

PROCESSING OF NR AND SOME DEVELOPMENTS IN RUBBER CHEMISTRY AND TECHNOLOGY IN SRI LANKA¹

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The land use pattern in Sri Lanka indicates that out of the 6.56 million hectares of available land, approximately 2.1 million hectares are under cultivation. The largest portion of area is under paddy. The three major export crops viz. tea, rubber, and coconut are the next major components of land use (Fig. 1). A recent study reveals a remarkable decline in the rubber extent. The present extent of rubber is 161,500 ha, representing nearly 7.7 percent of the total cultivated area.

In 1994, about 44 percent of the total rubber extent was under the category of large estates (above 40 ha), and the balance 56 percent consisted of both medium estates (between 4-40 ha) and smallholdings (less than 4 ha). The extent under both public and private sectors has shown a downward trend. Nearly 70% of the rubber extent belongs to the private sector (Fig. 2).

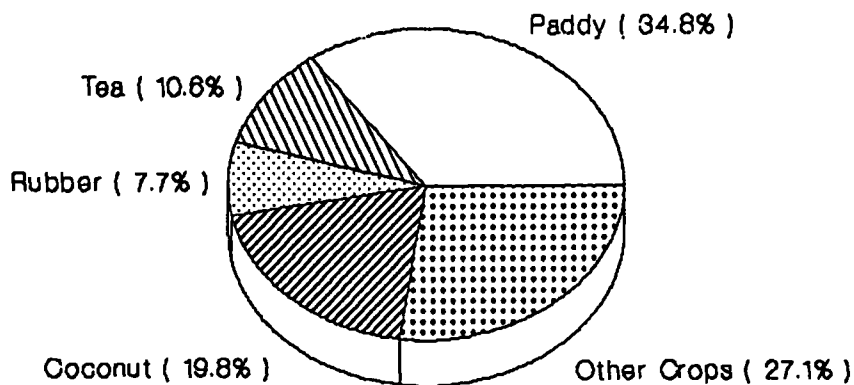


Fig. 1. Agricultural land use pattern in 1995

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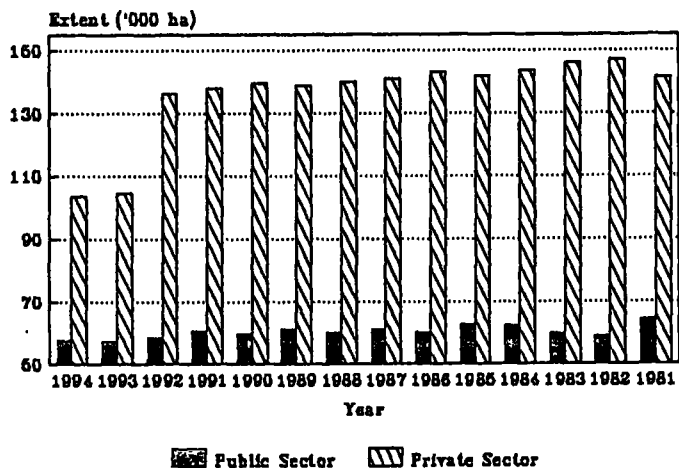


Fig. 2. Rubber area by ownership (1981-94)

Natural rubber production and exports have also shown a declining trend particularly since the mid 1980s. Yet, a marked increase in domestic consumption is evident especially since the liberalization of economic policies in late 1970s. The domestic consumption presently accounts for 37% of total production and this upward trend is likely to continue into the distant future (Fig. 3).

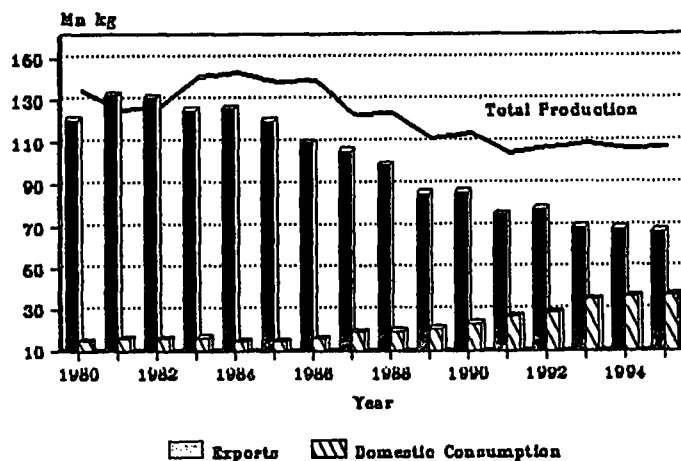


Fig. 3. Rubber production: Exports and domestic consumption (1980 - 95)

