

TURBIDIMETRIC DETERMINATION OF SODIUM THIOSULPHATE

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A new method for the turbidimetric determination of sodium thiosulphate has been described. Selenium dioxide has been used as a reagent for producing very fine orange coloured turbidity which was measured with a colorimeter using filter No 44 in position. The method is reasonably sensitive, accurate and convenient to perform in an ordinary laboratory. Sulphite and sulphide do not interfere when present in a concentration of 2 and 10 μg respectively in a 1.0 mg sample of sodium thiosulphate. The interferences due to sulphate, chloride, calcium and lead have also been checked.

INTRODUCTION

The most important method for the determination of thiosulphate is its oxidation with iodine between pH 4.5 to 9.5. The end point is detected visually or potentiometrically [1-2]. There is another method where thiosulphate is oxidized by using bromate/bromide or periodate/bromide in acidic medium. The excess of bromine can be back titrated iodometrically [3-6]. N-Bromosuccinimide has also been used as a direct titrant for thiosulphate using bordeaux red as indicator [7]. Thiosulphate can be determined by potassium ferricyanide in strongly alkaline medium using osmium tetroxide as catalyst and the end point was determined potentiometrically [8]. It also reacts with excess of cyanide to form thiocyanate. The excess of cyanide and generated sulphite can be masked by using formaldehyde and then thiocyanate is determined colorimetrically or excess of cyanide is determined [9]. Thiosulphate reacts with cyanide in presence of Cu (II) to form thiocyanate which after complexing with Fe^{+++} can be determined photometrically at 496 nm [10]. Toluidine gives a blue colour when it reacts with copper salts in presence of thiosulphate [11]. This also makes the basis for its spectrophotometric determination.

In most of the methods pure compound has been determined and interferences have not been checked. The present investigation is intended to determine thiosulphate with some convenient, and accurate method. The effect of various contaminants like sulphite, sulphide, lead etc. is also studied.

EXPERIMENTAL

All the turbidimetric measurements were made with photoelectric colorimeter Model 581 (made in China).

Reagents

All the reagents used were of analytical grade or otherwise stated.

Sodium Thiosulphate: A 0.1% solution was prepared in distilled water. This solution was then standardized iodometrically [1].

Selenium Dioxide: A 0.1% solution w/v was prepared in distilled water. The compound was from Riedel De Haenag Seelze, Hannover (West Germany).

Sodium Carbonate: A saturated solution of sodium carbonate was prepared in distilled water.

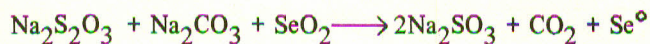
Procedure

Took 1 ml solution of sodium thiosulphate containing 1 mg of the compound. To this was added 3 ml of selenium dioxide solution followed by the addition of 3 ml of saturated solution of sodium carbonate. The contents were kept at room temperature for 5 min and then diluted to 10 ml with distilled water. The absorbance of the resulting coloured turbidity was measured in the photoelectric colorimeter using filter No 44 with 1 cm thickness glass cell in position. A standard calibration graph was then prepared by taking different amounts of thiosulphate.

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RESULTS AND DISCUSSION

Results in Table 1 show that thiosulphate can be quantitatively determined by SeO_2 . The stoichiometry of the reaction can be represented by the following equation:



From this equation it is clear that thiosulphate is oxidized by selenium dioxide in alkaline medium to sulphite and SeO_2 is reduced to metallic selenium which is responsible for the orange coloured turbidity. This turbidity is measured by a colorimeter using filter No 44 in position. A calibration graph was then constructed using different amounts of thiosulphate (Fig 1).

Stability of Coloured Solution The orange coloured product is stable from 3 to 30 min after which it starts to settle down. The results are shown in Fig. 2.

Effect of pH on the Production of Colour: The colour gains maximum stability in the range of pH 10 to 14 (Fig. 3).

Effect of Reagent Concentration on the Production of Colour: 3 mg SeO_2 10 ml was required for 2 mg of $\text{Na}_2\text{S}_2\text{O}_3$ in this volume for the complete production of colour Fig.4.

Effect of Temperature on Colour Production: The colour fades on heating above room temperature.

Effect of Diverse Ions: The common contaminants of sodium thiosulphate are sulphite, sulphide and sulphate.

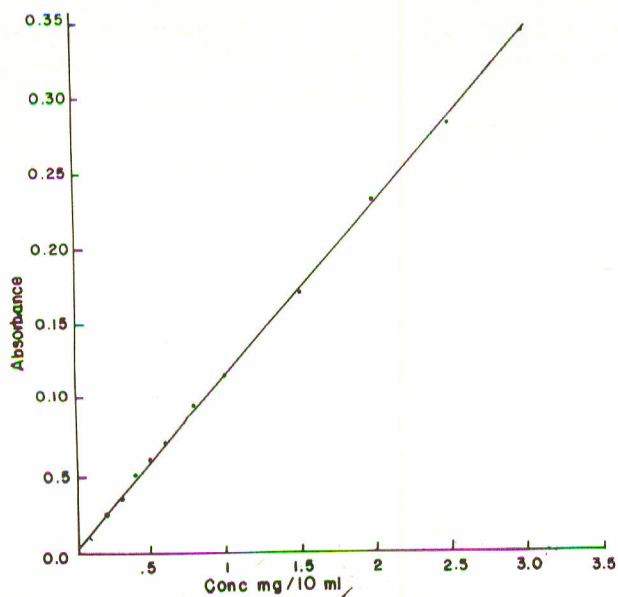


Fig. 1. Standard calibration curve of sodium thiosulphate.

