CHAPTER I
INTRODUCTION

Natural rubber is widely used in several applications. Besides being an important industrial material particularly in the tire industry, it has its place in the manufacture of household, engineering, medical, and industrial goods. However, the properties of natural rubber are often not appropriate for direct uses in the above applications. Therefore, improvement of various rubber properties is important. The economic crisis and the increasing use of synthetic rubber have been added to the problems for the rubber industry in Thailand, and changes are needed in the industry.

Reinforcing fillers are commonly used to enhance the mechanical properties of rubber. These fillers include carbon black, sulfur, carbon-silica and $CaCO_3$, which are intentionally added to rubber to improve its tensile strength, abrasion, modulus and tear resistance, (Wang, 1998). Carbon black has been widely used because of its efficient reinforcement and relatively low cost. However, its black color is a major drawback.

Silica is an alternative filler for using in white or neutral color rubber products. Silica provides beneficial properties including 1) adhesion to adjoining compounds, tire and fabric reinforcements 2) a neutral color, which can lead to a wider range of product applications than carbon black. Compared to carbon black, silica can form a stronger and more developed filler network resulting in higher modulus and lower hysteresis (heat build-up) at low temperature (Wang, 1998). Unfortunately, the unmodified silica cannot directly form chemical bonds with rubber due to incompatibility between hydrophilic silica and hydrophobic rubber.

Several methods such as bifunctional organosilance and grafting are available for the surface silica modification (Chinpan, 1996). Siloxane, titanate, and zirconate coupling agents are used extensively in industry for this purpose. These chemical coupling agents can impart significant improvements in important composite physical properties. However, they also can be expensive, thus significantly increasing the cost of a product.

Admicellar polymerization is an alternative method for the surface silica modification. This technique is reported to be quite versatile and is applicable to a variety of surfaces (Hawell *et al.*, 1985). Various potential applications have been proposed for thin films formed by this technique, e.g., in the microelectronic industry, solid lubrication, corrosion inhibition, optical coatings, and surface-modified electrodes (Sakhalar and Hirt, 1995).

The formation of ultrathin films in adsorbed surfactant bilayers admicellar has been investigated since the mid 1980's. Wu *et al.* (1987) first investigated this phenomenon in the formation of polystyrene from styrene adsolubilized in sodium dodicyl sulfate (SDS) admicelles on alumina. Though previous studies showed the process capable of producing high performance filler, there is a lack of emphasise on the result from using the commercial grade surfactant in the modified silica surface. A better understanding of this process will allow researchers to more accurately predict the best condition for the modification of silica surface by admicellar polymerization.

The present study examined the modification of amorphous precipitated silica, Hi-Sil®255, with a mixed surfactant system consisting of a cationic surfactant, Arquad®T-50, and a nonionic surfactant, Teric®X-10, in a continuous stirred tank reactor (CSTR). In addition, effects of surfactant adsorption level and mole ratio of surfactant adsorbed to co-monomer adsolubilized on the properties of the modified silica and rubber compound were investigated.