NOTES ON THE ASSAYING OF SILVER ORES.

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THE author in the following short paper, proposes to compare the scorification with the crucible method of assaying silver ores, by setting out the results obtained by both methods of assay upon different classes of ore.

The assays have not been made specially for the purpose of comparison, but have been obtained in the ordinary course of professional work, whilst dealing with the fixing of the value of ore parcels sold to Customs Smelting Works.

In determining the value of consignments of silver ore it has been the author's custom to make both assays, by the scorification and crucible methods, in duplicate, thereby to check one set of results by the other, and to take as the value of the consignment the mean of whichever prove higher, the scorification or crucible results.

By this practice it is possible to arrive more nearly at the actual silver value of a consignment, than by relying solely on the one of other method of assay.

Judging from the comparative results shown in this paper, preference should be given to the scorification assay, which averages higher results than the crucible assay and it is a very safe assumption to make that, that assay is the correct one which gives the uniformly higher results. Although as a rule higher results are obtained by scorification, yet on certain ores this rule does not hold good and higher results are obtained by the crucible assay, hence showing the necessity in important work, such as fixing the value of ore parcels, of adopting both methods of assay.

The author's experience has been to find that, in the case of silicious silver ores containing a relatively small percentage of mineral, there is but little difference as a rule in the results of scorification and crucible assays, and perhaps, taken all round, when the slags obtained in the crucible method are cleaned, that the latter method gives slightly higher results.

In the case of base ores containing a large per centage of mineral and especially when blende is present the scorification results are decidedly higher than those obtained by crucible assay.

In the results given in this paper as only one crucible charge was tried for each class of ore, with the exception of one, it might be contended that those lower results were due to the fact that the proportion of fluxes used in making up the charges for each different class of ore was unsuitable.

Even assuming that this were so, one advantage of the scorification method is at once apparent in that one is not haunted by the fear that would always attend the making of crucible assays—viz., that the results are low owing to an unsuitable selection of fluxes.

As the author's almost invariable practice in the crucible assay of silver ores containing a high percentage of sulphides is to forego the lengthy and troublesome operation of roasting, and in its place to adopt the fusion of such an ore unroasted with iron nails, and so to obtain a button of lead free from sulphur, an iron matte and slag, which latter two are cleaned, it might be suggested that the low results obtained by crucible assay were due to this method of procedure, and that the ore should have been first roasted. The results obtained by either method of assay of the sulphide ores under consideration—viz., by fusion of the unroasted ore with nails and fluxes, or by roasting followed by the fusion of the roasted ore with suitable fluxes, the author has found to be practically the same, and, from the point of view of quickness, the use of nails is much to be preferred to roasting.

Dealing with the matter of quickness, the scorification method has much to recommend it. The one furnace does for the two operations of fusing and cupelling. There is no roasting required as in crucible assay, no refusing of the slag, no experimental charges to determine the right kind and right proportion of fluxes; and, lastly, the assay can be completed in a much shorter time than the crucible assay.

The main conclusion arrived at, viz., that higher and, consequently more correct results are obtained by scorification assay, especially in the case of base ores, the author has no intention of basing upon the few results noted below. These results only confirm his belief in the accuracy of the statements of Furman, Hofmann, and others, who state that of the two methods of silver assay the scorification is the more accurate.

Dealing with this matter, Furman states that he considers the best practice to be that in which the gold is determined by crucible assay, and the silver by scorification.

The reason why the crucible is preferable to the scorification assay is owing to the fact that in the former method larger quantities of ore

can be taken for assay, a material advantage in the case of gold ores, which for the most part contain less than one ounce of that metal per ton, but one that does not hold in the case of silver ores.

Each method of assay is the favourite one in different places. For instance, in Colorado, the scorification method of assay of silver ores is the one entirely in vogue; whereas in California, the order of preference is reversed. In Australia everywhere the tendency seems to be towards the adoption of the crucible method to the entire neglect of the scorification, which is an entire reversal of what the order of things should be. The general custom should be the determination of silver by scorification assay for general work, and by both methods, selecting the higher as the correct result, when the sale value of ore parcels are being determined.

The following are the scorification and crucible assay results for a series of shipments of concentrates, the composition of all the shipments being very uniform.

The concentrates are free from sand, consisting mostly of pyrites, galena and blende, and a small quantity of copper pyrites.

The zinc runs about fifteen per cent., the lead about twelve per cent., the copper about three per cent., and the balance iron, sulphur and insoluble.

The charge for the crucible assay was :—

Ore	= 1 assay ton	= 32·66 grms.
Red Lead	= 30 grms.	
Sod. Carbonate	= 60 „	
Sand	= 15 „	
Borax	= 10 „	
Nails	„	

The matte and slag were refused and the following added :—

Red Lead	= 20 grms.
Flour	= 2 „

In ruuning down the slag and matte nails were used in the fusion as in the case of the ore.

