

A SURVEY OF LATEX COAGULANTS USED BY MALAYAN SMALL-HOLDERS

BY

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Introduction

Although it is the fact that rubber produced on small-holdings has for many years formed a large part of the total amount of rubber exported from Malaya, it has not until recently become possible to obtain reliable information as to the nature of the coagulants commonly used by small producers. A great part of the rubber from Malayan small-holdings finds its way to the United States of America and, although the fact of a steady demand might perhaps be taken as some indication that the intrinsic properties of such rubber are reasonably satisfactory and that dangerous coagulant substances are therefore not in general use, it was nevertheless considered necessary to take the first opportunity of making a survey of the coagulants commonly employed. Information based on direct analyses of reliable samples drawn from all parts of the country has been lacking and, in its absence, nobody could state with any certainty that the most suitable available coagulants were used either universally or even by the majority of small-holders. A survey of this nature demands for its prosecution an organisation which is able to make a close search through many villages in all districts, because most small-holders, or the tappers employed by them, purchase their supplies of coagulant in small bottles from local shops and there can be no certainty that the coagulants sold in one shop are identical with those sold in others nearby, or in neighbouring villages. The recent establishment of the Small-Holders' Advisory Service with Asiatic Rubber Instructors stationed in a number of districts made such a survey possible and towards the end of 1934 coagulants were collected in the States of Kedah, Perak, Negri Sembilan, Pahang, Selangor, Johore and also in Malacca Territory.

Method of Sampling

The Asiatic Rubber Instructors, who were responsible for the collection of samples, purchased unopened bottles of all available brands of coagulant from shopkeepers in all districts.

Their meetings with the small-holders also often enabled them to discover which brands if any were specially favoured in the district. The samples were forwarded to the Institute for analysis together with notes as to cost and, where possible, relative popularity.

Testing

Before analysis, the volume of each sample was measured so that, where analysis indicated that constituents were present in a diluted form, fairly accurate cost comparisons could be made against the price of the same material at commercial strength.

Each sample was analysed qualitatively and the amounts of major and minor constituents were determined. No attempt was made however to estimate the amounts of harmless impurities of which traces were found in some samples. Careful watch was kept for traces of the metals, copper and manganese, but in no case were they found present in dangerous amounts.

The results of the analyses of samples collected and tested between September 1934 and March 1936 are set out and discussed according to States.

TABLE I

Coagulants used by Small-holders in Kedah

Sample No.	Brand if any	Where bottled	Districts where sold	Volume per bottle cc Price per bottle cents		Constituents		Composition by weight per cent					What user pays to purchase in this form 4 gallons of			Cross Reference
								Major	Minor	Sulphuric acid	Hydro-chloric acid	Acetic acid	Formic acid	Alum	Sulphuric acid 95% \$	
1	Lion	Perak	Kulim	325	15	Sulphuric acid	...	56.4	...	...	...	...	14.12	...	...	Perak No. 5
2	Lark	do	do	350	15	Sulphuric acid	...	51.1	...	...	...	...	14.47	...	...	Perak No. 7
3	Axe	Penang	do	730	23	Sulphuric acid	...	64.3	...	...	...	...	8.45	...	...	Perak No. 2
4	Bow & Arrow	do	Alor Star	640	25	Sulphuric acid	...	66.7	...	...	...	...	10.48	...	...	Perak No. 14
			Bandar Bahru	330	8								6.27			
5	Three Stars	Bagan Samak	Langgar	680	22	Sulphuric acid	...	65.2	...	...	...	...	8.36	...	...	Perak No. 10
6	Triple Fives	do	Bandar Bahru	165	6	Sulphuric acid	...	55.3	...	...	...	...	9.62			
			do	185	6	Sulphuric acid	...	55.3	...	...	...	...	10.12			

TABLE I—(Continued)

Sample No.	Brand if any	Where bottled	Districts where sold	Volume per bottle cc	Price per bottle cents	Constituents		Composition by weight per cent					What user pays to purchase in this form 4 gallons of			Cross Reference
						Major	Minor	Sulphuric acid	Hydro-chloric acid	Acetic acid	Formic acid	Alum	Sulphuric acid 95% \$	Acetic acid 99% \$	Formic acid 90% \$	
7	Flag & Lion	...	Kulim	800	15	Sulphuric acid	...	61.8	...	...	...	...	13.96			
8	Tiger	...	Bandar Bahru	180	6	Sulphuric acid	...	65.7	...	...	...	...	8.75	...	...	Perak No. 4
9	Colonial Coagulant	Penang	Alor Star	680	22	Sulphuric acid	Alum	22.2	...	...	...	11.8	25.14	...	...	Perak No. 19
10	Three Rubber Leaves	do	Bandar Bahru	680	28	Sulphuric acid	Hydro-chloric acid	52.5	1.1	...	...	...	13.53	...	...	Perak No. 20
			Alor Star	680	25			"	"				12.08	...	...	Johore No. 17
11	Acid Geta	do	Bandar Bahru	690	25	Sulphuric acid	Hydro-chloric acid	54.0	0.7	...	...	...	11.58	...	...	Perak No. 22
			Alor Star	640	25			"	"				12.48			

TABLE I—(Continued)

