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Equilibrium, kinetic and mechanism study for the adsorption of neutral red onto rice husk

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ABSTRACT

Adsorption of neutral red (NR) onto rice husk from aqueous solutions was investigated. Experiments were carried out as a function of pH, adsorbent dosage, contact time and dye concentration. The equilibrium adsorption data were analyzed by Langmuir, Freundlich, Redlich–Peterson models using nonlinear regressive analysis. The results indicated that the Langmuir and Redlich–Peterson models provided the best correlation of the experimental data. The adsorption capacities of NR adsorption onto rice husk from Langmuir model were 25.16, 29.15, 32.37 mg/g at 288, 308, 318 K, respectively. Adsorption kinetic data were fitted using the pseudo-first-order kinetic model and pseudo-second-order kinetics. It was shown that the pseudo-first-order and second-order kinetic equations could describe the adsorption kinetics. The process mechanism was found to be complex, consisting of both surface adsorption and pore diffusion. The effective diffusion parameter D_i values estimated in the order of 10^{-9} cm^2/s indicated that the intraparticle diffusion was not the rate-controlling step. Using the equilibrium concentration constants obtained at different temperatures, various thermodynamic parameters, such as ΔG^0, ΔH^0 and ΔS^0, have been calculated. The thermodynamics parameters of NR/rice husk system indicated spontaneous and endothermic process. It was implied that rice husk may be suitable as adsorbent material for adsorption of NR from aqueous solutions.

Keywords: Rice husk; Neutral red; Adsorption isotherms; Kinetics; Thermodynamics

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