

CHAPTER III

EXPERIMENTAL

3.1 Equipment and Chemicals

The MMP measurement was in the Parr reactor model 4576A (Parr Instrument Company, USA) and the reactor temperature was controlled by a controller model 4848. Gas pressure outlet from gas tank was controlled by a high pressure regulator (Morris Engineering Works LTD., USA) 0-1000 psi. The pressure inside the reactor was controlled by a back pressure regulator (Swagelok, USA) 0-1000 psi. Petroleum crude samples were crude oil API 62.1 supplied by PTTEP (Lan Krabue crude) and three liquid hydrocarbons, n-pentane (purity 99.6%) supplied by UNIVAR, n-heptane (purity 99.7%) supplied by CARLO ERBA REAGNTI and n-decane (purity 99.0%) supplied by Sigma-Aldrich. Carbon dioxide (CO₂) with a purity of 99.99% was supplied by Praxair.

3.2 Experimental Set Up Schematic Diagram

The setup of experiment is shown in Fig. 3.1, mainly consisted of Parr reactor, reactor temperature controller, pressure regulator, back pressure regulator and high pressure CO₂ cylinder. The temperature inside the Parr reactor was controlled by a reactor temperature controller which was heated by a ceramic heater and cooled by a water bath which the cooling liquid was flowing through the cooling coil inside the reactor vessel. The reactor vessel capacity was 250 mL. The top of the vessel was connected to the thermocouple and pressure transducer to measure the temperature and pressure inside the reactor. Pressure and temperature data were collected by the Parr software. The reactor was pressurized with CO₂ from the CO₂ cylinder with a pressure range from 0 to 1000 psi. The pressure inside the reactor was controlled by a back pressure regulator with pressure range from 0 to 1000 psi.

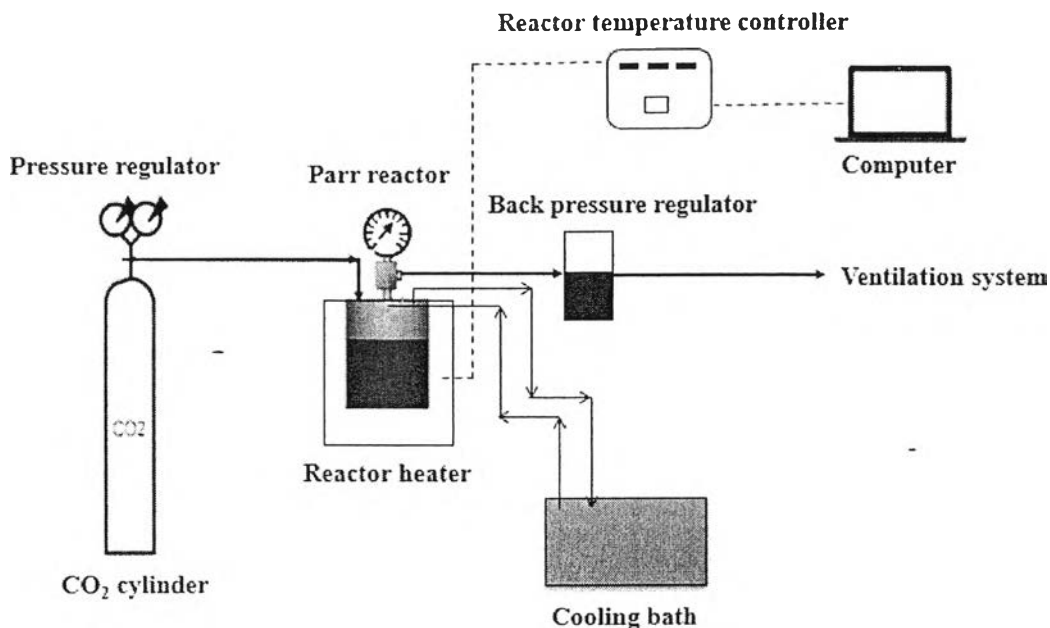


Figure 3.1 Schematic diagram of extraction experiment.

3.3 Pressure Decay Experiment Procedure

Sample 100 mL was loaded into the Parr reactor. CO₂ was introduced into the Parr reactor to pressurize the system to the desired value, allowed the pressure decay for 4 hours for crude oil and 2 hours for n-pentane, n-heptane and n-decane to collect the data. Time of CO₂ injection into the reactor was very important. It was carefully controlled to minimize the error that could affect the pressure decay curve. A fresh sample was used in every experiment. For crude oil and n-heptane system, the experiment were carried out at two different temperatures (30 °C and 40 °C), for n-pentane at 30 °C and n-decane at 20 °C. The MMP of n-decane and CO₂ system was compared with the results from Yong-Chen *et al.* (2011), in which magnetic resonance imaging method was used to measure the MMP of n-decane and CO₂ system at 20 °C as the reference. And the experimental results were compared to the calculation by using Li *et al.* correlation.