silicates. Fig. 8 shows a typical experiment. In Table II is shown the composition of glasses employed and the results obtained.

and it has been shown that for a variety of silicate glasses the surface tension lies within not very wide limits. Borate glasses possess a surface tension which

Fig. 9.

is lower than that of the silicates and which is markedly different for the several lead borates.

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TABLE II.

No.	B ₂ O ₃ Equiv.	BaO Equiv.	PbO Equiv.	Na ₂ O Equiv.	α .	β .	T dynes per centi- meter.
1.....	66.7	..	..	33.3	38.0	15.0	118.0
2.....	72.8	..	..	27.2	34.0	15.0	116.0
3.....	62.1	..	9.7	28.2	34.0	15.0	106.0
4.....	59.0	..	16.7	24.3	30.0	15.0	94.0
5.....	81.1	..	18.9	..	19.0	..	59.0
6.....	68.1	..	31.9	..	31.0	..	96.0
7.....	50.7	..	49.3	..	37.0	15.0	115.0
8.....	49.1	..	50.9	..	37.0	15.0	115.0
9.....	37.2	..	62.8	..	28.0	15.0	87.0
10.....	25.3	..	74.7	..	29.0	15.0	90.0
11.....	80.0	20.0	..	..	22.0	15.0	69.0
12.....	78.0	22.0	..	..	25.0	15.0	78.0
13.....	65.5	34.5	..	..	40.0	15.0	125.0

Although these data are not complete, they bring out some interesting points. The values of β are the same for all the glasses in which enough measurements were made to determine the nature of the curve. The addition of boric oxide to borax, as shown in Experiments 1 and 2, lowers the surface tension. The addition of lead borate has the same effect, as shown in Experiments 1, 3 and 4. In Experiments 11, 12, and 13, in which barium borates were used, an increase in amount of boric oxide also causes a decrease in surface tension. On comparing these with Experiments 5-10, in which lead borates were used, we find boric acid showing the same effect when present in more than one molecule of B₂O₃ to one of PbO. In glasses which contain less than one molecule of B₂O₃ to one of PbO the surface tension behaves irregularly, showing in general a lowering of the surface tension with a decrease in the amount of boric oxide.

Further work will be necessary to determine whether the surface tension may be relied upon to indicate definite compounds in a glass. The series of lead borates, as given above and plotted in Fig. 9, is sufficient to show that the presence of compounds has considerable influence on surface tension of the glass.

The purpose of this paper has been to bring forward a simple and rapid method measuring the surface tension of certain high-melting substances, especially glasses. A number of experiments have been recorded

A RAPID AND ACCURATE METHOD FOR THE ANALYSIS OF WHITE METALS.

By J. C. BENEKER, Metallurgist, Cincinnati Metal Products Company.

After investigating and trying many methods for the analysis of bearing and type metals, I have devised a composite scheme which embodies the best features of other researches and several ideas which I believe are original. The method is rapid and at the same time quite accurate.

Dissolve 1/2 gram of the fine drillings in a mixture of 25 cc. HCl + 5 cc. HNO or 25 cc. HCl saturated with liquid bromine (not bromine water), warm on the steam bath and add about one gram tartaric acid to hold up the antimony. Dilute with hot water to about 400 cc. and slowly add an excess of a solution of NaOH. Now add an excess (about 20 cc.) of a 10 per cent. solution of Na₂S. This is made by saturating half of a 10 per cent. NaOH solution with H₂S and then adding the other half. Allow to settle and filter by decantation a couple of times, using hot, dilute Na₂S solution for washing. Transfer the precipitate to the filter and wash with a hot, dilute Na₂S solution several times. The residue consists of the sulphides of Cu, Pb, Fe and Zn, while the filtrate contains Sn and Sb also As if present (Method of A. Rössing).¹

Dissolve the residue in HNO₃ and run down with H₂SO₄ for the lead. The Cu, Fe and Zn are determined as usual, the copper preferably by A. H. Low's iodometric method.² Add to the filtrate a small excess of HCl and allow to settle on the steam bath about an hour. Filter the precipitate, washing well with luke warm water to remove all H₂S. Place the paper containing the sulphides in an Erlenmeyer flask. Add a measured excess of N/10 iodine solu-

¹ Journal Society Chemical Industry, 1902, 191.

