CHAPTER I
INTRODUCTION

Microemulsions are transparent, homogeneous, mixtures of water and oil, even to the extent of equal fractions of those bulk phases; they are stabilized by a fairly large amount of surfactant (Hunter, 1989). The microemulsions can be of the droplet type, either with spherical oil droplets dispersed in a continuous medium of water (oil-in-water microemulsions, O/W) or with spherical water droplets dispersed in a continuous medium of oil (water-in-oil microemulsions, W/O). The droplet-type microemulsions can be either a single-phase system or part of a two-phase system wherein the microemulsion phase coexists with an excess dispersed phase. There are also non-droplet-type microemulsions, referred to as middle-phase microemulsions (Nagarajan and Ruckenstein, 2000). Winsor referred to this new phase as a Type III microemulsions, as opposed to Type I (micelles) and Type II (reverse micelles) microemulsions; these are now known as Winsor Type I, II and III microemulsions, as illustrated in Figure 1.1. If both phases coexist, the surfactant will partition between the two phases in accordance with the surfactant's relative hydrophilicity. The hydrophilic-lipophilic balance (HLB) is a parameter that approximates this partitioning. By varying system conditions, water-soluble surfactants can be forced to partition into the oil phase.

Sabatini *et al.*, (2000) stated that middle phase microemulsion systems exhibit an ultra-low interfacial tension and possess high limits for oil solubilization. By considering the Chun-Huh relationship, as shown in equation 1.1

$$S = \sqrt{\frac{C}{IFT}} \qquad 1.1$$

where, S = solubilization ratio; C = constant; IFT = interfacial tension, minimum oil/water interfacial tension would be expected to correspond to optimum conditions for Type III microemulsions formation and optimum detergency might be expected at this point.

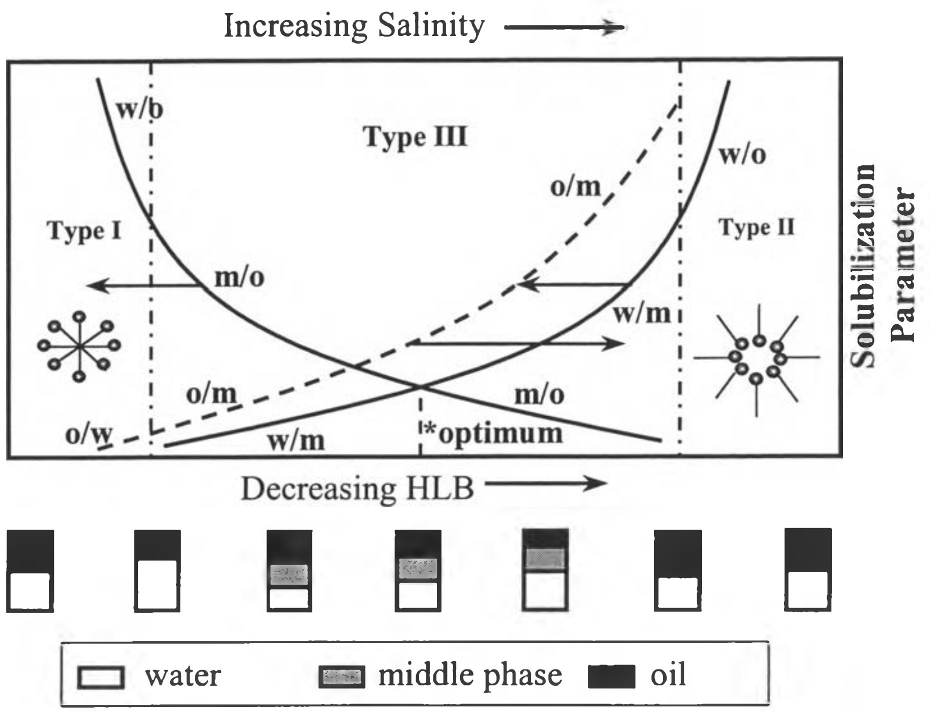

Figure 1.1 Winsor phase diagram (Wu *et al.*, 2000)

DOWFAX 8390 consists of alkyldiphenyl oxide disulfonate (ADPODS) surfactant components which limits their use for solubilizing highly hydrophobic soils. Several approaches were done for enhancing the solubilization potential of ADPODS surfactants. Recent studies show that middle phase systems can significantly increase solubilility enhancement of the DOWFAX surfactants and their use for environmental remediation (Deshpande *et al.*, 1999).

A novel approach to be investigated for detergency is the so-called "super-solubilization" phenomenon. As shown in Figure 1.1, as the salinity is adjusted within the Type I system in the direction of a Type III system, the oil solubilization increases. At the point where the Type I to Type III transition occurs, the solubilization is the same in the aqueous phase (Type I) as in the middle phase (Type III) since the aqueous phase becomes the middle phase at that transition point. While the solubilizations in this Type I system near the transition are not as high as at the optimum conditions in the Type III system, they can be orders of magnitude higher than for ordinary micelles (a Type I system far from Type I to III transition boundary). The high oil solubilization in a Type I system near the transition point is referred to as supersolubilization (Sabatini *et al.*, 2000).

From several studies, the optimal microemulsion phase for maximizing detergency is not well defined due to the lack of systematic studies with the supersolubilization of different surfactants with respect to detergency application. Therefore, formulating Type I microemulsions system exhibiting supersolubilization which have much higher solubilization capacity than normal surfactant solutions using DOWFAX 8390 in order to maximize detergency was studied in this research.

The objectives of this research work are as follows:

1. To study phase diagram of a selected surfactant system to obtain the compositions required to form Type I microemulsions to Type III microemulsions with hexadecane and motor oil.
2. To determine the solubilization capacity at the point of supersolubilization compared to solubilization in middle-phase microemulsion system.
3. To compare the oily soil removal ability of the microemulsion system at the point of lowest IFT (the optimum condition) in the middle-phase microemulsion.