DIVISION OF
ORE DRESSING AND
METALLURGY

DEPARTMENT OF MINES
CANADA

MINES BRANCH

O T T A W A April 14th, 1931.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES

Report No. 395

Experimental Tests on ~~a Sample~~ of Gold and Silver Bearing Ore from the Moss Gold Mines, Limited, Kashabowie, Thunder Bay District, Ontario.

J.S. Godard

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Shipments: A shipment of 265 pounds of ore from the Moss Gold Mines Ltd., was received on February 27th, 1931. Mr. Norman R. Fisher, President of the Company, 132 St. James St., Montreal, was responsible for the shipment.

Characteristics of the Ore: The sample submitted was that of a high grade gold, low-grade silver ore. The sulphides present are principally galena and chalcopyrite. Very little free gold is present as only 15 percent is amalgamable. We are of the opinion that the gold is chiefly associated with the chalcopyrite and the silver

with the galena. The gangue material is a clean hard quartz.

Analysis:

Analysis of the head sample is as follows:

Gold	- 1.255 oz./ton.	Iron	- 3.4%
Silver	- 9.57 oz./ton.	Arsenic	- nil
Copper	- 0.52%	Sulphur	- 2.32%
Zinc	- 0.75%	Insoluable	-80.93%

Purpose of Experimental Tests: The purpose of the experimental tests was to secure some information about this ore that might be of assistance in designing a mill suitable for the recovery of the gold and silver.

Experimental Tests: Tests 1, 2 and 3 -

Amalgamation Tests: Three small scale amalgamation tests were made on samples of ore dry crushed to pass given meshes.

Test 1. Ore dry crushed -35 mesh.

Results:

Screening the Amalgamation Tailing.

Mesh	Wt. %	Assays Au	Assays Ag	% Values. Au	% Values. Ag
+48	6.4	1.09	8.72	6.4	5.9
+65	15.8	1.24	9.53	17.9	15.8
+100	16.8	0.99	8.11	15.2	14.3
+200	22.8	0.89	8.29	18.6	19.9
-200	38.2	1.20	10.96	41.9	44.1

Amalgamation Tailing - Au 1.09 oz./ton.
Ag 9.50 oz./ton.

Recovery - Au 13.5%
Ag 0.7%

Test 2. Ore dry crushed -65 mesh.

Results:

Screening the Amalgamation Tailing.

Mesh	Wt. %	Assays Au	Assays Ag	% Values Au	% Values Ag
+100	14.6	0.93	8.53	12.8	12.8
+200	31.0	0.90	8.28	26.4	26.4
-200	54.4	1.18	10.84	60.8	60.8

Amalgamation Tailing - Au 1.06 oz/ton.
Ag 9.71 oz/ton.

Recovery Au 15.9 percent.
Ag nil.

Test 3. Ore dry crushed -150 mesh.

Results:

Screening the Amalgamation Tailing.

Mesh	Wt. %	Assays Au	Assays Ag	% Values Au	% Values Ag
+200	26.5	0.92	8.00	22.8	22.2
-200	73.5	1.12	10.08	77.2	77.8

Amalgamation Tailing - Au 1.07 oz/ton.
Ag 9.53 oz/ton.

Recovery Au 15.1 percent.
Ag 0.4 "

Conclusions: As only about 15 percent of the gold and practically none of the silver is amalgamable, amalgamation need not be further considered on this ore.

Tests 4 and 5

Concentration, flotation and tabling tests.

Test #4.

Test #4.

Results:

Product	Wt. %	Assays Au	Assays Cu	% Values Au	% Values Cu
Flot. Conc.	10.8	11.24	4.80	89.5	97.7
Table Conc.	2.6	0.54	---	1.0	---
Table tail. +100	6.6	0.23	0.02	1.1	0.2
Table tail. +200	27.9	0.21	0.01	4.3	0.6
Table tail. -200	26.5	0.12	0.01	2.4	0.6
Slimes	25.6	0.09	0.02	1.7	0.9

Test #5.

