RUBBER FROM AUTOCLAVED LATEX

BY

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There is a demand in the rubber manufacturing industry for rubber which is very plastic and easily manipulated. A softened rubber prepared from crepe and sheet is now being sold at a premium, but its preparation requires special plant and is protected by patent.

A number of alternative methods of preparing very soft rubber have been investigated by this Institute. One is a method suggested by Mr. D. Graham of Teluk Anson, Perak, and consists of the coagulation of latex by heating in an autoclave. Mr. Graham supplied three samples of crepe rubber prepared by this process.

The latex in the autoclave was raised to a temperature of 145°C over a period of 30 minutes, kept at that temperature for 60 minutes, and then slowly cooled. The heat treatment caused the latex to coagulate without the addition of a coagulant and the coagulum so obtained was machined into thin crepe in the usual way. The same procedure was employed in the preparation of all the samples, but they were prepared at different times, and the last two were obviously soft and were therefore submitted for examination in the laboratories of the London Advisory Committee with a view to determining their suitability for manufacturing purposes, particularly as regards ease of manipulation.

Two further samples were prepared by this Institute and for this purpose three gallons of fresh latex in an open pail were placed in an autoclave and the pressure was slowly raised to give a temperature of 149°C; this occupied 25 minutes. The full pressure was maintained for 60 minutes more and the autoclave was then allowed to cool overnight. The next morning the contents were examined; coagulation had taken place at the exposed surface and down the sides after the manner of the crust on a loaf of bread. This crust was removed, machined into crepe, and forms sample B 80/1. There remained a very thick curd-like mass which was returned to the autoclave and treated exactly as before; coagulation took place but the serum still contained a good deal of rubber. This second coagulum was machined into crepe and forms sample B 80/2. These samples were also forwarded to the London Advisory Committee for examination.

The samples were small and it was not possible to make a thorough examination in London, but sufficient quantitative data were obtained to indicate the main characteristics of the rubber.

PLASTICITY

The results of plasticity tests are given in Table I:

TABLE I

Sample	Prepared by	D_{30} (mm.)	Mastication No.	Relative Viscosity of 1 per cent solution of unmasticated Rubber (Benzene = 1)
A	Graham	1.16	74	...
B	"	1.09	68	...
C	"	1.00	61	...
B 80/1	R. R. I.	1.29	74	32
B 80/2	"	1.30	70	27

The D_{30} tests shew that the samples prepared by Mr. Graham are extremely soft. The average hardness of Ceylon crepe is 1.7 mm. and the range is from 1.35 to 2.00 mm. The samples are therefore much softer than any estate samples. They are not as soft however as the "softened" rubber now on the market.

Considering the softness of Mr. Graham's samples they are surprisingly difficult to masticate. It is necessary to pass them between the mixing rolls about 68 times to reach the arbitrary standard of plasticity adopted for testing purposes. Estate crepe and sheet from Ceylon require from 69 to 130 passes between the rolls to reach this degree of plasticity. Mr. Graham's samples are therefore only slightly more easily masticated than some samples of estate crepe and sheet and they compare very unfavourably with the softened rubber now on the market which requires no mastication. It is possible that steam has changed the accessory substances in the rubber so that the rubber is more resistant to the softening action of oxygen during mastication.

The two samples prepared by the Institute are somewhat harder than those prepared by Mr. Graham and, although one of them received two periods of heating, it does not appear to be softer than the other.

The viscosities of the solutions of the samples prepared by the Rubber Research Institute are about half those of standard crepe. The reduction in viscosity is not sufficiently marked to be of interest to manufacturers.

Vulcanisation

The results of vulcanisation tests in a rubber-sulphur mixing (100 : 10) at 148°C are given in Table II.

TABLE II

Vulcanisation (min.)	A		B		C	
	Tensile Strength (lb./sq. in)	$E_{1\cdot00}$* (per cent)	Tensile Strength (lb./sq.in)	$E_{1\cdot00}$* (per cent)	Tensile Strength (lb./sq. in)	$E_{1\cdot00}$* (per cent)
60	—	—	1450	960	—	—
70	1400	933	1850	885	—	—
80	1900	870	1950	793	—	—
100	2140	799	1200	710	1810	913
120	1830	724	—	—	1920	824
140	1120	660	—	—	420	—

*$E_{1\cdot00}$ = Elongation at load of 1.00 Kg./sq.mm.

These results shew that the samples display considerable variation in rate of vulcanisation. It is calculated that sample B vulcanises in 79 min., sample A in 100 min. and sample C in 125 min. The average for Ceylon blanket crepe is 138 min. and the range is from 95 to 159 min. All the samples therefore vulcanise more quickly than average Ceylon crepe. The strength of the samples is almost as good as estate crepe and sheet which usually has a maximum tensile strength between 2000 and 2400 lb./sq.in. "Softened" rubber prepared by oxidation gives poor strength results (about 1500 lb./sq.in.) when tested in this mixing, although the strengths are satisfactory in other mixings.

Chemical Examination

It has been found in previous experiments that, when creped coagulum is immersed in hot water, there is a marked reduction in the "acid value" of the dry rubber. These samples were therefore submitted to chemical examination to determine the effect of autoclaving the latex in the absence of a coagulant. The results shown in Table III were obtained.

TABLE III

Sample	Acetone Extract (per cent.)	Acid value (mgm. KOH per 100 grm. rubber)
A	2.98	91.2
B	2.94	69.5
C	3.28	86.6

The amounts of the acetone extracts are normal, but the acid value of the extracts are only one quarter to one third of the usual value for crepe and sheet.

The effect is similar to that of hot water on wet coagulum. It is strange that after the rubber has been dried, hot water no longer has this effect. In view of the low acid value of these samples it would be necessary to add additional stearic acid to many technical mixings when using rubber prepared according to this process. The need for additional stearic acid is not an important disadvantage but difficulties might occur if manufacturers were unaware of the low acid value of this type of rubber.

Summary

Crepe rubber from autoclaved latex is definitely softer, more easily masticated and gives solutions of lower viscosity than estate crepe or sheet but does not offer the manufacturers the manipulative advantages of softened rubber now on the market.

When vulcanised in a rubber-sulphur mixing it is much stronger than would be expected for soft rubber. It would be necessary to use an increased proportion of stearic acid in many technical mixings when using this rubber.

The samples supplied display considerable variation in rate of vulcanisation in a rubber-sulphur mixing, but it is necessary to obtain extensive experience with a large range of samples before conclusions can be drawn as to the extent of variability.

Conclusions

Although the samples prepared by Mr. Graham and by the Institute are soft, their manipulative advantages are not sufficiently marked to ensure a premium.

This method of preparation involves a certain amount of expense and is not free from difficulty, so that a premium is

essential if this method is to be adopted on estates. The samples have not been tested exhaustively but it is unlikely that more detailed tests would yield results which would render it necessary to modify this opinion.

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