Comparison study on Cr(VI) removal by anion exchange resins of Amberlite IRA96, D301R, and DEX-Cr: isotherm, kinetics, thermodynamics, and regeneration studies

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ABSTRACT

The adsorption of Cr(VI) by three resins of Amberlite IRA96, D301R, and DEX-Cr was studied under varying experimental conditions including pH, resin amount, contact time, and temperature. The results showed that the maximum removal could be achieved at pH 3 for the three resins. The removal efficiencies of Cr(VI) by the resins all increased with increasing the resin amounts, whereas the adsorption capacity decreased. DEX-Cr presented the highest adsorption capacity (248 mg/g) and the longest equilibrium time (80 min). The resins all processed well at high temperature but presented different tolerance to temperature changes, which was dependent on moisture holding capacity. The thermodynamic results indicated that the uptake of Cr(VI) was endothermic and spontaneous. The adsorption equilibrium of DEX-Cr and D301R fit well with Freundlich and Langmuir isotherm, respectively, while Amberlite IRA96 showed better correlation to both two models. Kinetic analysis indicated that the adsorption followed both first-order and second-order equations. Intraparticle diffusion and chemical reaction were the rate-limiting steps. Desorption study revealed the addition of NaCl to NaOH helped improve desorption efficiency significantly, and the optimal dosage of the eluant was 6% NaOH (mass fraction) with 10% NaCl (mass fraction).

Keywords: Cr(VI) removal; Anion exchange resin; Adsorption isotherms; Adsorption kinetics; Desorption