

There is a battery of three egg-end boilers, which furnish motive power for washer and brick yard. Both fire-brick and common brick are made here.

There is also a large coal bunker having a capacity of four thousand tons, in which the coal is stored during the absence of shipping.

City of Cumberland.—It is the residential town for the miners and others engaged in and about the mines, having a population of twenty-five hundred. Its situation is admirable, being on rather high ground, having a gentle slope to the south and east. A splendid system of water works supplies the town with water. It is taken from Hamilton Lake, situated about three miles from the town, at an elevation of about 500 feet above the city, giving over 200 pounds pressure per square inch.

A private company is now engaged installing an electric lighting and telephone system.

THE LITHARGE PROCESS OF ASSAYING COPPER-BEARING ORES AND PRODUCTS AND THE METHOD OF CALCULATING CHARGES.*

By Walter G. Perkins, Grand Forks, B. C.

IN the assay of copper-bearing material for gold and silver, the elimination of copper before the final cupellation is of course essential, because any copper left in the lead-button will carry gold into the cupel; and a method which will effectively remove the copper with the smallest amount of manipulation is desirable. The scorification method is often rendered long and tedious by the necessity of repeatedly re-scorifying the button—to say nothing of the risk of losing Au-Ag thereby incurred. An ore carrying, for instance, 10 per cent. of copper and only 0.1 or 0.2 oz. gold per ton, cannot be scorified with accurate results, because so many portions would have to be taken in order to get enough gold for weighing. On the other hand, the crucible method, with potassic nitrate and nails, would not do at all in such a case, because all the copper would be reduced by the nails, and (if the charge were 0.5 A.T.) this would defeat cupellation, by causing cupel-absorption of gold.

In matte-assays, more concentrated value permits the determination of gold from smaller portions and thus diminishes the difficulty experienced with ores.

The method here described has been severely tested, during use for more than a year, and has never failed hitherto, in the assay of any ore or product to which it has been applied.

It is not proposed as perfect for every variety of ore or matte—probably no method would be that; but it is believed that, intelligently used, with the modifications dictated by practice, it will give better results, with less expenditure of time and labor, than any other known to the writer.

This method is based on the fact that PbO can be so used in a crucible, together with the subsidiary fluxes, such as Na₂CO₃, K₂CO₃, SiO₂KNO₃, and flour, as to give, in the determination of gold and sil-

ver ultimate results, at least equal, and in most cases superior, in accuracy to those of scorification. If the analysis of the ore be approximately known, the charge can be so calculated as to give for all ores and mattes a uniform slag, and a clean lead-button containing only small quantities of copper or other interfering elements, thus doing away with the tedious operations and repeated manipulations of the scorification method.

According to experiments in control-assays of ores and mattes, the slag that gives the best results is one of which the section, shown by breaking the cone after cooling, exhibits a silicate of lead, copper and iron on the outside edge, gradually passing to crystalline litharge towards the centre. At the proper temperature this slag pours very fluid, without including small shots of lead, and gives a clean, bright button, with little or no slag adhering to it.

The temperature of the furnace must be carefully regulated, if the calculated flux is to do its work properly. There is danger in both directions, above and below the proper point. If the furnace be too cold, the slag will be wholly crystalline and will not pour well; and probably some small shots of lead, not collected with the button, will remain in the crucible. On the other hand, if the furnace be too hot, the charge will take up silica from the crucible, leaving it in cavities in which lead may be deposited, and overlooked. Excessive temperature, moreover, increases loss by volatilization.

The best results have been secured by starting with the muffle fairly red, and a rising fire, which should in 30 minutes increase the color of the muffle to bright-red, with the charge all reduced and fusing quietly. The furnace is held at this heat for 10 minutes, and then the charge is poured. The danger of boiling over is eliminated by the fact that the bulk of the charge is lead oxide, without excess of silica or potassic nitrate to bring about any violent action. Such action is invariably encountered in using the nails or nitrate method, where the fluxes are not well balanced, and everything is added or left out, on the cut-and-try-again principle.

CALCULATIONS OF CHARGES.

In order to calculate the proportion of ore and flux, the analysis of the ore must be known as regards Cu, SiO₂, Fe and S. The reducing-effect of the sulphur and the oxidizing-effect of the nitrate must be known, not from theory, but from the results of practice with a variety of ores, such as a smelter receives, from which an average standard has been deduced. The following table was thus constructed from such experiments, made upon the same charges of ore as were used in the final assay. It was thus found as a practical rule that, upon a charge of 0.5 A. T. of ore:

1 gramme of flour will reduce.....	10	grammes Pb from PbO
4 per cent. of sulphur will reduce...	16	" " " "
4 per cent. of antimony will reduce...	3	" " " "
4 per cent. of arsenic will reduce...	6	" " " "
1 gramme of KNO ₃ will oxidize....	4	" " " "

The amount of PbO to be used will depend on the impurities to be fluxed off, the principal of these being copper, which must be taken out in order to reduce the loss by cupel-absorption. From low-grade ores (2 to 4 per cent. copper), 5 A. T. of PbO to 0.5 A. T. of ore, and from matte (48 to 60 per cent.

*From a paper read before the American Institute of Mining Engineers.