International Conference on Low Carbon Asia
11-12 October 2015, Johor, Malaysia.
ICLCA 2015

PREPARATION OF COMPOSITE ACTIVATED CARBON NANOFIBERS (ACNFs) FOR ADSORPTION OF HEAVY METALS

Norfadhilatuladha Abdullah[a,b], Norhaniza Yusof[a,b], Juhana Jaafar[a,b], Ahmad Fauzi Ismail[a,b], Faten Ermala Che Othman[a,b], Nurasyikin Misdan[c]

[a] Advanced Membrane Technology Centre (AMTEC), Universiti Teknologi Malaysia, 81310 Skudai, Johor Bahru, Malaysia.

[b]Faculty of Petroleum and Renewable Energy Engineering, Universiti Teknologi Malaysia, 81310 Skudai, Johor Bahru, Malaysia

[c] Faculty of Engineering Technology, University Tun Hussien Onn Malaysia, 86400 Parit Raja, Johor, Malaysia

Corresponding Author's E-mail: norhaniza@petroleum.utm.my

Keywords: Activated carbon; Activated carbon nanofibers; Adsorption; Heavy metals removal

ABSTRACT

The objective of this study is to prepare a new and highly efficient nanomaterial for heavy metals adsorption. Owing to that, activated carbon nanofibers (ACNFs) from precursor polyacrylnitrile (PAN) and manganese oxide (MnO_2) have been prepared via electrospinning process for removal of heavy metals (lead and cadmium) from aqueous solution. The PAN/MnO_2-based ACNFs were characterized in term of its morphological changes, specific surface area and functional groups analysis using SEM, BET and FTIR analysis respectively. The results showed that the specific surface area (SSA) of the electrospun composite ACNFs was higher than the neat ACNFs which is 499m^2/g as compared to 800m^2/g. SEM analysis illustrated that composite ACNFs have more compact fibers with presence of MnO_2 beads and smaller fiber diameter of 437.2 nm whereas neat ACNFs possessed more aligned nanofibers with average fiber diameter of 575.5 nm. From adsorption study, the removal of Pb (II) and Cd (II) using both ACNF/MnO_2 and ACNFs were higher than the commercial GAC with the removal efficiency is 100% for Pb (II) and 97% for Cd (II). The high removal efficiency of ACNFs/MnO_2 is attributed by its larger SSA, presence of functional groups that play role in adsorption process such as hyroxyl and carboxyl groups and the role of manganese oxide as adsorbent itself (Han,2006). This excellent adsorption performance of ACNFs exhibits the potential of this composite adsorbent to solve the environmental issue of heavy metal contamination.

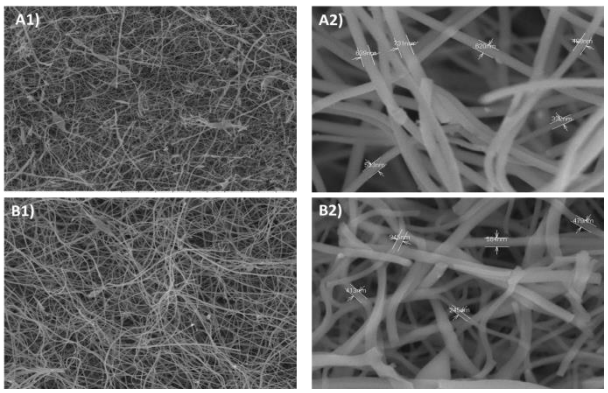

Figure 1. SEM micrograph analysis of A)neat ACNF, B)ACNF/MnO_2 where 1)500x magnification and 2)10000x magnification.

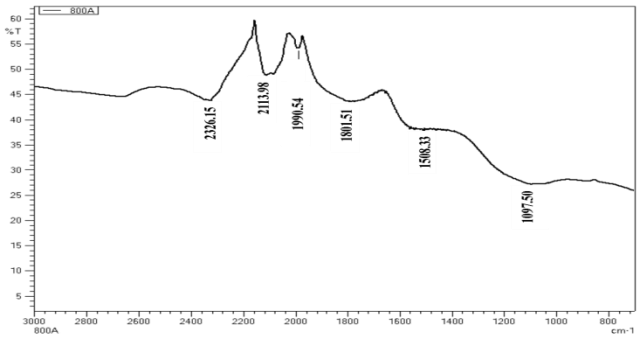

Figure 2:FTIR spectrum of ACNFs/MnO_2.

Table 1: Adsorption of Pb (II) and Cd (II). Operating conditions: membrane dose=1g/L; pH= 6.5 ± 0.5; stirring speed = 180 rpm, temperature= room temperature, contact time = 48 hours.

Metal	Adsorbents	Removal efficiency (%)	Adsorption capacity (mg/g)
Pb (II)	GAC	97	6.8
	Neat ACNFs	100	7
	ACNF/MnO_2	100	7
Cd (II)	GAC	74	5.4
	Neat ACNFs	88	6.2
	ACNF/MnO_2	97	6.6

The removal efficiency and adsorption capacity was calculated using equation 1 and 2, respectively:

$$\boldsymbol{Removal}\ (\%) = \frac{(C_o - Ce)}{C_o} \times \mathbf{100} \quad (1)$$

$$\boldsymbol{Adsorption\ capacity}, q_t = \frac{(C_o - Ce)V}{M} \quad (2)$$

where C_o and C_e is the initial and final concentration of the metal solution ($mg.L^{-1}$), V is the volume of the solution (L), and M is the weight of the adsorbent used (g) (Kampalanonwat & Supaphol,2014).

Acknowledgement

The authors would like to acknowledge the financial support from Malaysian Ministry of Education and Universiti Teknologi Malaysia under Grant No. R.J130000.7842.4F279 and Q.J130000.2542.05H46. The authors would also like to acknowledge the technical and management support from Research Management Centre (RMC), Universiti Teknologi Malaysia.

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