CHAPTER I
INTRODUCTION

Since the last decade, membrane-based technology has become an alternative separation technique most widely used in the chemical industrial applications. Nowadays, membrane separation techniques are selected in order to separate a high valuable gas from the gas mixture due to their advantages over other conventional gas separation technologies for instance low energy consumption, low investment, simple operation and high selectivity. However, membrane separation techniques have a limitation with a permeation rate which is quite low while the selectivity is somewhat high. So far, many researchers have been investigating and developing membranes to reach a better performance of membrane (Kulprathipanja *et al.*, 2002).

In gas separation process by using membrane-based technology, a mixture of gas feed is passed through the membrane surface which is selective to the specific gas (permeable species). Membrane-based separation process produces an enrich gas with more permeable gas from the mixed gas feed to the other side of the membrane called permeate stream. The non-permeating molecules that remain in the feed-stream side exit the membrane as a retentate. The most used applications from membrane separation technique include CO_2 and water removal from natural gas, hydrogen recovery from gas refining process, VOC removal from air or nitrogen streams, nitrogen production for inert gas application, and the separation of methane from carbon dioxide.

Polymer based membranes have been firstly developed for olefin/paraffin separation, but with a low efficiency, the further development of such membrane yields multicomponent membranes or mixed matrix membranes (MMMs) which are found to provide a higher membrane performance. There are three types of mixed matrix membranes; solid-polymer, liquid-polymer and solid-liquid-polymer MMMs. The first type is an organic polymer deposited on highly porous support (e.g., zeolite dispersed in cellulose acetate MMM) in order to increase the selectivity in gas separation process. The second type is a membrane which dispersed liquid in a polymer phase (e.g., polyethylene glycol dispersed in silicone rubber MMM). The last, solid-liquid-polymer MMM, has been developed to avoid undesirable liquid leakage from polymer by incorporating liquid additive into pores of porous materials (solid) and then dispersed absorbed-solid in a polymer phase (Kulprathipanja *et al.*, 2002).

From the previous studies of the Petroleum and Petrochemical College thesis, it was found that the solid-liquid-polymer MMMs composed of PEG, activated carbon, and silicon rubber were used as plasticizer, solid, and polymer, the CO_2/N_2 selectivity were significantly improved due to the hydroxyl groups, present in each of PEG molecules, could enhance solubility coefficient CO_2 through the membrane material. Moreover, Ultem (polyimide) was found to be one of the especially attractive polymers with high both selectivity and performance, and used for incorporating with three types of zeolite. The results revealed that permeability increased without improving the C_3H_6/C_3H_8 selectivity. The conclusion from the experiment was that all type of zeolite was not suitable to develop Ultem MMMs.

The purpose of this work was to investigate the performance of solid-liquid-polymer mixed matrix membranes composed of Ultem (polyimide), activated carbon and various butanediol isomers using membrane-testing unit at room temperature and different pressures. The effects of glycol isomers and pressure were analyzed through the permeability and selectivity of gases (e.g., H_2, N_2, CH_4 and CO_2).