Desalination and Water Treatment
www.deswater.com

doi: 10.1080/19443994.2015.1040465

57 (2016) 10767–10775
May

Taylor & Francis
Taylor & Francis Group

Adsorptive removal of Cr(VI) from aqueous solutions with an effective adsorbent: cross-linked chitosan/montmorillonite nanocomposites in the presence of hydroxy-aluminum oligomeric cations

Yu-Mei Wang, Lian Duan*, Yue Sun, Ning Hu, Jin-Yun Gao, Hong Wang, Xian-Mei Xie*

School of Chemistry and Chemical Engineering, Research Institute of Special Chemicals, Taiyuan University of Technology, Taiyuan 030024, China, Tel. +86 18935128026; email: wangyumeijia90@163.com (Y.-M. Wang), Tel. +86 351 6018564; emails: duanlian@tyut.edu.cn (L. Duan), sunyue@tyut.edu.cn (Y. Sun), Tel. +86 18234085967; email: huning_syit@126.com (N. Hu), Tel. +86 15536013341; email: 15536013341@163.com (J.-Y. Gao), Tel. +86 18334707121; email: 18334707121@163.com (H. Wang), Tel. +86 351 6018564; email: xxmsxty@sina.com (X.-M. Xie)

Received 9 October 2014; Accepted 5 April 2015

ABSTRACT

On the basis of laboratory research, the adsorbent of cross-linked chitosan/Al_{13}-pillared montmorillonite (CCPM) was examined on the removal of Cr(VI) from aqueous solutions. In order to determine the effects of process parameters namely cross-linked chitosan-to-clay ratio, temperature, initial solution pH, initial Cr(VI) concentration, adsorbent dose, and contact time on Cr(VI) uptake, batch studies were systematically conducted. Equilibrium data were applied to the Langmuir and Freundlich isotherm models and best described by the Langmuir isotherm model. It was shown that monolayer adsorption capacity was 15.67 mg/g of Cr(VI) obtained by the Langmuir isotherm model. The kinetics of adsorption correlated well with the pseudo-second-order equation. Moreover, the intra-particle diffusion model was applied to investigate the mechanism of adsorption. Furthermore, thermodynamic parameters including free energy change, enthalpy change, and entropy change revealed that the adsorption of Cr(VI) onto CCPM was endothermic and spontaneous. The results suggest that CCPM is an effective adsorbent for removing Cr(VI) ions from aqueous solutions.

Keywords: Adsorption; Cr(VI); Cross-linked chitosan; Al_{13}-pillared montmorillonite; Equilibrium isotherms; Kinetics

*Corresponding authors.