

CHAPTER I

INTRODUCTION



1.1 The Statement of Problem

The reinforcement of rubber is expressed by enhancement of the modulus and failure properties (tensile and tear strength of the vulcanizates). The main aim for filler addition is to improve certain properties and cheapen the compound. The effects of filler on the mechanical and other properties of the composites depend strongly on its shape, particle size, aggregate size, surface characteristics and degree of dispersion. In general, the mechanical properties of the composites filled with micron-sized filler particles are inferior to those filled with nanoparticles of the same filler.

Calcium carbonate is an inexpensive natural mineral so it has been used as a filler for rubber and plastic for many years. Historically, it has been used as filler for rubber and plastics for saving polymer consumption and reducing the cost. The particle size of most commercially available calcium carbonate varies from 1 to 50 micrometer. The results of numerous studies have indicated the improvement in the mechanical properties of micron-sized-calcium carbonate filled composites which is found to be minimum. One of the key factors is believed to be the poor filler-rubber interaction. The use of nanocalcium carbonate particles may bring new insights in the study of rubber-filler interaction, because the dramatic increase in the interfacial area between the filler and rubber gives the high surface-to-volume ratio. Furthermore, many efforts have been devoted to surface modified calcium carbonate particles to increase the polymer-filler interactions.

Thermoplastics, such as poly(vinyl chloride) and polypropylene filled with nanocalcium carbonate have been studied. Only a few research work on rubber-nanocalcium carbonate composites was performed. Therefore, the objective of this work is to prepare natural rubber compound by filling with modified and unmodified surface nanocalcium carbonate at loading range of 0 to 50 phr. Tensile strength, modulus 300 (tensile stress at 300% elongation)

and tear strength were investigated. The mechanical properties of the rubber compound filled with nanocalcium carbonate were compared with that filled with commercial reinforcing and non-reinforcing filler such as carbon black, silica and 2 μ -calcium carbonate.

1.2 Objectives

The objectives of this research are as follows:

1. To prepare natural rubber/nanocalcium carbonate composites and investigate the effect of filler content on the mechanical properties of composites.
2. To compare the mechanical properties of natural rubber/nanocalcium carbonate composites with commercial reinforcing and non-reinforcing filler.

1.3 Scope of the Investigation

The natural rubber/nanocalcium carbonate composites were prepared at various loading level of nanocalcium carbonate. The mechanical properties rubber filled with nanocalcium carbonate, carbon black, silica and 2 μ -calcium carbonate at same ratio were investigated and compared.

The experimental procedures were carried out as follows:

1. Investigate literature survey and study the research work.
2. Prepare the compound of natural rubber filled with coated and uncoated nanocalcium carbonate at 0-50 phr.
3. Investigate the mechanical properties of natural rubber/nanocalcium carbonate.
4. Prepare the compound filled with carbon black (330), silica, 2 μ -calcium carbonate, uncoated and coated nanocalcium carbonate at the same loading level.
5. Investigate the mechanical properties of rubber compound filled with carbon black (N330), silica, 2 μ -calcium carbonate, uncoated and coated nanocalcium carbonate.
6. Study the crosslinking density and the cure characteristics.
7. Summarize the results.