

SUITABILITY OF HUNDRED SERIES CLONES FOR CREPE MANUFACTURE

PART I

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SUMMARY

The latex of clone PB 86, which is widely planted in Sri Lanka is eminently suitable for the production of latex crepe. Recently there has been a great interest in Sri Lanka in the RRIC 100 series clones owing to their significantly better immature vigour and yields in comparison with earlier selections such as PB 86. A series of tests showed that the crepe produced from RRIC 100 and RRIC 103 latex is comparable to that from PB 86 in quality and technical properties.

INTRODUCTION

The world demand for elastomers doubles every decade and this demand has to be supplied by the synthetic and natural rubber industries. Several factors have to be considered in increasing the production of natural rubber *e.g.* yield, replanting cycle, acreage, immature period, soils, terrain and diseases. Breeding and selection of higher yielding, earlier maturing clones, and their establishment in the industry and/or the judicious use of yield stimulants can assist in increasing the production of natural rubber. The RRIC 100 series clones, bred since 1957, and test tapped since 1966, were developed to shorten the immature period and appreciably increase yields. These clones have been issued to growers from 1969 and exchanged internationally in 1974 (Fernando, 1977).

Sri Lanka is the largest producer of high quality latex crepe and clone PB 86 has been found to yield latex eminently suitable for processing into latex crepe. However, a disadvantage in clone PB 86 is its lack of vigour in the immature period, generally taking seven years to reach maturity. In many of the large estates in Sri Lanka, more vigorous clones such as RRIC 100, 101, 102 and 103 have been planted and have been tapped at 5 years of age. The technical and technological properties of the rubber from some of these clones are described here in comparison with clone PB 86 (Perera, 1979).

MATERIALS AND METHODS

Visual appearance of crepe rubber

Latices from RRIC 100, 101, 102 and PB 86 were collected and processed into crepe rubber by different methods of manufacture with regard to fractionation and bleaching. Samples of the crepe rubber were prepared and were graded by one of the Rubber Broking Firms according to Green Book Specifications. The gradings were based mainly on colour, blemishes and mottled appearance, which are processing defects, were not taken into consideration. Two samples of each clones were examined.

Technical and technological properties

Latices from RRIC 100, 101, 102, 103, 112 and PB 86 were collected from Eladuwa Estate, Matugama, and were processed into crepe in the standard method without adding RPA 3 and without fractionation. 2% formic acid was used as the coagulant.

A Wallace Plastometer was used for plasticity determination, a Mooney Viscometer Mark III F/D for raw mooney determination, a laboratory two roll mill with friction ratio 1:1 for milling, a Monsanto Rheometer 100 for the study of curing behaviour, a Stress Relaxometer for aging studies, and a Hounsfield Tensometer for tensile strength determination.

The following formulations I and II were used to estimate vulcanisate properties and aging characteristics, respectively:—

<i>FORMULA I</i>		<i>FORMULA II</i>	
Rubber	100.0	Rubber	100.0
ZnO	6.0	ZnO	6.0
Sulphur	2.2	Stearic acid	0.5
Stearic acid	0.5	Sulphur	2.5
MBTS	0.75	MBT	0.6
DPG	0.25		

RESULTS

Stability of latices

RRIC 101 and RRIC 112 latices are less stable and tend to precoatulate more rapidly than PB 86 latex. The latices of the other clones of the RRIC 100 series under investigation show stability similar to that of PB 86.

Visual appearance of crepe rubber

Crepe rubber produced from unfractionated unbleached latices of RRIC 100, RRIC 103, RRIC 112 and PB 86 were all white, while that from RRIC 101 and RRIC 102 were light yellow in colour. This yellowish discolouration may have been inherited from one of the parent clones RRIC 7 in the case of RRIC 101 and RRIC 102.

The gradings obtained are given in Table 1. Grading IX is superior to 1 for colour.

