Proceedings of the International Conference on Rubber and Rubber like materials, 1986, Jamshedpur, India, pp. 511-515.

STUDIES ON THE RECLAMATION OF WASTE RUBBER FROM LATEX BASED RUBBER INDUSTRIES

K.T. Thomas, N.M. Claramma, Baby Kuriakose, E.V. Thomas
Rubber Research Institute of India, Kottayam-686009

INTRODUCTION

In India, the total consumption of rubber by latex based rubber industries comes to about 20,000 M. Tonnes. The waste rubber formed in latex based rubber industries is around 10 to 15% of the rubber consumed. The formation of a higher percentage of waste rubber in latex factories (WLR) is due to the unstable nature of latex compound and the strict specifications on the quality of latex products such as condoms and surgical gloves. These waste materials contain about 90 to 95% rubber hydrocarbon. So far no attempt has been reported to recover rubber from these polymer enriched WLR. Considerable work has been done on the reclamation of scrap rubber from dry rubber products by chemical[1,2], thermochemical[3,4] and cryomechanical[5,6,7] processes.

In the present study, it is proposed to develop a process for reclaiming WLR. The effect of incorporation of reclaimed WLR on the properties of tread compound is also studied.

EXPERIMENTAL

Waste condom supplied by M/s Hindustan Latex Ltd. was used as the starting material for the study. The reclaiming agent used was activated pentachlorothiophenol (Renacit-7) procured from M/s Bayer India Ltd.

Standardisation of the reclaiming process

The waste rubber was powdered by passing through a hot two roll mill (80-90°C) to a size of about 40

mesh. The powdered material was admixed with 10 parts by weight of naphthenic oil and different dosages of reclaiming agent in a cold mill. The resulting compound was heated in an air oven at different temperatures (80-140°C) for different periods of time. The extent of degradation was assessed by measuring the Wallace plasticity (Po) of the treated material. The results are given in Table-1.

Characterisation of reclaimed WLR

Characteristics like volatile matter, ash content, acetone extract and rubber hydrocarbon of the reclaimed WLR were determined as per IS 6306-1971. Results are given in Table-2. For comparison, the values for the above parameters for Whole Tyre Reclaim (WTR) were determined and are given in the same table.

The processing and technological properties of compound containing reclaimed WLR were evaluated in comparison with compound containing equivalent loadings of WTR. For this 3 tread compounds were prepared as per formula given in Table-3. The properties of these compounds were evaluated as per relevant IS/ASTM test methods. The test results are given in Table-4. Based on the laboratory evaluation, 3 tread compounds as described earlier were prepared again and these were used for retreading car tyres for assessing the service performance.

RESULTS AND DISCUSSION

The effect of dosage of activated pentachlorothiophenol, temperature and time of heating on the extent of degradation as indicated by plasticity, are shown in Table-1. Results show that the extent of degradation increases with increase in the dosage of reclaiming agent, temperature and time of heating. The reclaimed material is found to form a smooth band on the mill when the Po value is in the range of 25 to 30. So in this study, the conditions which resulted in reclaimed rubbers having plasticity in the range 25 to 30, were selected as the optimum conditions for reclaiming. From the results in Table-1, it is seen that the following conditions are suitable for reclaiming WLR.

(i) Reclaiming agent 1% and heating at 140°C for 30 minutes
(ii) Reclaiming agent 0.25% and heating at 140°C for 60 minutes

In the present studies, the first set of conditions

was selected for further trials.

The composition of reclaimed WLR as shown in Table-2 reveals that it contains 82% rubber hydrocarbon whereas the WTR contains only 48% rubber hydrocarbon. It is observed from physical properties of vulcanizates (Table-4) that addition of reclaimed rubber causes a decrease in tensile strength, elongation, resilience, tear strength, flex resistance and abrasion resistance. Compression set is not much affected by the addition of reclaimed WLR. An increase in heat build up and hardness is also observed. But the compound containing reclaimed WLR shows better processing characteristics and physical properties when compared with that containing WTR. The same trend is also observed from the service performance of the retreads (Table-5). The tread prepared with the incorporation of reclaimed WLR gave higher mileage than the one prepared with equivalent amount of WTR.