Sample No.	Brand if any	Where bottled	Districts where sold	Volume per bottle		Price per bottle		Constituents		Composition by weight per cent					What user pays to purchase in this form 4 gallons of			Cross Reference
				cc	cents			Major	Minor	Sulphuric acid	Hydro-chloric acid	Acetic acid	Formic acid	Alum	Sulphuric acid 95% \$	Acetic acid 99% \$	Formic acid 90% \$	
12	Acido-tex	Penang	Bandar Bahru	335	12			Sulphuric acid	Hydro-chloric acid	53.1	1.2	...	...	...	11.64	...	...	Perak No. 24
			Alor Star	630	25					"	"				12.89			
13	Arrow & Target	do	Bandar Bahru	330	11			Sulphuric acid	Hydro-chloric acid	50.5	1.8	...	...	...	11.39			
14	Sun Latex	do	Alor Star	650	25			Sulphuric acid	Hydro-chloric acid	53.5	1.5	...	...	...	12.40	...	...	Perak No. 21
15	Triple Twos	...	Bandar Bahru	175	5			Sulphuric acid	Acetic acid	48.6	...	4.2	...	...	10.14			
16	"90" Formic acid	Bagan Samak	do	335	15			Formic acid	Sulphuric acid	23.1	...	...	33.7					
17	Scale	...	Kulim	260	22			Formic acid	...	...	...	...	88.7	...	...	...	15.59	
				305	22			Formic acid	...	...	...	...	82.5	...	...	...	14.29	

TABLE 1—(Continued)

Sample No.	Brand if any	Where bottled	Districts where sold	Volume per bottle cc	Price per bottle cents	Constituents		Composition by weight per cent					What user pays to purchase in this form 4 gallons of			Cross Reference
						Major	Minor	Sulphuric acid	Hydrochloric acid	Acetic acid	Formic acid	Alum	Sulphuric acid 95%	Acetic acid 99%	Formic acid 90%	
18	Anchor & "S"	...	Kulim	630	50	Formic acid	...	...	...	...	79.1	...	...	...	16.40	
19	Um-brella	Penang	Alor Star	580	45	Formic acid	...	...	...	...	80.5	...	...	...	17.24	
20	Lion Globe	do	do	640	35	Formic acid	...	...	...	...	77.0	...	...	...	11.61	
21	...	do	do	610	45	Formic acid	...	...	...	...	91.2	...	...	...	13.22	
22	Horse	do	do	540	45	Formic acid	...	...	...	...	89.6	...	...	...	15.20	
23	Cat	...	Kulim	800	20	Acetic acid	...	...	...	94.7	...	...	...	12.66		
24	Glacial Acetic Flower Plant	...	Baling	300	23	Acetic acid	...	...	...	96.8	...	..	...	14.24		

TABLE I—(Continued)

Sample No.	Brand if any	Where bottled	Districts where sold	Volume per bottle cc Price per bottle cents		Constituents		Composition by weight per cent						What user pays to purchase in this form 4 gallons of			Cross Refer- ence
						Major	Minor	Sulphuric acid	Hydro- chloric acid	Acetic acid	Formic acid	Alum	Sulphuric acid 95% #	Acetic acid 99% #	Formic acid 90% #		
25	British Acetic acid	Penang	Baling	315	22	Acetic acid	...	...	...	97.1	...	...	...	12.93			
26	Um- brella	do	Alor Star	610	35	Acetic acid	...	...	...	97.5	...	...	...	10.58			
Average prices paid by users													11.89	12.60	14.79		
Dealers costs for sulphuric, acetic and formic acids in four gallon lots are taken as													4.80	7.90 to 8.25	9.45 to 9.90		

Coagulants used by Small-Holders**(i) THE STATE OF KEDAH**

In addition to the coagulants detailed in Table I, a few small-holders were found to be employing alum as a coagulant and, in rarer cases, sodium bisulphite. The survey thus indicates that of the twenty-eight different brands of coagulant used in this State, sixteen contained sulphuric acid alone, or were mixtures in which it was either a major or a very appreciable constituent. In eight of these cases sulphuric acid was the only coagulant present; in five cases it appeared in admixture with small amounts of hydrochloric acid and in three other instances it was found in association with alum, acetic acid and formic acid respectively. The concentration of sulphuric acid varied approximately between 22 and 67 per cent from brand to brand. This is indicative of considerable dilution by the bottlers who are no doubt actuated firstly by considerations of profit, secondly by the possible loss of trade which might result from injuries by a 95 per cent commercial acid in the hands of unskilled persons, and thirdly by the desire to offer a product which, although cheaper to produce, will have approximately the same efficiency as formic or acetic of good quality.

Six samples were formic acid of good quality of which the strengths lay between 79 and 90 per cent. This acid is sold commercially in two strengths of 80 per cent and 90 per cent so that a charge of dilution by the bottler cannot here be made with fairness. Four samples were undiluted acetic acid of good quality.

