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SUGGESTED IMPROVEMENTS IN THE MANUFACTURE OF CEYLON NATURAL RUBBER

By

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Until now emphasis in Ceylon has been on increasing production, *i.e.* by replanting low-yielding rubber land with high-yielding material. This has been done with the aid of subsidies. There has been as yet no planned, large scale effort in improving the quality of natural rubber (NR) and its presentation. The various forms of raw rubber and the quantities produced in Ceylon in 1968 and in 1969 are given in Table 1.

TABLE 1

RAW RUBBER PRODUCTION IN CEYLON IN TONS PER YEAR IN 1968 AND 1969

Type	1968		1969	
	Production	% on total production	Production	% on total production
RSS	87,038	59·5	86,879	58·5
Latex crepe	37,527	25·6	39,977	27·0
Scrap crepe	19,854	13·6	19,798	13·3
Sole crepe	1,203	0·8	1,058	0·7
Latex	748	0·5	741	0·5
New process rubbers	—	—	60	—
Total	146,370	100·0	148,513	100·0

The estimated distribution of NR production in 1968 in various sizes of holdings is given in Table 2.

TABLE 2

APPROXIMATE DISTRIBUTION OF THE TYPES OF RUBBER PRODUCED IN CEYLON IN 1968 AND IN VARIOUS SIZES OF HOLDINGS
(in millions lb)

Total rubber produced 328														
Smallholdings (<10 acres)			Medium holdings (10—100 acres)			Small estates (100—500 acres)				Large estates (> 500 acres)				
RSS	Scrap		RSS	Scrap		RSS	Scrap	Latex crepe		RSS	Scrap	Latex crepe	Latex	
73	12		62	10		50	9	10		10	14	76	2	
85			72			69				102				

New process rubber manufacture

The manufacture as well as the presentation of general purpose NR, *i.e.* ribbed smoked sheet (RSS) and scrap have in recent times undergone significant changes due to the advent of new process natural rubbers. These developments have had very little impact in Ceylon as the manufacture of new process rubbers has to be done on a large scale.

Conversion of RSS into new process rubber: It would be necessary for producers of RSS to group together to form central factories if they wish to produce new process rubber. Table 2 shows the production of RSS in small and medium holdings as well as in small and large estates.

In view of the large number of producers from whom the latex or latex coagulum have to be collected, it is suggested that a central organisation be set up to arrange for the installation and operation of these central factories.

A feature of Ceylon's RSS market is the premium of 6 ¼ cts/lb paid for RSS 1, 2 and 3, sold on barter agreements, *e.g.* to China, Poland *etc.* The premium fetched by the equivalent grade of new process rubbers, SCR 5L, is now less than 6¼ cts and at these prices there would be a loss of foreign exchange to the country if there is a switch over to new process rubbers of the latex which is at present manufactured into RSS, unless the same premium can be obtained for the new process rubbers.

Of the 60 million lb of RSS produced by small and large estates, only 10% (*i.e.* 6 million lb) was exported as Nos. 4 and 5 which did not qualify for the premium obtainable for RSS 1, 2 and 3. Hence it is recommended that these estates should continue to produce RSS and that little endeavour should be made to divert them to new process rubber production, at present.

Of the 62 million lb of RSS produced by medium holdings, only 13%, *i.e.* (8 million lb) was classed as Nos. 4 and 5 and as the sale of RSS is by barter agreements there is no compelling necessity to divert them to new process rubber manufacture. However producers of RSS in these units have expressed interest in supplying their latex to central factories due to difficulties in managing small processing units and because of the shortage of rubber firewood. The implementation of the proposal for a factory to manufacture furniture from boric acid/borax-treated rubber wood would make this problem of obtaining rubber wood for smoking more acute. Hence it is recommended that this group be included in any programme for the installation of central factories.

Of the 73 million lb of RSS produced by smallholdings, not more than 15% is No. 1 and it may even be lower than this as RSS on storage deteriorates in quality. About 24% of smallholders' RSS is Nos. 4 and 5 (Table 3). Major changes in manufacturing techniques are necessary in the smallholders' group. A method of doing this is by manufacturing new process rubbers.

