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Lac and Modified Lacs as Compounding Ingredients for Natural Rubber: Part II— Epoxy Resin Modified Lac and Mg Salt of Lac in Gum Stock

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The incorporation of epoxy resin modified lac and Mg salt of lac brings about lowering in Mooney viscosity of natural rubber, indicating their possible use as processing aids. Epoxy resin modified lac also acts as an anti-scorching agent.

IN an earlier study[1], the effect of incorporating different types of shellac and ethylene glycol modified lac into natural rubber was investigated. In the present study, some other modified lacs, such as epoxy resin modified lac and Mg salt of lac have been tried as compounding ingredients for natural rubber using mercapto-benzthiazole (MBT) and cyclohexyl benzthiazyl sulphenamide (CBS) as accelerators.

Experimental procedure

The compositions of the various mixes prepared are given in Table 1. Epoxy resin modified lac[2] was prepared by fusing shellac and epoxy resin (epicot 10001) taken in the ratio 7:3 at 150 ± 1°C for 15 min, cooling and powdering to 30 mesh. A typical sample had acid value 40·2, softening point 80-82°C and melting point 90-92°C. Mg salt of lac[3] was prepared by dissolving 50 g shellac in 50 ml methylated spirit, adding 2·5 g magnesium oxide and refluxing for 5 hr. The product was diluted with a mixture (100 ml) of methylated spirit and toluene (1 : 1) filtered through glass wool, precipitated with water, dried and powdered to 30 mesh. A typical sample had acid value 37·0, softening point 112-15°C and melting point 123-25°C. All other chemicals were of commercial grade. The methods employed for mixing, vulcanization and physical testing were the same as reported earlier[1].

Results and discussion

Period for cure— The optimum period for vulcanization is enhanced by the addition of both epoxy resin modified lac and Mg salt of lac, more so by the former, which may be due to its higher acidity.

Table 1 — Effect of incorporating epoxy resin modified lac and Mg salt of lac on the properties of natural rubber

(*Base mix composition*: *natural rubber*, 100; *zinc oxide*, 4; *sulphur*, 2·5; *stearic acid*, 1; *PBN*, 1; *and accelerator*, 0·5 *parts*)

Modified lac added parts/100 parts rubber	Optimum cure time (at 140°C) min	Modulus at 200% elongation kg/cm²	Ultimate elongation %	Tensile strength kg/cm²	Tear resistance kg/cm	Durometer hardness	Impact resilience %
			Epoxy resin modified lac; accelerator, MBT				
0	20	9·6	870	178·6	31·8	32	83·7
2·5	50	7·3	900	129·9	30·5	30	74·1
5·0	50	7·3	870	120·4	31·9	31	74·1
7·5	50	6·1	830	85·1	27·1	30	68·7
10·0	50	5·8	800	58·9	20·0	28	61·7
			Mg salt of lac; accelerator, MBT				
2·5	30	8·7	850	149·3	29·9	32	78·5
5·0	30	7·2	890	129·1	33·6	30	75·1
7·5	40	7·4	885	125·0	33·5	31	74·1
10·0	50	7·5	880	120·5	33·6	31	71·6
			Epoxy resin modified lac; accelerator, CBS				
0	20	9·5	900	182·0	36·0	34	85·7
2·5	30	8·1	900	164·1	37·0	34	77·9
5·0	40	8·7	850	150·6	32·5	32	76·1
7·5	40	8·8	850	150·6	30·0	33	76·1
10·0	50	7·6	850	129·8	30·9	31	72·4
			Mg salt of lac; accelerator, CBS				
2·5	20	8·8	850	150·3	32·6	35	78·8
5·0	30	8·3	860	141·6	30·0	35	78·5
7·5	30	8·0	880	137·2	30·1	35	76·1
10·0	30	7·5	930	133·7	30·0	34	72·3

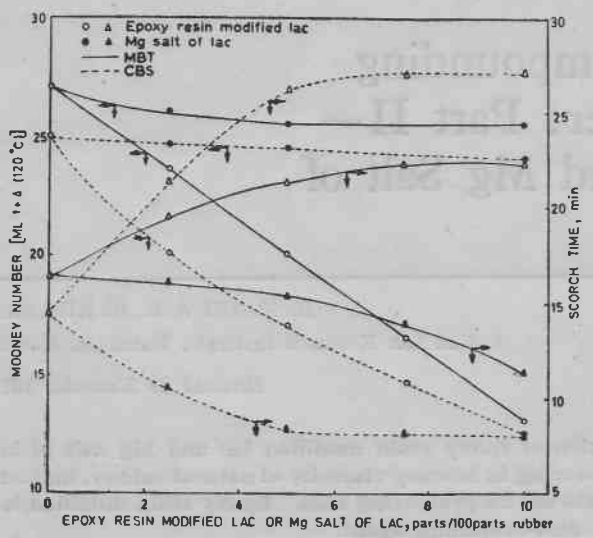

Fig. 1 — Effect of incorporating epoxy resin modified lac or Mg salt of lac in natural rubber on the Mooney viscosity and scorch time of the resulting compositions

Mooney viscosity and scorch time — The data presented in Fig. 1 show that the Mooney viscosity falls continuously with increase in the concentration of both epoxy resin modified lac and Mg salt of lac, the fall being more with the former. Epoxy resin modified lac acts as an antiscorching agent with both the accelerators, but the effect is reverse with Mg salt of lac.

Modulus and ultimate elongation — Modulus decreases with increase in the concentration of both types of modified lacs with both the accelerators, the decrease being more in the case of epoxy resin modified lac than Mg salt of lac. The ultimate elongation generally shows a decrease with the incorporation of epoxy resin modified lac, while an increase is noticed with Mg salt of lac.

Tensile strength and tear resistance — With both the accelerators (MBT and CBS), the tensile strength decreases with increase in the concentration of the modified lacs, the fall being more in the case of epoxy resin modified lac than Mg salt of lac. The incorporation of 2·5 parts of epoxy resin modified lac/100 parts rubber increases the tear resistance using CBS as accelerator, while an inerease is observed when 5-10 parts of Mg salt of lac/100 parts of rubber are incorporated using MBT as accelerator.

Hardness and impact resilience — The incorporation of Mg salt of lac brings about increase in the hardness using CBS as accelerator. The impact resilience falls on the incorporation of both types of modified lacs.

It may be concluded that the mechanical properties of the samples prepared by the incorporation of Mg salt of lac into natural rubber are superior in comparison to those obtained by the incorporation of epoxy resin modified lac. Epoxy resin modified lac, however, acts as a better plasticizer than Mg salt of lac and also exerts an anti-scorching effect.

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