TABLE II

Coagulants used by Small-holders in Perak

Sample No.	Brand if any	Where bottled	Districts where sold	Volume per bottle cc	Price per bottle cents	Constituents		Composition by weight per cent					What user pays to purchase in this form 4 gallons of			Cross Reference
						Major	Minor	Sulphuric acid	Hydro-chloric acid	Acetic acid	Formic acid	Alum	Sulphuric acid	Acetic acid	Formic acid	
													95% £	99% £	90% £	
1	Flying Horse	Kuala Kangsar	Taiping	305	10	Sulphuric acid	...	49.9	...	...	...	...	11.34			Kedah No. 3
			Kuala Kangsar	320	9			"	...	...	...	...	9.73			
2	Axe	Penang	do	355	11	Sulphuric acid	...	64.3	...	...	...	...	8.32	...	...	
				700	25			"	...	...	...	...	9.58			
3	Aero-plane	Kampar Tapah	do	325	10	Sulphuric acid	...	57.3	...	...	...	...	9.23			Kedah No. 8
				325	9			57.3	...	...	...	...	8.22			
				285	7			59.5	...	...	...	...	7.13			
4	Tiger	Kampar	Taiping	325	10	Sulphuric acid	...	57.7	...	...	...	...	9.17	...	...	
			Kuala Kangsar	330	9			57.7	...	...	...	...	8.17			
			Tapah	295	7			66.1	...	...	...	...	6.20			

TABLE II—(Continued)

Sample No.	Brand if any	Where bottle	Districts where sold	Volume per bottle cc	Price per bottle cents	Constituents		Composition by weight per cent					What user pays to purchase in this form 4 gallons of			Cross Reference
						Major	Minor	Sulphuric acid	Hydro-chloric acid	Acetic acid	Formic acid	Alum	Sulphuric acid 95 %	Acetic acid 99 %	Formic acid 90 %	
5	Lion	Taiping	Taiping	325	15	Sulphuric acid	...	56.4	...	...	...	...	14.14	...	...	Kedah No. 1
			Kuala Kangsar	330	9			..					8.34			
6	Malay Rubber Coagulant	Penang	Larut	610	35	Sulphuric acid	...	63.4	...	...	...	...	15.62			
7	Lark	Taiping	do	285	10	Sulphuric acid	...	51.1	...	...	...	...	11.85	...	...	Kedah No. 2
8	Ubat Geta Para	Batu Kurau	do	340	9	Sulphuric acid	...	58.9	...	...	...	...	7.75			
9	Coagulum Axe	...	Selama	700	25	Sulphuric acid	...	67.2	...	...	...	...	9.17			

TABLE II—(Continued)

Sample No.	Brand if any	Where bottled	Districts where sold	Volume per bottle		Price per bottle		Constituents		Composition by weight per cent					What user pays to purchase in this form 4 gallons of			Cross Reference
				cc		cents		Major	Minor	Sulphuric acid	Hydro-chloric acid	Acetic acid	Formic acid	Alum	Sulphuric acid 95% ¢	Acetic acid 99% ¢	Formic acid 90% ¢	
10	Three Stars	Bagan Samak	Selama South Krian	350	10			Sulphuric acid	...	69.0	...	...	...	...	7.15	...	...	Kedah No. 5
				330	12					65.2	...	...	...	...	9.63			
11	Poh Aun	do	do	650	40			Sulphuric acid	...	66.5	...	...	...	...	15.98			
12	Aik Leong Co.	do	do	710	40			Sulphuric acid	...	55.8	...	...	...	...	17.44			Kedah No. 4
				700	35					66.7	...	...	...	...	12.94			
13	Elephant	Kuala Kangsar	Kuala Kangsar	330	9			Sulphuric acid	...	43.1	...	...	...	...	10.93			
14	Bow & Arrow	Penang	Tapah	275	7			Sulphuric acid	...	59.6	...	...	...	...	7.97			
			Kuala Kangsar	745	28					58.9	...	...	...	...	11.04	...	...	Kedah No. 4
15	Globe	...	do	640	19			Sulphuric acid	...	39.4	...	...	...	...	13.02			

TABLE II—(Continued)

Sample No.	Brand if any	Where bottled	Districts where sold	Volume per bottle cc	Price per bottle cents	Constituents		Composition by weight per cent					What user pays to purchase in this form 4 gallons of			Cross Reference
						Major	Minor	Sulphuric acid	Hydro-chloric acid	Acetic acid	Formic acid	Alum	Sulphuric acid	Acetic acid	Formic acid	
													95% \$	99% \$	90% \$	
16	Hen	...	Tapah	320	7	Sulphuric acid	...	52.5	...	...	...	...	7.23			
17	Double Cock	...	do	260	7	Sulphuric acid	...	52.9	...	...	...	...	8.77			
18	Ship	...	Bruas	315	9	Sulphuric acid	...	56.6	...	...	...	11.8	8.71			
19	Colonial Coagulant	Penang	Taiping South Krian	710	38	Sulphuric acid	Alum	22.2	...	...	...	...	41.63	...	...	Kedah No. 9
20	Three Rubber Leaves	do	Taiping	720	40	Sulphuric acid	Hydro-chloric acid	52.5	1.1	...	...	...	48.21	...	...	Kedah No. 10
			Kuala Kangsar	710	38	Sulphuric acid							16.44			
21	Sun Latex	do	Larut South Krian	670	35		Hydro-chloric acid	53.5	1.5	...	...	...	17.19	...	...	Kedah No. 14
					350	10							Sulphuric acid			
				330	10								9.78			

TABLE II—(Continued)

