FRACTIONS FROM HEVEA BRASILIENSIS LATEX CENTRIFUGED AT 59,000g

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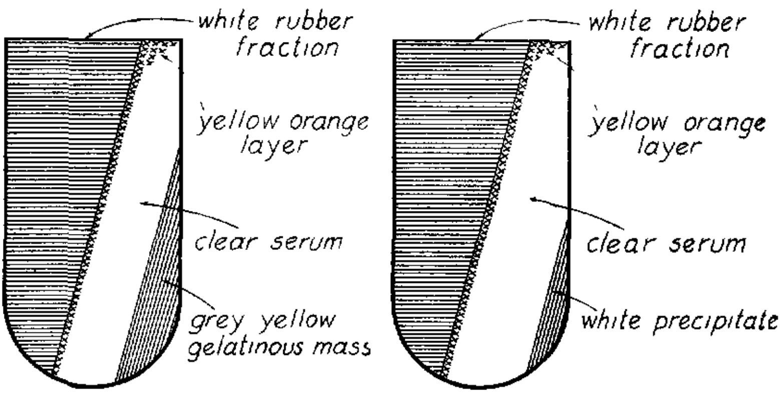
HOMANS and VAN GILS[1] have separated fresh latex, by centrifuging at 2,000 r.p.m. (*ca* 1,000 g) into two fractions, white and yellow, both consisting mainly of rubber particles and serum. They also reported the discovery of another discrete phase in fresh latex, which they called 'lutoids' and which were found mainly in the yellow fraction. HURET[2] has described the separation of ammoniated latex at 400,000 g into a white fraction, a yellow layer and clear serum. We have obtained four distinct fractions on centrifuging fresh latex at 20,000 r.p.m. (59,000 g) and these have not previously been described, although McCOLM[3] has reported on the sludge obtained at 40,000 r.p.m.

Latex was collected from a field of mixed clonal seedlings at the Rubber Research Institute of Malaya Experiment Station and cooled in an ice/water mixture within an hour of tapping the first tree. Part of the latex was weighed into Lustroid (celluloid) tubes fitted with air tight caps and spun at 59,000 g in a refrigerated vacuum centrifuge* at 5°C for three quarters of an hour. Another portion of the latex was ammoniated to 0.5% NH_3 by weight, using a 20% solution. Part of this latex was centrifuged with the fresh latex and part after 24 hours. *Figure 1* is diagrammatic of the separations obtained.



a *Fresh latex* b *Latex containing 0.5% NH_3*

Figure 1

The fractions were separated by puncturing the tube at the top and the bottom of the serum fraction and allowing the serum to run out. The top portion of the serum was

* Spinco Ultracentrifuge Model L

TABLE I: ANALYSES OF FRACTIONS

Determination	*Latex fraction*	*Fresh latex, stored in iced water and centrifuged 1 hour after collection*	*Latex containing 0.5% NH_3, centrifuged 1 hour after collection*	*Latex containing 0.5% NH_3, centrifuged 24 hours after collection*	*Fresh latex, not centrifuged*
Dry rubber content [% wt]	*Whole latex*	—	—	—	44.24
Total solids [% wt]	*Whole latex*	—	—	—	47.65
Nitrogen [% wt]	*Dried rubber*	0.21	0.21	0.25	
	Dried serum	2.29	4.23	5.78	0.57
	Dried bottom fraction	5.23	4.54	3.94	
Magnesium [% wt]	*Dried rubber*	0.01	0.01	0.01	
	Dried serum	0.28	0.01	0.01	0.07
	Dried bottom fraction	1.25	7.82	8.00	
Phosphorus [% wt]	*Dried rubber*	0.04	0.04	0.04	
	Dried serum	0.67	0.54	0.63	0.13
	Dried bottom fraction	2.06	8.00	9.62	
Potassium [% wt]	*Dried rubber*	0.04	0.08	0.05	
	Dried serum	4.72	5.75	5.04	0.42
	Dried bottom fraction	3.13	1.34	1.24	
Copper [% wt]	*Dried rubber*	0.00017	0.00021	0.00036	
	Dried serum	0.00594	0.00341	—	0.00040
	Dried bottom fraction	0.00439	0.00500	—	
Ash [% wt]	*Dried rubber*	0.28	0.35	0.26	
	Dried serum	11.20	9.23	—	1.16
	Dried bottom fraction	17.11	29.47	39.96	
Rubber hydrocarbon [% wt]	*Dried rubber*	96.3	—	96.6	90.6
	Dried bottom fraction	14.9	—	—	
Alcohol extract [% wt]	*Dried rubber*	1.88	—	2.24	6.54
	Dried bottom fraction	42.15	—	—	
Total acid value [mgm KOH/100 gm t.s.]	*Dried rubber*	34	—	62	301
	Dried bottom fraction	3,983	—	—	

TABLE II: APPROXIMATE DISTRIBUTION OF COMPONENTS AMONG THE FRACTIONS

(% wt of whole latex)

