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Adsorption behavior of Cr(VI), Ni(II), and Co(II) onto zeolite 13x

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ABSTRACT

The adsorbed behavior of zeolite 13x was tested for the removal of chromium (Cr(VI)), nickel (Ni(II)), and cobalt (Co(II)) in single- and multi-solute (binary and ternary) systems, using a batch adsorption technique under different experimental conditions namely solution pH and initial metal-ion concentration. pH 6 was the optimum condition for the adsorption of Cr(VI), Ni(II), and Co(II). The removal rate decreased as the temperature and the initial concentration increased. Kinetics experiments indicated that the processes can be simulated by pseudo-second-order model. The Langmuir adsorption model fitted the experimental data reasonably well better than Freundlich, D–R, and Redlich–Peterson model for the three metal ions studied. The maximum monolayer adsorption capacity for Cr(VI), Ni(II), and Co(II) was 3.929, 6.195, and 10.389 mg/g, respectively. The main energy of adsorption (E), calculated as 8–16 kJ/mol, demonstrated chemical characteristics of adsorption process. Thermodynamic calculations showed that the adsorption of all metal ions onto zeolite 13x was feasible, endothermic in nature and the degrees of freedom increased at the solid–liquid interface during the adsorption. The sequential adsorption–desorption cycles showed that hydrochloric acid held good desorption on saturated zeolite.

Keywords: Adsorption; Desorption; Isotherm; Kinetics; Thermodynamics; Zeolite 13x

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