

## **CHAPTER III**

### **EXPERIMENTAL**

#### **3.1 Materials**

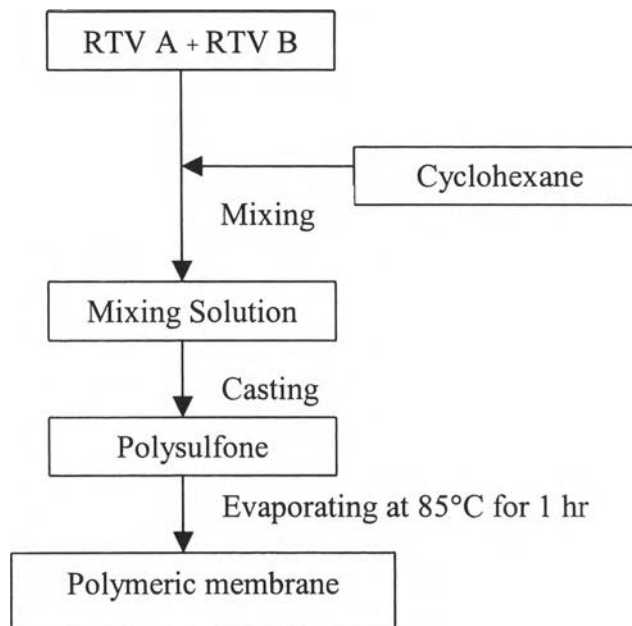
The following materials were donated by UOP LLC; the silicone rubber used in this work was RTV615A and a curing agent RTV615B from General Electric Co., Ltd.; activated carbon from Aldrich Chemical Co., Inc.; polysulfone support membrane coated on non-woven cloth. The solvent used was cyclohexane from CARLO ERBA REAGENTI Co., Ltd. Polyethylene glycol (PEG) MW400 was used as a plasticizer. Gases used in this study were carbon dioxide (CO<sub>2</sub>), nitrogen (N<sub>2</sub>), hydrogen (H<sub>2</sub>), propane (C<sub>3</sub>H<sub>8</sub>), and propylene (C<sub>3</sub>H<sub>6</sub>). CO<sub>2</sub>, N<sub>2</sub> and H<sub>2</sub> were obtained from Prax air Co., Ltd. whereas the rest were donated by National Petrochemical Public Company Limited.

#### **3.2 Membrane Preparation**

All membranes were prepared by a solution-casting method. But the different procedure depended on types of membranes. There are three types of membranes prepared in this work such as polymeric membrane, solid-liquid-polymer mixed matrix membrane and solid-polymer mixed matrix membrane.

##### 3.2.1 Polymeric Membrane Preparation

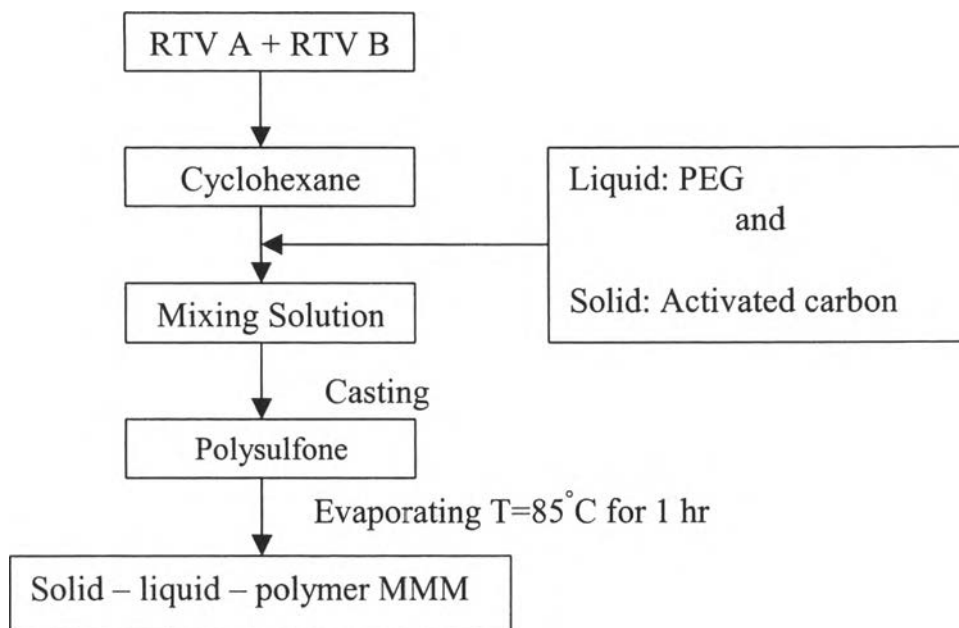
Polymeric membranes were prepared by solution-casting and solvent evaporation methods as schematically shown in Figure 3.1. The solution was formed by mixing 2.7 grams of RTV615A silicone rubber with 0.3 grams of RTV615B curing agent in 5 grams of cyclohexane. After mixing together the casting solution was then degassed using a vacuum pump. The bubble free solution was casted on a polysulfone sheet. The thickness of coating layer was adjusted by a caster knife as a 22-mil thick film. The cast film was allowed to cure at a temperature of 85°C for 1 hr in order to initiate the crosslinking reaction and to remove the residue solvent.



