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A Rapid Titrimetric Method for the Estimation of Sodium Sulphite in Field Latex

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A rapid titrimetric method of estimating sodium sulphite in field latex is proposed, based on its reaction with formaldehyde to give sodium hydroxide. The method requires the use of a simple pH meter and estimates within 5% accuracy sodium sulphite contents above 0.2% w/w. It is therefore suitable for routine use. Alkaline preservatives such as ammonia and potassium hydroxide affect the estimation and the method is therefore unsuitable in the presence of unknown amounts of such preservatives. Formaldehyde which is used in the sodium sulphite – formaldehyde preservative system does not affect the estimation at the normal dosage of 0.05% w/w or less.

Field latex undergoes natural coagulation as soon as it leaves the tree due to bacterial actions on the non-rubber constituents. The rate of natural coagulation depends on the clone types, weather, seasons, tapping systems, stimulation programmes, age and cleanliness of the containers (RUBBER RESEARCH INSTITUTE OF MALAYA, 1952). A normal field latex will remain fluid for a few hours without any preservative but latex collected after rain or in areas where a combination of stimulation, high tapping and high intensity exploitation is employed is prone to pre-coagulation and can cause problems in factory processing. Although ammonia is the preservative most commonly used in field practise, sodium sulphite is also sometimes used to depress pre-coagulation for short periods (RUBBER RESEARCH INSTITUTE OF MALAYA, 1953; COOK, 1960) since it is cheap and easily available. Also it is useful as a decoloriser in the preparation of pale crepe as colour may be adversely affected by other preservatives such as ammonia and formaldehyde. It is normally added as a 3% w/w solution to give a concentration of about 0.05% w/w of latex. The solution of sodium sulphite is prepared fresh daily because it deteriorates rapidly on storage and is added to collection cups and tapper's buckets. However, inadequate control often results in the addition of excessive amounts of sodium sulphite to field latex. This in turn necessitates larger quantities of acid for coagulation of the latex and results in the rubber sheets produced often having tacky surfaces due to excessive moisture retention.

A rapid estimation of the sodium sulphite content in field latex will allow a proper adjustment of its concentration to the desirable level. Where an excessive amount of sodium sulphite has been added, dilution with field latex containing less sodium sulphite can be achieved.

Although sodium sulphite has been used in latex for more than fifty years (DE VRIES, 1920), no quantitative method for its estimation in latex has been developed. Several methods are available for the estimation of sodium sulphite in other systems, but many have their limitations when used on latex systems. The titrimetric method (SCOTT, 1926) involving the use of sulphuric acid

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and phenolphthalein as indicator is unsatisfactory because of the difficulty in detecting the end-point. The well-known iodine method (BRITISH STANDARDS INSTITUTION, 1960; SOFFER, 1961; VOGEL, 1968) which involves the oxidation of sodium sulphite by iodine and the titration of excess iodine with sodium thiosulphate is unsatisfactory because of the interferences from the non-rubber constituents. Another well-known method (PANKHURST, 1942; VOGEL, 1968) which involves the oxidation of sulphite to sulphate and the reaction of the sulphate with ethylene diamine tetra-acetic acid, and the Monier-William method (ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS, 1970) are time-consuming. A method of estimating the content of sodium sulphite in field latex which is rapid and satisfactory for use in small laboratories is described, based on the reaction between formaldehyde and sodium sulphite which yields quantitatively sodium hydroxide (KURTENACHER, 1924; ROSENTHALER, 1927) as follows:

$$HCHO + Na_2SO_3 + H_2O \rightarrow HCH\ (OH)\ SO_3Na + NaOH$$

The content of sodium hydroxide is determined titrimetrically with a pH meter. The operational time is 10 min per determination.

EXPERIMENTAL

Ten grams of a representative sample of latex is weighted accurately (to $\pm$ 0.01 g) into a 250 ml beaker and the latex diluted to 100 ml with distilled water of pH 6. A quantity of 25 ml of 5% formalin, the pH of which has been adjusted to 6.0 with N NaOH, is added and the resulting mixture stirred for about 2 minutes. The solution is titrated with 0.02N sulphuric acid until the pH of the latex is 6.0, the latex being stirred throughout the titration. All chemicals used should be of analytical reagent grade. The content of sodium sulphite in the latex is calculated from the equation

$$\text{Percentage w/w sodium sulphite} = 12.605\ \frac{NT}{W}$$

where N is the normality of sulphuric acid, T is the volume in millilitre of the sulphuric acid used and W is the weight in gram of the latex taken for test.

RESULTS AND DISCUSSION

Sodium Sulphite Solutions

Standard amounts of analytical grade sodium sulphite (98% purity) were taken and estimated by the above procedure. The method estimated 91 – 96% of the amount of sodium sulphite taken; the accuracy of the estimation improved with increasing amounts of sodium sulphite. The results are shown in *Table 1*.

