O T T A W A November 19th, 1941.

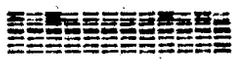
R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1114.

Gold Ore from the Leitch Gold Mines Limited,
Beardmore, Ontario.



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Shipment:

On June 5th, 1941, three sacks of ore, total weight 100 pounds, were received. The sample was submitted by Mr. A. D. Dickson, Manager, Leitch Gold Mines Limited, Beardmore, Ontario.

Purpose of Investigation:

To determine the best recovery that could be made on this high-grade ore by amalgamation followed by cyanidation of the gravity concentrates and amalgamation tailings.

Sampling and Analysis:

The ore as received was mixed and crushed to approximately 14 mesh and a head sample for analysis was cut out. The residue which was crushed all through 14 mesh was reserved for the test work. The results of the analysis are as follows:

Gold	-	8.67 oz./ton. *
Iron	-	2.64 per cent.
Sulphur (pyrite)	-	0.16 "
Sulphur (total)	-	0.49 "
Arsenic	-	0.12 "
Copper	-	0.05 "
Acid insoluble	-	87.53 "

* This assay was the average of the ten following figures: 9.42, 8.86, 7.71, 10.10, 8.08, 9.10, 7.63, 8.01, 9.70, and 8.09 ounces gold per ton.

The mineralogical analysis of the sulphide minerals is as follows:

Pyrrhotite	-	0.40 per cent.
Arsenopyrite	-	0.25 "
Chalcopyrite	-	0.14 "
Pyrite	-	0.45 "

Experimental Tests:

The various tests conducted involved gravity concentration using jigs and rubberized blankets with amalgamation of the concentrates, followed by cyanidation of the jig-blanket-amalgamation tailings. Owing to the extremely high values in the heads, recoveries by both amalgamation and cyanidation were high, although the cyanide tailings were not low. A portion of the gold content is in an extremely fine state and is not liberated by normal fine grinding. The cost of grinding fine enough to liberate all the gold does not seem to be justified.

(Continued on next page)

(Experimental Tests, cont'd) -

Gravity Concentration.

In order to check on the recovery of the gold by jigging, followed by blanketing of the jig tailing, the following preliminary test was run:

Ore at minus 14 mesh was ground at 60 per cent solids to 69.5 per cent minus 200 mesh. The ground pulp was passed over the Denver laboratory mineral jig, the tailing from which was passed over rubberized blanket. The jig and blanket concentrates were combined and the products sent for assay. A screen test on the jig-blanket tailing gave the following results:

Mesh		Weight, per cent
+ 65	-	0.1
+100	-	2.2
+150	-	12.5
+200	-	15.7
-200	-	69.5
		100.0

Jig-Blanket Concentration.

Product	Weight, per cent	Assay, Au, oz./ton:	Distribution of gold, per cent	Ratio of concentration
Jig-blanket conc.	3.81	190.00	86.64	26.3:1.
Jig-blanket tailing	96.19	1.16	13.36	
Feed (cal.)	100.00	8.35	100.00	

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Cyanidation.

Tests Nos. 1 and 2. - Straight Cyanidation of Jig Concentrates and Tailings.

Ore at minus 14 mesh was ground at 60 per cent solids to 78.3 per cent minus 200 mesh. The ground pulp was passed through the Denver laboratory mineral jig and over rubberized blankets. The jig-blanket concentrates were combined and reground to pass 99.99 per cent minus 325 mesh. The jig-blanket

(Tests Nos. 1 and 2, cont'd) -

concentrates and the tailing were each divided into two halves which were agitated in cyanide solution separately. The concentrates were both cyanided for 96 hours at 5:1 solution-to-solids ratio, with a solution strength of 3.0 pounds of NaCN per ton. 16 pounds lime per ton was added to maintain protective alkalinity. The jig-blanket tailings were cyanided for 24 and 48 hours in Tests Nos. 1 and 2 respectively, at 2:1 solution-to-solids ratio, with a solution strength of 2.0 pounds of NaCN per ton. 3 pounds lime per ton was added to maintain protective alkalinity.

