O T T A W A July 2nd, 1940.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 867.

Amalgamation, Cyanidation and Calcination of a Gold Ore from the Con Mine, Yellowknife, Northwest Territories.

BUREAU OF MINES
DIVISION OF METALLIC MINERALS
—
ORE DRESSING AND
METALLURGICAL LABORATORIES

CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

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Shipment:

Three bags of mill feed, total weight 120 pounds, and 1 can of mill tailing, weighing 35 pounds, were received on April 18th, 1940, from C. M. Spence, Mill Superintendent, Con Mine, Yellowknife, Northwest Territories.

Location of the Property:

This property of the Consolidated Mining and Smelting Company of Canada, Limited, which is known as the CON mine and from which the present shipment was received, is situated on Yellowknife bay, in the Yellowknife area, Northwest Territories.

Sampling and Analysis:

After cutting, crushing and grinding by standard methods, representative samples of the mill feed and mill tailing were obtained which assayed as follows:

	Mill Feed	Mill Tailing
Gold, oz./ton	0.57	0.06
Silver, "	0.19	0.07
Iron, per cent	5.53	5.62
Sulphur, "	1.22	1.22
Arsenic, "	0.49	0.58
Antimony, "	0.14	0.14
Copper, "	Trace.	Trace.
Zinc, "	0.35	0.35
Lead, "	Trace.	Trace.
Graphitic carbon, per cent	0.05	0.05

Characteristics of the Ore:

Owing to the finely divided condition of the shipment it was not possible to make polished sections which would reveal the relation of the different minerals to the gold deposition.

However, a number of sections made from super-panner concentrates of cyanide residues were studied and are reported on later in the context of this report.

Investigative Work:

The present flow-sheet of the Con mill was

followed as closely as possible in the test work. The mill feed sample was ground in cyanide solution and then passed through a Denver jig. The jig overflow passed over corduroy blankets. The jig and blanket concentrates were then amalgamated and the amalgam residue added to the blanket tailing. This product was then bottle-agitated for 24 and 48 hours. The grinds were from 68 to 86 per cent minus 200 mesh. By this procedure a cyanide residue of 0.04 to 0.05 ounce gold per ton was obtained. When a Wilfley table was introduced into the grinding circuit and the resulting concentrate was reground, a residue of 0.03 ounce gold per ton was secured. Alternatively, flotation of the cyanide residue and regrinding and agitation of the flotation concentrate showed an overall tailing loss of 0.035 ounce gold per ton.

A number of tests were also made on the cyanide residue by flotation followed by roasting of the flotation concentrate and cyanidation of the calcine. By this means an overall tailing loss of 0.02 ounce gold per ton was obtained.

On the mill tailing shipment it was shown that concentration by a Wilfley table followed by regrinding of the table concentrate and further agitation resulted in lowering the tailing from 0.06 ounce to 0.035 ounce gold per ton.

Details of Investigative Test Work:

The test work is divided into two parts. Part I consists of the work done on the mill feed sample

and Part II covers the work done on the mill tailing sample.

PART I. - MILL FEED.

As received from the mine, the mill feed screened 28.3 per cent minus 100 mesh and 19.2 per cent minus 200 mesh. Prior to the test work the shipment was ground to pass 100 per cent minus 14 mesh.

Test No. 1. - Amalgamation and Cyanidation.

The ore at minus 14 mesh was ground in a ball mill in cyanide solution of 1 pound NaCN per ton strength, with 3 pounds of lime per ton of ore, to pass 68 per cent minus 200 mesh. The pulp was then passed through a Denver jig and the jig overflow passed over a corduroy blanket. The combined jig and blanket concentrates were amalgamated with mercury in a jar mill and the amalgam residue was added to the blanket tailing. This product was then bottle-agitated in cyanide solution of 1 pound NaCN per ton strength for 24- and 48-hour periods. The resulting cyanide residues were combined, filtered, washed, repulped, and transferred to a flotation machine. The pulp was then conditioned with 2.2 pounds of soda ash and 1.3 pounds of copper sulphate per ton and floated with 0.08 pound Barrett No. 4 oil, 0.05 pound pine oil and 0.015 pound potassium amyl xanthate per ton. The concentrate was cleaned in a smaller machine. The cleaner concentrate was then washed, reground in cyanide solution of 3 pounds NaCN per ton strength to pass 99 per cent minus 325 mesh, and agitated for a 24-hour

(Test No. 1, cont'd) -

period. The different products were assayed for gold.

