A study on proper heat sensitization of natural latex compound for manufacturing thick wall rubber articles.

By

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TO MY DEAREST PARENTS

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Declaration of the Candidate

I certify that this dissertation does not incorporate without acknowledgement, any material previously submitted for a degree or diploma awarded by any institution of learning, and to the best of my knowledge and belief, it does not contain any material previously published or written by another person except where due reference is made in the text.

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Supervisor's statement

I certify that the above statement made by the candidate is true and correct and this thesis is suitable for submission to the University for the purpose of evaluation.

29/3/05

Date

Supervisor's Signature

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List of abbreviations

TSI	-	Toluene Swell Index
NR	-	Natural Rubber
SR	-	Synthetic Rubber
AR	-	Analar Grade Reagent
Mix compound	-	Initial latex compound mixed with gelling agent
TSC	-	Total Solids Content

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Abstract

Generally a heat sensitive process is used to manufacture babies feeding nipples, exercise bands and heavy duty industrial gloves consisting thick walls.

The effect of pH , temperature of gelling agent and initial latex compound have been studied in depth. The optimum quantity of gelling agent that has to be used in a predetermined quantity of natural latex compound has been established as 20 g of 18% ammonium chloride in 1000 g of latex compound. Then the most desirable temperature in gelling agent and also in latex compound was found as 21°C. Thereafter the most desirable pH of latex compound was established as 10.0 to 12.0 range. Finally the most desirable pH of gelling agent was found as 9.0 to 11.0 range.

In the final test series 4, when gelling agent pH was maintained within 9.0 to 11.0, the compound related quality problems such as thickening, latex particle formation and complete gelation of the latex compound bulk could be minimized.

This research explores the key factors influencing proper heat sensitization of natural latex compounds. Generally, in the latex based rubber industry, compound related quality problems such as thickening, latex particle formation and complete gelation of the latex compound bulk take place due to improper methods adopted at the compounding stage. As a result, material wastage and unplanned production plant stoppages occur leading to low productivity resulting in high costs to the industry. Industry practices and laboratory practices connected to heat sensitization of natural latex compounds have also been carefully studied and examined.

Chapter One

1.0 Introduction

1.1 Rubber industry in Sri Lanka

Rubber has been a traditional export commodity in Sri Lanka since the colonial era (5). The Rubber industry in Sri Lanka can be classified under different sectors of one of which is the plantations sector, which grows and harvests latex from trees and converts it to processed raw rubbers of different types. The second sector is the rubber products manufacturing sector, which converts raw rubber into value added rubber goods. There is a third sector which uses rubber wood as a material resource for manufacturing a wide range of wood based value added products.

Rubber plantation was established in Sri Lanka in 1876 with the planting of rubber seeds imported from Brazil. The rubber products manufacturing industry emerged in the 1950s primarily to retread tires and the industry expanded rapidly after the introduction of free trade policies and investment promotion zones in the late 1970s. At present, the value of the rubber products manufacturing sector is five times greater than the export value of raw rubber from Sri Lanka. However, the plantation sector remains an important component as it is the 'resource base' or the primary competitive advantage of Sri Lanka's rubber industry.

Prior to 1977, Sri Lankan rubber exports were mainly based on raw rubber products. According to Colombo rubber traders association annual report 2003/2004 (9), Sri Lanka recorded around 229,000 hectares under rubber in the 1960s but currently the land area under rubber is less than 129,000 hectares. Of this area, approximately 65% is less than 20 hectares in size and mostly owned by smallholders. The main types of rubber produced in Sri Lanka are Ribbed Smoked Sheets, Latex Crepe, Sole Crepe and Centrifuged Latex. Technically Specified Rubber is also produced but not in significant volumes due to lack of economies of scale. Production of raw natural rubber was 92,000 metric tons in 2003 although production levels in the 1970s have exceeded 155,000 metric tons.

The local consumption of raw rubber for value addition was around 63,000 metric tons in the year 2003. This accounted for 70% of local production. Raw rubber exports were mainly Latex Crepe and Sole Crepes, which serve a niche market. Statistics reveal that over the years more and more raw rubber was being consumed locally by the rubber products manufacturing sector. In the year 1980, local consumption stood at only 15,000 metric tons. But after 1977, due to the liberalization of the economy, the Sri Lankan government introduced free trade zones. It has caused world leading manufactures to bring their investments and technology into the country. Due to these reasons Sri Lankan rubber industry took a tremendous development towards manufacture of rubber products using raw dry rubber and concentrated latex. However over the next 20 years domestic consumption grew rapidly at approximately 16% p.a. due to the liberalization of the economy in 1977.

According to Colombo rubber traders association annual report (8) 1998/1999, natural rubber production which has shown a declining trend, recorded a further drop of 9% to 96 million kgs. in 1998. The principal factors attributable to this trend have been identified as declining in the land productivity. The yield per hectare in 1998 was 716 kgs. compared with 822 kgs. in 1997. The area under cultivation in 1998 was 158,000 hectares as compared with 163,000 hectares in 1997. The area under tapping was 125,000 hectares in 1998 as compared with 129,000 hectares in 1997. In 1998 there was approximately 3,100 hectares newly planted and under replanting. The new planting and replanting is currently supported by the government through a rubber replanting subsidy scheme. The replanting subsidy is not available to the large plantations. However, the replanting subsidy has paid a vital role and acted as a catalyst in encouraging the replanting of rubber by the small-holder sector who have availed of the replanting subsidy to renew their rubber stands with higher yielding clones developed by the Rubber Research Institute. Although the rubber replanting cess on export of raw rubber has been withdrawn, it is important that the subsidy is retained to ensure the long term sustainability of the rubber industry.

The application of fertilizer increased in 1998 in spite of the declining prices for rubber. The total quantity of fertilizer used in 1998 is 15,000 MT as compared with 12,000 MT in 1997. According to a survey carried out by the Central Bank on the small-holder sector in

the Kalutara and the Ratnapura districts (7) it was observed that small-holders who regularly apply fertilizer were able to survive the depressed market conditions.

However, low yields continue to be a major set back for the Sri Lanka rubber industry. The yield per hectare in 1998 declined by 7% as compared with 1997. Yields in other major producing countries is about 40 to 50 per cent higher than in Sri Lanka. The causes identified for low yields are loss of tapping days owing to rain, inadequate application of fertilizer, low stand per hectare and scarcity of tapers. The incidence of the use of rain guards is still low, although some of the plantation companies have started introducing the use of rain guards more extensively. Similarly plantation companies have started improving the stand on estates at the time of new planting and replanting. The extent of fertilizer application would of course be guided by prices. On the other hand the estates managed by plantation companies tend to be more scientific in regard to fertilizer applications, and many estates managed by privatized plantation companies follow systematic manuring programs to induce higher yields. Table 1.1 shows production output, area under cultivation, area under tapping, yield per hectare, fertilizer used, area replanted, area new planting, prices, cost of production, exports, domestic consumption and export earnings in the Sri Lankan rubber industry. Table 1.2 shows the quantities of dry rubber and latex consumed by Sri Lankan rubber industry for 1996, 1997 and 1998. It is evident that currently Sri Lanka has more than 180 factories producing raw dry rubber and 15 factories producing concentrated latex.