CHAPTER 1

INTRODUCTION

1.1 General aspect

Natural rubber is present in a wide range of plants, but *Hevea brasilliensis* is the only rubber tree that is truly considered to be an important commercial source of the polymer *cis*-polyisprene. At present, Thailand is the largest natural rubber producer. The major rubber plantation areas are in the Southern and Eastern regions. The total production of natural rubber in Thailand increased from 1,275,105 metrictons in 1990 to 2,346,487 metrictons in 2000, as shown in Table 1.1.

Table 1.1 Thailand natural rubber production.

Metrictons

Year	Production	Exports	Domestic Consumption	Stock	Imports
1990	1,275,105	1,150,790	99,131	83,696	196
1991	1,340,596	1,231,945	103,107	89,328	88
1992	1,530,941	1,412,850	118,371	89,090	12
1993	1,553,384	1,396,783	130,236	11,561	136
1994	1,717,861	1,604,964	132,195	96,546	283
1995	1,804,788	1,635,533	153,159	113,030	388
1996	1,970,265	1,762,989	173,671	147,669	1,034
1997	2,032,714	1,837,148	182,020	159,374	
1998	2,075,950	1,839,396	186,379	209,546	
1999	2,154,560	1,886,339	226,917	250,850	
2000	2,346,487	2,166,153	249,549	188,635	

Source: Thailand rubber statistic, 2000 [1]

Most of the natural rubber producing countries produce natural rubber for export. In 2000, Thailand produced 2,346,487 metrictons of natural rubber, of which only 249,549 metrictons were used by the local rubber industry, the rest was exported. The major exported rubber products in 2000 were rubber tires (29%) and rubber gloves (30%), value in excess of 25,000 million baht, or 60% of total export [1]. Commercial natural rubber can be classified into two major groups: solid natural rubber and latex concentrate. Thai producers produced 5 forms of dry rubbers listed in Table 1.2. Solid natural rubber can be produced from fresh field latex and skim latex. Solid natural rubber produced from skim latex can be divided into skim block and skim crepe. Solid natural rubber produced from fresh field latex can be divided into four groups: ribbed smoked sheet (RSS), air dried sheet (ADS), crepe rubber, and block rubber or Standard Thailand rubber (STR).

Table 1.2 Different types of rubber in Thailand, 2000.

Types of rubber	%weight
Smoked sheet (RSS)	48
Block rubber (STR)	35
Crepe rubber	0.4
Concentrated latex	12
Other rubber	4

Source: Thailand rubber statistic, 2000 [1]

The majority of Thai export rubber products are ribbed smoked sheets of comparatively low price and quality. It is therefore necessary for Thailand to develop new products from natural rubber.

Since 1801, natural rubber has been modified in many different ways, and modified forms have been available commercially since 1915. The degree of modification can vary from a few percent to complete modification of the polymer chain. Modification highly affects in physical and chemical properties. The most well-known

types of chemical modification are epoxidation, chlorination, hydrohalogenation, and hydrogenation. The modified products can lead to new interesting properties and can be used as they are. On the other hand, they can be subjected to further chemical modifications leading to 2^{nd} or 3^{rd} generation products, giving to natural rubber prospects in the field of high added value chemistry. The chemical modification of natural rubber can lead to novel materials, which are difficult to synthesize by conventional polymerization procedure.

Chemical modification of natural rubber by hydrogenation is an active field of research because of the technological importance of the modified products. Hydrogenation is one of the important methods for improving and changing the properties of unsaturated elastomer toward greater stability against thermal, oxidative, and radiation-induced degradation.

Hydrogenation of natural rubber using ruthenium catalyst has not been reported. Since $RuCl_2(PPh_3)_3$ has been extensively used for hydrogenation of synthetic rubber, it is interesting to investigate its activity in hydrogenation of natural rubber.

1.2 Objectives

The objectives of this research are as follows:

1. To prepare the hydrogenated natural rubber by using $RuCl_2(PPh_3)_3$ as homogeneous catalyst. Effects of temperature, hydrogen pressure, reaction time, and catalyst concentration were studied. The optimum condition to obtain high hydrogenation product will be explored.
2. To investigate changes in molecular weight of natural rubber during hydrogenation.
3. To study thermal properties of hydrogenated natural rubber by thermal analysis, DSC and TGA.

1.3 Scope of the Investigation

For the preparation of hydrogenated natural rubber, the appropriate hydrogenation conditions were studied. The necessary procedures to carry out are as follows:

1. Literature survey and in-depth study of this research work.
2. Preparation of the hydrogenated natural rubber by using $RuCl_2(PPh_3)_3$ as homogeneous catalyst and selection of the suitable reaction conditions.
3. Study of the effect of parameters on the percentage of hydrogenation of natural rubber.
4. Characterization of the hydrogenated natural rubber.
5. Investigation of the effect of parameters on the degradation during hydrogenation observed from the molecular weight and molecular weight distribution by using Gel Permeation Chromatography.
6. Study of the thermal properties of hydrogenated rubber products by DSC and TGA.
7. Summarization of the results.