CHAPTER ONE
INTRODUCTION

SUMMARY

This chapter gives overviews of the project and rubber industry. Although Southern Thailand is the world biggest producer of smoked rubber, the rubber smoking process was improved very little since its inception almost a century ago. Planning for research activities, therefore, is a step-by-step procedure. The project was divided into 4 phases namely; surveying of rubber smoking factories to acquire basic data, energy auditing of rubber smoking process, study on factors affecting rubber drying and theoretical work and field trial of air drier to accelerate ruhber smoking process.

1.1 OVERVIEW OF THE PROJECT

Energy Conservation in Smoked Rubber Industry is one of the six Energy Conservation in Industry Projects commenced in Thailand during 1990-1993. The project was financially supported by the ASEAN-Australia Energy Cooperation Programme Phase II (AAECP). Prince of Songkla University, by a research team from the Department of Mechanical Engineering, took responsibility of this project with a specific objective of finding energy conservation measures for the rubber smoking process. Rubber smoking industry was chosen because Thailand is the world biggest smoked rubber producer and 90% of rubber plantation of the country is in the South, where Prince of Songkla University is located.

1.2 OVERVIEW OF NATURAL RUBBER [1]

Nearly 2000 species of trees, shrubs, or vines of the tropical and temperate regions produce latex from which natural rubber or a closely related substance can be obtained. However, the latex from the trees of Hevea brasiliensis is the only important commercial source of natural rubber. The tree is indigenous to the Amazon valley.

Natural rubber has been known to the inhabitants of South America for centuries. Christopher Columbus is considered to be the first European to discover it, during his second voyage in 1493-6. He found the natives in Haiti playing with balls made from the exudate of a tree called "cau-uchu" or "weeping wood." The term "rubber" was coined by John Priestly in 1770, when he found that the material could erase pencil marks.

Rubber was introduced to the Western world by Charles de la Condamine, who sent samples to France from Peru in 1736 and published the results of his observations in 1745. By the end of the eighteenth century, Europe and America were using a few tons of rubber per year. However, users found it difficult to work with solid rubber. Moreover, articles made from natural rubber turned sticky in hot weather and stiffened in the cold.

Two important developments in the nineteenth century enabled these problems to be solved and laid the foundation for the multibillion dollar modern rubber industry. In 1820, Thomas Hancock invented a machine called the "masticator" that allowed solid rubber to be softened, mixed, and shaped. In 1839, Charles Goodyear discovered the process of vulcanization. He found that heating a mixture of rubber and sulfur yielded products that had much better properties than the raw rubber.

Soon a variety of articles from rubber started to come into the market and the demand for rubber grew rapidly. Exports of raw rubber from Brazil increased from a few hundred tons in 1846 to almost 10,000 tons by 1880.

It was soon apparent that Brazil would not be able to meet future demand. The British considered the possibility of cultivating rubber in Asia. In 1876, Henry Wickham collected 70,000 seeds from Brazil and sent them to Kew Gardens for germination. Of the more than 2,000 seeds that germinated, most were sent to Ceylon (Sri Lanka) and some to Singapore and Malaya (Malaysia). Later shipments were made to the East Indies (Indonesia). By 1880, Hevea seedlings were widely distributed in Asia.

Plantation rubber production in Asia grew rapidly and outstripped the production of wild rubber from Brazil by about 1913. Southeast Asia has remained the predominant natural rubber-producing region since then. The land under rubber cultivation and the production of natural rubber have grown steadily except during World War II. In 1983, more than 7.5 million hectares of land in the world were under rubber cultivation and about 4 million tonnes (metric tons) of rubber were produced. The Southeast Asian region accounted for about 80% of the total production.

1.3 NATURAL RUBBER IN THAILAND

1.3.1 Planting area.

A survey of rubber planting area was carried out by using images from Landsat 4 and 5 in 1986 [2]. The overall planting area of the country was 10.735×10^6 rais*. Table 1.1 and Figure 1.1 illustrate that 90% (9.655×10^6 rais) of the planting area is in the Southern part of the country and the rest 10% (1.080×10^6 rais) is in the Eastern part.

1.3.2 Rubber Production.

The first rubber tree introduced to Thailand was planted in Trang Province in 1901 by Praya Rattanupradit who was at that time the Governor. Since then rubber industry in Thailand expanded rapidly.

In 1989 seventy six percent of the world rubber production are from Malaysia, Thailand and Indonesia [3]. After Malaysia, Thailand is the world second biggest rubber producing country. It was estimated that during the 7^{th} National Economic and Development Plan (1992-1996) the gross rubber production of the country (Thailand) will increase from 1.30×10^6 tons to 1.58×10^6 tons as shown in Table 1.2

In comparison with other countries in Southeast Asia region (Table 1.3), Thailand is rapidly increasing her rubber production.