TABLE 1. ESTIMATION OF STANDARD SODIUM SULPHITE IN AQUEOUS SOLUTIONS

Sodium sulphite (% wt)		Recovery (%)
Amount taken	Amount estimated	
0.054	0.049	90.7
0.107	0.100	93.5
0.215	0.201	93.5
0.259	0.245	94.6
0.517	0.494	95.6
0.776	0.744	95.9
1.034	0.993	96.0

Average: 94.3% recovery

Freshly Preserved Field Latex

Freshly tapped field latex is nearly neutral but after dilution with water and addition of the formalin, the pH changes to 5.9–6.2, the average value being 6.02. Field latex preserved with 0.05% w/w or less of sodium

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sulphite has a pH of 6.1 – 6.3 when treated similarly. The proposed method therefore cannot be used to estimate sodium sulphite when it is present in low amounts less than 0.05% w/w. For field latices preserved with 0.05 – 0.10% w/w and 0.11 – 0.20% w/w of sodium sulphite, the pH changes caused by the added sodium sulphite are only 0.4 and 0.7 units respectively. The method overestimates sodium sulphite by 27% and 8% respectively at these concentrations. The limited accuracy at lower levels of sodium sulphite (0.05 – 0.10%) is attributed to the divergence of the initial pH of fresh latex from the mean of 6.0 taken for this determination. The accuracy of the estimation improves with increasing content of sodium sulphite and for field latex preserved with more than 0.21% w/w of sodium sulphite, the change in pH of the latex on addition of sodium sulphite is sufficiently large to offset the variation in the initial pH of the fresh latex. The effect of this pH variation becomes negligible at high levels of sodium sulphite giving consistent recoveries of added sodium sulphite above 0.7% w/w. An average recovery of 95.2% with coefficient of variation of 3.8% is achieved with sodium sulphite contents of 0.2 – 1.0% w/w *(Table 2)*.

Effect of Storage

Sodium sulphite solutions deteriorate rapidly when exposed to the atmosphere, the rate of oxidation being dependent on the concentration of sodium sulphite (MILBAUER AND PAZOUREK, 1922). The extent of oxidation is reduced at higher concentrations and when stored in closed containers. *Table 3* compares the stabilities of sodium sulphite solutions kept in closed containers with those exposed to the atmosphere. It is noted that sodium sulphite solutions of more than 5% w/w concentration are more stable than a 3% w/w solution, which is currently used in the field.

On addition to field latex, however, sodium sulphite remains fairly stable *(Table 4)*. Similar recoveries of sodium sulphite are obtained when field latex preserved with sodium sulphite is stored in stoppered flasks or exposed to the atmosphere and subjected to intermittent stirring over 3 h, indicating that sodium sulphite is stable under these conditions.

Effect of Other Preservatives

The estimation of sodium sulphite in field latex involves the titration of a base and an acid. Alkaline preservatives such as ammonia and potassium hydroxide will therefore affect the estimation. Formaldehyde which may be used together with sodium sulphite (RUBBER RESEARCH INSTITUTE OF MALAYA, 1968) does not affect the estimation at its normal dosage of 0.05% w/w or less *(Table 5)*; the results following the trends exhibited in terms of recovery percentage *(Table 2)*.

CONCLUSION

The small variation in pH of fresh field latex renders the proposed titrimetric method for the determination of sodium sulphite in field latex inapplicable for amounts of sodium sulphite below 0.05% w/w and overestimates sodium sulphite when it is present in the range 0.05 – 0.20% w/w. Satisfactory accuracy is obtained with the method when sodium sulphite content is 0.21 – 1.01% w/w which is normally the level of sodium sulphite in complaint samples. The simplicity of the method offers a rapid means for checking against excessive use of sodium sulphite.

TABLE 2. ESTIMATION OF ADDED SODIUM SULPHITE IN FIELD LATEX

Sodium sulphite added (% wt)	0.05 to 0.10	0.11 to 0.20	0.21 to 0.30	0.31 to 0.40	0.41 to 0.50	0.51 to 0.60	0.61 to 0.70	0.71 to 0.80	0.81 to 0.90	0.91 to 1.01	0.21 to 1.01
Number of latex samples tested	7	9	7	9	9	10	8	9	8	9	69
Average percentage recovery of sodium sulphite	127.1	107.8	99.1	99.2	96.2	94.7	95.3	92.7	92.8	92.6	95.2
s.d.	14.96	7.97	3.47	4.33	2.29	2.41	2.20	1.50	2.87	1.59	3.63
c.v. (%)	11.8	7.4	3.5	4.4	2.4	2.6	2.3	1.6	3.1	1.7	3.8

TABLE 3. STABILITIES OF 3%, 5% AND 10% AQUEOUS SODIUM SULPHITE SOLUTIONS UNDER DIFFERENT CONDITIONS

Storage time (h)	Recovery of sodium sulphite (%)				
	3% Na_2SO_3		5% Na_2SO_3		10% Na_2SO_3
	In closed container with little air	Exposed to air	In closed container with little air	Exposed to air	Exposed to air
0	97.4 97.1	93.7 93.9	98.6 98.5	97.8 97.7	98.1 98.4
2	94.8 96.5	73.9 74.2	97.4 97.6	94.8 94.9	97.4 98.2
4	96.0 96.1	59.0 58.0	98.1 98.2	90.6 90.7	97.0 96.2
6	92.4 92.4	28.3 27.8	97.8 97.9	86.6 86.4	96.2 96.3

The iodine method recommended in B.S. 3304:1960 'Specification for Sodium Sulphite Anhydrous' was adopted for the above investigation.

TABLE 4. STABILITY OF SODIUM SULPHITE IN FIELD LATEX

Item	Immediately after preparation	3 h in stoppered flask	3 h in beaker with stirring occasionally
Number of field latex tested	9	9	9
Average percentage recovery of sodium sulphite[a]	96.6	94.3	97.1
s.d.	5.07	4.90	6.82
c.v. (%)	5.3	5.2	7.0

[a]Percentage initial content of sodium sulphite was between 0.2% to 1.0%

TABLE 5. RECOVERY OF SODIUM SULPHITE IN FIELD LATEX CONTAINING 0.05% WT FORMALDEHYDE

Sodium sulphite added (% wt)	Recovery of sodium sulphite (%)
0.19	100.0 94.7
0.41	97.5 97.5
0.58	94.8 94.8
0.81	93.8 95.0
1.01	94.0 93.0

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