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Synergy of electrochemical oxidation using boron-doped diamond (BDD) electrodesand ozone (O_3) in industrial wastewater treatment

ElectroFenton process applied to the degradation of an anti-inflammatory drugs mix using BDD electrodes

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Several micro-pollutants found in water and wastewaters have caused great concern because they represent a threat to aquatic organisms and the human health. Many of these compounds are pharmaceutical drugs such as the anti-inflamatories. Conventional wastewater treatment plants (WWTP) can not totally remove this kind of molecules. On the contrary, electrochemical advanced oxidation process such as electroFenton, are a potential alternative to degrade this compounds. Boron doped diamond (BDD) electrodes have proved to be effective for this purposes. This study was aimed at assessing the effectiveness of the electroFenton process with BDD electrodes sheets in an undivided cell to remove an anti-inflammatories mixture (naproxen, ibuprofen and diclofenac) in water. Here we present and compare preliminary results on the performance of this oxidation process in ultrapure water and WWTP final effluent. Reaction conditions like current density (40 mA cm^{-1}) and Fe^{2+} concentration (3 mmol L^{-1}) were established by surface response analysis. Degradation was followed by UV-Vis spectrophotometry and total organic carbon (TOC) measurements. Two initial concentrations were tested: low (LCL) and high (HCL) concentration level, with 5 mg L^{-1} and 50 mgL^{-1} each drug respectively. According to our results, the first 30 min, the absorbance keeps its value (Fig. 1a) in HCL and after that, occurs a value decrease (faster than LCL). It is maybe due to more organic radicals formed which participate in the oxidization. In TOC removal (Fig. 2b) after 2 hours, is reached a similar mineralization percent (90%) in all the cases. The organic matter present in the WWTP effluent affects lightly the absorbance and TOC removal (Fig 1a and 1b) in both levels. This process shown to be effective in two matrix and two concentration levels in relatively short time, which makes it attractive in the final WWTP´s treatment stages.

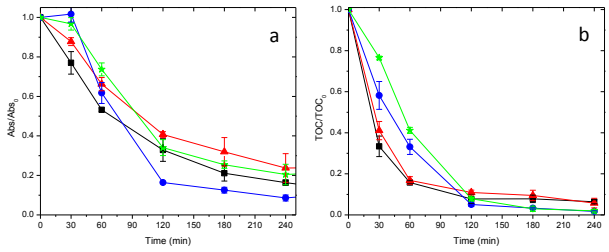

Fig. 1. a) Absorbance depletion, b) TOC removal by electroFenton process in an anti-inflammatory mixture. (■, ▲) 5 mg L^{-1} each drug [TOC_0≈80 mg L^{-1}]; (●,*) 50 mg L^{-1} each drug [TOC_0≈750 mg L^{-1}]. (■, ●) in ultrapure water, (▲,*) in WWTP effluent.