Preface

Transport of gases, vapours and liquids through polymers 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 polymers 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 transport of organic solvents, organic solvent vapours and gaseous molecules through neat and crosslinked EVA systems. Pervaporation separation of organic-organic mixtures was also investigated. EVA/clay nanocomposite membranes were prepared and their transport features was analysed in detail. The background, objectives experimental techniques and the results of the investigation have been presented in ten chapters of this thesis.

Chapter 1 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 transport
studies of polymeric systems. The details of the materials used and experimental
techniques adopted are given in Chapter 2.

Chapter 3 presents the transport characteristics of neat and dicumyl peroxide
(DCP) crosslinked EVA membranes with aromatic hydrocarbons as penetrants.
The sorption and diffusion have been examined in terms of crystallinity and
crosslinking. The results have been complemented with observations made on
morphology of the matrix by using transmission electron microscopy (TEM) and
X-ray diffraction (XRD) studies. The kinetic parameters related to the transport
process were also discussed.

The examination of the sorption and diffusion properties of aliphatic hydrocarbons
through EVA membranes has been presented in Chapter 4 with special
reference to crosslinker loading and penetrant nature. The results have been
explained in terms of polymer-solvent interaction parameter. Determination of
network structure was done by calculating the molar mass between crosslinks
\( M_c \). The phantom and affine models were used to analyse the deformations of
the network during swelling.

Chapter 5 gives the results of the investigation on the interaction of benzoyl
peroxide (BP) and DCP crosslinked EVA membranes with chlorinated
hydrocarbons. It is found that the maximum solvent uptake is lowest for DCP
system. This Chapter also deals with the stress-strain properties of the polymer
under dry and deswollen conditions.
The feasibility of pervaporation technique for the separation of organic liquid mixtures using EVA membranes has been described in Chapter 6. It is observed that DCP modified membranes showed maximum selectivity. The pervaporation performance was strongly influenced by the feed composition. DCP modified membranes can be effectively used for the separation of organic azeotropic mixtures.

Chapter 7 deals with the transport of organic vapours through EVA membranes. It is found that permeation process is influenced by crystallinity and crosslinks. Polymer membranes are widely used for gas separation processes. The gas permeation characteristics of EVA membranes have been described in Chapter 8. Gas permeation behaviour is dependent on the nature of crosslinks and crosslink density. DCP modified membranes showed maximum selectivity. The positron annihilation lifetime spectroscopic analysis (PALS) was carried out to support the observations.

A new class of membranes, EVA/clay nanocomposite membranes were prepared and their transport features are presented in Chapter 9. EVA/clay nanocomposite membranes showed very high selectivity and good mechanical properties. The morphology of the membrane was analysed by XRD studies and TEM. Free volume of the membranes were analysed using PALS measurements.

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