CHAPTER I
INTRODUCTION

Diesel is one of the most important transportation fuels in the growing transportation around the world. Because diesel engines possesses more thermally-efficient than gasoline engines, it is anticipated that diesel demand and utilization will still rise substantially in the next few decades (Song *et al.*, 2000). Besides, its widespread usage in several industrial processes such as metal manufacture and machining, food processors as well as petroleum refinery plant, diesel is often found in their wastewaters (Patterson, 1975). Hence, it is necessary to get rid of diesel from wastewaters before discharging into public water.

Froth flotation is one of surfactant-based separation processes (Scamehorn, 2000). It has been widely used in ore processing, but now being point outed to be a promising technique to solve oily wastewater problems.

Froth flotation operations are suitable for dilute wastewater treatment because it has several advantages including rapid operation, low space requirement for equipment set-up, high efficiency of removal, flexibility of application to various pollutants at various scales, and low cost (Choi and Choi, 1996). Consequently, froth flotation has been increasingly used in many wastewater treatment problems (Leu *et al.*, 1994; Zouboulis *et al.*, 1994; Choi and Choi., 1996; Wungrattanasopon, 1996). The schematic diagram of froth flotation to remove oils (either free oils or emulsions) from water is demonstrated in Figure 1.1.

In froth flotation process, a surfactant is first added into an oily wastewater, and gas is introduced into the system by a sparger which generates fine bubbles. At the air/water interface, the surfactant tends to adsorb with the hydrophillic or head groups in the water and the hydrophobic or tail groups in the air. The oil tends to attach at the air bubbles while they ascend through solution and are concentrated as the foam or froth at the top of the flotation cell which is generally skimmed off. As a result, the formation of stable bubble particle aggregates is required in the froth flotation technique to enhance separation efficiency (Freund, 1995).

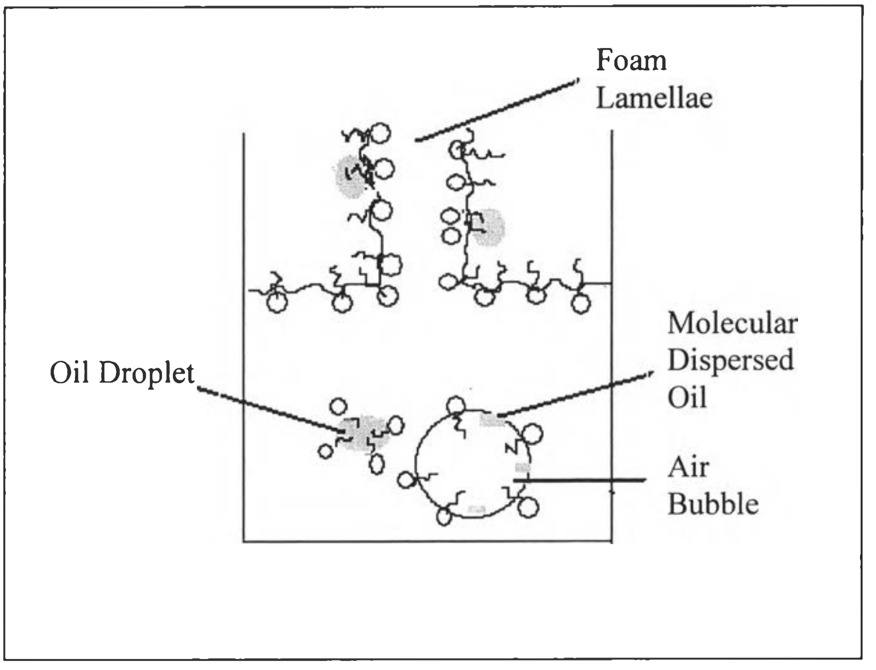

Figure 1.1 Schematic diagram of froth flotation removal of oil from water (Wungrattanasopon, 1995).

Various parameters affecting the efficiency of oil removal are the height of the foam–liquid interface, the air flow rate, the bubble diameter, the feed concentration, and the concentration of added electrolyte (Feng *et al.*, 2000).

A mixture of diesel, water and surfactants in the form of microemulsion was prepared as studied wastewater since a microemulsion has superior characteristics such as ultralow interfacial tension, relatively large interfacial area and large solubilization capacity (Bourrel and Schechter, 1988). It has been known that the lower the interfacial tension, the higher the efficiency of removal is, which is related to froth flotation efficiency (Pondsatabodee *et al.*, 1996). These properties render microemulsion intriguing from a fundamental point of view and versatile for industrial applications. Thus, microemulsion was introduced to apply in the froth flotation technique in this work. The formation of microemulsion with diesel oil was investigated in order to find out the minimum interfacial tension which is the first criteria for selecting what surfactant system is suitable for froth flotation operation (Withayapanyanon, 2003).

This study investigated the relationship between the efficiency of froth flotation and the ultra-low interfacial tension of diesel in wastewater. Alfoterra 145-5PO (branched alcohol propoxylate sulfate, sodium salt) and SDS (sodium dodecyl sulfate) were used as surfactants to form a Winsor Type III microemulsion or the middle phase with diesel. The effects of surfactant concentration, NaCl concentration, and oil to water ratio on the ultra-low interfacial tension of diesel was studied. After that, continuous froth flotation experiments were performed to investigate the efficiency of diesel removal from wastewater using mixed surfactants of Alfoterra 145-5PO and SDS that provided the ultra-low interfacial tension as well as the good performance on foamability and foam stability. Effects of oil/water ratio, concentration of surfactant, salinity, air flow rate, foam height and hydraulic retention time (HRT) on flotation efficiency were also investigated.