Sri Lankan natural rubber product mix consists of six product types, namely, RSS, Pale Crepe, Scrap Crepe, Sole Crepe, TSR and Centrifuged latex. Each product type consists of several sub-lines based on the grades and the ultimate types. RSS is produced largely in smallholdings and in small estates whereas the production of crepe rubber is mainly confined to large estates which are presently under the private management. The percentage share of both sheet and crepe rubber has shown a downward trend. The production of centrifuged latex has increased remarkably up to 1994 (Fig. 4).

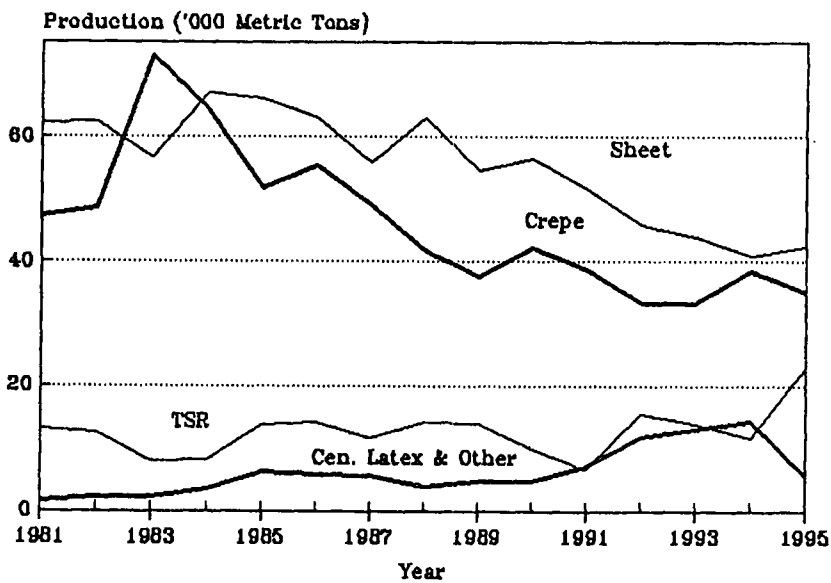


Fig. 4. Natural rubber production by type (1981-95)

The export earnings from natural rubber have fluctuated over the years. In 1995, the contribution from raw rubber exports increased upto Rs.5037 Mn; a 44% increase over the previous year (Fig. 5). This is mainly due to the increase in rubber prices as the total quantity of NR production has stagnated since 1991. In 1995, export earnings from NR accounted for 13.5 percent of the total agricultural earnings and 2.9 percent of the total export earnings.

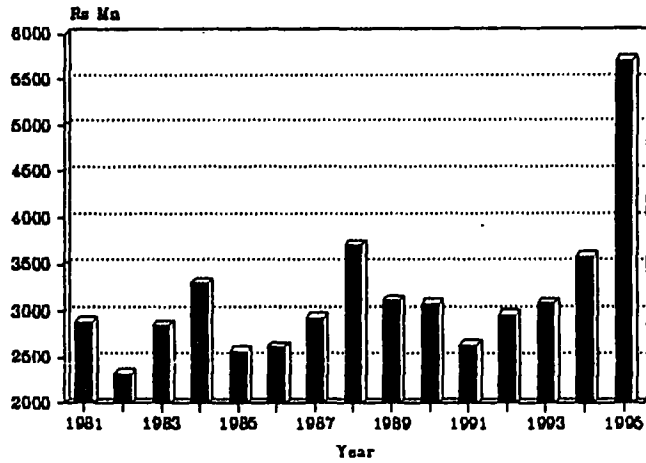


Fig. 5. Export value of Natural Rubber (1981-95)

The rubber products industry has shown a significant growth rate especially since 1991 (Fig. 6). In 1994, Sri Lanka earned nearly Rs.5000 Mn worth of foreign exchange from the export of rubber products by consuming nearly 37% of the total NR production. But, the foreign exchange collected from the export of remaining 63% of NR in raw form have brought only Rs.3500 Mn to the country. This clearly demonstrates the importance of converting raw rubber into more value added products at the domestic level.

