

CHAPTER I

INTRODUCTION

The wetting of solid surfaces by liquids has great practical importance in many industrial processes, such as cleaning, printing, painting, coatings, adhesion, and pesticide applications (Woodward *et al.*, 2000 and Extrand, 2003). Improvement and modification of wettability are essential for technological applications of surfactant science. Addition of surface-active agents to water is a well-established means of enhancing the ability of aqueous solution to wet and spread over solid surfaces by reducing both the surface tension of water and solid-water interfacial tension, as well as causing an increase in the value of spreading coefficient (Zdziennicka *et al.*, 2003 and Janczuk *et al.*, 1998). The ability to wet is a function of several parameters including the molecular structure of surfactant, its concentration, physical and chemical constitutions of each substrate and the environments.

In the most general sense, wetting is the displacement from a surface of one solid by another (Rosen, 1989). This phenomenon always involves three phases, at least two of which are fluids: a gas and two immiscible liquids, or a solid and two immiscible liquids, or a gas, a liquid, and a solid, or even three immiscible liquids.

The most common method of evaluating wetting is contact angle measurements that date back to the early days of the 19th century by Laplace and Young (Kabza *et al.*, 2000). The closer the contact angle is to zero, the better the wetting is. Furthermore, the measurement of contact angles on a solid surface is the most practical way to obtain information about surface energy: solid-vapor and solid-liquid surface tensions (Kwok *et al.*, 1997).

The contact angle is defined as the angle between the solid surface and the tangent to the surface of the drop at the point of contact of the two phases. For smooth and homogeneous surfaces its magnitude is given by the Young's equation:

$$\gamma_{SV} - \gamma_{SL} = \gamma_{LV} \cos \theta \quad (1)$$

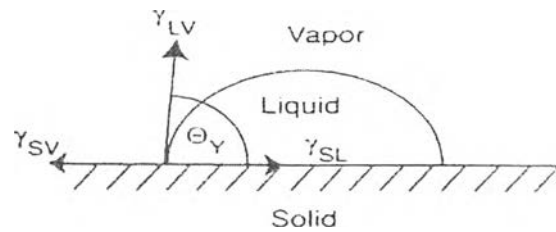


Figure 1.1 Diagram of Young's equation (Kabza, 2000).

which correlates the contact angle, θ , solid-vapor surface tension, γ_{SV} , solid-liquid surface tension, γ_{SL} , and liquid-vapor surface tension, γ_{LV} . Because γ_{SV} and γ_{SL} are not directly measurable, so this equation provides a possibility for the determination of these tensions only when an additional equation involving the three interfacial tensions is known (Kwok *et al.*, 1998). The well-known Young equation (Marmur, 1996) was developed for an ideal solid surface, namely a perfectly smooth, chemically homogeneous, rigid, insoluble, and non-reactive surface. For practical reason, there is a good deal of interest in the effects of surface heterogeneity and/or surface roughness on surface wetting and the subject has been studied sometimes (Woodward *et al.*, 2000).

Experimentally, however, contact angle phenomena are complicated and multifaceted. The experimentally observed apparent contact angle may or may not be equal to the Young contact angle. On ideal solid surfaces, there is no contact angle hysteresis and the experimentally observed contact angle is equal to the Young contact angle. Contact angle hysteresis, the difference between the advancing and the receding contact angle, can be caused by a range of chemical and physical causes, including surface roughness, surface restructuring, diffusion of liquid into solids, surface contaminations, and local surface adsorption (McHale *et al.*, 2001).

Various techniques are used for measuring contact angle, (Adamson, 1990) and the most commonly used method is sessile drop measurement that measuring contact angle (θ) directly from a drop of liquid resting on a flat surface of solid with goniometer scale or the contact angle may be obtained from a photograph of the drop profile as done in the previous work (Luangpirom *et al.*, 2001) by taking the photograph of the droplet on

the solid surfaces then determining the angle by a computer program with the precision of values within 5 degree error.

Study of the contact angles of saturated calcium dodecanoate (calcium soap precipitated) solutions on its precipitated surfaces was done by Balasuwatthi (2003). It was found that the second subsaturated surfactant solution of sodium dodecylsulfate (NaDS) can act as an effective wetting agent in the system due to the reduction of the contact angle of saturated calcium dodecanoate solution on its precipitated surface as NaDS concentration increase until reaching the CMC of the mixture solution.

In this study, the effect of sodium chloride salt (NaCl) on the contact angle of saturated calcium dodecanoate (CaC_{12}) containing a second subsaturated sodium dodecyl sulfate solution on the precipitated surface of calcium dodecanoate, the effect of sodium octanoate (NaC_8), and also the effect of nonylphenol ethoxylate nonionic surfactant (NPE) on contact angles of saturated calcium dodecanoate solution on its precipitated surfaces were investigated in order to illuminate the primary wetting mechanism by relating results from contact angle, surface tension and surfactant adsorption experiments.