Dr. J. Convey.

[redacted]

Declassified
Déclassifié

CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

OTTAWA

MINES BRANCH INVESTIGATION REPORT IR 62-10

FLOTATION TESTS ON AN OXIDIZED COPPER ORE FROM PHOENIX COPPER COMPANY LIMITED, GRAND FORKS, B. C.

by

G. O. HAYSLIP

MINERAL PROCESSING DIVISION

COPY NO. 5

FEBRUARY 22, 1962

Mines Branch Investigation Report IR 62-10

FLOTATION TESTS ON AN OXIDIZED COPPER ORE FROM PHOENIX COPPER COMPANY LIMITED, GRAND FORKS, B.C.

by

G. O. Hayslip*

SUMMARY OF RESULTS

No marked improvement could be made in laboratory tests over plant results. No correlation was found between plant losses and the amount of oxidized copper present in the mill feed.

In both the plant tailing and in a test tailing about 50 per cent of the copper losses was found to be in the minus 325 mesh material.

After desliming a ground sample of ore, it was found that the sand fraction gave a lower flotation tailing than the slime fraction.

---

* Senior Scientific Officer, Mineral Processing Division, Mines Branch, Department of Mines and Technical Surveys, Ottawa, Canada.

INTRODUCTION

Location of Property

Phoenix Copper Company Limited is a copper producer with a mine at Grand Forks, near Greenwood, British Columbia.

Shipment

A shipment of ore, weighing 434 lb, was received from the company on March 31, 1961. The shipment was made up of composite samples of the mill feed, taken over a period of one month and a small sample of highly oxidized ore. A second shipment of 6 lb of plant tailing was received on May 8, 1961. These samples were sent by Mr. G. Hingley, Mill Superintendent.

Purpose of Investigation

It was requested that test work be done to determine if the recovery of copper could be improved. Some of the ore being mined is oxidized and at times the recovery is low.

Sampling and Analysis

After removing pieces of ore for microscopic examination, the ore was crushed to minus $\frac{1}{4}$ in. and a representative sample was riffled out. This sample was crushed to minus 10 mesh and a head sample was riffled out for chemical analysis. The remainder was used for immediate test work.

The chemical analysis* of the head sample was as follows:

---

*From Mineral Sciences Division Internal Report No. MS-61-134, by L. Lutes, F. Piche, R. McAdam, May 11, 1961.

Gold	-	0.03 oz/ton
Silver	-	0.175 "
Copper (total)	-	0.62 per cent
" (oxidized)*	-	0.066 " "
Iron	-	9.60 " "
Sulphur	-	1.92 " "

* This determination was made by shaking the sample for 15 min with 10 per cent HCl.

MINERALOGICAL EXAMINATION*

Introduction

Three polished sections of ore were prepared and a head sample of the ore was separated into fractions by heavy liquids and the Frantz isodynamic separator. The minerals were identified by means of microscopical and X-ray diffraction studies.

Results of Investigation

The metallic minerals present in the sample are chalcopyrite, pyrite and hematite, and small amounts of magnetite, covellite and goethite. The non-metallic minerals are calcite, quartz, chlorite, epidote, garnet and malachite.

The copper-bearing minerals in the sample are chalcopyrite, malachite and covellite. Chalcopyrite is the dominant copper-bearing mineral and is the only one present in fresh unweathered specimens. It occurs in irregular-shaped masses that range between 0.02 mm and 0.7 mm in diameter (see Figure 1). The malachite and covellite were

---

* From Mineral Sciences Division Internal Report No. MS-61-42, by W. Petruk, May 9, 1961.

observed only in the head sample. Malachite is present as isolated grains and covellite is present as a film on a few tarnished pyrite crystals.

Pyrite and hematite are also present in the sample. The pyrite occurs as angular and rounded crystals that range between 0.05 mm and 2.0 mm in diameter, and a few of them contain small globules of chalcopyrite. A number of the pyrite grains in the crushed head sample are tarnished blue, and X-ray diffraction studies indicate that they are coated with a film of goethite and covellite. The hematite occurs in lamellar crystals that are 0.01 mm to 0.06 mm wide and 0.2 mm to 1.0 mm long. These hematite crystals contain variable amounts of magnetite and some of them are strongly magnetic.

