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Adsorption of Cr(VI) ions from aqueous systems using thermally sodium organo-bentonite biopolymer composite (TSOBC): response surface methodology, isotherm, kinetic and thermodynamic studies

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ABSTRACT

Chromium, as a serious environmental contaminant, is frequently encountered in different industrial effluents. In the present study, we focused on the combined application of a surfactant-modified bentonite and chitosan for the removal of Cr(VI). In addition, the effects of several important parameters such as pH (2–8), adsorbent dosage (0.1–1.5 g/L), Cr(VI) concentration (20–200 mg/L) and contact time (60–240 min) were also investigated and the process was optimized by means of response surface methodology. The analysis of variance of the quadratic model demonstrates that the model was highly significant. Optimized values of pH, adsorbent dosage, initial Cr(VI) concentration and contact time were found to be 3.7, 1.40 g/L, 77 mg/L and 180 min, respectively. The results revealed that the prepared adsorbent had significant adsorption capacity (124.1 mg/g) for Cr(VI). All results showed that thermally sodium organo-bentonite biopolymer composite (TSOBC) had a good affinity toward Cr(VI). Among the isotherm models tested, Langmuir isotherm model was found to be the best fit for the obtained data. The adsorption kinetics indicated that Cr(VI) adsorption on TSOBC followed pseudo-second-order better than pseudo-first-order model. Moreover, thermodynamic studies showed that adsorption of Cr(VI) on TSOBC was spontaneous and endothermic in nature. The applied adsorbent was characterized by scanning electron microscopy, X-ray diffraction, energy dispersive X-ray and Fourier-transform infrared spectroscopic techniques.

Keywords: Adsorption; Cr(VI); Modified bentonite; Chitosan

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