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R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1597.

Concentration and Cyanidation of a Gold Ore from the District of Rainy River, Ontario.

(Copy No. 13.)

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Concentration and Cyanidation of a Gold Ore from the District of Rainy River, Ontario.

Shipment:

A shipment of two sacks of gold ore, net weight 145 pounds, was received on January 26th, 1944, from Dr. D. R. Young, Emo, Ontario.

Location of the Property:

The property is located in the mining division of Fort Frances and consists of Mining Claims FF3998; FF3999, FF4000, and FF4001. These are near Swell Bay on Rainy Lake, 15 miles from Fort Frances, and are said to be either in or near the township of Farrington in the district of Rainy River, Ontario.

Purpose of the Investigation:

The sample was submitted to determine a method for the extraction of the gold.

Results of Experimental Tests:

The results of the test work show that 81.5 per cent of the gold was recovered by amalgamating a jig concentrate from ore ground 72 per cent minus 200 mesh. Cyanidation of the jig tailing together with the amalgamated residue resulted in an overall extraction of 98.2 per cent of the gold within 24 hours of agitation and 99.3 per cent of the gold after 48 hours of agitation.

Character of the Ore:

Polished sections made from selected specimens of the ore were examined microscopically to determine the character of the ore.

Gangue -

Gangue material consisted of clear glassy to milky white, rather fine-grained quartz, which bears extensive reddish brown stains of iron oxides and is transected by narrow sinuous fractures.

Metallic Minerals -

Metallic minerals are very sparingly disseminated and are represented by pyrite, chalcopyrite, galena, limonite, and native gold. The sulphides are present as medium-coarse to fine grains and small aggregates erratically disseminated throughout gangue. Limonite is visible as rare small irregular particles and deep stains in gangue.

Five small irregular particles of native gold were observed in the sections. All occur alone in quartz and range in size from 200 microns (-65+100 mesh) down to 60 microns (-200+280 mesh).

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Sampling and Analysis:

The sample of ore was crushed and sampled by standard methods, and was found to contain:

Gold	-	1.38 oz./ton.
Silver	-	0.22 "
Copper	-	0.03 per cent.
Lead	-	0.15 "
Iron	-	3.58 "
Sulphur	-	0.14 "
Zinc	-	None detected.
Arsenic	-	" "

Investigative Procedure:

The ore was treated by amalgamation of concentrates recovered from jigs and blankets. The residues were agitated in cyanide solutions for various periods.

A screen analysis of a blanket tailing was made to show the distribution of gold in the tailing.

EXPERIMENTAL TESTS:

Tests 1 and 2. - Jig Concentration and Amalgamation of the Jig Concentrate.

Test 1. -

A sample of ore was ground in a ball mill at a dilution of four parts solids to three parts water. A screen test showed that the ore was ground 53.5 per cent minus 200 mesh.

The ground ore was passed over a Denver laboratory mineral jig to recover free gold in the sample. A microscopic examination of this concentrate showed that free gold was present.

The jig concentrate was barrel-amalgamated and the mercury and amalgam were separated from the amalgamated concentrate. A microscopic examination of the amalgamated concentrate did not disclose the presence of any gold or floured mercury. The mercury and amalgam were clean and bright.

The amalgamated concentrate was returned to the jig

(Experimental Tests, cont'd) -

tailing which was filtered, sampled and assayed for gold. The recovery of gold was then calculated from the assays.

Test 2. -

A similar test was made at a grind of 72 per cent minus 200 mesh.

Results:

Amalgamation.

Test No.	Assays, Au, oz./ton: Feed	Tailing	Recovery of gold, per cent
1	1.38	0.32	76.81
2	1.38	0.255	81.52

A screen test was made on each amalgamation tailing from Tests 1 and 2.

Screen Test.

Mesh No.	Weight, per cent: Test 1	Test 2
+ 65	0.6	0.05
- 65+100	6.8	1.40
-100+150	20.0	10.60
-150+200	19.1	15.50
-200	53.5	72.45
	100.0	100.00

Test 3. - Jig and Blanket Concentration and Amalgamation of Concentrates.

This test was made to note the recovery of gold that could be obtained by amalgamation of a jig and blanket concentrate.

A sample of ore was ground 72 per cent minus 200 mesh and concentrated in a Denver laboratory mineral jig. The jig tailing was passed over corduroy blankets sloping about 2⅛ inches in 12 inches.

The jig and blanket concentrates were examined for gold separately, then combined and barrel-amalgamated.

The amalgamated concentrates were returned to the

(Test 3, cont'd) -

blanket tailing, which was filtered and dried. A representative portion was used to make a screen analysis to show the values in gold remaining in the various screen sizes.

The microscopic examination of the two concentrates disclosed a considerable number of coarse particles of gold in the jig concentrate. Gold was also seen in the blanket concentrate but consisted of smaller particles.

No free gold was seen in the amalgamated concentrates after separating the mercury and amalgam. No floured mercury resulted from the amalgamation.

Results:

Amalgamation.

