CHAPTER I
INTRODUCTION

Reinforcing fillers are intentionally added to rubber to improve its tensile strength, abrasion, modulus and tear resistance. Carbon black are the most common and efficient filler for the preparation of high quality rubber products such as tires because they offer excellent reinforcement at a relatively low cost. However, carbon black can only be used in products with black color. A search for alternative fillers, which permit the production of highly durable colored products, has led to the use of fumed and amorphous precipitated silicas.

Silica shows potential as an alternative filler because it provides natural color, lower hysteresis loss, which, for tire applications, leads to a lower rolling resistance and consequently fuel savings as compared to carbon black. However, in order to achieve a high loading of silica in the rubber, the silica surface requires some modification because unmodified silica cannot form chemical bonds with rubber due to low compatibility of hydrophilic silica with hydrophobic rubber. Several methods such as bifunctional organosilanes and grafting are available for the surface silica modification (Chinpan, 1996). However, the agents used in those techniques are expensive (Thammathadanukul *et al.*, 1995). Thus, the polymerization has been used as the alternative technique to modified silica because it is inexpensive.

Moreover, the polymerization beneficially reduces compound curing times and improves specific rubber compound performance in both chemical and physical properties (O'Haver *et al.,* 1996). Possibilities of using a continuous mode operation have been investigated and shown a great potential to produce a large amount of modified silicas with consistent properties (Chaisirimahamorakot, 2001; Nontasorn, 2002).

However, the method requires the use of a cationic surfactant which may prevent further development to a commercial scale because of a relatively high cost of the surfactant. A mixture of a nonionic surfactant and a cationic surfactant is an alternative for the silica surface modification by *in-situ* polymerization to reduce the modification costs.

The objective of the present research was to investigate the use of mixed surfactants in order to cationic surfactant used in the polymerization on silica, Hi-Sil®255, by a continuous stirred tank reactor (CSTR). Triton X-100 was used as a nonionic surfactant for reducing the amount of cationic surfactant, cetyltrimethyl ammonium bromide (CTAB). The adsorption isotherm of various molar ratios of CTAB to Triton X-100 was studied. Then the polymerization process both in monolayer and bilayer structures on the silica surface was carried out in the CSTR. The effects of surfactant structures and molar ratio of CTAB to Triton X-100 on the properties of the modified silicas and rubber compounds were investigated.