Modeling of Adsorption Isotherms and Kinetics of Remazol Red RB Adsorption from Aqueous Solutions onto Modified Clay

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There is an increase in environmental pollution as a result of rapid industrialization. The biological effects of dyes after biotransformation have been shown to be toxic, and in some cases these compounds are carcinogenic and mutagenic. Due to low biodegradability of dyes, a conventional biological treatment process is not very effective.Therefore, the treatment of effluents containing such dye is of prime importance due to its harmful impacts on receiving waters. Among the applied processes for the removal of substances in waste waters, adsorption has been found to be superior to other techniques for wastewater treatment in terms of initial cost, simplicity of design, ease of operation, and insensitivity to toxic substances.

In this study, the adsorption of an anionic dye Remazol Red RB, from aqueous solution on modified clay was investigated at 298, 313 and 333K. Different parameters that influence the adsorption process such as contact time, initial dye concentration, solution pH and temperature were systematically studied. Adsorption capacity increased with increasing of temperature, initial dye concentration and pH. The value of zeta potential decreased with increasing of pH. Experimental adsorption data were modeled by different equilibrium isotherms such as Langmuir, Freundlich, Temkin, Dubinin–Radushkevich (D–R), BET, Halsey, Harkins-Jura, Smith and Henderson isotherms. The adsorption process followed the Langmuir isotherm model with high coefficients of correlation (R2 >0.99) at different temperatures. The pseudo-second order kinetic model fitted well in correlation to the experimental results. Activation energy of the adsorption process (Ea) were found to be 34.49 kJ mol–1 and 40.27 kJ mol–1 for inital dye concentrations of 75 and 150 mg/L, respectively by using the Arrhenius equation, indicating the strong electrostatic interactions between adsorbent and dye. Thermodynamic parameters suggest that the adsorption process is spontaneous and endothermic in nature.

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