Desalination and Water Treatment
www.deswater.com

doi: 10.5004/dwt.2017.21451

95 (2017) 128–143
November

Hybridizing carbon nanomaterial with powder activated carbon for an efficient removal of Bisphenol A from water: the optimum growth and adsorption conditions

Haiyam Mohammed Alayan[a,b], Mohammed Abdulhakim Alsaadi[a,c,d,*], Ali Abo-Hamad[a,b], Mohamed Khalid AlOmar[a,e], Mustafa Mohammed Aljumaily[a,c], Rasel Das[f], Mohd Ali Hashim[a,b]

[a]*University of Malaya Centre for Ionic Liquids, University Malaya, 50603 Kuala Lumpur, Malaysia, Tel. +60163630693; Fax: +60 3 7967 5311; email: mdsd68j@gmail.com (M.A. Alsaadi), Tel. +601121881804; email: hayomchm@yahoo.com (H.M. Alayan), Tel. +46 739138360; email: aliabohamad@yahoo.com (A. Abo-Hamad), Tel. +60182238504; email: mohd.alomar@yahoo.com (M.K. AlOmar), Tel. +60188716877; email: mustafa.kh1989@gmail.com (M.M. Aljumaily), Tel. +60176706452; email: alihashim@um.edu.my (M.A. Hashim)*
[b]*Department of Chemical Engineering, University of Malaya, 50603 Kuala Lumpur, Malaysia*
[c]*Nanotechnology and Catalysis Research Centre (NANOCAT), University of Malaya, 50603 Kuala Lumpur, Malaysia*
[d]*National Chair of Materials Science and Metallurgy, University of Nizwa, Sultanate of Oman*
[e]*Department of Civil Engineering, University of Malaya, 50603 Kuala Lumpur, Malaysia*
[f]*Chemical Department, Functional Nano & Micro-Structured Surface, Leibniz-Institute for Surface Modification, Permoserstr. 15, D-04318 Leipzig, Germany, Tel. +49 (0)341 235 Ext. 3147; email: raselgeneticist@gmail.com*

Received 30 March 2017; Accepted 19 September 2017

ABSTRACT

This work focuses on the optimization of experimental factors affecting the adsorptive removal of Bisphenol A (BPA) using a response surface methodology in combination with central composite design. Thus, a multistructure carbon nanomaterial hybrid was prepared using chemical vapor deposition of methane onto powder activated carbon loaded with nickel nanoparticles. The effects of various growth parameters, including growth temperature, reaction time, and gas ratio were assessed and correlated with quantitative responses. The highest yield of hybrid nanomaterial and removal percentage of BPA were found at growth temperature, reaction duration, and feed gases ratio (H_2/CH_4) of 950°C, 20 min, and 1.0, respectively. Optimization for adsorption conditions namely pH, adsorbent dose, and contact time was performed using the selected carbon nanomaterial hybrid sample. The adsorption kinetics followed accurately the pseudo-second-order model. Langmuir isotherm model provides an excellent model with a maximum adsorption capacity of 181.8 mg g^{-1}.

Keywords: Carbon nanomaterials synthesis; Adsorption; Response surface methodology; Bisphenol A; Chemical vapor deposition

* Corresponding author.