Desalination and Water Treatment
www.deswater.com
12 (2009) 16–27
January
1944-3994 / 1944-3986
doi: 10.5004/dwt.2009.939

Removal of uranium(VI) from aqueous solutions and nuclear industry effluents using humic acid-immobilized zirconium-pillared clay

T.S. Anirudhan*, C.D. Bringle, S. Rijith

Department of Chemistry, University of Kerala, Kariavattom, Trivandrum-695 581, India
Tel. +91 (471) 2418782; Fax +91 (471) 2307158; email: tsani@rediffmail.com

Received 19 July 2008; Accepted in revised form 6 October 2009

ABSTRACT

Removal of uranium [U(VI)] from aqueous solutions with humic acid-immobilized zirconium-pillared clay (HA-Zr-PILC) was investigated using batch adsorption technique. Maximum removal of 99.2% was observed for an initial concentration of 25 mg L^{-1} at pH 6.0 and an adsorbent dose of 2 g L^{-1}. Equilibrium was achieved in approximately 4 h. The adsorbent was characterized using, XRD, FTIR, SEM, TG/DTG surface area analyzer and potentiometric titration. The effects of pH, contact time, initial concentration and adsorbent dose on removal process were evaluated. The experimental kinetic and isotherm data were analyzed using a second-order kinetic equation and Langmuir isotherm model, respectively. The monolayer adsorption capacity for U(VI) removal was found to be 134.65±4.07 mg g^{-1}. Adsorption experiments were also conducted using a commercial cation exchanger, with carboxylate functionality for comparison. Adsorption efficiency was tested using a simulated nuclear industry effluent sample. Experimental results obtained from repeated adsorption/desorption cycles indicate that the adsorbent can be potentially applied for the removal and recovery of U(VI) ions from various aqueous solutions.

Keywords: Pillared clay; Humic acid; Uranium; Adsorption kinetics; Isotherm; Regeneration

* Corresponding author.

Presented at the Symposium on Emerging Trends in Separation Science and Technology (SESTEC-2008)
March 12–14, 2008, University of Delhi, Delhi, India