Conclusion

The copper-bearing minerals in the sample are chalcopyrite, malachite and covellite, but only chalcopyrite is present in significant quantities. The chalcopyrite and malachite occur as isolated grains and can be concentrated by mechanical means, but the covellite occurs only on the tarnished surfaces of the other minerals, notably pyrite, and hence is not recoverable in ordinary mill practice.

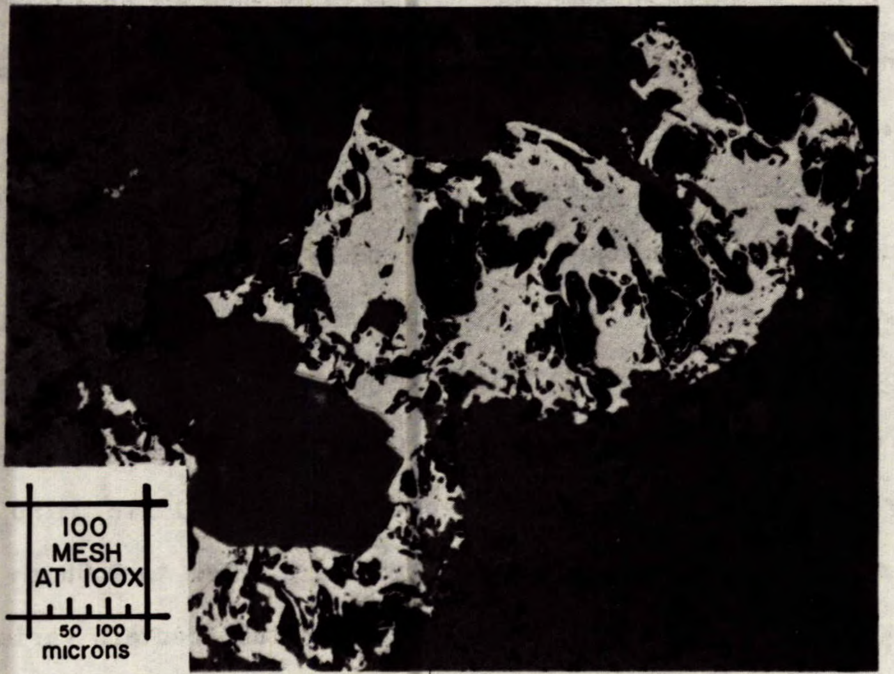

Figure 1. - Photomicrograph showing irregular-shaped grains of chalcopyrite in gangue.

DETAILS OF INVESTIGATION

After doing a test to duplicate plant operations, several tests were done using different reagents and under different conditions in an attempt to increase the recovery of copper. Grinding to different degrees of fineness was tried also. A screen analysis was done on the plant tailing and on the tailing from one of the tests to determine the distribution of the tailing losses.

Test 1

This test was done to duplicate plant operation as much as possible. In this test only a rougher concentrate was made.

Reagents and Conditions

Operation	Reagents, lb/ton	Time Min	pH
Grind (52.3% -200 M)		12	
Conditioning	Lime - 0.5 Sodium cyanide- 0.015 " sulphide- 0.01 Reagent Z-6 - 0.01 Aerofloat 208 - 0.02 " 25 - 0.01 MIBC frother - 0.05	2	9.3
Flotation (after 3 min)	Reagent Z-6 - 0.015	6	

TABLE 1

Results of Test 1

Product	Weight %	Assay % Cu	Distn % Cu
Feed (calcd)	100.0	0.63	100.0
Cu conc	2.7	16.12	69.0
Flotation tailing	97.3	0.20	31.0

Tests 2, 3 and 4

It was requested that these tests be done at different grinds. It was suggested that the ore be ground to approximately 45, 55 and 65% minus 200 mesh, all other conditions being kept identical.

Reagents and Conditions

Operation	Reagents, lb/ton	Time Min	pH
Grind			
Test 2 - (48.1% -200 M)		10	
Test 3 - (54.4% -200 M)		15	
Test 4 - (62.6% -200 M)		18	
Conditioning	Reagent Z-200 - 0.03	5	8.6
Flotation	Dowfroth 250 - 0.03	6	

TABLE 2

Results of Test 2

Product	Weight %	Assay % Cu	Distn % Cu
Feed (calcd)	100.0	0.63	100.0
Cu conc	2.8	15.24	67.7
Flotation tailing	97.2	0.21	32.3

TABLE 3

Results of Test 3

Product	Weight %	Assay % Cu	Distn % Cu
Feed (calcd)	100.0	0.64	100.0
Cu conc	2.8	15.79	69.6
Flotation tailing	97.2	0.20	30.4

TABLE 4

Results of Test 4

Product	Weight %	Assay % Cu	Distn % Cu
Feed (calcd)	100.0	0.67	100.0
Cu conc	2.7	18.2	73.1
Flotation tailing	97.3	0.18	26.9

Test 5

A screen analysis was made on a sample of flotation tailing from Test 3 and also from a sample of the plant flotation tailing.

