Desalination and Water Treatment
www.deswater.com

(2017) 1–10

doi:10.5004/dwt.2017.21080

Adsorption of cadmium onto activated alumina: kinetics and thermodynamics studies

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Received 29 December 2015; Accepted 28 October 2016

ABSTRACT

In this study, Activated Alumina was assessed as adsorbent for the removal of cadmium ions from aqueous solutions. Langmuir, Freundlich and Dubinin-Redushkevich (D-R) models were used to study the adsorption equilibrium at different temperatures (283, 298 and 313 K). It was found that the maximum adsorption capacities increased with temperature indicating an endothermic phenomenon. Furthermore, the values of sorption energy estimated for the studied range of temperature by the D-R model were found to be higher than 8 kJ mol^{-1} suggesting a chemisorption reaction. In addition, the correlation of sorption data by kinetic equations showed that the adsorption of cadmium follows the Elovich and the pseudo-second order models which confirms the chemisorption process. The thermodynamic parameters showed that the adsorption of cadmium onto activated alumina was spontaneous, and the positive values of enthalpy change ($\Delta H°$) confirmed the endothermic character of adsorption. In order to further study the cadmium sorption, different techniques were used for the characterization of the activated alumina before and after adsorption. BET measurements shown an increase of the specific surface area. In addition, FTIR and XRD analysis were used to discuss the role of functional groups in cadmium adsorption. Besides, the technical viability of the process was investigated for a wastewater sample. It was found that the activated alumina is an efficient adsorbent for the removal of cadmium from contaminated water, as the reached percentage removal was above 99%.

Keywords: Cadmium; Adsorption; Activated alumina; Kinetic; Thermodynamics

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Presented at the 5th Maghreb Conference on Desalination and Water Treatment — CMTDE 2015, December 21–24, 2015, Hammamet, Tunisia