Sample No.	Brand if any	Where bottled	Districts where sold	Volume per bottle cc	Price per bottle cents	Constituents		Composition by weight per cent					What user pays to purchase in this form 4 gallons of			Cross Reference
						Major	Minor	Sulphuric acid	Hydro-chloric acid	Acetic acid	Formic acid	Alum	Sulphuric acid 95% #	Acetic acid 99% #	Formic acid 90% #	
22	Acid Geta	...	South Krian	710	40	Sulphuric acid	Hydro-chloric acid	54.0	0.7	...	...	...	18.01	...	...	Kedah No. 11
23	Coagu-latex	...	do	710	40	Sulphuric acid	Hydro-chloric acid	52.5	1.1	...	...	...	18.52	...	...	
24	Acido-tex	...	do	680	45	Sulphuric acid	Hydro-chloric acid	53.1	1.2	...	...	...	21.52	...	...	Kedah No. 12
25	Shield & Basket	Penang	Kuala Kangsar	710	26	Sulphuric acid	Hydro-chloric acid	54.0	0.7	...	...	...	11.71	...	...	
26	Acetic Acid	...	Selama	710	48	Formic acid	Sulphuric acid	17.9	...	...	61.5	...	...	...	17.98	
	99%	...	South Krian	654	45	acid	acid	"	...	...	"	...	...	...	18.80	
27	90% Formic	...	Selama	320	18	Acetic acid	Sulphuric acid	23.9	...	51.7	...	...	...	19.58	...	
28	Balance	...	Trong	285	25	Formic acid	...	...	...	...	88.6	...	...	...	16.18	

TABLE II—(Continued)

Sample No.	Brand if any	Where bottled	Districts where sold	Volume per bottle cc.	Price per bottle cents	Constituents		Composition by weight per cent					What user pays to purchase in this form 4 gallons of			Cross Reference
						Major	Minor	Sulphuric acid	Hydro-chloric acid	Acetic acid	Formic acid	Alum	Sulphuric acid 95% #	Acetic acid 99% #	Formic acid 90% #	
29	Sham-rock	...	Taiping	635	50	Formic acid	...	...	...	...	90.5	...	...	...	14.31	
30	Acetic Acid	...	Kuala Kangsar	230	25	Formic acid	...	...	...	...	80.0	...	...	...	22.22	
31	Formic Acid	...	do	275	23	Formic acid	...	...	...	...	90.2	...	...	...	15.17	
32	Formic Acid	...	Kati	345	24	Formic acid	...	...	...	...	74.9	...	...	...	15.19	
33	Formic Acid	...	Padang Rengas	255	20	Formic acid	...	...	...	...	88.1	...	...	...	14.56	
34	Formic Acid	...	Kuala Kangsar	230	25	Formic acid	...	...	...	...	89.0	...	...	...	19.97	
35	Chinese Label	...	Selama	250	20	Formic acid	...	...	...	...	90.6	...	...	...	14.54	

TABLE II--(Continued)

Sample No.	Brand if any	Where bottle	Districts where sold	Volume per bottle cc	Price per bottle cent	Constituents		Composition by weight per cent					What user pays to purchase in this form 4 gallons of			Cross Reference
						Major	Minor	Sulphuric acid	Hydro-chloric acid	Acetic acid	Formic acid	Alum	Sulphuric acid 95 %	Acetic acid 99 %	Formic acid 90 %	
36	Hh. Man	...	Selama	295	22	Formic acid	...	...	...	...	70.7	...	...	...	17.26	
37	Md. Rani	...	do	385	20	Formic acid	...	...	...	...	88.3	...	...	...	9.60	
38	Ah Min	...	do	310	20	Formic acid	...	...	...	...	82.4	...	...	...	12.51	
39	...	...	do	205	20	Formic acid	...	...	...	...	57.4	...	...	...	27.80	
40	...	...	do	210	20	Formic acid	...	...	...	...	55.8	...	...	...	27.92	
41	...	...	do	220	20	Formic acid	...	...	...	...	60.4	...	...	...	24.62	
42	...	...	do	225	20	Formic acid	...	...	...	...	59.6	...	...	...	24.40	

TABLE II—(Continued)

Sample No.	Brand if any	Where bottled	Districts where sold	Volume per bottle cc.	Price per bottle cents	Constituents		Composition by weight per cent					What user pays to purchase in this form 4 gallons of			Cross Reference
						Major	Minor	Sulphuric acid	Hydrochloric acid	Acetic acid	Formic acid	Alum	Sulphuric acid 95% #	Acetic acid 99% #	Formic acid 90% #	
43	Cock Brand	...	Enggor	315	26	Formic acid	...	...	...	...	88.7		...	...	15.23	
44	'Japa-nese acid	...	Kuala Kangsar	210	15	Formic acid	...	...	...	...	77.5	...	...	...	15.08	
Average prices paid by users													11.29*		18.04	Note* Exclud-ing No. 19
Dealers costs for sulphuric, acetic and formic acids in four gallon lots are taken for comparison as													4.80	7.90 to 8.25	9.45 to 9.90	

(ii) THE STATE OF PERAK

Table II indicates that the situation in Perak is very similar to that which maintains in Kedah. Of forty-four samples analysed, no fewer than twenty-seven consisted either of sulphuric acid alone or contained it as a very appreciable constituent. Mixtures of sulphuric acid with one or other of the substances alum, hydrochloric acid, acetic and formic acid were again found. The concentration of sulphuric acid from brand to brand varied over the range 22-69 per cent which is similar to that found for preparations used in Kedah. Many of the brands used in Kedah are also found in Perak and emanate from the same group of wholesale bottlers. Of the seventeen samples of formic acid found in this State, eight were in use in the single district of Selama. Six of the samples of formic acid were seriously below commercial strength and had obviously been diluted deliberately by the bottler. No samples were found in which acetic acid was the sole coagulant present.

Reports from the various districts indicated that the more popular brands were those which were later found to consist either solely or mainly of sulphuric acid.