TABLE 1. Green book grading for crepe rubber obtained after different treatments

(FB — Fractionated Bleached, UFB — Unfractionated Bleached,
UFUB — Unfractionated Unbleached)

<i>Clone</i>	<i>Method of Manufacture</i>	<i>Grading</i>
PB 86	UFUB	1, 1+
RRIC 100	"	1A, 1
RRIC 101	"	1
RRIC 102	"	1A, 1
PB 86	UFB	1, 1+
RRIC 100	"	1
RRIC 101	"	1A, 1
RRIC 102	"	1, 1
RRIC 100	FUB	1X
RRIC 101	"	1X
RRIC 100	FB	1X
RRIC 101	"	1X
RRIC 102	"	1X, 1X
Blend 50—50 of RRIC 100, 101	UFB	1A

Table 1 shows that latex crepe of high quality, with regard to colour, can be produced, without using a bleaching agent from latices of these clones, by removing a fraction. This is important as the only rubber bleaching agent, RPA 3 is going out of production and may not be available in Sri Lanka very soon.

Storage

Crepe rubber manufactured without a bleaching agent and without fractionation was kept under observation under laboratory conditions for about two months and its appearance at the beginning and end of this period is shown in Table 2.

TABLE 2. Visual appearance on storage of crepe rubber from few selected clones

<i>Clone</i>	<i>Initial Appearance</i>	<i>Appearance after 2 months</i>
PB 86	White	White
RRIC 100	White	Light yellow
RRIC 101	Light yellow	Yellow
RRIC 102	Light yellow	Dark yellow
RRIC 103	White	White
RRIC 112	White	Light yellow

From Table 2, it is clear that the appearance of crepe produced from RRIC 103 latex is comparable to that from PB 86 initially as well as after storage. The crepes produced from RRIC 100 and 112, though comparable to PB 86 in appearance initially, show slight discolouration after storage. RRIC 101 and 102, have not only a slightly inferior colour initially, but substantial discolouration takes place on storage.

Technical properties

Technical Specification: There has been a substantial increase in block rubber production in Sri Lanka during the year 1978, about 2000 MT being produced in 1977 and 6000 MT in 1978. This substantial increase was possible by blocking of crepe rubber in lace form by a process developed by Tharmalingam and Dekumpitiya (1974) and, Tharmalingam (1978). These rubbers are sold as SLR grades subject to technical specifications, hence the technical and technological properties will be of prime importance when crepe is prepared for the blocking process. Some of the properties of crepe rubber which characterise the clonal behaviour, viz. the initial plasticity (P_o), the Plasticity Retention Index (PRI), Nitrogen Content (N), and the Mooney Viscosity (V_r), are given in Table 3.

TABLE 3. Physical properties of crepe rubber

<i>Clone</i>	<i>P_o</i>	<i>PRI</i>	<i>V_r</i>	<i>N</i>
PB 86	60	85	85	.34
RRIC 100	40	63	77	.40
RRIC 101	48	73	81	.38
RRIC 102	48	85	80	.40
RRIC 103	42	70	73	.36
RRIC 112	43	63	81	.36

As shown in Table 3 Po and PRI values for these clones, though lower than that of PB 86, are well within the limits laid down for SLR specifications for latex grades. Therefore rubber from these clones will satisfy the specification if processed into blocked crepe rubber. The raw Mooney values (V_r) for all RRIC 100 series clones are lower than that of PB 86 indicating that these newer clones have soft rubbers.

Mill Break Down: Mill break down studies were made on a laboratory two roll mill. This property reflects the processing characteristics of raw rubber. Wallace plasticity was measured after a different number of passes and the results are given in Table 4 for a maximum of 25 passes. Table 4 gives the change in Wallace plasticity, after specified numbers of passes through the mill.

TABLE 4. Change of Wallace plasticity (ΔP) with milling

Clone \ No. of Passes	After 5	10	15	20	25
PB 86	9.5	18	25	31	37
RRIC 100	9.5	15	20	24	27
RRIC 101	7.5	16.5	20.5	25.5	32
RRIC 102	13	21.5	27	32	37
RRIC 103	6	12.5	19	23.5	27
RRIC 112	9.5	16	21	24	27

From Table 4, it is clear that mill break down is faster for RRIC 102 initially, all the others have similar break down characteristics though the initial plasticities are rather different from one another. In general the mill break down characteristics of latices of the RRIC 100 series clones could be described as similar to that of PB 86.