TABLE 3

% GRADING OF RSS PRODUCED BY SMALLHOLDERS IN 1968

Grade	Percentage
No. 1	14
No. 2	29
No. 3	33
No. 4	12
No. 5	12

The Rubber Research Institute of Ceylon (RRIC) has put forward, for Government consideration, plans to set up a prototype central factory to manufacture new process rubbers with a capacity of 2,500 tons/year to cater for small and medium holdings at distances up to eight miles from the factory (Veerabangsa & Hansen, 1970). Small estates within range of the central factory may also be catered for.

Government participation is necessary to ensure the success of the proposed organisation to establish central factories for processing smallholders' latex. A scheme comparable to that in operation for rubber replanting is envisaged for the manufacture of new process rubbers. To produce about 50,000 tons of NR approximately 100,000 acres must be replanted with high-yielding clones at a replanting subsidy cost to the Government of about 150 million rupees. The investment necessary to convert 50,000 tons of rubber produced from small and medium holders to new process rubber would be 40 million rupees at Rs. 2 million per 2,500 ton/year factory.

Conversion of scrap into new process rubber: Large estates produce about 14 million lb of scrap annually and they have the equipment to change the scrap into scrap crepe. The conversion of a part of this scrap (10 million lb) as well as latex crepe No. 3 (fraction rubber) which is about 5 million lb, into new process rubber, by such estates pooling their resources, would siphon away perhaps 15% of their intake, thus reducing capital commitments for increasing drying accommodation and the installation of new machinery as a result of replanted areas coming into tapping. The RRIC has a pilot plant at Peenkande Group, Uda Karawita, to produce new process rubber from fraction and scrap and the results of the experiment indicate that large estates could pool their resources to manufacture new process rubber from their own raw material.

Small estates, medium holdings and smallholdings produce about 9 million, 10 million and 12 million lb of scrap respectively. These groups do not have the facilities to process their scrap (31 million lb) and hence smoke-dry or sun-dry it and sell it to traders who in turn sell it at the auctions or to remillers. Drying of rubber under such conditions has an adverse effect on the quality as it makes the removal of any dirt present difficult. Further, sun-drying adversely affects the technological properties of the rubber. In addition, the smallholder has difficulty in selling his scrap at a fair price. It is of interest to the country to up-grade this rubber and to ensure that the producer gets a fair price. Priority must, therefore, be given for the establishment of central factories to process fresh field scrap from these holdings into new process rubber. The necessary four or five factories should be established within the next three years, the siting of them being on a planned basis. The suggested capacity of each unit would be 10 tons/day, with provision for expansion to 20 tons/day to take in coagula or latex. Since all of the tree lace collected by the central factory would be unsuitable for new process rubber manufacture, facilities would have to be provided to manufacture conventional scrap crepe as well in the central factory. The total fixed capital investment for such a scheme is in the region of Rs. 10 million, of which the foreign exchange component will be approximately Rs. 6 million. The profitability on this investment is 22% and the annual return on the foreign exchange component due to enhanced earnings is 20% (Veerabangsa & Hansen, 1970).

RSS manufacture

Mould in RSS: The most serious defect encountered in Ceylon RSS is mould. This is due to the long delay between manufacture and packing the sheets into bales. Whilst the large estates send their RSS directly to shippers in Galle and Colombo and there is little delay in packing, the small and medium holders sell their RSS to a nearby rubber dealer, a co-operative society or to purchasing depots of the Commodity Purchase Department and it is the delay in these stores that gives rise to the defect of mould.

RSS is more liable to get mouldy during the rainy months or if the RSS is stored either on a cement floor or in close proximity to mouldy scrap or if wet undersmoked sheets are stored with good RSS. RSS from small estates can be kept free of mould for about three months but in the case of small and medium holders who produce RSS, their rubber is liable to become mouldy in a much shorter period because of the large number of non-rubber substances retained in RSS due to inadequate washing of the milled sheets.

