CHAPTER I
INTRODUCTION

Oily soil washing has been an important point of interest in the area of detergency study for decades. The oil can be either natural oil from plants or animals or petroleum-based liquids (Rosen, 1993). Nature of oils varies from one to another depending upon their type and structure. Concerning detergency on fabric, the oils that dirty our cloth in everyday life can be either petroleum-based liquids from some fuels and lubrication products, or natural fat products such as cooking oil, margarine, butter, cosmetic products, etc. Most natural oils are considered to be polar oils because of fatty acid or alcohol structures in their compositions. It is clear that oily soils to fabric are not just simple hydrocarbon liquids but they can be polar and nonpolar oils, fatty acids, fatty alcohol and others. Therefore, for the last few decades many research works have been conducted using several types of oils in order to understand the mechanism of oily soil removal in detergency process.

Microemulsion is one of the interesting approaches expected to improve detergency process due to its special property of ultra low interfacial tension. Microemulsion system is believed to enhance solubilization of oil and hence it improves detergency performance. However, microemulsion formation with some specific oils like highly hydrophobic oil or non-alkane hydrocarbons is rather complicated. Hence, a cosurfactant or an additive is added to enhance these systems to form microemulsion. In this work, hexadecane, motor oil and triolien were selected to represent a long chain hydrocarbon, a highly hydrophobic oil and a polar oil, respectively. Since triolien is different in properties from hexadecane and motor oil, the formulations of the mixed surfactants for triolien were different from those with hexadecane and motor oil.

Microemulsion is a system consisting of at least 3 components, water, oil and surfactant(s). Other components e.g. additive, cosolvent, electrolyte etc., may be needed for some systems. To obtain microemulsion formation with any given oil is done by trial and error since both properties of oil and surfactants influence interface interaction of microemulsion. However, there are some general guidelines for surfactant selection for any given oil for instance, hydrophile-lipophile balanced (HLB) concept, and addition of cosurfactants or additives or linkers. For this study, the preliminary experiment showed that a single surfactant was unable to form microemulsion with the studied oil. An addition of a linker is one of approaches to enhance microemulsion formation. A linker is an amphiphile-like molecule that believed to enhance the interaction at the interface. There are two types of linker; a lipophilic linker and a hydrophilic linker. Graciaa *et al.* (1993a and 1993b) first proposed a lipophilic linker to microemulsion system to enhance its capacity on solubilization. Their studies emphasized long chain alcohol as lipophilic linker in a microemulsion system. They found that alcohol is able to inhibit liquid crystal formation in microemulsion formation. In addition, they clearly explained the interaction of alcohol at the interface. Later, Uchiyama *et al.* (2000) and Acosta *et al.* (2002a, 2002b and 2003) introduced both lipophilic and hydrophilic linkers to microemulsion system and investigated their roles in the system. Their study found that the addition of lipophilic linkers tended to increase the interfacial thickness and interfacial rigidity while hydrophilic linkers showed the opposite effect.

In this study, instead of using linkers, other two surfactants which having high and low HLB values introduced to a system containing first surfactant that has intermediate HLB value. It is expected that these two surfactants would behave similar to hydrophilic and lipophilic linkers to enhance solubilization of microemulsion systems. For hexadecane and motor oil, formulation selected for this study consisted of sodium dioctyl sulfosuccinate (Aerosol OT), alkyl diphenyl oxide disulfonate (ADPODS) and sorbitan monooleate (Span 80). AOT has a moderate HLB value while ADPODS and Span 80 are highly hydrophilic and lipophilic surfactants, respectively.

For triolien, a mixed formulation that was able to form microemulsion consisted of sodium dihexyl sulfosuccinate (Aerosol MA), alkyl diphenyl oxide disulfonate (ADPODS) and secondary alcohol ethoxylate (Tergital 15-S-5). The first surfactant has an intermediate HLB value while the second and third surfactants are hydrophilic and lipophilic surfactants, respectively. ADPODS is interesting to apply for detergency area as it still exhibits excellent solubility in the presence of divalent counter ions such as Mg^{2+} and Ca^{2+} (Rouse *et al.*, 1993). This can solve the problem of precipitation in the presence of divalent counter which is undesirable in detergency application.

The objectives of this research work were to study phase behavior of three model oils of motor oil, hexadecane and triolien, and to perform detergency experiment. For the phase behavior experiment, mixed surfactants were used to form microemulsions with hexadecane, motor oil and triolien. Since a single surfactant was found unable to form microemulsions. The effects of salinity, temperature as well as solubilization parameter and interfacial tension were determined. For the second part of the study, the selected formulation obtained from the phase behavior results were used to conduct the detergency experiments. The laundry experiments were conducted using blend polyester/cotton fabric. The detergency results were expressed in term of % detergency from the change of reflectance of the fabric before and after wash, and % oil removal. In order to understand the detergency process, the correlation of phase behavior and detergency performance was determined. Moreover, mechanisms of the soil removal were proposed

This dissertation contains 6 chapters; the first chapter is the introduction of overall work. Chapters 2-4 present the result of the phase study with hexadecane and motor oil, the detergency results, and mechanism of the oil removal, respectively. The presentation of each chapter is in the format of a manuscript submitted to Journal of Surfactants and Detergents. Chapter 5 illustrates the result of the study with triolien including both phase study and detergency result. Chapter 6 is the overall conclusions of this study project and recommendation for the further work.