Quality tourist services
D- Modern ski slopes
E- Utilities infrastructure
F- Fun activities
G- Cable transport

Figure 3. (%) Things that Parâng resort lacks



A- The cabin lifts
B- Modern slopes
C- Utility zoning
D- Accommodation
E- Quality management
F- Correspondingly advertising the area
G- Cable lifts

Figure 4. (%) What is the most important thing to be realised in Parâng resort?

Therefore, if the Parâng ski resort seems to be pointless or an utopia for those outside the area or for other interest groups, the inhabitants lay all their hopes on it, being a sure way of **creating jobs** on one hand and attract other investments in the area. What the population and the local authorities need to understand is that mountain tourism is just one thing which may be realised in Jiu Valley from a touristic point of view: emphasising the beauties of the area, its cultural institutions (The Mining Museum is one example, being the only coal mining museum in the country), emphasising traditions and customs and not the least a quality mountain tourism to offer quality services all year long not only in winter time.

CONCLUSIONS

Tourism development is strongly related to infrastructure development, the development strategies together with the coal mining strategies need to be realised according to the requirements of a sustainable community development in full compliance with EU norms and regulations. There is a possibility for the quality tourism to be **the only solution** for an economic recovery, tourism meaning not only investors and profit as well as the development of adjacent activities: transportation, commerce, services, professional reconversion, in other words community participation directed towards the increase of the standard of living, i.e. jobs and economic revival of the region.

REFERENCES

1. Krausz S., Stegar I. and others, 2010, The impact of the project "Developing Parâng Ski Resort" on the population, Study for the Mayor's Office of Petroşani, elaborated by members of The Association Jiu Valley Social Institute.
2. Fodor D, Baican G, 2001, The impact of mining activity on environment, Infomin Publishing House, p.47, The Association Jiu Valley Social Institute Deva.

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EXPOSURE TO BIOLOGICAL AGENTS AND CHILDREN HEALTH

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ABSTRACT

Biological agents in indoor air are know to cause three types of human disease: infections, hypersensitivity diseases, and toxicosis. The objective of this investigention was to estimate the effects of the biological agents on the prevalence of respiratory symptoms and diseases as well as the prevalence of nonspecific symptoms on different organs at children. The study sample consisted of 1074 children aged 7 –11 years from three primary schools in Nis. A questionnarire which was based on recommendations of WHO is used. In this investigention it is established that exposure to biological agents has the significant health effects on exposed children.

Key words: biological agents, children health

INTRODUCTION

Biological air pollutants are found to some degree in every home, school, and workplace. Sources include outdoor air and human occupants who shed viruses and bacteria, animal occupants (infects and other arthropodes) that shed allergens, and indoor surfaces and water reservoirs where fungi and bacteria can grow, such as humidifiers [1]. A number of factors allow biological agents to grow and be released into the air. Especially important is high relative humidity, which encourages house dust mite populations to increase and allows fungal growth on damp carpet [2-4].

Biological agents in indoor air are know to cause three types of human disease: infections, where pathogens invade human tissues; hypersensitivity diseases, where specific activation of the immune system causes disease; and toxicosis, where biologically produced chemical toxins cause direct toxic effects [5]. In addition, exposure to conditions conducive to biological contamination (e.g., dampness, water demage) has been related to nonspecific upper and lower respiratory symptoms [6].

The objective of this investigention was to estimate the effects of the biological agents on the prevalence of respiratory symptoms and diseases as well as the prevalence of nonspecific symptoms on different organs at children.

METHOD

The study sample consisted of 1074 children aged 7 and 11 years from three primary schools in Nis. A questionnarire which was based on recommendations of WHO is used. Trainning physicians filled out qestionnary in directly interview with children's parents.

The first part of questionnary consisted of the questions about the child's home. Positive answers to questions like: "Have you got any pets in home?", "Have you got problems with insects and rats in the house?", "Do you have too much textile (carpets, curtains, covers) at home?", "Have you got an old mattress in your bed?"meant that a child has been in one way or the other exposed to biological agents.

The second part of the questionnary was about prevalence of respiratory symptoms (nasal congestion, nasal secretion, dyspnea, wheezing, cough), respiratory deseases (sinusitis, bronchitis, asthma, pneumonia) and nonspecific symptoms (watery eyes, dry throut, headache, fatigue) of children in the past 12 months.

All collected data were processed with a software system. All children were divided into an exposed group of biological agents and a nonexposed group. In bouth groups, prevalence of symptoms and disease was analysed. Interview data were analysed using programmes Epiinfo 6 and Microsoft excel. Statistical significance of difference was established by using a Pearson Chi – Squered test. The odds ratio and 95% confidence intervals for the all symptoms and diseases were done.

RESULTS

In a sample of this investigation, 554 (51,60%) were boys and 520 (48,40%) were girls (Table 1).

Table 1. The structure of children by sex

Sex	Number of children
Male	554(51.60%)
Female	520(48.40%)
Total	1074(100%)

The group of children ten years aged was the most number. Grafic 1 shows the structure of examines by age.

Table 2. The structure of children by age

Age	7	8	9	10	11	Total
Number of children	132 (12.30%)	258 (24.00%)	241 (22.40%)	277 (25.80%)	166 (15.50%)	1074 (100%)

Almost 20 % of children have kept pets in household. Most number of the children have kept birds. 23,74 % of children lived in homes which had problems with insects or rats.

Large amounts of textiles susceptible mites have coused problems for more than 48,70 % of children, while 23,37 % have had old mattress (more than seven years old) to sleep on.

Table 3. Children's exposure to different sources of biological agents

	Presence	Absence
Keeping pets	200 (18.62%)	874 (81.38%)
Insects and rats	255 (23.74%)	819 (76.26%)
Much amounts of textile materials	523 (48.70%)	551 (51.30%)
The old mattres	251 (23.37%)	823 (76.63%)

A positive relationship has not been established between keeping of pets and health (Table 4), except in cases of nasal congestion.

Table 4. Exposure to pets allergens and its influence on children's health

Symptoms and diseases	exposed		nonexposed		$\chi 2$	OR	CI	
	Yes	No	Yes	No				
nasal congestion	165	35	662	212	4.2*	1.51	1.00 -	2.29
nasal secretion	115	85	443	431	3.03	1.32	0.95 -	1.82
dyspnea	29	171	115	759	0.25	1.12	0.70 -	1.77
wheezing	62	138	258	616	0.17	1.07	0.76 -	1.52
cough	35	165	171	703	0.45	0.87	0.57 -	1.33
sinusitis	3	197	25	849	1.19	0.52	0.12 -	1.82
bronchitis	74	126	288	586	1.19	1.19	0.86 -	1.67
asthma	9	191	22	852	2.28	1.82	0.77 -	4.24
pneumonia	25	175	112	762	0.01	0.97	0.59 -	1.58
watery eyes	31	169	126	748	0.15	1.09	0.69 -	1.7
dry throut	40	160	167	707	0.08	1.06	0.71 -	1.58
headache	71	129	279	595	0.95	1.17	0.84 -	1.64
fatigue	67	133	285	589	0.06	1.04	0.74 -	1.46

* $p<0.05$

Presence of insects (e. g. coakroaches) and rats in household have been proven a significant risk factor for all the symptoms and diseases estimated, apart from asthma and pneumonia (Table 5).

Table 5. Exposure to insects and rats allergens and its influence on children's health

Symptoms and diseases	exposed		nonexposed		$\chi 2$	OR	CI	
	Yes	No	Yes	No				
nasal congestion	210	45	617	202	5.41*	1.53	1.05 -	2.22
nasal secretion	158	97	400	419	13.41*	1.71	1.27 -	2.3
dyspnea	52	203	92	727	14.05*	2.02	1.37 -	2.99
wheezing	99	156	221	598	13.03*	1.72	1.26 -	2.33
cough	69	186	137	682	13.39*	1.85	1.31 -	2.61
sinusitis	12	243	16	803	5.8*	2.48	1.09 -	5.62
bronchitis	114	141	248	571	18.11*	1.86	1.38 -	2.51
asthma	9	246	22	797	0.49	1.33	0.56 -	3.07
pneumonia	40	215	97	722	2.58	1.38	0.91 -	2.1
watery eyes	57	198	100	719	16.03*	2.07	1.42 -	3.02
dry throut	70	185	137	682	14.37*	1.88	1.33 -	2.66
headache	105	150	245	574	11.23*	1.64	1.21 -	2.22
fatigue	112	143	240	579	18.86*	1.89	1.4 -	2.55

* $p<0.05$

Large indoor presence of textile acts as a significant source of irritants and allergens and has an impact on the indoor air quality and health of the exposed. Children in contact with a lot of textile at home are at higher risk of nasal congestion, wheezing, asthma and nonspecific symptoms (fatigue and dry throat). Data are showed in Table 6.

Table 6. Exposure to textile allergens and its influence on children's health

Symptoms and diseases	exposed		nonexposed		$\chi 2$	OR	CI	
	Yes	No	Yes	No				
nasal congestion	424	99	403	148	9.53*	1.57	1.17 -	2.12
nasal secretion	279	244	279	272	0.79	1.11	0.87 -	1.43
dyspnea	66	457	78	473	0.55	0.88	0.61 -	1.26
wheezing	172	351	148	403	4.66*	1.33	1.02 -	1.75
cough	102	421	104	447	0.07	1.04	0.79 -	1.43
sinusitis	12	511	16	535	0.39	0.79	0.35 -	1.77
bronchitis	183	340	179	372	0.75	1.12	0.86 -	1.45
asthma	9	514	22	529	4.94*	0.42	0.18 -	0.97
pneumonia	63	460	74	477	0.46	0.88	0.61 -	1.28
watery eyes	83	440	74	477	1.28	1.22	0.85 -	1.73
dry throut	115	408	92	459	4.83*	1.41	1.03 -	1.93
headache	182	341	168	383	2.27	1.22	0.93 -	1.58
fatigue	198	325	154	397	11.96*	1.57	1.21 -	2.05

*$p<0.05$

Old mattresses are mostly associated with respiratory symptoms (nasal congestion, nasal secretion, dispnea, wheezing, and cough), bronchitis, and nonspecific symptoms (watery eyes and dry throut). Table 7 shows statistical significance of differences between exposure to biological agents from old mattress and children's health.

Table 7. Exposure to biological agents from old mattresses (more than 7 years old) and its influence on children's health

Symptoms and diseases	exposed		nonexposed		χ^2	OR	CI	
	Yes	No	Yes	No				
nasal congestion	211	40	616	207	9.22*	1.77	1.20 -	2.62
nasal secretion	151	100	407	416	8.83*	1.54	1.15 -	2.08
dyspnea	48	203	96	727	9.22*	1.79	1.20 -	2.66
wheezing	90	161	230	593	5.75*	1.44	1.06 -	1.97
cough	64	187	142	681	8.43*	1.64	1.16 -	2.33
sinusitis	9	242	19	804	1.24	1.57	0.65 -	3.72
bronchitis	99	152	263	560	4.82*	1.39	1.02 -	1.88
asthma	10	241	21	802	1.41	1.58	0.69 -	3.59
pneumonia	37	214	100	723	1.16	1.25	0.82 -	1.91
watery eyes	56	195	101	722	15.53*	2.05	1.41 -	3.00
dry throut	61	190	146	677	5.32*	1.49	1.05 -	2.12
headache	85	166	265	558	0.24	1.08	0.79 -	1.47
fatigue	86	165	266	557	0.33	1.09	0.80 -	1.49

* $p<0.05$

DISCUSSION

We identified the significant effects of exposure to biolodical agents on exposed children health in this study.

Biological agents in pets did not have any impact on children's health in our investigation. Nasal congestion proved to be only a symptom. This symptom can be a part of allergic rhino conjunctivitis which occurs more often in children who keep pets [7]. Results of other studies show that dogs and cats have the strongest impact on health. In our case the largest numbers of children have kept birds. It was probably the reason for discrepancy in results.

The great part of total indoor biological air pollution, besides pets, have insects, rats, and dust mites. It has been established that excrets of insects and rat, as well as their body parts have significant allrgen characteristics [8,9]. A domestic cockroach is consired an important source of indoor aeroallergens worldwide. Results of this investigation show that presence of insects and rats in children's home is a very important risk factor in all examined symptoms and respiratory diseases (sinusitis and bronchitis). Increasing prevalence of asthma has not be established, but symptoms

caracteristic of asthma (wheezing, dyspnea and cough) have been more frequent in the exposed children. Recent studies have suggested that the increased morbidity and mortality, when asthma and allergies are concerned, may be due to the increase in exposure to allergens in the modern indoor environment. Indoor allergen exposure is recognised as the most important risk factor for asthma in children [8,9].

Investigation in New England has showed that cockroaches in homes have been the cause of asthma in children three times more as much as those who have not been in contact with them [10]. Litonjua at al [11]. have established that exposure to cockroach allergen early in life may contribute to the development of asthma in susceptible children.

Major allergen in house dust derives from mites. Mites allergens are ususally air-borne and are found mostly in beds, soft furniture, and carpets. Therefore, studies have confirmed that the environmental control of allergens should be an integral part in the menagment of sensitive patients. [5].

Our investigation has established that respiratory and nonspecific symptoms are more frequent in children, who have been in contact with textiles. Jakkola et all [12] have also examined the impact of textiles on respiratory simptoms and established that the risk of bronhial obstruction was 1,58 (CI-0,98 to 2,54).

Mattresses are of great importance because they can contain from several thousands to milions of mites. Duration of using a mattress is very important. Older mattressess can contain more mites [10]. Children, who sleep on an older mattress (more than seven years old) had more prevalence for all respiratory symptoms, bronchitis and nonspecific symptoms (watery eyas and dry throut).

REFERENCES

1. Carrer P, Maroni M, Alcini D, Cavallo D. Allergens in indoor air: environmental assessmfgent and health effects. Sci Total Environ 270:33-42, 2001.
2. Fung F, Hughson WG. Health effects of indoor fungal bioaerosol exposure. Appl Occup Environ Hyg 18:535-44, 2003.
3. Meklin T, Husman T, Vepsalainen A. et al. Indoor air microbes and respiratory symptoms of children in moisture damaged and reference schools. Indoor Air 12:75-83, 2002.
4. Evans J, Hyndman S, Stewart-Brown S, Smith D, Peters S. An epidemiologycal study of the relative importance of damp home to relation to adulth health. J Epidemiol Community Health 54:677-86, 2000.
5. Bălan G. Quality of interior air: biological contaminants and their effects on health; bioaerosols and gathering techniques. Bacteriol Virusol Parazitol Epidemiol. 52:15-8, 2007.
6. Dales R, Liu L, Wheeler AJ, Gilbert NL. Quality of indoor residential air and health. CMAJ 179:147-52, 2008.
7. Carrer P, Moscato G. Biological pollution and allergic diseases. G Ital Med Lav Ergon 26:370-4, 2004.

8. Pearce N, Douwes J, Beasly R. Is allergen exposure the major primary cause of asthma? Thorax 55:424-31, 2000.
9. Boner AL, Bodini A, Piacentini GL. Environmental allergens and childhood asthma. Clinical and Experimental Allergy 28:76-81, 1998.
10. Van Wijnem JH, Verhoeff AP, Mulder-Folkerts DKF, Brachel HJH, Schou C. Cockroach allergen in house dust. Allergy 52:460-64, 1997.
11. Litonjua AA, Carey VJ, Burge HA, Weiss ST, Gold DR. Exposure to cockroach allergen in the home is associated with incident doctor-diagnosed asthma nd recurrent wheezing. J Allergy Clin Immunol 107: 41-7, 2001.
12. Jaakkola JJ, Nafstad P, Magnus P, et al. Interior surface materials in the hme and the development of bronchial obstruction in zoung children in Oslo, Norway. Am J public Health. 89:188-99, 1999.

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MILITARY USE OF DEPLETED URANIUM AND ECOLOGICAL CONSEQUENCES FOR KOSOVO SITES

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ABSTRACT

War conflict in FRY in 1999 attracted attention of the world public including, among other things, worries referring to the danger caused by use of ammunition filled with depleted uranium used the by the NATO forces. The use of such ammunition can be regarded as an ecological catastrophe, with long lasting effects both on the population and the environment. Having taken the issue of our environment into consideration, it is clear that ecological recovery of soil presents a challenge for a larger region of the Balkans, as it will present serious risk for peoples lives in case it is not properly dealt with .

Key words: Depleted uranium, ecological consequences, monitoring

INTRODUCTION

Depleted uranium (DU) is a by-product of crude uranium separation. Thousand tons of the nuclear waste had been accumulated in landfills for decades, and since seventies of the last century DU have been used in military industry for filling of the missiles. Almost twice as dense as lead (19,06 g/cm^3, to 11,3 g/cm^3) missiles filled with DU easily penetrate the domes of the modern tanks and other armoured vehicles. Due to their great penetrating power this type of ammunition is called a "silver bullet". Apart from its apparent "efficiency", another reason for using DU for filling the missiles is, no doubt, the fact that its costs are practically none.

This type ammunition was also used by the NATO alliance during the wars in the nineties (Iraq, Bosnia, FRY) as a powerful anti-tanks weapon.

DU was extensively used by the US forces during the Gulf War. Apparently this is the only conflict where large DU projectiles were fired from tanks. The Air Force fired 783.514 rounds of 30 mm DU ammunition corresponding to 259 tons of DU. The Army fired 9.522 DU tank rounds, corresponding to approximately 50 tons of DU and the Marine aviation expended DU ammunition corresponding to about 11 tons of DU. [1]

During the war conflict in Bosnia and Herzegovina, NATO bombarded the surroundings of Sarajevo with almost 11000 missiles, that is 3 tons of DU.

Finally in 1999, the airplanes A-10 in Kosovo, fired about 30000 bullets, which makes around 10 tons of DU.

During the bombardment campaign on FRY a quality of environment was seriously affected especially in the territory of Kosovo and Metohija such as follows: considerable harm to the health of the population, disturbance of environment equilibrium, pollution of soil, air, water and underground water currents, flora and fauna damage, degradation of natural eco-systems and biodiversity, in general. It is certain that the effects of the DU bombardment can be long lasting ones and that they caused considerable danger for the environment, not only at the local but also regional and global level.

MILITARY USE OF DU

In the beginning of the seventies of the last century, American army began a research on the possibility of using substance of greater density for military purposes. Possibilities of using DU and wolfram were studied. DU was chosen as more suitable one because of its availability, price and pyrophoricy. [1] DU is inserted into the top of the bullets of conventional, nonnuclear missiles. That part of the missile is called "penetrator". These missiles are covered on the outer side by aluminum jacket for the user's safety. The surface of the penetrator burns while making an impact (especially in contact with steel, due to the law point of uranium melting (1132° C). Considerably thicker than the lead (19,06 g/cm^3, to 11,3 g/cm^3) missiles filled with DU easily penetrate the domes of modern tanks and other armoured vehicles. Due to its high penetrating power this type of ammunition is called "silver bullet". The place of the impact of the missile filled with DU is characterized by a small, round entering hole. DU ammunition, caliber 30 mm, used in the NATO bombardment of former FRY, easily penetrates steel armour 10 cm of density. A bullet caliber 30 mm consists of conus DU penetrator, 95 mm in length,16 mm diameter and 280 g of weight. This penetrator is fixed to the aluminum ("jacket") 30 mm in diameter and 60 mm of length [1] (Figure 1*)*. American fighting planes A – 10 ("tank killers"), used in the NATO campaign in FRY were equipped with weapons firing 3900 bullets per minute. When the penetrator hits the target, due to its high penetration power and law point of melting of uranium, the bullet easily penetrates the armour, breaks down and starts burning with enormous energy emission, thus causing its own decomposition into a great number of tiny grains (fine dust – aerosol), which are dispersed into the atmosphere.

Figure 1. PGU-14 (Armour Piercing Incendiary)

ENVIRONMENTAL CONSEQUENCES OF DU USE

After the attack by DU-missiles, DU will be stored on the surface in the form of dust, metal pieces or in the form of oxide uranium powder, if the penetrator gets burned. It is estimated that one third of the penetrator, when hitting the target transforms into dust (uranium and its oxides), covering the soil and the objects .Stored particles move easily, the wind carries them for kilometers contaminating the environment. However, the highest concentration of DU is stored up to 100 m from the target hit. A majority of penetrators which miss the target, usually penetrate the soil intact up to the 50 cm in depth, where they can stay for a longer period. In such case, a small percentage of DU passes into a phase of dissoluble aerosols. Metal uranium will be found in the soil where reaction with water is possible. Depending of the geological situation, the pollution of underground waters is quite probable. The depth of penetration into the soil depends on the chemical composition and the characteristics of the soil (porosity, humidity, pH etc.). Thus, in sandy soil DU from the penetrator easily "moves", due to the weather conditions (showers, snow melting etc.) and in such a way underground waters may be contaminated. If the main ingredient of the soil is clay or organic matter, the mobility of uranium dust is considerably reduced thus making environment pollution less possible. The pollution of underground waters due to the decomposition of whole penetrators or their large parts presents a potentially big ecological problem. [2]

CHEMICAL PROCESS OF THE TRANSPORT OF DU IN SOIL AND UNDERGROUND WATER

When the penetrator hits the target it breaks and starts burning. As metal uranium has thermal-chemical instability in terms of oxide forms U (IV) and U (VI), it is

clear that when contacting the earth atmosphere oxide uranium will be created. Primary product of oxidation is U (IV)-oxide, UO_2. Further oxidation leads to the mixed U (IV) and U (VI)-oxides. Uranium gained by water falling off the fragments and dust of DU transferred to the soil or water appears as uranyl (U_2^{2+}) ion.

Migration of uranium depends on physical and chemical properties of soil and water, as well as oxidation products OU. Mobility of dissolved uranium will depend on pH values and presence of certain complex compounds in underground waters. In these complexes carbonates and phosphate are usually found as ligands. Uranium (VI) is more mobile than uranium (IV),which is explained by considerably higher solubility of U (VI)-compounds. Dissolved uranium (VI) easily makes complex compounds with OH^-, CO_3^{2-}, PO_4^{3-}, F^-, SO_4^{2-} and some organic ligands. These reactions lead to the reduction of the uranium concentration in the underground and surface waters. In pH values lower than 4, uranyl ion is present in the complex with fluoride ligand. If pH value is between 4 and 7,5 uranyl ion makes complexes with phosphates and with higher pH values with carbonate ligand. [3]

Decomposition of the remaining penetrator mainly causes corrosion and hydrated UO_3, highly soluble in water. Acid soil reduces concentration of uranium in the soil. Also, the soil with a high quantity of carbonate has the least concentration of uranium, due, probably, to the forming of very soluble uranyl carbonate. Also, uranyl ion ties to many iron minerals which considerably reduces uranium migration through the soil. [4]

Dissolved uranium in water currents will find its way through the ground to the underground water. The quality of uranium which enters underground waters dictates a degree of contamination of water currents. Normal concentration of uranium in underground waters is 0,1 – 12 mg/l.

TEST RESULTS OF UNEP IN KOSOVO

In November 2000, a field mission of UNEP-a (UN program for the protection of environment) visited 11 of 112 sites in Kosovo, hit by ammunition with DU. This team, consisting of 14 scientists from several countries, collected soil, water and plant samples and did the testing of the samples taken from the buildings, destroyed army vehicles and remaining DU bullets. The total sum of 355 samples was analyzed as followed: 249 soil samples, 46 water samples, 37 plant samples, 13 samples taken from buildings and vehicles, 3 samples of milk, 4 jackets (parts of ammunition), 2 penetrating bullets and 1 fragment of penetrating bullet. [2][3]

UNEP mission has used so called RESRAD computer code in its research, developed in Argon National laboratory. The code was designed for doses and risk estimation on the basis of measured concentration of radioactive substance in the environment. [5]

In the near vicinity of the impact a law level of radiation was detected and mild contamination caused by DU dust near the aimed targets. Beside U-238 isotope, which makes up the largest part of DU, penetrators consisted of both isotope of uranium U-236 and isotope plutonium Pu-239/240. According to the results of UNEP, a quantity of

trans-uranium isotope is very law and does not have to be of an importance in terms of its overall radioactivity.

In addition, according to UNEP, a widely spread contamination was not found in areas covered by the research. Therefore, respective chemical and radiological risks are not of considerable importance.

Results of the field research of UNEP mission in Kosovo, point to the fact that the majority of 10 tons DU penetrators ended deep in the soil. One of the possible effects which DU could have on the local population is an increase of uranium concentration in water, due to the decomposition of the penetrator and its presence in the water currents. Data from the USA tests point to the fact that each penetrator could, in soft soil penetrate to 7-8 metres of depth and each of them could contaminate 1 m^3 of soil. Having taken into account that the depth of the tested underground waters in tested locations in Kosovo is 2 - 25 metres, it is clear that there is a high possibility of water contamination. In these considerations, processes in nature which could slow down the transport of uranium (hydro-meteorological processes and composition of the soil) must be taken into account.

Research results show that the DU particles can be detected in the soil samples and in sensitive biological indicators such as lichens or fungi.

According to the warnings of the Serbian experts, there is an attempt of reducing the evident danger to some already recognized and harmless parameters, in the conclusions of UNEP report.

Representatives of UNEP mission, in their report, admitted existence of considerable scientific ambiguities, especially in the case of water safety. The remaining penetrators and jackets several metres hidden under the earth, as well as those above it, present a risk of future DU contamination of underground waters as well as tap water.

CONCLUSION

The use of DU ammunition can be considered as an ecological catastrophe, with long-lasting and unpredictable effects on the population and the environment. As far as our environment is concerned, it is certain that ecological recovery today, presents a challenge of a wider region of the Balkans, and if the problem is not solved soon the whole area will become of a great risk for peoples` lives.

Decontamination procedure should contain an elaborate research and the removal of the remains of the DU ammunition jackets. At least half a metre of surface layer of contaminated soil should be removed and stored in protected containers. The only way of removing DU is by continuous effects of rain and snow melting. Therefore, it would probably take several hundred of years before the contamination ceases

All locations identified as DU bombardment targets were decontaminated and recovered by 2002. But monitoring of DU effects on the environment should be continued in future for a long time. It is necessary to conduct a continous monitoring of radiation of the very locations and their surroundings following the elaborate Programe of radioactivity testing (water and soil samples, bioindicators – lichen and moss, food and the like).

REFERENCES

1. Bleise A., Danesi P. R., Burkart W., Properties, use and health effects of depleted uranium (DU): a general overview, Journal of Environmental Radioactivity 64 (93 – 112), 2003.
2. UNEP, Depleted Uranium in Kosovo, Geneva, 2001.
3. UNEP / UNCHS Balkans Task Force, DU Report, 1999.
4. Erikson R. L., et al. A review of the environmental behavior of uranium derived from depleted uranium alloy penetrators, Washington, 1990.
5. Yu C., et al. Data collection handbook to support modeling impacts of radioactive material in soil, Argonne National Laboratory, Illinois, 1993.

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HEALTH EFFECTS OF DEPLETED URANIUM IN THE AREA OF NORTHERN KOSOVO

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ABSTRACT

The very fact that during NATO bombardment of Kosovo and Metohija ammunition with depleted uranium (DU) was used is of considerable importance in the case of an increased number of malignant diseases in the post-war period. This research refers to the period of time from 1997 to 2008. The pre-war period has been taken into consideration in order to compare numbers of the diseased in the period before the use of ammunition with DU and the period after its use. This research was carried out on 30.000 patients hospitalized, during the period stated, in seven wards of Health Centre in Kosovska Mitrovica.

Key words: depleted uranium, radiation, malignant disease, consequences

INTRODUCTION

Depleted uranium (DU) is a by-product of the uranium enrichment process and presents a very dangerous nuclear waste. [1] About one hundred tons of this waste was kept in special storehouses until the beginning of the seventies in the last century, when it was used for ammunition, primarily aimed against armoured vehicles.

The DU missiles were used during bombardment campaign in FRY in 1999. On such occasion 112 locations (mainly in the territory of Kosovo) were hit with approximately 13 tons of DU. According to the reports of the NATO alliance leaders, the largest number of the missiles filled with DU was used in the territory west of Peć – Djakovica – Prizren road in the surroundings of Klina and in the territory of Prizren, Uroševac and Suva Reka municipalities (Figure 1). Places in near vicinity of Kosovo (four locations in the municipalities of Bujanovac, Preševo, and Vranje) and one location in Montenegro were also bombarded. DU is inserted into the tops of the conventional, non-nuclear missiles. Having being almost twice as much thicker than the lead (19,06 g/cm^3, to 11,3 g/cm^3) missiles filled with DU easily penetrate the domes of modern tanks and other armoured vehicles. The missiles filled with DU break when hitting the target start burning, thus causing its dissolution into a great number of tiny grains (fine dust – aerosol), which are dispersed into the atmosphere. These particles can

have a form of air suspension, when inhaled or swallowed they enter an organism, where they accumulate in the organs such as kidneys, liver or spleen. An individual contaminated in such a way gains a continuous source of radiation in his organism, which as a rule has catastrophic consequences. Emission of DU creates ionic pairs, which among other things destroy genetic material which is transferred onto the descendents. DU and its products of dissolution emit both *alpha* and *beta*-radiation, as cancer carriers they can damage lung, bone, kidney, prostate, intestines and brain cells causing cancer in these organs. After inhaling DU is dissolved and transferred from the lungs into other organs including liver, fat and muscles. It is finally excreted via kidneys, where being a heavy metal it causes nephritis, a chronic kidney disease. [2]

A research under the conduct of Medical section of SANU (Serbian Academy of Sciences), was presented in 2005. Points to an alarming number decrease of births and simultaneously, a considerable number of abortions. Also, another conclusion of the same research points to a considerable increase in number of malignant diseases as well as tumors of both benign and malign nature. Thus, a number of tumors of uterus cervix and ovaries increases from 26 to 496. A number of dead, premature born children has been increased from 50 to 357, a number of children with malformations from 121 to 610. [3] There is a similar situation with other kinds of malignant diseases.