Screen tests on the cyanide tailings of the jig-blanket concentrates and the jig-blanket tailing gave the following results:

Jig Concentrate.

Mesh	Weight, per cent
+325	0.01
-325	99.99
	100.00

Jig Tailing.

Mesh	Weight, per cent
+100	0.5
+150	6.6
+200	14.6
-200	78.3
	100.0

Tests Nos. 1 and 2.

Test No. 1. (Feed - Au, 8.67 oz./ton).

Product	Weight, per cent	Agitation, hours	Tailing assay, Au, oz./ton.	Extraction, per cent
Cy. tail of jig tailing	75.92	24	0.05	99.6
Cy. tail of jig conc.	24.08	96	0.58	93.2
Final tail (cal.)	100.00		0.178	97.00

Test No. 2. (Feed - Au, 8.67 oz./ton).

Cy. tail of jig tailing	76.23	48	0.135	98.8
Cy. tail of jig conc.	23.77	96	0.58	93.2
Final tailing (calc)	100.00		0.24	96.40

(Continued on next page)

(Tests Nos. 1 and 2, cont'd) -

Test No.	Reagents consumed, lb./ton			
	Jig Concentrates		Jig Tailing	
	NaCN	CaO	NaCN	CaO
1	0.75	7.0	1.10	2.7
2	0.75	6.8	1.05	2.7

The results of these two tests indicate that the cyanidation of the jig-blanket concentrates without prior removal of the free gold does not give a low tailing.

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Tests Nos. 3, 4, 5, and 6. - Cyanidation Following Amalgamation.

Ore at minus 14 mesh was ground at 60 per cent solids to 64.3 per cent minus 200 mesh in Test No. 3 and 78.8 per cent minus 200 mesh in Tests Nos. 4, 5, and 6. The ground pulps were passed through the Denver laboratory mineral jig and over rubberized blankets. The jig-blanket concentrates were barrel-amalgamated for ½ hour in Tests Nos. 3 and 4, and for 1 hour in Tests Nos. 5 and 6. The amalgam tailings and the jig-blanket tailings were re-combined in each case, sampled for assay, and then agitated in cyanide solution of a strength of 2.0 pounds of cyanide per ton. 2 pounds lime per ton was added to maintain protective alkalinity.

Amalgamation and Cyanidation. (Feed, 8.67 oz./ton.)

Test No.	Agitation, hours	Assay, Au, oz./ton: Jig-amalg. tailing	Final tailing	Extraction, per cent: Amalgam-ation	Cyan-idation	TOTAL
3	24	1.16	0.18	86.80	84.5	97.95
4	24	1.33	0.09	84.85	94.7	98.90
5	24	0.95	0.05	90.80	94.8	99.60
6	48	0.75	0.255	91.60	66.0	97.30

(Continued on next page)

(Tests Nos. 3, 4, 5 and 6, cont'd) -

Test No.	Reagents consumed, lb./ton	
	NaCN	CaO
3	1.4	3.35
4	0.6	3.80
5	0.6	5.10
6	1.2	5.10

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Tests Nos. 7, 8, 9, 10, 11, and 12. - Regrinding Gravity Concentrates Before Amalgamation, followed by Cyanidation.

Ore at minus 14 mesh was ground at 60 per cent solids. The ground pulps were passed through the Denver laboratory mineral jig and over rubberized blankets. The jig and blanket concentrates were combined in each test and reground, then barrel-amalgamated for ½ hour. The jig-blanket tailings and the amalgamation tailings were then combined and agitated in cyanide solution of a strength of 2.0 pounds NaCN per ton. 2 pounds lime was added to maintain protective alkalinity.