Results of Test No. 1:

The jig and blanket concentrates were 3.96 per cent of the weight of the feed. The blanket tailing assayed 0.16 ounce gold per ton. The blanket tailing + amalgam residue assayed 0.19 ounce gold per ton, showing an extraction of 66.7 per cent of the gold in the cyanide grind + amalgamation of the combined concentrates.

Cyanidation of Amalgam Residue + Blanket Tailing.

Agitation, hours	Grind, % -200 mesh	Assays, Au oz./ton Feed	Assays, Au oz./ton Tailing	Extraction of gold, per cent	Titration, lb./ton solution NaCN	Titration, lb./ton solution CaO	Reagents consumed, lb./ton ore NaCN	Reagents consumed, lb./ton ore CaO
24	68.0	0.19	0.04	79.0	0.96	0.32	0.30	4.36
48	68.0	0.19	0.04	79.0	1.00	0.24	0.40	5.12

The flotation of the cyanide residues resulted as follows:

Product	Weight, per cent	Assay, Au oz./ton	Distribution of gold, per cent	Ratio of concentration
Feed	100.00	0.04	100.0	
Flot. conc.	4.56	0.51	58.5	21.9:1.
Flot. middling	3.33	0.09	7.0	30:1.
Flot. tailing	92.11	0.015	34.5	

The pH of the pulp was 9.7.

The flotation concentrate was reground in cyanide solution and bottle-agitated, with the following results:

Agitation, hours	Grind, % -325 mesh	Assays, Au oz./ton Feed	Assays, Au oz./ton Tailing	Extraction of gold, per cent	Titration, lb./ton solution NaCN	Titration, lb./ton solution CaO	Reagents consumed, lb./ton conc. NaCN	Reagents consumed, lb./ton conc. CaO
24	99.0	0.51	0.40	21.6	2.6	0.25	6.6	14.0

(Continued on next page)

(Test No. 1, cont'd) -

Results, cont'd

The total cyanide consumption, including the cyanide grind, agitation of amalgam residue + blanket tailings, and the regrinding and agitation of the flotation concentrate, was 0.95 pound per ton of ore. The total lime consumption was 7.9 pounds per ton of ore.

Summary of Test No. 1:

		Per cent
Gold extracted by cyanide grind + amalgamation	=	66.7
Gold extracted by agitation of blanket tailing + amalgam residue	=	26.3
Gold extracted by regrinding and agitation of flotation concentrate	=	0.9
Overall extraction	=	93.9 per cent.
Overall tailing loss	=	0.035 Au oz./ton.

-

Test No. 2. - Amalgamation and Cyanidation.

This test was conducted similarly to Test No. 1. The initial cyanide grind was 86.2 per cent minus 200 mesh. The flotation concentrate was reground in water. Conditions otherwise were similar to those of Test No. 1.

After grinding in cyanide, passing the pulp through a jig followed by corduroy blankets, amalgamating the combined concentrates, and adding the amalgam residue to the blanket tailing, the product obtained assayed 0.15 ounce gold per ton. This was bottle-agitated in cyanide solution as follows:

(Continued on next page)

(Test No. 2, cont'd) -

(Results)

Cyanidation.

Agitation, hours	Grind, % -200 mesh	Assays, Au oz./ton: Feed	Assays, Au oz./ton: Tailing	Extraction: of gold, per cent	Titration, lb./ton solution: NaCN	Titration, lb./ton solution: CaO	Reagents consumed, lb./ton ore: NaCN	Reagents consumed, lb./ton ore: CaO
48	86.2	0.15	0.04	73.4	0.96	0.16	0.60	6.00

Concentration of Cyanide Residue by Flotation.