Determination	*Fresh latex centrifuged after 1 hour*			*0. 5% NH_3 latex centrifuged after 1 hour*			*0. 5% NH_3 latex centrifuged after 24 hour*		
	Rubber	*Serum*	*Bottom fraction*	*Rubber*	*Serum*	*Bottom fraction*	*Rubber*	*Serum*	*Bottom fraction*
Nitrogen	34	35	31	28	64	8	37	58	5
Magnesium	16	30	54	11	0.5	88.5	12	0.5	87.5
Phosphorus	34	54	12	19	29	52	24	26	50
Potassium	7	74	19	10	87	3	12	85	3
Copper	20	62	18	31	58	11	—	—	—
Ash	14	54	32	20	58	22	—	—	—

mixed with part of the yellow orange layer and some rubber particles. Both the top and bottom fractions were very viscous and did not flow. They were readily obtained by cutting open the Lustroid tube.

The fractions and a sample of the fresh latex were dried in air at 70°C and analysed. Results are given in TABLE I.

It was difficult to separate part of the serum from the yellow orange layer and hence the exact amounts of each fraction, except the bottom fraction, were not obtained accurately. Nevertheless, an approximate distribution of the various constituents among the fractions is given in TABLE II.

From the fresh latex, the top white fraction was a very thick cream of rubber particles, comprising roughly 60% of the whole latex and containing 70-80% solids. Most of this fraction could be redispersed in water.

The yellow orange layer was obtained mixed with serum and rubber particles. Under the microscope considerable numbers of spherical yellow particles were seen, either singly or in small clusters. These were very similar to the description given by FREY-WYSSLING[4] of the yellow globules which he observed in ammoniated latex.

The serum was clear and slightly brown in colour, comprising about 25% of the whole latex and containing 7% solids. It was somewhat viscous, frothed readily and appeared to contain most of the proteins, phosphorus, potassium, copper, ash and part of the magnesium present in the whole latex.

The greyish yellow bottom fraction comprised 12-15% of the whole latex and contained 12% solids. It was very compact and on standing in air it slowly darkened to a dark brown finally becoming black. It did not coagulate but remained as a thick paste, which did not appear to dissolve in water. In ammonia solution it slowly dissolved to give a brown solution and a white precipitate, which was crystalline.

Microscopical investigations of the bottom fraction, before and after mixing with water, ammonia and sodium citrate solutions, showed it to consist of a tightly packed mass of gel-like 'islands' similar to the lutoid 'islands' found in fresh latex and described by HOMANS and VAN GILS[1]. These islands had a particulate structure and when ammonia solution was added many particles in Brownian movement could be observed. The particles could be rubber or lutoid globules such as are found in very fresh latex or in latex which has been collected into sodium citrate solution. After dissolving in ammonia for a few days, many particles which appeared to be rubber were seen and also a few yellow Frey-Wyssling particles. This fraction contained most of the magnesium and taking the nitrogen as being protein it consisted of about 40% alcohol extractables, about 30% protein, 17% ash and 15% rubber. The presence of rubber could be attributed to rubber particles being trapped in the lutoid agglomerates.

Ammonia in the latex appeared to dissolve or disperse the lutoid fraction, giving in its place a white precipitate. The effects of the ammonia took place rapidly as will be seen by comparing the analyses of fractions from the ammoniated latex (a) centrifuged almost immediately and (b) after 24 hours. The bottom fraction from (a) was slightly larger than that from (b) indicating incomplete dispersion. The top white fraction and the orange yellow layer from the ammoniated latex, were similar to those from the fresh latex.

More serum was obtained from the ammoniated latex; about 40% of the whole latex containing 9% solids. It was cloudy and compared with the serum from the fresh latex it contained more nitrogen and potassium, about the same proportion of copper, less phosphorus and practically no magnesium.

The white precipitate at the bottom of the tube was only about 2% of the whole latex, and contained 32% solids. Compared with the lutoid fraction from fresh latex it contained more magnesium and phosphorus and less nitrogen, potassium and copper. Under the microscope it was seen to consist almost entirely of star shaped crystals. This precipitate is likely to be the same as that which has previously been described in the sludge from ammoniated latex[3] and is probably a magnesium phosphate.

Conclusions from these observations are that four fractions can be separated from fresh latex by centrifuging at 59,000 g: a thick cream of rubber particles; a layer of orange yellow Frey-Wyssling globules below the rubber; clear serum; and a gelatinous greyish yellow lutoid fraction at the bottom of the tube. Ammonia in the latex appeared to dissolve or disperse the lutoid fraction, forming an insoluble magnesium phosphate.

We are indebted to Mr J.E. Morris and his assistants for the analyses.

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May 1953

REFERENCES

[1] HOMANS, L.N.S. and VAN GILS, G.E. *Proc. 2nd Rubb. Tech. Conf.*, June 1948, 292

[2] HURET, M., *Rev. gen. Caoutch.*, 25(1948)124

[3] MCCOLM, E.M., *Industr. Engng Chem. (Industr.)*, 32(1940) 439

[4] FREY-WYSSLING, A. *Arch. Rubbercult. Ned.-Ind.*, 13(1929) 392