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(54) TREATMENT OF LATEX

(71) We, THE RUBBER RESEARCH INSTITUTE OF MALAYA, a Body Corporate of Malaysia, of 260 Jalan Ampang (P.O. Box 150), Kuala Lumpur, Malaya, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

Latex within the *Hevea* tree is sterile. However, after tapping, it becomes heavily contaminated by bacteria and yeasts which produce a variety of acids, particularly volatile fatty acids (V.F.A.), destabilising the latex in a few hours. To prevent this, small quantities of anticoagulants are added at concentrations depending on the period for which it has to be kept fluid. Ammonia added at 0.1 to 0.2% by weight keeps the latex fluid for about 12—24 hours, but this does not prevent the build-up of VFA. All percentages of ammonia used herein are by weight on the total weight of the latex.

If field latex is meant for producing concentrate, the VFA build-up has to be arrested early, to limit the VFA level of the concentrate to 0.2%, to conform with the strict technical specifications (British Standard Specification 4355, 1968). This is normally achieved by the addition of 0.3%—0.5% ammonia which, at these levels, acts as a bacteriostat/bactericide. But bacteria often become resistant, with the consequence that the level of ammonia has to be progressively raised, sometimes even up to 0.7%. An unduly high level of ammonia is undesirable, because of increasing cost and also on account of the practical difficulties involved in processing highly alkaline skim. Before the rubber can be coagulated, the excess ammonia will have to be dealt with, either by neutralisation with a strong acid or by mechanical deammoniation.

There are considerable advantages in storing field latex prior to centrifugation. Bulking over a much longer period than is currently possible would simplify considerably transport from field to the concentration plant, and will greatly reduce day to day variations in technological properties of the resulting concentrate.

The present invention therefore provides a method of treating latex to suppress bacterial acid production, which method comprises maintaining ammoniated whole field latex of *Hevea brasiliensis* at a temperature of from 40 to 60° C. for a period of at least 24 hours.

By the term "whole field latex" we mean a field latex which has not been purified e.g. by removal of protein prior to or during treatment according to the invention.

The ammonia is preferably present at a concentration of at least 0.2%, and preferably about 0.3%. The use of higher concentrations e.g. above 0.5% of ammonia is possible, but give rise to difficulties as mentioned above.

The latex is preferably maintained at the minimum temperature at which control of VFA is achieved, which we have found to be about 45° C. The use of temperatures above 60° C. adversely affects the latex properties and is expensive on fuel.

During the storage a steady decline in the number of bacteria takes place, particularly that of the acid-producing ones. Latex kept in this manner for 5 days is completely free of acid-producing organisms, accounting for the absence of deterioration on further storage.

The selective killing of acid-producing organisms is not brought about by the bactericidal effect of ammonia alone; field latex treated with even as much as 0.7% ammonia did not completely kill the acid-producing organisms when kept at ambient temperature (Table 1). Likewise, higher temperature alone is not sufficient to kill selectively these organisms; latex kept at 60° C. for 5 days still had large numbers of strong acid producers (Table 2). On the other hand, the storage at 45° C. of latex ammoniated to 0.3% had a marked effect on the acid-producing organisms resulting in the complete inhibition of VFA build-up (Table 3).

The optimum temperature to bring about this has been found to be 45° C; at lower temperatures VFA started building up by the second day of storage. The optimum concentration of ammonia required to bring about this effect is 0.3%. No difficulty was experienced in centrifuging the heated latex and no deleterious effect was observed on the pro-

properties of the resulting concentrate; if anything, it showed some improvements (Table 4).

In the following Examples Nos. 1, 2 and 8 are for comparison and Nos. 3 to 7 and 9 illustrate the invention.

EXAMPLE 1.

To find out the effect of ammonia on the bacterial population of field latex, aliquots treated with various levels of ammonia were stored at 30° C for up to 5 days and tested at various intervals for bacterial population and VFA. The mean results of two experiments are given in Table 1.