**Figure 3.1** Polymeric membrane preparation procedure.

### 3.2.2 Solid-Liquid-Polymer Mixed Matrix Membrane Preparation

Mixed matrix membranes were prepared by solution-casting and solvent evaporation methods as schematically shown in Figure 3.2. The solution was formed by mixing 2.7 grams of RTV615A silicone rubber with 0.3 grams of RTV615B curing agent in 7 grams of cyclohexane. After mixing together liquid was admixed into the solution first, and then solid. The casting solution was then degassed using a vacuum pump. The bubble free solution was casted on a polysulfone sheet. The thickness of coating layer was adjusted by a caster knife as a 22-mil thick film. The cast film was allowed to cure at a temperature of 85°C for 1 hr in order to initiate the crosslinking reaction and to remove the residue solvent.



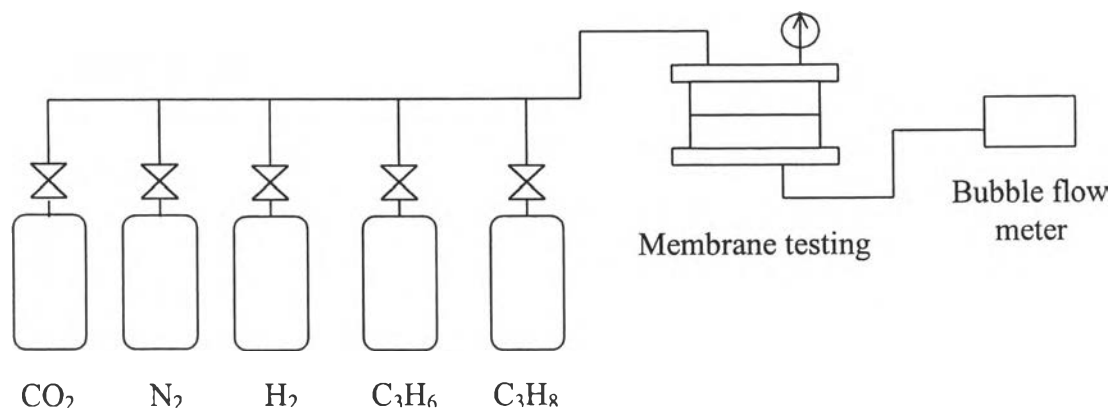
**Figure 3.2** Solid-liquid-polymer MMM preparation procedure.

### 3.2.3 Solid-Polymer Mixed Matrix Membrane Preparation

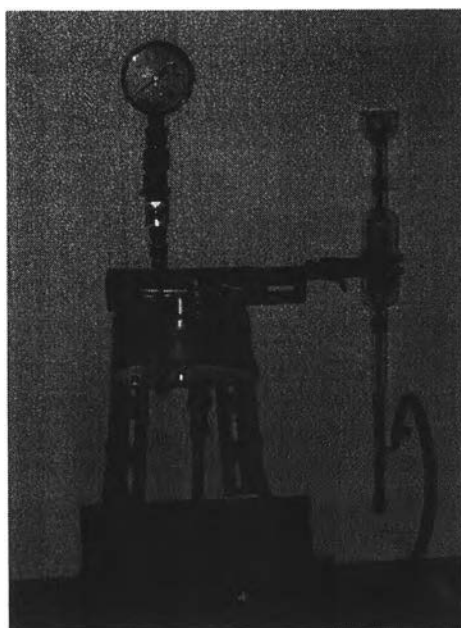
Activated carbon-silicone rubber MMM were prepared in a similar manner to the solid-liquid-polymer MMM, except the first step mixing activated carbon with cyclohexane and then add silicone rubber.

## 3.3 Gas Permeability Measurements

The experimental setup used for the determination of gas permeability is schematically shown in Figure 3.3. The membrane was tested by utilizing a 7.5 centimeters in diameter membrane sample, which was placed inside the membrane-testing unit with an O-ring forming a seal around the edge as shown in Fig. 3.4. The membrane was supported by a metal plate. The testing unit was pressurized at 5-100 psia at the feed side of the membrane while the permeate side of the membrane was at atmospheric pressure. After a time interval estimated to be sufficient for attaining steady state, flux of gas was measured using a bubble flow meter. After changing to the new gas, membrane testing unit have to purge and vacuum at permeate side by vacuum pump in order to get out the old gas from membrane.



**Figure 3.3** Experimental setup for measuring gas permeability.



**Figure 3.4** Membrane Testing Unit.