EMEC21

21st European Meeting on Environmental Chemistry
November 30 – December 3, 2021, Novi Sad, Serbia

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BOOK OF ABSTRACTS

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Publisher

Serbian Chemical Society

Karnegijeva 4/III, Belgrade, Republic of Serbia

For the publisher

Dušan Sladić

President of the Serbian Chemical Society

Editors

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Cover page photo

Branko Lučić

Design and prepress

Beoživković, Belgrade

Printed by

RIS Studio, Belgrade

Circulation

150

ISBN

978-86-7132-078-8

Year

2021

The Effect of Power on the Degradation of Propranolol by Nonthermal Plasma Reactor

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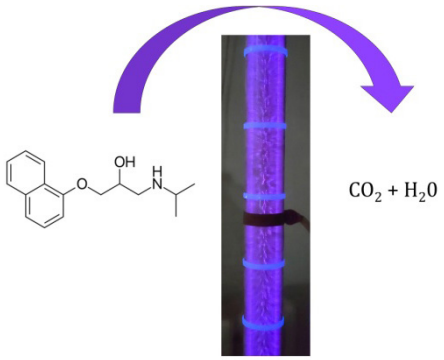

Propranolol (PRO) is a beta-blocker that is readily detected in surface water and hospital wastewater [1]. This pharmaceutical poses a danger for aquatic animals because it is commonly prescribed for heart diseases and anxiety issues [2]. Advanced oxidation processes are commonly tested for the decomposition of pharmaceuticals because they produce various reactive species at room conditions [3].

A liquid-falling film dielectric barrier discharge (DBD) reactor was used for the treatment of a PRO solution, with no catalysts added. A coaxial construction, accompanied by a peristaltic pump, enables the recirculation of the treated liquid. Ambient air was selected as a feed-gas for nonthermal plasma generation under three levels of power dissipated in plasma. Direct contact of liquid film with plasma in this coaxial reactor enables the efficient transfer of reactive oxygen and nitrogen species generated in plasma to the liquid phase.

The degradation rate of PRO, pH value, and conductivity were monitored after every cycle of treatment of PRO solution (100 mg/dm^3), and in the presence of scavengers (t-butanol and p-benzoquinone). The PRO concentration was monitored by HPLC-DAD, at 213 nm.

As expected, the highest applied power (60 W) contributed to the highest degradation rate (100%). At the same time, in these extreme conditions, pH values dropped from 6 to 2.5 and conductivity increased from 20 µS/cm to almost 1450 µS/cm in the tenth cycle of plasma treatment. Moreover, a high power yielded an excessive decontamination level, but also in the grand production of nitric acid.

On the other hand, lower values of power lead to less successful endpoints, over 85% and less than 60% of degraded PRO when 35 W and 15 W were applied, respectively. Accordingly, under these conditions, the total production of ions was less intensive. The maximum conductivity value was less than 500 µS/cm for PRO treated with plasma generated by 35 W of power, and under 130 µS/cm for 15 W.

To elude the exact role of reactive species, a pair of scavengers were added to a PRO solution. Both t-butanol and p-benzoquinone cut down the degradation efficiency to roughly 50%, which is 35% less than without scavengers. This result indicates an important role of hydroxyl radicals and superoxide anion radicals in air-generated nonthermal plasma.

Advanced oxidation using this type of nonthermal plasma reactor enables the production of active species *in situ* while working in ambient conditions [4]. The effectiveness of plasma treatment was confirmed with the degradation of propranolol, as a model compound for common waterborne pharmaceuticals.

Acknowledgements

This study was funded by the Ministry of Education, Science, and Technological Development of the Republic of Serbia; Contract numbers: 451-03-9/2021-14/200168 and 451-03-6812020-14.

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