CHAPTER III
EXPERIMENTAL SECTION

3.1 Materials

3.1.1 Surfactants

The surfactants used in this study were sodium dodecyl sulfate, nonylphenol polyethoxylate (EO = 10).

Sodium dodecyl sulfate (SDS) was supplied by Henkel company with a manufacture reported purity of at least 90%. SDS is an anionic surfactant, with a negatively charged sulfate head group and twelve carbon units of tail group.

Nonylphenol ethoxylate ($NP(EO)_{10}$) was supplied by ICI Australia (trade name TERIC N10). $NP(EO)_{10}$ is a nonionic surfactant, with containing approximatedly ten moles of ethylene oxide per mole of nonylphenol.

The chemical properties of the studied surfactants are shown in Table 3.1.

3.1.2 Water

Triple distelled and deionized water used through out this work to prepare the aqueous surfactants solution and clean the glassware. The triple distilled and deionized water was purchased from the government pharmaceutical organization, Bangkok, Thailand.

3.1.3 Oil

σ-dichlorobenzene (ODCB) was selected as a studied oil. ODCB was purchased from Fisher Scientific Co., Fair lawn, New Jersy with a purity of 99.9%. The chemical and physical properties are shown in Table 3.2.

Table 3.1 Properties of studied surfactants

Surfactant	Molecular Weight	Formula
SDS	288.38	$C_{12}H_{25}SO_4Na$
$NP(EO)_{10}$	660	$(C_2H_4O)_7C_{15}H_{24}O$

Table 3.2 Information of σ-dichlorobenzene properties

Boiling point	180.5 °C at 760 mm. Hg
Melting point	-17.0 °C
Molecular weight	147.01
Water solubility	156 mg/L at 25 °C
Vapor pressure	1.47 mm. Hg at 25 °C

3.2 Experimental Procedures

There were two parts of the experimental. The first part was to study the formation of microemulsion and the secound part was to determine the oil removal efficiency of the froth flotation process under microemulsion conditions.

3.2.1 Study of Microemulsion Formation

In investigation of phase behavior, 5 ml of a well-mixed surfactant solution was mixed with 5 mL of ODCB in a vial and sealed with a screw cap and hold in a constant temperature bath at 30°C. The vials were shaken every 2 hours for 12 hours , and left to stand in the oven at 30°C for at least 7 days in order to reach equilibrium as shown in Figure 3.1. The volume of each phase at equilibrium was determined by measuring of phase height and the concentrations of each surfactant component and ODCB were determined.

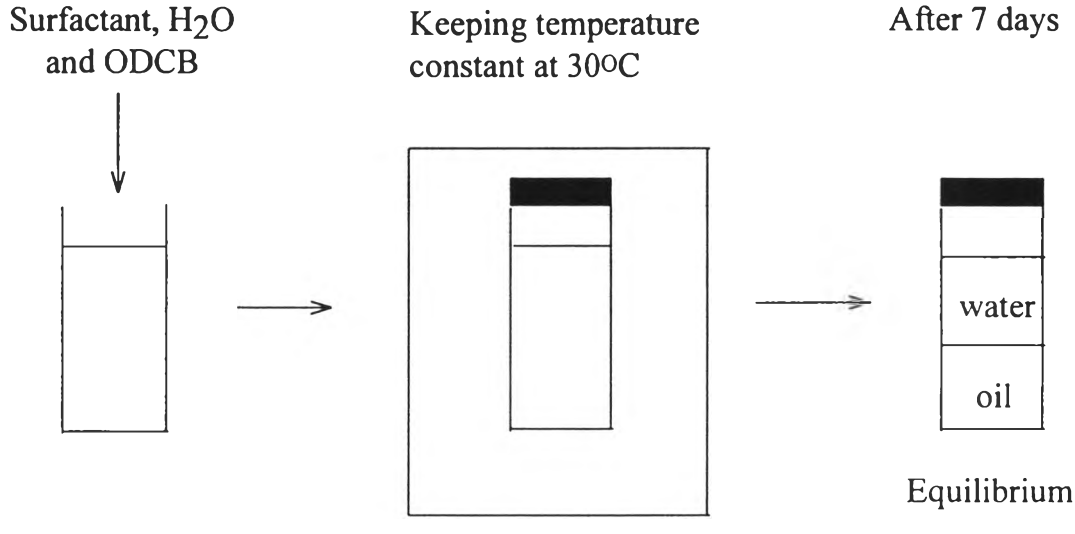

Figure 3.1 Schematic experiment of microemulsion formation.

