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Removal of Ba(II) and Sr(II) ions using modified chitosan beads with pendent amidoxime moieties by batch and fixed bed column methods

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ABSTRACT

A new Modified chitosan beads with pendent amidoxime moieties (CACR) was prepared by reaction of cross-linking chitosan beads (CLCB) with acrylonitrile and hydroxylamine hydrochloride, respectively. The resulted chelating resin was characterized using FTIR Spectroscopy, thermal gravimetric analysis (TGA), differential scanning calorimeter (DSC), BET surface area, and scanning electron microscope (SEM- EDX). Batch adsorption experiments of strontium and barium from aqueous solution onto CACR has been investigated as a function of pH, metal ion concentration, contact time, metal ion concentration and temperature. Adsorption experiments indicated that the adsorption capacity was dependent on operating variables. The saturated adsorption capacities at 25°C were 2.30 and 1.75 mmol/g resin for Ba(II) and Sr(II), respectively. Equilibrium isotherm data were analyzed using Langmuir, Freundlich, and Temkin isotherm models, the equilibrium adsorption results were obviously fitted with Freundlich model. The kinetics data were well fitted by pseudo-second order kinetic model. Thermodynamic parameters were calculated for the uptake of the metal ions under study and it was found to be a spontaneous and endothermic process. The adsorption performance of CACR toward Ba(II) and Sr(II) using fixed bed column method was investigated under different conditions. Thomas and Yoon–Nelson models were applied to the experimental data to analyze the column performance. Regeneration was effectively performed using nitric acid and the chelating resin could be used repetitively for five times with little decrease (2–9%) in adsorption of metal ions.

Keywords: Modified chitosan; Amidoxime; Adsorption; Kinetics; Thermodynamics; Barium; Strontium

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