CHAPTER III

METHODOLOGY

3.1 MATERIALS

3.1.1 Surfactants

There were three types of surfactants used for this study namely, cetyl pyridinium chloride, sodium dodecyl sulfate, and Mono and di-hexadecyl diphenyloxide disulfonate, sodium salt.

-Cetyl pyridinium chloride (CPC) which is a cationic surfactant, was purchased from Pfaltz and Bauer, Inc., and has purity of higher than 99.9 %. CPC is a quaternary ammonium compound with a pyridinium ring structure and an alkali chain length of sixteen carbon units.

-Sodium dodecyl sulfate (SDS), commercial grade with 90 % purity, was obtained from Henkel Company. SDS is a surfactant with a negative charged sulfate head group and an alkali chain length of twelve carbon units.

-Mono and di-hexadecyl diphenyloxide disulfonate, sodium salt (Dowfax 8390) with 36.5 % by weight pure was supplied in liquid form by Dow Company, Midland, Michigan. Both SDS and Dowfax 8390 are anionic surfactant.

The chemical formulas and other general information of these surfactants are shown in Table 3.1

Table3.1 General properties of studied surfactants

surfactant	molecular weight	Chemical Formular	Synonym
CPC	357.5	$C_{21}H_{38}NCl$	Ceepryn, Cepacal, Germidin
SDS	288.38	$C_{12}H_{25}NaO_4S$	Sodium Lauryl Sulfate
Dow-fax 8390	642	$C_{16}H_3C_{12}H_7O$-$(SO_3Na)_2$	DADS

3.1.2 Studied Oil

Ortho-dichlorobenzene (ODCB) from Fisher Scientific Co., Fair lawn, New Jersy with 99.9 % purity was selected as a studied oil. The properties of this organic compound are listed in Table 3.2.

Table 3.2 General information of ortho-Dichlorobenzene (Martin, 1992)

Properties	ortho-dichlorobenzene
Physical properties	
-chemical formula	$C_6H_4Cl_2$
-molecular weight	147.00
-melting point,°C	-17.5
-boiling point,°C	180.5
-specific gravity at 30°C	1.0348
Health Hazard	The symptoms are lacremation, depression of central nervous system, anesthesia, and liver damage.

3.1.3 Other Compounds

Sodium chloride (NaCl) analytical purity grade, was obtained from Aldrich Chemical Company, Inc.

Pentanol ($C_5H_{11}OH$) with a purity of more than 98.9 % was obtained from Fluka Chemical. It was selected to use as a cosurfactant.

Triple distilled water which was used throughout this work, was purchased from the government pharmaceutical organization, Bangkok, Thailand.

3.2 EXPERIMENTAL PROCEDURES

There were two parts of these experiments. The first part was the study of phase behavior of microemulsion and the second part was the froth flotation experiment. All of the experiments, the surfactant concentrations and salinity were expressed in weight percent of the overall system.

3.2.1 Study of Phase Behavior of Microemulsion

Aqueous surfactant solutions were prepared at desired concentrations of surfactant and NaCl. The mixture was heated to 40 °C and mixed vigorously with a autoshaker to get a homogeneous solution. The equal volume of o-dichlorobenzene was allowed to mixed in the surfactant solution. The sample was sealed with Teflon and then allowed to equilibrate at constant temperature in an environmental room. Equilibrium was assumed to have been achieved when the volumes and the appearance of the different phases did not change with time. The phase behavior was observed and measured in terms of height of phases present by using the Polarized Light Screen (PLS) as shown in Figure 3.1.

