Desalination and Water Treatment
www.deswater.com

doi: 10.5004/dwt.2019.23601

146 (2019) 210–226
April

Efficient amine-SBA-15-type adsorbents for treatment of water containing trace levels of Pb(II) and Cd(II)

Victoria Gascón[a], Amaya Arencibia[b,*], Jesús María Arsuaga[b]

[a]*Department of Chemical Sciences, Bernal Institute, University of Limerick, Limerick, V94T9PX, Ireland, email: Victoria.GasconPerez@ul.ie*
[b]*Chemical and Environmental Engineering Group, Department of Energy, Mechanical and Chemical Technology, ESCET – Universidad Rey Juan Carlos, C/Tulipán s/n, Móstoles (Madrid) Spain, Tel. +34 91 488 70 85; Fax: +34 91 488 70 68; emails: amaya.arencibia@urjc.es (A. Arencibia), jesusmaria.arsuaga@urjc.es (J.M. Arsuaga)*

Received 10 July 2018; Accepted 9 December 2018

ABSTRACT

Multiamine materials were prepared from SBA-15 mesoporous silica by grafting and impregnation methods. Polyethylenimine and two organosilanes containing amino groups: [amino-ethylamino]-propyltrimethoxysilane (NN), [(2-aminoethylamino)ethylamino]propyl-trimethoxysilane (NNN) were used as supply of the organic chains. These functionalized materials were used as adsorbents for the removal of aqueous lead(II) and cadmium(II), which are included in the EU list of Priority Substances in Water. The prepared materials were characterized by XRD, nitrogen adsorption–desorption, ^{29}Si MAS NMR, and elemental analysis. Experimental adsorption isotherms were determined up to saturation and successfully reproduced with the Langmuir model. The influence on Pb(II) and Cd(II) adsorption of the type of functional organic chain incorporated and the percentage of functionalization was studied. Likewise, pH effect and sorption mechanism were analyzed. Consequently, maximum adsorption capacities were significantly superior for Pb(II) achieving values as high as 1.37 mmol Pb g^{-1}. Furthermore, the observed strong affinity between adsorbent and metals at trace-level concentrations evidenced potential industrial application of these adsorbents for Pb(II) and Cd(II) uptake in contaminated water treatments.

Keywords: Amine-functionalized SBA-15; Water treatment; Selective adsorption; Lead and cadmium removal

* Corresponding author.