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* 1 rai = 0.16 ha

Table 1.1 Rubber Planting Area by Province (1986) [2]

Region/Province	Planting Area (Rai)
Eastern Region	Total 1,080,128
Chachoengsao	4,532
Chonburi	27,501
Trad	253,361
Chantaburi	396,918
Rayong	397,816
Southern Region	Total 9,654,626
Prachubkirikhan	3,397
Ranong	26,599
Phuket	106,559
Chumporn	145,739
Satoon	254,779
Pattani	354,450
Pattalung	522,066
Pangnga	553,415
Krabi	645,357
Yala	934,308
Narathivat	935,591
Trang	963,425
Surathani	1,117,510
Nakornsrithammarat	1,467,727
Songkhla	1,623,704

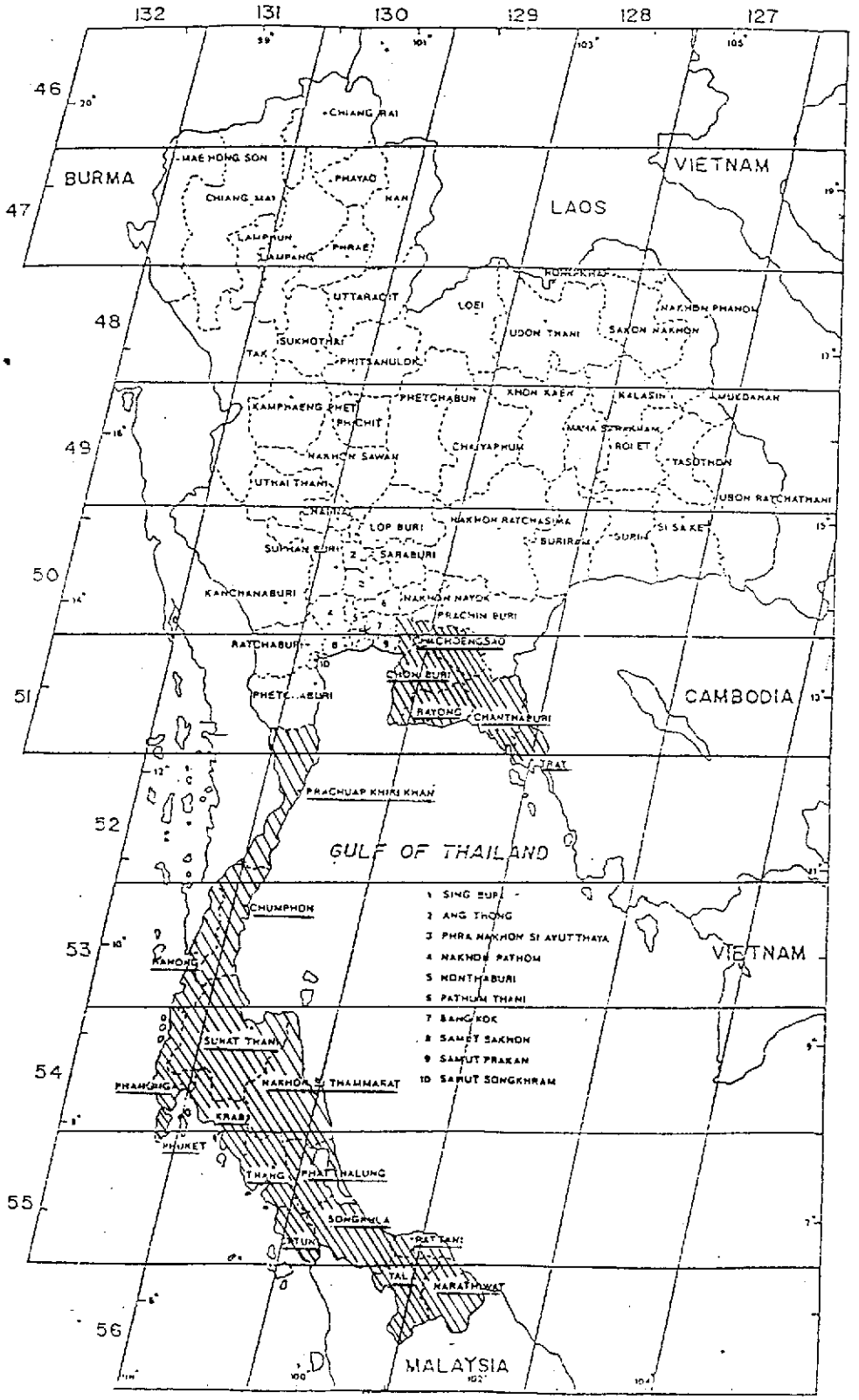

Figure 1.1 Rubber planting area in Thailand

Table 1.2 Projection of Thailand's Rubber Production during 1992-1996

Year	Planting area ($x10^6$ ha)	Production ($x10^6$ ton)	RSS* ($x10^6$ ton)
1992	1.89	1.30	1.09
1993	1.91	1.37	1.12
1994	1.93	1.44	1.15
1995	1.95	1.51	1.16
1996	1.96	1.58	1.18