TABLE 5

Results of Screen Analyses

Screen Size	Plant Tailing			Test 3 Tailing		
	Weight %	Assay % Cu	Distn % Cu	Weight %	Assay % Cu	Distn % Cu
Feed (calcd)	100.0	0.077	100.0	100.0	0.21	100.0
+65 mesh	12.1	0.110	16.9	7.8	0.16	5.7
-65 +100 "	13.1	0.060	10.4	13.3	0.24	15.2
-100+150 "	11.4	0.065	9.1	13.0	0.19	11.8
-150+200 "	10.5	0.062	9.1	11.5	0.15	8.1
-200+325 "	12.1	0.049	7.8	12.1	0.12	7.1
-325 "	40.8	0.088	46.7	42.3	0.26	52.1

Test 6

This test was done to show the effect of a dispersant, sodium tetraphosphate, on the flotation of the copper.

Reagents and Conditions

Operation	Reagents,	lb/ton	Time Min	pH
Grind (52.3% -200 M)	Sodium tetra-phosphate -	0.5	12	
Conditioning	Reagent Z-200 -	0.03	5	8.5
Flotation	Dowfroth 250 -	0.03	6	

TABLE 6

Results of Test 6

Product	Weight %	Assay % Cu	Distn % Cu
Feed (calcd)	100.0	0.66	100.0
Cu conc	3.5	14.29	75.8
Flotation tailing	96.5	0.17	24.2

Test 7

Two batches of ore were ground and then deslimed so as to make a separation of approximately equal weights of sand and slime. Each fraction was then floated using standard reagents as in previous tests.

Reagents and Conditions

Operation	Reagents, lb/ton	Time Min	pH
Grind (52.3% -200 M)		12	
Conditioning			
(Sands)	Reagent Z-200 - 0.03	5	8.7
(Slimes)	" Z-200 - 0.06	5	8.7
Flotation (each fraction)	Dowfroth 250 - 0.03	6	

TABLE 7

Results of Test 7

Product	Weight %	Assay % Cu	Distn % Cu
Feed (calcd)	100.0	0.64	100.0
Sand conc	3.5	7.57	40.6
Sand tailing	49.9	0.13	9.4
Slime conc	1.7	12.50	32.8
Slime tailing	44.9	0.24	17.2

CONCLUSIONS

No definite improvement was made in the recovery of copper and the use of different reagents did not improve its recovery.

No attempt was made to recover the oxidized copper as it was a minor constituent of the ore and did not appear to be a major cause of the tailing losses.

From the assays of the plant products, which were supplied by Mr. Hingley, the mill superintendent, there does not appear to be any correlation between the amount of oxidized copper in the feed and the tailing losses. As an example, the feed on February 2, 21, 25, 1961, assayed 0.65 per cent copper. The total copper in the tailing for these days was 0.14, 0.15 and 0.13 per cent respectively and the corresponding amounts of oxidized copper in the feed was 0.025, 0.045 and 0.07 per cent.

A possible answer to the problem lies in the size distribution of the copper. In a sample of the plant tailing and a test tailing it was shown that nearly 50 per cent of the copper loss is in the minus 325 mesh material (Table 5). It is possible that the copper is either too finely ground or there are too many slimes produced, which have a bad effect on the flotation results.

The use of dispersing reagents, which showed a slight improvement, indicate that the slimes may be the cause of the tailing losses (Test 6).

Another experiment that was tried was to deslime a ground sample of ore into approximately equal weight fractions, one fraction containing the sands, the other fraction containing the slimes. Each fraction was then floated separately with the sand fraction giving a much lower tailing than the slime fraction. The grade of the sand fraction concentrate was low as most of the copper was attached to gangue particles.

From the observations it would seem that anything that could be done to reduce the amount of slimes formed and, at the same time, keep the same or even a finer grind of the coarse fraction, should result in a better recovery of copper.

GOH:EBM