Reprinted from *Research and Industry*, 1970, Vol. 15, No. 1, pp. 11, 12

Modified Lacs as Compounding Ingredient of Styrene-Butadiene Rubber: Part IV—Ethylene Glycol Modified Lac in Filled Stock

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Manuscript received 19 *May* 1969

Chemical modification of lac through its reaction with ethylene glycol is known to improve its utility as a compounding ingredient for rubber. The results of a study on the use of ethylene glycol modified lac as a compounding ingredient for styrene butadiene rubber in the presence of three common fillers, viz. high abrasion furnace black (HAF), easy processing channel black (EPC) and clay (air blown) are presented. The modified lac has been found to improve the Mooney viscosity, modulus and hardness of the rubber when added in the presence of any of the fillers. With clay as the filler, there is improvement in tensile strength and tear resistance also.

IN an earlier communication[1], it was reported that ethylene glycol modified lac improves most of the mechanical properties of styrene butadiene rubber (1502) gum stock without impairing its rubberiness. This paper relates to the study of compounding of the modified lac with styrene butadiene rubber (SBR) using some common fillers.

Experimental procedure

The compositions of the various mixes used are given in Table 1. The methods employed for mixing, vulcanization and physical testing were the same as reported earlier[2]. The fillers used were: (1) high abrasion furnace black (HAF), (2) easy processing channel black (EPC); and (3) clay (air blown).

Results and discussion

Time of optimum cure, Mooney viscosity and scorch time — It is evident from the results presented in Table 1 that the time of optimum cure is somewhat enhanced by the addition of ethylene glycol modified lac with all the three fillers.

The modified lac has a plasticizing effect which is evident from a regular lowering in the Mooney viscosity of the resultant stocks on its progressive addition. The compositions at the same time become a little scorchy in a manner identical to that observed with the gum stock[1].

Modulus and ultimate elongation — The stocks become stiffer on the incorporation of the modified lac; this is evident from the increase in modulus with all the three fillers. However, when HAF black is the filler, the optimum increase in modulus is reached at a level of 5 parts/100 parts rubber, after which it starts falling.

On adding the modified lac in the presence of HAF or EPC, the ultimate elongation is somewhat reduced, while with clay there is an increase in the ultimate elongation.

Table 1 — Effect of incorporation of ethylene glycol modified lac on the properties of SBR

[*Base mix*: *SBR*(1502), 100; *zinc oxide*, 4; *sulphur*, 2; *stearic acid*, 1; *PBN*, 1 *part*]

Ethylene glycol modified lac added parts/ 100 parts rubber	Optimum cure time 140°C) min	Mooney No. (ML 1 +4 at 120°C)	Scorch time min-sec	Modulus at 200% kg/cm²	Ultimate elongation %	Tensile strength kg/cm²	Tear resistance kg/cm	Durometer hardness	Abrasion loss ml/1000 rev	Impact resilience %
FILLER (HAF BLACK), 40; MINERAL OIL, 5; SANTOCURE, 1 PART										
0	45	47	37-0	53·2	300	160·1	70·7	63	0·77	58·5
2·5	60	46·5	36-1	57·5	290	150·3	68·6	66	0·79	56·8
5·0	60	46	34-12	60·3	250	148·6	62·3	67	0·83	56·2
7·5	60	45·5	32-30	52·0	275	143·1	61·0	67·5	0·87	52·0
10·0	60	45	31-33	41·7	310	140·2	60·1	68	0·92	45·8
FILLER (EPC BLACK), 70; MINERAL OIL, 2; MBT 2 PARTS										
0	45	44·8	64-34	26·2	350	68·1	48·1	58	2·3	59·1
2·5	60	42·5	59-2	31·6	335	64·7	44·1	65	2·8	57·8
5·0	60	40·8	52-39	30·9	320	66·3	41·0	70	3·0	55·1
7·5	60	39·1	47-1	31·0	330	65·8	40·8	72	3·1	53·3
10·0	60	37·0	42-2	30·0	330	65·2	40·1	74	3·3	52·0
FILLER (CLAY), 100; MINERAL OIL, 3; MBT, 1·5 PARTS										
0	50	49	63-0	17·5	800	60·1	20·5	64	2·9	43·7
2·5	60	48	61-20	17·8	870	65·5	21·1	65	3·0	41·5
5·0	60	46·5	59-10	18·4	850	68·0	22·4	66	3·2	40·0
7·5	60	44·8	57·25	19·0	810	60·3	24·5	68	3·6	40·0
10·0	60	43	54-33	19·4	750	52·4	26·7	69	4·2	40·0

Tensile strength and tear resistance — When clay is the filler, the incorporation of the modified lac up to a level of 5 parts/100 parts rubber has a beneficial effect on the tensile strength. With the same filler, the tear resistance improves steadily on the addition of the modified lac.

Hardness, abrasion resistance and impact resilience — Hardness is consistently enhanced when the modified lac is added along with any of the three fillers; the increase is most marked with EPC.

The addition of the modified lac in the presence of any of the fillers has an adverse effect on the abrasion resistance and resilience of the stock. The influence of the modified lac is similar to that of shellac[2].

Acknowledgement

The author wishes to express his thanks to Dr G. S. Misra, Director and Dr T. Bhowmik, Senior Scientific Officer (Utilization) for their interest and to the authorities of the Indian Institute of Technology, Kharagpur for providing testing facilities.

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