



Enhanced removal of cefixime from aqueous solutions using Fe₃O₄@GO nanocomposite with ultrasonic: isotherm and kinetics study

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ABSTRACT

Antibiotics, including cefixime (CEX), are widely used in medicine and veterinary medicine and enter aquatic environments through various pathways such as agricultural runoff, direct discharge from municipal wastewater treatment plants, human excreta, direct disposal of medical, veterinary, and industrial wastewaters. The aim of this study was to investigate the applicability of GO (graphene oxide)-Fe₃O₄ nanocomposite with ultrasonic (US) in the removal of CEX from aqueous solutions. To conduct the experiments of this experimental-lab scale study, application of the response surface methodology was considered. The effect of important operational parameters such as solution pH, nanocomposite concentration, initial concentration of CEX, and reaction time was investigated at three levels (+1, 0, and -1) with a constant ultrasound intensity at 37 kHz. The optimization and analysis of the results were performed by Design-Expert 10 and Statgraphics software, and the residue of CEX was measured using a spectrophotometer at 288 nm. The results showed that the quadratic model was suitable for the data (P -value < 0.0001), and the proposed model (quadratic) was approved with a high correlation coefficient ($R^2 = 0.9824$ and $R^2_{Adj.} = 0.9670$). Under the optimal conditions for the process (pH = 3, nanocomposite of 1 g/L, initial concentration of CEX of 10 mg/L, and reaction time of 90 min), the observed removal efficiency was about 100%. According to the results, the GO-Fe₃O₄/US process was approved to be effective in the degradation of the antibiotic CEX, and the Box–Behnken design was found to be a suitable tool to optimize the process conditions in the removal of CEX.

Keywords: Cefixime; Graphene oxide; Nanoparticles; Ultrasonic; Fe₃O₄; Box–Behnken; Adsorption

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