CHAPTER I
INTRODUCTION

Membrane separation is nowadays considered to be a proven technology, which being widely use in a broad of applications such as petrochemical, food, pharmaceutical, biotechnology and a variety of environmental applications, including the treatment of contaminated air and water streams.

A membrane is a barrier material through which one component of the feed mixture permeates much easier than the others, which leads to a separation of the components. Current gas separation membranes are thin dense films, integrally skinned asymmetric membranes or composite mainly prepared from glassy polymers. Commercialization depends on the development of membrane with sufficient productivity and separating ability to make them economically attractive in industrial applications. Advantages of membranes are low capital investment, ease of generation, low energy consumption, cost effectiveness even at low gas volumes and good weight and space efficiency.

To further enhance permeability and selectivity of membrane technology, mixed matrix membrane (MMM) have been proposed as an alternative approach by adding specific dispersed materials; solid or/and liquid into a processable polymer matrix. There are many types of mixed matrix membrane (MMM) such as dispersed solid polymer mixed matrix membrane which has dispersed solid in polymer phase and dispersed liquid polymer mixed matrix membrane which has dispersed liquid in polymer phase. The solid can be zeolite such as silicalite, NaX, or AgX while polyethylene glycol (PEG) or diethadamine (DEA) can be used as dispersed liquid. In addition, the polymer can be cellulose acetate (CA), polysulfone (PSF), or polyimide (PI).

Membrane separations are used in many applications such as removal of CO_2 from gas stream in many industrial applications among which natural gas processing is the most important. Natural gas often contains various amounts of CO_2 and 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 membrane separation, it is well known that the gas streams often contain high level of plasticizing or condensable vapors, which can cause the plasticization problem. Plasticization is the major problem faced by CO_2-selective polymeric membrane. This action of CO_2 plasticization decreases the ability of the membrane to separate molecules on the basis of size, thereby causing the reduction in selectivity.

From a previous work, new types of dispersed solid-liquid-Polymer MMMs were developed and investigated for CO_2/CH_4 and CO_2/N_2 separations. Different types of liquids such as PEG and diethanolamine (DEA) were individually adsorbed onto activated carbon and zeolite. The adsorbed solid was then dispersed in silicone rubber and coated on a cellulose acetate support. It was found that the incorporation of solid and liquid was effective to improve the separation performance of MMMs. However, the gas permeation rate decreased as an increase in component loading due to those components densified the intersegmental packing of membrane phase. Moreover, it has been reported that CO_2 showed the plasticization phenomenon in which CO_2 permeance increased with increasing feed pressure. Therefore, membranes will lose selectivity due to the CO_2 plasticization that accelerates the permeance of CH_4 and N_2 (Soontraratpong, 2005).

In this work, CO_2- induced plasticization was investigated and minimized for CO_2/CH_4 and CO_2/N_2 separations. The appropriate MMMs from the previous work were used for investigating the plasticization in this study. Heat treatment was considered as a means to suppress the plasticization. Also, treated and untreated membranes were fabricated to study the effect of feed pressure on permeability of gases.