Test No.	Assay, Au, oz./ton: Feed	Tailing	Recovery of gold, per cent
3	1.38	0.20	85.50

Screen Analysis of the Blanket Tailing.

Product	Weight, per cent	Au, oz./ton	Distribution of gold, per cent
- 48+ 65	0.05)		
- 65+100	1.40)	0.073	4.82
-100+150	10.60)		
-150+200	15.50	0.075	6.38
-200+325	21.75	0.08	9.54
-325	50.70	0.285	79.26
Blanket tailing	100.00	0.182	100.00
-200 mesh	72.45	0.223	88.80

This test indicates that 88.8 per cent of the gold remaining in the tailing was in the minus 200 mesh portion of the ore and could best be recovered by cyanidation.

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(Experimental Tests, cont'd) -

Test 4. - Cyanidation of Jig Tailing.

This test was made to note the extraction of gold by cyanide solution.

Two samples from each of the final tailings from Tests 1 and 2 were used as the feeds for this test. Unless the coarse gold in the ore is previously removed, a prolonged period of agitation in cyanide solution would be required in order to dissolve these coarse particles.

The charges were agitated at a dilution of 1 part ore to 2 parts cyanide solution containing 1.0 pound of sodium cyanide per ton of solution. Lime was added to give protective alkalinity to the solution. Periods of agitation were 24 and 48 hours for each of the two different feeds.

The feed used for these tests was 53.5 and 72.5 per cent minus 200 mesh and is designated Tests 1 and 2 respectively in the table of results.

Results:

Test No.	Period of agitation, hours	Assays, Au, oz./ton		Extraction of gold, per cent	Final titration, lb./ton solution		Reagents consumed, lb./ton of ore	
		Feed	Tailing		NaCN	CaO	NaCN	CaO
1	24	0.32	0.025	92.19	0.95	0.15	1.10	10.25
1	48	0.32	0.01	96.88	0.95	0.55	1.11	12.40
2	24	0.255	0.025	90.20	0.90	0.20	1.20	9.80
2	48	0.255	0.01	96.08	0.85	0.25	1.32	13.00

These results indicate an excessive consumption of lime during cyanidation, due to the oxidized condition of this sample of ore.

(Continued on next page)

(Test 4, cont'd) -

Summary of Overall Recovery of Gold:

	Test 1, -per cent-	Test 2, -per cent-
Recovery by amalgamation -	76.81	81.52
Gold remaining in amalgamation tailing -	23.19	18.48
Extraction by cyanidation in 24 hours -	92.19	90.20
Extraction by cyanidation in 48 hours -	96.88	96.08
Extraction from original feed, 23.19 x 92.19 -	21.38	
Extraction from original feed, 18.48 x 90.20 -		16.67
Total combined extraction (24 hours) -	98.19	98.19
Final tailing after 24-hr. agitation -	1.81	1.81
Total - - -	100.00	100.00
Extraction from original feed 23.19 x 96.88 -	22.47	
Extraction from original feed 18.48 x 96.08 -		17.76
By amalgamation -	76.81	81.52
Total combined extraction (48 hours) -	99.28	99.28
Final tailing after 48-hr. agitation -	0.72	0.72
Total - - -	100.00	100.00
Grind of feed, per cent minus 200 mesh -	53.5	72.45

CONCLUSIONS:

The investigation discloses that ore represented by this sample contains free-milling gold, which is liberated for extraction at the comparatively coarse grind of 53.5 per cent minus 200 mesh. It was noted that grinding 72 per cent minus 200 mesh gave a higher recovery by amalgamation, but that the overall recovery including cyanidation was equal in both grinds.

An ore of this character presents no metallurgical difficulties, and high recoveries may be expected from a conventional flow-sheet. The elaborateness of the equipment prior to the grinding mill will depend to a large extent on the daily tonnage to be milled. The equipment should consist of a primary jaw crusher followed by a secondary crusher, preferably of the cone type, to reduce the ore to a size ranging from ¼ inch to 5/8 inch. From here it passes to the mill bin feeding a ball or rod mill. The ball mill discharge should pass through a jig or trap to remove coarse free gold which is drawn off and amalgamated in a small amalgam barrel. The tailing from the jig is then passed to a classifier, from which the sands are returned to the ball mill for further grinding. The classifier should be adjusted to give an overflow of material with a particle size of approximately 60 per cent minus 200 mesh.

Grinding should be done in cyanide solution with sufficient lime added to the ball mill feed to maintain protective alkalinity and to give a clear overflow.

The classifier overflow should then pass to the cyanide plant consisting of thickeners, agitators, filters and a precipitation unit.

Residues from the amalgamation of jig concentrates should be returned to the classifier-ball mill circuit for further treatment.

The results obtained on this sample can apply only

(Conclusions, cont'd) -

to the sample under investigation. Development of the property doubtless would supply a milling ore of a lower gold content and probably one in which oxidation was not so pronounced. Should the sulphide content increase with depth, different results can be expected.

When the property has been developed and an ore body of sufficient extent has been outlined, it is recommended that a representative sample be sent for further investigation.

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