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Mineralization and Proposed Sulfamethoxazole Degradation Route by photo electro-Fenton Process

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Electro-Fenton (EF) is one of the most efficient Electrochemical Advanced Oxidative Process (EAOP) in which organic compounds are oxidized in the presence of a solution with eletrogenerated *in situ* hydrogen peroxide (H_2O_2) and irons ions (Fe^{2+} /Fe^{3+}) acting as a catalyst [1]. Moreover, this process can be enhanced by irradiation with ultraviolet (UV) light, referred to as photo electro-Fenton (PEF). Advantages of EF and PEF compared to traditional Fenton and photo-Fenton AOPs is mainly the H_2O_2 to be generated *in situ,* without the need to handle and storage this agent [2]. In this way, this work focused on the degradation and mineralization of Sulfamethoxazole (SFX), an antibiotic, using both EF and PEF process (assisted by UVA light). The degradation of 10 mg L^{-1} SFX was carried out in a three-electrode bench cell in 0.05 mol L^{-1} K_2SO_4 (pH 2.5) as the support electrolyte applying 50 mA cm^{-2} in 0.5 L min^{-1} O_2 flow during 120 min. Iron salts were added to this system to give 0.25 mmol L^{-1} of Fe^{2+}, and H_2O_2 was electrogenerated by cathodic reaction of oxygen reduction using an efficient gas diffusion electrode (GDE) made with carbon Printex L6 supported on carbon cloth. Liquid and gas chromatography coupled with mass spectrometry (LC-MS and GC-MS) and ions chromatography (CI) was employed to investigate the by-products formed. As result, the PEF process was the most efficient, since it shows complete degradation of antibiotic in only 10 min and a partial mineralization of ~56% SFX. The low mineralization rate was explained by the accumulation of stable byproducts. By means of LC-MS it was possible to proposed three degradation routes, one of which involves the formation of polymeric compounds during the PEF process. The CI analyses showed an increase in the concentration of short-chain carboxylic acids, such as acetic and oxalic, which form stable complexes with Fe^{2+} and minimize degradation kinetics.

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References:

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