

ment had a deteriorating effect on ores, etc., containing sulphides. Thus:—

Extraction with sump solution only.			Extraction with sump solution treated with lime.			per ton.
oz.	dwt.	gr.	oz.	dwt.	gr.	
(a)	12	15	2	27	0	23
(a')	13	1	8	29	9	6
(b)	18	13	16	25	14	4
(b')	19	0	5	25	14	7
(c)	4	1	1	3	1	0
(c')	3	18	9	3	0	2

With fresh solution the extractions in this set on *c* and *c'* were 4 oz. 1 dwt. 1 gr. and 3 oz. 19 dwt. 7 gr. respectively. *a* and *b* were simple quartz ores containing free gold, and *c* was an ore carrying a considerable percentage of sulphides.

A number of experiments were carried out on the above lines, and the above results were confirmed. Lime being thus shown to be ineffective, except with simple quartz ores, treatment of the solutions with sodium sulphide, followed by excess of a soluble lead salt, such as acetate of chloride, was tried with the following results:

Extraction with fresh solution.			Extraction with sump solution.			Extraction with "treated" sump solution.		
oz.	dwt.	gr.	oz.	dwt.	gr.	oz.	dwt.	gr.
(c)	3	17	2	3	13	5	3	17
(c')	3	18	9	3	13	5	3	19

It is thus evident that the continued use of sump solutions is a cause of serious loss in actual work, and that, though a universal law cannot be laid down for the best treatment of such sump solutions, it is strongly desirable that these solutions should, from time to time, be tested, and the results obtained compared with those from freshly made-up solutions; also that the addition of lime, with time for the subsidence of any precipitate formed, is of advantage in the case of very free and coarse gold ores; and that the treatment with sodium sulphide, care being taken to avoid an excess, followed by the addition of a small amount of lead salt in excess, is efficacious where lime fails. In this latter treatment time must also be given for any precipitated sulphides to separate out and subside.

By such treatment the necessity of running foul sump solutions to waste may be avoided, when water is scarce or the cyanide or gold contents are high.

*The Effect of Zinc in Solution.*—The usual practice of precipitating the gold by running the aurocyanide solutions through boxes containing zinc, causes the accumulations in the solutions of a considerable quantity of zinc salts. It has been more than once suggested that the double cyanide of zinc and potassium in the presence of caustic potash was split up into a simple cyanide plus oxide of zinc and potassium—



The author, however, discovered by means of experiments involving the crystallising out of the products, that the above equation did not hold good, but that, on the contrary, any oxide of zinc and potassium in solution combined with the added cyanide of potassium to form the double cyanide of zinc and potassium. Thus:



This shows that the zinc oxide in solution actually takes up the cyanide added by the chemist in charge to make the solutions up to normal strength, though the silver test leaves the operator in ignorance of what has happened, and thus renders it less effective for the solution of the gold than the cyanide by itself would have been.

The following experiments illustrate this point:—

Extraction with a fresh 0.5 per cent. KCy solution.			Extraction with portion of same 0.5 per cent. solution, to which 0.25 per cent. K <sub>2</sub> ZnO <sub>2</sub> was added.			per ton.
oz.	dwt.	gr.	oz.	dwt.	gr.	
(a)	2	9	0	1	11	9
(b)	16	2	3	13	6	14
(c)	1	17	21	1	2	20
(d)	12	18	17	7	4	0

This is one of the drawbacks of the zinc process as compared with the electrical deposition process, which leaves the solutions in a condition of much greater energy, though the iron anodes used in the latter process are necessarily detrimental. Insoluble anodes are much needed. The accumulation of zinc in solution is, however, prevented by the action of the sulphides contained in the ore and in the cyanide, and treatment with sodium sulphide and lead salt as shown above is a good remedy for this inefficiency.

*Losses in Cleaning Up.*—Perhaps in no other part of the process are there so many variations in the methods pursued as in that of the clean-up. At the end of the bi-monthly or monthly period the boxes are charged with slimes containing usually gold, silver, lead, zinc, iron, lime, and, in certain instances, copper; and the object in view is the conversion of these slimes into bullion with the least possible loss. To accomplish this, the treatment varies from the direct melting of the coarse zinc and slimes to separation by sieves, roasting or acid treatment, with or without filter pressing, and subsequent fusion.

To determine, if possible, the amount of loss arising from these different methods, and the best general course to be adopted, a system of very carefully conducted experiments has been carried out and the results tabulated and compared.

At first the experiments were on known weights of metallic gold and zinc in the proportions used in practice; the gold was dissolved, precipitated from its aurocyanide solution by the zinc, shaken off the zinc in the form of gold slimes, the zinc remaining was dissolved separately and the residue added to the gold slimes, which were then treated by the various methods, and the amount of bullion recovered noted together with its fineness; the deficit from the amount originally taken represented the loss in treatment. In some cases the coarse zinc was disintegrated and dissolved by the addition of alkali and cyanide, instead of acid, with the results given below.

In the final experiments, however, to gain more accurate comparative results, a large quantity of gold slimes was made, shaken off the zinc, dried, well mixed and equal quantities taken from the bulk for the various experiments; these were carried out in duplicate, no two duplicate samples, however, were weighed consecutively. In the first set the losses were found to vary from 0.5 to 6 per cent., and, as a general rule, the less handling the slimes received the less was the loss. The heaviest losses were due to roasting, and varied with the amount of stirring or handling during the operation; the least loss from this cause was 0.23 per cent. additional to that resulting from the rest of the treatment.

In a method of roasting with nitre recently described in the *Journal of the Society of Chemical Industry* (Jan., 1897), the total loss amounted to 2.57 per cent., in spite of the greatest care in heating the mixture, and in adding as little nitre as would act in the manner described in the paper; probably with practice, this loss would be considerably reduced, but it is still too serious a matter to be lightly considered.

Acid treatment yielded results varying with the kind