Malignant diseases are diseases with a highest percentage of lethal outcome. History of malignant diseases is not well known, but risk factors which have effects on a higher incidence of malignant diseases (radiation, smoking) are known. During the NATO bombardment of Kosovo and Metohija ammunition with DU is used, which can be regarded as a considerable factor of malignant diseases number increase.

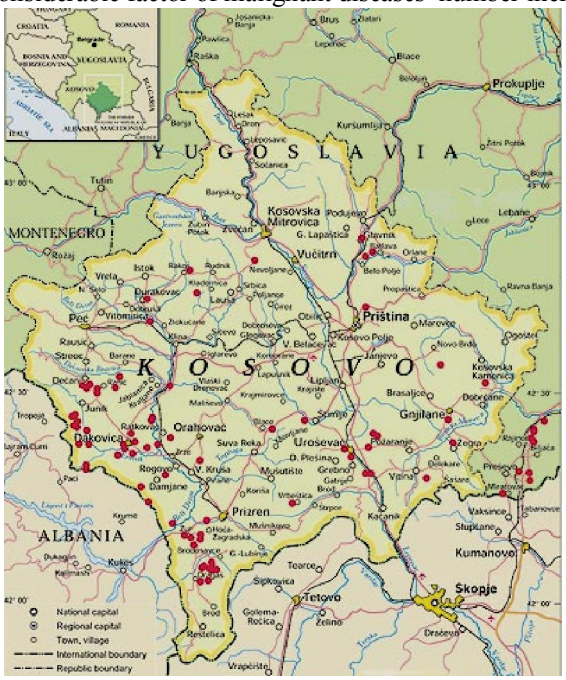

Figure 1. Locations identified as DU ammunition target

This research comprised population of Northern part of Kosovo and Metohija i.e. mainly Serbian population. War capable population from this region participated in the army formations in the district of Peć (a territory which suffered most severe attacks by ammunition filled with DU). An average age of this population group is between 30 and 40.

MATERIAL AND METHODS

The aim of this research is a numerical data processing of malignant diseases frequency in the observed population as well as determination of basic epidemiological characteristics of malignant patients via diagnostic and therapeutic treatment.

A period of time between 1997 and 2008.was under our observation. The pre-war period was taken into consideration in order to compare a number of the diseased in the period before the use of DU ammunition and the period after its use. A clinical, prospective, retrospective and numerical research was undertaken. The diagnostic procedure is based on laboratory analyses, x-ray and ultra-sound findings.

RESULTS AND DISCUSSION

The research comprised 30.000 patients, hospitalized in some of the seven wards of Health Centre in Kosovska Mitrovica. Table 1 shows years when the research was conducted and a percentage of the patients with malignant diseases.

Table 1. Percentage of the patients, suffering from malignant diseases, treated in Kosovska Mitrovica Hospital

WARD	1997	1998	1999	2000
ORTHOPEDICS	0.6	0.3	0.2	1.3
PEDIATRICS	0.4	0.3	0.3	0.5
GYNECOLOGY	2.6	1.6	1.0	3.6
SURGERY	1.3	2.6	3.8	3.4
PNEUMOPHTISIOL	2.6	1.7	4.0	22.0
UROLOGY	1.6	3.9	3.1	16.0
INTERNAL DISEASES	1.1	1.2	1.8	2.1

From the reasons stated above one can conclude that a number of malignant diseases in the territory of Northern Kosovo drastically increased after the NATO bombardment campaign.

An increase in number of malignant diseases circles to the extent of 2 to 10 times.

Our epidemiological data points to an increase in number of malignant diseases in patients of 30 to 45 years of age, while in the previous periods the most jeopardized age groups were in the range of 65 to 75 years of age (Figure 2 and 3). About 30% of the diseases end lethally (Figure 4).

The basic reason of such increase in number of malignant diseases can be found in an increase of radiation and the stress in the whole territory of Kosovo and Metohija. As a proof of this assertion, an occurrence of malignant diseases in children in 2002 can be

used. A frequent occurence of malignant diseases of hematopoeses organs in children was observed, as well as abortion occurence due to the degenaration of the fetus. Among increasing malignant disesaes cancer of lungs, cancer of colon, prostate in men and cancer of uterus cervix and cancer of breast in women are the most frequent ones.

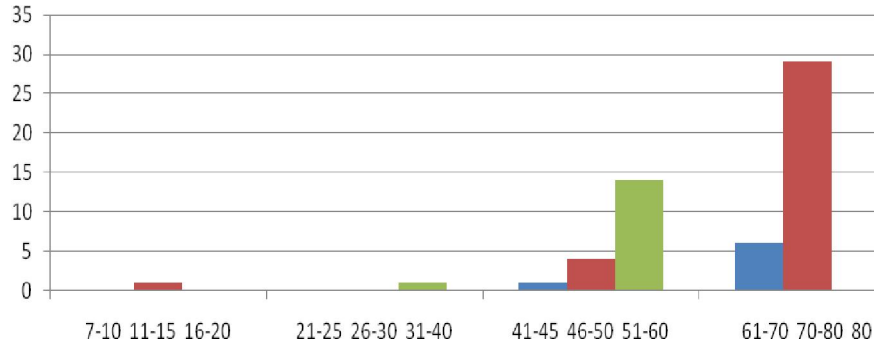

Figure 2. The patients age breakdown – 2004

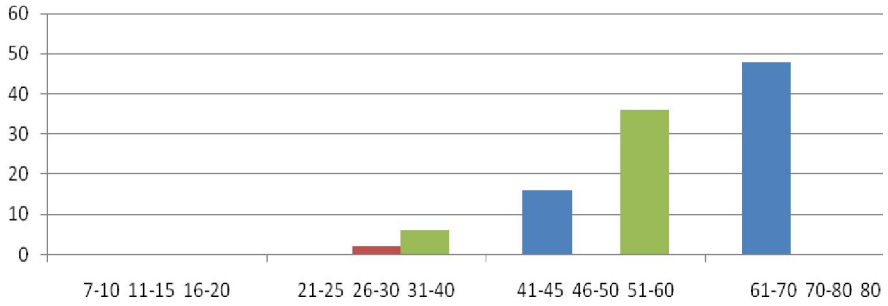

Figure 3. The patients age breakdown – 2006

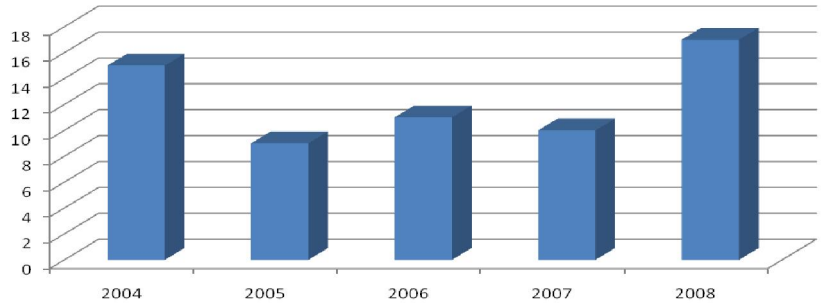

Figure 4. Number of th+e malignant diseases with the deadly outcome in period from 2004 – 2008

CONCLUSIONS

On the basis of this research an evident increase of malign deseases has been proved, with tendencies of increase in coming years, due to the long lasting effects on the population which lives in the areas where the ammunition with DU filling was used. It is also proved that the most risk groups consist of male popilation of Northern Kosovo, which participated in army formations in the area of Pec district (a teritory which suffered the worst devastation by the ammunition filled with DU).

The population has been advised to undertake regular health checks, at least annualy, with special emphasis on the war participants.

REFERENCES

1. Rajković Miloš B., Hemijska industrija, **55** (167) 2001.
2. Helen Caldicott, Global Research by Helen Caldicott, Centre for research on globalization (org) Montreal, Ca., 2009.
3. Medicinska sekcija SANU, „Reproduktivno zdravlje u Srbiji od 1989. do 2001. godine", Balkanski simpozijum o tumorima, 2005.

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EXPOSURE TO OUTDOOR AIR POLLUTION AND EFFECTS ON SCHOOLCHILDREN'S GROWTH

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ABSTRACT

The aim of this paper was to determine relationship between ambient air sulphur dioxide and black smoke lasting exposition and occurrence of low height-for-age and underweight in schoolchildren. In this retrospective cohort study pupils aged 11-14 y (n=354), non-smokers, were studied. There was no statistical significant difference between children's short stunt and air pollution exposition (p> 0,05), but we found difference between underweight among children from two group ($\chi 2$ = 4,156, p> 0,05; OR = 2,4). It could be supposed that these findings should be associated with increased respiratory morbidity of exposed children and need to be investigated more detailed.

Key words: air pollution, schoolchildren, growth

INTRODUCTION

Respiratory diseases morbidity is increased among urban children [1–3]. One hypothesis to explain this phenomenon is that exacerbating environmental factors, like exposure to air pollution, indoor allergens and environmental tobacco smoke, are more prevalent in the urban environment [4]. Less is known about the association between air pollution exposure and the continuing process of growth and development, that one of the most important characteristics in childhood.

The aim of this paper was to determine relationship between ambient air sulphur-dioxide and black smoke lasting exposition and occurrence of low height-for-age and underweight in schoolchildren.

SUBJECTS AND METHODS

The sample consisted of 354 children (aged 11-14 years), living in Nis. The group of exposed children (n=215), attended school in a city area with a high level of outdoor air pollution (School 1), while the children (n=139) of the comparative group, designated as the non-exposed group, attended school in an area with a lower level of outdoor air pollution (School 2). School 1 is located in an urban area with major traffic

roads surrounding the school building and School 2 in a residential area, far from the main street. All children lived in the areas close to the schools and at a distance of 0.5km from the measuring site. The exclusion criteria were any acute or chronic illnesses and residence within the studied area for less than 10 years prior to the study.

The ambient level of sulphur dioxide and black smoke concentrations was obtained from data basis of Public Health Institute, Niš (Serbia). The laboratory experiments on sulphur dioxide and black smoke were done according to the Regulation of Guideline Values of Imission (Official Register Republic of Serbia 54/92) [5].

The original structured questionnaire is used to collect information from the parents (98% of whom were mothers) on demographic characteristics and home characteristics.

The trained healthcare worker performed anthropometric measurements using a standardized procedure [6]. The procedure was approved by the Regional School Authorities of Niš (Serbian Ministry of Education). Anthropometric measurements: the standing height (in centimeters) measured by anthropometer and weight measured on the electronic scale (with a precision of 100g) were performed in lightly dressed children and parents, without shoes. The body mass index (BMI) calculated as weight in kg divided by square of height in m^2. According to the WHO guidelines, low height-for-age were defined by the 5^{th} percentile and underweight as body mass index below 15 kg/ m^2.

The investigation was done in 1998 year.

Statistical analyses were performed by using Epiinfo 6 and Microsoft Excel programs.

RESULTS

The characteristics of investigated subjects are presented in table 1.

Table 1. Characteristic of study group according to their age and sex

Age(y)	Exposed		Non-exposed		Total
	Boys	Girls	Boys	Girls	
11 - 12	33	27	29	20	109
12 - 13	28	26	26	27	107
13 - 14	25	30	13	11	79
14 - 15	15	31	5	8	59
Total	**101**	**114**	**73**	**66**	**354**

Table 2 shows that the statistically higher levels of sulphur dioxide in the outdoor air were determinated at the measuring spot at School 1.

Table 2. Statistically significant differences between mean annual concentrations ($\mu g/m^3$) of sulphur dioxide at two measuring sites

Year	Number of measurements	School 1 ($\overline{X}$ 1)	Number of measurements	School 2 ($\overline{X}$ 2)	t	p
1987	327	106	316	35	12,675	< 0,001
1988	324	137	342	31	23,428	< 0,001
1989	319	67	326	49	2,363	< 0,05
1990	315	59	339	46	2,434	< 0,05
1991	333	38	154	53	-3,312	< 0,05
1992	295	23	286	17	0.882	< 0,05
1993	292	150	304	36	16,474	< 0,001
1994	226	293	230	43	13,649	< 0,001
1995	338	50	339	28	9,129	< 0,001
1996	336	38	342	28	4,141	< 0,001

The similar situation was with black smoke in the air at two measuring sites (table 3).

Table 3. Statistically significant differences between mean annual concentrations of black smoke ($\mu g\ g/m^3$) at two measuring sites

Year	Number of measurements	School 1 ($\overline{X}$ 1)	Number of measurements	School 2 ($\overline{X}$ 2)	t	p
1987	335	12	324	9	2,101	< 0,05
1988	324	13	345	8	4,058	< 0,001
1989	320	11	326	7	2,392	< 0,05
1990	315	11	339	8	2,014	< 0,05
1991	343	11	152	10	0,545	>0,05
1992	293	7	285	7	-	-
1993	303	5	319	4	-1,526	>0,05
1994	227	5	230	5	-	-
1995	340	5	339	6	-1,334	>0,05
1996	336	4	341	4	-	-

There were no statistically significant differences in parents' smoking habits, parental education level, density of habitation and mode of heating between the two groups (Table 4).

Table 4. Home environment characteristics of examined schoolchildren

Home environment	**Exposed (n=215)**	**Non-exposed (n=139)**	**Significance**
Parental education level [b] Elementary Above elementary	 15% 85%	 31% 69 %	 n.s.
Parental smoking habit [b] YES	 43%	 45%	 n.s
Density of habitation [a] (person/room) mean ± SD	0.82 ± 0.32	0.88 ± 0.29	n.s.
Wood or coal heating [b]	20.0%	15.8%	n.s.

a t-test; b chi-square test; n.s.-no statistically significant

Table 5 show relationship between air pollution exposure and low height-for-age occurence in the investigated children**.**

Table 5. Occurrence of low height-for-age in children and ambient air pollution exposition

Thinness	Exposed		Non-exposed	
	n	%	n	%
Yes	6	2.8	209	1.4
No	2	1.4	137	99.6
Total	8	2.2	346	100

* n.s.-no statistically significant, Fisher-test($p>0.05$)

According to our data, children exposed to higher concentrations of sulfur dioxide and black smoke in the air do not have a significantly higher risk for the development of a lower height-for-age comparing to children from the control group.

Table 6 show that underweight was more present in the exposed group of children of both sexes.

Table 6. Occurrence of underweight in children and ambient air pollution exposition*

Thinness	Exposed		Non-exposed
	n	%	n
Yes	21	9.76	194
No	6	4.32	133
Total	27	7.62	327

*$\chi 2=4.156$, $p< 0,05$

Based on these results, exposure to air pollution containing sulfur dioxide and black smoke, and underweight of children aged 11 to 14 years are not independent phenomena.

DISCUSSION

It is well known that air pollution has many effects on the health of both adults and children. However, few studies have investigated impact of the air quality on the children's growth [7-9].

The previous study conducted in Poland found that the growth rate of children living in a highly polluted area was 1.5 cm lower than in a control area [10]. Bobak et al. found that children's height was inversely associated with air pollution, but the magnitude of the effect depended on age [7]. Both those studies are consisted with the result of our study in broader context.

The lack of published data on this issue is surprising, because a large number of studies collected data on children's height to adjust for height in analyses of lung function. While it is possible that researchers in the past did not explore the relationship between height and air pollution, it is more probable that such analyses were done but produced negative results, and were not reported.

This investigation suggest that a child's growth characteristics is not related so much to postnatal exposure to higher air pollution in the residence area. We only found that ambient air higher levels of sulphur dioxide and black smoke was significantly associated with increased prevalence of underweight among exposed children in Niš. It could be supposed that these findings should be associated with increased respiratory morbidity and anemia [12] of exposed children, reflected in their appetite and consequently in body weight and need to be investigated more detailed.

The potentially harmful growth effects of outdoor air pollution children should receive considerable attention in next years. Further study is needed to disentangle this interaction and the underlying mechanisms. The results of the study were limited by the short period of the examination and the relatively small number of observed subjects. It is most probably that those results are in accordance with recorded concentrations of pollutants. According to literature data , suspended particles and black smoke in the air, have more damaging effects on the bone system than sulfur dioxide and the measured values of black smoke in the air in our study were below the limit values of emission at both measuring points. Also, high concentrations of sulfur dioxide that children were exposed were moderately high. Our results can be explained by the fact that we didn't investigate the bone maturity and that, except environmental factors, genetic factors and nutrition determine children growth, development and nutrition to a large extent.

We hope that our already started examinations with larger sample of children will result in more precise evidence.

Taking into account the fact that there are cities in Serbia where measured pollutant concentrations were higher in comparison to Niš, it is necessary to perform epidemiological studies in these cities, too.

Still, antropometric measurements are of a special significance during adolescence period, because they make it possible to monitor and evaluate changes in growth, development and maturation, and are recommended for further research and development of growth failure in children living in contaminated areas. Low height-for-age on the population basis points to growth restriction and is most often related to socioeconomic and environmental conditions and poor feeding habits.

CONCLUSION

It can be concluded that even relatively low levels of urban air pollution have negative impact on the children's anthropometric characteristics and are hazardous to the children's health.

In this study we found that children exposed to sulphur dioxide and black smoke had an elevated prevalence of underweight, but the relatively low levels of mentioned air pollutants had no impact on children's height.

Acknowledgement

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REFERENCES

1. Cloutier M, Wakefield D, Hall B, Bailit H. Childhood asthma in an urban community: prevalence, care system and treatment, Chest 2002; 122: 1571–1579.
2. Castro M, Schechtman K, Halstead J, Bloomberg G. Risk factors for asthma morbidity and mortality in a large metropolitan city. J Asthma 2001;38:625–635.
3. L.J. Akinbami and K.C. Schoenderf, Trends in childhood asthma: prevalence, health care utilization and mortality. Pediatrics 2002;**110**: 315–322.
4. Kattan M, Mitchell H, Eggleston P, Gergen P, Crain E, Redline S. et al. Characteristics of inner-city children with asthma: the National Cooperative Inner-City Asthma Study, Pediatr Pulmonol 1997;24:253–262.
5. The Regulation of Guideline Values of Imission (Official Register Republic of Serbia 54/92).
6. Report of a WHO Expert Committee, Physical status: the use and interpretation of anthropometry. In: Proceedings (WHO: Geneva, 1995).
7. Bobak M, Richards M, Wadsworth M. Relation between children's height and outdoor air pollution from coal-burning sources in the British 1946 birth cohort. Int Arch Occup Environ Health 2004;77(6):383-6.
8. Vinokur IL, Gil'denskiol'd RS, Gus'kov GV, Kir'ianova IS, Karagodina IL, Bobyleva OV, et al. [Anthropotechnogenic burden in urbanized territory and population's health].Gig Sanit. 1997;(6):49-52.
9. Nikić D, Bogdanović D, Nikolić M, Stanković A, Zivković N, Djordjević A. Air quality monitoring in NIS (SERBIA) and health impact assessment. Environ Monit Assess. 2009;158(1-4):499-506.
10. Nikolić M. Sumpor-dioksid i čadj kao faktori rizika po zdravlje dece. Magistarski rad, 2000. Medicinski fakultet u Nišu
11. Jedrychowski W, Maugeri U, Jedrychowska-Bianchi I. Body growth rate in preadolescent children and outdoor air quality. Environ Res. 2002; 90(1):12-20.
12. Nikolić M, Nikić D, Stanković A. Effects of air pollution on red blood cells in children. Polish J Environ Stud 2008; 17(2): 267-271.

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HYGIENIC AND ECO-FRIENDLY SANITATION OF ANIMAL CEMETERIES USING ENZYME-BACTERIAL PREPARATIONS

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ABSTRACT

Hygiene maintenance of animal cemeteries is an outstanding problem, since it represents a potential source of infection, because remains of deceased animals are being deposited there. Treatment by chemical means (lime and sulphuric acid) will destroy pathogenic microoranisms, but there is a risk of pollution of groundwater aquifer.

One of the solutions according with EC Directives about environmental protection is application of enzymatic-bacterial preparations, which are very effective in destroying pathogenic microorganisms while significantly speeding process of removing bad odors, mineralization and regeneration in natural circumstances, with effective environmental protection. This paper represents an overview of the mentioned products, technological data about the application and achieved results.

Key words : enzymes, bacteria, micro-organisms, sanitation, regeneration

INTRODUCTION

New scientific findings gave very good results in this field. One of the solutions in accordance with EC Directives on environmet protection lies in the application of enzymatic-bacterial preparations, whose use is very effective in distroying patogenic micro-organisms with multiple accelation of mineralization in antural conditions, and effective environment protection. All enzyme-bacterial preparations are suitable for the environment and do not contain harmful ingredients for human and wild life or genetically modified organisms, on the contrary, contains probiotic micro-organisms and enzymes suitable to human and environment. In accordance with our knowledge and experience below provides an overview of preparations, technological processes and results of the application for :

1. Hygienic sanitation and bad odor elimination,
2. Regeneration of soils saturated by animal remains and
3. Mineralization of animal remains.

All preparations will be describe in the text, have been already successfully applied in JKP Pogrebne usluge Belgrade, Funeral company Konkordija and JKP Lisje in Novi Sad.

EXISTING APPROACH TO THE REMOVAL OF ANIMAL REMAINS

Current pracitice of disposal of animal remains in the Vojvodina, and it could be said and on the whole territory of Serbia related to the disposal of animal remains on mostly wild and undeveloped animal cemeteries, or uncontrolled burial providing enable acess to people and wild animals. One part, however due to the rendering plant where the heat-treated. Incineration as another form for elimination of these organic substances, hasn't yet come to life in our region.

SANITATION METHODOLOGY OF ANIMAL CEMETERIES USING ENZYME-BACTERIAL PREPARATIONS

Biotechological processes and preparations described in this paper are combination of enzymes and selected micro-organisms which are completely gentle to human and environment. All preparations are according to EEC Directive 91 / 155 and have certificates of safety, are non aggressive, neither corrosive (moreover prevent corrosion), are non toxic so there are no additional and unknown effect. Just as selected micro-organisms, with subsequent mutation, can't change it's characteristics in order to become dangeorus to people and environment. Procedure of choice and combination of preparations in completely natural way can be acchieved exeptional results, without great capital investment but with relatively low costs.

Laboratories and teams invested a great experience and knowledge in development and the application of preparations in completely natural way, aimed at solving environmental problems especially in communal activities with the following effects :

- Hygienic sanitation and elimination of bad odor,
- Reduction of environment polluted by organic waste material,
- Cleaning of human environment on probiotic way,
- Sanitary sanitation of soile, watercourses and revitalization of contaminated soil and water incurred as a result of excessive use of chemical compounds.

Positive expert opinion on the adequacy of technology and composition of enzyme–bacterial preparations is issued by the Institute for Health Protection, Department for Hygiene and environment protection Republic of Serbia, and there are toxicological opinions issued by National Center for Toxicological control the Military Medicinal Academy.

HYGIENIC SANATION AND ELIMINATION OF BAD ODOR

Liquid biological preparation PROMOTER with a sanitising and hygienising effect, made up of enzymes and bacteria that drastically reduces odors caused by disintegration processes. Contains enzymes (Lipase, Amilase, Protease and Celulase), non-genetically modified and non-pathogenic bacteria and nutrients intended for fast elimination of bad odors generated from rotting of animal corpse. Their bactericidal action removes and prevents formation of bad odorsand is very effective against wide

range of pathogenic micro-organisms including funigie and bacteria which caused well known deseases of people and animals. Next to desinfection this preparation degrade organic waste materials and thereby preventing later problems typical for organic waste. According to EEC Directive 626/94, the work conditions of cemetery operators sharply improve with the use of this preparation.

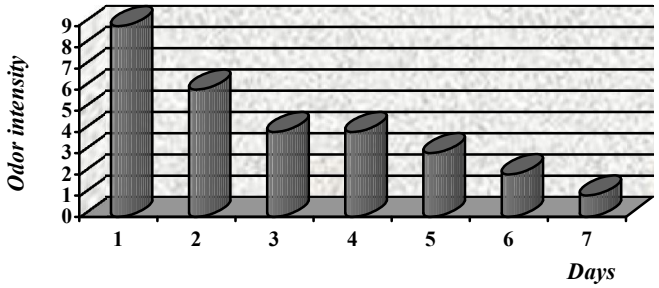

Figure 1. Display of reduction in emission of unpleasant odors

The application of this preparation has many advantages, because operators are not in direct contact under critical conditions. Advantage is obvious in the fiels of environment, because beside the effect of elimination of bad odors achieved oby preventing the spread of infections originating by pathogenic bacteria.

Recommendation for elimination of bad odors : use 10% water solution. If the intensity of bad odors is very high it's recommended use of 1:1 solution. In both cases is neccessary to distribute solution spraying over animal coprpes, as over surface which was in contact to mentioned materials.

REGENERATION OF SOIL SATURATED WITH ANIMAL WASTE

For the treatment of animal waste is use preparation ACTIVATOR as powder with complex of enzymes (Lipase, Protease, Pankrease, Pentozanase, Celulase, Pectinase, Beta-Glukanase, Hemicelulase, Alfa Amilase, Beta Amilase) and selected non pthogenic micro-organisms. This preparation is for soil regeneration which is polluted-saturated with the products of decompose corpse. The ACTIVATOR is recommended in the cases when animal remains has to be buried in pits.

This preparation accelerate :

- biodegradation process of organic mass,
- reduce bad odors, unpleasant phenomenon, pathogens and realise of ammonia and methane,
- fast degradation of organic materials and their mineralization eliminate the conditions for development of pthogenic bacteria and micro-organisms,
- the ACTIVATOR also accelerate improving characteristics of regenerated soil.

Dosage and mode of use : as powder should be apply on the bottom of animal cemetery, then on animal remains in uniform scattering by hand or by spraying with an appropriate powder diffuser.
Recommended dosage : 1 kg of Activator per cubic meter of animal materials.

Bellow is an overview of the results which indicate the effectiveness of ACTIVATOR as preparation for enrichment of soil with useful microorganisms.

Table 1. Results obtained before the treatment with ACTIVATOR (Microorganisms per g of soil in thousands)

DEPTH (cm)	AEROB. BACTERIA	ANAEROB. BACTERIA	AKTINO-MICETI	FUNGI	PROTOSOE	TOTAL
10-20	6.500	2.000	900	80	200	9.680
20-30	2.800	1.400	250	50	100	4.600
≥ 50	10	10	1	5	-	26
100 -150	-	0,50	-	2	-	2,50

Table 2. Results obtained 60 days after the treatment with ACTIVATOR
(Microorganisms per g of soil in thousands)

DEPTH (cm)	AEROB. BACTERIA	ANAEROB. BACTERIA	AKTINO-MICETI	FUNGI	PROTOSOE	TOTAL
10-20	25.000	3.800	4.000	220	390	33.410
20-30	10.000	3.000	2.100	120	300	15.520
≥ 50	20	25	5	5	3	58
100 -150	7	11	2	2	1	23

Overiew of the results which indicate the effectiveness of PROMOTER and ACTIVATOR in the treatment of existing and very neglected animal cemeteries near the city of Novi Sad in Serbia.

INSTITUTE OF VETERINARY NOVI SAD

- Sample type: samples after the treatment with PROMOTER and ACTIVATOR
- Sample origin : location Kać
- Number of samples : 10
- Sampling made by : Institute of veterinary Novi Sad
- Type of test: pathogenic bacterie

Hystory data:

- Condition of the sample on admission : corresponding
- Date of sample : 27.10.2010.
- Testing completed : 09.12.2010.

Department of clinical bacteriology, mycology and parasitology

Results of bacteriological testing

- Investigation of characteristics : isolation and determination of tahogenic bacteria

Testing methods
- Aerobic cultivation
- Microscopy
- Biochemical

Metric : there / there is no
Reference value : a negative finding
Values in the sample : no presence of pathogenic bacteria

DISCUSSION

Using enzyme-bacterial preparations for sanitation of existing and forming of new animal cemeteries can be expected the following positive effects :

- Fast elimination of unpleasant odors
  It's known to be just that odors attracts wild animals, which on animal cemeteries find food, and if not carried out adequate hygienic sanitation can participate in transmission of infection.
- Removal of pathogenic microorganisms
  Should be noted that preparations are very effective in eliminating of all known pathogenic bacteria (including agents of brucellosis Brucella abortis-Bang) and fungi.
- Security for workers and persons who manipulate the animal remains
  Primarilly prevents transmission of pathogenic microorganisms. As second should be noted that absence of unpleasant odors create mush comfortable environment for work.
- Accelereted regeneration and mineralization
  Enzymes and microorganisms presented in the preparations accelerate natural processes, and by that is faster degradation of organic materials, on that way is more efficient revitalization and reduction of existing volume.
- Preservation of groundwater quality
  Since the preparations do not contain agressive chemicals, or pathogenic microorganisms, they can not harm the quality of ground water. On the contrary, their bactericidal and fungicidal action can contribute reduction of pathogenic microorganisms in undergradound rivers.

CONCLUSION

It's evident that resolving issues of animal remains is constantly and extraordinary hazardous for people and environment. Therefore it's necessary to take adequate measures as soon as possible for repairs of existing and during formation of new animal cemeteries.

Application of enzyme-bacterial preparations is a modern approach which completely eliminates unpleasant odors and hazard in transmission of infection.

Regular application shows results in reduction of organic materials volume, what will enlarge life of all structures.

Needless to say that it will provide higher quality of enivironment for people and living world generally.

