CHAPTER I
INTRODUCTION

Membrane has long been considered as an attractive alternative to conventional separation methods, such as distillation. Membrane separations, because of their potential for both low capacity costs and high-energy efficiency, should have an inherent advantage over conventional separation methods. These attractive features have stimulated significant research in gas separation. So far, commercially successful gas separation membranes are mainly thin porous polymeric membranes.

In gas separation, a mixed gas feed at an elevated pressure is passed 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. Important well-developed applications are the recovery of hydrogen refinery and petrochemical purge gases (e.g., hydroprocessing unit purge gas); the separation of hydrogen from nitrogen, argon, and methane in ammonia plants; the production of nitrogen from air; the separation of carbon dioxide from methane in natural gas operations; and recovery of organic vapors from air stream.

To further enhance the commercial applicability of membrane technology, two types of mixed matrix membranes (MMM), solid-polymer and liquid-polymer MMM, were developed. The first type of MMM is a membrane with a zeolite such as silicalite, NaX, or AgX dispersed in the cellulose acetate (CA). The second type of MMM is produced by casting polyethylene glycol (PEG) and silicone rubber (SR) on a porous polysulfone support. The goal in developing the MMM is to enhance membrane selectivity through gas solubility optimization. Both types of MMM were evaluated for the separation of polar gas from non-polar gas and light olefin from light paraffin. Overall results indicated that the zeolite/CA MMM is selective for non-polar gases and light paraffin. However, the PEG/SR MMM is selective for polar gases and light olefin. It is further found that a new type of MMM can be developed to separate carbon dioxide from nitrogen.

Thus, in this work, liquid-solid-polymer MMM, combination of both types of above MMM, composed of carbonate salt were studied for CO_2/N_2 separation. PEG, activated carbon and silicone rubber were used as the plasticizer, solid, and polymer, respectively. Furthermore, potassium carbonate (K_2CO_3) was selected because it was expected that carbonate ions (CO_3^{2-}) could reversibly form a reaction with CO_2 in the presence of water. The ions can selectively carry CO_2 across the membrane in the facilitated transport mechanism while N_2 can be transferred across the membrane only by a simple physical dissolution-diffusion phenomenon.