CHAPTER I

INTRODUCTION

Reinforcement primarily signifies an increase in ultimate properties such as tensile strength, modulus, abrasion and tear resistance, which are obtained by adding a filler material. Fillers are often added to rubber for this purpose, to increase its usefulness in commercial applications. The degree of reinforcement provide by a filler depends on a number of variables, the most important being the development of a large polymer-filler interface (Mark et al 1994). There are many types of fillers used in the rubber industry. Carbon black is the most widely used reinforcing filler, providing excellent reinforcement at a relative low cost, but the only color available is black. Consequently, silicas are used for reinforcement in manufacturing rubber products in place of carbon black when colored, white or translucent products are desirable.

Commercially produced silicas are the highest reinforcing non-black fillers, but they have been lacking in one prerequisite for full rubber reinforcing capability, i.e. strong silica-rubber bonding. Unmodified silicas cannot form chemical bonds with elastomers. Additionally, the difference in nature between the two materials, mineral vs organic, can lead to poor dispersion of silica within rubber. In addition, compounding with precipitated silica is very different from compounding with carbon black. This is because silica has a much more reactive surface than carbon black. For these reasons, there have been various attempts to improve the compatibility between hydrocarbon elastomers and precipitated silica by modification of the silica surface in order to improve their performance in rubber. Currently, silica-rubber bonding can be provided by specific coupling agents. These surface modifications can improve important reinforced rubber physical properties, making it possible to design silica-reinforced rubber compounds which are comparable or superior in quality to carbon black-reinforced rubber. However, the cost of the improvement obtained with silane coupling agents may be prohibitive for many applications.

The present research focuses on the modification of silica by a process based on the *in-situ* polymerization of organic monomers solubilized in surfactant layers adsorbed onto the surface of precipitated silica. It offers a potentially inexpensive method for modifying chemical and physical surface properties of various substrates and has proven successful in improving cured rubber compound physical properties. The process to construct a thin polymer film consists of four basic steps: (1) adsorption, (2) adsolubilization, (3) polymerization, and (4) washing. This study is divided into two sections. The first deals with the comparison of how various surface-modified silicas, which differ in the amount of styrene/isoprene co-monomer coating per mass of silica, reinforce a model natural rubber. The second section deals with the investigation of the effect of percent silica loading in the natural rubber compound on the compound physical properties.