Results:

Product	Wt. %	Assays Au	Assays Ag	% Values Au	% Values Ag
Flot. Conc.	11.0	11.16	81.00	93.5	93.4
Table Conc.	1.8	0.13	1.18	0.2	0.2
Table tail. +200	18.6	0.18	1.18	2.5	2.3
Table tail. -200	22.6	0.12	0.71	2.1	1.7
Slimes	46.0	0.05	0.49	1.7	2.4

The flotation concentrate assayed Cu 4.78%
Pb 9.85%

Conclusions: Tabling following the flotation was not effective on this ore.

Test #6.

Flotation Test.

Results:

Product	Wt. %	Assays Au	Assays Ag	% Values Au	% Values Ag
Conc.	11.0	12.18	85.18	93.2	94.0
Tail. +200	12.9	0.34	1.18	3.1	1.5
" -200	76.1	0.07	0.58	3.7	4.5

The flotation concentrate assayed Cu 4.62%
Pb 9.83%

Conclusions: While recoveries of 93 and 94 percent of the gold and silver were obtained by flotation, we are at a loss to know what to do with the concentrate.

A mixed copper and lead concentrate is difficult to market at a satisfactory price, and we are reluctant to try to separate the lead from the copper by either flotation or gravity means. The former method is generally achieved by the liberal application of cyanide to the mixed concentrate for the purpose of depressing the chalcopyrite while floating the galena. On a concentrate assaying 12 ounces per ton in gold and 85 ounces per ton in silver there is a danger of some dissolution of these metals taking place during the flotation which might entail some loss.

By gravity methods a good separation of the coarser galena might be expected, but the finer crystals would probably follow the chalcopyrite.

The relatively high chalcopyrite in the flotation concentrate would be detrimental to its cyanidation because of fouling of the solution, high cyanide consumption and probably precipitation and refining troubles.

Tests 7-13.

Small Scale Cyanide Tests.

In these tests the ore at -18 mesh was wet ground in a ball mill in cyanide solution then diluted to 2.5:1 and agitated for about 48 hours. The tailings were filtered and repulped.

Head Sample - gold 1.255 oz./ton.
silver 9.57 oz./ton.

Test #7.

Cyanide solution during grinding KCN 0.05%, and during agitation 0.075%.

Results:

Mesh	Wt. %	Assays oz/ton. Au	Assays oz/ton. Ag	% Values. Au	% Values. Ag	Av. Tail. oz./ton. Au	Av. Tail. oz./ton. Ag	Extr'n. % Au	Extr'n. % Ag	Reagents lb./ton. KCN	Reagents lb./ton. CAO
+100	5.4	0.50	3.46	7.5	4.0	0.36	4.66	71.3	51.4	1.75	2.64
+200	33.0	0.43	5.33	39.4	37.7						
-200	61.6	0.31	4.41	53.1	58.3						

Test #8.

Cyanide solution during grinding KCN 0.05%, and during agitation 0.075%.

Mesh	Wt. %	Assays oz/ton. Au	Assays oz/ton. Ag	% Values. Au	% Values. Ag	Av. Tail. oz./ton. Au	Av. Tail. oz./ton. Ag	Extr'n. % Au	Extr'n. % Ag	Reagents lb./ton. KCN	Reagents lb./ton. CAO
+200	22.6	0.65	4.71	38.7	23.7	0.38	4.49	69.8	53.1	1.86	3.02
-200	77.4	0.30	4.43	61.3	76.3						

Test #9.

Cyanide solution during grinding KCN 0.05%, and during agitation 0.075%.

Mesh	Wt. %	Assays oz/ton. Au	Assays oz/ton. Ag	% Values. Au	% Values. Ag	Av. Tail. oz./ton. Au	Av. Tail. oz./ton. Ag	Extr'n. % Au	Extr'n. % Ag	Reagents lb./ton. KCN	Reagents lb./ton. CAO
+200	10.7	0.70	4.16	21.3	9.9	0.35	4.51	71.9	52.9	2.27	3.86
-200	89.3	0.31	4.55	78.7	90.1						

Test #10.

Cyanide solution during grinding KCN 0.075%, and during agitation 0.075%.

