

copper), 8 A. T. of PbO to 0.1 A. T. of matte, will remove nearly all the copper.

To get a slag of the composition described, SiO<sub>2</sub> must be added, if necessary (after calculating the percentage of SiO<sub>2</sub> in the ore), to make up the ratio of 1 part SiO<sub>2</sub> to 16 parts PbO. The percentage of S should also be calculated, and oxidizing or reducing agents added, to obtain a button of the required weight, which should be about 16 grammes. The buttons will vary to the extent of a few grammes either way, by reason of difference in the temperature of the furnace; but with care and practice this difficulty can be largely avoided.

On ore containing, for example, 5.4 Cu, 29.4 SiO<sub>2</sub>, 28.2 Fe, 13.1 CaO, and 15.8 S, the charge is calculated as follows. This ore contains a good deal of Cu, and also a high percentage of S, which would necessitate the use of a considerable amount of KNO<sub>3</sub>. It is, therefore, advisable to take as a charge only 0.25 A. T. of ore, to which should be added 8 A. T. of PbO, 0.5 A. T. of Na<sub>2</sub>CO<sub>3</sub>, K<sub>2</sub>CO<sub>3</sub>, and 18.3 grammes of SiO<sub>2</sub>. Since 4 per cent. of sulphur, as stated, would reduce 16 grammes of lead from 0.5 A.T. of PbO, this charge containing nearly 16 per cent. of sulphur, but being only half the weight, would give a button of about 32 grammes. To obtain a button of 16 grammes, therefore, enough KNO<sub>3</sub> must be added to oxidize 16 grammes of Pb back to PbO. This amount will be, according to the figures given above, 4 grammes of KNO<sub>3</sub>. The charge is to be thoroughly mixed and shaken down in the crucible, which is then filled up with NaCl. With careful melting, a button of about 16 grammes will be obtained.

#### COVERS.

As regards the efficiency of different covers, it may be observed that, with the same ore and flux, and under circumstances otherwise the same, two crucible-assays of a high-grade gold-ore gave the following results: With salt as a cover, 20.16; with borax, 19.00; while by scorification, 19.90 ozs. per ton of gold were obtained.

This tends to show that there is less volatilization with salt than with borax. For all-round use, salt is certainly the safest cover. Moreover, when salt is used as cover, the buttons are more uniform, because the sulphur does not volatilize; whereas, borax gives buttons of variable size, because variations in the furnace temperature offset the sulphur directly, and may prevent it from exercising its full reducing-effect.

#### THE EFFECT OF ARSENIC AND ANTIMONY.

Arsenic and antimony interfere with this method only when present in proportions exceeding 4 per cent., which is rarely the case in any other sulphide-ores than arsenopyrite or stibnite. The following experiments were made to determine the effect of these elements.

Experiment No. 1 comprised 4 crucible-meltings, each crucible containing 0.5 A.T. of the ore (a clean sulphide, containing 4 per cent. of S), to which, in the first crucible, no arsenic or antimony was added; in the second, 0.291 gramme (2 per cent. of the ore-charge) of antimony; in the third, the same amount of arsenic; and in the fourth, 0.291 gramme of each, making together 4 per cent. of the ore-charge.

The reducing effect of Sb and As is seen in the following figures:

| In Crucible No. 1, the button was 16 grammes Pb. |   |   |    |   |          |
|--------------------------------------------------|---|---|----|---|----------|
| "                                                | " | " | 2, | " | " 17.5 " |
| "                                                | " | " | 3, | " | " 19.0 " |
| "                                                | " | " | 4, | " | " 20.0 " |

Experiment No. 2 was made with ore containing SiO<sub>2</sub>, 29.0; Fe, 29.55; S, 25.4; and Sb, 4 per cent. Two charges were run, side by side. Each consisted of 0.25 A. T. of ore; 0.5 A.T. of Na<sub>2</sub>O<sub>3</sub>, K<sub>2</sub>CO<sub>3</sub>; 8 A. T. of PbO; and 18 grammes of SiO<sub>2</sub>, to which in the second charge, 8.7 grammes KNO<sub>3</sub> were added. Salt was used as cover in both.

The first charge gave an actual button of 49.5, the calculated button being 50.8 grammes. The second gave an actual button of 17.4 grammes, as against an actual button of 16 grammes. Both buttons were soft and clean, and showed none of the characteristics of As or Sb.

#### CONCLUSION.

This method may not be universally applicable; but it is useful in a smelter, where the analysis of the ore to be assayed, or, at least, of the last lot thereof, can always be obtained on the premises. Under such circumstances it is, beyond comparison, better than the haphazard KNO<sub>3</sub>-and-nails method. Moreover, in a smelter where there are always stock-ores, assay-fluxes can be mixed in large quantities and kept on hand. For matte, a single standard flux can always be used, since that product is, within 1 or 2 per cent. constant in composition.

#### METALLURGICAL PRACTICE AT THE GREENWOOD SMELTER.\*

By Paul Johnson, E.M.

THE B. C. Copper Co.'s smelter commenced operations on the 18th February, 1901, with one blast furnace, 42 by 150 inches at tuyeres. This was kept in blast till the 22nd of August, when it was shut down nine days for repairs, and started up again on the 31st August, since when it has been continuously in blast. During the time from February 18th to December 31st, 1901, in this one furnace, 117,077 tons of ore were smelted and 3,714 tons of matte, assaying from 45% to 60% in copper, from 2 to 6 oz. in gold, and from 10 to 30 oz. in silver were produced. Besides Mother Lode and Boundary ores, there have been smelted some gold quartz ores of 80% to 90% silica, utilising the basic character of the Mother Lode ore. The largest tonnage was put through during the month of December, when 13,098 tons of ore were smelted, thus averaging for the entire month, for every 24 hours, 422½ tons of ore. The largest tonnage smelted in one single day was on January 10th, 1902, when the furnace put through 459 tons of ore. To handle this amount of material, and to break up and pile the matte produced (the work of the blast furnace department proper) in 24 hours, 29 men were employed, viz.: 6 charge wheelers, 4 coke wheelers, 9 feeders (on 8-hour shifts), 2 charge weighers, 2 furnace men, 2 matte tappers, 2 roustabouts and 2 foremen; thus, during December

\*Minister of Mines Report.