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Kinetics, isotherms, and thermodynamic modeling of liquid-phase adsorption of Rhodamine B dye onto Fe/ZnO-shrimp shell nanocomposite

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ABSTRACT

A cost-efficient nanocomposite was synthesized by sol–gel production of Fe^{3+}-doped ZnO nanoparticles (Fe–ZnO) on a base of shrimp shell. Samples were characterized using X-ray power diffraction, Fourier transform infrared spectrometry, and scanning electron microscopy through energy-dispersive X-ray analysis. Experimental studies on the removal of Rhodamine B (RB) from an aqueous solution in batches revealed that the adsorption equilibrium was best represented by the Langmuir isotherm, with a maximum monolayer capacity of 83.81 mg g^{-1} for RB. Kinetic data were well described by a pseudo-second-order kinetic model. Different thermodynamic parameters, that is, changes in standard free energy, enthalpy, and entropy, were also evaluated. It was found that dye adsorption into the nanocomposite was a spontaneous, exothermic, and physical reaction.

Keywords: Fe^{3+}-doped ZnO nanoparticle; Shrimp shell; Adsorption isotherms; Adsorption kinetics

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