**Nanosecond Pulsed Corona Discharge Plasma as a tool for the degradation of cephalosporins in water**

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**ABSTRACT**

The excessive use of antibiotics and their slow and limited biological degradation which is more intense in aquatic systems has resulted a serious environmental contamination problem. Cold atmospheric plasma (CAP) is regarded as a highly competitive advanced oxidation process towards the removal of organic pollutants from wastewater, bearing advantages such as high removal rate of organic contaminants, simple operation and large treatment area1. The high potential of CAP-generated reactive oxygen and nitrogen species (RONS) is responsible for the rapid and cost-effective oxidation and mineralization of organic pollutants2. The effectiveness of CAP systems regarding the removal of antibiotics (fluoroquinolones, sulfonamides, etc.) from water has been previously investigated. However, to the best of our knowledge, there is only one recent report on CAP degradation of cefixime3 whereas there are no references on other commonly used cephalosporins such as cephalexin and cefazolin. In this study, for the degradation kinetics of antibiotics cephalexin and cefazolin, a gas-liquid dielectric barrier discharge (NSP-DBD) plasma reactor driven by nanosecond pulsed voltage generator in order to achieve rapid generation of plasma species (rising time about 4 ns) was used. Several critical parameters affecting cephalosporins’ degradation efficiency (treatment time, pulse voltage/frequency, energy yield, plasma gas, water properties, initial pollutant concentration) were investigated in order to establish the optimum operational conditions with the highest energy efficiency. Complete removal of cephalexin and cefazolin was achieved under the optimum conditions after 20 min. In parallel, the degradation mechanisms were analyzed in depth.The use of appropriate scavengers revealed that .OH and 1O2 govern the degradation process. Experiments with different gases were also performed and it was observed that the oxygen and air discharges acted similarly while the nitrogen discharges resulted reduced degradation efficiency, indicating that ROS species prevail on the process. The degradation intermediates of both cephalexin and cefazolin along with their potential toxicity was determined and possible degradation pathways were proposed. The complete degradation of cephalexin and cefazolin in water at high-energy yield, suggests that the gas-liquid NSP-DBD system has the potential to be an extremely cost-effective technology for the treatment of wastewater polluted by antibiotics.

**KEYWORDS:**

Cold atmospheric plasma; Wastewater treatment; Antibiotics; Reactive oxygen and nitrogen species; Cytotoxicity

**REFERENCES**

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