TABLE 1

Effect of ammonia on the bacterial population and VFA of field latex

Ammonia weight % on total latex	Period of storage (day)	Total bacterial count (log/ml)	VFA No.
0.1	1	7.08	0.27
	2	7.23	0.57
	5	7.72	0.94
0.3	1	6.80	0.25
	2	6.80	0.53
	5	7.71	0.82
0.5	1	6.10	0.06
	2	5.58	0.35
	5	6.10	0.65
0.7	1	4.80	0.04
	2	4.53	0.04
	5	5.59	0.21
Control	Prior to ammoniation	6.04	0.03

15 Bacterial proliferation continued at all levels of ammonia, increasing VFA; at higher levels of ammonia however, there was a delay in the bacterial proliferation, the VFA therefore formed rather slowly. The test indicates that
20 it is impossible to sterilise field latex within a reasonable time by treating it with ammonia alone.

EXAMPLE 2.

To show the effect of storage temperature on the bacterial population of unammoniated field latex, aliquots were kept at 10, 30 and 60° C and tested at various intervals up to 5 days. The mean results of two experiments are given in Table 2.

TABLE 2

Effect of storage temperature on the bacterial population of unammoniated field latex

Temperature (°C)	Period of storage (day)	Total viable population (log/ml)	Acid producing population (log/ml)	Acid producing population as a % of the total population
10	1	7.66	7.59	85
	3	8.28	8.20	84
	5	8.86	8.78	82
30	1	8.32	8.04	52
	3	8.26	8.20	89
	5	7.65	7.58	84
60	1	4.78	4.48	50
	3	5.26	5.08	67
	5	4.64	4.64	100
Control	Prior to heat treatment	6.90	6.23	21

Latex kept at 10° C remained liquid for 5 days, but there was a marked rise in the viable bacterial population, particularly of the strong acid producing (SAP) bacteria which increased from 21% to 85% of the total, in a day. At 30° C the latex remained liquid only for a few hours; nevertheless, bacteria proliferated in the serum with SAP bacteria dominating the flora on keeping. Latex kept at 60° C also coagulated immediately with SAP bacteria completely dominating in 5 days. It is thus evident that by merely storing latex at a

temperature higher than ambient the adventitious bacterial population cannot be completely killed.

EXAMPLE 3.

To observe the combined effect of ammonia and storage temperature aliquots of 0.3% ammoniated latex were stored at 10, 20, 30, 45 and 60° C for one, three and five days and tested for bacterial population and VFA (Table 3).

TABLE 3

Effect of storage temperature and ammonia on bacterial population and V.F.A. of field latex

Temperature of storage °C	Period of storage (day)	Bacterial count (log/per ml)	V.F.A. No.
10	1	6.80	0.05
	3	6.05	0.06
	5	4.72	0.06
20	1	6.60	0.06
	3	5.23	0.06
	5	4.81	0.19
30	1	4.88	0.06
	3	6.12	0.25
	5	6.38	0.41
45	1	2.91	0.06
	3	2.55	0.06
	5	2.55	0.05
60	1	2.62	0.05
	3	2.37	0.05
	5	2.06	0.06
Control Prior to heat treatment	0	7.25	0.05

A marked increase in VFA was observed only in samples stored at 20° and 30° C. Bacterial population steadily dropped with time in all samples except that stored at 30° C. Samples stored at higher temperatures gave a greater drop. There was an increase at 30° C after an initial delay.

Colonies isolated from samples kept at 10, 30 and 60° C were tested for their acid producing ability at the end of the 5-day storage. The samples kept at 10 and 30° C contained a large number of SAP bacteria while that kept at 60° C though not sterile, was free from SAP bacteria. It is, therefore, presumed that the absence of VFA build-up in the sample kept at 10° C was not due to the absence of SAP bacteria but due to their inability to decompose the indigenous substrates to acids and other end products at that low temperature. However, the absence of VFA build-up in the sample kept at 60° C was due

to the selective killing of all the SAP bacteria. It is thus apparent that the VFA build-up in field latex can be controlled by ammoniating it and storing it at above ambient temperature.

EXAMPLE 4.

Further work was directed towards finding out the optimum conditions under which this control is achieved. The tests were repeated, but storing samples at 30, 35, 40, 45 and 60° C. The bacterial populations increased at all temperatures up to 40° C accompanied by increased VFA, but at 45 and 60° C there was a marked drop in both, confirming that 45° C is the optimum temperature to achieve VFA control. Another series of tests with various levels of ammonia, but stored at 45° C, confirmed that 0.3% is the optimum concentration.