Product	Weight, per cent	Assay, Au oz./ton:	Distribution of gold, per cent	Ratio of concentration
Feed	100.00	0.04	100.0	
Flot. conc.	4.46	0.65	71.8	22.4:1.
Flot. middling	4.41	0.05	5.5	22.7:1.
Flot. tailing	91.13	0.01	22.7	

The pH of the pulp was 9.7.

The flotation concentrate was reground in water to pass 99.0 per cent minus 325 mesh and bottle-agitated for 48 hours.

Agitation, hours	Grind, % -325 mesh	Assays, Au oz./ton: Feed	Assays, Au oz./ton: Tailing	Extraction: of gold, per cent	Titration, lb./ton solution: NaCN	Titration, lb./ton solution: CaO	Reagents consumed, lb./ton conc.: NaCN	Reagents consumed, lb./ton conc.: CaO
48	99.0	0.65	0.465	28.5	2.9	0.25	4.4	13.5

Total reagent consumptions:

NaCN = 0.90 lb./ton ore
CaO = 8.20 " "

Summary of Test No. 2:

	Per cent
Gold extracted by cyanide grind + amalgamation -	73.7
" " " agitation of blanket tailing + amalgam residue -	19.3
" " " regrinding and agitation of flotation concentrate -	1.4
Overall extraction -	94.4 per cent.

Overall tailing loss = 0.032 Au oz./ton.

-

Test No. 3. - Amalgamation, Cyanidation, and Table Concentration.

The ore at minus 14 mesh was ground in cyanide solution to pass 78.1 per cent minus 200 mesh, passed through a jig and blankets, and the concentrates were amalgamated as in the previous tests.

The amalgam residue was then added to the blanket tailing and passed over a Wilfley table. The table concentrate was reground in cyanide solution to pass 99.0 per cent minus 325 mesh and added to the table tailing. This product was agitated for 24- and 48-hour periods.

The amalgam residue + blanket tailing assayed 0.15 ounce gold per ton, showing an extraction of 73.7 per cent of the gold in the cyanide grind and amalgamation. After passing over the Wilfley table the concentrate weighed 2.91 per cent of the feed. It was reground, added to the table tailing, and bottle-agitated, with the following results:

Agitation, hours	Grind, % -200 mesh	Assays, Au oz./ton: Feed	Assays, Au oz./ton: Tailing	Extraction of gold, per cent	Titration: lb./ton solution: NaCN	Titration: lb./ton solution: CaO	Reagents consumed, lb./ton ore: NaCN	Reagents consumed, lb./ton ore: CaO
24	78.1	0.15	0.04	73.3	0.96	0.20	0.30	4.0
48	78.1	0.15	0.03	80.0	0.96	0.20	0.40	4.6

Total reagent consumptions:

NaCN = 0.75 and 0.85 lb./ton ore
CaO = 6.50 and 7.10 " "

(Continued on next page)

(Test No. 3, cont'd)-

Summary of Test No. 3:

	Per cent
Gold extracted by cyanide grind + amalgamation	- 73.7
" " " bottle agitation, 24 hours	19.3
" " " " " , 48 "	21.0
Overall extraction, 24-hour agitation	- 93.0 per cent.
" " , 48-hour "	- 94.7 "
Overall tailing loss, 48-hour agitation	= 0.03 Au oz./ton.

Test No. 4 (A to F). - Straight Cyanidation.

In this test the ore was ground in a ball mill in cyanide solution to different degrees of fineness with various reagents added to the grind. The pulps were then agitated for 48 hours.