Mesh	Wt. %	Assays oz/ton. Au	Assays oz/ton. Ag	% Values. Au	% Values. Ag	Av. Tail. oz./ton. Au	Av. Tail. oz./ton. Ag	Extr'n. % Au	Extr'n. % Ag	Reagents lb./ton. KCN	Reagents lb./ton. CAO
+200	5.7	1.13	5.85	29.9	9.8	0.21	3.51	85.0	63.4	2.70	3.07
-200	94.3	0.16	3.36	70.1	90.2						

Test #11.

Cyanide solution during grinding KCN 0.075%, and during agitation 0.075%.

Mesh	Wt. %	Assays oz/ton: Au	Assays oz/ton: Ag	% Values: Au	% Values: Ag	Av. Tail. oz./ton.: Au	Av. Tail. oz./ton.: Ag	Extr'n. %: Au	Extr'n. %: Ag	Reagents lb./ton.: KCN	Reagents lb./ton.: CAO
+200	4.9	0.24	1.98	15.0	7.3	0.08	1.53	93.6	86.1	2.19	2.60
-200	95.1	0.07	1.29	85.0	92.7						

Test #12.

Cyanide solution during grinding KCN 0.075%, and during agitation 0.075%.

The cyanidation tailing from this test was floated.

Results:

Product	Wt.%	Assays: Au	Assays: Ag	Assays: Cu	Assays: Pb	% Values: Au	% Values: Ag	% Values: Cu	% Values: Pb
Conc.	13.5	1.52	25.76	3.58	6.64	82.6	91.6	94.9	98.1
Tail.	96.5	0.05	0.37	0.03	0.02	17.4	8.4	5.1	1.9

Cyanidation tailing from products - Au 0.25 oz/ton, Ag 3.80 oz/ton, Cu 0.51%, Pb 0.91%.

Extraction by cyanidation - gold 80.1% - silver 60.3%

Reagent consumption lb./ton - KCN 2.60
CAO 2.90

Test #13.

This test was made on a sample of ore, dry crushed -150 mesh. Cyanide strength was 0.075% and the agitation period was 50 hours.

Results:

Mesh	Wt. %	Assays oz./ton. Au	Assays oz./ton. Ag	% Values. Au	% Values. Ag	Av. Tail. oz./ton. Au	Av. Tail. oz./ton. Ag	Extr'n. % Au	Extr'n. % Ag	Reagents lb./ton KCN	Reagents lb./ton CAO
+200	41.8	0.24	4.28	51.9	50.8	0.193	3.52	84.7	63.2	3.46	3.0
-200	51.2	0.16	2.98	48.1	49.2						

Test #14.

Cyanide Test in 100 lb. Unit.

Flowsheet: The ore at -18 mesh was fed mechanically into a small rod mill in closed circuit with a classifier. The classifier overflow was emptied into a pachuca tank. In addition to the usual air agitation equipment, the tank was in closed circuit with a small pump, which insured positive circulation of the pulp. On completion of the grinding the contents of the classifier were roughly classified and the coarse product reground in a batch mill, then emptied into the tank.

Lime equivalent to 4 lb./ton of ore, was mixed with the feed, and the grinding was done in cyanide solution, KCN 0.07%. Dilution during agitation was 2.5:1 and the cyanide strength was 0.075% KCN.

Agitation was continued for 48 hours, at the end of which period the tank was sampled both at the discharge of the agitation pump and at the discharge of the tank.

Samples of each tailing were screened on 200 mesh.

Head sample for this test was - gold 1.25 oz./ton,
silver 9.25 oz./ton.

Results:

#1 Tailing Sample (from discharge of agitation pump.)

Mesh	Wt. %	Assays oz./ton. Au	Assays oz./ton. Ag	% Values. Au	% Values. Ag	Av. Tail. oz./ton. Au	Av. Tail. oz./ton. Ag	Extr'n. % Au	Extr'n. % Ag
+200	17.9	0.075	0.98	24.6	21.7	0.055	0.81	95.7	91.2
-200	82.1	0.05	0.77	75.4	78.3				

#2 Tailing Sample (from discharge of tank.)