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AIR POLLUTION AND RESPIRATORY DISEASES: SHORT – TERM HEALTH EFFECTS

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ABSTRACT

The health effects of air pollution have been subject to intense study in recent years. In this review, we discuss the evidence of relation between short term variations in ambient concentrations of air pollution and short-term health effects of respiratory diseases. Acute exposure to environmental pollutants such as particulate and gaseous matters (black smoke, nitrogen oxides, sulphur dioxide and ozone) has been associated with a series of adverse health effects, ranging from subclinical effects to clinical respiratory symptoms, as well as emergency-room visits, hospital admissions, and mortality because of respiratory diseases.

Key words: air pollution, respiratory diseases, short-term effects

INTRODUCTION

Urban air pollution is considered a major health problem [1]. The first evidence of an association between acute exposure to increased air pollution and mortality dates back to the serious events that occurred in the Meuse Valley, Belgium (1930), and in London (1952) [2,3]. Although the concentrations of pollutants decreased substantially in many countries, the negative effects of air pollution are still an important public health problem.

Air pollution consists of gaseous and particulate-matter pollutants. The most common ambient air pollutants are black smoke (BS) and sulphur dioxide (SO_2). The development of air quality standards in many countries have been substantially decreased the levels of air pollutants derived from the burning of fossil fuels. However, the recent increase in motor vehicle traffic has produced a relative increase in the levels of new pollutants, such as ozone (O_3), nitrogen dioxide (NO_2), and fine-particulate air pollution [4].

The effects of air pollution on health have been intensively studied in recent years. Epidemiological studies on the short-term effects of air pollution have shown that patients with respiratory diseases are susceptible to the acute effects of air pollution, and have more exacerbations during periods of increased pollution. There is also evidence of acute effects of air pollutants on respiratory function, lower respiratory symptoms and

increased medication use. Acute increases in air pollutants are paralleled by increases in emergency room admissions, hospital admissions and mortality for respiratory events. In the same time, a reduction of ambient air particles concentrations resulted in a decrease of such adverse events [5].

Recent studies indicate that effects exist around and below the current national and international air quality guidelines and standards [6].

AIR POLLUTION AND SHORT-TERM HEALTH EFFECTS

Numerous epidemiological studies have shown a positive, significant relationship between the levels of air pollutants and exacerbations of airways diseases and even deaths from respiratory causes [4]. Because various measurements of particulate pollution were used, precise comparisons between the studies are difficult. Results of most of the studies suggest that a 10 $\mu g/m^3$ increase in particulate matter ≤ 10 μm (PM_{10}) resulted in less than a 1% decline in lung function. A 10 $\mu g/m^3$ increase in PM_{10} was typically associated with a 1-10% increase in symptoms such as cough, combined lower respiratory symptoms, and asthma attacks. These effects were also observed at comparable 150 $\mu g/m^3$ PM_{10} levels [7].

The European time-series analyses conducted within the Air Pollution on Health, European Approach (APHEA) study reported significant associations between daily values of SO_2 and the number of daily admissions for asthma in children, but not with asthma or chronic obstructive pulmonary disease (COPD) in adults [8,9]. In APHEA 2 project, in 8 European cities, it was found that an increase of 10 $\mu g/m^3$ in SO_2 was associated with a 0,6% (95% CI 0,0-1,2%) increase in emergency room admissions for COPD and asthma at ages 65+ years [10].

In a 10 year study in East Germany (Erfurt), a significant relationship was found between SO_2 or particulates and daily mortality. Comparing the 5^{th} percentile to the 95^{th} percentile, an increase of 23 to 929 $\mu g/m^3$ SO_2 leads to an increase in mortality of 10%, whilst 15 to 331 $\mu g/m^3$ suspended particulates causes a 22% increase [11].

The analysis of mortality data over the period 1975-1982 in Athens [12] resulted in a statistically significant effect of air pollution, which was shown to be mainly attributable to deaths from respiratory causes among the elderly [13].

The Barcelona study on emergency admissions for COPD was extended to a 5 year period. In this study, an increase of 25 $\mu g/m^3$ in SO_2 was associated with a 6% to 9% increase in emergency room admissions for COPD during winter and summer, respectively. For BS, a similar change was found during winter, although the change was smaller in summer. The association of each pollutant with COPD admissions remained significant after control for the other pollutant [14].

Several studies from the USA indicated small, statistically significant increases in mortality as a result of short-term exposure to air pollution, especially to PM_{10}. These studies use data from cities and areas with different socioeconomic, geographic and climatic characteristics, and different levels and mixtures of air pollutants. The areas include Utah Valley [15] and Steubenville, Ohio [16].

In one of the time series study providing quantitative estimates of the short-term effects of air pollution in our country, we evaluated the short-term association between

BS and SO_2 levels in urban air and the daily number of emergency room admissions for COPD in Niš. In this study, the emergency room admissions for all ages for COPD were significantly associated with previous-day level of BS and lag 0-2 (1,60% and 2,26% increase per 10 μg/m^3, respectively). After controlling for SO_2, single lagged (lag 1 and lag 2) as well as mean lagged values of BS (up to lag 0-3) were significantly associated with COPD emergencies. No effect was found for SO_2, even after controlling for black smoke. The present findings support the conclusion that current levels of ambient BS may have an effect on the respiratory health of susceptible persons [17].

POTENTIAL BIOLOGIC MECHANISMS

Various physiologic and toxicologic considerations suggest that exposure to fine particles may be a health concern. The diversity of effects may reflect the complexity of airborne particulate matter, which is made up of a rich mixture of primary and secondary particles.Their size is such that they can be breathed most deeply in the lungs. They include sulfates, nitrates, acids, metals, and carbon particles with various chemicals adsorbed onto their surfaces. Relative to coarse particles, they more readily penetrate indoors, are transported over longer distances, and are somewhat uniform within communities, resulting in highly ubiquitous exposure.

Numerous studies evaluated acute morbidity effects of particulate pollution by examining short-term associations between lung function measures and/or respiratory symptoms and pollution. Measures of lung function including forced vital capacity (FVC), FEV_1, and peak expiratory flow (PEF) were used. The particulate pollution effect on lung function was generally physiologically small but statistically significant. Fine and large particles may act as inflammatory agents with an abrupt increase in airways resistance, and worsen expiratory flow limitation and dynamic hyperinflation [18].

Many studies have shown that particulate matter exposure activates inflammatory pathways in the respiratory system. For example, in vitro exposure of normal human bronchial epithelial cells stimulates release of oxidants, and cytokines [19]. Experimental 2-h human exposures to particulate matter increases the numbers of neutrophils in lavage fluid [20]. Direct instillation of particles collected in an area where a smelter was a principal pollution source of particles less than 2,5 μm in aerodinamic diameter ($PM_{2.5}$) increased neutrophils, cytokines, and oxidant species on lung lavage of the exposed volunteers one day later [21].

Older experimental studies established very short term responses to high levels of SO_2 which included decreases in lung function, and increases in specific airway resistance and respiratory symptoms. There is still considerable uncertainty as to whether SO_2 is the pollutant responsible for the observed adverse effects or whether it is a surrogate for particles or some other pollutants. In the second edition of the World Health Organization, it was noted that later epidemiological studies documented separate and independent adverse public health effects for PM and SO_2 [22]. Although the effect of SO_2 appears to be independent of particles, it may be associated with sulphates and be an indicator of specific particle characteristics. Asthmatic are the most sensitive group, although individuals vary in their responsiveness.

Ozone, as a potent oxidant, may cause many short term effects. They include increased respiratory symptoms, pulmonary function changes, increased airway responsiveness and airway inflammation. The individual responsiveness to ozone exposure varies substantially for reasons which remain unexplained. Exposure to ozone is associated with increased nasal inflammation in non-atopic children [23], and SO_2 and NO_2 enhance the response to inhaled allergens [24].

Because of urban air pollution consists of a complex mixture of gases and particulate agents that vary over time and through space, depending on its sources, distance and meteorological conditions, the knowledge about the underlying biologic mechanisms remains limited and requires much additional study.

CONCLUSION

There is good evidence that persons with respiratory diseases are more susceptible to adverse health effects of air pollution than healthy people. Improving air quality has substantial, measurable and important public health benefits. Improving our understanding of the biologic mechanisms underlying the acute respiratory effects of air pollution is essential to define the best prevention strategies.

REFERENCES

1. Katsouyanni K. Ambient air pollution and health. Br Med Bull 2003;68:143–56.
2. Nemery B, Hoet P, Nemmar A. The Meuse Valley Fog of 1930: an air pollution disaster. Lancet 2001;357:704–8.
3. Logan W. Mortality in the London fog incident, 1952. Lancet 1953;1:336–8.
4. Mac Nee W, Donaldson K. Exacerbations of COPD. Chest 2000;1147:390-7.
5. Brunekreef B, Holgate S. Air pollution and health. Lancet 2002;360:1233–42.
6. Air Quality Guidelines for Europe. World Health Organization. Regional Office for Europe. Copenhagen, WHO Regional Publications, European series No. 23, 1987.
7. Pope C, Bates D, Raizenne M**.** Health Effects of Particulate Air Pollution: Time for Reassessment? Environmental Health Perspectives 1995;103:472-80.
8. Sunyer J, Spix C, Quénel P, et al. Urban air pollution and emergency admissions for asthma in four European cities: the APHEA project. Thorax 1997;52:760–5.
9. Anderson H, Spix C, Medina S, et al. Air pollution and daily admissions for chronic obstructive pulmonary disease in 6 European cities: results from the APHEA project. Eur Respir J 1997;10:1064–71.
10. Sunyer J, Atkinson R, Ballester F, et al. Respiratory effects of sulphur dioxide: a hierarchical multicity analysis in the APHEA 2 study. Occup Environ Med 2003;60(8):e2.
11. Spix C, Heinrich J, Dockery D, et al. Air pollution and daily mortality in Erfurt, East Germany, 1980-1989. Environ Health Persp 1993;101:518-26.

12. Hatzakis A, Katspuyanni K, Kalandidi A, et al. Short-term effects of air pollution on mortality in Athens. Int J Epidemiol 1986;15:73-81.
13. Katsouyanni K, Karakatsani A, Messari I, et al. Air pollution and cause-specific mortality in Athens. J Epidemiol Commun Health 1990;44:321-4.
14. Sunyer J, Saez M, Murillo C, et al. Air pollution and emergency room admissions for chronic obstructive pulmonary disease: a 5 year study. Am J Epidemiol 1993;137:701-5.
15. Pope CA, Schwartz J, Ransom MR. Daily mortality and PM10 pollution in Utah Valley. Arch Environ Health 1992;47:211-7.
16. Schwartz J, Dockery DW. Particulate air pollution and daily mortality in Steubenville, Ohio. Am J Epidemiol 1992;135:12-9.
17. Milutinović S, Nikić D, Stošić Lj, et al. Short-term association between air pollution and emergency room admissions for chronic obstructive pulmonary disease in Niš, Serbia. Cent Eur J Public Health 2009;17:8-13.
18. Pope C. Epidemiology of Fine Particulate Air Pollution and Human Health: Biologic Mechanisms and Who's at Risk? Environmental Health Perspectives 2000;108:713-23.
19. Becker S, Mundandhara S, Devlin R, et al. Regulation of cytokine production in human alveolar macrophages and airway epithelial cells in response to ambient air pollution particles: further mechanistic studies. Toxicol Appl Pharmacol 2005;207:269-75.
20. Harder S, Soukup J, Ghio A, et al. Inhalation of PM2.5 does not modulate host defense or immune parameters in blood or lung of normal human subjects. Environ Health Perspect 2001;109:599-604.
21. Ghio A, Devlin R. Inflammatory lung injury after bronchial instilation of air pollution particles. Am J Respir Crit Care Med 2001;164:704-8.
22. Air Quality Guidelines for Europe, 2nd ed. World Health Organization. Regional Office for Europe. Copenhagen, WHO Regional Publications, European series No. 91, 2000.
23. Kopp M, Ulmer C, Ihost G, et al. Upper airway inflammation in children exposed to ambient ozone and potential signs of adaptation. Eur Respir J 1999;14:854-61.
24. Devalia J, Rusnak C, Herdman M, et al. Effect of nitrogen dioxide and sulphur dioxide on airway response of mild asthmatic patients to allergen inhalation. Lancet 1994;344:1668-71.

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ATTITUDES ABOUT CONTRACEPTION IN WOMEN OF NIS

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ABSTRACT

Objective of the study is to make an assessment about contraception attitudes by women in the Municipality of Nis. The biggest number of those who do not use protection think that contraception is harmful to health and not safe enough; 40.4% interviewees state the reason for the use of contraception as having preferred number of children; 52.9% of interviewees make the decision on the use of contraception on their own; 39.2% of interviewees think that condom presents the most efficient method of contraception. It is necessary to promptly begin with promotion of protection of reproductive health.

Key words: attitudes, contraception, women

INTRODUCTION

Family planning allows individuals and couples to anticipate and attain their desired number of children and the spacing and timing of their births. It is achieved through use of contraceptive methods and the treatment of involuntary infertility. The use of methods for family planning reduces maternal mortality, prevents unwanted and highly risky pregnancies, need for (un)safe abortion and protects from sexually transmitted diseases [1].

It is estimated that over 200 million couples do not use contraceptives, despite wanting to space or limit their childbearing. In addition, many women who use contraceptives nevertheless become pregnant. At the same time, many couples who want to have children are unable to conceive [2]. Insufficient knowledge about methods for family planning is leading to increased number of unwanted pregnancies. According to WHO, approximately 120 million couples in the world continue not to use contraception and 300 million are not satisfied with the applied method [3].

The issue of unwanted pregnancies, where majority is ended with abortion, is present in our country too. Observing the number of women of generative period, in 1989 (the last year of reliable registration), abortions had their highest rate in central Serbia (95.1 in 1000 women of generative age), then in Vojvodina (74.1), Montenegro (48.4) and Kosovo and Metohia (24.1) [4].

OBJECTIVE OF THE STUDY

Objective of the study is to make an assessment about contraception attitudes by women in the Municipality of Nis.

METHOD OF THE STUDY

We have applied observational cohort study as the fundamental method in the assessment of the problem. Study included 1584 women age 15-49, who lived in the Municipality of Nis, which composed 2.5% of women of generative age according to the 2002 registration. Interviewees were selected according to the accidental sampling method. Data was collected through the opinion poll examination. The attitudes were examined compared to: ages, place of living and education level.

In order to test the established scientific hypotheses, we applied the statistical method of quantitative analysis. In the description of data we used standard statistical parameters (arithmetical medium – Xsr, standard deviation – SD, structure index - %). Pearson Shi-Squared and Fisher exact test were performed (when at last one expected frequency was less than 5). Values of $p<0,05$ were considered significant.

RESULTS AND DISCUSSION

1. Reasons for the use of contraception

81.9% of interviewees, having sexual relations, protect themselves from unwanted pregnancy permanently or occasionally. 18.1% of interviewees don't use protection.

As the reason for the use of contraception, 40.4% of interviewees state that they already have preferred number of children, 22.4% use contraception for health reasons, 17% - because they are not married, 7.6% - because of poor economical condition, 2.7% - because of bad housing conditions 3.4% - because of unemployment, 2.1% are afraid of giving birth, and other reasons are present in significantly lesser percentage (Figure 1).

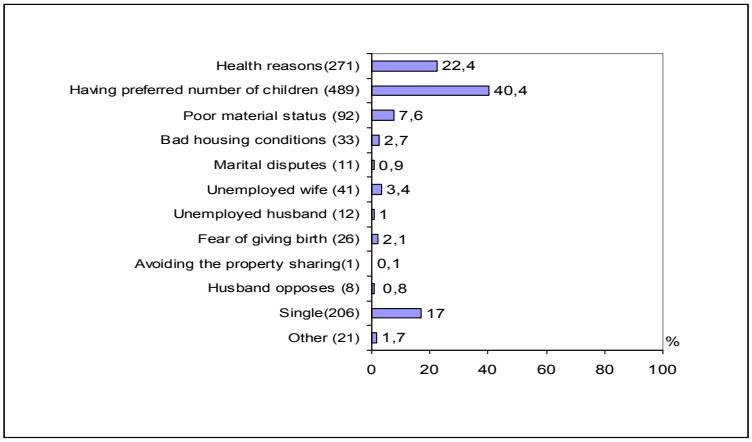

Figure 1. Structure of the interviewees according to the reasons for the use of contraception

In Great Britain, 27% of women stated that their decision about the use of contraception was influenced by the knowledge, firstly about HIV and other sexually transmitted infections [5]. The possibility of post-fertilization effects may influence Spanish women's choice of a family planning method [6].

2. The reasons for nonuse of protection from unwanted pregnancy

374 interviewees do not use protection from unwanted pregnancy, where 107 of them did not have sexual relations yet. Out of those interviewees, who do not use protection from unwanted pregnancy and have sexual relations, 28.1% think that it harms health, 27.7% think that it is unsafe, in 5.6% husband is against the use of contraception, 5.2% do not use protection according to doctor's advice, 4.5% are not familiar with contraception methods, 1.1% use abortion, 0.7% have their religion forbidding contraception. 27% of interviewees do not use contraception for other reasons (Figure 2).

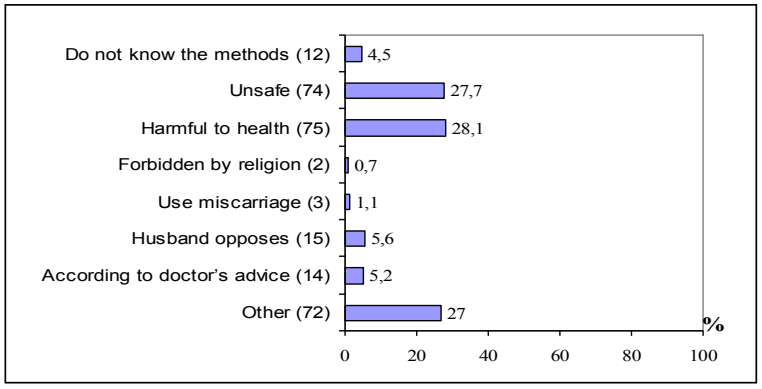

Figure 2. Structure of the interviewees according to the reasons for nonuse of protection from unwanted pregnancy

In Cairo, risk factors for unmet contraceptive need were: belief that contraception is religiously prohibited, poor interspousal communication about the desired number of children, husband opposition to contraceptive use and experiencing side effects from previous contraceptive use (OR 5.69, 95% CI 3.46-9.37) [7]. 79% sexually active women in Poland reported that the Church had little or no influence on reproductive decisions [8]. Women in USA gave an average of 9 reasons for having unprotected intercourse. The most common reasons fell into 3 categories: lack of thought/preparation (87% of respondents), being in a long-term or strong relationship (70%), and concerns about side effects of contraception (80%) [9].

3. Accepting the advice about the use of contraception

Interviewees who use contraception mostly choose particular method on their own will, without being consulted (52.9%), only 24.5% ask for a doctor's advice, 15.4% talk to their husband (partner), and 7.2% of interviewees accept the advice from others (friends, relatives etc.) (Figure 3).

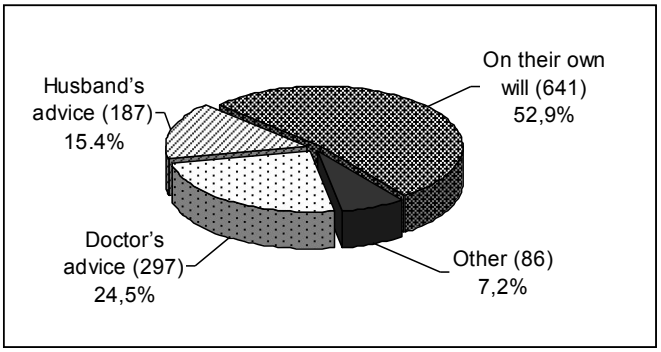

Figure 3. Structure of the interviewees according to acceptance of the advice about the use of contraception

Interviewees of all age categories mostly make the decision about the contraception use on their own, having in mind that most of these women (56.5%) are between 20 and 35 years old, then, there are 46.5% of women age 36-49 and only 40% of women younger than 20. A husband is consulted by 32% of women younger than 20, 16.9% of women age 20-35 and 11.5% of women older than 35.

There is a statistically significant difference in acceptance of the advice about the use of contraception between interviewees age 15-19 and 36-49 (χ^2=15,2; p<0,05) and between interviewees age 20-35 and 36-49 (χ^2=60,6; p<0,00001).

53% of interviewees from city and 45.8% from village make the decision about the contraception use on their own. Women from village twice more (than others) accept the advice from the husband (partner) about the contraception use (28.3%), while only 20.8% accept the advice from doctor, which is different than in case of interviewees from city, who practice this in 24.8%.

There is a statistically significant difference in acceptance of the advice about the use of contraception between women from city and village (χ^2=16,1; p<0,005).

57.1 % of interviewees with higher education, 52.3% of interviewees with secondary education and 39.7% of interviewees with primary education make the decision about the contraception use on their own. A husband (partner) is consulted mostly by interviewees with primary education (30.2%), while only 9.4% of interviewees with higher education do this. There is a statistically significant difference in acceptance of the advice about the use of contraception between interviewees with primary and higher education (χ^2= 21; p<0,0005) and between interviewees with secondary and higher education (χ^2= 10; p<0,05).

In some countries women are not independent in making the decision about he use of contraception. Thus, in Turkey, a husband makes the decision and this is why interrupted coitus presents mostly used contraceptive method [3]. There are male domination in decision making in India [10] and Nigeria [11]. Majority of the women in Nigeria [12] and Scotland [13] received information from a health professional.

4. Opinion about the most efficient method of contraception

39.2% of interviewees think that condom presents the most efficient method of contraception, 23.2% think it is pills, 21% - spiral, 10.3% - interrupted coition, 5.8% - calendar of fertile days and 0.5% choose local contraceptive means (Figure 4).

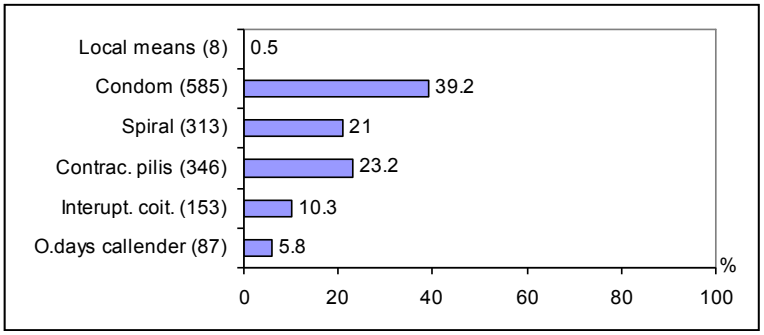

Figure 4. Structure of the interviewees according to the opinion about the most efficient method of contraception

Knowledge about the efficiency and effect of contraceptive means is very poor in some countries. Hence, in Turkey, according to the WHO report, there is a very small use of oral hormonal contraception due to belief that such contraception causes damage to lever and kidney and provokes cancer [5].

In most of the developed countries women, especially young ones are well informed about contraception. Hence, according to one study in the USA [14], there are 59% of adolescents, visiting 79 clinics for family planning, who apply one of the modern methods of contraception. Approximately 6 % does not use contraception, but they go to a clinic in order to obtain the information about contraception.

Interviewees up to 19 years old think that condom is the most efficient method of contraception (76.2%). This opinion is, in a lesser percentage, shared by the interviewees age 20-35 (45.1%). Interviewees age 36-49 think that the most efficient method of contraception is intra-uterus spiral (29.5%).

There is a statistically significant difference between women of different age in regard to the opinion about the most efficient method of contraception. Apparently, women age 15-19 in bigger number (92.3%) give the advantage to the modern methods of contraception, compared with the women age 20-35, who give the advantage to such methods in 80.5% (χ^2= 15,1; p<0,05). 74.3% of women older than 35 think that modern methods of contraception are more efficient than traditional ones, so there is a statistically significant difference between women age 15-19 and 35-49 (χ^2= 81,1; p<0,005) and women age 20-35 and 35-49 (χ^2= 4,6; p<0,05).

Interviewees with higher education have mostly chosen condom as the most efficient method of contraception (44.6%). This method was, in a lesser percentage, chosen by the interviewees with secondary education (42.2%) and, in evidently lesser percentage, by those with primary education (26.7%). It needs to be mentioned that 20.9% of women with primary education have chosen the interrupted coition as the most efficient method, which was different than with other interviewees.

There is a statistically significant difference between the women with primary and secondary education in regard to the opinion about the most efficient method of contraception (χ^2= 20,9; p<0,0001), because 61.2% of interviewees with primary education and 80.7% of interviewees with secondary education gave the advantage to the modern methods of contraception. Furthermore, there is a statistically significant difference between the women with primary and higher education (χ^2= 8,2; p<0,005), because 78.9% of interviewees with higher education think that modern methods of contraception are the most efficient ones.

None of the interviewees mentioned urgent contraception as possible method of contraception. Studies in England showed that even women in England still do not have enough information about this method. Percentage of women using urgent hormonal contraception, no matter the availability, in Great Britain in 2004 was 7.2 [15]

CONCLUSION

Four fifths of interviewees protect themselves from unwanted pregnancy. The biggest number of those who do not use protection think that contraception is harmful to health and not safe enough. Most of the interviewees state the reason for the use of contraception as having preferred number of children and poor economical status. More than a half of interviewees make the decision on the use of contraception on their own, without consulting the doctor or husband (partner).

Therefore, it is necessary to promptly begin with promotion of protection of reproductive health and promotion of the use of modern methods for family planning, as a part of nurturing of healthy lifestyle, in order to prevent the occurrence of unwanted pregnancies and preserve the reproductive health of women.

REFERENCES

1. WHO. Repositioning family planning. World Health Organization,UNAIDS, 2008.
2. WHO. Family planning for health and development: actions for change. Meeting report 2010.
3. WHO. Progress in reproductive Health Research. Geneva, 2004.
4. Rašević M. Program za planiranje porodice Republike Srbije. Potomstvo, 2001; (2):2.
5. Contraception and sexual health, 2004/05. Series OS no. 28 ISBN 1 85774 612 0. National Statistics. London, 2005.
6. Lopez-del Burgo C, Lopez-de Fez CM, Osorio A, et al. Spanish women's attitudes towards post-fertilization effects of **birth** control methods. Eur J Obstet Gynecol Reprod Biol. 2010 Jul;151(1):56-61.
7. Kotb MM, Bakr I, Ismail NA, et al. Women in Cairo, Egypt and their risk factors for unmet contraceptive need: a community-based study. J Fam Plann Reprod Health Care 2011;37(1):26-31.

8. Mishtal J, Dannefer R. Reconciling religious identity and reproductive practices: the Church and contraception in Poland. Eur J Contracept Reprod Health Care. 2010 Aug;15(4):232-42.
9. Nettleman MD, Brewer J, Ayoola A. Why women risk unintended pregnancy. J Fam Pract. 2009 Apr;58(4):E1-5.
10. Yadav K, Singh B, Goswami K. Agreement and concordance regarding reproductive intentions and contraception between husbands and wives in rural ballabgarh, India. Indian J Community Med. 2010 Jan;35(1):19-23.
11. Nte AR, Odu N, Enyindah CE. Male involvement in family planning: women's perception. Niger J Clin Pract. 2009 Sep;12(3):306-10.
12. Naqvi S, Hashim N, Zareen N, Fatima H. Knowledge, attitude and practice of parous women regarding contraception. J Coll Physicians Surg Pak. 2011 Feb;21(2):103-5.
13. Glasier A, Scorer J, Bigrigg A. Attitudes of women in Scotland to contraception: a qualitative study to explore the acceptability of long-acting methods. J Fam Plann Reprod Health Care. 2008 Oct;34(4):213-7.
14. Jones RK et al.Teenagers' Sexual Behavior Might Become More Risky if Parents Had to Know of Family Planning Clinic Visits Journal of the American Medical Association, 2005, 293(3):340–348.
15. Marston C, Majeed H. Impact on contraceptive practice of making emergency hormonal contraception available over the counter in Great Britain: repeated cross sectional surveys. BMJ 2005;331:271 (30 July), doi:10.1136/bmj.38519.440266.8F.

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SANITARY AND EPIDEMIOLOGICAL SAFETY OF CENTRAL AND DISTRIBUTIVE KITCHENS OF KINDERGARTENS IN NIS

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ABSTRACT

In period from 2001 to 2010, we analyzed 770 smears taken from Central kitchen and 3300 samples from distributive kitchens of kindergartens in Nis. The results of the analysis shows that percentage of unsafe smears has been - 8,2% in Central kitchen, and 4,4% in Distributive kitchen. In this period the results showed negative trend of unsafe smears in Central and also in distributive kitchens of kindergartens- Niš. It is necessary to continue permanent hygienic inspection and staff education.

Key words: safe food, nutritious diet, sanitary-hygienic conditions in kindergartens

INTRODUCTION

In kindergartens a nutritious diet is essential for children's growth and development, so also food must be safe. Children receiving food from a kitchen in kindergarten with poor food handling practices could suffer a foodborne infection.
In order to prevent infections and intoxication of children in kindergartens as well as those of persons working on preparation and distribution in kitchens, it is necessary to insist on the maintenance of a high degree of hygiene both in Central kitchen and distribution kitchens. In Niš, control of nutrition and sanitary situation in kindergartens started for the first time in Nis in 1975.

The purpose of this paper is to analyze sanitary-hygienic conditions in kindergartens in Niš based on retrospective analysis of microbiological smears from central and distributive kitchens.

METHOD

This study was carried out in the kitchens of kindergartens of Niš, in the period between 2001 and 2010. Sanitary-hygienic situation of kindergartens was controlled by the methods of the local inspection and by the bacteriological analysis of smears. The smears in Central kitchen were taken every month, from dishes, cutlery,

kitchen surfaces, from the employees' hands and work clothes, and in Distributive kitchens every fourth month.

