Kinetic study of heterogeneous H_2O_2-assisted treatment of a winery wastewater using pillared clays

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1. Introduction – The discharge of winery wastewater (WW) in the aquatic systems represents a serious environmental problem due to its high organic load, which is characterized by high concentrations of very recalcitrant compounds [1].

In the present research, it is intended to apply a lumped kinetic model, based on the Fermi's equation, in order to describe the kinetics of the photo-oxidation processes, under different experimental conditions. The performance of both heterogeneous catalysts (Fe or Cu - pillared smectite), Al-Fe-ST and Al-Cu-ST, was evaluated in detail.

2. Results and Discussion - The experimental results show that the kinetic model based on the Fermi's equation has successfully described the kinetics of the photo-oxidation processes. An induction period followed by a rapid oxidation of the organic compounds was observed for different AOPs, which was associated with reactants adsorption on the catalyst surface, promoting its activation and, therefore, the production of HO• radicals. The kinetics of AOPs was highly influenced by the experimental conditions. Accordingly, the higher rate process was achieved at pH 3.0, using a H_2O_2 concentration corresponding to 98 mM, and a Al-Cu-ST dosage of 3.00 g/L ($k_{TOC} = 3.76\times10^{-2}$ min^{-1}). The results also demonstrated that the photocatalytic activity is significantly affected by the metal species immobilized on smectite. Accordingly, the Al-Cu-ST catalyst, presenting higher surface area and porosity, revealed more activity than Al-Fe-ST when submitted to the different experimental conditions. In terms of leaching levels, the Al-Fe-ST catalyst demonstrated higher stability at different operational conditions, obtaining Fe concentrations lower than the legal limit of discharge (2.00 mg/L). In general, the leaching levels were higher using Al-Cu-ST, however, the Cu concentrations were lower or very close to the legal limit imposed ([Cu]: <1.22 mg/L; limit:1.00 mg/L).

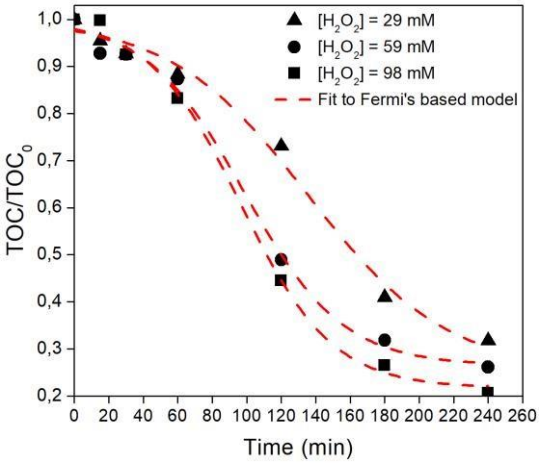

Figure 1. Fit of Fermis model to the photocatalytic experimental data (Al-Cu-ST).

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