Mesh	Wt. %	Assays oz./ton. Au	Assays oz./ton. Ag	% Values. Au	% Values. Ag	Av. Tail. oz./ton. Au	Av. Tail. oz./ton. Ag	Extr'n. % Au	Extr'n. % Ag
+200	17.8	0.10	1.11	23.6	23.4	0.075	0.85	94.0	90.8
-200	82.2	0.07	0.79	76.4	76.6				

Average tailing samples #1 and #2.

Au - 0.065 oz./ton. Ag - 0.83 oz./ton.

Extraction based on average tailing.

Au - 94.8% Ag - 91.0%

Flotation Test on Cyanide Tailing.

A sample of the cyanide pulp was withdrawn from the tank 8 hours before discharge and this sample was filtered, washed and then floated with the following results.

Results:

1. Flotation.

Product	Wt. %	Assays Au	Assays Ag	Assays Cu	Assays Pb	% Values. Au	% Values. Ag	% Values. Cu	% Values. Pb
Conc.	9.3	0.90	6.40	5.10	9.40	77.0	70.4	94.4	93.6
Mid.	8.8	0.05	0.24	0.14	0.31	4.1	2.5	2.4	2.9
Tail.	81.9	0.025	0.28	0.02	0.04	18.9	27.1	3.2	3.5

Head Sample to flotation - Au 0.109 oz./ton,
Ag 0.85 oz./ton,
Cu 0.50 oz./ton,
Pb 0.93 oz./ton.

11. Screen analysis on the flotation tailing.

Mesh	Wt. %	Assays				% Values.			
		Au	Ag	Cu	Pb	Au	Ag	Cu	Pb
+200	27.7	0.05	0.55	0.01	0.02	56.3	53.9	16.2	13.2
-200	72.3	0.015	0.18	0.02	0.05	43.7	46.1	83.8	86.8

Flotation tailing from products - Au 0.025 oz./ton,
Ag 0.28 oz./ton,
Cu .02%
Pb 0.04%

Summary:

Head Sample	Au 1.25	oz./ton.	Ag 9.25	oz./ton.
Extraction (40 hrs.)	Au 91.2%		Ag 90.8%	
Recovery by flot.	Au 6.8%		Ag 6.5%	
Total Recovery	Au 98.0%		Ag 97.3%	

Conclusions:

Cyanidation.

The results of the small scale cyanidation tests indicate that the ore is fairly refractory. The test on the 100 pound unit showed that 94.8 percent of the gold and 91% of the silver were extracted. This test is indicative of what might be expected in actual milling.

Flotation of the cyanide tailing while interesting is of doubtful economic value on cyanide tailings of the grade of those in test #14.

The cyanide consumption is high, averaging about 2.4 lb./ton per ton of ore, exclusive of any mechanical loss. Chalcopyrite is the chief cyanicide present in the ore, and the cyanide consumption is about that which might be expected on an ore containing 0.53 per copper, as chalcopyrite. The consumption of lime is moderate.

General Conclusions:

Concentration.

Concentration by flotation showed recoveries of 93 percent of the gold and 94 percent of silver in the concentrate, which assayed gold 12 oz./ton, silver 85 oz./ton, copper 4.9% and lead 9.8%. By cleaning this concentrate the grade and ratio of concentration would be increased.

Concentration might be considered if a satisfactory market could be found for the concentrate. On account of the presence of chalcopyrite, difficulty would no doubt be experienced in its treatment by cyanidation.

One of the reasons why such good results were obtained by flotation was the clean hard gangue material in this sample. In the second shipment of ore from this mine, on which some testing has already been done, the gangue material is of a decidedly talcy nature, which is interfering with flotation.

Cyanidation.

The ore is fairly refractory to this process. Extractions of 94.8 percent of the gold and 91 percent of the silver were made on ore ground to 82 percent minus 200 mesh and by the use of fairly strong solution, .075% KCN in a dilute pulp, 2.5:1.

Grinding.

Grinding to 80 percent minus 200 mesh is necessary whether concentration or cyanidation be practised.