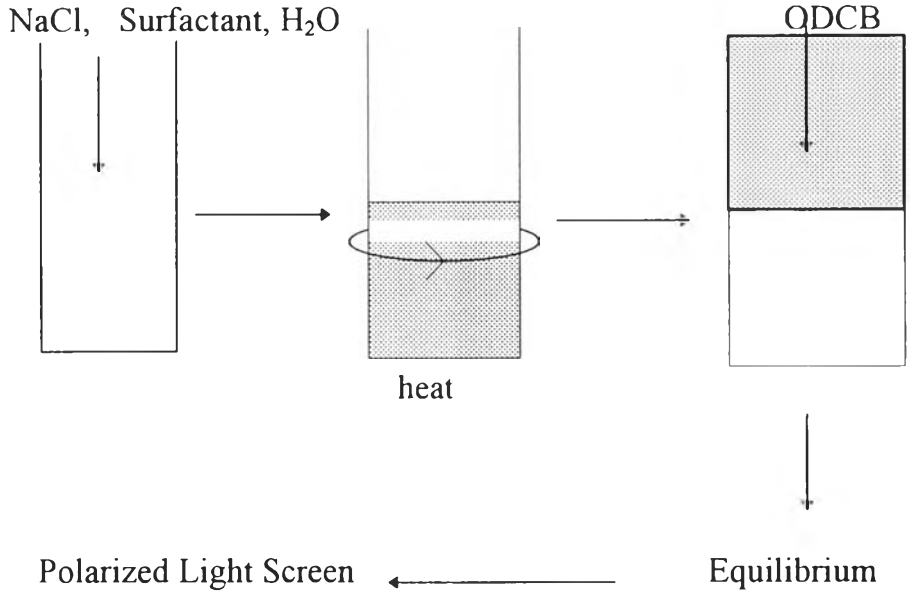

Figure 3.1 Schematic experimental equilibrium phase behavior.

3.2.2 Froth Flotation Experiment

A schematic diagram of the froth flotation unit used in this study is shown in Figure 3.2. A glass cylindrical column with 5 cm. internal diameter and 60 cm. height was used as the froth flotation column. Filtered air was introduced into the bottom of the column through a sintered glass disk, having pore size diameter about 16-40 μm. The sample that was prepared under the microemulsion condition was transferred to the froth flotation column (see Figure 3.3). The generated air bubbles rose through a pool of aqueous slurry. The froth accumulated at the top of the column and was collected into the receiver over the period of 300 seconds. The froth was broken by freezing and then followed by thawing. The tailing stream was withdrawn at the bottom of the column.

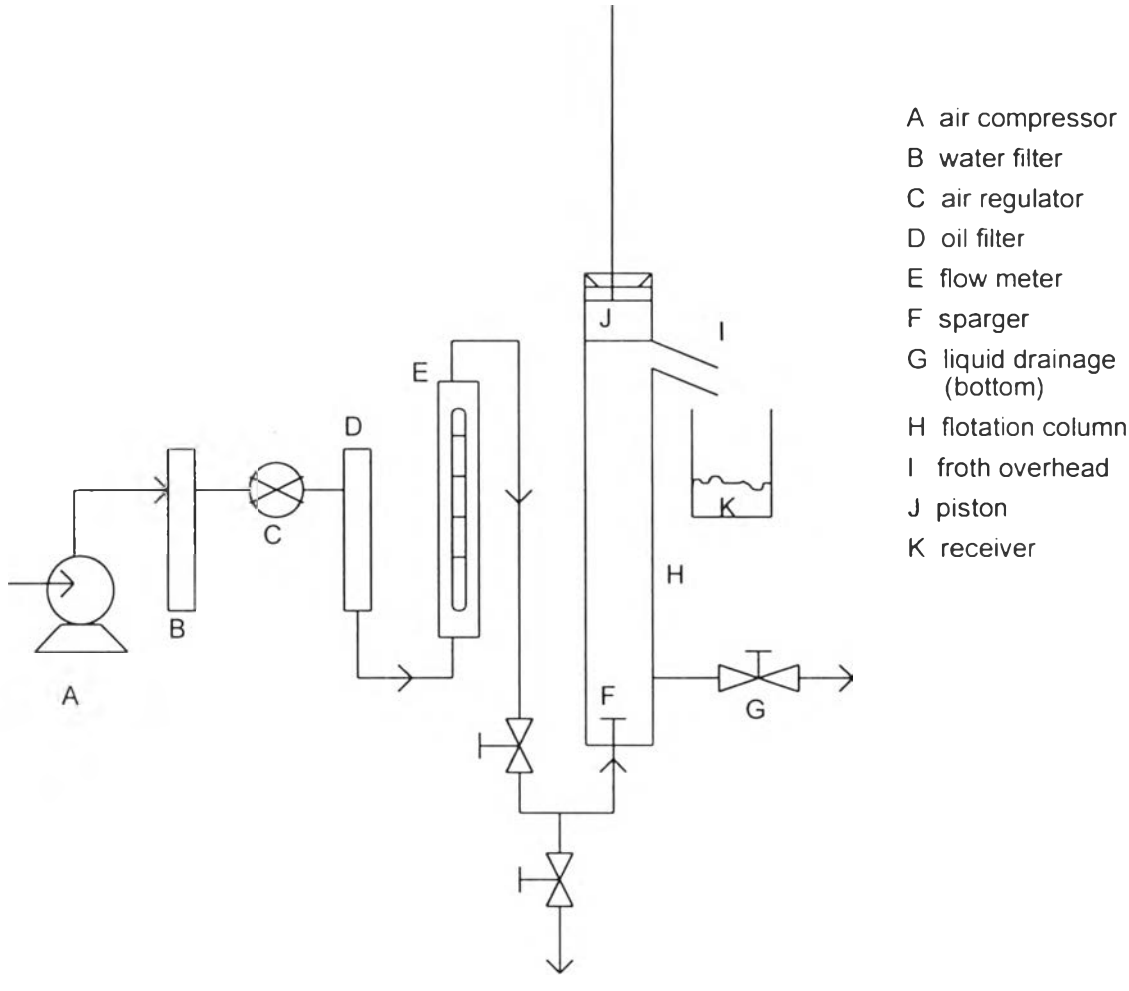

Figure 3.2 Experimental froth flotation apparatus.

