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Artificial neural network mathematical modeling of methyl violet removal with chitosan-coated clinoptilolite

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ABSTRACT

In this study, the use of chitosan-coated clinoptilolite zeolite as an adsorbents in the removal methyl violet from an aqueous solutions were investigated. Firstly, the structural and chemical characterization of the adsorbent was carried out using various analytical techniques such as X-ray diffraction, Brunauer–Emmett–Teller and scanning electron microscopy. Then, the effects of different batch parameters such as initial pH (2–9), adsorbent dosage (0.05–1.0 g/100 mL), temperature (298–318 K), initial dyestuff concentration (25–125 mg L^{-1}) and mixing time (5–120 min) on the adsorption process were examined. The kinetic, thermodynamic and isotherm parameters of chitosan-coated clinoptilolite zeolite was investigated by batch adsorption experiments. The experimental data showed that the adsorption isotherms were well defined by the Langmuir equilibrium isotherm model equation. The maximum adsorption capacity was found 111.11 mg g^{-1} for chitosan-coated clinoptilolite zeolite adsorbent at 318 K. The methyl violet adsorption was determined to conform to the pseudo-second-order kinetic model. The thermodynamic calculations were made in the adsorption study of chitosan-coated clinoptilolite. As a result of calculations, it was determined that the $\Delta H°$ values were 34.53 kJ mol^{-1}, and the fact that this value is positive indicates that the adsorption process is spontaneous and endothermic. The recovery test exhibited that the developed composite had significantly adsorption/desorption performance particularly until the seventh cycle. In the last step, considering the effects of some experimental parameters on methyl violet adsorption, an artificial neural network model was developed, and it was concluded that it could be used for dye removal from aqueous solutions. All experimental studies showed that found to be a natural, cost-efficient and eco-friendly of the developed chitosan coating on clinoptilolite zeolite composite make it economic easily applicable adsorbent in the removal of methyl violet from the aqueous solutions.

Keywords: Methyl violet; Adsorption; Chitosan; Clinoptilolite; Artificial neural network modeling

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