

CHAPTER I

INTRODUCTION

Contact angle measurement on a given solid surface is the simplest method of characterizing the simultaneous interaction between solid, liquid, and vapor phases. If a liquid with well-known properties is used for the measurement, the resulting interfacial tension can be used to identify the nature of the solid used in the measurement (Hudson, 1997); for example, hydrophobic surfaces are characterized by high contact angle with water, often in the range of 40 to 110 degrees (Zettlemoyer, 1968). In this study, the contact angle of an aqueous surfactant solution onto a solid precipitated surfactant surface is investigated.

Wetting of solids by surface active agents is important for many technological applications such as oil recovery, coating, adhesion, ore flotation, printing, and detergency (Janczuk *et al.*, 1997). Surfactants are often used to enhance the wetting ability of aqueous solution since they can modify the solid/liquid and liquid/vapor interfacial tension (Berg, 1993; Hauthal, *et al.*, 1999; Bahr *et al.*, 1999). The ability of a liquid to spread over a solid surface is controlled by the overall free energy at the interfaces. If spreading of a liquid results in the lowering of the total free energy at the interfaces, then the wetting process can occur spontaneously (Guy *et al.*, 1996). Adsorption of anionic or cationic surfactants on nonpolar solids such as teflon can change the interfacial tension and contact angle (Shiao, *et al.*, 1998; Alexandrova and Grigorov, 1998; Chesters *et al.*, 1998; Luner *et al.*, 1996). Adsorption of surfactant onto surfactant crystals during the precipitation process was reported to affect both kinetics of surfactant precipitation (Garti and Zour, 1997) and the surfactant crystal habit (Lin *et al.*, 1998; Paton and Talens-Alesson, 1998).

Wetting, in its most general sense, is the displacement from a surface of one fluid by another. The tendency for fluids to wet can be indicated by the contact angle which can be measured by several methods such as capillary penetration techniques (Rosen, 1989; Subrahmanyam *et al.*, 1996), the adhering gas bubble method (Gyorvary *et al.*, 1996), the wilhelmy plate method, and the sessile drop technique (Adamson, 1990; Serre *et al.*, 1998).

In this study, the sessile drop technique was used to measure contact angles by depositing a drop of liquid on a solid surface, and placing a tangent to the drop at its base by a computer program. Some operator subjectivity comes into play in this measurement technique, since the positions of the tangent line and the base line of the droplet are estimated by the sight. Because the images are often small, a fairly large error (5-10°) is possible. In addition, the optical phenomenon known as parallax can cause inconsistency between measurements (Hudson, 1997). Moreover, obtaining a valid, reproducible contact angle is more difficult than it appears for a number of reasons: contamination of the droplet, surface cleanliness, surface heterogeneity, surface roughness, and environmental conditions (Serre *et al.*, 1998). These factors result in a precision of about ± 5 degrees in measurement of contact angle in this work.

In part I of this series (Luangpirom *et al.*, 2000), the contact angle of surfactant solutions on precipitated surfactant surfaces, was discussed for the first time. In that work, the contact angle of saturated solutions of sodium and calcium salts of both fatty acids and alkyl sulfates of varying alkyl chain length and of free fatty acids of varying alkyl chain length was measured on solid precipitated surfactant of the same type. In this study, contact angles of solutions containing a second surfactant as well as a saturated solution of solid surfactant was studied as well as alkyl trimethylammonium salts as model cationic surfactants, the effect of pH for fatty acids, and non-stoichiometric ratios of saturated surfactant and counterion in solution were studied. One

practical application of this work is to develop a better understanding of the antifoam properties of fatty acids in hard water through a dewetting mechanism (hydrophobic nature of the particles of calcium/magnesium precipitate with the soap destabilizes foam lamellae) (Garrett, 1993).