Technological properties

The cure characteristics, vulcanisate properties and aging characteristics of vulcanisates of crepe rubber from RRIC 100 series clones are compared with those of PB 86 in this section.

Cure Characteristics: Vulcanisation characteristics were studied using the Monsanto Rheometer. The results are presented in Table 5. The formulation I, given under Methods and Materials was used.

TABLE 5. Vulcanisation characteristics for crepe rubber using formulation I

Clone	Cure time (min)	Scorch time (ts_2) (min)	Cure rate index
PB 86	26	8.00	5.6
RRIC 100	23	8.50	6.9
RRIC 101	26	7.50	5.6
RRIC 102	26	8.50	5.9
RRIC 103	26	8.25	5.8
RRIC 112	25	7.75	5.8

As shown in Table 5 the vulcanisation characteristics of crepe rubber from the RRIC 100 series clones are similar to that of PB 86.

Vulcanisate Properties: The properties of vulcanisates of crepe rubber from RRIC 100 series clones and of PB 86 are shown in Table 6. Formulation I is used again.

TABLE 6. Properties of vulcanisates from crepe rubber using formulation I

<i>Clone</i>	<i>Cross link density</i>	<i>Mod at 100% kg/cm²</i>	<i>Mod at 300% kg/cm²</i>	<i>Tensile Strength</i>	<i>Elongation at break</i>	<i>Resilience</i>
PB 86	0.093	5.92	13.25	198.33	750	72
RRIC 100	0.073	5.11	12.58	171.78	750	68
RRIC 101	0.073	3.18	12.51	162.67	725	70
RRIC 102	0.075	5.26	13.10	174.48	750	67
RRIC 103	0.078	6.39	15.99	190.87	700	70
RRIC 112	0.077	5.08	13.99	197.19	725	68

It is seen that there is no marked variation of vulcanisate properties between the clones studied.

Aging Characteristics: The aging characteristics of vulcanisates was estimated using the Stress Relaxometer. Formulation II was used for this estimation. An antioxidant was not used in this formulation in order to study the antioxidant activity of non-rubber substances in latices from different clones. Fig. 1 gives the aging characteristic estimated by the Stress Relaxometer, and gives a plot of $\log f/f_0$ against time F .

Fig. 1 shows that vulcanisates of RRIC 100 and RRIC 102 are more resistant to oxidation on aging than of PB 86, while RRIC 112, RRIC 103, RRIC 101 are less resistant. This resistance to oxidation has no direct correlation with raw rubber properties such as PRI, but nitrogen content to some extent gives a direct correlation with the antioxidant activity of vulcanisates.

