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Heavy metal removal by modified cellulose nano fibers(MCNF)

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Abstract

In this work, at the first step hardwood pulp was modified by the maleic anhydride; and then electrospinning of modified solution was carried out under different voltages. At last obtained fibres was washed with water and aqueous 70% (w/w) ethanol and prepared to use as a nano absorbent.

The synthesized absorbent was characterized by SEM and FTIR. The degree of substitution of modification reaction is 1-1.8 by titration method. The affection of other parameters like PH, Contact time and temperature on removal was studied. The results show that the modified CNF has a great capacity of absorption for Hg(II).

Keywords: Heavy metals removal; Electrospinnig; Cellulose nano fiber; Modification.

I. I. Introduction

Many studies has been carried out to remove heavy metals, but compare to other methods, adsorption could be more economic, flexible and efficient[1,2].

Cellulose as a cheap, abundant, renewable, and having hydroxyl functional groups could be a great material to start many reactions[3,4].

The aim of this work is to obtain nano fibers which previously modified by maleic anhydride to remove Hg(II) and investigate capacity of it.

II. Methods

Cellulose provided from waste paper. Industrial maleic anhydride was purchase from Tianjin No. 1 chemical reagent factory.. DMAc, LiCl salt and DMAP was from Shanghai Chemical Reagent Co., Ltd., China.

Hg(II) ions waste water was from an industrial field with the concentration of 0.002 $mol.L^{-1}$.

Waste papers was dried and shredded, then dissolved in LiCl/DMAc. DMAP as catalyst was added with maleic anhydride to modify cellulose.

Electrospinning of this solution was carried out under different voltages.

III. Results and discussion

The FTIR scpectra of MCNF and waste paper are presented in Fig.1. As demonstrated in this figure the relevant change observed in bands at about 1730, Which indicate that maleic anhydride was grafted onto cellulose surface. The band at 1730 is due to the stretching of carboxyl group(C=O).

Scanning electron micrographs presented in Fig.2. demonstrate the size of fibers before and after electrospinning. The desire diameter of cellulose fibers had obtained at 15Kv, collector distance of 12cm and flow rate of 5$ml.hr^{-1}$.

Obviously this nano fibers are more effective comparison to micro fibers[5].

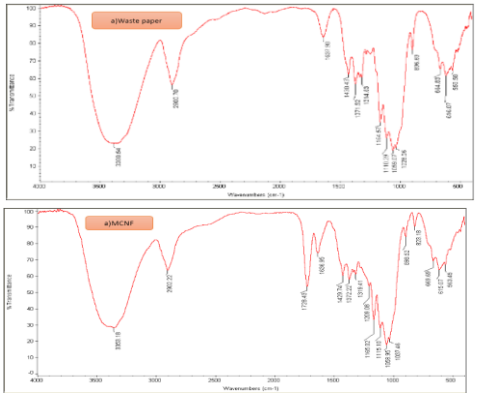

Fig.1.FTIR of waste paper and MCNF .a)waste paper. b) MNCNF

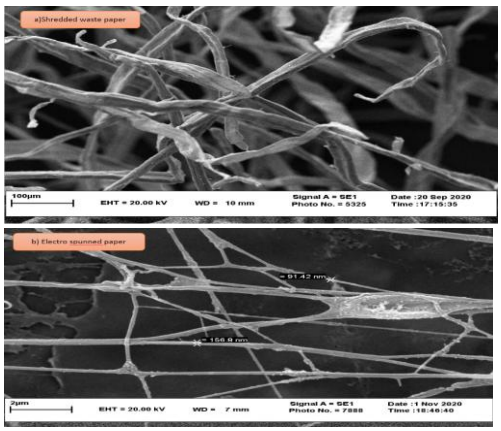

Fig.2. SEM images of a)waste paper b) MCNF

The removal of heavy metal ions from pollutant is dependent on PH of solution. PH range can effect on the surface charge and degree of ionization of the absorbate. A series of test was carried out at different PH values. Fig.3.a demonstrate that at the high PH adsorption was increased sharply, because of the reaction between hydroxyl groups and Hg(II) .So the optimum PH to remove Hg(II) is 5.5.

The effect of temperature on the adsorption of Hg(II) at the range of 10-60 ℃ was investigated. The adsorption capacity was changed from 10 to40℃ and negligible from 40 to 60 ℃.

The effect of stirring time on the adsorption was demonstrated in Fig.3.c. The adsorption rate increased till 32 min and the equilibrium time is around 400min.

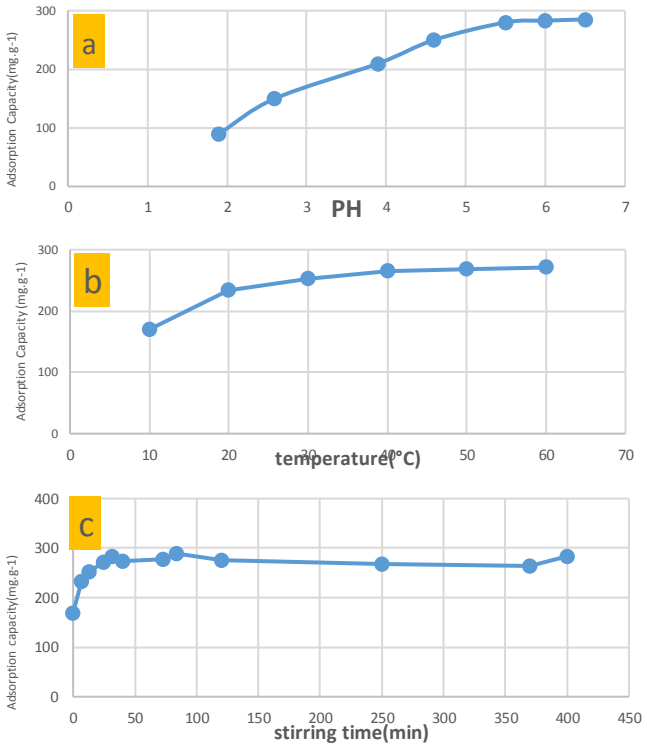

Fig.3. effect of a)PH b)temperature c)stirring time, on adsorption capacity.

IV. Conclusions

In this study, the possibility of using MCNF as adsorbent for Hg(II) ions has investigated. MCNF has a good adsorption capacity for Hg(II) and the maximum uptake of Hg(II) ions from its aqueous solution was found to be 275.2 $mg.g^{-1}$ at the optimum PH of 5.2 and 38 ℃ and stirring time of 32min.

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