CHAPTER III
EXPERIMENTAL

3.1 Materials

Polysulfone support membrane coated on non-woven cloth was used as a backing. The silicone rubber used in this study was RTV615A and a curing agent RTV615B purchased from General Electric Co. Ltd. The cyclohexane solvent was purchased from Carlo Erba Reagenti. Polyethylene glycol (PEG) MW400 and 1,4-butanediol used as plasticizers, both were purchased from Fluka. NaX zeolite that was used as an additive was donated from UOP LLC. Gases, except nitrogen, were donated from National Petrochemical Public Company. Gases used for permeability testing were ethylene polymerization grade, ethane 99.99% purity, propylene 99.95% purity, and propane 99.95% purity. Nitrogen gas was purchased from Prax Air.

3.2 Membrane Preparation

3.2.1 Preparation of PEG Adsorbed NaX

Polyethylene glycol (PEG) MW400 was gradually adsorbed into NaX by dropping PEG into NaX zeolite. After treating at 90°C for 60 minutes, the mixture was dried in an oven at 130°C overnight.

3.2.2 Mixed Matrix Membranes Preparation

Mixed matrix membranes were prepared by solution casting and solvent evaporating method. The silicone rubber RTV615A and the curing agent RTV615B were dissolved in cyclohexane. After mixing together glycols were admixed into the casting solution. The casting solution was then degassed by using vacuum pump. The bubble free solution was casted on polysulfone sheet. The thickness of coating layer was adjusted by a caster knife. After that, the mixed matrix was placed in an oven at 85°C for one hour in order to initiate the crosslinking reaction and to remove the solvent. PEG adsorbed NaX filled membranes were prepared in a similar way, except that the silicone rubber and the curing agent were admixed into the suspension of PEG adsorbed NaX in cyclohexane.

3.3 Permeability Measurement

A schematic diagram of the experimental setup for gas separation studies is shown in Figure 3.1. The prepared membrane was fixed on a circular porous metal plate inside the membrane testing cell demonstrated in Figure 3.2. An O-ring was mounted around the edge to prevent gas leakage. The effective area of the membrane in the testing cell was 44.2 cm^2. The experiments were performed at room temperature, with pure gases: propylene, propane and nitrogen. Each gas was slowly introduced into the feed side of the membrane test cell until the desired pressure 50 psig was reached. The permeate side of the membrane test cell was exposed to atmospheric pressure via a soap bubble flow meter. A pressure difference of 50 psig was maintained across the membrane during the experiments. The flux of permeate gas was measured by using a bubble flow meter and recorded until the steady-state flux was obtained.

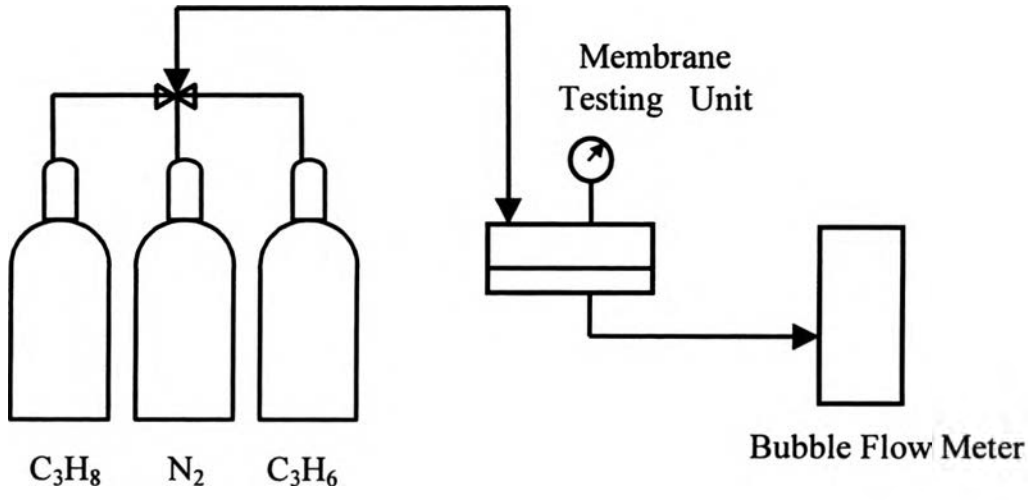

Figure 3.1 Schematic diagram of the experimental setup.

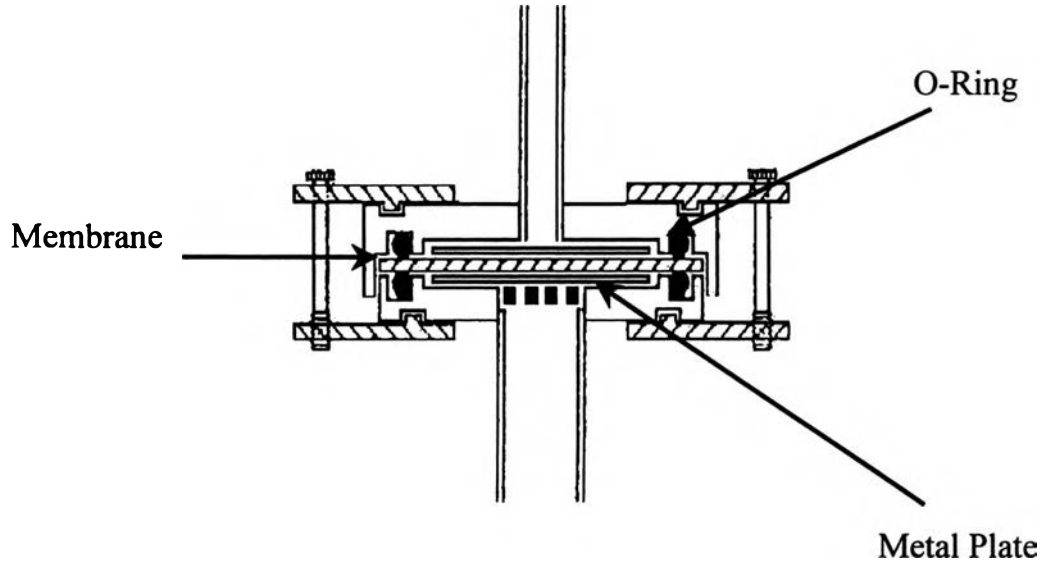

Figure 3.2 Membrane permeability test cell.

The obtained steady-state fluxes of gases were then used to determined the permeablities by using equation (2.4). The permeabilities were further used to calculated selectivity by using equation (2.6).