Contact surfaces of food utensils were swabbed using a sterile cotton swab moistened with sterile quarter strength Ringer solution. The samples were transported as soon as possible to the laboratory using an insulated ice box containing an ice pack [1]. The analysis of the smears has been conducted by use of standard microbiological methods [2].

RESULTS AND DISCUSSION

The main factors that contribute to the occurrence of food-borne disease are: keeping food at temperatures outside the recommended range; inadequate cooking; poor personal hygiene among food handlers; use of food from unsafe sources; and use of contaminated equipment. Poorly cleaned utensil and equipment surfaces harbor and promote the spread of microorganisms.

In period from 2001-2010, we analyzed 3300 samples taken from Central kitchen and 770 samples taken from distributive kitchens of kindergartens in Niš (table 1 and table2) .

Table 1. The results of smear analysis taken in the Central Kitchen

Period	n	Unsafe smears n (%)	Saprophyte n (%)	Sterile n (%)
2001	80	11(13.7)	17(21.3)	52(65)
2002	100	13(13)	17(17)	70(70)
2003	80	7 (8.8)	13 (16.3)	60(75.0)
2004	80	4 (5)	14(17.5)	62(77.5)
2005	60	8 (13.3)	12 (20)	40 (66.7)
2006	60	3 (5)	7 (11.7)	50 (83.3)
2007	80	7 (8.8)	4 (5)	69 (86.2)
2008	80	2(2.5)	0(0)	78(97.5)
2009	80	6 (7.5)	3 (3.8)	71 (88.7)
2010	70	2 (2.8)	5(0)	63(98.6)
∑	**770**	**63 (8.2)**	**92(11.9)**	**615 (79.9)**

In the ten years of research - 63 (8.2 %) of smears taken from Central kitchen were bacterogically unsafe (isolated pathogenic or unconditional pathogenic bacteria)(table 1).

The smears from the central kitchen were bacteriological unsafe more often (8.2%) compared to the samples from distribution kitchens (4.4%) (table 2). Pathogenic bacteria can be the cause of opportunistic infections, especially among vulnerably population such as children, which is of epidemiological importance [3].

In the Central kitchen, the greatest number of unsafe smears have been found from the equipment and kitchen utensils (9.3%). The reason for such situation was inadequate washing and disinfection of equipment and kitchen utensils (table 3).

Table 2. The results of smear analysis taken in the Distributive Kitchens

Period	n	Unsafe smears n (%)	Saprophyte n (%)	Sterile n (%)
2001	320	27(8.4)	49(15.3)	244(76.3)
2002	310	23(7.4)	25(8.1)	262(84.5)
2003	320	36 (11.3)	37 (11.5)	247 (77.2)
2004	320	22 (6.9)	23 (7.2)	275 (85.9)
2005	340	14 (4.1)	35 (10.3)	291 (85.6)
2006	240	4 (1.7)	16 (6.7)	220 (91.6)
2007	320	10 (3.1)	9 (2.8)	301(94.1)
2008	340	2 (0.6)	1 (0.3)	337 (99.1)
2009	430	5 (1.2)	6(1.4)	419(97.4)
2010	360	1(0.3)	3(0.8)	357(99.2)
∑	**3300**	**144(4.4)**	**204 (6.1)**	**2952 (89.5)**

Table 3. The numbers of unsafe smears according place were they taken in Central kitchen

Year	Hands and work clothes		Work surfaces		Equipment and kitchen utensils	
	n	Unsafe smears n (%)	n	Unsafe smears n (%)	n	Unsafe smears n (%)
2001	15	1 (6.7)	9	2(22.2)	56	8(14.2)
2002	16	2 (12.5)	8	1(12.5)	76	10 (13.1)
2003	19	0 (0)	8	0 (0)	53	7 (13.2)
2004	21	1 (5.3)	6	1 (16.7)	53	2 (3.8)
2005	15	1 (6.7)	9	1 (11.1)	36	6 (16.7)
2006	14	0 (0)	8	1 (12.5)	38	2 (5.3)
2007	22	3(13.6)	6	0 (0)	52	4 (7.7)
2008	23	0 (0)	7	1 (14.3)	50	1 (2)
2009	24	0 (0)	8	0 (0)	48	6 (12.5)
2010	20	1(0.5)	9	0 (0)	41	1 (2.4)
∑	**189**	**9 (4.8)**	**78**	**7 (9)**	**503**	**47 (9.3)**

The percentage of unsafe smears from work surfaces in the Central kitchen was high (9%) (table 3).

The greatest number of unsafe smears has been found on work surfaces in the distributive kitchens (8,8%) (table 4). The probable cause for these results is the fact that working surfaces in the central and distributives kitchen are very often amply covered by organic materials which can inhibit the effect of disinfectants so preliminary cleaning before the application of disinfectants is of the greatest importance.

Table 4. The numbers of unsafe smears according place were they taken in distributive kitchens

Year	Hands and work clothes		Work surfaces		Equipment and kitchen utensils	
	n	Unsafe smears n (%)	n	Unsafe smears n (%)	n	Unsafe smears n (%)
2001	58	11 (19)	21	2 (9.5)	241	14 (5.8)
2002	40	5(12.5)	20	4(20)	250	14 (5.6)
2003	58	10 (17.2)	15	2 (13.3)	247	24 (9.7)
2004	60	4(6.7)	17	4 (23.5)	243	14 (5.8)
2005	86	3 (3.5)	29	3 (10.3)	225	8 (3.6)
2006	51	1 (2)	15	0 (0)	174	3 (1.7)
2007	77	3 (3.9)	15	1(6.7)	228	6 (2.6)
2008	70	1 (1.4)	11	0 (0)	259	1 (0.4)
2009	105	3 (2.9)	24	2 (8.3)	301	0 (0)
2010	80	1 (1.25)	26	0(0)	254	0(0)
∑	**685**	**42(6.1)**	**193**	**17 (8.8)**	**2422**	**84 (3.5)**

Graph 1 and graph 2 (Fig. 1,2) show linear trends of unsafe samples from Central and distributives kitchens in Niš in period 2001-2010.

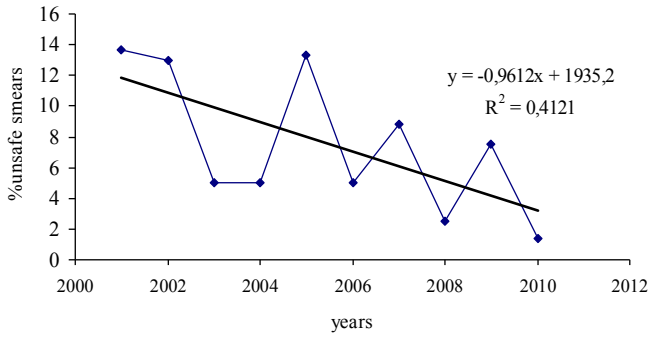

Figure 1. Linear trend of unsafe smears in Central kitchen Niš in period 2001-2010

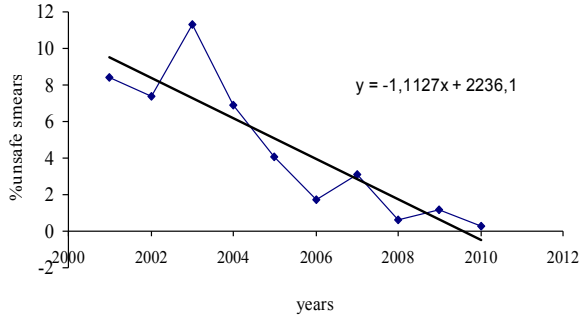

Figure 2 . Linear trend of unsafe smears in Central kitchens "Pčelica in period 2001-2010

The results showed a decreasing trend in percentage of unsafe smears in Central kitchen and also in distributives kitchens. Sanitary and epidemiological safety is better then in the previous period [4].

An improvement in these conditions, according HACCP (*Hazard Analysis Critical Control Point*) – concept now is started.

CONCLUSION

During the last few years, the number of bacteriologicaly unsafe smears taken from the kitchens kindergartens in Niš has been decreasing, so we can conclude that sanitary-hygienic situation in this institution is now satisfactory.

Our conclusion is that continuous health care education of the kitchen staff and regular sanitary hygienic controls and implementation HACCP are needed.

REFERENCES

1. Microbiology: general guidance for the preparation of dilutions for microbiological examination. Geneva, International Standards Organization, 1980.
2. Kocić B, Veličković M. Model sistema kvaliteta u mikrobiološkoj laboratoriji za vode. Monografija. Prosveta Niš, 2000; 87
3. WHO. Foodborne disease outbreaks : guidelines for investigation and control. WHO Geneva, 2008.
4. Stojanović D, Tiodorović B., Kocic B. Društvena ishrana predškolske dece-sanitarno higijenski aspekt. Ekološka istina, Donji Milanovac 2003. Zbornik radova: 214-217.

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MANGANESE IN PREPARED INFANTS FORMULAS AND HEALTH RISK

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ABSTRACT

Studies indicate that preparation of common infant formulas with water (with manganese content equivalent to the WHO guideline values), result in exceeding the maximum manganese concentration for infant formula. Also, several studies have reported relationships between manganese intake and neurobehavioral disorders in infants and children. In this article the manganese concentration of infant formula was determined and compared with literature data.

Key words: manganese, infant formula, health

INTRODUCTION

Manganese is a naturally-occurring element that can be found in the air, soil and in surface and ground water sources. Although manganese is an essential nutrient, chronic exposure to high doses may be harmful to health.

Infants are more susceptible to excessive exposure - they have higher retention of manganese, because bile flow is lower in infants compared to adults [1].

The greatest manganese exposure of human population is from food, and manganese intake from drinking water is usually lower than intake from food. Common infant formulas prepared with water, containing manganese concentrations equivalent to the WHO guideline values result in exceeding the maximum manganese concentration for infant formula [2].

MATERIALS AND METHODS

This paper presents results of manganese content in infant formula analyzed in Public Health Institute Niš and reviews the available literature on the association between manganese exposure through prepared infants formula and children's health.

The laboratory of the Public Health Institute Nis, in the period from 2006-2009, using atomic absorption spectrophotometry, determined the content of manganese in 36 imported and domestic infant formulas.

RESULTS AND DISCUSSION

The maximum manganese content in infant formula is based on studies of adults. Table 1 presents the maximum values in infant formula and the adequate daily intake values for manganese together with calculated LOAEL and intake values in different units.

Table 1. Guideline and calculated values for manganese presented for different age groups of infants [3,4]

Parameter	Age (months)	Assumed Weight (kg)	Manganese concentration		
			µg/ 100kcal	µg/l	µg/day
Max value infant and follow-on formula [3]	0-12		100	650	500
Adequate intake [4]	0-6	5	-	3.8	3
	7-12	7-9	-	600	600
LOAEL	0-6	5	-	385	300
	7-12	7-9	-	420-540	420-540

Table 2. show manganese concentration in 36 infant formulas from markets in Niš analyzed in Public health Institute Niš in period 2006-2009. Results in our investigation (table 2) has similar results as in study in Sweden [2].

Table 2. Concentration manganese in infant formulas

Infants formulas	Number of samples	Concentration (µg/l)	
		Average	Min-max
Infant formula 1 (from birth)	17	176	60-310
Infant formula 2 (from 4 months)	10	191	70-410
Infant formula 3 (from 6 months)	9	251	70-540

Breast-fed infants tend to have a low exposure to manganese then those fed with infant formula, because infant formulas contain manganese concentrations much higher than breast milk (3.1-7.5 µg/L) [5-7]. Its important to note that the bioavailability of manganese in water and formula is much lower than in breast milk [2].

Also, the high water intake in infants, may influence that manganese present in water (including infant formulas prepared with drinking water), contribute significantly to the infant's total daily manganese intake [2], especially when manganese in drinking water is in excess of WHO guideline values (400 µg/L) [8] . Manganese is natural drinking water contaminant in many countries and also in some parts of South East Serbia [9].

When infant formulas containing the average manganese concentration of 325 µg/L are mixed with drinking water containing manganese equivalent to the WHO guideline value [10], the maximum value for manganese in infant formula (100 µg/l) by

the European Commission's Scientific Committee on Food (SCF) is exceeded (3). The current maximum manganese concentration in infant formula set by the SCF is 650 μg/L [3]. New Serbian Draft of regulations does not stipulate maximum manganese concentration for infant formula [11].
Hafeman et al. found positive association between water manganese and all-cause infant mortality in the offspring of female participants [12]. Also, there is an increasing number of studies reporting associations between neurobehavioral symptoms and manganese exposure in infants and children [13].

CONCLUSION

Results of testing infant formula in Public health Institute Nis indicate that some infant formulas contain significant amounts of manganese.

To make a clear conclusion regarding the association between manganese in drinking water and infant formulas and infant's health more epidemiologic studies are needed.

In the region of South East Serbia when manganese concentrations in drinking water is equivalent or higher then the WHO guideline values, health professionals must inform parents of infants how to avoid any potential elevated manganese exposure of infants (e.c. to prepare infant formula with water with low concentration of manganese).

REFERENCES

1. Lonnerdal, B. 1994. Manganese nutrition of infants. Chapter 11. In: Klimis-Tavantzis (ed). Manganese in health and disease. CEC Press, Boca Raton, Florida. 212 pp. 175-192.
2. Ljung K, Vahter M, Berglund M. Manganese in Drinking Water. IMM-report 1/2007. Stockholm 2007: Karolinska Institutet. pp.
3. (Scientific Committee on Food). 2003. Report of the Scientific Committee on Food on the Revision of Essential Requirements of Infant Formulae and Follow-on Formulae. SCF/CS/NUT/IF/65 Final. Brussels:European Commission.
4. IOM (Institute of Medicine). 2001. Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc (2000). Institute of Medicine, Food and Nutrition Board. Washington, DC:National Academy Press.
5. Al-Awadi FM, Srikumar TS. Trace-element status in milk and plasma of Kuwaiti and non-Kuwaiti lactating mothers. Nutrition 2000;16:1069–73.
6. Leotsinidis M, Alexopoulos A, Kostopoulou-Farri E. Toxic and essential trace elements in human milk from Greek lactating women: association with dietary habits and other factors. Chemosphere 2005; 61:238–47.
7. Krachler M, Prohaska T, Koellensperger G, Rossipal E, Stingeder G. Concentrations of selected trace elements in human milk and in infant formulas

determined by magnetic sector field inductively coupled plasma-mass spectrometry. Biol Trace Elem Res 2000 76:97–112.

8. WHO 2006. Guidelines for Drinking-Water Quality [electronic resource]: IncorporatingFirstAddendum.Available:http://www.who.int/water_sanitation_health/dwq/gdwq0506begin. pdf .
9. Dalmacija B. Kontrola kvaliteta voda. Prirodno matematički fakultet. Institut za hemiju Novi Sad,2001 pp.31
10. Pravilnik o zdravstvenoj ispravnosti dijetetskih proizvoda Sl.glasnik RS 45/010
11. Sievers E. Nutrient minerals in drinking water: implications for the nutrition of infants and young children. In: Nutrients in Drinking Water (WHO). Geneva: WHO Press, 2005;164–79.
12. Hafeman D, Factor-Litvak P, Cheng Z, van Geen A, Ahsan H. Association between manganese exposure through drinking water and infant mortality in Bangladesh. Environ Health Perspect 2007;115(7):1107-12
13. Lazarević K, Gligorijević S, Djonović N. Mangan u vodi za piće i ponašanje dece. Svet rada 2010; 7(3):303-307

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ENVIRONMENTAL EXPOSURE TO TOBACCO SMOKE AND RISK OF THE OCCURANCEOF LARINGEAL CANCER

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ABSTRACT

The incidence of laryngeal cancer is closely correlated with smoking. The aim of the paper was to analyse incidence trend of larinegeal cancer on the terithory of Nishava District in the period 1999-2008. **Matherial and method**. The official data from population based cancer register of Serbia were used. Descriptive epidemiological method was used. Linear trend was calculated. **Results.** The average annual standardized incidence rate was 75.39 (145.77 in men and 11.16 in women). Men had 13 times higher incidence rate than women. Incidence trend in men was (y=0.5565x+9,422 and R^2=0,4554). Incidence trend in women was (y=0,1426x + 0,3807 and R^2=0,3347). **Conclusion.** Increasing incidence trend of laryngeal cancer in both men and women were registered in the observed period.

Key words: smoking cigarettes, laringeal cancer, incidence, trend

INTRODUCTION

Tobacco smoking is well established as the main risk factor for laringeal cancer [1-3]. A vast majority (86-98%) of the patients with laringeal cancer were smockers [3,4]. The cancerogenic effect of tobacco smoke is correlated with the intensity and the duration of smoking [3,4]. The risk of laringeal cancer has found higher among smockers of hand-rolled than factory-made cigarettes and unfiltered cigarettes are more harmful than filter ciggaretes. The use of unfiltered cigarettes or dark, air-cured tobacco is associated with further increases in risk [4].

Laryngeal cancer is the second most common cancer of respiratoty system [5,6]. The incidence of laryngeal tumors is closely correlated with smoking, as head and neck tumors occur 6 times more often among cigarette smokers than among nonsmokers. The age-standardized risk of mortality from laryngeal cancer appears to have a linear relationship with increasing cigarette consumption. Death from laryngeal cancer is 20 times more likely for the heaviest smokers than for nonsmokers.

According to the data from survey in 2002, in Serbia there are members of closed family who smoking about 65.7% of subjects. At working place about one third of subjects (27.3%) were exsposured to tobacco smoke more then 5 hours per day. Men

were more exposed at working place compared with women (31.5% vs 23.5%), younger workers were more exposed than older workers (31.4% vs 10.1%). Employed with high level of education were more exposed to tobacco smoke than employed with lower education (28.5% vs 12.9%), [7].

Smoking cigarettes is prevalent habit in adult population in Serbia [7,8]. According to the clafication of smokers/nonsmokers FINBALT countries it was established that 30.9% of women and 46.0% of men are everyday smokers. The greatest number of smokers are 44 years of age, and in older age groups the number is decreasing. There were more men who are smokers than women. The average number of smoked cigarettes was 18.62. In rural areas of Serbia there was the greatest number of daily smocked cigarettes compared with the urban areas (19.14 vs 18.34). The average number of cigarettes per day was greater in men compared with women (21.56 vs 14.56). The number of smocked cigarettes increasing after the 54^{th} years of age and in older age groups decreasement was registered [7,8].

MATHERIAL AND METHOD

The official data from population based cancer register of Serbia were used. In order to achieve data about smoking habits the anonimus questionnaire was used. Descriptive epidemiological method was used. Crude incidence rate was calculated in 100. 000 inhabitans (assessment Census). Direct method of standardization was applied used world standard population as a standard. Linear trend was calculated too. The mean and standard deviation (SD) were used to describe parametric and non-parametric continuous data, and number and percentages to describe categorical data.

RESULTS

The data about prevalence od cigarette smoking, average number of daily smoked cigarettes, and the average lenght of year are presented in table 1.

Table 1. Distribution of smokers, nonsmokers and former smokers and smoking habits

Smoking status	Men (N=120)	Women (N=120)	Significance
Nonsmoker	49 (40.8%)	59 (49.2%)	ns†
Current smoker	55 (45.8%)	49(40.8%)	ns†
Former smoker	16 (13.4%)	12 (10%)	ns†
Daily number of smoked cigarettes	22.90±9.72	20.92±9.85	ns‡
The average period of smoking (years)	27.41±13.43	26.96±13.62	ns‡

According to presented results there were more women then men who were nonsmokers (40.8% vs 49.2%, X^2= 1.41 and p=0.2343). There were more men compared with women who were current smokers (45.8% vs 40.8%, X^2= 0.57 and p=0.4497) and there were more former smokers among men than among women (13.4% vs 10%, X^2=0.77 and p=0.3816). Men have smoked more ciggarette per day than women

(22.90±9.72 vs 20.92±9.85) in average. Men had loger period of smoking cigarettes compared with women in average, too (27.41±13.43 vs 26.96±13.62).

In the observed period a total number of 532 new diagnostic patients was registered (495-93.05% men and 37-6.95% women). The average age of patients were 61.02±10.7 (34-86). The average annual standardized incidence rate was 75.39 (145.77 in men and 11.16 in women).

The ten year incidence trend of laringeal cancer both in men and women is preseted in chart (Figure 1).

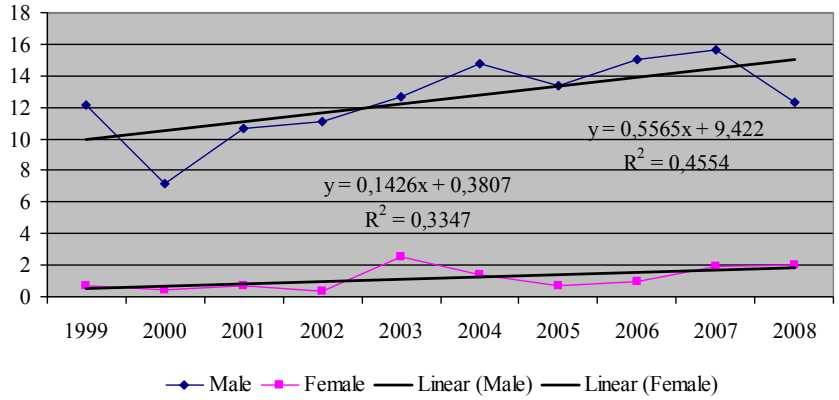

Figure 1. Incidence trend of laringeal cancer on the terithory of Nishava District in the period 1999-2008

An increasing incidence trend of laringeal cancer is registered both in men (y=0.5565x+9,422 iand R^2=0,4554) and in women (y=0,1426x + 0,3807 and R^2=0,3347). There was a greater increase of incidence trend in men compared with women.

The greatest annual standardized incidence rates in men were in 2004., 2006 and 2007. In women the highest annual standardized incidence rate was in 2003.

DISSCUSION

The time trends for laryngeal cancer incidence and mortality are consistent with the trends for other cancers which are associated with tobacco smoking [9]. According to the presented results on the terithory of Nishava Districs in the period 1999-2008 an increasing incidence trend of laringeal cancer both in men and in women was noticed. Increasing trends are also seen in central and eastern Europe and in most developing countries [9,10].

Laryngeal cancer is generally uncommon in males and very rare in females[11]. In this study there were 13 times more men than women who suffered from the laringeal cancer. The annual standardized incidence rate in men from the Nishava District was slightly higher than the same rate in men in Central Serbia (14.5 vs 13.5). The annual

standardized incidence rate in women from the Nishava District was a litlle lower than in women in Central Serbia (1.2 vs 1.4), [11].

Laryngeal cancers represent around 5.2% of all cancers in men and about 0.5% in women on the Nishava District [11].

One of the explenation of noticed increase of incidence trend of laringeal cancer is the overall number of current smokers is the increasing. According to the presented results the average number of smocked cigarettes was similar both in men and in women (20.90±9.72 vs 20.92±9.85). There was not significant difference between men and women (27.41±13.43 vs 26.96±13.62).

CONCLUSION

Incidence trend of laringeal cancer incsreasing both in men and in women in Nišava District. Laringeal cancer is an important cancer in men. Primary prevention the majority of laringeal cancers could be achieved by elimination of tobacco smoking.

REFERENCES

1. IARC (1986) Monographs on the Evaluation of Carcinogenic Risks to Human, Vol 38: Tobacco Smoking. IARC: Lyon
2. IARC (1988) Monographs on the Evaluation of Carcinogenic Risks to Human, Vol 44: Alcohol Drinking. IARC: Lyon
3. IARC (2002) Monographs on the Evaluation of Carcinogenic Risks to Humans, Vol 83; Tobacco Smoke and Involuntary Smoking. IARC: Lyon
4. Filho Ŵ V. The epidemiology of laryngeal cancer in Brazil. Sao Paulo Med. J. 2004; 122(5):
5. Cattaruzza MS, Maisonneuve P, Bojyle P. Epidemiology of laringeal cancer. Eur J Cancer Oral B Oncol 1996; 32(B), 293-305
6. Riotiola H.: Epidemiology, Clinical characteristics and treatment outcome of laringeal cancer. University of Tampere, Medical School of Medicine, Finlad 2000
7. National Health Survey Serbia. Key findings. I part. The Official Gazete of the Institute for Public Health of Serbie, 2002; 76(1-2):142-147
8. National Health Survey Serbia. Key findings, 2006; May,2007. Institute for Public Health, "Milan Jovanović-Batut"; Beograd
9. Dechaphunkul T. Epidemiology, Risk Factors, and Overall Survival Rate of Laryngeal Cancer in Songklanagarind HospitalJ Med Assoc Thai 2011; 94 (3): 355-60
10. Coupland HV, Chapman P, Linklater MK, Sehgal A, Møllerand HE, Davies A**.** Trends in the epidemiology of larynx and lung cancer in south-east England, 1985–2004. British Journal of Cancer, 2009; 100:167–169
11. Cancer incidence and mortality in Central Serbia 2008. Institute of Public Health of Serbia «Dr. Milan Jovanović-Batut», Belgrade,2010

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PRINTING INDUSTRY CHEMICALS AS ENVIRONMENTAL POLUTANS

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ABSTRACT

Printing industry generates a significant amount of pollution. The vast majority of these chemicals are used in press cleaning operations, blanket washes, and as components of ink formulations. The main reason that press washes are large generators of volatile organic chemicals is that the vast majority are folmulated with petroleum-derived solvents, resulting in products that adversely affect the environmental and pressroom workers. The volatile organic chemicals contribute to the creation of smog. Biochemicals are alternatives to these toxic petrochemicals. Biochemicals for press cleaning, blanket washes and inks can save businesses money, while reducing pollution and improving worker safety. New low regulations called for a 15% volatile organic chemicals reduction in emission.

Key words: printing industry, petrochemicals, biochemicals

INTRODUCTION

In general, printing industry generates a significant amount of pollution. For example, in 1995, more than 41 million pounds of toxic compounds were transfered or released into the environmentaly the printing industry. The petroleum-derived chemicals which are the most frequently use in the printing industry are: Toluen, Methyl Ethyl Ketone (MIK), Glycol Ethers, Xylene (mixed isomers), Tertachlorethylene, Methyl Isobutyl ketone (MIBK), Metanol, 1,1,1,-Trichloroethene (TCA), Dichlormethane, Ethylene Glycol. Toluen is by far the most used chemical, accounting for 75% of all toxic chemicals used in printing (Biobhemicals).

THE VOLATILE ORGANIC CHEMICALS

Press chemicals are by far the greatest contributors to the release of VOCs from printing establishments.

VOCs is abbrevation for Volatile Organic Chemicals. Chemicals made from oil, certain minerals, plants and animals are very reactive with other matherials and very volatile. Organic chemicals are any compund or mixture including carbon. VOCs also produce strong fumes which are very dangerous when touching the skin and can be

poisonous if swallowed VOCs contribute to the creation of smog (Biocmemicals).The printing industry use different VOCs for ink, solvents and photograpfic developing and fixing solutions. Reducing VOCs is essential step for all size of printing industry.

The difference between high persistent and biocative and less persistent and bioacumulative chemical are based on the chemical half/life and its bioacumulation and bioconcentracion factor (BAF/ BCF).

BAF is the ratio of a substances concentracione´s concentration in tissues of an aquatic organism to its concentration in ambient whater in situations where both the organism and its food are exposed and the ratio does not change over time.

BCF is the ratio of a substance´s concentration in tissue of an aquatic organisam to its concentration in ambient whater in situations where organism is exposed thought water only and the ratio does not change over time.

BIOCHEMICALS

Nowdays, new technologies, new laws and an increasingly environmentaliy awere public are ushering in a new materials base for the 21st century - plant matter. Corn, soyabean, beets, grass,alfaalfa etc. A new term for that is a «carbohydrate economy».

Biological alternatives of toxic petrochemical are biochemicals such as**:** Soybean Oil, Coconut Oil, Grain-derived alcohol, Reppeseed oil, terpene (pinene). The low toxicity and high biodegrability of biochemicals offers benefits to workers and the natural environment alike.

VEGETABLE-BASED INKS

Petroleum-based inks enabled printers to run job faster and increase overall productivity and they quickly domined the industry. More than two billion pounds of ink are used by printing industry ecah year. More than half of all inks are used in lithographic printing process, including newspapers, books and magazines. Soy inks can also be used in packaging, business forms and other comercial printing applications. There have not yet been developed soy inks for gravure and screen printing. Soy inks have advantages comared with petroleum inks. Petroleum is dark and soyabean oil is relatively clear in color. This allows the pigment to be seen more readily, resulting in brighter colors.

Biochemicals can be used in inks as carrier solvents and enhancing agents.

CONCLUSION

Reducing VOCs is an essential step in reducing toxic contaminants entering the environment through groundwater, air and soil contamination. Low regulations called for a 15% volatile organic chemicals reduction in emission.

REFERENCES

1. Profile of the printing Industry. EPA Office of Compliance Sector Notebook Project, 1995,EPA,310 R95-014
2. EPA´s Guide to Pollution Prevention. The Commercial Printing Industrz, 1990
3. National Soy Ink Information Center

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CHARACTERISTICS OF NOISE IN PRINTING FACILITIES AND ITS RELEVANCE TO THE WORKWRS HEALTH

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ABSTRACT

The noise spectrum of four different types of machines in printing companies in Novi Sad, Serbia was determined. The measured L_{eq} values for all machines generally varied between 70 - 90 dBA. This is in agreement with the results obtained in literature. Octave analysis was performed and it was found that the noise was dominated by higher frequency noise, 3 kHz and above. This is potentially risk for hearing impairment of the workers. Thus, it is recommended to establish hearing conservation programmes in printing companies and to perform a questionnaire about the noise and audiometric tests to check subjective response to the noise and hearing impairment of the workers.

