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Optimization of total organic carbon removal of a real dyeing wastewater by heterogeneous Fenton using response surface methodology

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ABSTRACT

An iron-activated carbon catalyst was prepared by calcination of an activated carbon derived from banana spike previously impregnated with iron sulphate, and then characterized by N_2 and CO_2 adsorption–desorption experiments and scanning electron microscopy coupled to energy dispersive spectroscopy. The presence of iron-based nanoparticles highly dispersed in the porosity was demonstrated and the nanoparticles were identified as wüstite (FeO) by X-ray photoelectron spectroscopy. The performances of this catalyst were investigated for the treatment of actual textile wastewater from Bamako handicraft loincloths dyeing by the heterogeneous Fenton process. The response surface methodology was used to optimize the effects of three independent parameters (catalyst dose, H_2O_2 concentration, and initial total organic carbon (TOC) concentration) on the efficiency of wastewater treatment assessed by the rate of TOC reduction. The optimal conditions are found for 2 g/L catalyst, 16.73 mmol/L H_2O_2 and 99.83 mg/L initial TOC corresponding to a prediction of 90.2% reduction of TOC. In these experimental conditions, the measured rate of degradation of 90.4% is in agreement with the proposed model. This high level of mineralization demonstrates that the Fenton process using the prepared catalyst is a viable treatment for the waste water from Bamako handicraft textile dyeing.

Keywords: Activated carbon; Catalyst; Dye; heterogeneous Fenton; Optimization; Wastewater treatment

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