

CHAPTER I

INTRODUCTION

1.1 Statement of Problems

Natural rubber (NR) is an important agriculture product essential for manufacturing. Asia is the center of production and Thailand is the biggest producer of NR today [1]. The world production of NR has increased at an average rate of 2.48 percent over the five years period (1997-2001). The average production of NR is 6.79 million tons per year, while the world consumption is 6.80 million tons per year during that period. Moreover, Thailand is the biggest exporter of NR and has ratio of exporter rubber about 41 percent of the world exporter [2].

Usually, inorganic fillers are mixed with rubbers to reinforce the rubber products. Beside carbon black, silica (SiO_2) is the other important filler used in the rubber industry. The products obtained from mixing with silica are colorless or white. Therefore, other colors can be added to these products.

A problem of silica-reinforced rubber is incompatibility between silica and rubber, resulting in poor mechanical properties. A well-known method for improving the reinforcement effect is to treat silica surface by 'silane coupling agent' to promote interaction with rubber. Another method is to add silane coupling agent during NR-silica mixing process. Until recently, *in situ* synthesis of silica particles inside NR matrix has been widely studied as a new compounding method for NR composite.

Since Thailand can produce NR latex in a great quantity, the focus of this work is to study methods for mixing tetraethoxysilane (TEOS), a liquid precursor of silica, directly into NR latex. Thus, the name '*in situ* silica' is used. Water and ammonia in the latex should be able to initiate sol-gel process of TEOS to transform to silica particles inside the NR matrix.

Therefore, the objective of this research is to prepare the silica reinforcement of NR by sol-gel process of TEOS inside the latex. Mechanical properties of the composite with *in situ* silica and mechanically mixed silica are also compared.

1.2 Objectives

The objectives of this research are the following:

1. To prepare silica-reinforced NR by sol-gel reaction of TEOS in NR latex.
2. To compare the curing behavior and mechanical properties of NR-silica generated *in situ* with conventionally mixed silica powder.

1.3 Scope of the Investigation

The stepwise investigation was carried out as follows:

1. Literature survey for related research work.
2. Prepare silica reinforcement of NR by sol-gel process in latex.
3. Study the effect of experimental factors on mechanical properties by using two-level factorial design.
4. Characterize and study the morphology of the NR-silica composites by SEM and TEM
5. Determine curing behavior and mechanical properties of NR-silica composites according to ASTM methods.
6. Make a comparison between the NR composites filled with *in situ* silica and mechanically mixed silica
7. Summarize the results.