As uniformly lower results were obtained by this method, than by scorification alterations in the method of conducting the assay were made. The concentrates were first roasted. Charges of half assay ton of ore with twenty grammes of red lead, this quantity of red lead being rather more in proportion than for the original charge were taken. Charges with a correspondingly less amount of red lead than the foregoing were also made up. Lead buttons for cupellation were obtained varying in weight between fifteen and twenty-five grammes, but the results were no higher than those obtained with the original charge.

The reason for taking one assay ton of concentrates for the charge, was on account of the material carrying gold which also had to be determined.

CRUCIBLE ASSAY.	SCORIFICATION ASSAY.	DIFFERENCE.
24·2 ozs. per ton ...	26·1 ozs. per ton ...	1·9 ozs. per ton
32·5 „ „ ...	35·3 „ „ ...	2·8 „ „
32·0 „ „ ...	35·3 „ „ ...	3·3 „ „
28·1 „ „ ...	30·0 „ „ ...	1·9 „ „
32·6 „ „ ...	35·9 „ „ ...	3·3 „ „
39·6 „ „ ...	44·4 „ „ ...	4·8 „ „
43·8 „ „ ...	45·7 „ „ ...	1·9 „ „
57·2 „ „ ...	60·2 „ „ ...	3·0 „ „
	Average difference =	2·86 „ „

The scorification assay was made upon five grammes of ore; forty grammes of test lead and 1·5 grammes borax being used as fluxes and the assays from the out-set gave no trouble whatever.

The following results are from samples of rich ore from the same property from which the concentrates were obtained.

The rich ore can be pretty confidently determined on examination, by the absence of blende, and although very highly mineralized the ore is by no means as base the concentrates, and is free from blende.

In the assay of this high-grade material the crucible results agree very well with those obtained by scorification.

CRUCIBLE ASSAY.	SCORIFICATION ASSAY.	DIFFERENCE.
276·2 ozs. per ton ...	278 ozs. per ton ...	1·8 ozs. per ton
334 „ „ ...	335·8 „ „ ...	1·8 „ „
337·4 „ „ ...	336·10 „ „ ...	1·3 „ „
	Average differences =	1·63 „ „

The average difference is only 1·66 ounces between the crucible and scorification assays, and in one instance out of the three the crucible assay gives the higher result. The charge for the crucible assay was as follows :—

Ore	= ½ assay ton = 16·33 grms.
Red lead	= 20 grms.
Sod. carbonate	= 30 „
Sand	= 5 „
Borax	= 5 „
Nails	

The slags obtained from the fusion were cleaned in the same way as that already described for the matte and slags, resulting from the running down of the concentrates.

The scorification assay was made upon five grammes, taking the same quantity of assay lead and borax as used for the concentrates, and worked satisfactorily.

The following are the assay results of a sample of highly mineralized ore, containing about forty per cent. of blende :—

CRUCIBLE ASSAY.	SCORIFICATION ASSAY.	DIFFERENCE.
(a) 233·5 ozs. per ton ...	241·5 ozs. per ton ...	8 ozs. per ton
(b) 231·6 „ „		

Result *(a)* was obtained from a charge of half assay ton, the fluxes being the same and in the same quantities as in the charge already quoted for the consignment termed rich ore. The matte and slag was cleaned in the usual way.

Result *(l)* was obtained from an assay in which roasting of the ore was practised in place of fusion with iron nails.

The following are the results for a sample of quartz ore carrying twenty per cent. of pyrites, mostly iron pyrites :—

CRUCIBLE ASSAY.	SCORIFICATION ASSAY.	DIFFERENCE.
147·2 ozs. per ton ...	146·8 ozs. per ton ...	·6 ozs. per ton.

The results in this example are slightly in favour of the crucible assay. As with most of the assays recorded, iron nails were used in place of roasting for the crucible assay in this instance also.

The following are the results obtained from the assaying of silver bearing galenas the matrix being quartz.

	CRUCIBLE ASSAY.	SCORIFICATION ASSAY.	DIFFERENCE.
Lead = 16·6 %	80·8 ozs. per ton.	80·3 ozs. per ton.	·5 ozs. per ton
Lead = 11·48 %	51·2 „ „	48·1 „ „	3·1 „ „

With this class of ore in which the matrix is mostly quartz and the mineral galena, the results obtained by crucible assay run rather higher than by scorification.

With regard to another class of ore that is one containing a large percentage of copper, undoubtedly with such an ore the scorification assay gives uniformly higher results than the crucible assay.

In conclusion, it may be stated that these results, obtained in the ordinary course of assay work, go to confirm opinions already expressed, and based upon the large experiences of such well-known authorities as Furman and Hofmann, that the scorification assay gives uniformly higher results than the crucible assay, and is specially to be recommended in the case of base ores carrying large percentages of sulphides of arsenic and zinc.

Such facts should be specially noted by assayers and metallurgists in New South Wales, as the tendency, for some unaccountable reason, is to ignore scorification assays entirely, and to accept results obtained solely by crucible assay.