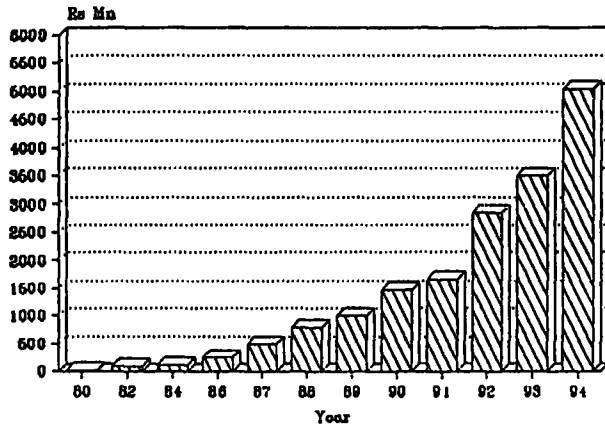


Fig. 6. Rubber products industry: Annual growth in exports (1980-94)

With regard to export earnings, rubber apparel and clothing industry accounts for the largest share of export earnings with 37%, followed by tyres and tubes (27%), footwear (17%) and articles of unhardened rubber (17%) (Fig. 7).

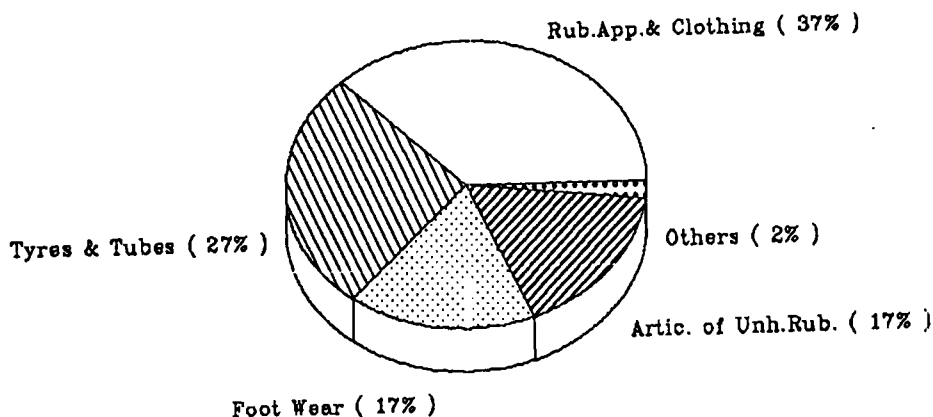


Fig. 7. Rubber products industry: Distribution of export earnings by major products (1993)

DEVELOPMENT OF SPECIALITY RUBBER FOR VALUE ADDITION

Thermoplastic Natural Rubber (TPNR)

Thermoplastics of different types are well known commercial materials that are produced as impact resistance synthetic polymers. One important class of thermoplastic elastomers (TPEs), can be obtained by blending Natural Rubber (NR) with polypropylene (PP). These blends offer specific property advantages such as excellent stress and strain tolerance, high impact and tear resistance etc. to the end product. Unlike the conventional rubber, TPNR needs no compounding or vulcanization. TPNR can be injection moulded and recycled to manufacture the products that require especially high impact strength. It is quite easy to manufacture TPNR products in a plastic processing factory. Recycled plastics can be used in the production without affecting the properties very much due to the presence of rubber component in the blend.

On the other hand, some products manufactured out of Polypropylene (PP) or HIPS which are costly, may not have the required strength, high impact resistance etc. and also will not have the flexibility in the manufactured products such as toilet seats and cover, ice cube trays, motor cycle mirror holders etc. The raw materials used in the manufacture of these items can be replaced by the locally produced TPNR for better performance. Soft blends which have high NR component can be used in shoe soles.

The manufacturing process of recycled blends of TPNR developed at the RRISL is very economical and it involves blending of granular natural rubber and recycled plastics wastes in plastic processing machinery unlike in some other countries where rubber processing machinery are used to blend NR and PP. TPNR eliminates the need for vulcanization and the main advantage is that the rejects and wastes can be recycled unlike natural rubber alone.

Latex coagulating pans made out of TPNR have become very popular among the Sri Lankan rubber small holders who are manufacturing RSS rubber. Use of upto 50% recycled plastics is recommended with 1-20% dynamically cross linked natural rubber to introduce high impact strength required for latex coagulating pans. The cost of TPNR coagulating pans weighing 450g and 40x31x7 cm dimensions is 60 Sri Lanka Rupees (US\$ 1.2). The current demand for latex coagulating pans is about 200,000 per annum and the pans are distributed among the smallholders through the Rubber Extension Officers. A conventional aluminium pan used for coagulation of latex would cost over 200 Sri Lankan Rs. (US\$ 4), about 3 times higher than the TPNR pans. If plastics products manufacturers use this raw material with high impact strength, the import of plastics raw materials may be reduced by about 20%. This would help to save valuable foreign exchange and also enable the consumption of natural rubber as a raw material in the plastics manufacture.