Of the constituents of smoke that are retained in the RSS, it is the more volatile constituents that are effective as fungicides. On storing of unbaled RSS, these are liable to escape (Heinisch & Nadarajah, 1961). Recently the amount of mouldy rubber at Torbay Stores was over ½ million lb.

It is recommended that, for the present, a fungicide be used by smallholdings and small estates in their RSS manufacture. Treatment with para-nitrophenol (PNP) is suggested, but because of its toxic nature due precautions must be taken against skin absorption and ingestion. The concentration normally used for incorporation into latex is 0·1% wt PNP on the rubber content and where conditions for dipping of freshly milled sheets are feasible, a solution of 0·05% — 0·1% PNP at immersion periods up to five minutes is used.

Investigations carried out by the Plant Pathology Department on physical methods of mould inhibition on RSS will be described later at this conference.

Group processing centres (GPCs): It is expected that the central factories will eventually cater for smallholders and medium holders of rubber but this change over will come in gradually. The smallholder is unable to equip himself with the necessary milling and smoking facilities due to the small scale of his operation. He has therefore to pay a fee to mill and smoke his rubber and to meet the cost of transport of the sheets for sale. He invariably sells his product at a discount to No. 1 RSS price.

To assist the smallholder in an immediate and practical way and also to solve some of the initial organisational problems involved in latex or coagulum collection in central factory operations, it is proposed to organise 16 GPCs for sheet manufacture at the rate of two such centres per Advisory Officer's Division per year. As central factories come into being, most of these centres are expected to be absorbed into its area of operation without much difficulty.

As far back as 1942, the RRIC realised that GPCs were important in improving the quality of RSS manufactured by the smallholder and the " Hataraliyadda Rubber Co-operative Society " which is still being successfully operated was formed (Pieris, 1948). However progress in this direction has been slow since that time. If GPCs and central factories are to be a success, then a central organisation as mentioned earlier must be set up rather than allow individual co-operatives to solve their problems.

The RRIC has now assisted in the construction and operation of a smallholders' group processing centre at Millcniya. With this experience it is proposed to organise GPCs, each capable of processing about 600 lb of rubber per day, entailing the handling of the produce of 60—80 smallholders. Assuming that five days are required for smoke-drying of a day's lot of sheets, it would require a smoke house of 3,500 lb capacity. Figures for buildings and major equipment costs for one centre are presented in table 4.

TABLE 4

GROUP PROCESSING CENTRE—BUILDINGS AND MAJOR EQUIPMENT (600 LB/DAY)

Item	Cost (Rs.)
Smoke house	7,000
Curing shed, well and pump	6,500
Two sets of rollers	3,160
Coagulating pans, 600 @ Rs. 4/50 each	2,700
Strainers (4)	50
Utensils	300
Table 2½′ × 4′ of Milla	90
Transport and installation of rolls	200
	20,000

The estimated recurrent annual costs are given in Table 5.

TABLE 5

GROUP PROCESSING CENTRE — ANNUAL RECURRENT COST

Item	Cost (Rs.)
Manager, Rubber-maker	1,800
Paid Assistant to Rubber-maker	600
Labour	2,400
Acid	800
Firewood	2,000
Maintenance	200
Insurance and other charges	400
Transport	200
	8,400

In the proposed group processing centres it is suggested to levy a manufacturing charge of 16 cts/lb. This charge would be of the same order as the discount on the No. 1 RSS price in the proposed central factories scheme. It is suggested that group processing centres, when they are built, should consider the following :—

(*a*) That GPCs be sited so that it would be possible to convert them into collection centres for the central factories scheme for new process rubber, at the end of five years and the investment be recovered at the end of this period in the form of a processing charge ;

(*b*) That GPCs be located in areas where it would not be possible, in the foreseable future, because of its isolation by good access roads, for assimilation into the central factories scheme. Here, the investment would also be paid for in five years and thereafter, continue to earn a reasonable profit on such investment.