(iii) THE STATE OF NEGRI SEMBILAN

The investigations made in this State indicated beyond doubt that the coagulant in almost exclusive use is formic acid of good quality and strength. One sample, although labelled "acetic acid", was found to consist of 88.2 per cent formic acid. The survey revealed only one sample consisting of any coagulant other than formic acid. This sample was "Aeroplane Brand" coagulant (see Perak No. 3) containing 57 per cent of sulphuric acid. In this State however, this brand of coagulant was not found to be popular, and the conclusion can safely be drawn that formic acid is the coagulant in general use.

TABLE III
Coagulants used by Small-holders in Pahang

Sample No.	Brand if any	Where bottled	Districts where sold	Volume per bottle cc	Price per bottle cents	Constituents		Composition by weight per cent		What user pays to purchase in this form 4 gallons of		Cross Reference
						Major	Minor	Formic acid	Acetic acid	Formic acid 90% \$	Acetic acid 99% \$	
1	Acetic acid	Kuala Lipis	Kuala Lipis	660	50	Formic acid	...	85.4	...	14.51		
2	Best Acetic acid	do	do	290	25	Formic acid	...	85.8	...	16.54		
3	...	do	do	280	25	Formic acid	...	79.7	...	18.32		
4	...	do	do	270	25	Formic acid	...	84.3	...	17.97		
5	...	do	do	285	25	Formic acid	...	85.7	...	16.74		
6	Monsoon	Bentong	Bentong	345	25	Formic acid	...	85.5	...	13.87		
		Raub	Raub	350	25			89.6	...	13.04		
		Temerloh	Temerloh	345	30			89.1	...	15.97		

TABLE III—(Continued)

Sample No.	Brand if any	Where bottled	Districts where sold	Volume per bottle cc	Price per bottle cents	Constituents		Composition by weight per cent		What user pays to purchase in this form 4 gallons of		Cross Reference
						Major	Minor	Formic acid	Acetic acid	Formic acid	Acetic acid	
										90% \$	99% \$	
7	...	Dong	Dong	300	28	Formic acid	...	89.4	...	17.08		
8	...	do	do	275	25	Formic acid	...	90.0	...	16.52		
9	Tiger	Bentong	Bentong	345	25	Formic acid	...	83.5	...	14.19		
		Temerloh	Temerloh	385	30			90.1	...	14.16		
10	No. 800	do	do	330	30	Formic acid	...	70.5	...	21.09		
11	...	do	do	325	25	Formic acid	...	65.0	...	19.36		
12	Cat	Bentong	Bentong	310	26	Formic acid	...	81.3	...	16.87		
		Pekan	Pekan	360	25			84.3	...	13.48		
13	Formic acid	Bentong	Bentong	700	55	Formic acid	...	67.4	...	19.07		
14	No. 1872 Shamrock	Raub	Raub	340	25	Formic acid	...	89.9	...	13.38		
		Temerloh	Temerloh	345	30			89.9	...	15.81		
		Beserah	Beserah	340	30			79.1	...	18.24		
		Gambang	Gambang	630	54			82.4	...	17.02		
		do	do	670	60			87.8	...	16.68		
		Pekan	Pekan	340	30			83.6	...	17.26		

TABLE III—(Continued)

Sample No.	Brand if any	Where bottled	Districts where sold	Volume per bottle cc	Price per bottle cents	Constituents		Composition by weight per cent		What user pays to purchase in this form 4 gallons of		Cross Reference
						Major	Minor	Formic acid	Acetic acid	Formic acid 90% \$	Acetic acid 99% \$	
15	Chinese Label	Kuantan	Kuantan	730	55	Formic acid	...	88.7	...	13.90		
16	...	do	do	700	55	Formic acid	...	88.6	...	14.51		
17	Crossed Flags	do	do	660	55	Formic acid	...	88.7	...	15.37		
18	Cock	do	do	720	55	Formic acid	...	83.8	...	14.91		
19	Ant	Pekan	Pekan	365	30	Formic acid	...	83.5	...	16.11		
20	Formic Japanese	do	do	325	25	Formic acid	...	59.4	...	21.17		
21	Acetic Tiger	do	do	345	23	Acetic acid	...	...	97.9	...	12.26	
22	Acetic ...	do	do	325	25	Acetic acid	...	...	96.3	...	14.37	

TABLE III—(Continued)

Sample No.	Brand if any	Where bottled	Districts where sold	Volume per bottle cc	Price per bottle cents	Constituents		Composition by weight per cent		What user pays to purchase in this form 4 gallons of		Cross Reference
						Major	Minor	Formic acid	Acetic acid	Formic acid 90% \$	Acetic acid 99% \$	
23	Cat	Pekan	Pekan	365	25	Acetic acid	...	...	96.7	...	12.75	
24	Formic	do	do	340	25	Acetic acid	...	...	97.8	...	13.53	
25	...	do	do	320	25	Acetic acid	...	...	93.6	...	15.02	
Average prices paid by users										16.31	13.59	
Dealers costs for formic and acetic acids in four gallon lots are taken as :—										9.45 to 9.90	7.90 to 8.25	

(iv) THE STATE OF PAHANG

It will be seen from Table III that, in this State, formic and acetic acids are used exclusively. Of twenty five samples, twenty were found to consist of formic and five of acetic acid. In four instances formic acid was being sold in a diluted condition but, in all other cases, the coagulant, whether formic or acetic acid, was of reasonably good commercial strength.