The various screen analyses of the cyanide tailings from these tests gave the following results:

Mesh	Weight, per cent					
	Test No. 7	Test No. 8	Test No. 9	Test No. 10	Test No. 11	Test No. 12
+ 65	-	0.3	-	0.1		
+100	0.1	3.7	1.6	2.4	As Test	As Test
+150	3.5	11.5	10.1	12.0	No. 7.	No. 10.
+200	11.0	15.5	16.6	15.8		
-200	85.4	69.0	71.7	69.7		
	100.0	100.0	100.0	100.0		

(Continued on next page)

(Tests Nos. 7, 8, 9, 10, 11, and 12, cont'd) -

Amalgamation and Cyanidation. (Feed - Au, 8.67 oz./ton.)

Test No.	Regrind time, minutes	Agitation, hours	Assay, Au, oz./ton. Jig-amalgam tailing	Final tailing	Extraction, per cent Amalgamation	Cyanidation	TOTAL
7	30	24	1.38	0.065	84.0	95.1	99.50
8	30	24	0.95	0.19	88.0	80.0	97.80
9	60	24	1.345	0.075	84.6	94.3	99.00
10	60	24	1.52	0.095	82.6	92.4	98.95
11	60	24	2.04	0.13	76.75	93.5	98.85
12	60	48	1.75	0.095	80.0	94.4	98.95

Test No.	Reagents consumed, lb./ton NaCN	CaO
7	0.60	3.8
8	1.00	3.25
9	1.00	3.25
10	0.80	2.9
11	0.70	3.3
12	0.60	2.9

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It may be seen from this and the preceding series of tests, that with the high gold values in the feed, it is not possible to get low tailings when treating this ore.

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Tests Nos. 13 and 14. - Pre-Aeration of Pulp and Cyanidation.

Ore at -14 mesh was ground at 60 per cent solids to 85.0 per cent minus 200 mesh. The ground pulp was passed through the Denver laboratory mineral jig and over rubberized blankets. The jig-blanket concentrates were reground to 99.0 per cent minus 325 mesh and then barrel-amalgamated for ½ hour. The amalgam tailings and the jig-blanket tailings were then re-combined and aerated for 20 hours in a Wallace agitator with 6 pounds of lime per ton of ore. This lime was all consumed. After aeration, the pulp was agitated in a cyanide solution of a strength of 1.0 pound per ton NaCN. 2.0 pounds

(Tests Nos. 13 and 14, cont'd) -

lime per ton was added to maintain protective alkalinity.

Tests Nos. 13 and 14. (Feed - Au, 8.67 oz./ton.)

Test No.	Regrind time, minutes	Agitation, hours	Assay, Au, oz./ton: Jig-amalgam tailing	Assay, Au, oz./ton: Cyanide tailing	Extraction, per cent: Amalgamation	Extraction, per cent: Cyanidation	Extraction, per cent: TOTAL
13	60	24	1.43	0.075	83.70	94.3	99.00
14	60	48	1.29	0.19	85.05	85.3	97.90

Test No.	Reagents consumed, lb./ton: NaCN	CaO
13	0.7	2.9
14	0.7	2.9

It will be noted from these tests and preceding tests that in almost all cases the 48-hour cyanide tailing was higher than the 24-hour tailing although in some cases the feed to cyanidation (the jig-blanket-amalgam tailing) was lower than the feed to the 24-hour cyanidation. In order to ascertain whether or not any carbonaceous material was responsible, the following tests were conducted:

Tests Nos. 15 and 16. - Use of Kerosene to Prevent Indicated Re-Precipitation.

Ore at minus 14 mesh was ground at 60 per cent solids to 85.0 per cent minus 200 mesh. The jigging, blanketing and amalgamation procedure was identical with that of Tests Nos. 13 and 14. The amalgam tailings and jig-blanket tailings were re-combined and agitated in cyanide solution of a strength of 1.0 pound NaCN per ton for 24 and 48 hours

(Tests Nos. 13 and 14, cont'd) -

for Tests Nos. 15 and 16 respectively. 2.0 pounds lime per ton was added to maintain protective alkalinity. In Tests Nos. 15 and 16, 1.0 pound per ton and 2.0 pounds per ton of kerosene were added to deactivate any carbon or carbonaceous material that might be present.

