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Degradation of ciprofloxacin antibiotic by Homogeneous Fenton oxidation: Hybrid AHP-PROMETHEE method, optimization, biodegradability improvement and identification of oxidized by-products

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Abstract

The main purpose of this experimental study was to optimize Homogeneous Fenton oxidation (HFO) and identification of oxidized by-products from degradation of Ciprofloxacin (CIP) using hybrid AHP-PROMETHEE, Response Surface Methodology (RSM) and High Performance Liquid Chromatography coupled with Mass Spectrometry (HPLC–MS). At the first step, an assessment was made for performances of two catalysts ($FeSO_4.7H_2O$ and $FeCl_2.4H_2O$) based on hybrid AHP-PROMETHEE decision making method. Then, RSM was utilized to examine and optimize the influence of different variables including initial CIP concentration, Fe^{2+} concentration, $[H_2O_2]/[Fe^{2+}]$ mole ratio and initial pH as independent variables on CIP removal, COD removal, and sludge to iron (SIR) as the response functions in a reaction time of 25 min. Weights of the mentioned responses as well as cost criteria were determined by AHP model based on pairwise comparison and then used as inputs to PROMETHEE method to develop hybrid AHP-PROMETHEE. Based on net flow results of this hybrid model, $FeCl_2.4H_2O$ was more efficient because of its less environmental stability as well as lower SIR production. Then, optimization of experiments using Central Composite Design (CCD) under RSM was performed with the $FeCl_2.4H_2O$ catalyst. Biodegradability of wastewater was determined in terms of BOD_5/COD ratio, showing that HFO process is able to improve wastewater biodegradability from zero to 0.42. Finally, the main intermediaries of degradation and degradation

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