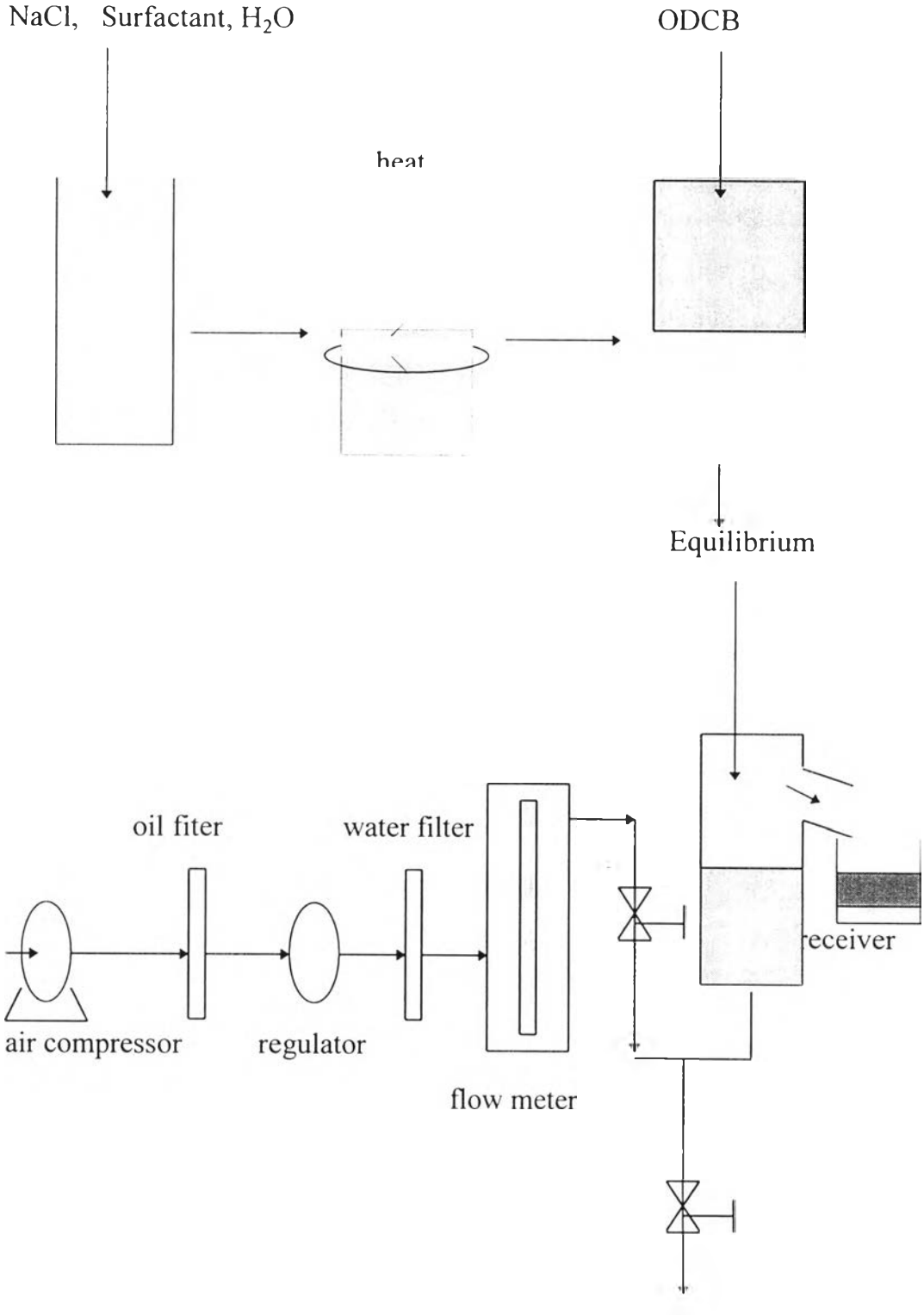

Figure 3.3 Schematic of experimental procedure.

3.3 ANALYTICAL METHODS

A high performance liquid chromatography (Hewlett Packard, HP 1050 series HPLC Modules) was used to determine the concentrations of each surfactants and ODCB in the experiments. The conditions of each compounds that were detected by HPLC are shown in Appendix A.