

A blank titration was run on the cupric acetate alone, using the same amount as was used in the precipitation. The difference in the two readings gives the sodium thiosulphate equivalent to the CuO in the copper xanthate.

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THE TECHNICAL DETERMINATION OF CARBON BISULPHIDE IN ILLUMINATING GAS.

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No satisfactory working method for the determination of carbon bisulphide in gaseous mixtures has been found by the writers in the accessible literature.

Sutton¹ in his "Volumetric Analysis" mentions a method proposed by Gastine in which the gas is dried, the carbon bisulphide absorbed by concentrated alcoholic potash, the potassium xanthate solution acidified with acetic acid, an excess of sodium carbonate added, and the xanthate then titrated with a standard iodine solution. Sutton also mentions that the gas may be passed through an alcoholic potash solution, the carbon bisulphide absorbed as potassium xanthate, the potassium xanthate solution acidified with acetic acid and titrated with a standard solution of cupric sulphate. This reference in all probability is to Macagno's² method for determining carbon bisulphide in carbon bisulphide preparations.

Butterfield³ mentions a method, probably also Macagno's method referred to above, which consists in separating the carbon bisulphide as potassium xanthate, acidifying the xanthate solution with acetic acid and titrating with standard cupric sulphate.

The triethylphosphine qualitative test appears never to have been used for a quantitative determination of carbon bisulphide.

In the above methods no mention is made of getting rid of the carbon dioxide previous to the absorption of the carbon bisulphide by the alcoholic potash. Unless this is done the potash soon becomes neutralized and ineffective, the carbon dioxide ranging from 2% to 3% and even higher in illuminating gas, depending upon the purifying efficiency of the plant. The difficulty of titrating directly the potassium xanthate in an acetic acid solution with cupric sulphate was made apparent in the preceding paper. It takes some time to precipitate the xanthate in a dilute acetic acid solution and unless the cupric sulphate is added at once, the precipitate slightly dissolves. The acetylene present in the gas might also, under certain conditions, cause serious errors in

¹ Sutton, Vol. Anal., p. 367.

² Chem. News 43, 138.

³ Chemistry of Gas Manufacture, p. 175.

the titration due to possible compounds which it might form with copper.

A volumetric method was devised by the writers which apparently overcomes these objections and which gives very good comparative results. The method, in general, consists in passing the gas through a meter in absorbing the carbon dioxide by caustic potash, then drying the gas with concentrated sulphuric acid and absorbing the carbon bisulphide in absolute alcoholic potash. The potassium xanthate solution is then acidified with acetic acid, precipitated with an excess of standard cupric acetate, the copper xanthate filtered, washed and the excess of cupric acetate in the filtrate determined iodometrically.

The method, in detail was as follows: Simultaneous duplicate determinations were made to ensure the same quality of gas. The two meters used for measuring the gas were of the water type, standardized against each other and the water thoroughly saturated with the gas. After passing through the meter the gas was first bubbled through a wash bottle containing about 50 cc. of a caustic potash solution of sp. gr. 1.27, then through a second wash bottle containing about 30 cc. of concentrated sulphuric acid and finally through two 8-inch test tubes, each containing 20 cc. of saturated absolute alcoholic potash for absorbing the carbon bisulphide. The gas thus bubbled through a column of the absorbent 20 cm. long and the flow was regulated to a nicety by means of a glass cock inserted between the absorption tubes and a water suction pump. About two cubic feet of gas was used for each determination and passed through the meter at the rate of one-half cubic feet per hour. The potassium xanthate solution in the test tubes was transferred to a beaker, the tubes rinsed with a small amount of absolute alcoholic potash, boiled to expel the absorbed gases, cooled, distinctly acidified with acetic acid and precipitated at once with an excess of standard cupric acetate. The solution was allowed to stand from one to two hours, then filtered, and the precipitate washed three or four times with 30 cc. to 40 cc. portions of cold water to remove all cupric acetate. The excess of cupric acetate was determined by adding to the filtrate about 3 g. of finely pulverized potassium iodide, allowing to stand about three minutes and then titrating the liberated iodine with a standard solution of sodium thiosulphate, using a freshly prepared starch solution as indicator.

The sodium thiosulphate solution was standardized against C. P. copper foil and also against standard potassium bichromate, and its CS_2 value calculated by multiplying its CuO value by 1.927 (see preceding paper.)

A blank was run on the same amount of cupric acetate solution as was used in the precipitation of the xanthate, thus fixing by difference the value of the absorbed cupric acetate in terms of carbon bisulphide.

The following results were obtained on the gas furnished by the city of Minneapolis:

	Determinations	Grains per 100 cu. ft.
April 15	1	14.13
April 15	2	14.16
April 19	1	12.30
April 19	2	12.42
April 23	1	12.68
April 23	2	12.60

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THE PROBABLE EFFICIENCY OF ACCIDENTAL GAS EXPLOSIONS.

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The amount of literature on this phase of gas explosions is apparently very small, as we were able to find no accounts of work done or tests made; yet explosions of accidental nature can easily and do often occur, since the leakage from the gas mains and pipes is always considerable, averaging about fourteen per cent. and rarely less than seven. All that is necessary is a cavity protected so that the gas shall not escape from it too rapidly, and some method of ignition.

The object of this work was to determine what part of the energy of the gas, figured from its thermal value, shows itself in external or visible work. To imitate conditions occurring in practice, this work revealed itself by raising the weighted cover of a box. In the experiments about to be described two different shapes of boxes, cubical and prismatic, of three different sizes and two types of covers, outside and inside, were employed. They were made of wood, strongly built and provided with movable covers. Although these do not simulate accurately the conditions of practice where the hard ground forms the sides and bottom, yet if the boxes be well made with dovetailed bottoms, reinforced corners and sides well hooped with strap iron, the actual conditions are closely approached.

Description of Apparatus.

The various boxes used were cubical, of one foot, four feet and eight feet capacity, also a prismatic box four feet high and one foot square in section.

The smallest box was made of $7/8$ inch whitewood and was dovetailed together very strongly. It was not hooped, yet nevertheless it stood a considerable number of explosions without injury. The other three boxes were made of $1\frac{3}{8}$ inch southern pine and were at first reinforced by wooden hoops of $1\frac{1}{2}$ inch stock dovetailed. One hoop was put on each box half way down the side. These were not strong enough and iron hoops had to be added. In the prismatic box a great deal of difficulty was experienced because of the leakage along the long side joints. This