(v) THE STATE OF SELANGOR

The search in this State revealed the fact that formic and acetic acids are used almost exclusively. In all, five samples consisting of sulphuric acid were found and these represented in each case the remains of consignments which had proved to be virtually unsaleable in the various districts. Of these, four were brands which find a ready sale in the north but the Selangor small-holders are not apparently converted to their use. In the remaining instance, a 34.5 per cent sulphuric acid was being offered as acetic acid but it was not popular. It is a fairly common practice in some parts of this State for the head-man of a village to purchase a whole demijohn of commercial formic acid and to issue it in small lots to the small-holders. It may be said of this State that undesirable coagulants are not in use.

TABLE IV
Coagulants used by Small-holders in Johore

Sample No.	Brand if any	Where bottled	Districts where sold	Volume per bottle cc	Price per bottle cents	Constituents		Composition by weight per cent				What user pays to purchase in this form 4 gallons of			Cross Reference
						Major	Minor	Sulphuric acid	Hydrochloric acid	Acetic acid	Formic acid	Sulphuric acid 95% #	Acetic acid 99% #	Formic acid 90% #	
1	Sun	Muar	Muar	670	45	Formic acid	...	...	...	...	70.1	...	...	15.68	
2	Red De-mijohn	do	do	630	40	Formic acid	...	...	...	...	65.3	...	...	15.91	
3	Chinese Label	...	do	315	21	Formic acid	...	...	...	...	58.4	...	...	18.67	
3	Chinese Label	...	do	640	46	Formic acid	...	...	...	...	84.9	...	...	13.84	
4	Lion	Muar	do	680	40	Formic acid	...	...	...	...	73.0	...	...	13.18	
5	Bee	...	Johore Bahru & Kota Tinggi	650	45	Formic acid	...	...	...	...	84.7	...	...	13.37	
6	Sham-rock	...	do	650	45	Formic acid	...	...	...	...	94.2	...	...	12.01	

TABLE IV—(Continued)

Sample No.	Brand if any	Where bottled	Districts where sold	Volume per bottle cc	Price per bottle cents	Constituents		Composition by weight per cent				What user pays to purchase in this form 4 gallons of			Cross Reference
						Major	Minor	Sulphuric acid	Hydrochloric acid	Acetic acid	Formic acid	Sulphuric acid 95% #	Acetic acid 99% #	Formic acid 90% #	
7	Cock's Head	...	Johore Bahru & Kota Tinggi	660	45	Formic acid	...	...	...	...	92.9	...	...	12.00	
8	Soroban	...	do	550	34	Formic acid	...	...	...	...	79.1	...	...	12.78	
9	Cat's Head	...	do	300	25	Formic acid	...	...	...	...	80.9	...	...	16.85	
10	Cat Brand	...	Kluang	...	...	Formic acid	...	...	...	...	84.8				

TABLE IV—(Continued)

Sample No.	Brand if any	Where bottled	Districts where sold	Volume per bottle cc	Price per bottle cents	Constituents		Composition by weight per cent				What user pays to purchase in this form 4 gallons of			Cross Reference
						Major	Minor	Sulphuric acid	Hydrochloric acid	Acetic acid	Formic acid	Sulphuric acid 95% \$	Acetic acid 99% \$	Formic acid 90% \$	
11	800 Brand	...	Kluang	...	...	Formic acid	...	...	...	...	90.8				
12	Spider	...	do	...	...	Formic acid	...	...	...	...	85.5				
13	Green Demi-john	...	Muar	670	33	Formic acid	Sulphuric acid	19.5	...	...	38.7				
14	Elephant	...	Kluang	...	...	Formic acid	Sulphuric acid	29.4	...	...	35.0				
15	Swan	...	Johore Bahru & Kota Tinggi	620	35	Sulphuric acid	...	66.4	...	...	...	14.68			
16	Motor Car	...	do	...	...	Sulphuric acid	...	63.2							

TABLE IV- (Continued)

Sample No.	Brand if any	Where bottled	Districts where sold	Volume per bottle cc	Price per bottle cents	Constituents		Composition by weight per cent				What user pays to purchase in this form 4 gallons of			Cross Reference
						Major	Minor	Sulphuric acid	Hydrochloric acid	Acetic acid	Formic acid	Sulphuric acid 95% \$	Acetic acid 99% \$	Formic acid 90% \$	
17	Three Rubber Leaves	Penang	Johore Bahru & Kota Tinggi	700	40	Sulphuric acid	Hydrochloric acid	52.5	1.1	...	...	18.79	...	...	Kedah No. 10 Perak No. 20
18	Red Demijohn	...	Muar	680	35	Acetic acid	...	...	...	66.5	...	...	13.93	...	
19	Acetic acid	...	do	750	35	Acetic acid	...	...	...	92.9	...	...	9.04	...	
Average prices paid by users												16.74	11.49	14.43	
Dealers costs for formic acid in four gallon lots is taken for comparison as }												...	...	9.45 to 9.90	

