Desalination and Water Treatment
www.deswater.com

41 (2012) 1–8
March

1944-3994/1944-3986
doi: 10.1080/19443994.2012.664615

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Nitrates removal on PUROLITE A 520E resin: kinetic and thermodynamic studies

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Received 7 January 2010; Accepted 1 February 2012

ABSTRACT

Ion-exchange technology was studied to remove nitrates using PUROLITE A 520E. Predicting the rate at which adsorption takes place for a given system is probably the single most important factor for adsorber design, with adsorbate residence time and ultimately the reactor dimensions controlled by the system's kinetics. A fixed volume stirred tank reactor was used to study the kinetics of adsorption in a single-component system. Results of the intraparticle diffusion and the film diffusion models show that the film diffusion was the main rate-limiting step at high concentrations of nitrates. Process parameters including the rate of agitation, pH, and initial concentrations of nitrates were examined and the obtained data were modeled using three kinetic models including the pseudo-first-order equation, second-order equation, and intraparticular diffusion model. The best fit of experimental adsorption data was obtained by means of the pseudo-second-order models. Equilibrium data were fitted to the Freundlich, Langmuir, and Dubinin–Radushkevich isotherm equations, and the equilibrium data were found to be well represented by the Langmuir isotherm equation. The thermodynamic constants of adsorption phenomena, ΔH^0 and ΔS^0 were found to be −14.88 kJ/mol and 1.08 J/mol in the range 300–343 K respectively. The negative values of the Gibbs free energy ΔG^0 demonstrate the spontaneous nature of adsorption of nitrates onto PUROLITE A 520E.

Keywords: Adsorption; Nitrates; Resin; Kinetics

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