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HEXAVALENT CHROMIUM ADSORPTION CAPABILITY ONTO CARBON BLACK: KINETIC AND THERMODYNAMIC ASPECTS

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Abstract

The adsorption rate and dynamic behavior of the system are important factors as regards the process design and operational control. The aim of this study was to find a suitable kinetic model for the hexavalent chromium removal in a batch reactor. The experimental data were analyzed using four adsorption kinetic models: the pseudo- first and second order equations, the Elovich equation, and the intraparticle diffusion equation, so as to determine the best fit equation of the Cr(VI) adsorption onto the carbon black. The rate constants and the related correlation coefficients for the each kinetic model were calculated and discussed. Also, the predicted $q_{e,cal}$ values from the kinetic equations were compared with the experimental data. The results showed that the pseudo-second order equation provided the best correlation of the adsorption process (R^2 = 0.9820 – 0.9978), whereas the Elovich equation also fitted well with the experimental data (R^2 = 0.9561 – 0.9599). The corresponding rate constants corresponded to values 0.0144 – 0.0205 g/mg min. Analyses were performed at 293, 313, and 333 K. Based on the rate constants, obtained by the kinetic model using the Arrhenius and Eyring equations, the activation parameters were determined, i.e. the activation energy (4.37 kJ/mol), the change of entropy (273.74 J/mol K), enthalpy (- 1.79 kJ/mol), and the Gibbs free energy (- 1.78 kJ/ mol).

Key words: carbon black, Cr(VI) adsorption, kinetics, thermodynamics

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