TABLE V
Coagulants used by Small-holders in Malacca

Sample No.	Brand if any	Where bottled	Districts where sold	Volume per bottle cc	Price per bottle cents	Constituents		Composition by weight per cent		What user pays to purchase in this form 4 gallons of		Cross Reference
						Major	Minor	Formic acid	Acetic acid	Formic acid 90% \$	Acetic acid 99% \$	
1	...	...	Alor Gajah	700	40	Formic acid	...	46.2	...	20.23		
2	...	...	do	690	40	Formic acid	...	64.2	...	14.78		
3	...	...	Rumbia	630	48	Formic acid	...	83.2	...	14.98		
4	...	...	Durian Tunggal	630	45	Acetic acid	...	...	99.5	...	12.91	
Average prices paid by users										16.66		
Dealers costs for formic and acetic acids in four gallon lots are taken as :—										9.45 to 9.90	7.90 to 8.25	

(vi) THE STATE OF JOHORE

It should be mentioned that, in addition to the coagulants detailed in Table IV, a number of small-holders were noted to be employing self-made mixtures of alum with acid. It will be observed that, in this State, formic and acetic acids are not used exclusively and it was noted in North Johore that the Green Demijohn Brand was one of the two brands most popular with small-holders. This coagulant contains a by no means negligible proportion of sulphuric acid. Four other brands of coagulant containing this acid either alone or in appreciable proportions were finding a sale in various districts and, in view of these facts, it would appear that in this State the amount of rubber produced by the use of sulphuric acid cannot be taken as negligible.

(vii) MALACCA TERRITORY

In this territory formic and acetic acids are seen to be in exclusive use, but in two cases formic acid was being sold in a diluted condition.

Cost of Coagulants

From the volume, price and percentage composition of the samples, comparable figures have been derived in Tables I to V for the prices paid by users, for four gallons of commercially pure coagulant when purchased in bottles. It will be seen from the tables that, for the same brand of coagulant, users in different districts pay in some cases widely different prices. This had been expected; different retailers work to different margins of profit. A very rough indication of prevailing prices for different coagulants is obtained by averaging all the calculated prices found for a particular coagulant in different States.

The average values are given in Table VI.

TABLE VI

Coagulants	Estimated price paid by dealer for 4-gallon lots \$	Average price paid by user for 4 gallons when purchased in bottles			
		Kedah \$	Perak \$	Pahang \$	Johore \$
Formic Acid	9.45 - 9.90	14.79	18.04	16.31	14.43
Acetic Acid	7.90 - 8.25	12.60	...	13.59	...
Sulphuric Acid	4.80	11.89	11.29	...	...

It is at once seen that, between the purchase of acid in demijohns by the dealer and its sale in bottles, there is a very large increase in price and that, where small-holders can either individually or collectively purchase supplies in four gallon lots, not only do they obtain a coagulant of known and constant strength but they also effect a considerable saving in cost. It is found however that, in many districts, small-holders are not easily persuaded to the system of collective purchase, and they or their tappers are likely to continue to obtain their individual supplies in bottles. Because of this fact and because the difference between "demijohn prices" and "bottle prices" is considerable, it was felt that there might be scope for large importers of formic acid to bottle and distribute supplies of good-quality acid, in sealed bottles at more reasonable prices. Enquiry revealed that this would in all probability prove impracticable. A large organisation considered the matter carefully and it was estimated that when bottled, sealed, labelled and packed for distribution, in free cases containing 36 bottles the price per half-pint bottle of formic acid would approximate 25 cents, which is equivalent to a price of \$16 for four gallons of the acid and shows no improvement on the prevailing prices shown in Table VI. This is unfortunate because if a good-quality bottled formic acid of guaranteed strength could have been placed on the market at a competitive price it would have assisted materially the efforts which are being made to wean the small producer from the use of undesirable but cheaper coagulants. The small shopkeeper-bottler, whose overhead charges are small, can make a handsome profit on the bottling and local distribution of formic and acetic acids but there is little scope for the wholesale distribution of bottled supplies from a central business depot to distant sale points.

The position is further complicated by the fact that sulphuric acid, because of its very much lower initial cost and higher coagulative efficiency, does admit of this procedure. Certain non-European organisations have undoubtedly made use of the fact and are distributing by road, bottled and labelled sulphuric acid coagulants from central depôts to shopkeepers in many districts at prices lower than those of acetic and formic acids. The small-holder or more particularly the tapper, who is often paid by the holder on the weight of sheet rubber which he produces, is concerned mainly as to the price of available coagulants. He has usually no knowledge of their chemical nature and a brand of coagulant which produces more rubber at a lower cost is attractive to him. It is unfortunate that these non-European organisations have taken advantage of the low price of sulphuric acid in this way; they have popularised to an appreciable extent coagulant

mixtures about the use of which the manufacturer is nervous and it will take time and much propaganda to displace them.

Labelling of bottles

In nearly all cases, the samples consisting essentially of sulphuric acid were being sold in bottles bearing coloured distinctive labels designed to attract the eye. In most cases the label gave no indication of the chemical nature of the contents. In no single case, where sulphuric acid was the sole or main constituent, was the fact disclosed on the label. In a few cases, samples containing this acid as an active constituent bore labels which mis-represented the nature of the contents. In Kedah (see Table I, No. 16), a mixture of sulphuric and formic acids was on sale as "90" Formic acid. In Perak, (see Table II, Nos. 26 and 27) two mixtures, one of sulphuric and formic acids and the other of sulphuric and acetic acids were sold as "Acetic acid 99%" and "90% Formic" respectively; in Selangor, a sample of sulphuric acid was sold under the label "Acetic acid B". This indicates that those who bottle sulphuric acid for sale to small-holders are by no means anxious to advertise the fact but rather to hide it.