3.2.2 Froth Flotation Experiment

A schematic diagram of the froth flotation apparatus used in this study is shown in Figure 3.2. A cylindrical glass column with 5 cm internal diameter and 70 cm height was used as a froth flotation column. One liter of well mixed solution which composed of surfactants, water and oil was

transferred into the flotation column. Filtered air was introduced at the bottom of the froth flotation column at a constant flowrate of 250 ml/min through a sintered glass disk. Foam from the top of the column was collected at 20, 30 and 60 minutes and was then broken for analysis as a liquid.

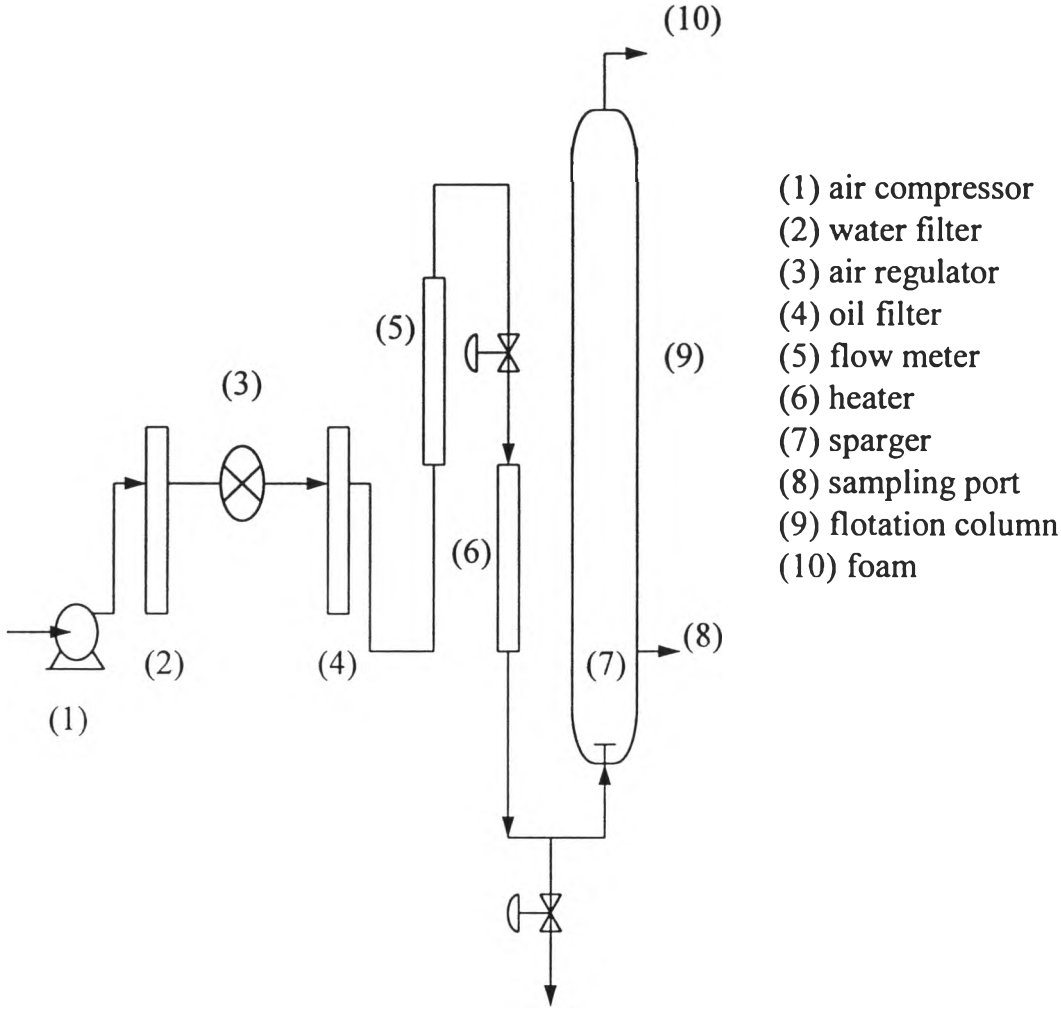

Figure 3.2 Schematic diagram of the experimental apparatus.

3.3 Analytical Methods

A high performance liquid chromatography (HPLC) was used to determine the concentrations of surfactants and ODCB in each phase of the

solution. The conditions of each compounds detected by HPLC are shown in Appendix A.