

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

The H-ePAN fiber mats were obtained from the hydrolytic treatment of the ePAN fiber mats using a NaOH solution. The conversion of the nitrile groups, native to PAN, into the imine conjugated sequences could be identified simply from the change in the color from whitish of the ePAN fiber mats to light yellowish of the post-washed H-ePAN fiber mats. Chemically, this was confirmed by FT-IR. The extent of the conversion increased with an increase in the concentration of the NaOH solution. The chelating property of the H-ePAN fiber mats was evaluated using Cu(II) ions as the model hazardous metal ions. The initial pH of the Cu(II) ion solution posed a strong influence on the adsorption behavior of the H-ePAN fiber mats, with the initial pH of 5.0 being the optimal condition. The adsorption capacity of the H-ePAN fiber mats towards the Cu(II) ions increased with an increase in the time interval the materials were in contact with the Cu(II) ion solution and the equilibrium was reached after about 5 h of immersion. The isotherm for the adsorption of Cu(II) ions on the H-ePAN fiber mats was studied and was fitted well to the Langmuir equation, with the maximal adsorption capacity being $31.3 \text{ mg}\cdot\text{g}^{-1}$. Lastly, desorption of the pre-adsorbed H-ePAN fiber mats was achieved upon their submersion in 0.1 M HCl aqueous solution for at least 30 min.

The APAN nanofiber mats were obtained from the reaction between the electrospun PAN nanofiber mats and DETA. The conversion of the nitrile group, native to PAN, into the the amidino diethylenediamine group, native to APAN, increased with an increase in the reaction time. The chelating property of the obtained APAN nanofiber mats was evaluated against Cu(II), Ag(I), Fe(II), and Pb(II) ions. The initial pH of the testing solutions posed a strong influence on the adsorption behavior of the materials, with the initial pH of 4.0 being the optimal value where the APAN nanofiber mats showed high adsorption towards all four types of the metal ions. On the other hand, the adsorption capacity was found to

increase with an increase in the contact time and the equilibria were reached at about 10 h for Cu(II) ions and about 5 h for the rest. The adsorption of these metal ions was fitted well with the Langmuir equation, with the maximal adsorption capacities were calculated to be 150.6, 155.5, 116.5, and 60.6 $\text{mg}\cdot\text{g}^{-1}$ for Cu(II), Ag(I), Fe(II), and Pb(II) ions, respectively. The transient adsorption data of the four metal ions on the APAN nanofiber mats were better described with the pseudo second order kinetic model. Lastly, the nanofiber mats (0.1 g) can be generated by using 20 mL of a 10 M HCl solution, with a desorption efficiency greater than 99 %. It was found that adsorption isotherms were better described by Langmuir model for all of those metal ions. The maximum adsorption capacity values of Ag(I) and Cu(II) ions in a mixture of four ion metals with APAN nanofiber mat, estimated from Langmuir model, were 53.48 and 30.40 $\text{mg}\cdot\text{g}^{-1}$, respectively. These results suggest that the APAN nanofiber mat may be a good adsorbent for heavy metal ions and may have great potential use in wastewater treatment.

For thin-layer chromatography application, the experimental results show that electrospun PAN nanofibers are effective as the stationary phase for thin layer chromatography. The devices have been shown to decrease time of analysis and volume of solvent needed. The visualization of preservatives on the stationary phase was easily done by put UV_{254} indicator directly into polymer solution. In addition to enhanced chromatographic performance, e-spun PAN nanofibers phase is also cost and time efficient and can be applied for different surface selectivity by changing the type of polymer.

7.2 Recommendations

A multi-syringes electrospinning set-up should be used to achieve a large quantity of fibers within a short spinning time.

The modification of these electrospun fiber mats needed to be further studied in order to achieve the suitable functional group with higher adsorption capacities and specific adsorption ability.