CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The permeation of organic solvents through a carbon membrane depends on adsorption and diffusion properties of the solvents and the nature of membrane. In mixtures the permeation through the membrane is determined by coupling effects. In this work, pervaporation (PV) and vapor permeation (VP) of four organic compounds through Kapton® polyimide membrane carbonized at 600 ^{o}C were studied. The organic solvents used in this study possessed different molecular diameters and dipole moments. The experiments were designed to study the influence of these two properties on permeation through the membrane. The single-component permeation tests were done with methanol, ethanol, isopropanol and acetone as feeds, whereas bi-component experiments were performed with methanol/acetone, methanol/ethanol, isopropanol/acetone and acetone/ethanol mixtures. The results suggested that both adsorption and diffusion influenced the permeation of a molecule through the carbon membrane. It was found that the organic compounds with small molecular size had higher permeabilities than those of the larger molecules. The results showed that methanol, being the smallest molecule, had the highest permeability in both PV and VP modes of operations. The permeability through the membrane was also dependent on dipole moment. For molecules having comparable molecular diameters, a molecule with a relatively higher dipole moment showed higher permeability. In this work, acetone showed higher permeability than that of IPA, a molecule with approximately the same size. It was likely because acetone was more readily adsorbed onto the hydrophilic surface of the membrane. It was also possible for a larger molecule to be more permeable than a smaller molecule. Acetone, despite its larger molecular diameter, demonstrated higher permeability than that of ethanol because it was more adsorbable. However, the opposite was observed for the competitive permeation. Ethanol permeability became greater which could be the result of higher adsorption induced by acetone.

5.2 Recommendations

Further experiments in the following areas have potentials to expand understanding of permeation mechanism through carbon membranes:

1. Experiments exploring the effects of organic compositions on permeation.
2. Use mathematical model to predict transport through carbon membrane.
3. Because of the high adsorption strengths of many molecules, carbon membranes are vulnerable to fouling, which should be investigated during pervaporation. Most mixtures separated in industrial applications contain impurities or are multi-component mixtures, but few studies on pervaporation using these mixtures have been performed.