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EVALUATION OF PERFORMANCE OF FLAT BARK CREPE, SCRAP CREPE AND RSS IN TYRE RETREAD COMPOUNDS

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INTRODUCTION

It is well known that the invention of the radial tyre increased the usage of NR in tyre components because of its high green strength, tack and cohesive strength which are proved to be of prime importance in maintaining green tyre uniformity during building and shaping operations. However, with the advent of precured retreading techniques, the usage of NR in truck tyre retreading industry has declined in USA and Europe. Many commercial precured treads for heavy duty truck tyres are based primarily on SBR or SBR/BR blends.

In Sri Lanka retreading industry is totally dependent on NR. There is nothing wrong in this, provided that the retreaders use the proper grade of NR in making their tread compounds. Most of our retreaders use the cheapest grade of raw rubber for their tread compounds without giving any consideration to the performance of the final retreads. This attitude seriously affects the growth of retreading industry. As such the prime objective of this project has been to collect data to illustrate the importance of the use of proper grades of raw rubber in the production of tyre retreads.

Work plan

The project consists of three phases.

a. Laboratory Evaluation
b. Factory Evaluation
c. Fleet Trial

a. *Laboratory Evaluation*

For lab scale trials 3 types of raw rubber grades, namely, FB crepe, scrap crepe and RSS 3 were used. Their raw rubber characteristics are given in Table 1.

Table 1. *Raw rubber characteristics of three types of rubber used.*

	FB crepe	Scrap crepe	RSS 3
Dirt, %	0.82	0.15	0.09
Ash, %	0.80	0.43	0.31
Volatile Matter, %	0.99	0.84	1.28
Nitrogen, %	0.52	0.42	0.41
PO	41.00	51.00	45.00
PRI	45.00	29.00	62.00

As it is clear from the above table, FB crepe contain very high percentages of ash and dirt. The retreads made out of this grade would show very poor resistance to chipping and chunking particularly if they are used in off-the-road (OTR) vehicles. Wear properties of such retreads will be poor. Furthermore, high nitrogen content would increase the heat build up characteristics of the retread and therefore may cause premature failure during service.

The compounding of tread materials were done at the Associated Motorways Ltd. according to a standard formula used by them to produce their retreads. The rheological and technological properties of the three tread compounds were as given in Table 2.

As expected, the rheological as well as technological properties of the tread compounds made using FB crepe were poor. Low scorch time of this compound is mainly a consequence of the presence of high percentage of non rubbers. These compounds do not possess adequate processing safety and therefore tend to overcure during curing. Furthermore they would consume more energy in subsequent operations such as extrusion and building. The rolling resistance of retreads made out of this type of tread compounds would be high as their resilience properties are poor. This will result high fuel consumption during service. Poor abrasion properties of the tread compounds forecast a shorter retread life. Poor retention of tensile strength after ageing also contributes to a shorter retread life.

Table 2. *Rheological and technological characteristics of the tread compounds used.*

	FB crepe	Scrap crepe	RSS 3
Scorch time, ts, min	2.60	3.00	3.5
Cure time, t90, min	8.00	8.50	10.0
Mooney viscosity ML(1+4) 100 C	62.50	67.00	69.00
Hardness, IRHD	55.00	60.00	62.00
Resilience, Lupke	42.00	44.00	52.00
Compression set %	28.90	53.90	29.50
Abrasion resistance volume loss (mm)	130.00	113.00	109.00
Tensile strength, MPa	14.57	13.04	15.32
Elongation at break, %	350.00	305.00	325.00
Modulus, 300%	12.25	13.02	13.36
After ageing at 100 C for 72 hours			
Tensile strength, MPa	5.72	4.63	8.54
Elongation at break %	175.00	150.00	100.00

b. *Factory Evaluation*

It became apparent from the lab scale trials that the performance of scrap crepe compounds is always more or less in between those of FB crepe and RSS compounds.Therefore for the factory scale trials only the flat bark crepe and RSS compounds were used.

The two retreads made using FB crepe and RSS compounds separately, were fixed to a vehicle of Associated Motorways Ltd. The FB crepe retread was fixed in rear-off position and the other one was fixed in rear-in position. The following parameters were noted before starting the evaluation.

Tyre size	- 750 * 16
Initial tread depth	- 13 mm
Initial meter reading of the vehicle	- 136284
Date of fixing of the retreads	- 12/11/1991

After fixing the retreads, vehicle was released to the pool of vehicles and used in normal daily transport activities of the company. Tread depth of two retreads and the meter reading of the vehicle were recorded in monthly intervals and the results were as follows :

Table 3. *Results of the factory evaluation*

Date	Meter reading of the vehicle	Mileage done by the vehicle, km	Tread depth, mm		% Tread loss	
			FB	RSS	FB	RSS
12/11/91	136284	-	13	13	-	-
12/12/91	138233	1949	9	11	30.7	15.3
08/01/92	140036	3752	5	9	61.5	30.7
14/01/92	41326	5042	2	8	84.6	38.4

The FB crepe retread was burst on 14th January, 1992. It was then removed from the vehicle and the trial was discontinued.

The tread depth figures given in Table 3 clearly indicate the unsuitability of FB crepe as a raw material for retread manufacture. At about 2000 km mileage 30% of the tread of FB crepe retread was worn out. The equivalent figure for the RSS retread was only 15% at the same mileage. In other words, by about 2000 km mileage, wear rate of the FB crepe retread was double that of RSS retread. As the mileage increases, the wear resistance of FB crepe retread became even poorer. For instance at about 5000 km mileage 85% of the retread of FB crepe retread was worn out whilst the equivalent of RSS retread was less than 40%. *ie* wear rate of RSS retread was less than 50% of that of FB crepe retread.

c. *Fleet trial*

The results of laboratory evaluation as well as those of factory evaluation clearly demonstrated the unsuitability of FB crepe as a raw material for retread manufacture. In order to obtain more comprehensive data a fleet trial was designed, again in collaboration with Associated Motorways Ltd. In this trial 36 retreads will be evaluated, 25% of these retreads after fixing to Rubber Research Institute's vehicles and the remainder will be evaluated at Associated Motorways Ltd.

CONCLUSION

The initial wear resistance of FB crepe retread was about half of that of RSS retread. As the mileage of the vehicle was increased the wear performance of FB crepe retread became even poorer. After about two months running, *ie* at about 5000 km mileage, nearly 85% of the tread of the FB crepe retread was worn out and the tyre burst. At the same mileage only 30% of the tread of the RSS retread was worn out.

These results clearly suggest that in order to produce retreads of better performance, the manufacturers should give considerable thought in selecting the raw material. It has been found that most of our retreaders use scrap rubber grades to make their tread compounds. Most of these scrap rubber grades have been found to be adulterated with various other poorer grades such as skim rubber and FB crepe. Use of such grades will further damage the reputation of the retread industry. If someone wishes to continue as a retread manufacturer over along period he should use RSS 3 as the starting raw material for tread compounds.

Abbreviations :

RSS	Ribbed Smoked Sheets
FB	Flat Bark
NR	Natural Rubber
SBR	Styrene Butadiene Rubber
BR	Butyl Rubber
PO	Initial Plasticity Number
PRI	Plasticity Retention Index

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