² "Technical Methods of Ore Analysis."

tion, 30-50 cc. conc. HCl, and about two grams of tartaric acid. Never omit the tartaric acid, which serves to hold the antimony in solution. Insert a rubber stopper having a small swan-neck thistle tube in it to condense and retain any iodine vapors that might be evolved in heating. Heat the flask almost to boiling for a few minutes, whereupon the sulphides are changed to iodides:

As will be seen, the tin is completely oxidized, whereas the antimony goes only to the triiodide form. Cool the flask, wash out the bulb tube and dilute somewhat. Titrate the excess of iodine with a tenth-normal solution of sodium thiosulphate, using a starch indicator.

Now wash, or filter (if a sharper end point is desired), into a beaker, neutralize with Na_2CO_3 and add an excess of powdered sodium bicarbonate. Now titrate with a tenth-normal solution of iodine (Mohr's method). In this alkaline solution the antimony triiodide is oxidized to the quinquivalent condition:

From this last titration the amount of antimony present can be calculated. Multiply the volume of iodine solution used in this titration by $3/2$ and subtract this from the volume of iodine consumed in the first titration. This will give the volume of iodine consumed by the tin alone.

This method of getting the tin and antimony by the titration of the sulphides is, as far as I know, original and for it I can claim several advantages. One is that the antimony is put in just the stage of oxidation that is required for Mohr's titration. Another is that it does not matter in what condition of valency the sulphides are, even free sulphur does not interfere. This fact was ascertained by taking two samples of tin of 0.1 gram each, dissolving one in conc. HCl, forming SnCl_2 , and the other in $\text{HCl} + \text{HNO}_3$, forming SnCl_4 . Analyzing as above, gave almost identical results.

The separation of the insoluble sulphides from the tin and antimony can be made almost absolute by dissolving these sulphides of Cu, Pb, Fe and Zn in hot HCl and reprecipitating by means of NaOH and Na_2S . In this manner any traces of Sb or Sn that may have been retained by the first precipitate are removed and added to the main filtrate.

To test the above method of titrating the sulphides by means of iodine, I have weighed out samples of pure tin and run them through with this method and have obtained the following close results, using the theoretical tin factor for the iodine:

Tin taken. Gram.	Tin obtained. Gram.
0.0664	0.0669
0.0702	0.0705
0.0923	0.0922
0.1132	0.1135

To further test the method, known amounts of pure copper, lead, tin and antimony were dissolved together and tested in the above manner with the following result:

	Taken. Gram.	Obtained. Gram.
Copper.....	0.2995	0.2996
Lead.....	0.2990	0.2997
Tin.....	0.0946	0.0953
Antimony.....	0.0942	0.0936

THE VOLUMETRIC CHROMATE DETERMINATION OF LEAD.

By JOHN WADDELL.

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In the Transactions of the American Institute of Mining Engineers, Vol. 35, page 359 (1905), Mr. H. A. Guess gives a method for determining lead in ores. Though it can be used for nearly all kinds of ores, it is most satisfactory in just those cases for which the results obtained by the molybdate method are least reliable, namely, with ores poor in lead and containing a large amount of calcium carbonate.

Guess claims that the method is easily carried out and I understand that it is employed at the Traill Smelter in British Columbia.

It does not seem, however, to have become at all general. I have not found it in any of the books on quantitative analysis nor have I seen it described in any of the chemical periodicals. Guess describes the method as follows:

"To the ore charge of from 1 to 5 grams in a 250 cc. flask add from 3 to 5 cc. of strong nitric acid and 15 cc. of strong hydrochloric acid; digest until everything is in solution and the excess of acid has been reduced to about 8 cc. The whole operation on the hot plate requires but 15 minutes. The flask is then removed, and slightly diluted ammonia is added slowly in slight excess, the neutralizing action being sufficiently vigorous to render the contents of the flask quite hot. Acetic acid of 80 per cent. strength is then added slowly, the flask being shaken vigorously until the smell indicates a decided excess of acetic acid. Then 5 cc. of strong ammonium acetate are added to insure the solution of any lead compounds remaining undissolved by the ammonium acetate already formed in the flask.

If the ore contains no antimony or separated gelatinous silica and if the siliceous residue in the bottom of the flask is only in slight amount (as is usual with heavy lime ores or with concentrates) add to the hot, undiluted and unfiltered solution an excess—about 10 cc.—of a ten per cent. potassium chromate solution. Under these conditions the bulk of the contents of the flask will not exceed 50 cc., and after shaking and letting the precipitated lead chromate settle for about five minutes the contents are filtered through an 11 cm. filter of any fairly rapid and close paper. If these directions are carried out the lead chromate will be quite granular and will show no tendency to run through. The precipitate in the flask and on the filter is washed several times with hot water containing about 0.5 per cent. of acetic acid until free from soluble chromates. The funnel