The percentage No. 1 RSS manufactured by GPCs would be about 95% which could be compared with 14% as at present produced by smallholders. At a price differential of say 7 cts between No. 1 and No. 3 RSS, it would result in an additional increase of about Rs. 6,800/- in foreign exchange per GPC per year.

Crepe manufacture

Pale crepe has competition from its synthetic equivalent namely cis-polyisoprene. It has been stated that because of its high purity and uniformity, cis-polyisoprene is being increasingly used as starting material for chemical modifications. It has been further stated that the 92% cis-material has an additional advantage in that the absence of gel simplifies the preparation of reaction solutions (Krol, 1968).

It is thus necessary that methods of crepe manufacture should be such as to give a pure, uniform product with low gel content. The pale crepe should have a high viscosity and low oxidisability.

Pure, uniform product: In the preparation of pale crepe the latex is diluted to 1¼, 1½ or 2 lb dry rubber content per gallon; a fraction may or may not be taken, the bleaching agent (RPA No. 3) which is xylyl mercaptan is added before or after taking a fraction. The coagulant used is formic acid, oxalic acid or a mixture of both. If the preparation of the pale crepe could be standardised, then there would be minimum variability in the pale crepe prepared by different estates. The more the latex is diluted and the greater the fraction taken, the purer will be the resultant crepe.

Low gel content: Pale crepe when bleached with RPA No. 3 has a low gel content. Further when fractionated, the yellow fraction contains most of the gel. Hence it may be said that bleached, fractionated pale crepe has no gel content and is suited for the preparation of reaction solutions (Nadarajah *et al.*, 1970). Table 6 gives the gel content of crepes from different methods of preparation and treatments.

TABLE 6

GEL CONTENT OF THICK PALE CREPE

Sample	Gel content %
Latex coagulated with formic acid	9·5
Yellow fraction	17·3
Yellow fraction — RPA No. 3 added to latex before fractionation	5·3
White fraction — RPA No. 3 added to latex before fractionation and coagulated with formic acid	0
White fraction — RPA No. 3 added to latex after fractionation and coagulated with formic acid	0

High viscosity and low oxidisability

Users of pale crepe prefer a pale crepe with high viscosity and low oxidisability. A convenient measure of this is initial Wallace plasticity and the plasticity retention index (PRI). Even when RPA No. 3 is used in large amounts for the bleaching of pale crepe, if the crepe is well washed during manufacture, there should be no problem in manufacturing pale crepe having a high viscosity and low oxidisability. Pale crepe which on mastication shows an abrupt breakdown allowing for insufficient time for incorporation of antioxidants and other compounding ingredients, should be marketed as a separate grade. Our experience is that this problem arises mainly from remilled sole crepe cuttings marketed as No. 1 pale crepe. In the manufacture of sole crepe, these cuttings could amount to as much as 25·7% of the rubber input (Morris, 1964). Hence, for the 1,100 tons of pale crepe produced per year in Ceylon about 370 tons of pale crepe No. 1 are from sole crepe cuttings. It is recommended in marketing pale crepe that in addition to colour, methods of preparation which have an influence on technological properties, be also specified and that better consumer-producer liaison be established.

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QUESTIONS AND ANSWERS

Question : Has any sample of new process rubber from Ceylon been sent to China, our main buyer of smoked sheet, to ascertain the demand for this form of rubber ? (Anon).

Answer : No, for the simple reason that no such rubber has been so far produced in Ceylon in any substantial quantity. That China is interested in NPR is indicated by reports of limited purchases made by her in overseas markets. One of the reasons why the RRIC is advocating the setting up of a prototype factory for latex and scrap rubber is just for this purpose of market evaluation.

Question : It is evident that the RRIC does not advocate the change over to the production of NPR as long as the China agreement is in force. With the drop in price of RSS will not China some day be in a position to strangle the rubber industry, by offering terms adverse to Ceylon ? (Anon).

