



Removal of toxic dye (Rhodamine B) from aqueous solutions by natural smectite (SMC) and SMC-nanoTiO₂

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ABSTRACT

Titanium oxide nanoparticles-modified smectite (SMC-nTiO₂) as a low-cost adsorbent was investigated for the removal of Rhodamine B (RhB) from aqueous solutions. The adsorbents (SMC and SMC-nTiO₂) were characterized by scanning electron microscopy, Fourier transforms infrared spectroscopy, and energy-dispersive X-ray spectroscopy. The effects of various parameters like contact time, adsorbent weight, pH, and temperatures were examined. Three kinetic equations (pseudo-first-order (PFO), pseudo-second-order (PSO), and intra-particle diffusion) were used to evaluate the experimental kinetic of the data and the results showed that the adsorption process is in line with the PSO kinetic model. Adsorption equilibrium isotherms were modeled using Langmuir, Freundlich, and Temkin equations. The removal processes of RhB onto SMC and SMC-nTiO₂ were fitted well by the Freundlich isotherm. The maximum cationic dye removal of 91.4% and 99.9% were obtained at pH 9.04, for the adsorbent surfaces SMC and SMC-nTiO₂, respectively. Thermodynamic parameters such as ΔG° , ΔH° , ΔS° , and E_a were also estimated for the whole process. The error function, the nonlinear Chi-square test (χ^2) have been also determined. Titanium oxide nanoparticles- modified smectite clay sample shows very good potential as a low-cost adsorbent for the removal of RhB from aqueous solutions.

Keywords: Nano-TiO₂; Rhodamine B; Smectite; Removal; Freundlich isotherm; Kinetic

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