Chemical Engineering Journal 218 (2013) 238–246

Contents lists available at SciVerse ScienceDirect

Chemical Engineering Journal

journal homepage: www.elsevier.com/locate/cej

Multi-walled carbon nanotubes as sorbent for recovery of endocrine disrupting compound-bisphenol F from wastewater

Lei Zhang *, Fang Pan, Xueyan Liu, Lijun Yang, Xiaoqing Jiang, Jichun Yang, Wen Shi

College of Chemistry, Liaoning University, Shenyang 110036, People's Republic of China

HIGHLIGHTS

- EDCs-BPF removal and recovery using MWCNT was studied for the first time.
- A rapid and simple method for separation and recovery of BPF was developed.
- The method exhibits higher removal ratio and anti-interference species ability.
- The method was satisfactorily employed to extract BPF in different water samples.
- The adsorption rate-controlling mechanism was revealed and elucidated in detail.

ARTICLE INFO

Article history:
Received 11 September 2012
Received in revised form 12 December 2012
Accepted 14 December 2012
Available online 20 December 2012

Keywords:
Bisphenol F
Multi-walled carbon nanotubes
Removal
Recovery

ABSTRACT

In this study, the removal and recovery of bisphenol F (BPF) by multi walled carbon nanotubes (MWCNTs) were investigated. MWCNT has shown the great potential as a kind of effective adsorbents for endocrine disrupting compounds (EDCs)-BPF in wastewater treatment. The results indicated that the removal percentages of BPF could reach up to 96.2% within 4 min under pH 4–10. BPF adsorption kinetics was found to be very fast and the equilibrium was attained within 4.0 min following the pseudo-second-order model with observed rate constants (k) 0.707–3.175 g mg^{-1} min^{-1} (at varied temperatures). The adsorption mechanisms were the non-electrostatic dispersion interaction, hydrogen bonds and hydrophobic interaction between BPF and MWCNT and the overall rate process mainly governed by the external mass transfer. Most of the co-existing ions which were studied have negligible effect on the sorption BPF by MWCNT. Furthermore, MWCNT was of high stability in eight times removal–regeneration recycles. In summary, MWCNT is an excellent adsorbent which can be used for BPF removal in contaminated water treatment process.

1. Introduction

Bisphenol F [4,4′-dihydroxydiphenyl-methane] (BPF) has a broad range of applications in industry (liners lacquers, adhesives, plastics, drink packages and food cans), agricultural purposes [1,2]. Especially within the plastic compounds, the using of bisphenol F in diverse domestic materials and products led to its presence in greater or lesser concentrations in food and drinking water. BPF can be accumulated in animal and human bodies through the food chain [3–5] and produce a number of disorders in them [6,7]. BPF has been confirmed to be one of the EDCs by the Environmental Protection Agency (EPA) of United States. The adverse health effects of exposure to EDCs have been reported, such as decreased sperm count, reduced fertility, increased incidences of breast, ovarian and testicular cancers [8–13]. Wastewater from chemical factories and the leachate from waste landfill are pointed as the main contamination sources of artificial endocrine disruptors in aquatic environment. EDCs are subsequently discharged into water and wastewater streams. Recently, bisphenol derivatives have been reported to be found in municipal wastewater [14]. Considering the serious adverse impacts of bisphenol derivatives on the human health and environment, therefore, effective removal of bisphenol derivatives contaminants is vital to maintain public human health.

Many investigators have presented some separation processes for the removal of EDCs from wastewater, such as biological and chemical conversion techniques. Conventional separation techniques, such as coagulation [15], flocculation [16] and precipitation processes [17], are not effective in removing low molecular weight compounds EDCs. Conventional biological processes, such as activated sludge [18], biofiltration [19] and soil aquifer treatment [17], have shown limited EDCs removals, which were mostly derived from biodegradable and/or other compounds readily

* Corresponding author. Tel.: +86 24 622027809; fax: +86 24 62202380.
E-mail address: zhanglei63@126.com (L. Zhang).

1385-8947/$ - see front matter © 2012 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.cej.2012.12.046