CHAPTER I
INTRODUCTION

1.1 State of Problem

Surfactant adsorption plays a significant role in governing the ability of surfactant solutions to wet solid surfaces; known as wettability. The wettability of a liquid in contact with a solid surface plays a dominant role in many industrial processes and applications, such as deinking, painting, coating, detergency and adhesion.

The simplest and most common method to evaluate wettability and solid surface tension is to use contact angle measurement (Zhang and Kwok, 1996). Although this approach appears straight forward, the underlying physics and its interpretation are not trivial (Kwok and Neumann, 1999; Neumann and Spelt, 1996). The basis of contact angle measurement to determine solid surface tensions relies on the well known Young's equation (Young, 1805). Furthermore, Zisman's relation (Zisman, 1964) is also used to determine the surface energy of heterogeneous surface (e.g. polymer surface) which is another way of characterizing a surface. From a thermodynamic point of view, the critical wetting tension of a surface obtained from the Zisman's relation is not identical to its surface energy, but from a practical point of view, the numbers are very similar. Therefore many workers use critical wetting tension as a usable approximation to surface energy (www.firsttenangstroms.com/pdfdocs/DyneSolutions.pdf). Generally, the surface tension of the liquid ($\gamma_{l.v}$) is considered the main factor of wetting, but in some case, the adsorption of the surfactant onto solid/liquid interface can play an important role of wettability (Bernett and Zisman, 1959). According to the Gibbs adsorption relation, the correlation of the surface tension of the liquid and contact angle on a low-energy surface (hydrophobic surface) is also employed to determine the ability of approximate surfactant adsorption on the hydrophobic surface. Interestingly, the other functions affecting the wettability on low-energy surfaces are needed to obtain more accuracy in unmeasured parameter.

In addition, the wettability and adsorption of surfactants on solid surfaces (both hydrophilic and hydrophobic surfaces) can be applied in the deinking process from plastic bottles or film which is the important process for plastic recycling from environment (Chotipong *et. al.*, 2006) and flotation-recycling paper processes (Chaiarrekij *et. al.*, 2000; Riviello, *et. al.*, 2001; Beneventi *et. al.*, 2008). Hence, surfactant adsorption is interesting both in terms of academic and application points of view.

1.2 Objectives

The main objective of this study was to better understand the role of surfactant adsorption onto solid surfaces (both hydrophilic and hydrophobic surfaces) relating to wettability phenomena. The overall objectives of this work were as follows:

1. To study the effect of surfactant structure and type on the correlation of surfactant adsorption and wettability onto different polymer surfaces.
2. To study the surfactant adsorption with various chain lengths and head groups at various solution pHs onto different polymer surfaces.
3. To study the surfactant adsorption with calcium ions onto model ink and model fiber surfaces relating to deinking of paper process.

1.3 Scope of Work

In this work, surfactant tail length – hexadecyl trimethyl ammonium bromide (CTAB), tetradecyl trimethyl ammonium bromide (TTAB), and dodecyl trimethyl ammonium bromide (DTAB), and surfactant head group – sodium dodecylsulphate (SDS), 4-octyl benzene sulfonate sodium salt (SOBS), and sodium octanoate (C8) – were used to examine the effect on the surfactant adsorption and the wettability onto different powdered plastics with different hydrophobicity – polytetrafluoroetylene (PTFE), high density polyethylene (HDPE), polycarbonate (PC), polyvinylchloride

(PVC), acrylonitrile butadiene styrene (ABS), polymethyl methacrylate (PMMA), polyhexamethylene adipamide (PA66), and polycapolactone (PCL).

In addition, the anionic surfactants – SDS and C8 were selected to determine the mechanism of adsorption on model ink (carbon black) and model fiber (office paper) with varying calcium chloride concentration.

Moreover, the effect of the solution pHs on CTAB and SDS adsorption onto PVC and PTFE was studied. For all effects, the surfactant adsorption, surface tension and contact angle were measured to correlate the adsorption and wetting behavior. Furthermore, the correlation of the surfactant adsorption and wettability – Young's, Gibbs', and Zisman's relation – was examined in order to obtain a better understanding the role of surfactant adsorption relating to the wettability phenomena.