Key words: Noise spectrum, octave analysis, printing facilities

INTRODUCTION

Noise is generally defined as the unpleasant sounds which disturb the human being physically and physiologically and cause environmental pollution by destroying environmental properties [1]. Nowadays, noise is one of the most common occupational health hazards. It is the major cause of concern for safety and health of industrial workers. The general effect of noise on the hearing of workers has been a topic of debate among scientists for a number of years. According to some estimates, in the United States only, about 30 million workers are exposed to high levels of noise (more than 85 dBA) in their workplace [2]. Recent studies show approximately 600 million workers are exposed to occupational noise worldwide [3].

Regulations limiting noise exposure of industrial workers have been instituted in many places. The major risk factor for noise induced hearing loss (NIHL) is long-term, unprotected exposure to levels of noise higher than 85 dB [4]. The National Institute for Occupational Safety and Health (NIOSH) in United States estimates that prolonged exposure to noise at 100 dB will result in 56 out of 100 workers suffering hearing loss; at 90 dB, 29 workers out of 100 will suffer hearing loss and at 85 dB, 15 out of 100 workers will suffer hearing loss. Even at 80 dB, 3 out of 100 will suffer hearing loss [5].

Negative effects of noise on human beings are generally of a physiological and psychological nature. Hearing loss is the most common effect among the physiological ones [6]. Continuous hearing loss differs from person to person with the level, frequency and duration of the noise exposure. It is possible to classify the effects of noise on ears in three groups: acoustic trauma, temporary hearing loss and permanent hearing loss. Hypertension, heart beat accelerations, appearance of muscle reflexes, sleeping disorders may be considered among the other physiological effects [7]. The psychological effects of noise are more common compared to the psychological ones and they can be seen in the forms of annoyance, stress, anger and lack of concentration, as well as difficulties in resting and perception. Reinhold and Tint [8] studied the connection between risk levels due to noise and stages of health problems, determined using a simple/flexible risk assessment method. They distinguished five different risk levels (Table 1). The numerical criteria were derived from European regulations, calculations using standards on occupational noise and scientific publications.

Table 1. Connection between risk levels of noise and health complains [8]

Risk level numerically	Risk level	Criteria (dBA)	Possible injuries to health
I	Tolerable risk	< 80	Slight harm and complaints such as unpleasant feelings, mild difficulties in conversation, fatigue and psychological stress.
II	Justified risk	> 80...85	Moderate harm such as that mentioned above + decrease of cognitive capacities, reflex muscles' stress difficulties in conversation.
III	Unjustified risk	> 80...87	Severe harm such as temporary impairment of hearing, disturbances in the circulatory system through the nervous system, heart diseases, severe problems in communication, etc.
IV	Inadmissible risk	> 87...85	Extreme harm such as hearing-loss, ultimate deafness, severe sleeping disturbances, etc.
V	Intolerable risk	> 95	Rapid health impairments and excessive increase of the risk of accidents and occupational diseases. These noise levels should be avoided definitely.

It is well documented that repetitive exposures to high intensity sound can cause acoustic trauma to the ear resulting in hearing loss and that occupational noise is a significant cause of adult-onset hearing loss. Research worldwide has indicated a significant number of workers with hearing loss attributed to noise exposure [5].

METHODS

The noise level of four different types of machines: digital colour presses, offset printing presses, cutters and folders was measured using TES-1358A Sound Level Meter (SLM), with RS-232 Interface. The A-weighted levels on L_{eq} Sound Pressure Level (SPL) in dBA for 27 machines were collected. For conducting the noise survey, Serbian guidelines for noise measuring were followed [9]. The desired response of SLM was set at "fast". The noise levels were measured about 1.5 m above the floor and the

measurements were taken over a period of 10 s for paper cutting machines and 30 s for other types of machines. At the end of experiment, the data were downloaded to a personal computer and, with the help of utility software, the equivalent SPL and noise spectrum at each reading were obtained.

RESULTS AND DISCUSSION

Noise measurements

In printing industry, noise occurs during printing, binding, folding and cutting processes. The sources of noise are all moving parts of the machines and the elements of the machinery drive such as motors, compressors and vacuum pumps, which supply mechanical energy, air under pressure or vacuum. Printing presses are one of the major sources of high noise levels. The dominant noise source from a printing press came from the second print head air drum. Secondary noise sources included drying fans and suction systems. In printing facilities where noise measurements for this study were conducted, there were two types of printing presses: digital colour presses and sheet-fed offset lithographic presses [10]. This kind of offset technology is normally used for short-run orders. In many countries noise has been ranked among the top occupational risk factors in printing manufactures. A survey of noise levels in printing industry in different countries is given in Table 2.

Table 2. L_{eq} levels (dBA) in printing industries in different countries [11]

Country	Industry	L_{eq} range (dBA)
Singapore	Printing and publishing manufactures	85 - 96
Brazil	Rotogravure printing	71 - 93
Saudi Arabia	Printing, publishing and paper products industry	76.5 - 93.3
Ghana	Printing industry	85 (mean)
Malaysia	Publication and printing industry	78 - 94
Germany	Rotogravure printing	77.4 - 85.8

Noise measurements was carried out for 5 digital colour presses, 11 offset printing machines, 5 folders and 6 cutters. The levels on L_{eq} in dBA of 27 machines totally, were collected. The measured L_{eq} values for all machines generally varied between 70 - 90 dBA. This is in agreement with the results obtained in printing industry in the other countries (Table 2). For digital colour presses L_{eq} levels were the lowest, in the range of 65.4 – 76.8 dBA, and with the mean value of 70.66 (4.17) dBA. For offset printing machines and cutters, the L_{eq} levels were in the range of 75.3 – 93.5 and 75.2 – 94.8 dBA, respectively. The mean value was 82.7 (3.92) dBA for offset printing presses and 80.21 (6.87) dBA for cutters. The highest L_{eq} levels were measured for folders with the mean value of 87.66 (3.14) dBA and the range of 84.1 – 91.2 dBA.

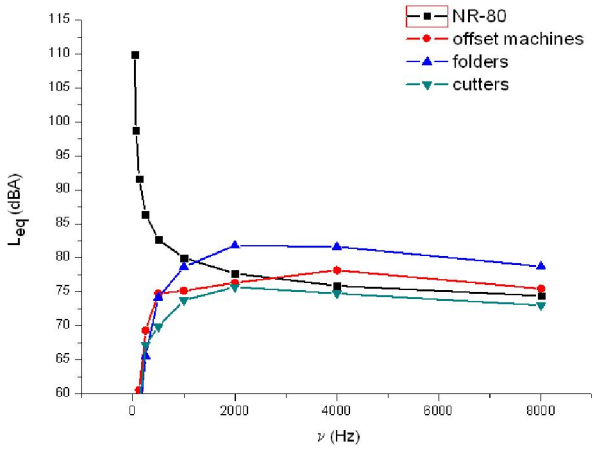

Figure 1. Means of L_{eq} in dBA at 1/1 octave bands for offset printing machines, folders and cutters in comparison with NR-80 curve

For digital colour presses the mean values of L_{eq} levels were below the acceptable values given by law, thus octave analysis was not performed. Frequency analysis of the L_{eq} means at 1/1 octave bands for folders, cutters and offset printing presses was conducted. The dBA means of L_{eq} at 1/1 octave bands for those three types of machines in comparison with NR-80 curves[1] are presented in Figure 1. The means of L_{eq} levels for folders exceeded the levels given by law at 1 kHz and are considerably greater than the permissible levels at higher frequencies (2 kHz and above). For offset printing machines the means of L_{eq} levels exceeded the NR-80 curve levels at 3 kHz and the levels were slightly over the permissible values for higher frequencies. It was also found that for cutters the means of L_{eq} levels did not exceed NR-80 curve values, but the levels were very close to those values at 2 kHz and above.

As it can be seen, for obtained noise levels, the most critical are the levels at higher frequencies - above 3 kHz. This is potentially risk for hearing impairment of the workers because hearing damage from excessive noise usually occurs at higher frequencies (3, 4, 6 kHz) and then spreads to lower frequencies (0.5, 1, 2 kHz) [12]. For effective noise induced hearing loss prevention, it is important to consider the spectral content of noise as the personal protective equipment is often designed according to the noise spectrum [8]. In the following paragraph the effect of excessive noise on hearing impairment will be explained.

Pathogenesis of NIHL

It is well documented that repetitive exposures to high intensity sound can cause acoustic trauma to the ear resulting in hearing loss, and that occupational noise is a

[1] The Noise Rating - NR - curves are developed by International Organization for Standardization (ISO) to determine the acceptable indoor environment for hearing preservation, speech communication and annoyance. The Noise Rating level for industrial noise should not exceed the levels of NR-80 curve.

significant cause of adult-onset hearing loss. Research worldwide has indicated a significant number of workers with hearing loss attributed to noise exposure.

Noise-induced hearing loss is a hearing impairment that develops over the years of exposure to noise. It is predominantly noted in the high frequency region with typical notch at 4 – 6 kHz. The first symptom of hearing loss is commonly an inability to hear another person speaking, especially in noisy surroundings. Tinnitus, a ringing, buzzing or swishing noise heard in the ears which often accompanies NIHL, is a common complaint of workers who are exposed to noise. Characteristics of NIHL include the following [5]:

- It is bilateral, symmetrical and sensorineural as it affects the hair cells in the inner ear.
- NIHL develops gradually, but most rapidly in the first 10 years of exposure.
- It starts in the higher frequencies (3000 – 6000 Hz) i.e. greater loss at these frequencies than at 500 – 2000 Hz.
- The greatest loss usually occurs at 4000 Hz. The audiogram has a characteristic "ski-slope" appearance. This notch at 4000 Hz deepens with additional years of exposure, but reaches a plateau after 15 – 20 years of exposure.
- The high frequency hearing loss usually averages 50 – 70 dB. With additional years of exposure there is some spread of hearing loss to the lower frequencies, but the maximum loss at low frequencies is much less, usually not more than 20 dB.

Sound travels from external ear and falls on the tympanic membrane, which is then set into vibration and these vibrations are transmitted to the middle ear where the sensory hair cells in the cochlea are responsible for initiating the neural impulses that carry information to the brain regarding the sounds [12]. The human cochlea has one row of inner hair cells and three rows of outer hair cells (Figure 2).

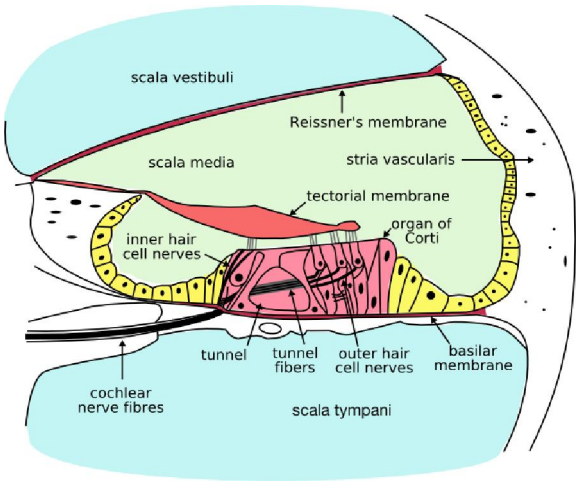

Figure 2. A cross section of the human cohlea

Permanent noise damage initially consists of degeneration of hair cells. Although both types of hair cells may degenerate, outer hair cells (OHCs) are more susceptible than inner hair cells (IHCs) to acoustic over-stimulation. OHCs in the basilar part of the cochlea are the most sensitive to noise damage in part because of they are the first along the way of sound waves and in part because of reduced vascularization in basal coil area [13]. Those hair cells are in the area which responds to 4 kHz and the adjacent areas of 3 – 6 kHz, and this accounts for the high frequency hearing loss found in noise-damaged ears.

After exposure to a typical hazardous industrial sound, for an 8-hour work day, the ear fatigues and develops a temporary threshold shift (TTS) [14]. The hair cells become exhausted from the excessive metabolic stress placed upon them and hearing becomes less acute. This is usually transient and after appropriate rest, recovery ensues. Workers notice this with their car radios: when they leave work they turn the volume up and by the next morning the radio is too loud - their ears have recovered.

Low levels of damaging sound exposure produces TTS, as described in the preceding paragraph. If TTS occurs day after day, the recovery becomes less complete and a permanent threshold shift (PTS) occurs because with persistent exposure to such sounds some hair cells do not recover.

CONCLUSIONS

The aim of this paper was to determine noise spectrum of four different types of machines in printing facilities in Novi Sad in Serbia and to discuss the relevance of noise characteristic to the workers' health. The L_{eq} noise levels of 27 machines were determined. The measured L_{eq} values for all machines generally varied between 70 - 90 dBA. This is in agreement with the results obtained in printing industries in the other countries. It was found that folders and offset printing presses are the predominant noise sources with the average L_{eq} levels of 87.66 and 82.7 dBA, respectively. Octave analysis at 1/1 octave bands was performed and the noise was dominated by higher frequency noise (3 kHz and above). The means of L_{eq} levels exceeded the permissible levels given by NR-80 curve above 1 kHz for folders and above 3 kHz for offset printing presses. This is potentially risk for hearing impairment of the workers because hearing damage from excessive noise usually occurs at high frequencies (3, 4, 6 kHz) and then spread to the lower frequencies.

There is causal relationship between workplace noise and hearing loss and the other health problems of the workers. In further investigations more extensive studies are necessary in order to determine the exact impact of noise on the workers. Thus, it is recommended to establish hearing conservation programmes in printing companies and to perform a questionnaire about the noise and periodically audiometric tests to check subjective response to the noise and hearing impairment of the workers.

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REFERENCES

1. Melnick, W. Hearing loss from noise exposure. Handbook of Noise Control. Harris, C. M., (Ed.). Mc. Grow Hill, New York, 15, 1, 1979.
2. NIOSH (National Institute for Occupational Safety and Health) (2001) Work related hearing loss, DHHS Publication No. 2001-103, USA.
3. Pouryaghoub, G., Mehidad, R., Mohammadi S. (2007) Interaction of smoking and occupational noise exposure on hearing loss: a cross sectional study. BMC Public Health. 7, 137.
4. Sataloff, R., Sataloff, J. (1987) Occupational hearing loss. New York, NY: Marcel Dekker, Inc.
5. Viljoen, C.A., (2007) Noise induced hearing loss in a paper mill in Kzn South Africa. A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg
6. McCunney R.J., Meyer, J.D. (1998) Occupational exposure to noise. In: Rom WN, ed. Environmental and Occupational Medicine. 3rd ed. Lippincot-Raven, Philadelphia, New York, USA, pp. 1345-57.
7. Stansfeld, S. A., Matheson, M. P. (2003) Noise pollution: non-auditory effects on health, British Medical Bulletin, 68(1), 243-257.
8. Reinhold, K., Tint, P. (2009) Hazard Profile in Manufacturing Determination of Risk Levels towards Enhancing the Workplace Safety. Journal of Environmental Engineering and Landscape Management, 17(2), 69-80
9. Pravilnik o merama i normativima zaštite na radu od buke u radnim prostorijama, Službeni List SFRJ br.21, 3. april 1992 str. 310-316
10. Grujic, S., Mihailovic, A., Kiurski, J., Radin Oros, I., Krstic, J., Kovacevic, I. Frequency analysis at 1/1 octave bands for different types of printing machines. (2019) 18th Scientific and Professional Conference Eco-Ist 2010, Apatin
11. Mihailovic, A., Grujic, S., Kiurski, J., Krstic, J., Radin Oros, I., Kovacevic, I., (2010) Occupational noise in printing companies. Environmental Monitoring and Assessment, DOI: 10.1007/s10661-010-1817-5
12. Nandi, S. S., Dhatrak, S. V. (2008) Occupational noise-induced hearing loss in India. Indian Journal of Occupational & Environmental Medicine, 12(2), 53-56.
13. Živić, Lj., Ignjatović, S., Terzić, N., Jakovljević, V.Lj., Živić, D., Đonović, N. (2010) Comparative analysis of audiometric and impedancemetric findings in workers exposed to the effects of various duration industrial noise. Vojnosanitetski pregled. Vol. 67, No. 3, 229-235.
14. Alberti, P.W. The Pathophysiology of the ear. Available from: http://www.who.int/occupational_health/publications/noise3.pdf

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PHARMACEUTICALS IN THE ENVIRONMENT: CONSEQUENCE OF DISPOSAL PRACTICE

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ABSTRACT

Pharmaceuticals have important role in curing and preventing diseases but if improperly disposed in environment they might have adverse effect on various ecosystems. Although pharmacovigilance is well defined and organized in most of the countries, potential harmful effect of the pharmaceuticals on the environment lately has been in the focus of scientific interest. As a consequence, European directives on pharmaceuticals request environmental risk assessment prior to the marketing. Often neglected problem is disposal of unused or unwanted pharmaceuticals from the households. Stronger education of both primary health care and patients is needed, but advices and recommendations must be acceptable and applicable for each specific group of patients and health care users.

Key words: pharmaceuticals, environmental pollution, disposal, legislative

INTRODUCTION

Use of pharmaceuticals and personal care products in 21st century has reached maximums in the history of pharmaceutical trading. Pharmaceuticals have important role in curing and preventing diseases but if improperly disposed in environment they might have adverse effect on various ecosystems. Pharmacovigilance is well defined as activities comprising detection, evaluation, understanding and prevention of adverse drug reaction as well as other reactions caused by medicinal products. It is on going activity well organized in most of the countries for decades with strong and clear legal support. At the moment legal requirements in EU are changing towards even more proactive approach in order to monitor safety of pharmaceuticals before and after marketing[1]. On the other hand, adverse effects of the pharmaceuticals on the environment have been neglected as a potential problem and only lately this became a focus of scientific interest.

Presence of the pharmaceuticals in the environment for the first time was described by Garrioson et all in 1976 who detected clofibric acid in concentration

between 0.8 and 2 μg/L in the wastewaters even after the treatment processes. In mid eighties, in Great Britain's rivers pharmaceutical residues were determined, as well as presence of ibuprofen, naproxen in waste waters in Canada [2,3,4]. Today it is possible to detect around 160 various pharmaceuticals in the surface waters in the world after the wastewater processing. Their concentrations range from ng/L to μg/L. Carbamazepin and primidon are pharmaceuticals that are present in surface waters even after six years after release. The most stable pharmaceuticals are sulphonamides, fluorokinolons, macrolides, tetracycline, aminoglycozides and beta-lactamin antibiotics. Also they are the most quickly absorbed in the soil and sediments. The most frequent pharmaceuticals found in the environment are diklofenac, clofibric acid, acetaminophen, ibuprofen, acetylsalicylic acid, carbamazepin, atrovastatin, gemfibrizol, fluoksetin and 17beta-ethynilestradiol [5].

HOW PHARMACEUTICAL GET INTO ENVIRONMENT AND WHY THEY STAY THERE

Use of pharmaceuticals, vary around the world, but the global use trends are growing. Along with prescription pharmaceuticals we can follow two trends on over the counter market, globalization and self-medication. For example ibuprofen, non-steroid anti-inflammatory drug has annual production of several kilotons [6] is non-prescription pharmaceutical that can be purchased by anyone. Globalization and use of internet made possible to get various pharmaceuticals that might not be approved by regulatory bodies, without control of proper use in relation to diagnosis and without control of proper dosages.

The more drugs we use the more end up in the environment. There are several ways how pharmaceuticals enter the environment: first, during the technological process of the production, second, as process of pharmaceutical waste disposal and third through actual biotransformation during therapeutic use. In all cases they end up in the water streams endangering aquatic ecosystems.

After the pharmaceuticals are ingested, injected or applied in form of the infusion, pharmaceuticals are bio transformed in human body and are excreted through urine or feces. Also, topical pharmaceuticals are washed off the body during the washing. Biotransformation results in release of number of metabolites that might have even higher bioactivity than primary substance, while some substance might exit the body without any change. Unmetabolised pharmaceuticals are often most non biodegradable substances in the environment [7] All pharmaceutical substances are intended to perform some biological function so when they enter the environment they act in the same way, they bioaccumulate, and induce various effects on ecosystems. Many of them are lipophilic, so they easily pass cell membranes [5].

Unfortunately most of the wastewater treatment plants still do not manage to remove most of the pharmaceuticals particularly synthetic hormones. Older type of plants uses one or more tanks with microorganisms that remove primarily phosphates and nitrates from the sewage waters. New facilities use multiple tanks with different microorganism cultures and different chemical and physical conditions that manage to brake down active pharmaceutical ingredients (API) [8]. A comprehensive survey of

drinking water that supplies 28 million Americans revealed presence of 51 compounds of pharmaceuticals and hormonally active substances. They were in low-level concentrations but authors argue that even if they do not pose public health threat still they may influence health or therapy in severely ill or immune compromised patients or particularly susceptible individuals. [9].

Figure 1. presents how pharmaceuticals enter and cycle in the nutritional chain.

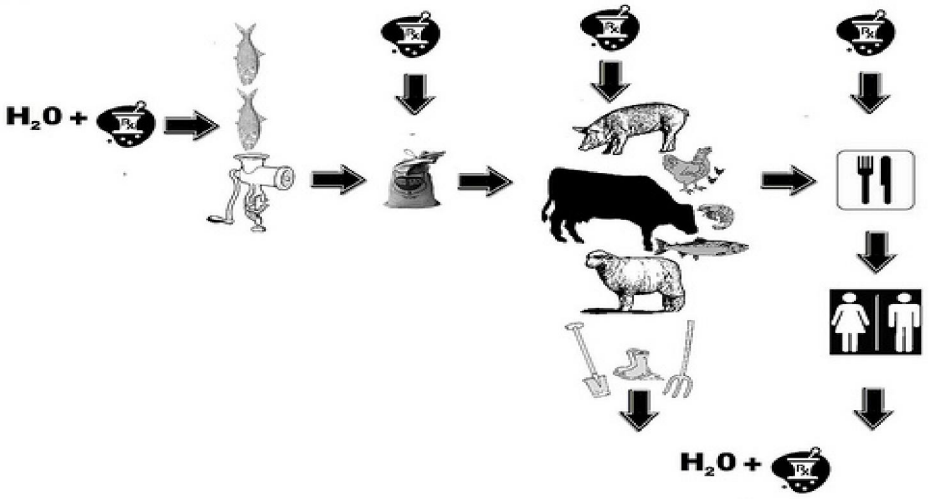

Figure 1. Pharmaceutical and nutrition chain

The well-known impact of pharmaceuticals in the environment is their effect on biological functions primarily reproduction. Aquatic ecosystems are the most exposed due to the constant inflow of wastewaters. Many studies documented feminization of the fish due to the ethynilestradiol in the water that comes from contraception pills. Concentration less than 1 ng/L is enough to influence reproductive system of zebra fish [11]. Shellfish spawning is affected by fluoxetin, while diklofenac has influence of lifespan of vultures, and non-steroidal anti-inflammatory pharmaceuticals appear to be highly toxic to some other species of birds. Bacterial resistance is another consequence of antibiotic residues in the environment particularly macrolides and tetracycline that are water-soluble. Beta-blockers propranolol and metpropolol that are found in surface waters are toxic for plankton Daphna magna [8].

In Figure 2. Disposal as the contributor to the pharmaceuticals in the environment is presented [10]

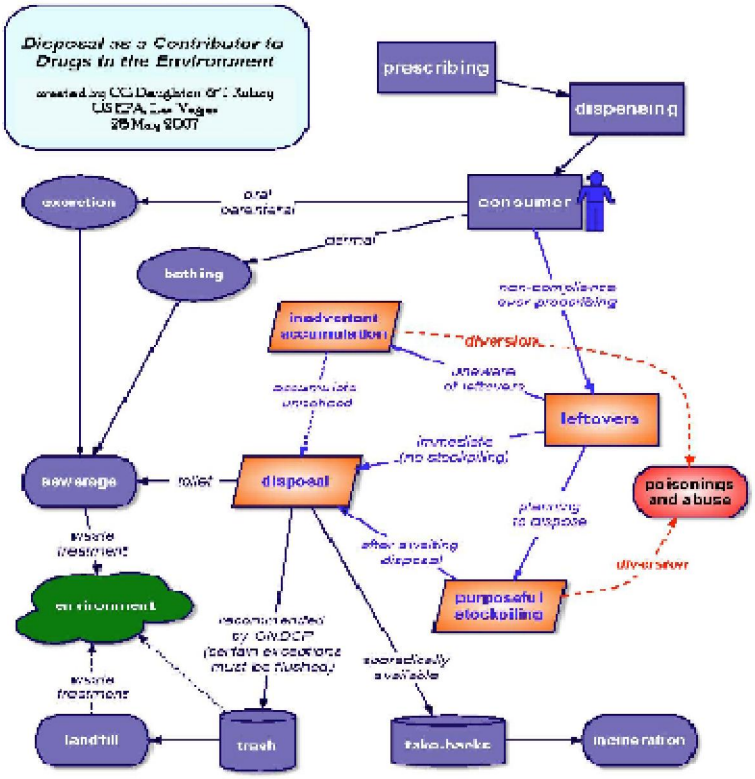

Figure 2. Disposal as the contributor to the pharmaceuticals in the environment

LEGAL REQUIREMENTS

These findings resulted in some changes in EU directives emphasizing assessment of environmental risk of every pharmaceutical prior to the marketing [12]. Environmental risk assessment is a process in two phases. In phase one API is tested regardless the way of application, pharmaceutical form, metabolizing and way of excretion. Predicted environmental concentration in aquatic environment is calculated and if it is under 0.01 μg/L without other indication of adverse effects on the environment it is considered as non risky without further analysis. If calculated concentrations are equal or above 0.01 μg/L than pharmaceutical goes to the second phase where various and available data on physical, chemical, toxicological, pharmacodynamic, stability, excretion, metabolizing characteristics are gathered. Also, predicted effect and no-effect concentrations of API are compared. Some pharmaceuticals like hormones automatically go to the phase two, while some are completely absolved from phase two testing like vitamins, electrolytes, amino acids, peptides, proteins, carbohydrates and lipids as well as vaccines and herbal medicines.

However, regardless analysis results there is no criteria on which certain pharmaceutical would be refused for marketing, meaning that regardless potential high risk for the environment the pharmaceutical will still go to the market. Also, pharmaceuticals that are classified as non-risky for the environment are never re tested after marketing to see if the estimations were correct. FDA never turned down proposed pharmaceutical due to the test results [13].

DISPOSAL PRACTICE

The largest quantities of pharmaceuticals that are disposed without control are the pharmaceuticals from the households. Usually they are disposed along with the rest of communal waste that ends up at the landfill. Literature reveals that populations in USA, New Zealand, England and east Europe dispose their unused or unwanted pharmaceuticals as well as those with expired date of use in the communal waste [14,15,16]. Given the fact that most of the patients who are above age 55 have multiple morbidity that quantity of pharmaceuticals could be significant [10]. But same study reveals that number of people who dispose pharmaceuticals along with communal waste decreased from 2005 to 2008, and number of those who return pharmaceuticals in the pharmacy grew for 12.25% [14,15,16]. Our findings in some rural areas of Croatia show that 66.25% of people dispose pharmaceuticals in communal waste.

Although guidelines for manufacturing companies exist and they are mostly focus on incineration, there is no clear stand on how to manage household pharmaceuticals. In some EU countries as well as in the USA it is allowed to dispose pharmaceuticals along with communal waste [5], so around one third of prescription drugs in Germany and around 25% of prescribed drugs in Austria are disposed with communal waste or in sewage. In the USA more than half unused drugs are flushed down the toilette. Environmental protection Agency (EPA) published a list of the pharmaceuticals that may be disposed in that way but it is unknown weather people comply with those recommendations or they use the same method for other pharmaceuticals as well [17].

Many countries have organized collecting of unused pharmaceuticals through pharmacy chains. Croatia has strategy on waste management with plan on waste management along with number of laws and regulations but they regulate mostly pharmaceutical waste generated from health care facilities. Household pharmaceutical waste should be collected through pharmacy chains, but downside of this regulation that makes it poorly complied with is the fact that pharmacies has to pay for collected waste disposal. In that way pharmacies pay for the intermediate role of collectors. As a consequence they are not displaying collecting boxes and in general tend to give impression of non-existing possibility to dispose old pharmaceuticals within their premises. According to the European environment agency among 28 European states Croatia collects least amount of pharmaceutical waste through pharmacy chains 0.19 tones per million inhabitants. The highest amount is collected in Switzerland 237 tones per million inhabitants, followed by Ireland, Luxemburg, Sweden and France. Most of the states reported between 10 and 100 tones collected pharmaceuticals per million inhabitants. At the same time it is estimated that as an average of all states 50% of

unused packages are not collected via pharmacies, meaning they are stored at home or disposed in some other way [8]. Some other studies revealed that only 23% of household pharmaceutical waste is collected via pharmacies and that percentage is highly correlated with advising in the pharmacy [18].

Good example of public health campaign is action of collecting pharmaceuticals from the households in the city of Zagreb, Croatia in 2007. During three months ten 700L containers were collected with total of 13.320 packages. The project was extensively advertised, and all pharmacies willingly participated because one, at the time, local, pharmaceutical company financed disposal [19].

Croatian law on pharmaceuticals [20] clearly states that every package of pharmaceutical should contain instructions for use and for disposal after use. At the moment, this is still not the case, information sheets contain information on the product, indications, possible side effects way of storage and other registration information, but not the instruction what to do with the pharmaceutical after end of therapy or after expiring date.

