

Bentonite surface modified with magnetite nanoparticles for removal of the anionic dyes of reactive yellow and toluidine blue aqueous solutions

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The present study deals with the development of an innovative cost effective bentonite adsorbent modified with Fe₃O₄ MNPs for the removal of Reactive yellow 160 (RY 160) and Toluidine blue (TB) dyes aqueous samples. For this propose, bentonite/Fe₃O₄ nanocomposites were synthesized via the co-precipitation method with addition of ammonium hydroxide to a solution of Fe²⁺ /Fe³⁺ in the presence of bentonite. The structure, magnetic property and morphology of the prepared composite were investigated by Fourier transform infrared spectroscopy (FT-IR), vibrating sample magnetometer (VSM), Diffuse reflectanc spectroscopy (DRS), Energy Dispersive X ray (EDX), X-ray diffraction (XRD) and Field emission scanning electron microscopy (FESEM) instruments, respectively. Experimental factors affecting the removal of RY 160 and TB dyes such as pH, ionic strength, adsorbent dosage and contact time were studied using orthogonal array design (OA16). Under the optimum conditions (for RY 160: solution pH= 8.5, NaCl concentration: 0.1 mol L⁻¹, contact time: 40 min and adsorbent dosage: 0.1 g in 25 ml of solution (4 g l⁻¹), and for TB: solution pH= 7.0, NaCl concentration: 0.1 mol L⁻¹, contact time: 25 min and adsorbent dosage: 0.2 g in 25 ml of solution (8 g l⁻¹)), the removal efficiency higher than 97% was obtained. The adsorption kinetic was studied using two different concentrations of RY 160 and TB (15 and 100 mg L⁻¹) via four kinetic models including pseudo-first-order, pseudo-second-order, intra-particle diffusion and Elovich models. The data were obeyed pseudo-second-order kinetic model (RY 160: R² = 0.9997, q_e=24.57 mg g⁻¹ and TB: R² = 0.9999, q_e=12.40 mg g⁻¹). Also, three well-known isotherm models (Langmuir, Freundlich and Tempkin) were studied in the optimized conditions. Finally, the applicability of magnetite modified bentonite for removal of RY 160 and TB dye real aqueous samples was successfully investigated. The results indicated that

modification of bentonite surface by magnetite generates an adsorbent with suitable adsorption capacity for removal of dyes like RY 160 and TB aqueous solutions.

Keywords : Bentonite, Magnetite, Reactive yellow, Toluidine blue.

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