REFERENCES:

1. A. Ratcliffe, Chem. Eng., 79(7), 62 (1972).
2. A.A. Harshaft, Environ. Sci. Technol., 6(5), 412 (1972).
3. T.C.P. Lee and W. Millens (to Gould Inc) U.S. 4,046,834 (1977).
4. A.A. Phadke, A.K. Bhattacharya, S.K. Chakraborty and S.K. De, Rubber Chem. Technol., 56, 726 (1983)
5. N.R. Braton and J.A. Koutsky, Chem. Eng. News., 52(6), 21 (1974).
6. M.C. Kazarnowicz, E.C. Osmundson, J.F. Boyle and R.W. Savage, Rubber Chem. Technol., 51, 386 (1978)
7. L.E. Peterson, J.T. Moriarty and W.C. Bryant, Rubber Chem. Technol., 51, 386 (1978).

Table 1. Effect of dosage of reclaiming agent, temperature and time of heating on plasticity

Sl. No.	Dosage of reclaiming agent (%)	Temperature (^{o}C)	Heating time 30 minutes Po	Heating time 60 minutes Po
(1)	(2)	(3)	(4)	(5)
1	0	80	98	98
2	0.25	80	61	57
3	0.5	80	60	55
4	1.0	80	61	50

(Table 1 contd...)

(1)	(2)	(3)	(4)	(5)
5	0	100	96	94
6	0.25	100	57	58
7	0.5	100	58	54
8	1.0	100	49	53
9	0	120	96	90
10	0.25	120	66	60
11	0.5	120	60	58
12	1.0	120	53	57
13	0	130	95	95
14	0.25	130	57	63
15	0.50	130	58	55
16	1.0	130	49	45
17	0	140	80	64
18	0.25	140	44	26
19	0.50	140	41	19
20	1.0	140	24	12

Table 2. Characterisation of reclaim.

Parameters	Reclaimed WLR	Whole tyre reclaim (WTR)
Volatile matter (%)	0.01	0.60
Acetone extract (%)	15.54	12.97
Ash content (%)	2.40	7.93
Carbon black (%)	-	30.49
Rubber hydrocarbon (%)	82.05	48.01

Table 3. Compounding recipe.

Ingredients	Parts by weight		
	I	II	III
Natural rubber (RSS.1)	100	80	80
Reclaimed WLR	-	24.4	-
Whole tyre reclaim (WTR)	-	-	41.6
Zinc oxide	5	5	5
Stearic acid	2	2	2
Phenyl β-naphthylamine	1	1	1
N-(1,3 dimethyl butyl)-N' phenyl p-phenylene diamine	1	1	1
HAF black (N 330)	50	50	50
Aromatic oil	5	5	5
N-Cyclohexyl-2-benzothiazyl sulphenamide	0.6	0.6	0.6
Sulphur	2.5	2.5	2.5

Table 4. Properties of tread compounds.

Properties	I	II	III
1. Modulus at 300% elongation (kg/cm^2)	93	97	95
2. Tensile strength (kg/cm^2)	273	233	198
3. Elongation at break (%)	660	604	540
4. After ageing at 70°C for 96 hours			
a) Retention of modulus at 300% elongation (%)	129	123	127
b) Retention of tensile strength (%)	95	93	95
c) Retention of elongation at break (%)	85	81	81
5. Tear strength(kg/cm)	106	86	79
6. Abrasion resistance (loss in volume, cc/hr)	0.64	0.69	0.78
7. Hardness (Shore A)	61	65	69
8. Heat build up at 50°C (ΔT, °C)	23	25	32
9. Compression set (%)	34	34	40
10. Rebound resilience (%)	51	45	43
11. Flexing (Kilocycles)			
Crack initiation	71	42	31
Crack failure	229	179	94
Cure time at 150°C (Minutes)	10	9	9.5
Scorch time at 120°C (Minutes)	25	17	14

Table 5. Service performance of retreads.

Compound No.	Original non-skid depth (1/32")	Distance covered (km)	Present non-skid depth (1/32")	Projected mileage (km)
I	12	3674	8.25	11,756
II	12	3674	7.75	10,373
III	12	3674	7.50	9,797