# CHAPTER I
# INTRODUCTION

One of the most common problems for decades in various industries is oily wastewater treatment, and oily wastewaters discharged into an aquatic environment cause tremendous problems. Major industrial sources of oily wastewaters include petroleum refining, metals manufacturing and machining, and food processing. The oily wastewater generated by steel and metal-finishing industries contains grinding oils, cutting oils, lubrication fluids, and coolant oil-water emulsions. The cutting oils are used in particular during the mechanical operations of cutting and shaping metals. They combine the properties of cooling and lubrication. A cutting fluid usually contains a mineral oil, a surfactant mixture (emulsifiers), in some cases water, and various additives which are included to meet the commercial specifications, such as resistance to bacterial growth and low corrosion capacity. These cutting fluids lose their effectiveness because of their thermal degradation and the presence of the suspended matters. Hence, it is necessary to carry out their replacement periodically and to get rid of the worn effluents, therefore resulting in producing oily wastewater.

The main problem in oily wastewater treatment is the removal of fine colloidal particles and highly emulsified oil from the process wastewater. Oil can be present as a free (non-dispersed) surface layer which can be separated off by gravity and as fine particle dispersions which cannot be spontaneously coalesced due to electrostatic repulsion forces between them, making them difficult to separate by gravity separation (Becher, 1983). Because of the stability of these emulsions, there is not a universal solution for their treatment, and sometimes it is necessary to combine one or more processes to have a good effectiveness of purification.

Several methods have been used to remove oil from wastewaters. Primary treatment takes advantage of the differences in the specific gravities of the oil and grease and the water to separate the floatable oils from the water and emulsified oil. A secondary treatment phase is then required to break the oil-water emulsion that has been passed through the primary separator and to separate the emulsified oil from the water phase. Emulsions may be broken by chemical, physical, or electrical methods. Chemical methods are the most widely used in the treatment of oily wastewater by adding chemical reagents. The destabilized droplets are then separated by decantation, centrifugation, coalescence, or flotation (Bensodok *et al.*, 2007).

Froth flotation is a surfactant-based separation process (Scamehorn, 1989). It has been widely used in the mineral industry, but is presently being pointed out as a promising technique to solve oily wastewater problems and froth flotation operation is suitable for dilute wastewater treatment. In the froth flotation process, a surfactant is usually added to an oily wastewater to enhance the oil separation efficiency. Air is introduced into the system through a sparger which generates fine bubbles. The surfactant is adsorbed at the air/water interface. The oil tends to attach to the air bubbles as they rise through the solution to form 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).

This study investigated the operational parameters affecting froth flotation performance in continuous mode to remove cutting oil from water. Alfoterra 145-3PO Sulfate (branched alcohol propoxylate sulfate, sodium salt) was used as the surfactant to form a Winsor Type III microemulsion or the middle phase with the cutting oil. In order to know the minimum surfactant concentration, to exhibit a Winsor Type III microemulsion, which is known as the critical microemulsion concentration (CμC), the so-called fish diagram was studied. The effects of surfactant concentration, NaCl concentration, and oil-to-water ratio on the system interfacial tension studied. After that, continuous froth flotation experiments were performed to investigate the efficiency of cutting oil removal from wastewater under different microemulsion types. The effects of surfactant concentration, salinity, and hydraulic retention time (HRT) on the flotation efficiency were also investigated. In addition, foamability and foam stability were investigated independently in order to aid the process assesment of the continuous froth flotation. Finally, the air bubble size distribution in the froth flotation column was measured to correlate to the performance of the continuous froth flotation.