Among the samples which were found to consist of formic and acetic acids, there were again a few cases of mis-description. In Pahang (see Table III, Nos. 1, 2, 20 and 23) three samples of formic acid were described as "Acetic acid", "Best acetic acid" and "Japanese acid" respectively and one sample of acetic acid was sold as "cat formic"; in Negri Sembilan one sample labelled "acetic acid" was found to consist of formic acid.

There is at present no legal obligation on the bottler of coagulants to describe on the label the nature and strength of the active principle, and those bottlers whose coagulants are sold under brand names only and who do not attempt to disclose the chemical nature of the materials used, commit no breach of the law; those on the other hand who sell say sulphuric acid in the guise of acetic acid, could probably be punished by law for such mis-description. They are however in a minority. It would greatly assist the efforts of the officers of the Small-Holders Advisory Service, if all those who bottle or sell coagulants were bound by law to describe on the labels the nature and strength of the coagulant concerned. Asiatic Rubber Instructors could then in the course of their duties advise small-holders to avoid certain specific brands of which the constituents were admittedly undesirable. Analysis of samples collected from time to time would make it possible to punish those who mis-described deliberately the nature of the coagulant sold.

Individual Coagulants and the Extent of their Use

In order to obtain an indication of the extent to which the various coagulants are in use, the acreages of rubber on estates of less than 100 acres, as shown by the Rubber Statistics Handbook 1935, are set out by States in Table VII against the coagulants favoured.

TABLE VII

Coagulants favoured	Acreage of rubber on estates of less than 100 acres							Total
	Kedah	Perak	Selangor	Negri Sembilan	Pahang	Malacca	Johore	
Acetic and formic acids	...	...	157,850	82,707	76,902	74,985	...	392,444
Mainly sulphuric acid	100,691	254,886	...	...	...	...	...	355,577
Mainly acetic and formic, but sulphuric acid also used in appreciable amounts	...	...	...	...	...	...	392,589	392,589

It would seem that on roughly one-third of the total acreage of small-holdings, the coagulants used are those employed by European-owned estates. In the four territories, Selangor, Negri Sembilan, Pahang and Malacca which make up this acreage, the position with regard to coagulants is very satisfactory.

In one-third of the total acreage, the favoured coagulant is sulphuric acid. This acid is sold in a number of forms. It is found in the main as a simple mixture of sulphuric acid and water. It also occurs under different names in admixture with small amounts of hydrochloric acid. The composition of these brands is 53—54 per cent sulphuric acid, together with amounts of hydrochloric acid up to 1.5 per cent (see Table I, Nos. 10 to 14, Table II, Nos. 20 to 25 and Table IV, No. 17). Curiously enough one of these mixtures is named "Coagulatex" and in 1918 Eaton, Grantham and Day (1) described tests on a proprietary coagulant which bore this name and had an almost identical composition. It is probable that this preparation may have survived since that time. Sulphuric acid also appears in preparations which contain in addition, acetic or formic acids. These mixtures, like those containing sulphuric and hydrochloric acids, are designed to simulate pure acetic and formic

acids in pungency, appearance and effectiveness while allowing greater profit to the bottler. It is surprising that sulphuric acid is in such common use over such a large area and the indications are that it has been in common use for some years. This is the outstanding feature of the survey. Although nobody has been aware of the fact, users have undoubtedly consumed thousands of tons of rubber prepared by the use of this acid during the last few years. There have been many signs of nervousness on the part of manufacturers when, during slump times, some large estates proposed to use this acid and a few actually did so. Tests carried out by manufacturers' organisations on specially prepared samples led to the issue of a strong request by the Institute that estates should refrain from the use of this acid; it was further requested that any estate which did employ it should declare the fact to the buyer at the time of consignment. The feeling among manufacturers is one of timidity towards this coagulant, even when it is known to be in the hands of comparatively skilled persons. That it should now transpire that it has been largely used for some time by the country's most unskilled producers is disturbing. It is tempting to infer that, because of the undoubtedly large amounts of sulphuric acid-rubber which have been consumed without serious outcry, the grounds for the prejudice against its use are not strong but manufacturers may however have had difficulties which have not been made known and which may perhaps be traceable to the coagulant. Further there can be no gainsaying the fact that the use of numerous coagulants of this type must militate against uniformity in Malayan rubber as a whole and it would therefore be extremely unwise not to deter small-holders from their use wherever possible. Fortunately, the Small-Holders' Advisory Service of the Institute, which has brought the facts to light, can be and is being employed actively to advise and persuade small-holders in the territories concerned to use formic and acetic acids only. There are already indications that the propaganda is having the desired effect.

Although, in the remaining one-third of the total acreage of small-holdings, the chief coagulants are formic and acetic acids, the popularity in some districts of Johore of certain brands which contain sulphuric acid, is rather disturbing.

In all districts, where organic acids are in use, formic acid is much more popular than acetic acid. It will be observed from Tables I to V that, of seventy samples of these acids found in the country, fifty eight were of formic acid. On European estates formic acid has very largely displaced acetic acid and the same is apparently true of small-holdings.

Alum enjoys only a minor popularity as a coagulant.

Summary

A survey has been made of the coagulants employed by Malayan small-holders. Although in the main they are found to be employing formic and acetic acids, sulphuric acid is found to be employed to a much greater extent than has been supposed. Propaganda against the use of this coagulant was commenced recently through the Small-Holders Advisory Service, and reports from the districts are encouraging.

Acknowledgement

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