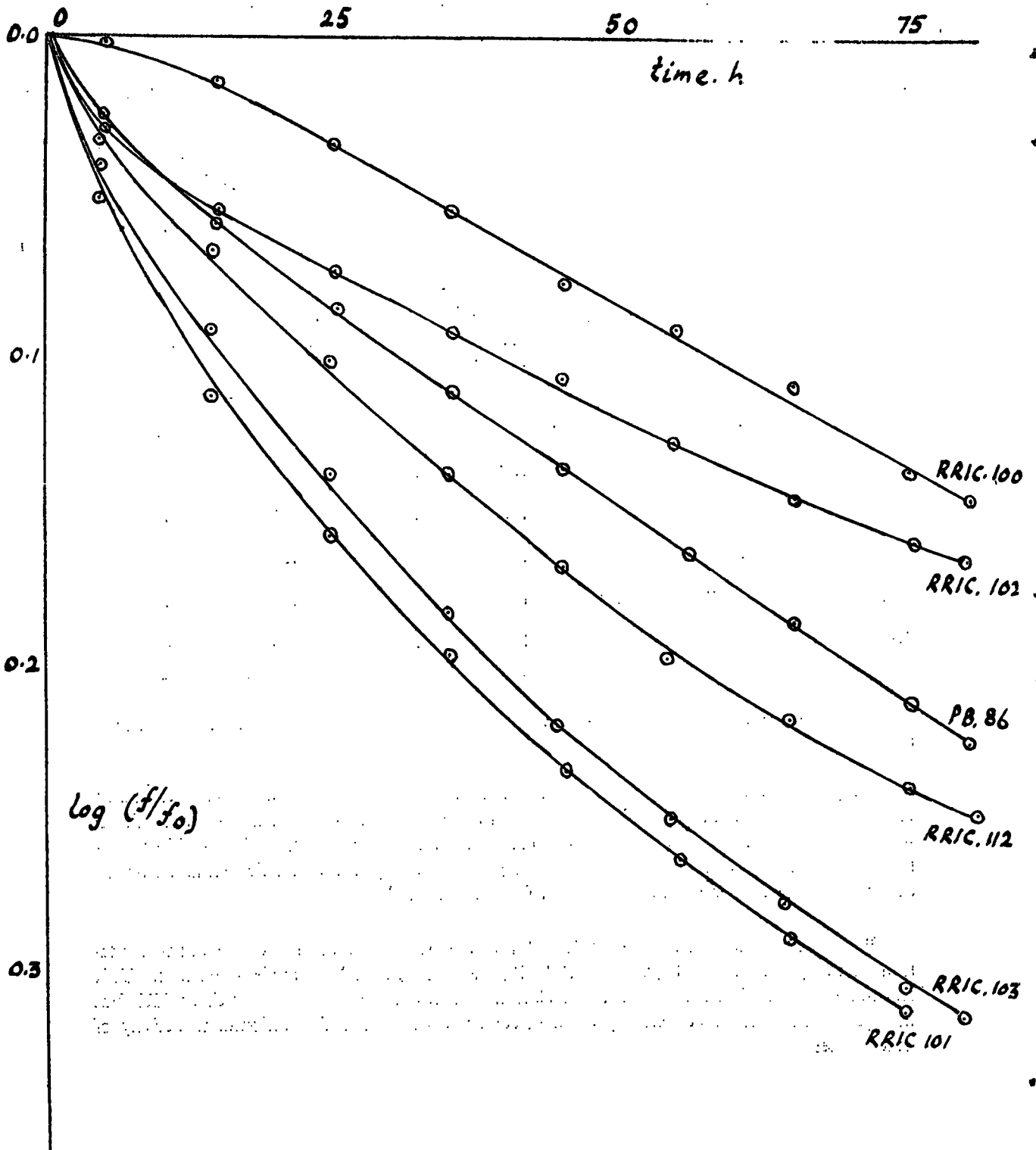


Fig. 1. Stress Relaxometer Curve.

DISCUSSION

The results obtained in evaluating the properties of the different latices are summarised in Table 7.

TABLE 7. Summary of properties

Properties	PB 86	RRIC 100	RRIC 101	RRIC 102	RRIC 103	RRIC 112
Latex Stability	G	G	P	G	G	P
Initial Appearance	G	G	S	S	G	G
Retention of colour on storage	G	S	P	VP	G	S
Technical Properties	S	S	S	S	S	S
Vulcanisation Characteristics	S	S	S	S	S	S
Vulcanisate Properties	S	S	S	S	S	S
Aging Characteristics	S	G	P	G	P	S

G = Good

P = Poor

S = Satisfactory

VP = Very Poor

RRIC 101 and 112, are generally unsuitable for crepe manufacture in view of the tendency to precoatulate.

From Table 7, it is evident that the latices of RRIC 101 and 102 have a serious drawback for crepe manufacture, due to discolouration on storage. This is an important criterion as far as the recommendation for crepe manufacture is concerned (Nadarajah *et al* 1971). Though technically these two clones are not at all inferior to PB 86, because of this lack of retention of colour, these two clones are not recommended for crepe manufacture. RRIC 100 and 103 could be described as similar to PB 86. RRIC 101 and 103 are poor in aging characteristics as estimated by the Stress Relaxometer. As this is only an estimation of the antioxidant activity of the non-rubber substances on vulcanisates this will not detract from suitability, as resistance to oxidation of the raw rubber (PRI), and vulcanisate properties with added antioxidants, are very satisfactory.

CONCLUSIONS

This study has shown that fractionation is by far the most important operation to obtain high quality crepe.

It is also clear that the overall properties of the latices of RRIC 100 and RRIC 103 are comparable to PB 86 and these two clones could be recommended for large scale planting for crepe manufacture.

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