CHAPTER I

INTRODUCTION

The incorporation of fillers into elastomer matrices leads to a significant improvement in the physical, mechanical, and electrical properties of crosslinked elastomeric composites. This reinforcing effect is primarily due to hydrodynamic interactions between the rubber and filler surfaces. There are many types of fillers used in the rubber industry. Traditionally, carbon black is the most widely used reinforcing filler due to its excellent reinforcing effects and its relatively low cost. Unfortunately, the color of the resulting rubber products is black. Alternatively, precipitated silica with sizes being comparatively to that that of carbon black can also be used to obtain reinforeced rubber compounds or natural color, but at a much higher cost.

Nowadays, nanometer-scale reinforcing particles have received considerable attraction, due primarily to their high aspect ratio (length/diameter) and low density that render them to be used as substitutes for traditional fillers in polymer matrices. The largest class of such particles is inorganic clay mineral consisting of nanolayered silicates. Stacking of layers of approximately 1 nm thickness by weak dipolar forces leads to interlayers or galleries between the layers. These galleries are normally occupied by metallic cations such as K^+, Na^+, Ca^{++}, and Mg^{++}. When the layered silicates fully delaminate, dispersion of them even less than 10 wt.% may replace up to a four-fold reduction in the amount of traditional fillers that are required to attain similar mechanical properties.

Different methods for synthesizing polymer-layered silicate-reinforced nanocomposites have been described: that are, for examples, *in situ* intercalative polymerization, solution intercalation, and melt intercalation. Several studies have shown the possibility of preparing intercalated or exfoliated rubber nanocomposites by different methods. It has been reported that the nanolayered silicates dispersed into a rubber matrix provide an effective reinforcement to the rubber composite products.

The modification of clay by a process based on admicellar polymerization of organic monomers solubilized in surfactant layers adsorbed onto the surface of clay in order to enhance clay/elastomer interactions should lead to improved rubber product performance. Based on previous works (waddell *et al.*, 1995 and O'Haver, 1995), it was proven to be successful in improving the physical properties of rubber compounds when admicellar-modified silicas were used as fillers. Recently, clay surface modification by admicellar polymerization has been successfully performed only in a batch system which yielded modified products that were quite inconsistent in their properties that could render actual uses in industrial applications. Thus, a continuous admicellar polymerization process seems to be the best alternative way to produce "rubber-ready nanoscale fillers" with improved reinforcing capabilities for the rubber industries.

However, the method requires the use of a cationic surfactant which may prevent further development to a commercial scale because of the cost of the surfactant. A mixture of a nonionic surfactant and a cationic surfactant is an alternative way for the clay surface modification by *in situ* polymerization to reduce the operating cost. The present study focused on minimization the use of a cationic surfactant in the polymerization on clay, Bentonite H, by a continuous stirring tank reactor (CSTR). Teric X10 was used as a nonionic surfactant for reducing the amount of cationic surfactant (ARQUAD®). Both surfactants are of commercial grade. The adsorption isotherm of various molar ratios of ARQUAD® to Teric X10 was studied. Then the admicellar polymerization process of isoprene on the clay surface was carried out in the CSTR. The effects of surfactant type and molar ratio of ARQUAD® to Teric X10 on the modified clay and resulting rubber compounds were investigated.