Preface

Transport of gases, vapours and liquids through polymer nanocomposites is an important and in some cases, the controlling factor in a number of important applications such as protective coatings, membrane separation processes and packaging for foods and beverages. Therefore, a better understanding of the transport mechanisms in polymer nanocomposites is highly important in order to achieve significant improvement in these areas and to develop new ones. Hence, evaluation of transport characteristics of different macromolecular systems is an extremely fascinating field of research.

Poly(ethylene-co-vinyl acetate) (EVA), a semi crystalline polymer, offers excellent weather resistance, toughness, chemical resistance and processability. The goal of the present work is to investigate the morphology, mechanical and thermal characteristics, and rheological properties of the EVA/clay nanocomposites. The liquid transport, gaseous transport and vapour sorption characteristics through EVA/clay nanocomposites were investigated in detail. The feasibility of utilising EVA/clay nanocomposite membranes for the separation of organic liquid mixture (chloroform/acetone) by pervaporation process has been examined. The background of the study, objectives experimental techniques, and the results of the investigation has been presented in ten chapters of this thesis.

Chapter 1 gives an overview of the recent advances in polymer nanocomposites and also provides an overview of the fundamentals of transport phenomena and membrane based transport process. Topics covered include the factors affecting transport process and transport in various polymeric systems. Relationship between membrane characteristics and separation efficiency has been treated briefly. It also presents an account
of earlier works done in the field of polymer/clay nanocomposites. The details of the materials used and experimental techniques adopted are given in Chapter 2.

Chapter 3 gives the investigation on the morphology using Scanning Electron Microscopy (SEM), Small angle X-ray scattering (SAXS), Wide angle X-ray scattering (WAXS), Transmission Electron Microscopy (TEM), Positron Annihilation Life time spectroscopy (PALS) and Dielectric studies of the prepared EVA/clay nanocomposites.

The examination of the mechanical and thermal properties of EVA/clay nanocomposites has been presented in Chapter 4 with special reference to the different type of organic modifiers used for the modification of nanoclays. The results have been explained in terms of variation in the loading of nanoclays.

Chapter 5 gives the results of the investigation on the rheological measurements of the prepared nanocomposites. The results indicated that, with increasing nanoclay content, the storage modulus (G’), loss modulus (G’’), and complex viscosity (η*) increased. This Chapter also deals with the theoretical correlation of creep recovery behaviour using Burger model.

The diffusion and transport of organic solvents through the membranes have been investigated in detail as a function of clay content, nature of solvent and temperature in the temperature range of 28–70 °C is described in Chapter 6. It is observed that the solvent uptake was minimum for composites with 3 wt% of filler and it gets increased with increasing filler content, which is presumably due to aggregation of clay filler at higher loading.

The pervaporation performances of membranes were analyzed using chloroform/aceton mixture and are discussed in this chapter 7. A drop in
selectivity and an increase in permeation rate were observed at higher clay loadings. It was noticed that the sorption and diffusion phenomena are dependent on the composition of liquid mixture and the permeation properties are strongly influenced by the feed composition.

Polymer membranes are widely used for gas separation processes. The gas permeation characteristics of EVA/clay membranes have been described in Chapter 8. The studies revealed that the incorporation of nanoclay in the polymer matrix increased the efficiency of the membranes towards with better barrier properties. Different models have been applied to explain the observed permeability of nanocomposites. The results are in line with the prediction by Bharadwaj model at lower concentration of clay and experimental curve deviates from theoretical curve at higher concentration of nanoclay loadings.

The vapour transport through the nanocomposite membranes was investigated and the results were compared in the chapter 9. The permeability was found to be lower for the CCl₄ and maximum for the CHCl₃ due to difference in the interaction parameters between solvent and polymer.

The major findings of the present investigation and the scope of the future work have been given in Chapter 10.