Tests Nos. 15 and 16. (Feed - Au, 8.67 oz./ton.)

Test No.	Regrind time, minutes	Agitation, hours	Assay, Au, oz./ton. Jig-amalgam tailing	Assay, Au, oz./ton. Final tailing	Extraction, per cent Amalgamation	Extraction, per cent Cyanidation	Extraction, per cent TOTAL
15	60	24	1.405	0.105	83.75	92.8	98.90
16	60	48	1.38	0.095	84.00	93.1	98.95

Test No.	Reagents consumed, lb./ton NaCN	CaO
15	0.2	2.9
16	0.4	2.9

From this test, as the use of kerosene did not give any marked increase in extraction, it is assumed that carbonaceous material does not cause the low extraction.

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Tests Nos. 17 and 18.

In these tests the grinding, jigging, blanketing and amalgamation procedures were identical with those in Tests Nos. 13 and 14. Test No. 17 was run as a check test to determine the reducing power of the solution with respect to N/10 $KMnO_4$ and the potassium thiocyanate present at the end of 24 hours' agitation. Test No. 18 had 0.5 pound per ton litharge added in the agitation period to prevent the formation of thiocyanates.

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(Tests Nos. 17 and 18, cont'd) -

Tests Nos. 17 and 18. (Feed - Au, 8.67 oz./ton.)

Test No.	Regrind, time, minutes	Agitation, hours	Assay, Au, oz./ton.: Jig-amalgam tailing	Assay, Au, oz./ton.: Final tailing	Extraction, per cent: Amalgamation	Extraction, per cent: Cyanidation	TOTAL
17	60	24	1.39	0.16	84.00	88.5	98.40
18	60	24	1.99	0.11	77.20	94.5	98.90

Test No.	Reagents consumed, lb./ton: NaCN	CaO
17	0.2	2.9
18	0.2	2.9

Final Cyanide Solutions.

Test No.	Reducing power, c.c. N/10 $KMnO_4$ per litre	KCNS, mg./litre
17	34.0	3.99
18	30.0	3.99

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Test No. 19. - Superpanning.

In this test the 24-hour cyanide tailing from Test No. 18 was treated in the Haultain superpanner to produce three products: a concentrate of the sulphides, a sand tailing, and a slime tailing. These products were each assayed for gold, sulphur, and arsenic. No free gold was recognized in the panner concentrate under the binocular microscope.

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(Test No. 19, cont'd) -

Results:

Product	Weight, per cent	Assays Oz./ton Au	Assays Per cent S	Assays Per cent As	Distribution, per cent Au	Distribution, per cent S	Distribution, per cent As	Ratio of concentration
Concentrate	2.95	1.75	5.40	1.97	45.58	39.08	71.55	34:1.
Sand tailing	52.57	0.075	0.21	0.01	34.81	27.08	6.53	
Slime tailing	44.48	0.05	0.31	0.04	19.61	33.84	21.92	
Feed (cal.)	100.00	0.113	0.41	0.08	100.00	100.00	100.00	

From the results of this test it appears that the gold in this high-grade ore is in an extremely fine state, with the largest percentage associated with the sulphides.

Summary and Conclusions:

From the results of the various tests which have been conducted on this ore, it appears that although a high percentage recovery of the gold may be made by amalgamation of jig-blanket concentrates followed by cyanidation of the jig-blanket-amalgamation tailings, it is not possible to make a low final tailing.

This is assumed to be due to the fact that a small percentage of the gold is extremely fine and remains in association with the gangue and sulphides when ground as fine as 99.99 per cent minus 325 mesh, as in Tests Nos. 1 and 2. As a result of this, it does not seem possible to produce a low tailing within the economic limits of grinding even if only a gravity concentrate is

(Summary and Conclusions, cont'd) -

reground.

It is to be recommended that this high-grade ore be blended with the mill feed as evenly as possible in order that the tailing loss due to the refractory portion of the ore may be kept at a minimum.

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