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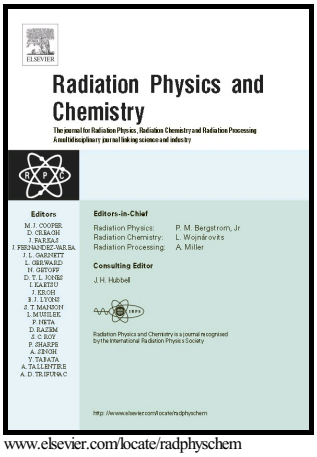

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ADVANCED WATER REMEDIATION FROM OFLOXACIN BY IONIZING RADIATION

Biagio R. Esposito[a], Massimo L. Capobianco[a,b], Alessandro Martelli[b], Maria Luisa Navacchia[a,b], Luca Pretali[b], Michela Saracino[b], Alberto Zanelli[a,b], and Salvatore S. Emmi[a,b*]

[a]Proambiente s.c.r.l., 101, via P. Gobetti, 40129 Bologna, Italy.

[b]Consiglio Nazionale delle Ricerche (CNR) Istituto per la Sintesi Organica e la Fotoreattività (ISOF), 101, via P. Gobetti, 40129 Bologna, Italy.

Abstract

The performances of remediation processes initiated by ionizing radiation on ofloxacin are investigated in ambient conditions. The effectiveness of the decomposition of ofloxacin has been assessed both by γ-rays and electron beam in various aqueous solutions differentiated by the dissolved gases (Air or oxygen saturated) and H_2O_2. By HPLC it is shown that ofloxacin is removed according to a first order process vs. dose in any system. O_2 accelerates the decomposition rate, while H_2O_2 does not seem to enhance any oxidation effect. The simultaneous oxidative-reductive treatment (no additive) demonstrated to have better mineralizing performances than the fully oxidative one (H_2O_2 present). Mineralization by γ results to be more efficient than by EB. The Total Organic Carbon decrease was investigated in dependence of dose and of the •OH production rate. The latter parameter was changed over 7 orders of magnitude by controlling dose rate and/or by adding H_2O_2. A steep increase of acidity remarks the phases of fluorine-carbon bond break.

Keywords: antibiotics mineralization; emerging contaminants remediation; ofloxacin; advanced oxidation processes; ionizing radiation remediation.

1. Introduction

Both Advanced Oxidation Processes (AOPs), and Advanced Reduction Processes (ARPs) can be started by ionizing radiations: while AOPs fund their action on the oxidizing properties of the •OH radical, ARPs make mostly use of the reducing power of the hydrated electron and hydrogen atom (e_{aq}^-, •H) (Saracino et al., 2015; Vellanki et al., 2013). Together, they actually appear to satisfy the need of decomposing organic material as well as neutralizing toxic ions by changing their valence states. Moreover, they can be engineered to a multi-scale water load, which properly responds to the remediation claims of agricultural, industrial and municipal effluents.

Actually, the classification of a process as solely *oxidative* or solely *reductive* seems to be often unable to conceive an acceptable mechanism, and raises inappropriate expectations about the structures of intermediates. As a matter of fact, oxidized products form side-by-side with reduced ones in some well known treatment methods, like H_2O_2 mediated photolysis, photocatalysis, and water radiolysis.

In water radiolysis, particularly, oxidizing and reducing species are simultaneously produced in almost equivalent yields (reaction 1), however well defined operative conditions are known to activate a neat oxidation or a neat reduction or a combination of both (hybrid process).

The object of this work is to **discuss the degradation** behaviour of **ofloxacin** (OFX) **and its mineralization** process during radiolysis in various conditions.

OFX is a carboxylic acid of the fluoroquinolones antibiotic class (FQs), with a broad therapeutic spectrum of applications, from the treatment of urinary and respiratory tracts infections, otitis, conjunctivitis, tuberculosis, traveler's diarrhea, Helicobacter pylori infection, to mention only few of them. Among the emerging organic contaminants (EOCs) it is classified toxic (Petrie et al., 2015), and also ranked "critically important" for human health by the World Health Organization, due to their misuse in animal food (Collignon et al., 2009). FQs are only partially metabolized before excretion and accumulate in the aquatic environment, principally because of a poor bio-degradability. Also they are introduced to environment almost intact through conventional wastewater treatment plants (WWTPs), most of which were not designed to treat these kinds of emerging contaminants. FQs, due to their antibacterial properties, are unaffected by secondary bio-treatment, but rather they improve the resistance of microbial population (Van Doorslaer et al., 2014). Their occurrence is reported in surface water