Deproteinised Natural Rubber (DPNR)

Normal grades of natural rubber contain about 3% protein. It has been found that the dynamic properties such as creep and heat build up, of natural rubber could be greatly enhanced if the protein content can be reduced to less than one percent. DPNR with low protein content is therefore preferred in the manufacture of engineering components, bridge bearings and building mounts.

Several methods based on enzymatic treatment are available for the preparation of DPNR. RRISL has been working on the preparation of DPNR of the last 10-15 years and has developed a method for the production of this rubber as crepe, using papain as the coagulant. This value added speciality rubber can be carried out in commercial scale up to the coagulation stage by the smallholders using raw papaw juice which will enable them to cut down the costs on acid used in conventional rubber manufacture.

Constant Viscosity Rubber (CVR)

Viscosity or "Hardness" of raw natural rubber increases steadily during storage and causes storage hardening. This is not desirable as more energy is needed for processing the storage hardened rubber into finished products. This hardening of rubber could be prevented by adding a very small percentage (0.15%) of hydroxyl amine salts to rubber latex, prior to coagulation. Malaysia has introduced several grades of CV rubber on technically specified block form. The most popular ones are CV 50 and CV 60, the number denotes viscosity lattices from selected clones. The rubber from most of the clones in Sri Lanka such as PB 86, RRIC 100, 121 etc. has a high mooney viscosity in the range of 75-80, by using a small percentage of peptizers along with hydrogen amine salts, it has been possible to produce CV grades of rubber from high viscosity rubber in commercial quantities. Using a similar procedure it is possible to produce CV grades of rubber in crepe form in factories. The CV grades are used for special extrusion and moulded articles. There is a growing demand for these grades in the market.

Centrifuged Latex

The centrifuged latex industry is now gaining popularity in Sri Lanka. In all there are already 49 centrifuging machines in operation with a production capacity of approximately 33,000 MT per year. Arrangements have already been made to install additional 7 machines in the near future. Out of these, atleast 25 machines depend on smallholder latex for production. The main suppliers of field latex for centrifuged latex production are therefore the smallholders who would benefit by this system in having a better bargaining power for their field latex. Moreover, it is more convenient and profitable, as these are not affected by any problems that may arise in processing their latex and also by the escalating costs of labour, firewood etc. In view of this, incentive subsidies are now provided by the government for setting up of new centrifuging factories.

Rubber based sealent for fixing rainguards

Although the advantages in the use of rainguards have been known for the last 25 years or so, yet it had not been used by the rubber industry of Sri Lanka, due to nonavailability of an effective sealent to fix the rainguards. The sealents that were available earlier had the disadvantages of cracking, melting etc. RRISL developed a compound to overcome these problems by adding a small percentage of NR into bitumen. This rubber bitumen based compound is very simple to make, and now even the smallholders are making this sealant at the site for use in fixing rainguards in their holdings. The preparation of the sealant involves mixing of tar (10 kg) sulphur (200

g), rubber (500 g dissolved in kerosene) and china clay (13.5 kg) in an empty 3/4 tar barrel. The approximate cost of this compound is Rs.25/= to 30/= per killograme. Fixing of the Apron type of rainguard would cost approximately Rs.2.50 to Rs.3.00 per tree and for Gutter type it would be approximately Rs.5/= to 6/=.

UTILISATION OF SOLAR ENERGY FOR DRYING OF RSS

Traditionally, rubber sheets are smoked in a smoke house for 4–5 days. Smoke and heat are generated by burning of firewood. Though firewood was considered as a cheaper source of energy it has now become a scarce and costly material. RRI is now exploring the possibility of utilising freely available solar energy for the purpose for drying RSS.

Initial trials conducted in 1995 involves hanging RSS sheets in open sun during day time and in a shed during night. This method of drying is continued for 3–4 days. Subsequently smoked in a smoke house for a day. Results have shown that continuous drying of RSS for 3–4 days in open sun does is not adversely affect the qualities of rubber, but drying beyond that period had adverse effects on the sheet. It has also been found that the colour of the sheet is lighter than the conventionally smoked sheet.