Reagents added to grind:

Test No.	NaCN, lb./ton solution.	Lime, lb./ton ore.	Fuel oil, lb./ton ore.	$PbNO_3$, lb./ton ore.
4-A	1.0	3.0		
4-B	2.0	3.0		
4-C	1.0	3.0	0.05	-
4-D	1.0	3.0	-	0.5
4-E	1.0	2.0		
4-F	1.0	8.0		
4-G	1.0	2.0		
4-H	1.0	8.0		

(Continued on next page)

(Test No. 4, cont'd) -

Results of Grinding and Agitation:

(Feed = Au 0.57 oz./ton)

Test No.	Agitation, hours	Grind, % -200 mesh	Tailing assay, Au oz./ton	Extraction of gold, per cent	Titration, lb./ton solution: NaCN	Titration, lb./ton solution: CaO	Reagents consumed, lb./ton ore: NaCN	Reagents consumed, lb./ton ore: CaO	Reducing power, ml. N/10 $KMnO_4$ per litre
4-A	48	82.2	0.04	93.0	1.0	0.15	0.6	6.6	110
4-B	48	82.2	0.045	92.1	2.0	0.15	1.4	6.6	120
4-C	48	82.2	0.05	91.2	1.0	0.15	0.6	6.6	110
4-D	48	82.2	0.05	91.2	1.0	0.15	0.6	6.6	70
4-E	48	74.0	0.045	92.1	1.0	0.15	0.6	5.2	96
4-F	48	74.0	0.045	92.1	1.0	0.50	0.8	11.4	96
4-G	48	95.0	0.035	93.9	1.0	0.15	0.8	5.2	130
4-H	48	95.0	0.04	93.0	1.0	0.50	0.8	11.4	130

A portion of the cyanide residue from Tests Nos. 4-A and 4-B and a second portion from Tests Nos. 4-C and 4-D were concentrated on the Haultain superpanner, with the following results:

(Tests Nos. 4-A and 4-B)

Product	Weight, per cent	Assay, Au oz./ton	Distribution of gold, per cent
Feed	100.0	0.0425	100.0
Panner concentrate	2.3	0.60	32.7
Panner sands	45.2	0.04	42.6
Panner slimes	52.5	0.02	24.7

(Tests Nos. 4-C and 4-D)

Feed	100.0	0.050	100.0
Panner concentrate	2.0	1.25	50.0
Panner sands	32.1	0.04	25.6
Panner slimes	65.9	0.02	24.4

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(Test No. 4, cont'd) -

Under the binocular microscope the concentrates were seen to consist mainly of pyrite and arsenopyrite. No free gold was visible.

The concentrates were then divided into two parts, consisting of the "Tip" and the "Bulk". These parts were made into polished sections and examined under a high-power reflecting microscope, with the following results:

Tests Nos. 4-A and 4-B:

Superpanner Tip -

Minerals: Pyrite, arsenopyrite, stibnite, tetrahedrite, and sphalerite.
Gold: One grain about 10 microns in size; free.

Superpanner Bulk -

Minerals: Pyrite, arsenopyrite, sphalerite, tetrahedrite, magnetite, chalcopyrite, and stibnite.
Gold: None visible.

Tests Nos. 4-C and 4-D:

Superpanner Tip -

Minerals: Pyrite, arsenopyrite, tetrahedrite, stibnite, and sphalerite.
Gold: Three grains of free gold, from 70 to 10 microns in size.

Superpanner Bulk -

Minerals: Pyrite, arsenopyrite, tetrahedrite, sphalerite, chalcopyrite, stibnite.
Gold: None visible.

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Test No. 5. - Haultain Infrasizing.

Following the flow-sheet used in Tests Nos. 1 and 2, a cyanide residue was obtained assaying 0.04 ounce gold per ton at a grind of 91.25 per cent minus 200 mesh.

The plus 200 mesh portion, consisting of 8.75 per cent by weight of the residue, assayed 0.04 ounce gold per ton and 0.80 per cent sulphur. The minus 200 mesh material was passed through the Haultain infrasizer, with the following results:

Size in microns	Weight, per cent	Assays, Au, oz./ton	Assays, S, per cent	Distribution, per cent Au	Distribution, per cent S
+56	2.0	0.14	6.99	7.3	11.2
-56 +40	13.8	0.06	1.90	21.7	20.9
-40 +28	12.9	0.05	1.72	16.8	17.7
-28 +20	13.4	0.05	1.42	17.6	15.2
-20 +14	10.9	0.04	1.27	11.5	11.0
-14 +10	9.6	0.02	0.99	4.7	7.6
-10	37.4	0.02	0.55	20.4	16.4
Totals	100.0	0.038	1.25	100.0	100.0

Length of time for test: 7 hours, 10 minutes.
Number of drops per minute: 63.
Differential pressure: 19 inches of water.
Height of drop: 5/16 inch.
Standard golf balls were used.