CONCLUSION

Effects of pharmaceuticals on the environment during the past will be visible more and more in the future. In order to protect environment, flora, fauna and humans as integral parts of ecosystems some changes should be introduced. As proposed by Kummerer 2008 advanced systems for water purification should be installed with constant monitoring of water quality. Strong education of health care sector is needed for both rational prescription and education of patients what to do with unused pharmaceuticals. Compliance with prescribed therapy and less self medication and use of over the counter medicines are also in the domain of advices that should be given by primary health care. Pharmacies should be part of organized national networks that should encourage pharmaceuticals collection and final waste management by incineration. And finally pharmaceutical industry should turn to new design of pharmaceuticals that will have beneficial characteristics for humans and will be safe for environment.

REFERENCES

1. EU Directive 2004/27/EC of European Parliament amending Directive 2110/83EC on the Community code relating to medicinal products for human use. 2004 off. J. Eur. Communities L136, 0034-0057.
2. Garrison AW, Pope JD, Allen FR. 1976 GC/MS analysis of organic compounds in domestic wastewaters, u L. H. Keith (ed.) Identification and analysis of organic pollutants in water. Ann. Arbor Science Publishers Inc, Ann. Arbor. pp. 517–556.
3. Richardson ML, Bowron JM. 1985 The fate of pharmaceutical chemicals in the aquatic environment, J. Pharm. Pharmacol. 37:1–12

4. Rogers IH, Birtwell IK, Kruznyski GM. 1986 Organic extractables in municipal wastewater of Vancouver, British Columbia,Water Pollut. Res. J. Can. **21:**187–204.
5. Kümmerer K. 2008 Pharmaceuticals in the Environment: Sources, Fate, Effects and Risks; third edition, Springer-Verlag Berlin, Heidelberg Germany.
6. Cleuvers M. 2003 Mixture toxicity of anti-inflammatory drugs diclofenac, ibuprofen, naproxen and acetylsalicylic acid. Ecotox Envion Safety. available on: www.dx.doi.org/10.1016/S0147-6513(03)00141-6
7. Steur-Lauridsen F, Birkved M, Hansen LP, Holten Lutzhoft HC, Halling-Sorensen B. 2000 Environmental risk assessment of human pharmaceuticals in Denmar after normal therapeutic use. Chemosphere 36:2437-2445.
8. European Enviroment Agency 2001 Pharmaceuticals in the enviromet. Results of EEA workshop. EEA Tecnical Report No 1/2010. Copenhagen, Danmark.
9. Bruce GM, Pleus RC, Snyder SA. 2010 Toxicological Relevance of Pharmaceuticals in Drinking Water. Environ Sci Tec 41:5619-5626.
10. Ruhoy IS, Daughton CG. 2007 Types and quantities of leftover drugs entering the environment via disposal to sewage — revealed by coroner records. Sci Total Environ 388:137–48. available on: http://www.epa.gov/nerlesd1/bios/daughton/SOTE2007.pdf
11. Jobling S, Williams R, Johnson A, Taylor A, Gross-Sorokin M, Nolan M, Tyler CR, van Aerle R, Santos E, Brighty G. 2006 Predicted exposures to steroid estrogens in U.K. rivers correlate with widespread sexual disruption in wild fish populations. Environ Health Perspect 114(Suppl 1):32–9.
12. EU Guidelines EMEA/CHMP/SWP/4447/00, 2006. Guidelines on the environmental risk assessment of medicinal products for human use.
13. Rahman SZ, AliKhan R, Gupta V, Uddin M. 2007. Pharmacoenvironmentology – a component of pharmacovigilance. Enviro Health 6:20 available at: www.ehjournal.net.
14. Bound JP, Voulvoulis N. 2005 Household disposal of pharmaceuticals as a pathway for aquatic contamination in the United Kingdom. Environ Health Perspect 113:1705–11.
15. Braund R,. Peake BM, Shieffelbien L. 2009 Disposal practices for unused medications in New Zealand. Environ Int 35:952–955.
16. Glassmeyer ST, Hinchey E, Boehme SE, Daughton CG, Ruhoy IS, Conerly O, Daniels RL, Lauer L, McCarthy M, Nettesheim TG, Sykes K, Thompson VG. 2009 Disposal practices for unwanted residential medications in the United States, Environ Int 35:566–572.
17. Environmental Protection Agency Drugs and the Environment:Stewardship & Sustainability http://www.epa.gov/nerlesd1/bios/daughton/APM200-2010.pdf
18. Seehusen DA, Edwards J. 2009 Patient practice and beliefs concerning disposal of medications. J Am Bord Fam Med 19:542-547.
19. Institute for Public Health „A. Stampar" County of Zagreb. 2007 Statistics and health yearbook.
20. Croatian National Gazette Law on pharmaceuticals 72/07.

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ELECTROMAGNETIC RADIATION AND ITS EFFECTS ON PEOPLE AND THE ENVIRONMENT

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ABSTRACT

In the modern world there is no space on the planet that is not exposed to electromagnetic radiation. They become very intens, so that living world and people are constantly exposed to this radiation of different frequencies and wavelengths. Numerous tests in the past thirty year, conducted in the most prominent international labs, did not produce any direct evidence that the electromagnetic radiation is harmful to the human body unless it is the radiation from small distances from the radiation source. In this work are listed the principles for the prevention of adverse effects and allowed values of electric and magnetic fields that have brought the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the EU. Also, on the basis of international recommendations and regulations propose certain protection measures to be implemented by all participants in the process of electromagnetic radiation. In addition, the paper has analyzed and sources of electromagnetic radiation, their intensity and frequency area in which it manifested.

Key words: Eelectromagnetic Radiation, Non-Ionizing Radiation, effects on people and the environment

INTRODUCTION

Generally, the **radiation** means the emission and propagation of energy through space by of particles or waves. Sources of radiation are very different: the Sun, radioactive waste, equipment for induction heating, electric power plants, electrical appliances, radio-relay antenna systems, mobile phones, radars and the like. Electromagnetic radiation is a combination of oscillating electric and magnetic fields that is propagated through space. Electromagnetic energy is propagated through space in the form of electromagnetic waves, which represent the spatial propagation of mutually linked and time-varying electric and magnetic fi elds. In the vicinity of any electrified body is an electric field, and around the conductor through which flows an electric current generated magnetic field. In addition, the electric field strength is proportional to the voltage and power magnetnoog field is proportional to the intensity of current flowing conductor. On this basis, we may conclude that wherever there are current and voltage, there are electrical, magnetic or electromagnetic fields.

Today, the modern world is inconceivable without the use of electricity. It is omnipresent in: the home, office, factory, theater and other places. Virtually no part of the planet who do not reach the electromagnetic radiation that are more intense. Living world and people constantly exposed to electromagnetic radiation, innuendo that people are moving and, generally speaking, live in a stronger or weaker or magnetsnim electric fields. Therefore, the logical question: is there stay and people working in such an electric, magnetic and electromagnetic fields harmful consequences for their health?

THE CONCEPT AND SPECTRUM OF ELECTROMAGNETIC RADIATION

Radiation that is transmitted through particles (neutrons, protons, mesons, etc..) is called the corpuscular radiation, and that which is transmitted in the form of waves called the electromagnetic radiation. Electromagnetic radiation change is the electromagnetic field a function of time. This radiation is the carrier of electromagnetic interaction (forces) and can be interpreted as a wave or a particle, depending on the case. Particles that quantify the electromagnetic radiation consists of photons. Each electric charge is a change of pace generates electromagnetic fields. This information is spread through space at light speed and features of the corresponding electromagnetic waves are directly related to the dynamics of change in electric charge movement. Alternatively, if we look at electromagnetic radiation as the emission of particles (photons), the energy they carry is directly related to the wavelength or frequency of waves. The higher the frequency the higher energy photons. Photon energy can be expressed as:

$$E = hf \qquad (1)$$

where: E- Photon energy , $h=6,62 \times 10^{-34}$ *J/Hz* - Planck's constant , and f- frequency waves.

Photons of electromagnetic radiation with frequencies of 50 Hz (60 Hz in the US) that are used in electric power systems have a long wavelength and low energy, only approximately 3×10^{-13} eV (electronvolts). This energy cannot break down the electron bonds in organic molecules and cause detrimental biological effects in such a manner. Electromagnetic radiation that cannot cause the ionization of organic substances is known as **non-ionizing radiation** [1]. Non-ionizing radiation includes the part of the spectrum with frequencies lower than 3×10^{15} Hz, in which the photons lack suffi cient energy for the ioniziation of matter. Non-ionizing radiation is divided into two basic forms, which are known as light radiation and electromagnetic fields.

Light radiation includes optical (visible) and infrared radiation with frequencies of 3×10^{11} Hz to 3×10^{15} Hz. The sources of light radiation are various types of lamps, pointing devices, devices for gas welding and various laser devices. The strongest source of this type of radiation in nature is the Sun. Electromagnetic fields is a common name for the part of non-ionising radiation, which includes electric and magnetic fields and electromagnetic waves of frequencies up to 3×10^{11} Hz (300 GHz). This area covers a wide spectrum of static electric and magnetic fields, fields of network

frequencies, field radio, to microwaves. Earth's magnetic field, electric fields that accompany lightning and electrical storms in the atmosphere are natural phenomena, while all the other electromagnetic fields are largely artificial creation of man. For these fields often use the term electromagnetic pollution. Much to the electromagnetic pollution caused by electric and magnetic fields at power frequency of 50 Hz (60 Hz in the U.S.).

Ionizing radiation are characterized by very adverse effects that are proportional to field strength and duration of exposure. Electromagnetic radiation of very high frequencies from 1015 to 1025 Hz (ultraviolet rays, gamma rays and X-rays) have very short wavelength and consequently high energy photons (up to several MeV). Photons of the radiation causing ionization of molecules, and thereby more or less tissue damage. Heavy damage can result in tissue death and living beings. Significant damage to the reproductive cause mutations and very damaging consequences in the progeny. Ionizing radiation, because of their destructiveness, it is well studied and is subject to international harmonized legislative control. This type of radiation is not the subject of this paper.

SOURCES OF NON-IONIZING RADIATION

Sources of non-ionizing radiation benefit and happiness in everyday life, from the place where we live and work, to the modern means of communication, and they were all created human activities. These sources can be grouped as:

Natural sources - electric and magnetic fields that are created: the earth with its magnetism, solar activity phenomena in the atmosphere during the creation of lightning and others. Earth's magnetic field is oriented in the south - north. Flux density of Earth's magnetic field varies from 30 μT to 70 μT depending on latitude and the composition of Earth's crust. The average density of Earth's magnetic field is 45 μT [2].

Friction electric non-conductive material movement, through the non-conductive substrate that is, movement in conditions of dry air, highlighting the liquid through the tube and in other ways there is a separation of charge and the creation of an electric field. Such a static electric field in extreme cases can create voltage 100 000 V, and can often be the cause explosions if their breakthrough desu in the atmosphere of flammable gases or dust.

Earth also creates a static electric field that depends on the state of the atmosphere. During the calm and clear, the field has a strength of about 200-300 V / m, but the storm can grow to over 10 000 V / m. Also, the natural biological processes create electrical and magnetic fields inside the human or animal body. These fields are primarily the result of cardiac activity, and muscle activities. All cells generate electric fields. Electric field strength of the heart is up to 50 mV / m, and the brain and other vital organs to 5 mV / m. Electrical signals of these fields can be recorded by electrocardiograms (ECG) or electroencephalogram (EEG) and to detect health problems or damage in the body.

Electric power plants and electrical appliances as a source of electromagnetic fields - Electricity produced in power in Serbia is transferred to urban areas by high voltage power lines 110 kV and 400 kV. Transformers to reduce the

voltage to 400/230 V for use in distribution. Are therefore, electric power plants and electrical appliances significant sources of electromagnetic fields, frequency 50 Hz. This field is exposed to a wide population, but also the personnel in those facilities. Transmission lines and transformer stations in your environment create is magnetic radiation is the induction of 5.0 μT to 100 μT more, but at distances of 50 m to 100 m, this value rapidly decreases, as shown in Figure 1. Electric fields, measured under the power lines at a height of 1 meter from the country, reaching values of 0.6 kV / m to more than 10 kV / m.

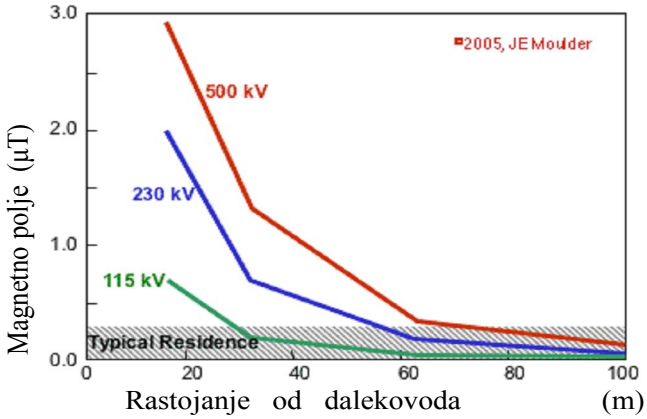

Figure 1. Diagram of the magnetic fields around transmission lines and substations of different voltage levels

Devices in the home- Television screens and computer screens generate static electric fields and alternating electric and magnetic fields of different frequencies. While the older technology of these devices created field strength, which is at a distance of 30-40 cm and was 10 kV / m, and next to the device and more, the new devices do not generate a field greater than 700 nT, and 10 V / m. The value of field strength for different devices, at a distance 30 cm, are given in Table 1 [1].

Table 1. The characteristic values of intensity of electric and magnetic fields at a distance of 30cm from some electrical appliances

Electrical Devices	The intensity of the electric field (V/m)	The intensity of the magnetic field (μT)
Radio	180	1
Fridge	120	0.01-0.25
Iron	120	0.012-0.3
Hairdryer	80	0.01-7
Color TV	60	0.04-2
Aspirator	50	2-20
Electric furnace	8	0.15-3

Other sources - electromagnetic field is created in many other devices, such as automobiles, electric trains, where the carriages magnetic field can reach values up to 50μT, and electric field strength to 300 V / m. Mobile phones and their transmitters are also sources of electromagnetic fields. Mobile phones and their transmitters are also sources of electromagnetic fields. Mobile phone users are exposed to radiation, but not due to adverse effects, because of the very small output power. However, due to the widespread use of mobile phones, the International Commission on Non-Ionizing Radiation Protection(ICNIRP) In his recommendation to the density be limited to a value of f / 200 W / m^2 for the frequency range from 400 MHz to 2 GHz and for the general population [3]. Satellite antennas, radar, microwave ovens and other equipment are also sources of the fields.

CRITERIA FOR ASSESSING THE EFFECTS OF ELECTROMAGNETIC RADIATION ON PEOPLE AND THE ENVIRONMENT

Very large and diverse number of sources of non-ionizing radiation in our environment, resulted in the adoption of appropriate regulations. In European countries there are over 130 laws, regulations, standards and recommendations in the field of radio frequency radiation. Basis for international regulation in protecting people from electromagnetic fields was given by the International Commission on Non-Ionizing Radiation Protection ICNIRP which is the most important document "Recommendations for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)" which was published in 1998. The [3]. It defines two categories of exposure to electromagnetic fields: exposure of the general population (24 hours / day) and exposure (up to 8 hours / day). For each of these categories in particular are set exposure limits (reference noise limits), with the exposure of the general population recommended stricter exposure limits. Of particular importance is the recommendations of the Council of Europe of 12 July 1999. number 1999/519/ES [4], which as a minimum requirement to limit population exposure to electromagnetic fields takes exposure limits for the general population, as defined by the ICNIRP. Member countru's are recommended to limit exposure in the national law must not be less stringent than the ICNIRP limits are, and allows up to national legislation (in accordance with the principle of precaution) to prescribe more stringent exposure limits. In our country, after many years of preparation, in May 2009., the Law on Non-Ionizing Radiation Protection [5]. This Act has finally begun the legal regulation of protection of public health impact of electromagnetic fields. The Act provides that the reference noise limits are prescribed in a regulation that was passed in December 2009. These Regulations for the general population and for industrial frequency 50 Hz, defines the reference threshold level of 40 μT (ie 2.5 times lower level of exposure limits) [6]. Table 2 provides the limits of human exposure (reference noise limits) time-varying magnetic field frequency 50 Hz according to official guidelines and Regulations.

Table 2. Comparative review of exposure limits to relevant documents, for fields of 50 Hz

	Recommendations EU 1999 / 519 / EC ICNIRP Guidelines, 1998		Guidelines ICNIRP i Directive 2004/40/EC.		Regulation on limits of exposure to non-ionizing radiation December 2009.	
	E field	B	E field	B	E field	B
	[kV/m]	[μT]	[kV/m]	[μT]	[kV/m]	[μT]
Professional staff			10	500	5	100
Broad population	5	100	5	100	2	40

EFFECT OF ELECTROMAGNETIC RADIATION ON HUMAN HEALTH AND ENVIRONMENT

Experimental exploration and epidemiological studies it was concluded that electromagnetic fields and waves (which are all around us, and whose intensity increases the daily allowable limits over) constitute the principal threat to our health even if they are within the permissible limits. Experts have warned for years that the first symptoms of diseases caused by harmful action of radiation: increased irritability and nervousness, insomnia, headaches, feeling of malaise and fatigue, anxiety, tendency to depression, difficulties with memory and concentration problems, loss of vitality, reduce physical and mental activity and the like. Today's research clearly indicate that the combined effect of geopatskih fields with harmful effects and electromagnetic radiation could lead to weakening of the organism.

The way in which electromagnetic radiation affects people depends on many factors. Of course, that the most important power sources of radiation, but has a major influence and frequency of radiation. For frequencies below 10 MHz, the primary effect in living tissue is manifested in the form of inducing eddy currents in the body, but still not enough data on the biological effects of non-ionizing radiation of low frequency. At frequencies below 3 MHz are possible shocks or burns on contact with the conductors that are in a strong field, and the frequencies below 100 kHz, expressed pacing cells.

The primary and simplest harmful effects of electromagnetic radiation is heat. Exposure to radio frequency radiation more than mW/cm^2 can cause serious damage to human tissue due to overheating. In certain circumstances it can make a measurable heating of tissues and the radiation whose value ranges između 1 and 10 mW/cm^2, but that does not cause tissue damage. The heat generated by the field dissipates the thermoregulatory mechanism, as a kind of defense the body from overheating.

SAFETY MEASURES OF THE EFFECT OF ELECTROMAGNETIC RADIATION

The effect of a low frequency electric field is relatively simple to eliminate, based upon the principle of the Faraday cage, i.e. by the erection of metal or metal-foil screens. Out of such an installation does not have significant electric field. Magnetic field intensity, low frequency can be reduced in some places only a display of magnetic conductive material. The influences of electric and magnetic fields can significantly

reduce the distance from the source of these fields. Non-ionizing radiation protection is based on the following principles: Exposure to non-ionizing radiation must be below a prescribed limit exposure, the use of non-ionizing radiation sources is justified if it provides benefits exceeding procijnjene damage; any unnecessary exposure to ionizing radiation is not allowed.

In implementing the prevention of non-ionizing radiation to take the following measures: Prescribing the limits of the field strength exposure to ionizing radiation, detecting the presence and determine the level of exposure to non- ionizing radiation; creating better conditions for production, transport, use, marking and recording of non-ionizing radiation sources, which may be hazardous to human health and the zone of dangerous radiation, providing organizational, technical, financial and other requirements for implementing the protection of non-ionizing radiation, the use of funds and equipment for the protection of non-ionizing radiation, control the degree of exposure to ionizing radiation in the environment and control measures taken against non-ionizing radiation protection, provision of professional and health conditions for persons working with sources of non-ionizing radiation, providing material, technical and other requirements for systematic testing and monitoring levels non-ionizing radiation in the environment; Education and training of personnel in the field of non-ionizing radiation in the environment, informing the population about the health effects of exposure to ionizing radiation and protection measures [5].

Technical protection measures on power plants and facilities include, in addition to the above-mentioned, that during the design, equipment selection, construction of transmission and distribution lines and stations traformatorskih, and reconstruction and construction of production facilities, can significantly reduce the effects of electromagnetic fields, or lead the prescribed limit.

CONCLUSION

The influence of electromagnetic fields on health and the wider population of occupationally exposed persons is a problem that more than thirty years attracted public attention. Scientists around the world conduct extensive research on the effects of electromagnetic fields on humans and the environment wihove. So far, the results of the studies did not reliably confirm a direct link between exposure to low frequency electromagnetic radiation of low intensity and the number of patients posmtrane population. However, it is evident that there are harmful effects that depend on field strength, frekifencije and time of exposure and the like. The general conclusion is that we should, whenever possible, to avoid unnecessary exposure to these fields, take necessary measures to protect and abide the rules and regulations which it regulates.

Electromagnetic radiation and ionizing and nejonijuzuća, when it comes to quality of life, can be viewed from two aspects. The first is their influence on the development of human society, and the other is their impact on human health. Today's civilization has increasingly uses electromagnetic waves and fields in a range of technologies. Thus, communication, radio and television, electricity, taensport, medicine, computers, based on Electromagnetic fields and electromagnetic radiation. This progress has enabled people a high quality of life, which until only a century ago could have

imagined. Breakthrough in the study of the universe and its unimaginable without electromagnetic waves, as well as access to the microparticles. Their contribution to the development of modern civilization is the immense importance.

On the other hand, the negative impact of electromagnetic radiation is that in certain circumstances can cause health problems in people (close to the source of radiation, radiation power, wave frequency, ionization). In addition, ionizing radiation are much more dangerous to human health from non-ionizing. What is good in all this is that the non-ionizing radiation in far greater use of ionizing and is therefore greatly reduced risk to human health.

If we measure the contribution of electromagnetic radiation or fields on the development and welfare of human communities and negative effects on human health, we can conclude that the positive effects far beyond the negative effects. In fact the use of electromagnetic fields and waves is the basis of development of modern civilization.

REFERENCES

1. Radiation, Republic of Serbia Ministry of the Environment and Spatial Planning, Belgrade, October 2009.
2. Mileusnic, E. "Exposure to Electromagnetic Radiation, Energy, no. 5, pp. 550-577, vol. (2006)
3. „Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz)", ICNIRP 98 Guidelines 1998. god.
4. „Council recommendation of 12 July 1999 on the limitation of Exposure of the General public to Electromagnetic fields (0 Hz to 300 Hz)", 1999/519/EC, 1999. god.
5. „Act Protection Non-Ionizing Radiation", Sl. glasnik RS br. 36/09 od 15.05.2009.
6. „Regulation on Limits of Exposure to Non- Ionizing Radiation ", Sl. glasnik RS br. 104/09 od 15.05.2009.

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THE SIGNIFICANCE OF GREEN SPACES IN AN URBAN ENVIRONMENT

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ABSTRACT

Green spaces are the reflection of one city's culture, of its inhabitants' lifestyle and of its stature. In any given urban environment greenery secures sanitary living conditions, therefore providing manifold benefits. Parks, connected by green linear systems, tree alleys, constitute the greatest portion of green belts in the cities. What kind of influence do the green spaces exert on the urban environment, and vice versa, how do the urban environments influence the green spaces?

Key words: green spaces, urban environment

INTRODUCTION

When it comes to specific value of plants in an urban landscape, there are many queries, the most important of which is the one about the true meaning of plant material in a particular surrounding: are the (decorative) plants in an urban environment primarily ecological or aesthetic agents, i.e., do the plants, either viewed individually or as parts of the urban green spaces, serve us chiefly as "the producers of cleaner air" or as a source of beauty (Anastasijević, 1998) that is another urgent need of an urban man? [1]

In the cities or inside the infrastructural systems, green spaces are surfaces on which greenery is groomed, often artificially planted and organized according to certain principles: a park, a square, a floral parterre, a lawn, an alley, a group of jardinieres...Beside the urban greenery, the suburban greenery located on the city fringes with its miscellaneous purposes, functions and vegetation, also bears a great significance for cities: the park-forests, the protective green strips around the industrial facilities or drinking water springs, the individual greenery surrounding cemeteries, recreational spaces, excursion sites, etc.

In any urban environment, greenery provides for sanitary living conditions. Its importance is manifold:

- It restores oxygen in the atmosphere,
- It performs the biological function of oxygen and CO2 exchange,
- It regulates air temperature, air pressure and air circulation,
- It increases air humidity and performs ionization,

- It alleviates the effects of street noise,
- It protects from the wind rushes,
- It protects from sand and snow drifts,
- Moisture in leaves of broad-leaved trees delays the spread of flame in case of fire,
- It absorbs dust and soot,
- In the shape of parks and squares, it has a sociological, cultural and educational value,
- It has a positive impact on human physiological functions,
- It has a positive role in the maintenance of degraded soils
- It affects lighting in communities, diminishes reflection,
- It acts as a bactericide in a polluted environment,
- It neutralizes odours,
- It prevents soil erosion,
- It has an invaluable aesthetic worth in the cities.

Different types of trees play an unequal part in the process of gas exchange, which varies from 100% to 700%, depending on the leaf size. Given that in this proportion the common fir tree (*Abies sp.)* has the efficiency of 100%, the numbers for other trees are:

Table 1. Gas exchange of some plants expressed in percentages

Larch	(*Larix decidua*)	118%
Pine	(*Pinus sp.*)	164%
Broad-leaved linden	(*Tilia grandifolia; platyphyllos*)	254%
Oak	(*Quercus sp.*)	450%
Berlin Poplar	(*Populus x berlinensis*)	691%

In urban environments, the artificial surfaces and the natural ones, the green spaces, warm up at different paces. Consequently, there is a discrepancy in the atmospheric pressure above those surfaces. The uneven air pressures strive toward balance. The cooler and denser air from the vegetation moves toward the bare surfaces.

Greenery and vegetation with its vaporizing leaves intensify the humidity of air. With the increase in air humidity, the atmospheric transparency decreases, along with the amount of solar heating, which ultimately leads to temperature regulation. In this way, greenery affects the climate.

Vegetative cover contributes to a more balanced precipitation pattern. Vegetation abounds in water that it draws from the soil. With it physiological vaporization, transpiration, it releases large quantities of moisture. The plant leaves (especially of the woody plants, with large crowns) retain the water from precipitations on their surface, and later it evaporates. This phenomenon is called evaporation. It is the cause of higher air humidity.

The city green, especially its alleys, diminishes the effects of noise by 25%. Since transportation vehicles are responsible for 60 – 80% of noise in urban environments, the protection against them is valuable. Reduction of noise by 15 to 18 dB is possible at a distance of two to three rows of plantings, trees and shrubs. Most of the sound is absorbed by the front 10 - 15 meters of vegetation.

Trees and other green vegetation mitigate the effects of winds, snow drifts and sand drifts. They also contribute to the moderation of the solar regime.

Vegetation has the capacity to slow down air circulation due to enhanced friction. As a result, the areas covered in large portions of vegetation are protected from the impact of cold or hot and dry winds.

Vegetation protects from soot and dust with its leaves by creating a barrier against these substances which due to slower movement accumulate or remain glued to the leaves. The absorbing properties of certain types of vegetation are following:

Table 2. Absorption of dust particles through the leaf surface of some species

Elm	(*Ulmus sp.*)	3,39 gr/m2
Lilac	(*Syringa vulgaris*)	1,61 gr/m2
Linden	(*Tilia sp.*)	1,32 gr/m2
Field Maple	(*Acer campestre*)	1,05 gr/m2
Poplar	(*Populus sp.*)	0,55 gr/m2

Vegetation has a favourable influence on man, on his/her health and on his/her physiological functions. Being in an environment rich in greenery can reduce one's pulse by 4–8 beats per minute. It also affects skin temperature, lowering it by 1–1.3ºC.

With the help of the vegetative cover, it is possible to drain underwater terrains, to ameliorate land, to reduce soil erosion and to recultivate the biologically degraded areas.

A large number of different surfaces in an urban environment (glazed facades, walls, pavements, roadways) reflect light and create light flashes that are unpleasant to the eye. However, greenery indirectly produces better lighting by filtering the polluted air, thereby decreasing the atmosphere's dimness.

Green plantings, both short and tall ones, diminish the unpleasant odours that proceed from various human activities. Particularly effective are the pleasantly-smelling plantings, such as conifers, decorative bushes and floral plantings. [2]

Complex ecological analyses of plants' impact on the environment and the surrounding's impact on plants prove that plant organisms in cities, just as in a landscape, wield an influence proportionate to their quantity: minor amounts of greenery, i.e. a small number of decorative plants is bound to achieve only a minor ecological effect.

PARK

Park is the pivotal element of the urban green system, significant both as a place of daily rest and as a much needed piece of nature. It is characterized by a bigger vegetation volume, amounting to 2–25 ha, giving the highest performance of functions such as improvement of microclimatic conditions, organization of relaxation and the inhabitants' recreation.

According to their territorial features, parks are classified into urban, suburban (on the city fringes) and intercity (beyond the outskirts). In terms of their functional purpose, parks are divided into multifunctional and specialized urban parks. City park's facilities depend heavily on its size and location within the city. Vast parks may contain

an indoor or outdoor sports/cultural centre, a children's playground, minor ball parks, promenades, restaurants, lookouts on prominent points. [3]

It is recommended that the parks be located in parts of the city with favourable natural conditions: zones with already existing green facades, with soil that is suitable for forest vegetation, with water areas, etc.

Relief provides the basis for the construction of park's landscape and its shape either unveils or conceals vistas. The territories with characteristic natural landscapes and existing plantings should be preserved and included in the urban green system in the form of parks, habitats or other types of green spaces. [4]

ALLEYS

Alleys are one of the most important categories of public greenery. Their worth is reflected in their positive sanitary effect, as much as in the aesthetic shaping of the city blocks in both the old streets with dilapidated buildings and the newly developed urban districts. They soothe the city heat in the summer by increasing the relative humidity of air, tone down the urban noise and decrease air pollution. Pedestrian traffic is made more enjoyable by putting up alleys between the pavement and the roadways.

