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Elimination of the Antibiotic Doxycycline Using a Helicoidal Flux Photoreactor: By-Products and Eco-Toxicity Assessment

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Abstract

Doxycycline (DOX) is an antibiotic belonging to the tetracycline family used in the treatment of infectious diseases caused by different types of bacteria and protozoa, it is the case of pneumonia, chlamydia, and cholera. Additionally, due to their incomplete metabolization, antibiotics are excreted without modifications into the sewage system via urine or feces, which together with the fact that most of the wastewater treatment plants (WWTPs) do not have an appropriate design to remove them completely, they are discharged directly into water sources, which represents a potential risk for ecosystems, and even for humans, due to the proliferation of bacterial resistance.

DOX has been detected in water bodies in some Latin-American countries like Brazil and Colombia.

Different techniques, including the advanced oxidation technologies, have been used to remove antibiotics from water. In this sense, this research sought to evaluate the use of a helicoidal flux photo-reactor and the application of the Fenton process (Fe^{2+} + H_2O_2) in the removal of DOX. The focus of the work was directed toward the analysis of the reaction by-products using gas chromatography coupled to mass spectrometry (GC/MS) and the evaluation of the toxicity of the samples using luminescent bacteria (*Vibrio fischeri*).

Results indicated that hydroxylation of the DOX molecule is one of the routes for its removal. The presence of hydroxyl radicals contributes to the organic matter oxidation and the reduction of the matrix eco-toxicity.