EXAMPLE 5.

To find out whether a higher storage temperature affects centrifugation, trials were carried out in which samples of 0.3% ammoniated latex were stored at 30, 45 and 60° for 48 hours and centrifuged. No difficulty was experienced in centrifuging samples kept at 30 and 45° C, both behaving similarly, but the sample stored at 60° C became slightly more viscous, affecting the efficiency of centrifugation.

EXAMPLE 6.

To observe whether a high storage temperature affects the properties of the resulting latex concentrate, experiments were carried

out in which field latex ammoniated to 0.3% was divided into 2 portions; one was kept at 30° C (simulating the temperature in a concentrate plant) and the other at 45° C for 40 h. Both portions were then separately centrifuged, and the resulting concentrates further ammoniated to 0.7%, stored at 30° C and tested at various intervals (Table 4). No deleterious effect was observed on the properties of the concentrate prepared from latex stored at 45° C; if anything, it showed some improvements particularly in the VFA No. and KOH No. over the conventionally prepared concentrate.

TABLE 4
Properties of latex concentrate

Latex	Age of latex	Kept at 30°C				Kept at 45°C			
		Bacterial count (log/ml)	VFA No.	MST (S)	KOH No.	Bacterial count (log/ml)	VFA No.	MST (S)	KOH No.
0.3% AFL	0 hour	7.30	0.05	—	—	7.30	0.05	—	—
	40 hour	4.73	0.13	—	—	2.62	0.05	—	—
0.7% ACL*	0 hour	3.36	0.07	90	0.50	NIL	0.02	90	0.46
	2 weeks	NIL	0.07	415	0.53	NIL	0.02	400	0.52
	1 month	NIL	0.07	665	0.63	NIL	0.02	770	0.55
	3 months	NIL	0.07	860	0.64	NIL	0.02	870	0.60
	6 months	NIL	0.09	—	0.67	NIL	0.03	—	—

AFL = Ammoniated field latex

ACL = Ammoniated concentrate latex

*ACL samples obtained from both sources were kept at 30°C throughout the storage.

MST (S) = Mechanical Stability Time in Seconds.

EXAMPLE 7.

To find out whether a clean concentrate can still be obtained from a partially deteriorated field latex, experiments were carried out, in which field latex ammoniated to 0.15% and kept at 30° C. for about 12 h (to simulate partial deterioration) was further ammoniated to 0.3% and divided into two portions. One portion was stored at 30° C. and the other at 45° C, and both were centrifuged after 40 h. The resulting concentrate samples were stored at 30° C for two months and tested at various intervals. The heat-treated portion did not deteriorate further, and the resulting concentrate had a low VFA and a comparatively high MST (Mechanical Stability Time) indicating that a clean concentrate with satisfactory properties can be obtained even from a partially deteriorated field latex. (See Table 5).

EXAMPLE 8.

To find out whether any chemical other than ammonia, has any synergistic lethal effect at higher than ambient temperature, fresh

latex was separately treated with urea, dimethylaminomethyl phenol (DMP—30), formalin, sodium sulphite, potassium hydroxide or sodium hydroxide, stored at 30 and 45° C for 5 days and tested for VFA at various intervals. Urea, sodium sulphite, sodium hydroxide and potassium hydroxide at 45° C did not control the VFA build-up, while no apparent benefit was observed with formalin and DMP—30, suggesting that the synergistic lethal effect of ammonia is its specific characteristic. (See Table 6).

EXAMPLE 9.

To find out whether the synergistic lethal effect of ammonia at higher than ambient temperature is dependant on the clonal characteristics of the latex, 10 clones were extensively studied. Fresh latex was collected from each clone, ammoniated to 0.3%, stored at 30° C and 45° C and tested daily for 5 days. All the 10 clones behaved similarly, indicating that the synergistic effect of ammonia is not dependant on the clonal characteristics. (See Table 7).

