

To DRD, WAC - file  
From EOF  
Subject Laboratory Studies of Treatment Plant Waste Solutions

Date June 23, 1966  
Ref. EOF/nh

The purpose of this report is to identify the chief sources of soluble arsenic in the treatment plant circuits, and to offer an explanation for the increasing arsenic content in the final mill effluent. In addition a review of the experimental work that has been done in an effort to devise a feasible treatment process for eliminating arsenic from the mill waste solution is also presented.

The results of surveys made in February 1963 and June 1966 indicating the sources of the bulk of the soluble arsenic in the mill solutions, are tabulated here for comparative purposes -

Table No. I: Results of February 1963 Survey

	<u>Solution pE</u>	<u>Estimated Tonnage</u>	<u>Assay As ppm</u>	<u>Soluble As lb/day</u>
Calcline Wash Thick. O'Flow in Roaster	5.4	192	143.0	55
Calcline Wash Thick. O'Flow in Mill	5.8	546	6.4	7
Barren Bleed Solutions - Cyanide Circuits	10.8	1,800	12.0	43
Cottrell Dust - Wash Thick. O'Flow	5.6	219	119.0	52
Dust Treatment Barren	8.6	23	110.0	5
				162

During this period Mill Waste Solution to Bow Lake showed 5,938 t.p.d. assaying 4.6 ppm As = 54.6 lb/day

Table II - See Page 2

Table No. H : Results of June 1966 Survey

	<u>Solution pH</u>	<u>Estimated Tonnage</u>	<u>Assay As ppm</u>	<u>Soluble As lb/day</u>
Calcine Wash Thick. C'Flow in Roaster	6.8	177	160.09	57
Calcine Wash Thick. C'Flow in Mill	7.6	778	63.6	99
Barren Bleed Solutions - Cyanide Circuits	11.1	2,200	10.8	48
Cottrell Dust - Wash Thick. C'Flow	6.7	330	344.0	( 227 )
Dust Treatment Barren	8.3	20	935.5	37

During this period Mill Waste Solution to Dow Lake showed 4.450 t.p.d. assaying 44.93 ppm As = 402.6 lb/day.

In June 1968 changes in the roasting operation involving top feeding technique, and reduced air flows resulted in improved metallurgy. Solubility of gold in the calcine increased from 50.0 per cent to 96.0 per cent. Unfortunately the solubility of residual arsenic in the calcine also increased as indicated by the assays of the wash solutions in Table H.

Originally these solutions were quite acidic and contained appreciable amounts of soluble iron. The present wash solutions are almost neutral and contain only a trace of iron. This soluble iron content of the acidic wash solutions, when mixed with the carbonate slimes and alkaline waste solutions produced freshly precipitated ferric hydroxide which combined with soluble arsenic to form insoluble ferrous arsenate. The efficiency of this phenomenon is illustrated by the discrepancy between the total soluble arsenic in the wash solutions and the arsenic content in the final mill effluent. (Table No. I). Unfortunately under present operating conditions this beneficial reaction is practically non-existent.

A great deal of thought has been given to the treatment of waste solution for precipitating arsenic as an insoluble compound. Some of the schemes suggested included —

- (a) De-mineralizing the solutions with ion exchange resins.
- (b) Treating the acidic wash solutions with lime to form insoluble calcium arsenate.
- (c) Saturating the treatment plant solution with iron salts to precipitate the arsenic as insoluble ferrous arsenate.

The suggestion of using ion exchange resins is unrealistic. The capital expenditure for a plant to process 1,000,000 gal./day of waste solution would be exorbitant. In addition the task of disposing of the waste liquor from regenerating the ion exchange columns would be as undesirable as the original problem.

Treating acidic wash solution with lime to precipitate arsenic yielded promising results when the solution contained soluble iron. Treating wash solutions, pH 5.3, containing 5 g.p.l. iron, by oxidizing the solution and adjusting the pH to 8.6 with CaO precipitated 91.5 per cent of the arsenic. Lime required amounted to 1.5 lb per ton of solution treated (3.75 tons @ \$90 = \$337 per day). Another undesirable feature is it would be necessary to remove the bulky precipitate from the solution by filtration or decantation. This treatment applied to neutral wash solution containing only a trace of iron did not precipitate any arsenic from solution.

Saturating waste solution with iron by the addition of soluble iron salts or highly oxidized scrap iron is also effective in precipitating arsenic from solution. An excess of iron is necessary. The quantity of iron in solution should exceed the arsenic content. It is also necessary to oxidize the solution by aeration or by the addition of chemicals, and a long retention time is required for satisfactory precipitation. Laboratory tests indicated 61.7 percent of the arsenic could be removed with 18 hours retention time. Almost complete precipitation, 99.5 per cent, was achieved at the end of one week's retention time. From an economic point of view the only practical application of this process is to use scrap iron. This necessitated the removal of all suspended solids from the solution, and requires an enormous reservoir or pond to provide ample retention time for precipitation. The high iron content in the treated water could be considered a health hazard, and it would be desirable to retreat the solution with lime for removal of the iron.

None of the processes investigated could be considered practicable for the large amount of waste solution requiring purification.

---

E. O. Foster

EOF/nh