

Fe-pillared clay as a Fenton-type heterogeneous catalyst for cinnamic acid degradation

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Abstract

Fe-pillared montmorillonite has been used as a Fenton-type heterogeneous catalyst for the removal of cinnamic acid in water. The influences of the cinnamic acid, catalyst and H₂O₂ concentrations and pH on the removal rate of cinnamic acid have been studied. The results show that the efficiency of Fe-pillared montmorillonite is higher than that of the Fe ions in the homogeneous phase, and less sensitive to pH.

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1. Introduction

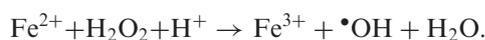
The production of olive oil in the Mediterranean countries accounts for approximately 95% of the world production. It generates around 30 million m³ of wastewater a year (Chamkha et al., 2001). According to some reports, the COD and BOD values of these wastewaters are 200–400 times higher than those of typical municipal sewage. Therefore, the overall contamination by olive oil wastewaters in the Mediterranean countries is equivalent to that produced by at least 60 millions inhabitants.

The very high content of organic matter comprises phenols, polyphenols, pectin, colloids, lipids, and simple aromatic compounds (tyrosol; syringic, vanillic, veratric, caffeic, *p*-coumaric and cinnamic acids, etc.) resulting from olive cell wall degradation during oil extraction (Chamkha et al., 2001; Al-Mallah et al., 2000; Centi et al., 2001; Cossu et al., 1993). Lipids are considered toxic for certain strains of bacteria, whilst phenols and other aromatic compounds are considered as biorecalcitrant and can be a source of chlorinated phenols when chlorination is used for water

disinfection. This high phenolic and aromatic content in olive oil mill effluents is also of great concern in anaerobic treatment because they can have an inhibition effect on bacteria, even though this effect is weaker than that of lipids (Beccari et al., 2002).

The conventional biological or physico-chemical treatments are slow or non-destructive, and consequently are considered as inadequate for eliminating these classes of contaminants (Benitez et al., 1997; Velioglu et al., 1992). Attempts to develop an appropriate technology based on partial oxidation of phenolic and aromatic compounds using ozone as an oxidant or by applying wet air oxidation have been reported. However, these methods are either expensive or require a high reaction temperature (Centi et al., 2001).

As an alternative, it has been proposed to use H₂O₂ and Fe ions (Fenton's reagent). Highly oxidative OH radicals are generated from H₂O₂ in the presence of ferrous and ferric ions as shown below:



Because the OH radical is a non-selective oxidizing species, the Fe²⁺/H₂O₂ and Fe³⁺/H₂O₂ reagents could

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