As can be seen from the above results it is only in the smallest-sized particles of minus 14 micron size that an appreciable reduction in the gold assay occurs. The sulphur content follows the gold quite closely and it is apparent that the refractory gold occurs in close relationship to the sulphides.

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Test No. 6 (A, B, and C). - Flotation and Roasting.

In this test, portions of the cyanide residues were repulped in a flotation machine, conditioned with 2.2 pounds of soda ash and 1.3 pounds of copper sulphate per ton, and a flotation concentrate secured by the further additions of 0.08 pound Barrett No. 4 oil, 0.05 pound pine oil, and 0.15 pound potassium amyl xanthate per ton. This concentrate was cleaned in a smaller machine. The cleaner concentrate was then washed, dried, and roasted in an oxidizing atmosphere. The temperature was gradually raised to 280° C. where it was held until no further fumes of sulphur and arsenic were visible, the concentrate being constantly rabbled during the process. Temperature was then gradually increased to a maximum of 650° C. where it was held for a further 1-hour period. The calcine was then cooled, weighed, washed, reground to pass 99 per cent minus 325 mesh, and agitated in cyanide solution of 3 pounds NaCN per ton strength for 48 hours.

Three cyanide residues, assaying 0.0425 ounce gold per ton in Test No. 6-A, 0.035 ounce gold per ton in Test No. 6-B, and 0.047 ounce gold per ton in Test No. 6-C, were repulped and concentrated by flotation, as follows:

Test No.	Weight of flot. conc., per cent of feed	Assays, Au oz./ton			Distribution of gold, per cent		
		Concentrate	Middling	Tailing	Concentrate	Middling	Tailing
6-A	4.26	0.73	0.09	0.01	73.2	4.9	21.9
6-B	4.59	0.54	0.03	0.01	70.3	3.7	26.0
6-C	4.07	0.66	0.05	0.02	56.8	4.3	38.9

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(Test No. 6, cont'd) -

A screen test on the cyanide residues showed:

Residue 6-A	=	82.2	per cent	minus	200	mesh
" 6-B	=	91.2	"	"	"	"
" 6-C	=	68.0	"	"	"	"

In Test No. 6-C the comparatively coarse grind resulted in a flotation tailing of 0.02 ounce gold per ton.

After the roasting of the flotation concentrates the following losses in weight were shown:

6-A	=	21.0 per cent
6-B	=	18.0 "
6-C	=	19.0 "

In Tests Nos. 6-A and 6-B the concentrate was ground in cyanide prior to agitation. In Test No. 6-C the grinding was done in water prior to agitation.

The cyanidation of the calcines resulted as follows, the head assays being calculated from the loss in weight:

Test No.	Agitation, hours	Grind, % -325 mesh	Assays, Au oz./ton: Feed	Assays, Au oz./ton: Tailing	Extraction of gold, per cent	Titration, lb./ton solution: NaCN	Titration, lb./ton solution: CaO	Reagents consumed, lb./ton calcine: NaCN	Reagents consumed, lb./ton calcine: CaO
6-A	48	99.0	0.83	0.175	78.9	2.7	0.25	7.9	14.1
6-B	48	99.0	0.64	0.18	71.9	2.5	0.25	8.3	12.2
6-C	48	99.0	0.78	0.29*	62.8	2.8	0.30	5.9	8.0

* Water grind.

The calcine residues assayed as follows:

Residue from Test No.	Au, oz./ton	Total S, per cent	SO_3, per cent	SO_2, per cent	As, per cent
6-A	0.175	0.68	0.63	0.05	1.22
6-B	0.18	1.07	1.07	Trace	1.98
6-C	0.29	1.16	1.14	0.02	1.95

(Continued on next page)

(Test No. 6, cont'd) -

Summary of Test No. 6:

Test No.	Cyanide residue, Au oz./ton	Gold in flot. concentrate: Oz./ton	Gold in flot. concentrate: Per cent	Gold extracted from calcine of flot. concentrate: Oz./ton	Gold extracted from calcine of flot. concentrate: Per cent	Overall tailing loss, Au oz./ton
6-A	0.0425	0.83	73.2	0.665	78.9	0.018
6-B	0.035	0.64	70.3	0.46	70.3	0.017
6-C	0.047	0.78	56.8	0.59	62.8	0.030

-

This concluded the work on the mill feed sample, the remainder of the report being devoted to the mill tailing.

