CHAPTER 5

SUMMARY AND CONCLUSION

The suitability of magnetic iron oxide loaded activated carbon for the adsorption and subsequent separation of the adsorbent by retention in a magnetic field were investigated. The effects of magnetic iron oxide (MIO) deposited on GAC on the physico-chemical properties were investigated using TG, SEM, Mossbauer spectroscopy, XRD and Vibration Sample Magnetometry were studied.

Mossbauer spectral results and XRD showed the presence of maghemite and other oxides of iron in various proportions. The structural environment and proportion of iron oxide varied depending on the sample. Equilibrium moisture uptake under ambient conditions varied with the proportion of iron oxide in the sample. TG further revealed the suitability of thermal desorption for the regeneration of spent adsorbent. In the middle range of temperature iron oxide facilitated increased mass loss. However, loss of carbon by burn-off was suppressed by iron oxide.

Evaluation of pore properties of magnetic iron oxide loaded activated carbons by nitrogen adsorption and micrographic images revealed that micro, meso and macro pores were affected by MIO to different extent. MIO was deposited inside and outside the pores. The crystallites of MIO had size distribution corresponding to the pore diameter. The surface area determined by the nitrogen adsorption and solution adsorption decreased with increasing MIO loading. The decrease in adsorption properties could not be directly correlated to the iron oxide content. This may be due to the variability in the chemical characteristics and particle size distribution of the mixed oxide.

Solution adsorption studies using phenol, 4-nitrophenol and methylene blue revealed some interesting aspects. Corresponding to the decrease in the surface area due to the MIO loading there is a decrease in the adsorption frequency for the solute loading. The Lagergren
plots revealed a decrease in rate constant for adsorption kinetics. The intra particle diffusion rate constant also reveals a similar trend. Thermodynamic parameters showed a modification in the parameters induced by the presence of MIO.

Regeneration of spent adsorbate using hot water showed a loss in adsorption capacity with increase in regeneration cycle. The advantageous property of MIO-GAC is that after effecting adsorption, the adsorbate could be conveniently retained in a flow through reactor using externally applied magnetic field. Hence the influence of particle size, flow velocity and strength of the scavenging magnetic field were investigated. Retention efficiency increased with increasing particle size and applied field strength and decreased flow velocity. Such changes were also influenced by the extent of loading GAC with MIO.

The studies and results presented in the thesis point to a new direction in the use of activated carbon. Such a flow through application can revolutionize the use of powdered activated carbon. The preliminary studies presented here is a modest contribution to separation science with a specific plausible application in the removal of organic gases in emissions and organic solutes in effluents.

The investigation also opens up some new challenges. These include studies on

- Influence of the method of preparation of MIO-GAC on the distribution of iron oxide phases, modification of pore size distribution and their bearing on adsorption properties.
- Adsorption of volatile organic compounds from gas streams onto MIO-GAC.
- Design and evaluation of devices for MIO-GAC adsorption, retention in magnetic field and regeneration of the used adsorbent.