When planning alleys, one must take into account the difficult position of trees in view of the ecological factors that dominate the city streets. A special attention must be paid to the choice of species when planting an alley. Species resistant to harsh environment are chosen, the ones having dense and branchy crowns, fast growth rate and resistance to diseases. In our conditions (in the moderate continental climate), those are: plane tree (*Platanus sp.*), Horse -chestnut (*Aesculus hippocastanum*), linden (*Tilia sp.*), ash (*Fraxinus sp.*), maple (*Acer sp.*), Norway maple (*Acer platanoides*), European nettle tree/ Mediterranean hackberry (*Celtis australis*), Turkish hazel (*Corylus colurna*), etc.

The differences among alleys may be the following: 1) qualitative (one or more species), homogenious or heterogenious, 2) positional (one-sided or two-sided) on one or both sides of the street, 3) structural – one row, two rows or multiple rows on both sides of the street. [3]

The distance between the trunks in an alley is 6 – 12 m, depending on the diameter and height of the crown, the shape and size of the root, the need for sun or shade, the street's profile, the desired waiting period for the final effect. [4]

THE INFLUENCE OF URBAN ENVIRONMENTS ON THE GREEN SPACES

Urban green spaces are threatened by various forms of pollution:

- by all forms of air pollution,
- by secondary thermal radiation from artificial urban surfaces,
- by decreased insolation,
- by unfavourable urban soil,
- by the negative impact of the city's entomofauna
- by the water contaminated with petrolium derivatives, oil from the industrial salt, etc.

Various kinds of human activity and intervention on the plants or in their vicinity may produce a negative effect on the plants: arbitrary cutting, salting over the melted snow and water used for street cleaning, concreting and paving, etc.

Air pollution is also responsible for the depletion of green areas in urban environments. Urban environments that are also industrial are often desperately devoid of green reserves. It sometimes occurs that when building an industrial plant, a factory, the predicted protective belt never develops, but rather gradually turns into construction land: either for the expansion of the plant's facilities or for deposition of waste materials. [2]

When planning green plantings, it is necessary to consult experts in landscape architecture regarding the type of greenery that is the most fitting and the most resilient toward pollution.

When selecting green plants, it is important to:

- use taller plants which are more valuable in terms of hygiene,
- anticipate the insecticides and antisepticides, if possible,
- employ the tree species which are able to endure in the urban conditions, the ones with a fast growth rate, the ones with a lengthy vegetative period and the ones that are resistant to plant diseases.

CONCLUSION

Due to its numerous advantages, greenery is required in any urban environment. Various forms of human activity and interventions in cities in close proximity to green areas may have an adverse effect on the very plants. Therefore, an appropriate attitude toward the planning and maintenance of urban greenery is of vital importance. Apart from all the ecological and biological potentials, the aesthetic function of greenery should not be neglected: it arouses a pleasant mental experience among people, thus (at least partially) cultivating the increasingly dynamic urbanized man.

REFERENCES

1. Anastasijević, N., Vratuša, V., „Analiza estetske vrednosti biljaka u formiranju slike velikog grada", Zbornik radova Ekološkog pokreta grada Novog Sada, 445 – 450, volume I, Ekološki pokret grada Novog Sada, 1999.
2. Đukanović, M., „Ekološki izazovi", Elit, Beograd, 1991.
3. Anastasijević, N., „Podizanje i negovanje zelenih površina", 87-93, Šumarski fakultet, Beograd, 2002.
4. Vujković, LJ., „Pejzažna arhitektura – planiranje i projektovanje", 88-93, Šumarski fakultet, Beograd, 2003.

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URBAN EARLY WARNING TO THE THREAT OF FLOODS FOR THE CITIZENS OF NOVI SAD

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ABSTRACT

Natural characteristics of Vojvodina and more and more frequent meteorological phenomena and extremes make flood a constant threat to our survival every year. Based on that, the Public Water Management Company "Vode Vojvodine" published the competition for elaboration of conceptual solution for early warning in cases of threats of flood on the Danube at Novi Sad. The significance of this competition is in evoking and rising of awareness on the relevance of flood defence on one of the largest and most important rivers not only in our country but also in the world – the Danube River, all aimed at educating and warning the citizens of Novi Sad. The paper explains in details the significance of the conceptual solution that won the first prize at the competition via historical data on floods in Novi Sad.

Key words: floods, the Danube, warning, Novi Sad

INTRODUCTION

Novi Sad was established in 1694. Today, it has more than 400,000 inhabitants and it is the largest city and the centre of public administration bodies of the Autonomous Province of Vojvodina, the northern province of Serbia, and administrative centre of the South Backa District with a long history and tradition, and a large number of monuments of culture that make Novi Sad unique and special. Novi Sad is located on the banks of the river Danube (between 1,252th and 1,262th kilometre of the river flow). On the left bank of the river, there is a flatland part – Backa, and from the right the hilly part on the foothill of Fruska Gora Mountain – Srem.

The Danube springs in the foothill of the Schwarzwald Mountain in Germany and it flows with its delta into the Black Sea. The flow length makes the Danube the second largest river in Europe, and it flows through Germany, Austria, Slovakia, Hungary, Croatia, Serbia, Romania, Bulgaria, Moldova, and Ukraine. The Danube is a powerful and large river, not only in Europe but also in the world. It is the main recipient and regulator of surface and ground waters in the territory of Vojvodina, primarily of Novi Sad.

Considering that Novi Sad arose on the banks of the Danube, its development has been oriented to that river and it has largely depended on it. Looking from that

aspect, the Danube is very important for providing of economic development (industry, agriculture, water transport, drinking water supply, etc.), development of water sports, river tourism, etc. However, it can also show its negative side, which means floods and drought. Numerous floods have been recorded in a long history of Novi Sad.

MATERIAL AND METHODS APPLIED IN THE PAPER

The data of the Hydro-meteorological Institute of the Republic of Serbia on water levels on the Danube at Novi Sad were used for the needs of this paper. The systematisation of water levels determined the maximum water levels and singled out two absolute water levels (from 1965 – 778 cm, and from 2006 – 745 cm). Those two water levels were used for fulfilment of the objectives.

The research methods that were used in the paper include:

- Methods of analytical study of all the factors that are relevant for early warning
- Researches on the site of the future "Urban hydrological benchmark display"
- The conclusion on significance of potential setting of the "Urban hydrological benchmark display" was reached via synthesis based reasoning.

HISTORY OF FLOODING IN THE CITY

Floods are the most frequent in our sector of the Danube by the end of winter, during spring, and beginning of summer. The construction of defence dikes protected significant surfaces against flooding from water courses. However, although the dikes resolved the issue of protection against direct flooding with water from the water course, the flooding occurs on defended surfaces, namely on wider inland territory of Vojvodina. That was the basis for the following division: flooding from external waters (dike over spilling and breach) and flooding from inland waters (large precipitation quantities).

When it comes to historical phenomena of high waters in our sector, there are no available reliable-registered hydrological data, except for the date and year of emerging. The years of application of certain elements of measuring and monitoring at Hydrological Station Novi Sad are presented in Table 1.

Table 1. Elements of water level measuring and monitoring

Method of water level registering:	Years
1. The bar since	1919
2. The liminigraph since	-
3. Digital registering since	2006
4. Water level measuring since	1945
5. Water temperature measuring since	1948
6. Suspended deposit flow since	-
7. Occurrence of ice since	1900
8. Water quality testing since	1965
9. Reporting method	Telephone

The years with floods in the City of Novi Sad are presented in Table 2, together with characteristics of those floods.

Table 2. Years with floods in the City of Novi Sad and characteristics of those floods

Years	Water level of the Danube (cm)	Characteristics
1770	+620	The first recorded flood. A larger part of the city, city centre and its direct vicinity were surrounded with water from all sides and became an island during the flood period (30 days). The disappearance of the fishermen's settlement (in the vicinity of the former railroad bridge) is connected with this flood.
1876	+650	Despite the measures that were undertaken and huge efforts, the city was not defended against high waters of the Danube and it was flooded again, just as it was 100 years before that.
1926	+659	The Report of the Water Directorate that was compiled on the occasion of those catastrophic floods stated: "In resolving of a number of problems that arise from the analysis of causes of the flood, it would be of great significance to establish co-operation between the hydro-metric service of Hungary and the one in our country that would be aimed at exchange of necessary data."
1940	+706	The existence of the telephone line and facilitated communication with dike watch towers. Based on the information on the water level the forecasts were made related to certain water metering stations on the flood wave migration, namely better organisation of flood defence (the defence lasted for 14 days). The elevation and strengthening of the existing dike. The breach at Sombor railroad, flooded Adamovic's settlement. More than 3,000 inhabitants of Telep were left homeless. The construction of the dike in the length of 2.3 km implied the use of 40.000m^3 of soil.
1965	+778	Novi Sad was under direct threat and intervention demolition of certain upstream dikes was undertaken in order to discharge surplus water into arable land in order to save the city. Flood defence lasted for 128 days (the longest until then). If the dike had been breached 80% of the City of Novi Sad would have been flooded. After those floods, the threat from the Danube was largely diminished due to the construction of the dike system.
2006	+745	Once again, we witnessed a long and tiring flood defence struggle. Around 225,000 ha of arable land were under water, residential and industrial facilities were flooded, some residential premises were destroyed, and a large material damage was caused. After those large scale floods it was decided to reconstruct the quay wall. The existing defence line at the Belgrade Quay was elevated for 60 to 80 cm on the average.

Due to the fact that floods have become more and more frequent, the need has arisen to establish an urban early warning system based on the benchmark that would show how floods are destructive and how important is the timely knowledge on their arrival for protection of the population, as well as significant institutions and structures.

URBAN BENCHMARK DISPLAY USED TO WARN THE CITIZENS OF NOVI SAD ON THE THREAT OF FLOODS

The objective of the "Urban hydrological benchmark display" is to provoke and strengthen the awareness on the significance of flood defence and to serve for education and warning purposes. The facility consists of two parts: the "benchmark" that is set vertically, and a chess field that is set horizontally.

Figure 1. The "benchmark" and the chess field

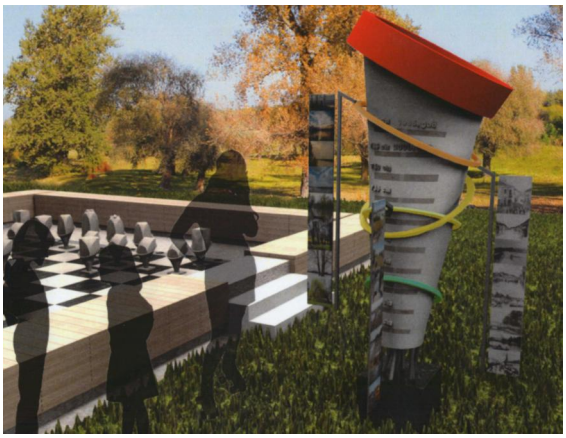

Figure 2. The "benchmark"

The "benchmark" (which represents and new symbol and urban detail in the City) was designed to read different water levels of the Danube and in the case of elevated level it warns to the threat of floods. Water level reading from the water metering bar on the "benchmark" is enabled via the electronic "reader", which was designed to connect with the electronic device in the Public Water Management Company "Vode Vojvodine" and send data on a daily basis. In addition to water level reading and warning of floods, the "benchmark" also contains three static frames. Within

the frames, there are photographs, namely presentations of the City of Novi Sad during floods from the past, the current situation, as well as the display of potential scenario of flooded significant institutions in the City of Novi Sad in the case of future high flood wave on the Danube.

The "benchmark" is of a conical shape. It also consists of three elliptical rings that are connected with the water level and that are of different colours, each with a different meaning. For example, the green colour represents a normal water level of the Danube, yellow represents the introduction of measures of regular flood defence (e.g. the criterion for regular flood defence at Bezdan is 500 cm, and at Novi Sad it is 450 cm), orange represents extraordinary flood defence (e.g. the criterion for extraordinary flood defence at Bezdan is 700 cm and at Novi Sad it is also 700 cm) and on the top a large red elliptical ring that represents the arrival of a flood wave. It is planned for each ring to glow so that the information on the current water level on the Danube would be available to everyone and at all timers. The light would be seen both on land and on the Danube. The dimensions and material that the "benchmark" would be made of depend primarily on its location, but it certainly should not disturb the concept of the surroundings and surrounding structures.

The chess field: (presented in Figure 1) its purpose is to provide a form of entertainment and recreation. It would be located directly beside the vertically set "benchmark" so that the largest number of people possible (players, passers by and tourists) could see the vertically set "benchmark". The chess field is dug in so that it can provide space for sitting and watching the game. In addition, during rainfalls, the field is filled with water and the game terminates, which suggests that floods interrupt functioning of people and the surroundings. Since the field is dug in, the problem of precipitation, discharge would be resolved via drainage.

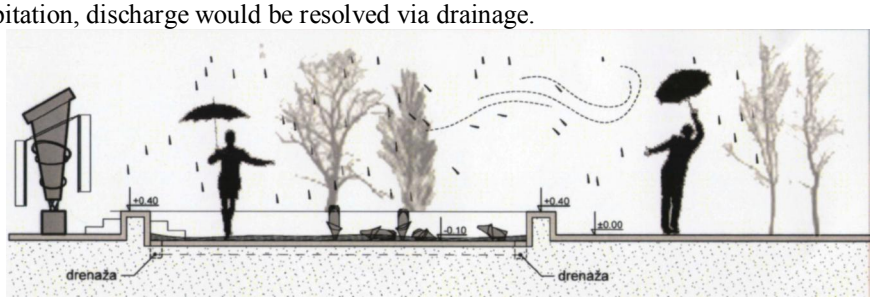

Figure 3. The "benchmark" during rain

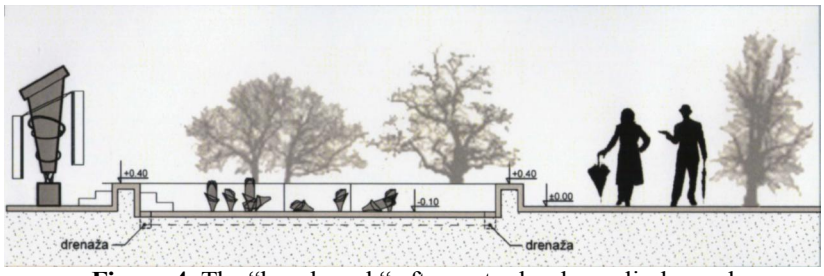

Figure 4. The "benchmark" after water has been discharged

The figures in the chess field follow the concept of vertically set "benchmark", namely they are of the conical shape, each figure being typical in its own way without disturbing the concept of the structure as a whole. The dimensions and material that the chess field would be made of depend primarily on its location, but it certainly should not disturb the concept of the surroundings and surrounding structures.

CONCLUSION

Despite a relatively high level of protection against floods, nature can often surprise us unpleasantly, which, in extreme cases, leads to over spilling of rivers from their beds. In such case, only a fast and efficient intervention can prevent large scale damages on economic and residential structures. That is the main purpose of the "benchmark" that serves to warns on floods. The result of the overall project should show and contribute to better information of people on floods, warn them on potential consequences and serve for recreation and enrich visually the selected site.

However, the problem with floods cannot be resolved by such an "urban benchmark". If such type of benchmark would be used in all the countries, namely cities and villages through which the Danube flows, and if those benchmarks would be connected, much higher efficiency and speed in resolving of problems that we are faced with today would be achieved. The possibility to accomplish the connection of the "urban warning benchmark for the citizens of Novi Sad on threat of floods" would contribute to better informing of people and eliminate in such a way or minimise potential consequences of floods in the future. This benchmark can also have a wider application, in particular in places with smaller rivers and places where floods have already occurred previously or places where there is the possibility of their occurrence. This type of benchmark used to warn on the threat against flood is a novelty and there is nothing similar to it in practice.

REFERENCES

1. http://www.turizamns.rs/istorija-2/
2. http://www.vodacom.co.me/mne/marketing/rekli-su-o-vodi
3. Wikipedia, Dunav, http://sr.wikipedia.org/sr/Dunav
4. Wikipedia, Novi Sad, http://sr.wikipedia.org/sr/Novi_Sad
5. Milošev Žarko: Poplave u Novom Sadu tokom prostornog razvoja grada 1770 - 1965

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USE OF LANDSCAPE ARCHITECTURE IN ENVIRONMENTAL REGULATION OF WILD BEACH 'OFICIRAC' IN NOVI SAD

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ABSTRACT

Design of the riverbanks in the form of beach and regulation of its banks is an important element of improvement as well as concerns about ecology.Ways of designin and arranging banks are in a special form of regulation of public green spaces and therefore must comply with these conditions.Beach Oficirac is by the project of organization divided into five functional areas:entertainment,bathing beach,sport and recreation,parking and resting zone.

Key words:enviromental regulation,beach,wild waste,sand

INTRODUCTION

Rivers are an important factor in the life of the sity ,not only from the standpoint of the organization work zones,traffic and utility equipment but also as an element of urban landscape that it can enrich,enhance and make more interesting and more human.On the other hand ,close to the river-movable,the element can be moody and harm the city,its structure and unbuild degrade the quality of life in it.Rivers mean a very significant hydro potential of a country.They have a very significance and recreational properties are primarily in the form of swimming,water sports ,the use of rest and recreation,room of its bank,etc.and what kind of recreational activities will take plase of the river depends primarily of its properties.Danube River is the second largest in Europe,and near Novi Sad flows the length near 50 km and o the waterway from the source to the mouth of the Black Sea from 1233 to 1283 km and its significance for Novi Sad is very big.All above its importance for Novi Sad is that it draws from the tap water,it is traffic,with him are the most beautiful cottages,forests and beaches and many others.Because of this characteristics of the river,arrangement of its coast is indeed an important element in advancing the environment and the care of ecology.

METHODS AND MATERIALS OF WORK

Officier beach is located on the right of the Danube,across from Novi Sad,a little downstream of the Petrovaradin,where the Danube makes a sharp bend,and turns to the southeast,at 1252 km and belongs partly to the Koviljsko-Petrovaradin marsh,which is one of the natural protected goods.If not the most beautiful thenit is certainly one of the most popular and the oldest bathing resorts in Novi Sad.But Officier beach falls into the category of" wild swimming beach",which among its charms its accompanied by numerous problems related to the actual space resort and beyond.Problems are the first of all wild dump on the beach,the problem of extracting sand nearby,the road works arond that distort the appearance,contamination,rusty pipes that are used for pumping sand and therefore it is located on the beach threatening not onljy appearance but also the safety of the people who spend their time here.

The current state of the beach as mentioned is very bad. Area which occupies a space that is used as the beach is sandy with very slight drop by the river. On both sides there are large quantities of excavated sand deposited which violates the look together with a large amount of rusty pipes set a side (Figure 1., Figure 2.).

Figure 1. Current state- large quantities of excavated sand

Figure 2. Current state- Rusty pipes

Due to the growing needs of the population for the arrival of the beach and their growth,and simultaneously increasing carelessness and lack concern about waste whose influence is damaging. On the other hand an increasing number of visit ilustrates the necessary arrangement and expansion of the beach in order to create an optimal environment to visit and vacation residents, because above all it is a public space accessible to all residents.The vegetation is stretch along the coast but there are plenty in the dense, so it loses the aeshtetic appearance of the coast. The analysis of the biological basis of existing species was found some kind should be replaced. Basic needs such as showers, toilets, dressers, trash bins and other equipment belonging to the principle of accessible beaches are left and the path that leads to the beach is without pavement, communication is not properly connected to the main road from Petrovaradin. All these items show that these beach is an example of degraded and neglected area, especially in environmental terms.However many people and through it all visit these beash in summer months and therefore the aim of this project is primarily ecological regulations in accordance with the basic ecological principles ,as well as meeting the needs of people for better organized area.Residents visiting the beach are mostly sitizens of Petrovaradin and are located in larger numbers,of course in addition to other citizens of Novi Sad and its surroundings.According to statistics on population surveys Petrovaradin and the number of visits to the beach Oficirac,results suggest that a greater number of them regurarly visit this beach.

RESULTS OF WORK

Acording to the project,given that the plan purpose planing bathing beache,the wild character of the of the existing poor condicion,there is the possibility of solving the reconstruction of the wild beach Oficirac.The starting point for development of this project was the functional data on (Figure 3.) under which the territory of beach is divided into five segments that are associated with communications that had to be connected to the city roads. In further text are details and description of solition (Figure 4.).

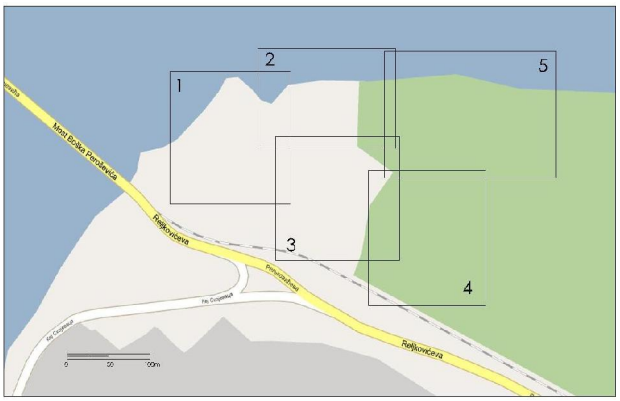

Figure 3. Functional scheme: Zone1-fun and entertainment, zone 2- bathing beach, Zone 3-rest, Zone 4-parking, Zone 5-sport and recreation

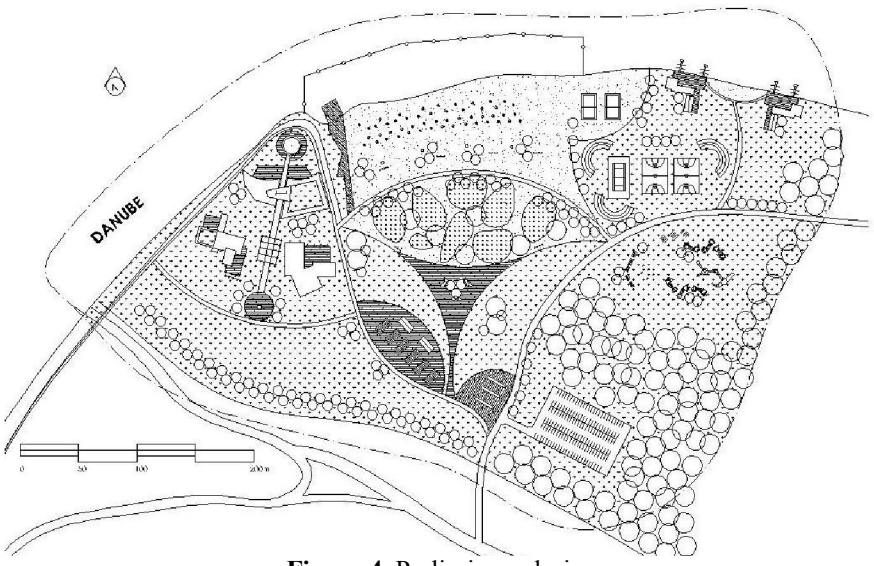

Figure 4. Preliminary design

Figure 5. Legend

Zone 1-fun and entertainment

This area begins with an entrance from the south side. Main content of this zone is establisments (cafes,restaurants.gardens) intended for fun and relaxation. Also there is planed a stage for smaller concert performances.Because of the proximity of the railway here is the planned zone of woody and bushy vegetation as a buffer zone. Catering facilites are arranged and designed in accordance with the owerall arrangement of the beach.They are eco-friendly design and the construction also mean a use of ecology as it is planned to use solar energy and some of them also planned construction of roof gardens. Because one part of this zone is located at higher altitude than the rest of the beach, with which one can enjoy beautiful views of the opposite side of the Danube river bank.Therefore it can be used as a kind of viewpoint.

Zone 2-bathing beach

Represents the most important part for the visitors because of the sandy beach, whih is regulated in accordance with their needs. Fall of the beach to the river is 3 %, thus providing easy access to water especialy for younger and older persons. From equipment located in this part there are four platforms for beywatch, many umbrellas and deck chairs, benches, showers, trash bins and lighting.The left side of the beach is provided for a little while, wooden blinds will appeal to the holidays and other activities to the needs of visitors. For the wall that is the end of enbakment is planned to build dry stone wall, with the use of perrenials to achieve a visual, aesthetic and sanitary hygiene function. From security reasons it is nesssary to set th buoys on the watr and limit the space for swimmers.

Zone 3-rest

This zone is located in the central part of the territory.Within these zone there are three parts.The first goes to the different zone and its function is similar to the above mentioned and it can also be used as a plase for sunbathing and recreation.The difference is in the number of trees(here is less).A space for sunbathing is a combination of sand and grass wnich is a system of green spots.The center of this zone is intented for retailers which are located on the wooden path. Second part of this zone has a sanitary function and contains toilets, changing rooms and a fountain.The entrance side of this zone is reserved place for storing bikes, with the halo rostrum and information board about the area of the beach.

Zone 4-parking

This is the part of the main entrance to the beach and is therefore provided addition to pedestrian and vehicular access.By the project is planned the parking for 100 parking spaces. Because of the noise insulation and a part of pollution transport and railway thet is nearby ,it is planned to make a thick protective strip of vegetation.

Zone 5-sport and recreation

It is located on the eastern part of the beach and within this zone is planned to raise ancillary facilities for sport and recreation on the water (boat rental).It is also planned to set up courts for volleyball, basketball and table tenis. For younger children

there are content for creative play (mounting climbing, slides, see-saws, swings and various interesting benches).

In all zones the vegetation was used is accordance with soli and other geological and climatological conditions, which are primarily woody plants of some specius of the genus *Salix, Populus, Alnus, Robinia sp.* (cultivars without thorns). There are also many of ornamental grasses. For dry stone wall where used *Allysum sp., Sagina subulata, Veronica incana, Sedum sp., Plox subulata.* Paths are paved with wood and combination of stone slabs.

CONCLUSION

This new arrangement area is contributing even greater decorative of city of Novi Sad.Part of the beach is extended,so that visitors can rest,walk around and enjoy a cleaner and safer environment and freely use this surface. The problem of waste materials is solved,why is this part of assumed much greater importance in ecological meening. Visitors have all the necessary equipment and pipes are moved. The location for the extracting sand is also moved and placed at the edge of the town. We think that with this proposals we pointed to a long existing problem and gave an example solution for existence of a very beautiful and functional green spase.

REFERENCES

1. Harris, C., W., Dines, N., T., Time-saver standards for landscape architecture in design and construction data, McGraw-Hill Pablishing Company, 1998.
2. Neufert P., Neufert, E.: Arhitects' data, Third edition, Blackwell science
3. Selman, P., Planning at the landscape scale, Routledge, London and New York, 2006.
4. Vujović, Lj., Nećak, M., Vujičić, D., Tehnika pejzažnog projektovanja, Šumarski fakultet, Beograd, 2003.
5. Vukićević, E., Dekorativna dendrologija, Šumarski Fakultet Univeritet i Beogradu, Beograd, 1996.
6. Vujković, Lj., Pejzažna arhitektura-planiranje i projektovanje, Šumarski fakultet, Beograd, 2003.

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PROTECTIVE EFFECT OF CAMPHOR AND EUCALYPTOL AGAINST UV-INDUCED MUTAGENESIS IN BACTERIA

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ABSTRACT

Genotoxic influence is implicated in many important human diseases, including cancer. Nowadays, when the environment is severely disrupted, with increasing influence of genotoxic agents, it may be helpful to isolate and characterise bioactive substances that could protect against DNA damage, in order to use their possible protective effect for chemoprevention. In this research we determine whether pre-treatment with camphor and eucalyptol had antimutagenic effect against UV-induced mutagenesis. Research was conducted using *Escherichia coli* K12 reverse mutation assay. Protective properties of both substances were detected, with the highest inhibition of mutagenesis obtained at medium dosages. The protective effects against UV-induced damage, obtained in bacteria, could be valuable basis for further research in eukaryotes and human cell lines, especially important due to increasing destruction of atmospheric ozone layer.

Key words: Antigenotoxicity, UV-irradiation, Bacterial reverse mutation assay, Monoterpenes

INTRODUCTION

Genotoxicity is common negative impact from different environmental, exogenous, and endogenous sources. Negative influence of genotoxic agents can produce different types of DNA lesions (Simić et al., 2002), and if they are not correctly repaired they could be processed into mutations. Living organisms have developed a spectrum of mechanisms that reduces the rate of mutations to a level that is acceptable in terms of preserving the integrity of the genome and enabling successful reproduction. Since the problem of DNA damage has existed *ab initio*, DNA repair mechanisms must have arisen early in evolution, and consequently all known repair pathways are highly conserved, even across the pro/eukaryotic evolutionary border (Eisen and Hanawalt, 1999).

In order to protect human health, a relatively new area of research, designated as antimutagenesis/anticancerogenesis, is continuously developing (De Flora et al, 2001; De Flora et al, 2005). Basic categorization of antimutagens in two major groups: bioantimutagens and desmutagens, was given by Kada et al. (1986). Bioantimutagens are modulators of DNA replication and repair, which prevent processing of premutagenic lesions into mutations.

