UNIVERSITY OF
CHEMISTRY AND TECHNOLOGY
PRAGUE

5th European Conference on Environmental Applications of Advanced Oxidation Processes (EAAOP5)

Book of abstracts

Editor
Josef Krýsa

Prague, Czech Republic, 2017

DEGRADATION OF PROPYL PARABEN BY CX/FE ACTIVATED PERSULFATE: INVESTIGATION OF SYNERGY EFFECTS

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It is well known that conventional wastewater treatment systems are unable to remove completely endocrine disrupting compounds (EDCs), substances that cause hormonal imbalance and disrupt the normal functioning of the human organism [1]. One such substance is propyl paraben (PP), which belongs to the class of parabens. Parabens are alkyl esters of p-hydroxybenzoic acid, which, due to their antimicrobial and antifungal properties coupled with low toxicity and high stability, were applied for many years as additives for pharmaceutical and cosmetic products, as well as food preservatives [1,2]. These substances can reach groundwaters or surface waters mainly due to insufficient conventional wastewater treatment, and there is a possibility of their transfer to drinking water. For this reason it is of great importance to study the effective degradation of such substances in aqueous environments [2].

Advanced oxidation processes (AOPs), in a broad sense, are a set of physicochemical treatment procedures designed to remove organic (and sometimes inorganic) materials in water and waste water by oxidation through reactions with reactive oxygen species, mainly but not exclusively hydroxyl radicals (·OH). In recent years, activated persulfate oxidation has been developed as a new advanced oxidation process for the degradation of organic pollutants. However, since persulfate is a weak oxidant, it must be activated (through transition metals, heat or irradiation) in order to produce very reactive sulfate and hydroxyl radicals [3].

In this work, we studied the application of iron immobilized on carbon xerogel (CX/Fe) as the catalyst and sodium persulfate (SPS) as the oxidant source to remove propyl paraben from various water matrices. Experiments were performed to study the effect of various parameters such as the initial concentration of propyl paraben, the concentration of catalyst and oxidant, the effect of pH and the water matrix. In addition, we examined the effect of simultaneous application of light radiation (UVA or solar), as well as the combination with ultrasounds for the degradation of PP in environmental matrices. Finally, experiments were conducted to study catalyst reuse.

The experimental results showed that the process was favored under acidic conditions with an optimum value of 3, but the presence of inorganic and organic components, such as bicarbonate or humic acid, which are commonly found in environmental samples, led to reduced removal rates. In addition, there is an optimum SPS/catalyst ratio that maximizes the efficiency. The simultaneous application of UVA or simulated solar radiation did not improve significantly the performance of the system, unlike the use of ultrasound that resulted in increased degradation, possibly due to enhancement of the mass transfer. Finally the catalyst activity decreased by nearly 20% after five sequential experiments.

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