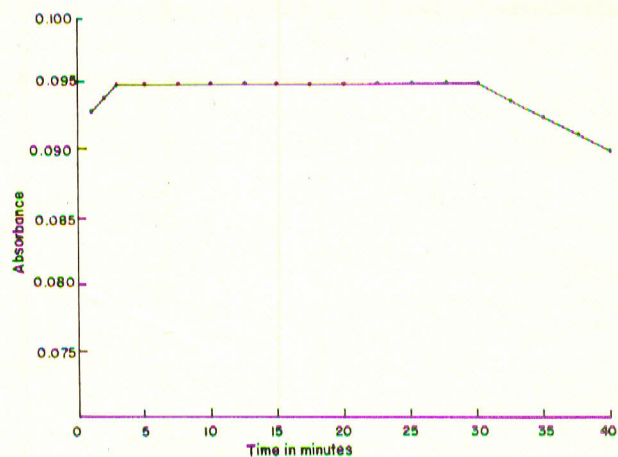


Fig. 2. Effect of time on colour intensity.

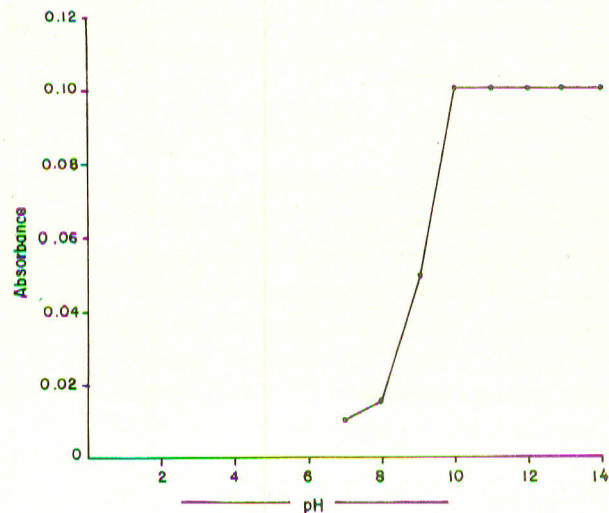


Fig. 3. Effect of pH on colour intensity.

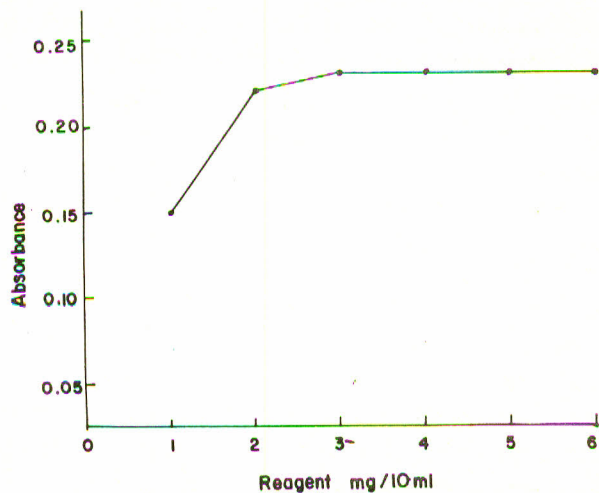


Fig. 4. Effect of reagent concentration on color intensity.

Sulphite and sulphide interfere in the procedure upto certain limit. Their tolerance limits have been studied and the results are shown in Tables 2 and 3. Lead and calcium show no interference in the development of colour.

Table 1. Turbidimetric determination of sodium thiosulphate.

| Amount of thiosulphate taken (mg)/10 ml | Amount found (mg) | Rel. std Dev. % |
|---|-------------------|-----------------|
| 0.10 | 0.11 | 0.02 |
| 0.20 | 0.20 | 0.00 |
| 0.30 | 0.29 | 0.02 |
| 0.40 | 0.41 | 0.01 |
| 0.60 | 0.60 | 0.02 |
| 1.00 | 1.02 | 0.01 |
| 1.30 | 1.29 | 0.02 |
| 1.50 | 1.53 | 0.01 |
| 1.80 | 1.80 | 0.02 |
| 2.00 | 2.00 | 0.00 |
| 2.30 | 2.30 | 0.01 |
| 2.50 | 2.50 | 0.01 |

Every found value is the average of 5 determinations.

Table 2. Tolerance limit of sodium sulphite in the determination of sodium thiosulphate.

| Amount of $\text{Na}_2\text{S}_2\text{O}_3$ taken mg/10 ml | Amount of Na_2SO_3 added μg | Amount of $\text{Na}_2\text{S}_2\text{O}_3$ found mg | % Error |
|--|--|--|---------|
| 1.05 | 20 | 1.36 | + 30.00 |
| 1.05 | 10 | 1.28 | + 22.00 |
| 1.05 | 4 | 1.13 | + 8.00 |
| 1.05 | 2 | 1.05 | + 0. |

Every found value is the average of 5 determination.

Table 3. Tolerance limit of sodium sulphide in the determination of sodium thiosulphate.

| Amount of $\text{Na}_2\text{S}_2\text{O}_3$ mg/10 ml | Amount of Na_2S added mg | Amount of $\text{Na}_2\text{S}_2\text{O}_3$ found mg | % Error |
|--|--|--|---------|
| 1.00 | 20 | 1.77 | + 77.0 |
| 1.00 | 18 | 1.32 | + 32.0 |
| 1.00 | 12 | 1.05 | + 5.0 |
| 1.00 | 10 | 1.00 | + 0. |

Every found value is the average of 5 determination.

The method can be applied to check the purity of sodium thiosulphate in a common laboratory. It is rapid, convenient and accurate.

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