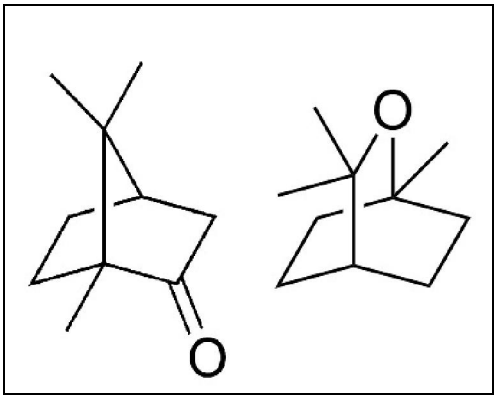

Figure 1. Chemical structures of camphor (left) and eucalyptol (right).

Desmutagens are agents that inhibit conversion of promutagens into mutagens, inactivate mutagens or prevent their interaction with DNA.

Terpenes are the largest group of natural substances (Wang et al, 2005). They are abundantly found in fruits, vegetables, and aromatic and medicinal plants, with important role in protection against various stressors. A variety of monoterpenes and their derivatives have been shown to exhibit cancer chemopreventive and chemotherapeutic properties (Crowell, 1999). Monoterpenes investigated in this study, camphor (C) and eucalyptol (E) (According to IUPAC, camphor is named as 1,7,7-trimethylbicyclo[2.2.1]heptan-2-one, while eucalyptol is named as 1,3,3-trimethyl- 2-oxabicyclo[2,2,2]octane.), are presented in essential oils of many medicinal and aromatic plants, including sage, eucalyptus etc. In our previous work antimutagenic potential of essential oil of sage, as well as C and E, have already been determined (Knežević-Vukčević et al, 2005; Vuković-Gačić et al, 2006).

The goal of this work was to evaluate the bioantimutagenic effect of C and E against UV-induced mutagenesis. The research was performed by reversion assay in repair proficient strain *E. coli* K12 SY252 (Nikolić et al, 2004). The strain contains *argE3* mutation (ochre), leading to auxotrophy and can revert to prototrophy by base substitutions (Tood et al, 1979). The experimental set-up included antimutagen pre-treatment assay.

MATERIALS AND METHODS

Bacterial strains:

The bacterial strain of *E. coli* K12 used in this research was repair proficient SY252, with *argE3* relevant marker (Nikolić et al, 2004).

Chemicals, media and growth conditions:

D, L-Camphor (Cas No. 76-22-2, Alfa Aesar) and Eucalyptol (Cas No. 207–431-5, Fluka) were freshly dissolved in dimethyl sulfoxide (DMSO). Bacteria were grown overnight in LB medium (5 g yeast extract, 10 g Bacto tryptone, 5 g NaCl, 3 ml 1M NaOH, 1000 ml distilled water) at 37°C. Semi-enriched minimal medium (minimal medium supplemented with 3% (v/v) nutrient broth) - SEM (as described by Witkin,

1976) and top agar (5 g NaCl, 6 g agar, 1000 ml distilled water), were used for *E. coli* K12 reversion assay.

Ultraviolet irradiation:

UV-irradiation was carried out with a germicidal lamp (Benda, NU-8 KL) having maximum output at 254 nm (UV-C). Dose rates were measured with the Latarjet dosimeter (Latarjet et al, 1953). Cell suspensions in 0.01M $MgSO_4$ were irradiated in glass Petri dishes at a thickness of less than 1 mm. Cell suspensions and plates were kept in the dark to prevent photoreactivation.

Assay for detection of antimutagenic potential:

Overnight cultures of bacteria were dissolved in LB medium (1:14 rate) and incubated with a rising set of concentrations of test-substances with aeration on a 150rpm shaker (Heidolph Unimax 1010; Heidolph Incubator 1000), at 37 C°, for 120 minutes. Afterwards, cells were washed by centrifugation at 1700*g* for 10 minutes (Heraeus Sepatech Centrifuge) and resuspended in the same volume of 0.01M $MgSO_4$. For UV-treatment, cell suspension was irradiated with dosage of 28 J/m^2. Samples (0.1 ml) of unirradiated and UV-irradiated cells, appropriately diluted for determination of cell survival and Arg^+ revertants, were added to 3 ml of molten top agar, mixed and quickly spread on SEM plates in triplicates. Plates were incubated at 37 °C for 48h. Two control groups were made: distilled water as negative control and DMSO as a solvent control.

Statistical and graphical data preparation:

The Student's t-test was employed for statistical analysis. Significance was tested at the $p<0.05$ level. The results presented in figures and tables are expressed as the means from three independent experiments performed in triplicates, with the standard error of the mean. In all applied tests, we calculated the percentage of inhibition of mutagenesis (%I) as described by Wall et al. (1988) and categorised it as described by Ikken et al. (1999). Origin 8 SR0 v8.0724 (OriginLab) software package was used for the statistical analysis, while Adobe Photoshop CS4 v11.0.1 (Adobe Systems Incorporated) was used for adequate adjustment of raw images and image format conversion.

RESULTS AND DISCUSSION

The antimutagenicity screening was performed by antimutagen pre-treatment assay performed in repair proficient *E. coli* K12 strain. Bacteria were pre-treated with rising non-toxic concentrations of test-substances and after that irradiated with UV dosage that gave high mutagenic response with about 50% of lethality (chosen in preliminary experiments, data not shown).

Both C and E managed to inhibit UV-induced mutagenesis with optimal inhibitory range obtained at medium concentrations tested (Tab. 1, Fig. 2). C induced the highest inhibition at 0.167 μg/ml (41%); its inhibitory effect decreased at higher tested concentrations. The moderate inhibition of mutagenesis obtained with E (31%) was maintained in the concentration range 0.167-0.33 μl/ml, but it was diminished at higher concentration.

Table 1. Antimutagenicity screening results.

Camphor							
concentration [µg/ml]		**0**	**DMSO**	**0.033**	**0.167**	**0.33**	**1.67**
UV^-	Viability/plate[1)]	36±3	39±4	31±2	40±2	32±3	37±3
	Arg^+ revertants /plate[2)]	11±2	8±3	12±3	12±3	11±4	11±2
UV^+ (28 J/m^2)	Viability/plate[1)]	124±11	100±4	132±2	114±1	96±14	120±13
	Arg^+ revertants /plate[2)]	110±6	173±11	137±16	103±4*	120±10*	113±12*
%I [3)]				*21*	*41*	*31*	*34*
Eucalyptol							
concentration [µl/ml]		**0**	**DMSO**	**0.033**	**0.167**	**0.33**	**1.67**
UV^-	Viability/plate[1)]	39±4	49±3	43±2	48±1	48±5	50±3
	Arg^+ revertants /plate[2)]	14±3	16±4	12±2	14±4	12±4	14±4
UV^+ (28 J/m^2)	Viability/plate[1)]	156±6	152±13	154±9	141±11	153±6	158±12
	Arg^+ revertants /plate[2)]	181±16	214±13	189±17	148±12*	148±8*	209±18
%I [3)]				*12*	*31*	*31*	*-4*

The results are presented as the means obtained from three independent experiments performed in triplicates, with the standard error of the mean.

[1] To determine viability cell dilution was 10^{-6} for UV^-, and 10^{-5} for UV^+.

[2] To determine mutagenesis cell dilution was ½.

[3] Inhibition of mutagenesis (%I =100% x (1-Nt/Nc); Nt-recombinants/plate with test substances, Nc-recombinants/plate in solvent control).

* $p<0.05$.

UV-irradiation induces DNA lesions such as cyclobutane-pyrimidine dimers and 6–4 pyrimydine-pyrimidone photoproducts (Sinha et al, 2002). These lesions are repaired mainly by nucleotide excision repair (NER), which plays an important role in DNA repair. In addition, mechanisms such as photoreactivation and post-replicative recombinational repair are included in establishing the original DNA sequence. However, translesion DNA synthesis (replicative bypass) is also induced by UV-induced DNA damage and it contributes to mutants' formation (Friedberg et al, 2006). Substances with bioantimutagenic effect can act to propagate small amount of DNA lesions that consequently elicits repair mechanisms to repair all DNA damage more intensively, including UV-induced damage (Sinha et al, 2002). But, when the concentration of these substances becomes too high, produced DNA damage can saturate all "error-free" reparative enzymes and hence stimulate "error-prone" repair, eventually leading to mutagenic effect. Therefore, when we establish a test substance as a bioantimutagen, it is important to determine the optimal concentration range that will actually be protective against genotoxicity and mutagenesis.

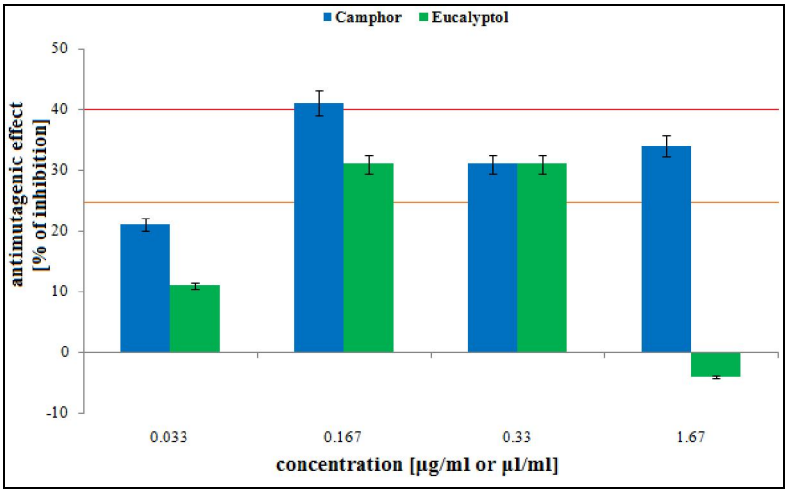

Figure 2. Antimutagenic effect of camphor and eucalyptol against UV-induced mutations in the repair proficient strain. (Orange line indicates lowest level of moderate antimutagenic effect (%I=25%), while red line indicates lowest level of strong antimutagenic effect (%I=40%). Categorisation of antimutagenic effects according to Ikken et al, 1999.)

According to our results, it is appropriate to claim that pre-treatment of repair proficient strain with C and E induced moderate antimutagenic effect against UV-induced mutagenesis. This is in harmony with previously reported data, which indicated antimutagenic effect of post-treatment with C and E against UV-induced mutagenesis (Vuković-Gačić et al, 2006). It is important to emphasise that E also reduced oxidatively-induced mutagenesis and genotoxicity (Mitić-Ćulafić et al, 2009), pointed at possible multiple mechanisms of antigenotoxic/antimutagenic potential. In order to elucidate the molecular mechanisms of antimutagenic action of C and E, further research in strains deficient in different DNA repair processes should be conducted.

CONCLUSIONS

Taken together, we can conclude that our results recommend monoterpenes camphor and eucalyptol for further antimutagenicity and antigenotoxicity research against differently induced DNA damage, and in different test-systems. Bearing in mind the evolutionary conservation of many cellular functions, including DNA repair processes, this could be valuable basis for further evaluation of protective potential in eukaryotes, and ultimately in human cell lines.

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REFERENCES

1. Simić D., Knežević-Vukčević J., Vuković-Gačić B., Mitić D., Berić T., Nikolić B., Stanojević J., Stanković S., 2002. Genotoxic effect of environmental pollutants, genotoxic monitoring and detection of antigenotoxic effects, In: Antić D.P. and Vujić J. Lj. (Eds.), Environmental Recovery of Yugoslavia. Vinča Institute of Nuclear Sciences, pp. 378-382.
2. Eisen J.A., Hanavalt P.C., 1999. A phylogenomic study of DNA repair genes, proteins and processes. Mutat. Res. **435**, 171-213.
3. De Flora F., Izzotti A., D'Agostini F., Balansky R.M., Noonan D., Albini A., 2001. Multiple points of intervention in the prevention of cancer and other mutation-related diseases. Mutat. Res. **480-481**, 9-22.
4. De Flora F., Ferguson R.L., 2005. Overview of mechanisms of cancer chemopreventive agents. Mutat. Res. **591**, 8-15.
5. Kada T., Inoue T., Ohta T., Shirasu Y., 1986. Antimutagens and their modes of action, In: Shankel D.M., Hartman P.H., Kada T., Hollaender A. (Eds.), Antimutagenesis and Anticarcinogenesis Mechanisms. Plenum Press, New York, pp. 181-196.
6. Wang G., Tang W, Bidigare R.R., 2005. Terpenoids as therapeutic drugs and pharmaceutical agents. In: Zhang, L., Demain, A.L. (Eds.), Natural Products: Drug Discovery and Therapeutic Medicine. Humana Press, Totowa, pp. 197–227.
7. Crowell P.L., 1999. Prevention and therapy of cancer by dietary monoterpenes. J. Nutr. **129**, 775S–778S.
8. Knežević-Vukčević J., Vuković-Gačić B., Stević T., Stanojević J., Nikolić B., Simić D., 2005. Antimutagenic effect of essential oil of sage (Salvia officinalis L.) and its fractions against UV-induced mutations in bacterial and yeast cells. Arch. Biol. Sci. **57**, 163-172.
9. Vuković-Gačić B., Nikčević S., Berić-Bjedov T., Knežević-Vukčević J., Simić D., 2006. Antimutagenic effect of essential oil of sage (Salvia officinalis L.) and its monoterpenes against UV-induced mutations in Escherichia coli and Saccharomyces cerevisiae. Food Chem. Toxicol. **44**, 1730-1738.
10. Nikolić B., Stanojević J., Mitić D., Vuković-Gacić B., Knezević-Vukcević, J., Simić D., 2004. Comparative study of the antimutagenic potential of vitamin E in different E. coli strains. Mutat. Res. **564**, 31–38.
11. Tood P.A., Monti-Bragadini C., Glickman B.W., 1979. MMS mutagenesis in strains of E. coli carrying the R46 mutagenic enhancing plasmid: phenotypic analysis of Arg^+ revertants. Mutat. Res. **62**, 227-237.
12. Witkin, E.M., 1976. Ultraviolet mutagenesis and inducible DNA repair in Escherichia coli. Bacteriol. Rev. **40**, 869-907.
13. Latarjet, R., Morenne, P., and R. Berger (1953). Un appareil simple pour le dosage des rayonnments ultraviolets emis par les lampes germicides. Ann. Inst. Pasteur. **85**, 174 - 179.
14. Wall E.M., Wani M.C., Hughes T.J., Taylor H, 1988. Plant antimutagenic agents, 1. General bioassays and isolation procedures. J. Nat. Prod. **51**, 866-873.

15. Ikken Y., Morales P., Martinez A., Marin M.L., Haza A.I., Cambero M.I., 1999. Antimutagenic effect of fruit and vegetable ethanolic extracts against N-nitrosamines evaluated by the Ames test. J. Agric. Food Chem. **47**, 3257–3264.
16. Sinha R.P., Häder D.P., 2002. UV-induced DNA damage and repair: a review. Photochem. Photobiol. Sci. **1**, 225–236.
17. Friedberg E.C., Walker G.C., Siede W., Wood R.D., Schultz R.A., Elleberger T., 2006. DNA Repair and Mutagenesis. Seconnd Edition, ASM Press, Washington D.C.
18. Mitić-Culafić D., Žegura B., Nikolić B., Vuković-Gačić B., Knežević-Vukčević J., Filipič M, 2009. Protective effect of linalool, myrcene and eucalyptol against t-butyl hydroperoxide induced genotoxicity in bacteria and cultured human cells. Food and Chemical Toxicology. **47**, 260–266.

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INSPECTION IN ENVIRONMENTAL PROTECTION

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ABSTRACT

Establishment of inspection departments which provide a constant surveillance of the environment is one of the ways for goverment to establish a controlling mechanism in order to achieve legal regulations compliance. Therefore, a well-organised legal system, compliant with the international legal system of environmental protection, is needed. Ecological issues in Republic Serbia are under the juristiction of The Ministry of Environmental Protection. Provincial authorities and local self-government are also involved.

Key words: role, inspection, environmental protection

INTRODUCTION

Today's performance of Serbian state administration inspection tasks has its roots in the period between 1945-1965., during which the appropriate constitutional and legal requirements were fulfiled. In the year 1990., by the administrative procedures centralisation, the final form of administrative supervision was adopted and it has not been improved since, despite the general and enviromental politic democratisation.

Carrying out the inspection tasks of environmental protection in legally more developed countries is not uniformed and does not provide answers on a "turnkey". What these services have in common is their precisely defined role in the overall administrative supervision which has its basis in comprehensive legal regulations and procedural clarity, and results in improved inspection work.

When it comes to enviroment protecton an important part of regulatory mechanism in Serbian legal system is the inspectional supervision which works on every level of the public administraton.

MATERIAL AND METHODS

The paper briefly deals with inspection activities which goes into the sphere of environmental protection, with emphasis on issues of organization and efficiency of inspection for environmental protection in managing the system of environmental protection in order to fight and prevent environmental crimes.

In order to comprehend the situation and find the answer on what is it that reduces the efficiency of the competent inspection services and lowers the quality of their interventions and why is there a disagreement betwen the regulations and it's practical aplication, it is necessary to define these basic tasks:

- analyze the situation of environmental protection systems
- analyze and examine the positioning of inspection services in the environmental protection system
- review the situation of national and international normative and legal regulations relevant to the inspection departments.
- analysis of the staff and organizational solutions and inspection services equipment
- estimating the level of cooperation and coordination between the various inspection services
- analysis of cooperation and coordination of inspection services with other institutions and organizations
- analysis of the inspectors' activities in the field
- realizing the benefits and the weaknesses of inspection services functioning

INSPECTION ORGANS

Inspection organs as the state administration apparatus are established by the Constitution in 1963. but the environment as constitutionally covered issue is established by the Constitution of 1974.

The role of inspectional supervision is not only reflected in the monitoring of certain elements of the environment or the implementation of sanctions, but rather in advocating for consistent implementation of preventive measures for environmental protection and preventing all causes that may directly or indirectly degrade the environment, endanger the health of humans and other living things and jeopardize their survival.

Institutional organization of environmental protection is very complex and can not be reduced to an inspection for the environment, but it is divided among several ministries and various institutions. It all makes regular activities more complex and often leads to jurisdiction overlapping. Therefore, it is necessary to cooperate in various fields to ensure coordination and harmonization in making and implementing decisions.

Beside the Ministry of Environmental Protection, as the main coordinating institution for environment protection, there are many other ministries, institutions and services with which it cooperates in agriculture, forestry, water, health, veterinary medicine, mining, construction and urban planning. These include:

- Ministry of Health
  - Sanitary Inspection

- Ministry of Agriculture, Forestry and Water Management
  - Agricultural Inspection
  - Veterinary
  - Veterinary inspection

- Administration for Plant Protection
- Directorate of Water
- Water management inspection
- Administration of Forests
- Forestry Inspection

ORGANIZATION OF INSPECTION AND ENVIRONMENTAL

Ministry of Environment i.e. Department of Environmental Protection, performs the inspection through an inspector for the Environmental Protection organized on three levels: national, provincial and city / municipal**.**

Depending on the level of organization, the inspectors have different responsibilities for the supervision of the implementation of regulations on environmental protection. Organization of inspection of environmental protection in Serbia is given in the first diagram (Figure 1).

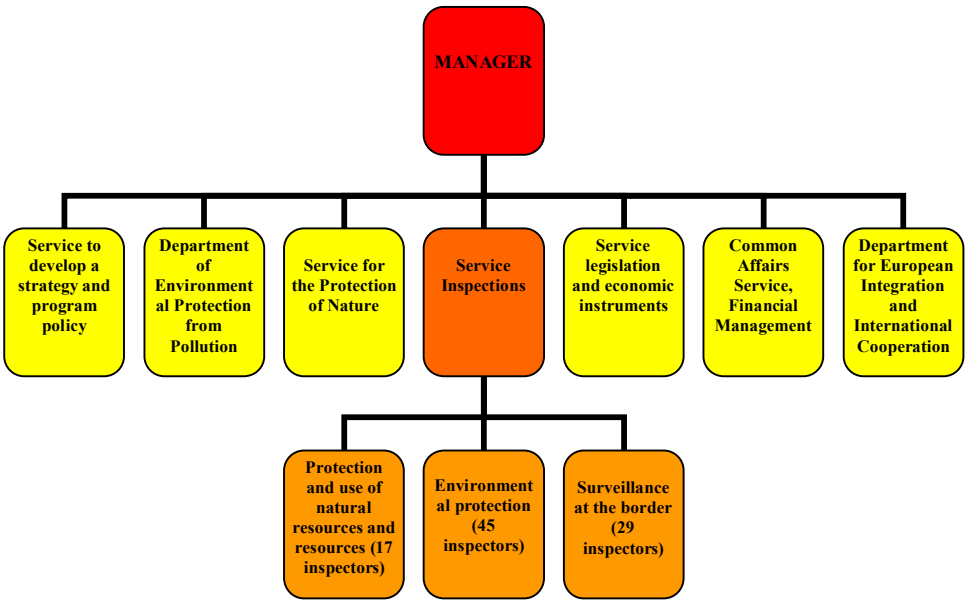

Figure 1. Organization of inspection for environmental protection in Serbia

Inspection services include:

- Department of Inspections for the protection and exploitation of natural goods and resources (operates in the area of surveillance, protection and exploitation of natural resources, protected areas and wild flora and fauna)
- Department of Inspections for environmental protection (carries out inspection tasks in areas that include: hazardous materials, accidents, waste management, noise, air pollution, protection from ionizing and non-ionizing radiation,

planning and construction of facilities which can severely endanger the environment)

- Departments of environmental border inspection with headquarters in Belgrade and Nis, perform surveillance including cross-border trade control:
  - ✓ import, export and transit of waste, toxics, substances that deplete the ozone layer, radiation ionizing sources, protected animal and plant species;
  - ✓ import and transit: measuring the level of radioactive contamination of all goods from the Chernobyl disaster endangered areas as well as metals, ores, construction materials and waste, regardless of the country of origin, in accordance with the established list of goods.

GENERAL AUTHORIZATIONS AND DUTIES OF ENVIRONMENTAL PROTECTION INSPECTORS

Considering the authorizations and duties of environmental protection inspectors, it is necessary to point their general rights and duties i.e. the rights and responsibilities which share a general character and equally apply to all inspection bodies in the field of environmental protection and special rights and responsibilities which are valid for environmental protection inspection bodies only.

General rights and obligations are derived from the Law on State Administration, and the special rights and duties of environmental protection inspectors are established by the Law on Environmental Protection. General rights and duties of inspectors are reviewed in terms of the provisions contained in the Law on Public Administration and expressed through the following forms:

- Actions and measures taken by inspectors during the inspection
- Accountability and independence of inspectors
- Preparing the sheet which contains the report of completed inspections and obligations of enterprises, institutions and other organizations and state agencies in order to inform the inspector of measures taken and provided by the sheet.
- Taking measures and actions in the process of carrying out inspection surveillance.
- Cooperation with other inspectors and their preventive actions
- Relationships among the inspectors and the companies and institutions considering the inspection performance.
- Signing applications, or requests for initiating criminal and disciplinary proceedings or proceedings for economic offense.

Environment protection inspectors are independent with their work within the regulations established by the Law on Public Administration, Law on Environmental Protection and other regulations. They are personally responsible for their work in supervising the implementation of regulations on environmental protection.

POWERS OF THE INSPECTORS

Environmental Protection inspector, from all organization levels, within the limits of his powers, may:

- order the execution of measures and actions, and determine the required deadline for their execution
- impose fines (fine on the spot, which expresses a simplified procedure without a hearing of the defendant and the implementation of other evidence)
- submit the report to the competent authority for the criminal or civil offense, or file a report for legal proceedings
- issue temporary orders or prohibitions in accordance with the law
- adopt security measures in case of danger to life and health or other public interests
- notify the other authority if there are reasons for the measures for which that authority is competent
- take the initiative of the authorized body for the suspension of execution, to cancel or revoke regulations or other general act of the body or organization that is responsible for state administration, or to suspend the execution of laws - for company, institution or other organization if they are not in accordance with the Constitution and the law
- take other measures and actions given by the law.

PREVENTIVE AND REPRESSIVE INSPECTOR ACTIVITIES

Procedure of inspection is regulated by the Law on General Administrative Regulations on Environmental Protection and the Law on State Administration. The basic method of the inspection process involves a variety of activities aimed at controlling the legality of operations and taking appropriate actions and preventive measures. Supervision may be instituted ex officio or upon the application of the party. For regular inspections the control is mostly planned on a monthly basis, but accidental situations and other emergency controls are priorities.
The procedure of supervision can be divided into three phases:

- prepare inspectors for supervision
- supervision - an overview
- issuing decisions (taking measures based on the surveilance)

The inspectors, from all the levels of organization, or persons authorized by ministries to perform certain inspection supervision over implementation of laws and other regulations, perform verification through documentation access, practices and discussion with competent authorities. They also have a right and duty to:

- review general and individual acts, records and other documentation
- interrogate and take statements from persons responsible
- view the premises, facilities, equipment, devices, and goods
- take samples of goods and other items for analysis, expertise etc.

- impose measurements to other professional organizations to perform, when a company or other organization in which the inspection is taken, makes the measurements in certain areas by itself or through a particular professional organization, and the results provide a basis for ordering such measurements
- take measurements and other actions that are authorized by law or regulation.

Environmental Protection inspector, as well as inspectors from other inspections, is obligated to make an inspection record. The record is uniformed and contains a record sheet (statement of non-compliance) and proposed (preventive or corrective measures) or by the record issued measures. It includes information about the authority which supervises, the object of the supervision and the employer data. The record contains a precise and short course of actions carried out during the examination and given statements. It also lists all the documents that were used during the inspection, which are attached to it, if necessary.

Primal function of an environmental protection inspector is surveillance over the implementation of regulations on environmental protection, but also acts as a law enforcement body. This function consists of an obligation to submit an application to the competent authority, the State Prosecutor, Minor Offence court, disciplinary authority in order to initiate appropriate proceedings if the violations of regulations which are monitored by the inspector represent a crime, economic offense, misdemeanor or violation of duties. The inspector must, without delay, submit an application or a request to the competent authority, immediately after finding that grounds exist to initiate such proceedings, that is.

CONCLUSION

Protecting the environment is a global problem of today's society. For it to be realized, legal regulation of this issue is not enough, because there are always going to be flaws, so called. Loopholes and thus environmental violation remains unpunished and the perpetrator undiscovered. It is necessary to complete the reform of human society that will enable the design of a new type of industry and technology, which will be aligned with environmental conditions. Technological development should be tailored to the needs of the society and environmental protection.

Inspection authorities and the inspection of the environment in particular are just one link in the chain of concern for environmental protection. In addition to this chain of governmental and nongovernmental institutions and organizations, a major role should be played by the citizens. It is therefore essential that the system of education include educational programs on environmental protection and develop an ecological culture, starting with the youngest members of the society.

By analyzing the role of environmental inspection activities against environmental crime, we can see that the environmental offenses are, in most cases, inspired by the profit or any financial or material benefit, but there is also human carelessness and ignorance that can contribute to environmental pollution even in some common daily activities. Inspection of Environment, through their authorized staff or the inspector sees to the implementation of regulations on environmental protection and

through their work contribute to the prevention and combat with environmental crime, which role is all ours to share with every inhabitant of this planet.

REFERENCES

1. Environmental protection regulations, official list no.135/04
2. Ljuština Aleksandra, (PhD thesis), Police role in prevention and control of environmental work, Faculty of security, Belgrade
3. Vranješ Dušan, (PhD thesis), Environmental protection in the local community through the functions of civil defense, Faculty of security, Belgrade
4. Stevanović Melani, (Master thesis), Municipal inspection for environmental protection in local development, Faculty of security, Belgrade
5. www.unep.org
6. www.natureprotection.org.rs
7. www.srbija.gov.rs

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MONITORING AND STATE OF THE AIR QUALITY IN ZAJECAR FROM 2002 TO 2010

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ABSTRACT

The problems of air pollution are becoming more intense and more important on a global level and potential environmental preservation is one of the imperatives. In accordance with the DPSIR method, reporting emissions of pollutants into the air represent a pressure on the environment and has a detrimental effect on the territory of which arise, and the cross-border areas.

The correct approach to solving the problem of pollution is constantly monitoring and implementing air protection measures.

In Serbia, the collection and management of databases on air pollution is on the basis of methodology for making the integral cadastre of polluters (Official Gazette of RS, No. 94/07), which includes emissions to air from point and diffuse sources of pollution.

Air is an important health risk factor in the Republic of Serbia. One in five citizens of Serbia could be informed on the level of sulfur dioxide exposure, and one in ten could be informed on the corresponding level of exposure to nitrogen dioxide.

Protection from air pollution is regulated in Serbia by the Law on Environmental Protection (Official Gazette of the RS, No. 135/04, 36/09), the Law on Air Protection (Official Gazette of RS, No. 36/09), the Regulations on conditions and requirements for monitoring air quality (Official Gazette, No. 11/10) and the Regulations on limit values for emissions of pollutants into air (Official Gazette of RS, No. 71/10).

Systematic measurements of air quality in Serbia are performing in several observation networks falling under the competency of different state-run organizations and institutions.

During last years, the Public Health Institution "Timok" Zajecar measured the basic pollutants that may be found in air: sulpherdioxide, soot, nitrogen dioxide and the total sedimentary matter (including heavy metals Pb, Zn and Cd). Measurements were taken at measuring stations for SO_2, NO_2 and soot: "Elektrotimok" and "Red Cross" and at measuring stations for total sedimentary matter and heavy metals: "Elektrodistribucija", "Str. Hajduk Veljkova", "Grafičko preduzeće" and "Selište".

The goal of this report is to point out the air pollution levels in the communal area of Zajecar, to compare the results with the norms of average emission levels prescribed by the Regulations, to point out the possible consequences of air pollution to people's health, and the need to take necessary measures to lower the pollution levels of air.

Key words: monitoring. Air quality, Zajecar, SO_2, NO_2, soot, sedimentary matter and heavy metals

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