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Electro Fenton process catalyzed by $Fe@Fe_2O_3$ nanowire for degradation of carbamazepine from aqueous solutions

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ABSTRACT

In this study, $Fe@Fe_2O_3$ nanowires were applied in combination with electro Fenton (EF) process to decompose of carbamazepine (CBZ) drug in an electrochemical reactor using a graphite rod cathode and Ti/PbO_2 anode. Response surface methodology (RSM) based on central composite design was used to optimize various parameters such as pH, current, $FeSO_4{\cdot}7H_2O$, drug and $Fe@Fe_2O_3$ concentrations, and reaction time. The results of RSM showed a good statistical relationship between experimental values of CBZ removal and their predicted values using the suggested multi-parameter model. The efficacy of CBZ removal significantly enhanced with increasing density, $Fe@Fe_2O_3$ nanowire dose, and reaction time, while it was reduced with increasing pH, $FeSO_4{\cdot}7H_2O$ concentration, and initial concentration of the drug. The results on a percentage of contribution and the *F*-value (PC% = 42.99 and *F* = 346.4003) showed that $Fe@Fe_2O_3$ dose plays an important role in increasing the efficiency of the electro Fenton process. RSM results also revealed that EF process effectively removed 88.55% of CBZ and 65% of total organic carbon from aqueous solutions under optimum conditions; that is pH = 4, current = 0.18 A (current density = 5.14 mA cm^{-2}), $FeSO_4{\cdot}7H_2O$ concentration = 3.87 mg L^{-1}, CBZ concentration = 7.49 mg L^{-1}, $Fe@Fe_2O_3$ dose = 1,050 mg L^{-1}, and reaction time = 50 min. The utilized multi-parameter optimization approach revealed the presence of interactions between pH with $FeSO_4{\cdot}7H_2O$ concentration and pH with reaction time. As a conclusion EF process catalyzed by $Fe@Fe_2O_3$ nanowire can be used for the removal of pharmaceutical compounds such as CBZ from aqueous solutions.

Keywords: Electro Fenton; Carbamazepine; $Fe@Fe_2O_3$ nanowire; Ti/PbO_2 Anode; Response surface methodology

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