

NOTE ON THE INCORPORATION OF A RUBBER SOFTENER WITH LATEX AND ITS EFFECT ON THE PLASTICITY OF THE RUBBER

BY

G. MARTIN, W. S. DAVEY, H. C. BAKER AND E. RHODES

There is a demand for soft, plastic rubber which offers the advantages of being easily mixed with large quantities of compounding ingredients and easily moulded to the shape required. An extremely soft rubber not only reduces the consumer's cost of manipulation but also extends the field of application of rubber. The manufacturer, when working with ordinary grades of rubber, frequently adds softeners to improve processing but these are not altogether satisfactory. A new proprietary softener named "Plastogen" for which many advantages are claimed has recently been placed on the market. It was considered likely that, if a small quantity of this softener could be incorporated with latex before coagulation, the resultant rubber would be much more easily manipulated than usual and would therefore be more acceptable to the manufacturer on this account.

Many of the proprietary softeners available are unsuitable for incorporation with latex, since they are resinous, insoluble in water and extremely difficult to emulsify; it is essential that the softener be capable of ready and homogeneous dispersion with latex so as to produce a uniform rubber on coagulation. Plastogen is a mobile liquid which, while not freely miscible with water, can, it was found, be dispersed to form an aqueous emulsion which is readily miscible with latex from which a smooth and uniform coagulum can be obtained. This softener was therefore chosen for experiment and a number of air-dried sheet samples obtained from latex-Plastogen mixtures were subjected to plasticity tests in comparison with air-dried sheet from the same crop of latex to which no Plastogen had been added.

EXPERIMENTAL

A 20 per cent emulsion of Plastogen in water was prepared at the Rubber Research Institute by passing the mixture thirty times through a Premier Paste Mill with a clearance of 3/1000 inch. The emulsion was added to a latex containing 1½

lbs dry rubber per gallon in proportions chosen so as to give approximately 1, 2, 3 and 5 per cent by weight of Plastogen calculated on the weight of dry rubber present. Coagulation was then carried out, using 3 fluid ounces of 5 per cent. acetic acid per gallon of latex. In all cases coagulation was good and the resulting serum was clear. The coagula were machined into sheet, allowed to drain for two hours and dried in hot air at 120°F for 46 hours. The dry sheets showed no signs of softness or stickiness when despatched from Malaya to the laboratories of the London Advisory Committee for plasticity tests. The results of these tests are given in Table I.

TABLE I

Group	Plastogen emulsion added (ccs. per gal. of 1½ lb. latex)	Weight of Plastogen calculated on rubber (per cent.)	D30 mm.	Mastication No.
A	Nil	Nil	1.44	93
B	40	0.97	1.44	89
C	80	1.94	1.34	91
D	120	2.91	1.40	79
E	200	4.85	1.35	75

In a further experiment samples of rubber were prepared in a similar manner but containing approximately 20 per cent of Plastogen, calculated on the dry rubber. The results of hardness and mastication tests are given in Table II.

TABLE II

Sample No.	Plastogen on dry rubber Per cent.	D30 (mm.)	Mastication No.
B 91/1	Nil (control)	1.52	105
B 91/2	About 20	1.01	53

The rubber containing 20 per cent. Plastogen was much softer than the samples containing smaller amounts, but it was not sufficiently soft to render mastication unnecessary, as in the case of "softened rubber" marketed by a firm in Great Britain. The rubber containing 20 per cent Plastogen was also submitted along with its control to a "Recovery" test, which is a measure of elasticity. This property is of considerable practical importance in

manufacturing operations such as calendering, extruding, etc. After squeezing or pressing to shape through rolls or dies, rubber always recovers its shape to a certain extent so that material shaped to accurate dimensions is difficult to obtain and there is frequently formed a considerable amount of scrap which is usually worked up with new material and then re-shaped. A soft rubber should have little elasticity in order to increase its advantage to manufacturers. The results obtained after passing the Plastogen sample through masticating rolls 50 times and the control sample 100 times are given in Table III. By this treatment the samples were masticated so as to reach a degree of plasticity suitable for manufacturing practice.

TABLE III

Sample No.	No. of grindings	Plasticity K	Compression at 100°C (per cent.)	Recovery		
				Per cent of compression		
				1 min.	5 min.	24 hours.
B 91/1	100	0.29	54	25.5	53.1	62.4
B 91/2	50	0.29	54	38.6	62.0	78.3

These results shew that, although the Plastogen and control samples have been masticated to give the same plasticity figures, it would be necessary to masticate the Plastogen sample still further to reduce its elasticity to that of the masticated control.

Discussion

The tests for hardness and plasticity indicate that, in so far as concerns manipulative properties, rubber prepared from latex treated to give up to 5 per cent of Plastogen in the dry rubber possesses little advantage over a rubber from untreated latex. The advantage becomes somewhat more marked in rubber from latex treated to give 20 per cent. of Plastogen, but it is not comparable with that obtained by an oxidative softening of rubber. There is no evidence that Plastogen decreases the elasticity of the rubber except in so far as it increases plasticity and ease of manipulation. The softening effect produced by Plastogen in amounts up to 5 per cent would be sufficient to obviate the production of occasional samples of hard rubber which cause some difficulty to certain manufacturers but, even when incorporated in amounts up to 20 per cent, it falls short of the true objective, which is a rubber sufficiently soft to require little or no mastication.

tion, while possessing at the same time other processing advantages.

The results described confirm those obtained in the laboratories of the London Advisory Committee in experiments with preserved latex and Plastogen, and it now seems clear that substances which give efficient softening when added to the dry rubber at the time of mastication do not necessarily produce the same degree of softening when incorporated into latex and brought down with the rubber itself during coagulation. The reason for this is obscure and no explanation can at present be attempted.

Summary

The addition of the proprietary softener Plastogen to latex before coagulation has little or no commercial prospects in that it does not yield a rubber which is sufficiently soft to warrant its acceptance as a soft rubber for which a premium might be obtained.

Kuala Lumpur,
3rd. March, 1934