* RSS = Ribbed Smoked Sheet Rubber

Source : Rubber Research Institue, Ministry of Agriculture and Cooperative, Bangkok, 1992

Table 1.3 Current and Forecasted of World Rubber Production

Year	Production ($x10^3$ ton)				
	Malaysia	Indonesia	Thailand	Others	Total
1970	1269	815	287	734	3105
1975	1459	823	355	678	3315
1980	1530	1080	501	799	3910
1985	1470	1130	726	1009	4335
1990	1600	1513	1159	1036	5308
1995	1600	1513	1318	1168	5599
2000	1600	1613	1550	1381	6144

Source : Committee on Rubber Policy, Ministry of Agriculture and Cooperative, Bangkok, 1985.

Note : Figures in Table 1.2 and 1.3 were derived from different bodies.

Since 80% of the country's rubber products is ribbed smoked sheet (RSS) rubber, Thailand is the biggest RSS producing and exporting country in the world. In 1989 Thailand exported $920x10^3$ tons of RSS compared to $278x10^3$ tons and $152x10^3$ tons for Malaysia and Indonesia, respectively. During 1980-1989 Thailand increased her RSS export by 168% [3].

RSS is one of the solid forms of rubber products. Hot gas and smoke obtained from wood burning are used to cure the rubber sheets in smoking rooms. The smoke acts as a disinfectant which renders the rubber less liable to mould attack. Although Thailand is the biggest RSS rubber producer, scientifically, the study of the rubber smoking technique has received very little attention. The design and operation of the smoking rooms merely relied on past experiences. Development of the smoking process was generally based on trial and error method.

1.4 TREND OF RUBBER INDUSTRY IN THAILAND

Unlike Malaysia where substantial rubber planting area was converted to oil palm plantation, Thailand rubber planting area is expanding. Due to unsecure future of cassava, the Government has encouraged cassava grower to turn to rubber. It was estimated that rubber plantation resulted from this scheme was 33,230 rais in 1991. Furthermore, over 100,000 rais of new planting area is expected for the Northeastern part of Thailand during 1989-1992. This new rubber planting region will inevitably face with the lack of firewood problem for rubber smoking process since replanting will not take place until the next 25-30 years. Economic life time of rubber tree is 25-30 years, at the time which rubber trees are cut down to make way for replanting. The cut down rubber trees are the only source of firewood for the rubber smoking industry.

1.5 PLANNING OF PROJECT

Although Prince of Songkla University is situated in rubber growing region (Southern Thailand), rubber smoking technology is an

unknown to the University people. Rubber smoking industry is a very competitive business. Technological know-how is always kept secret. The project has to start right at the study to perceive the fundamental knowledge of the industry. The following step-by-step activities (1.5.1-1.5.4) were planned for the project. Details of these activities formed the following Chapters in this report.

1.5.1 Surveying of rubber smoking factories to acquire basic data.

It is essential to understand, in general, the rubber smoking process so that the research work can move in the right direction. Surveying of rubber smoking factories in near-by provinces was carried out during the first 6 months of the project.

1.5.2 Energy auditing of rubber smoking process.

A research work aiming for energy conservation always start with energy auditing in order to clarify energy used in the process. Energy auditing of a rubber smoking room was conducted in May 1991. Results from data analysis thereafter was used to justify the following activity (1.5.3).

1.5.3 Study on factors affecting rubber drying.

Analysed data from 1.5.2 pointed out a possibility of increasing productivity by dehumidifying the inlet air flowing into the furnace. However, laboratory experiment is needed to verify the hypothesis. In this study, humidity and volume flow rate of air were the controlled parameters.

1.5.4 Theoretical work and field trial of air drier to accelerate rubber smoking process.

Information on the specification and price of various types of commercial air driers was studied. It was decided to develop an air drier based on refrigeration principle for this special purpose. Theoretical work was performed to determine technical and financial feasibilities. A prototype unit was manufactured and field trial test was undertaken.