Study of the kinetics and thermodynamics of adsorption of Red Bemacid on the cords of Luffa cylindrica

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ABSTRACT

The present study explored the possibility of using Luffa cylindrica cords for the removal of dye Red Bemacid CL-BN200 through the adsorption batch process under different experimental conditions. The determination of the concentrations of dye have been performed using an UV–visible spectrophotometer (S6). The kinetics and thermodynamics of adsorption of Red Bemacid by cords of L. cylindrica were studied. Experimental data were analyzed by the Langmuir, Freundlich, and Temkin isotherms, and isothermal constants were calculated using a linear regression analysis. The Langmuir isotherm showed the maximum value of adsorption capacity was 12.30 mg/g, and the correlation coefficient ($R^2$) was 0.997. The pseudo-first- and pseudo-second-order kinetic models were applied to the experimental data. The experimental data fitted very well the pseudo-second-order kinetic model ($R^2 = 0.99$) and also followed the model of intraparticle diffusion ($K_{ad}$ vary from 0.261 to 2.341 mg/(g min$^{1/2}$) for concentrations between 5 and 50 mg/L), whereas diffusion is not the only rate-control step. The thermodynamic parameters were evaluated. The positive value of $\Delta H^\circ$ (2.06 kJ/mol) indicated that the adsorption of Red Bemacid on L. cylindrica cords was endothermic, the result was supported by the increase in the adsorption of Red Bemacid more and more with temperature. Positive values of entropy ($\Delta S^\circ = 11.87$ J/mol K) correspond to a good affinity cords L. cylindrica molecules Red Bemacid. Negative values of the free enthalpies ($\Delta G^\circ = -1.21, -1.36, and 1.43$ kJ/mol at 277, 290, and 296 K, respectively) for the studied system show that the adsorption process is spontaneous.

Keywords: Adsorption; Luffa cylindrica cords; Red Bemacid CL-BN200; Langmuir and Freundlich isotherms; Kinetics; Thermodynamics

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