The advantages of sun drying are:

- (1). Firewood consumption is minimised.
- (2). Colour (appearance) is improved.
- (3). Defects occuring during smoking are reduced.
- (4). The number of sheets which can be smoked in a smoke house is increased and
- (5). Ensures a cleaner, odour free sheet.

Disadvantages of sun drying are:

- (1). Sheets should be loaded in to a shed or to a smoke house before night fall.
- (2). Drying cannot be done on a rainy day
- (3). Possible contamination in with dirt particles.
- (4). Sheets of uniform thickness of 1/8" are only recommended for efficient drying and good quality.

Green house type dryer:

In order to overcome the above mentioned disadvantages, a "Greenhouse type dryer" has been devised on experimental basis (Figure 8).

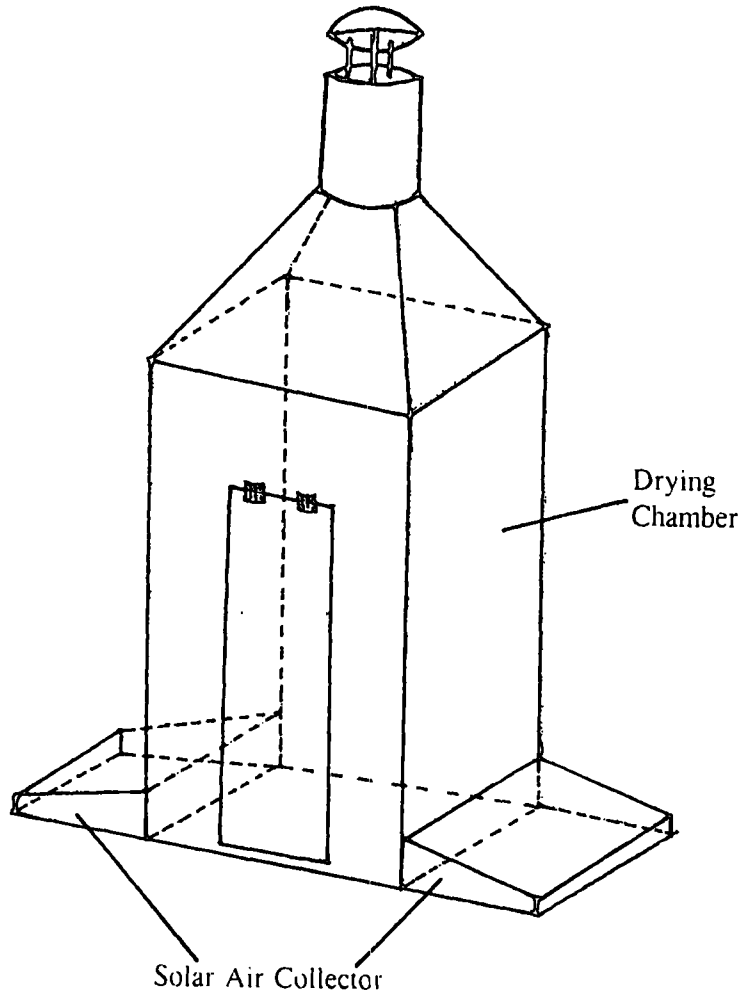


Fig. 8. Green house type dryer

This dryer consists of two solar air flat plate collectors and a drying cabinet. Each flat plate air heater has an area of 1 m^2 . Galvanized iron sheets Polythene (Gauge 1000) was used for absorber plate and cover plate respectively. Drying cabinet

has dimensions of 1.2 M length, 1.0 M height and 0.9 M width and can accommodate 60 normal size RSS sheets weighing up to 30 kilos. The cabinet was made out of timber which is covered by polythene of gauge 100. It has been found that the internal temperature was higher than the ambient temperature for more than 8 hours during the day, the minimum difference being 4 degrees while the maximum around 12 degrees. The sheets are dried within 3-4 days without any adverse effect on the physical properties of rubber. Subsequent smoking will prevent any possible mould growth on the sheet.

Advantages of a green house type dryer are:

- (1). Not affected by rain.
- (2). Contamination with dirt and sand is avoided.
- (3). Temperature higher than the ambient could be achieved.
- (4). Temperature could be controlled.
- (5). Low construction cost.

Disadvantages of greenhouse type drying are:

- (1). An operator is required to control the temperature.
- (2). Life time is less than the conventional smoke house.