



Kinetics, thermodynamics, and equilibrium evaluation of adsorptive removal of methylene blue onto natural illitic clay mineral

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ABSTRACT

The natural illitic clay mineral (NICM) has been used as a low cost and highly effective adsorbent in the removal of a toxic cationic dye, methylene blue (MB), from aqueous solution by a batch adsorption technique. The effects of experimental parameters such as initial pH of the aqueous solution, contact time, initial MB concentration, adsorbent concentration, ionic strength, and temperature were studied in detail upon the adsorption process. The process was found to be independent of initial solution pH and the adequate equilibrium time for the adsorption of MB onto NICM was only 60 m. The experimental data were analyzed by the Langmuir, Freundlich, Temkin and Dubinin–Radushkevich isotherm models and showed a good fit with both the Langmuir and Freundlich isotherm models. The monolayer adsorption capacity of NICM was found to be 24.87 mg g⁻¹ by using Langmuir isotherm model. The kinetics of the adsorption were tested using pseudo-first-order, pseudo-second-order, and intraparticle diffusion models. The results showed that the adsorption of MB onto NICM proceeds according to the pseudo-second-order model. Thermodynamic parameters indicated that the present adsorption process was feasible, spontaneous, and endothermic in nature.

Keywords: Illitic clay mineral; Isotherms; Methylene blue; Removal; Thermodynamics

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