PART II. - MILL TAILING.

Test No. 1 (A, B, and C). - Cyanidation.

In Test No. 1-A the tailing was agitated in cyanide solution of 1 pound NaCN per ton strength for 24 hours without regrinding.

In Test No. 1-B the tailing was reground in cyanide solution of 1 pound NaCN per ton strength to pass 86.2 per cent minus 200 mesh and agitated for 24 hours.

In Test No. 1-C the tailing was reground in cyanide to pass 92.4 per cent minus 200 mesh.

(Continued on next page)

(Test No. 1, cont'd) -

Results: (Cyanidation)

(Feed, Au 0.06 oz./ton)

Test No.	Agitation, hours	Grind, % -200 mesh	Tailing assay, Au oz./ton	Extraction of gold, per cent	Titration, lb./ton solution: NaCN	Titration, lb./ton solution: CaO	Reagents consumed, lb./ton ore: NaCN	Reagents consumed, lb./ton ore: CaO
1-A	24	No re-grind.	0.06	Nil	0.96	0.18	0.70	3.6
1-B	24	86.2	0.04	33.3	0.92	0.18	0.75	4.6
1-C	24	92.4	0.035	41.7	0.92	0.20	0.90	4.6

-

Test No. 2. - Amalgamation.

A portion of the tailing was barrel-amalgamated with mercury for 1 hour in a jar mill without regrinding. The amalgam residue was assayed for gold.

Results of Barrel Amalgamation:

Assays, Au oz./ton: Feed	Assays, Au oz./ton: Tailing	Recovery of gold, per cent
0.06	0.0525	12.5

-

Test No. 3. - Table and Flotation Concentration.

A sample of the tailing was passed over a Wilfley table and the table tailing concentrated on a flotation machine, with the following results:

Table Concentration.

Product	Weight, per cent	Assay, Au oz./ton	Distribution of gold, per cent	Ratio of concentration
Feed	100.00	0.06	100.0	
Table concentrate	1.27	1.10	23.3	79:1.
Table middling	6.90	0.135	15.5	14.5:1.
Table tailing	91.83	0.04	61.2	

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(Test No. 3, cont'd) -

The table tailing was conditioned with 2.2 pounds of soda ash and 1.5 pounds of copper sulphate per ton and a flotation concentrate removed by the further additions of 0.04 pound Barrett No. 4 oil, 0.05 pound pine oil, and 0.10 pound of potassium amyl xanthate per ton.

Flotation of Table Tailing.

Product	Weight, per cent	Assay, Au oz./ton	Distribution of gold, per cent	Ratio of concentration
Feed	100.00	0.04	100.0	
Flot. concentrate	2.43	0.77	46.7	41:1.
Flot. middling	3.80	0.07	6.6	26:1.
Flot. tailing	93.77	0.02	46.7	

The pH of the pulp was 9.2.

Summary of Test No. 3:

	Per cent
Gold recovered in table concentrate + table middling -	38.8
Gold recovered in flotation concentrate + flotation midding -	32.5
Overall recovery -	71.3 per cent.

-

Test No. 4. - Flotation Concentration.

A portion of the tailing was repulped, transferred to a flotation machine, conditioned with 2.2 pounds of soda ash and 1.2 pounds copper sulphate per ton, and floated by the further additions of 0.04 pound Barrett No. 4 oil, 0.05 pound pine oil and 0.10 pound potassium

(Test No. 4, cont'd) -

amyl xanthate per ton. The resulting concentrate was cleaned in a smaller machine.

Results: (Flotation).