Answer : On the contrary, the paper just read indicates the stages in which Ceylon can profitably switch over to NPR manufacture. With increasing availability of such rubber in Ceylon, we see no reason why China should not pay for it at least the premium paid for RSS No. 1. After all, it is better processed and better presented rubber.

Question : Do you think it is possible to sell on technical specifications rubber which was prepared by the conventional methods and carefully controlled by the RRIC ? (Anon).

Answer : The Standard Ceylon Rubber scheme provides for the marketing of conventionally prepared rubbers. The control that the RRIC would exercise would be by seeking conformance to packing and technical specifications. No consumer would object to conventional rubber conforming to technical specifications, but it is doubtful whether he would pay a premium which would off-set the control testing which for small lots may be unduly high.

Question : In the event of blanket crepe being marketed to technical specifications, would we not compete successfully with NPR ? (Anon).

Answer : NPR is an alternative to RSS and scrap crepe and not to thick pale crepe. SCR 5L which is the NPR which competes with blanket crepe fetches at present a premium of only about 5 cts whilst you all know that blanket crepe fetches a premium of about 25 to 30 cts over RSS 1. There is a new type of NPR which has more stringent specifications than SMR 5L and called SMR EQ which may come into the market and this could be a more serious competitor to pale crepe. As stated in our paper, we must be aware of the requirements of the consumers of thick crepe and change our methods of grading and of manufacture to cater for them. (Mr. M. Nadarajah).

Question : Is there any control by the RRIC on the methods of manufacture of RSS rubber at present ? If not, will the RRIC think of some control in the future ? (Anon).

Answer : No. In view of the great number of small scale producers of RSS, the RRIC is unable to exercise effective control on methods of manufacture. In the past some limited impact has been achieved through advisory work, by creation of demonstration smoke houses and by the supply of coagulating pans, strainers etc. at subsidised rates.

As stated in the paper, the RRIC encourages the establishment of group processing centres for RSS manufacture. Such centres will be supervised and in this way some control can be exercised. Effective control can only be established by manufacture in large central factories. But it is not contemplated to manufacture RSS in central factories.

Question : Would it not be possible to eliminate the expenditure on group processing centres (GPCs) by coagulation in the field ? (Mr. E. O. B. Lover).

Answer : As mentioned by us, the establishment of GPCs is a short term objective for improving the quality of RSS. Whilst coagulation in field is suited for NPR manufacture it is not suited to RSS manufacture. (Mr. M. Nadarajah).

Question : Have you devised ways and means of testing for additives that may have been added to increase the DRC, *e.g.* rice cunjee, tea etc. on the spot ? (Anon).

Answer : An increased hydrometer (metrolac) reading obtained as a result of additives can best be checked by trial coagulation of samples from suspected latex, as the additives have no effect on the DRC determined in this way. The effect is an increase in viscosity or a decrease in specific gravity which influences the movement and the final position of the hydrometer. On the spot detection is virtually impossible and therefore the RRIC laboratories provide services for testing for adulterants such as starch.

Question : To avoid a " plum pudding " effect a pelletizer will be a very useful unit, in the manufacture of block rubber from scraps, to get even pellets which will give an even drying. Therefore, for a mechanical process why not use the following units of machinery ?

1. Macerator — for cleaning and blending,
2. Hammermill — less maintenance than granulator,
3. Pelletizer,
4. Dryer. (Anon).

Answer : There can be no objection to the use of machinery in the sequence suggested above

The " plum pudding " effect is avoided by adequate blending in a macerator. With the combination, a creper on top of the hammermill a uniform feed is delivered to the hammermill and an increased uniformity in particle size has been achieved thereby.

It is possible that even greater uniformity could be obtained by subsequent pelletization, but it is unlikely that such improvement would be sufficient to justify the installation of pelletizers. In this connection it must be mentioned that a creper/hammermill has a throughput of 1,800 lb/hr or more while the throughput of a pelletizer is below 500 lb/hr. At least four pelletizers would thus be needed to cope with the output from one hammermill.