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The challenge facing global water scarcity is to reduce water contamination. Nowadays, conventional wastewater treatment plants (WWTPs) are not able to remove certain organic compounds such as pesticides, pharmaceuticals and hormones. Although these compounds, called micropollutants, are found in secondary wastewater effluents at very low concentrations (ng L^{-1} - $\mu\text{g L}^{-1}$), they have a toxic effect on organisms and environment [1]. Among Advanced Oxidation Processes (AOPs), the photo-Fenton process has been reported as an environment friendly treatment for micropollutant removal. It involves the oxidation of organic matter with the hydroxyl radicals generated by a redox cycle between iron and hydrogen peroxide accelerated by UV radiation.

The photo-Fenton process is carried out at mild oxidative conditions for micropollutant removal, around 5 mg L^{-1} of Fe and some tens of mg L^{-1} of H_2O_2 . At acidic pH, 2.8, and low concentration of the light absorbing species (Fe^{3+}), an excess of photon availability is observed when using reactors with short light path length. As a consequence, the use of raceway pond reactors (RPR) was proposed [2]. RPR consists of open channels in which the light path length can be varied by changing the liquid depth.

A simplified kinetic model predicting photo-Fenton kinetics as a function of environmental (irradiance and temperature), geometrical (light path length) and operating variables (reactant concentration) has been developed. Additionally, it tracks the saturation of ferric iron photoreduction at high values of the volumetric rate of photon absorption (VRPA), above $866 \mu\text{E m}^{-3} \text{ s}^{-1}$ [3].

The use of the iron chelator, ethylenediamine disuccinic acid (EDDS), has been proposed to run the photo-Fenton process at the natural pH of water, and hence to reduce operating costs [4]. Micropollutant removal in RPR at neutral pH using the Fe^{3+} -EDDS complex has been studied and the main reactions taking place have been characterized. Again, an excess of light at short light path length was observed and photosaturation was reached at a VRPA of $1550 \mu\text{E m}^{-3} \text{ s}^{-1}$, higher than that corresponding to Fe^{3+} at acidic pH due to

the higher absorptivity of the complex. Although the Fe^{3+} -EDDS complex decomposes with light, and consequently iron precipitates, high micropollutant removal rates can be achieved at short reaction times [5]. In line with this, a mechanistic model of the process has recently been proposed for the first time. Despite the complexity of the reaction system at neutral pH (iron precipitation and presence of species such as $\text{HCO}_3^-/\text{CO}_3^{2-}$ ions), the model acceptably reproduces the kinetics of Fe^{3+} -EDDS reaction, iron precipitation, H_2O_2 consumption and micropollutant removal.

Finally, both the model at acidic pH and at neutral pH have been successfully validated outdoors with a change of scale from 0.35 to 360 L under solar UV radiation in winter and summer conditions. These models are, therefore, of great application for RPR design as well as for the control and optimization of the photo-Fenton process as a tertiary treatment in WWTPs.

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