CHAPTER 7

SUMMARY
Pervaporation (PV) membrane processes have been established as an important separation unit operation in chemical processes. The pervaporation process is technologically important technique for the dehydration of aqueous alcohol mixtures and is expected to find more progress in the Aqueous – water mixtures.

Various pervaporation membranes made from NaAlg polymers such as chitosan and alginate have been fabricated and investigated in terms of the flux and selectivity in pervaporation experiments. Dense film composite membranes were extensively investigated for the separation of water from aqueous alcohol mixtures.

The hypothesis underlying the present work addresses the notion of process efficiency, specifically that of pervaporation of IPA-water through a selective membranes. An overall evaluation of efficiency (selectivity) is beyond the scope of this work, since it would include an analysis of productivity (flux), which may be defined in terms of time, processing unit surface area, energy expenditure or other parameters, most of which interact.

This literature survey present current research efforts on molecular sieves (Zeolites) fabrication with natural polymers CS, SA and gelatin and their
characterization and use for pervaporation studies of IPA water mixtures. The results are incorporated in this thesis.

This thesis consists of six chapters.

Chapter 1 gives a brief introduction of separation technology along with the membrane technology. It also includes the history and classification of membranes, different separation methods with a special mention to pervaporation technique, review of the work done and importance of the present study.

Chapter 2 explains the basic principles and theory of pervaporation process. It also includes the discussion on the factors affecting membranes performance like molecular flux, selectivity, sorption studies etc. It also describes the basic requirements for the of membrane selection according to Hasen solubility parameters and Flory-Huggins interaction parameters.

Chapter 3 discusses the details of the materials used and methods involved in caring out the present work. Procedures for the preparation of zeolite filled membranes have been presented in this chapter. It also describes the details of the construction and working procedure of the laboratory pervaporation system. This chapter also gives several characterization techniques such as Fourier Transform Infrared (FTIR) Spectroscopy, Thermal Gravimetric Analysis (TGA). The experimental details of the sorption and tensile strength measurements are also included in the presented work.

Chapter 4 presents investigations on the preparation of NaAlg and NaAlg filled ZSM-5 zeolite membranes crosslinked with GA, and to test their
performance in pervaporation separation of water – Ethanol and water – Isopropanol mixtures and these results are discussed in terms of pervaporation and sorption properties. Dispersion of zeolite particles was assessed by Scanning Electron Microscopy and the thermal properties by TGA studies. The membrane performance was studied by calculating flux, selectivity. The ZSM5 zeolite membrane has good ability for separation of the aqueous mixtures. By incorporating the ZSM-5 zeolite into NaAlg, the membrane performance is found to be affected substantially. From PV results it was observed that as zeolite content increases from 5 to 10 % flux and selectivity increases. Flux and selectivity values are found by using the membrane to separate the IPA/water and Ethanol / Water mixtures at different temperatures.

Chapter 5 explains the details of the preparation and characterization of 3A-zeolite filled sodium alginate (SA) composite membranes by solution casting method. Loaded with himordenite zeolite and crosslinked with glutaraldehyde (GA). The membrane performance was studied by calculating flux, selectivity. Pure NaAlg membrane and zeolite incorporated membranes for pervaporation (PV) experiments were performed at different temperatures for the feed mixtures of 5 to 30% of water – Ethanol and water – Isopropanol. TGA confirmed thermal stability of the zeolite 3A-zeolite membranes which are found to have good ability for dehydrating of water – Ethanol and water – Isopropanol. Dispersion of zeolite particles was assessed by Scanning Electron Microscopy and the thermal properties by TGA studies. The flux and selectivity results indicated that this membrane exhibited the best PV performance characteristics.

Chapter 6 describes the preparation of HY zeolite filled NaAlg membranes which were crosslinked with glutaraldehyde. The developed
membranes have been assessed for intermolecular interactions, using Fourier Transform Infrared (FTIR) technique. Suitability of these membranes to dehydrate water – Ethanol and water – Isopropanol by Pervaporation (PV) has been demonstrated at different temperatures. The effect of feed composition as well as amount of filler loading on PV separation performance of these membranes has been evaluated. Addition of zeolite into crosslinked NaAlg membrane matrix has been instrumental in increasing the membrane selectivity.

Chapter 7 presents a summary of the research work done.

In conclusion, in all the cases pervaporation is proven as the most promising alternative technology for the separation of aqueous-organic mixtures, particularly at the separation of azeotropic composition and in the separation of close boiling liquid mixtures. In future, there is ample opportunity to continue this type of research by developing different types of membranes for attacking other mixture separation problem.