

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

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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 polyacrylonitrile (PAN) and manganese oxide (MnO₂) have been prepared via electrospinning process for removal of heavy metals (lead and cadmium) from aqueous solution. The PAN/MnO₂-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 499m²/g as compared to 800m²/g. SEM analysis illustrated that composite ACNFs have more compact fibers with presence of MnO₂ 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/MnO₂ 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/MnO₂ is attributed by its larger SSA, presence of functional groups that play role in adsorption process such as hydroxyl 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.

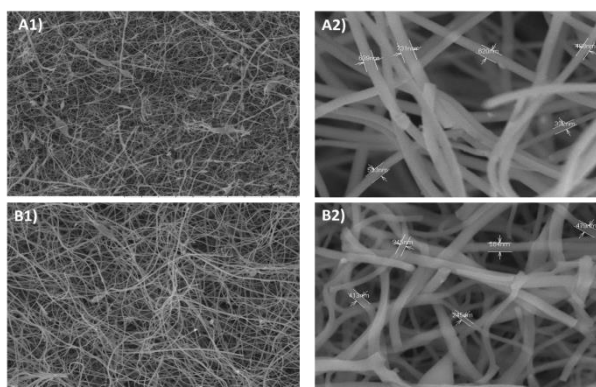


Figure 1. SEM micrograph analysis of A)neat ACNF, B)ACNF/MnO₂ where 1)500x magnification and 2)10000x magnification.

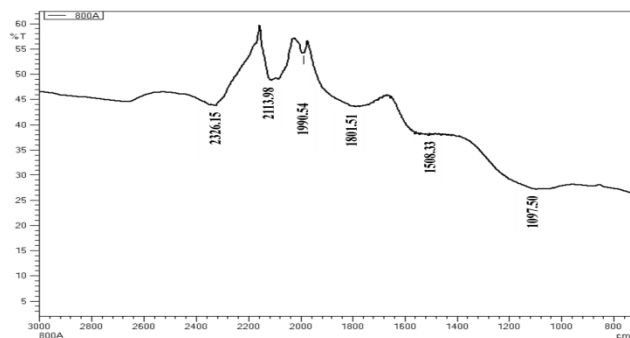


Figure 2: FTIR spectrum of ACNFs/MnO₂.

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:

$$\text{Removal (\%)} = \frac{(C_o - C_e)}{C_o} \times 100 \quad (1)$$

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

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).

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