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Lac and Modified Lacs as Compounding Ingredients for Natural Rubber : Part III— Rosin Lac Ester and Hard and Soft Resins of Lac in Gum-stock

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The effect of incorporation of rosin lac ester and hard and soft resins of lac into natural rubber has been studied. It has been observed that while the incorporation of rosin lac ester provides better mechanical properties, soft resin is a better plasticizer and antiscorching agent than hard resin or rosin lac ester.

IN earlier communications[1,2], the effect of incorporation of various types of shellac and modified lacs, such as ethylene glycol modified lac, magnesium salt of lac and epoxy resin modified lac into natural rubber was studied. It was observed that various types of shellac and modified lacs lower the Mooney viscosity and increase the scorch time, indicating their possible use as processing aids and antiscorching agents. The results of a study of the effects of incorporation of rosin lac ester and hard and soft resins of lac into natural rubber gum-stock using mercaptobenzthiazole (MBT) and cyclohexyl benzthiazyl sulphenamide (CBS) as accelerators are reported in this paper.

Experimental procedure

Rosin lac ester[3] was prepared by heating together 50 g rosin and 25 g lac (6.66 : 1 molecular proportion) at 260±5°C for 35 min. A typical sample thus obtained had melting point 87–89°C, acid value 92.9 and hydroxyl value 86.3. Hard and soft resins were fractionated from lac using ethyl acetate[4]. Lac (1 kg) was mixed with 2.5 litres ethyl acetate and charged into a ball mill which was run for 4 hr. Soft resin of lac dissolved in ethyl acetate, while the hard one remained as residue. The residue was again treated in a ball mill with 1.5 litres ethyl acetate for 4 hr. Ethyl acetate was removed from the solution thus obtained by distillation under reduced pressure; the last traces were separated by evaporation on a water-bath. The hard resin thus obtained had acid value 61.8 as against 94.4 for the soft one. All other chemicals used were of commercial grade. The methods employed for mixing vulcanization and physical testing were the same as reported earlier[1].

Results and discussion

The compositions of the various mixes prepared and their characteristics are given in Table 1.

Time of cure—The optimum time for cure is enhanced by the addition of rosin lac ester. Hard resin enhances the optimum time of cure to a lesser extent than the soft one, possibly due to its lower acidity.

Mooney viscosity and scorch time—The Mooney viscosity decreases as the concentration of rosin lac ester or hard and soft resins is increased. The fall in Mooney viscosity is more with the soft resin than with the hard resin, indicating that the plasticization effect is more pronounced with the former. Scorch time shows an increase in all the cases, but it is much more pronounced with the soft resins, possibly due to their higher acidity.

Modulus and ultimate elongation—Modulus decreases with increase in the concentration of all types of lacs, the decrease being more with the soft resin than with the hard one. The ultimate elongation generally shows a slight decrease. However, a slight increase is noticed with the soft resin using CBS and with rosin lac ester using MBT as the accelerator.

Tensile strength and tear resistance—Tensile strength generally decreases with the increase in the concentration of rosin lac ester or hard and soft resins, the decrease being maximum in the case of soft resin and least with the rosin lac ester, hard resin coming in between. Tear resistance shows a similar behaviour as tensile strength. However, the incorporation of 2.5 parts of hard resin/100 parts of rubber using CBS as the accelerator brings about an increase in its value.

Hardness and resilience—Hardness remains almost constant when rosin lac ester or hard resin is used, but a decrease is noticed when soft resin is incorporated. Impact resilience shows a decrease with all the lacs.

It is concluded that the mechanical properties of the samples prepared by incorporating rosin lac ester into natural rubber are better in comparison to those obtained by incorporating hard and soft resins. Soft resin is a better plasticizer and antiscorching agent than hard resin and rosin lac ester.

Table 1 — Compositions of the various mixes prepared and their characteristics

[base mix composition : natural rubber*, 100; zinc oxide, 4; sulphur, 2.5; PBN, 1; stearic acid, 1; and accelerator, 0.5 parts]

Modified lac added part/100 parts rubber	Optimum cure time at 140°C min	Mooney No. (ML 1+4 at 120°C)	Scorch time min–sec	Modulus at 200% elongation kg/cm²	Ultimate elongation %	Tensile strength kg/cm²	Tear resistance kg/cm	Durometer hardness	Impact resilience %
(i) Rosin lac ester; accelerator MBT									
0	15	25	10–30	9.1	820	178.1	33.0	35	81.9
2.5	30	23	15–30	8.8	900	157.7	32.4	32	78.5
5.0	40	21	19–20	8.2	870	151.8	29.9	32	75.1
10.0	40	19	24–25	8.7	860	151.0	29.1	34	76.1
(ii) Rosin lac ester; accelerator CBS									
0	15	33.5	24–40	6.4	900	181.5	34.7	35	84.1
2.5	30	31.5	26–30	5.8	920	178.9	33.4	31	77.8
5.0	30	30.0	29–29	5.7	900	168.9	31.9	31	76.1
10.0	60	28.0	39–21	4.9	870	125.6	24.3	32	68.8
(iii) Hard resin of lac; accelerator MBT									
0	20	35.5	17–18	6.2	830	157.9	32.8	30	74.1
2.5	30	30.5	30–15	3.4	850	70.7	24.2	29	65.2
5.0	30	26.0	39–15	3.4	820	70.5	24.6	29	65.2
10.0	40	24.5	39–30	4.5	800	70.9	25.5	30	63.5
(iv) Soft resin of lac; accelerator MBT									
2.5	30	25.5	37–30	4.1	950	129.8	24.5	29	63.5
5.0	50	21.0	49–07	3.9	820	55.6	21.8	29	66.2
10.0	50	14.0	52–30	3.5	790	46.2	21.5	29	56.6
(v) Hard resin of lac; accelerator CBS									
0	20	19.0	10–32	6.1	1000	211.5	34.2	34	81.9
2.5	20	18.0	14–32	5.4	910	169.6	35.2	34	79.8
5.0	30	16.5	15–30	5.6	940	177.4	33.7	34	77.8
10.0	40	16.5	16–13	5.7	930	135.6	31.1	35	74.1
(vi) Soft resin of lac; accelerator CBS									
2.5	30	13.0	12–27	5.8	910	143.3	29.0	35	74.1
5.0	40	11.5	21–43	3.5	940	64.6	19.3	30	72.3
10.0	40	10.0	31–30	3.2	950	60.0	18.0	30	70.2

*Natural rubber used for compositions (i)-(iv) was RM 1 and for (v)-(vi), SMR-H-5

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References

1. KHANNA, B. B., *Res. & Ind., New Delhi*, (in press.)
2. SINGH, R. & KHANNA, B. B., *Res. & Ind., New Delhi*, **18** (1973), 15.
3. BHATTACHARYA, R. & GIDWANI, B. S., *Shellac esters* (London Shellac Research Bureau, London) Tech. paper No. 15, 1938.
4. PALIT, S. R., *A simple method of preparing pure resin from shellac* (Indian Lac Research Institute, Namkum, Ranchi), Technical Note No. 7, 1942.