Product	Weight, per cent	Assay, Au oz./ton	Distribution of gold, per cent	Ratio of concentration
Feed	100.00	0.06	100.0	
Flot. concentrate	4.70	0.66	51.7	21:1.
Flot. middling	7.95	0.07	9.3	12.6:1.
Flot. tailing	87.35	0.025	39.0	

The pH of the pulp was 9.4.

The flotation tailing assayed 0.025 ounce gold per ton and 0.54 per cent sulphur.

-

This test was repeated on another sample of the mill tailing and the results were approximately the same. Due to the oxidized condition of the tailing and also the coarseness of the grind, it was not possible to produce a flotation tailing lower than 0.025 ounce gold per ton. This result would not necessarily follow on a fresh sample of mill tailing.

-

Test No. 5. - Table Concentration followed by Cyanidation.

A sample of the mill tailing was passed over a Wilfley table and the resulting table concentrate and middling products reground in cyanide solution to pass 99.0 per cent minus 325 mesh. The reground concentrate was then added to the table tailing and this product agitated in cyanide solution of 1 pound NaCN per ton

(Test No. 5, cont'd) -

strength for 24- and 48-hour periods. The table concentrate + middling were 6.0 per cent of the weight of the feed.

Results of Cyanidation:

Agitation, hours	Assays, Au oz./ton: Feed	Assays, Au oz./ton: Tailing	Extraction of gold, per cent	Titration, lb./ton solution: NaCN	Titration, lb./ton solution: CaO	Reagents consumed, lb./ton ore: NaCN	Reagents consumed, lb./ton ore: CaO
24	0.06	0.035	41.7	1.0	0.20	0.60	4.0
48	0.06	0.035	41.7	1.0	0.10	0.70	4.6

-

Test No. 6 (A, B, and C). - Screen Analysis, Infrasizing, and Superpanning.

In Test No. 6-A a screen analysis was made on the tailing sample.

In Test No. 6-B, a Haultain infrasizer test was made on the minus 200 mesh product. The length of time for this test was 5 hours, 45 minutes. Conditions otherwise were similar to those of Test No. 5, Part I.

In Test No. 6-C, a portion of the tailings was concentrated on the Haultain superpanner and the concentrate made into polished sections and examined under the microscope.

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(Test No. 6, cont'd) -

Results:

(6-A) Screen Analysis.

Mesh	Weight, per cent	Assays, Au, oz./ton	Assays, S, per cent	Distribution, per cent Au	Distribution, per cent S
+ 48	0.1				
- 48 + 65	0.6	0.12	0.68	11.5	3.3
- 65 +100	5.1				
-100 +150	11.9	0.065	0.50	12.9	4.9
-150 +200	12.9	0.055	1.22	11.8	12.9
-200	69.4	0.055	1.38	63.8	78.9
Totals	100.0	0.06	1.21	100.0	100.0

Infrasizing.

The minus 200 mesh product infrasized as follows:

(6-B)

Size, in microns	Weight, per cent	Assays, Au, oz./ton	Assays, S, per cent	Distribution, per cent Au	Distribution, per cent S
+56	4.59	0.23	7.45	20.9	22.1
-56 +40	12.02	0.07	2.34	16.5	18.1
-40 +28	9.14	0.075	2.53	13.4	14.9
-28 +20	8.58	0.06	2.05	10.0	11.3
-20 +14	8.51	0.055	1.58	9.3	8.7
-14 +10	9.56	0.035	1.14	6.5	7.0
-10	47.60	0.025	0.58	23.4	17.8
Totals	100.00	0.051	1.55	100.0	100.0

(6-C) Superpanning.

Product	Weight, per cent	Assay, Au oz./ton	Distribution of gold, per cent
Feed	100.00	0.06	100.0
Panner conc.	1.24	2.29	47.3
Panner sands	59.26	0.04	39.4
Panner slimes	39.50	0.02	13.3

The microscopic examination of the polished sections secured from the tip and the bulk of the

(Test No. 6, cont'd) -

superpanner concentrate resulted as follows:

Superpanner Tip -

Minerals: Pyrite, arsenopyrite, tetrahedrite, stibnite, and chalcopyrite.

