CHAPTER I
INTRODUCTION

Membranes have long been considered as an attractive alternative to conventional separation methods due to their low capital cost and high-energy efficiency. Such attractive features have stimulated significant research in gas separation. Membrane-based separation processes are finding today wide and ever increasing not only use in the petrochemical, but also food, and pharmaceutical industries, in biotechnology, and in a variety of environmental applications, including the treatment of contaminated air and water streams.

In gas separation, a mixed gas feed at an elevated pressure across the surface of a membrane that is selectively permeable to one component of the feed. The membrane separation process produces a permeate enriched in the more permeable species and a residue enriched in the less permeable species.

To further enhance the commercial applicability of membrane technology, mixed matrix membranes (MMM) have been proposed as an alternative approach by adding molecular sieving material such as zeolites through incorporating these sieves into polymer phase. Two types of mixed matrix membranes (MMM), solid-polymer and liquid-polymer mixed matrix membranes, were developed. The first is a membrane with adsorbent embedded in the polymer phase (MMM_{ADS}). The adsorbent can be zeolite such as silicalite, NaX, or AgX. The polymers can be cellulose acetate (CA), polysulfone, polyimide or silicone rubber. The second type of MMM is produced by casting polyethylene glycol (PEG) and silicone rubber on a porous polysulfone support.

For application of removing CO_2 from gas stream in many industrial applications among which natural gas processing is the most important. CO_2 content needs to be reduced to minimize corrosion potential of pipelines and downstream processing unit as well as to maintain a higher heating value of the gas stream. In addition, it is known that CO_2 acts as a plasticizer in CO_2/CH_4 separations at elevated pressures. The polymer matrix swells upon the sorption of CO_2, accelerating the permeation of CH_4. As a consequence, the membrane separation loses its selectivity (Bos *et al.*, 1998). This phenomenon is called plasticization. Fundamental

understanding of plasticization phenomenon is necessary to study. This plasticization effect therefore should be reduced in order to make membranes attractive in membrane separation applications. It is necessary to develop a membrane for gas separation which can maintain the separation performance at sufficiently high driving pressures.

In this study, new types of solid-liquid-polymer MMMs prepared by a solution-casting method were investigated for CO_2/CH_4 and CO_2/N_2 separations. Different types of liquids such as polyethylene glycol (PEG) and diethanolamine (DEA) were individually adsorbed into activated carbon, NaX and LiX zeolites. Then, the adsorbed solid was dispersed in silicone rubber and casted on cellulose acetate support. Additionally, plasticization phenomenon was also investigated.