TABLE 5
Properties of latex concentrate prepared from partially deteriorated field latex

Age of latex (day)	Kept at 30°C				Kept at 45°C			
	Bacterial count (log/ml)	V.F.A. No.	MST (S)	KOH No.	Bacterial count (log/ml)	V.F.A. No.	MST (S)	KOH No.
0	4.08	0.10	35	0.46	3.70	0.01	55	0.42
1	4.41	0.10	35	0.50	3.23	0.01	55	0.43
2	3.86	0.10	55	0.50	3.15	0.01	80	0.40
4	Nil	0.11	80	0.49	Nil	0.01	160	0.43
7	Nil	0.11	95	0.50	Nil	0.01	245	0.50
14	Nil	0.11	270	0.50	Nil	0.01	480	0.50
56	Nil	0.10	480	0.71	Nil	0.01	990	0.55

TABLE 6

Effect of some preservatives at higher
than ambient temperature

Treatment		Age (day)	VFA No.	
Preservative	Concentration (%)		30°C	45°C
Ammonia (Control)	0.3	1	0.025	0.025
		3	0.04	0.025
		6	0.11	0.03
Urea	3.0	1	0.260	0.14
		3	0.275	0.22
		6	0.275	Coagulated
Formalin	0.3	1	0.04	0.035
		3	0.045	0.045
		5	0.045	0.045
Sodium sulphite	1.0	1	Coagulated	Coagulated
DMP-30	0.3	1	Coagulated	Coagulated
Potassium hydroxide	0.5	1	0.88	0.81
		5	1.86	1.98
Sodium hydroxide	0.5	1	0.28	0.29
		5	0.29	0.29

TABLE 7

Combined effect of ammonia and temperature on the bacterial population and VFA of 10 clonal latices

Clone	Age of latex (day)	Kept at 30°C		Kept at 45°C	
		Bacterial count (log/ml)	VFA No.	Bacterial count (log/ml)	VFA No.
RRIM 600	5	6.78	0.06	2.60	0.03
RRIM 623	5	5.60	0.11	Nil	0.03
Tjir 1	6	4.00	0.25	2.98	0.03
RRIM 605	5	3.20	0.32	3.04	0.03
PB 5/51	5	3.20	0.25	1.85	0.02
RRIM 628	5	8.18	0.35	2.80	0.04
RRIM 501	5	3.48	0.24	2.72	0.04
PB 86	6	4.72	0.40	Nil	0.04
PR 107	6	6.84	0.30	3.23	0.03
GT 1	6	4.30	0.30	2.88	0.02

WHAT WE CLAIM IS:—

1. A method of treating latex to suppress bacterial acid production, which method comprises maintaining ammoniated whole field latex of *Hevea brasiliensis* at a temperature of from 40 to 60° C. for a period of at least 24 hours.
2. A method as claimed in claim 1 wherein the latex is maintained at a temperature of about 45° C.
3. A method as claimed in either of claims 1 or 2 wherein the ammonia content of the latex is in the range 0.2% to 0.5% by weight.
4. A method as claimed in claim 3 wherein the ammonia content is about 0.3%.
5. A method as claimed in any one of claims 1 to 4 wherein the latex is maintained at an elevated temperature for up to 5 days.
6. A method as claimed in any one of claims 1 to 5 and substantially as hereinbefore described in any one of Examples 3, 4, 5, 6, 7 and 9.
7. Ammoniated whole field latex of *Hevea brasiliensis* whenever treated by the method claimed in any one of claims 1 to 6.
8. Natural rubber produced from the latex claimed in claim 7.

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TABLE 7

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3. A method as claimed in either of claims 1 or 2 wherein the ammonia content of the latex is in the range 0.2% to 0.5% by weight.
4. A method as claimed in claim 3 wherein the ammonia content is about 0.3%.
5. A method as claimed in any one of claims 1 to 4 wherein the latex is maintained at an elevated temperature for up to 5 days.

6. A method as claimed in any one of claims 1 to 5 and substantially as hereinbefore described in any one of Examples 3, 4, 5, 6, 7 and 9.

7. Ammoniated whole field latex of *Hevea brasiliensis* whenever treated by the method claimed in any one of claims 1 to 6.

8. Natural rubber produced from the latex claimed in claim 7.

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