CuFe₂O₄@graphene nanocomposite as a sorbent for removal of alizarine yellow azo dye from aqueous solutions

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ABSTRACT

CuFe₂O₄@graphene nanocomposite was synthesized by chemical co-precipitation method. The nanocomposite was characterized by Fourier infrared spectroscopy, X-ray diffraction, scanning electron microscopy, and transmission electron microscopy. Adsorption of alizarine yellow (AY) by graphene, CuFe₂O₄, and CuFe₂O₄@graphene nanocomposite was studied. Effect of different factors including agitation time, pH, and adsorbate concentration on the adsorption capacity of adsorbent for AY dye was investigated. Experimental results demonstrated that AY could be effectively removed from aqueous solution by CuFe₂O₄@graphene nanocomposite within 40 min of contact time and pH 3. Two common kinetic models, pseudo-first order and pseudo-second order, were employed to describe the adsorption kinetics. The results indicated that the adsorption kinetics of AY well matched with pseudo-second-order rate expression. The equilibrium adsorption was best described by the Langmuir isotherm model. Various thermodynamic parameters such as the Gibbs free energy (ΔG˚), enthalpy (ΔH˚), and entropy (ΔS˚) change were also evaluated. Thermodynamic results revealed that the adsorption of AY onto CuFe₂O₄@graphene is endothermic, spontaneously process and feasible in the range of 303–333 K. The adsorption capacity of CuFe₂O₄, graphene, and CuFe₂O₄@graphene was found to be 98, 105, and 145 mg g⁻¹ for AY, respectively.

Keywords: Adsorption; Alizarine yellow; CuFe₂O₄@graphene; Nanocomposite