Gold: Two grains of free gold, 30 and 20 microns in size.

Superpanner Bulk -

Minerals: Pyrite, arsenopyrite, pyrrhotite, tetrahedrite, stibnite, chalcopyrite, and sphalerite.

Gold: One grain of gold, 60 microns in size.

Summary and Conclusions:

The flow-sheet of the present Con mill, consisting of a cyanide grind, concentration by means of jigs and blankets, followed by amalgamation of the resulting concentrates and agitation of the amalgam residue and blanket tailing, was used as a basis for the test work.

By this method a recovery of 93 per cent of the gold was obtained, with an overall tailing loss of 0.04 ounce gold per ton, at a grind of 68 per cent minus 200 mesh. Flotation of the cyanide residue followed by regrinding of the concentrate to 99 per cent minus 325

mesh and agitation in cyanide solution did not give any additional recovery of the gold that would be considered economical.

When the fineness of the initial grind was raised to 78 per cent minus 200 mesh and a Wilfley table was used in the grinding circuit, the overall recovery of the gold was 94.7 per cent, with an overall tailing loss of 0.03 ounce gold per ton.

Flotation of the cyanide residue, followed by roasting of the flotation concentrate and regrinding and agitation in cyanide solution, gave an overall tailing loss of 0.017 ounce gold per ton.

By straight cyanidation of the ore a cyanide residue of 0.045 ounce gold per ton was obtained at a grind of 74 per cent minus 200 mesh and a residue of 0.035 ounce per ton at a grind of 95 per cent minus 200 mesh. In both cases the lime titration was kept at 0.15 pound per ton of solution.

The infrasizer test on the cyanide residue showed that a portion of the gold was so locked up in the sulphides that only in the minus 14 micron size was there any noticeable difference in the amount of gold freed and susceptible to cyanidation.

In the superpanner tests on the cyanide residue, some free gold in very small particles was observed through the microscope in the polished sections made from the tip of the concentrate. This gold evidently was not amalgamated or was not soluble in cyanide solution.

(Continued on next page)

In the tests on the mill tailing shipment, flotation concentration was not successful, probably owing to the somewhat oxidized condition of the sample and the coarseness of the grind. It was shown in the work on the mill feed that a grind of over 80 per cent minus 200 mesh was necessary to produce a flotation tailing of 0.01 ounce gold per ton.

Further agitation of the mill tailing in cyanide solution did not succeed in reducing the amount of gold in the residue. When the tailing was reground prior to agitation the cyanide residue was lowered to 0.035 ounce gold per ton at a grind of 92 per cent minus 200 mesh.

Barrel amalgamation of the tailing gave a recovery of some 12.5 per cent and lowered the amount of gold in the tailing to 0.0525 ounce per ton.

By passing the tailing over a Wilfley table, regrinding the table concentrate in cyanide solution, adding the reground concentrate to the table tailing, and agitating in cyanide, the cyanide residue was reduced to 0.035 ounce gold per ton. This result checked fairly closely with the result obtained in Test No. 3 on the mill feed.

The infrasizer and superpanner tests on the tailing gave approximately the same results as on the mill feed sample and indicated that a portion of the gold was so locked up in the sulphides as not to be susceptible to cyanidation and that another portion was

free but was not extracted by either amalgamation or cyanidation.

The test work on the mill feed indicates that the finer the grinding of the sulphides the greater will be the extraction of the gold. This higher extraction probably could be obtained by the addition of a Wilfley table in the grinding circuit; and it was confirmed by the work on the tailing shipment. Finer initial grinding also should improve the extraction to a noticeable extent.

The test work shows that amalgamation could be dispensed with if the fineness of grinding and the agitation period were increased.

A scavenging operation of the cyanide residue by means of flotation followed by regrinding and agitation of the flotation concentrate would not increase the extraction to an economic extent.

When the flotation concentrate is roasted and the calcine reground and agitated, an overall tailing loss of 0.017 ounce gold per ton was obtained. This method should be taken into consideration if the amount of refractory gold in the sulphides warrants the additional expenditure involved.

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