

O T T A W A

December 17th, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1335.

Cyanidation and Concentration Tests on a
Gold-Silver-Zinc Ore from the Golden Manitou Mine
at Val d'Or, Quebec.

(Copy No. 5.)

I/R 1335

1781



CANADA

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

DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

The property of the Golden Manitou Mines Limited
presently known as W.A.T.O. was received in
Bourlons township, Abitibi county, northwestern Quebec,
and was acquired from the Quebec Manitou Mines Limited.

Purpose of Investigation:

In letters received from the company (dated Sept.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

In the October 1942 investigation No. 1335.

solutions loaded badly and gave a reducing power of 750 even
after a great deal of bleeding of the solutions.

Two flow-sheets have been used in the milling

procedure. In the "Previous Method" the ore was ground in

Cyanidation and Concentration Tests on a
Gold-Silver-Zinc Ore from the Golden Manitou Mine
at Val d'Or, Quebec.

stage filtration with heavy water wash. The filter discharge

was conditioned with $CaSO_4$ and xanthate and filtered for zinc

The alkalinity of the flotation circuit was about 10.8 and

the rougher zinc concentrates were cleaned twice. The

thicker overflow was clarified and the gold and silver

Shipment:

One bag of ore weighing 60 pounds, one bag of

zinc concentrates weighing one pound, and a hand-picked

sample of an unidentified silver mineral were received on

October 27th, 1942. The samples were sent in by A. T.

Klenen, Mill Superintendent, Golden Manitou Mines Limited,

Val d'Or, Quebec, on behalf of H. W. Knight, President,

Golden Manitou Mines Limited, 330 Bay Street, Toronto,

Ontario.

Location of the Property:

The property of the Golden Minotou Mines Limited from which the present shipment was received is situated in Bourlamaque township, Abitibi county, northwestern Quebec, and was acquired from the Quebec Minotou Mines Limited.

Purpose of Investigation:

In letters received from the company (dated Sept. 30th and October 9th, 1942), it was stated that the arsenic contents of their zinc concentrates were too high, 0.05 per cent arsenic being the maximum amount allowed by the smelter. In the October 9th letter, Mr. Koenen stated that the cyanide solutions fouled badly and gave a reducing power of 750 even after a great deal of bleeding of the solutions.

The flow-sheets have been used in the milling procedure. In the "Previous Method" the ore was ground in cyanide and classified to 75 percent minus 200 mesh. The pulp was then agitated for 12 to 16 hours and given a one-stage filtration with heavy water wash. The filter discharge was conditioned with CuSO_4 and xanthate and floated for zinc. The alkalinity of the flotation circuit was about 10.6 and the rougher zinc concentrates were cleaned twice. The thickener overflows were clarified and the gold and silver precipitated by the regular Merrill-Crowe precipitation unit.

The flow-sheet which is beginning to be used at present is to grind in water, adding 1.0 pound soda ash and 0.5 pound of zinc sulphate per ton to the grinding unit. The classifier overflow is treated by flotation, using a limited amount of xanthate and pine oil. The resultant pyrite concentrate is filtered, agitated in cyanide for 24 hours, thickened, and again filtered. The cyanide tailing is combined with the primary flotation tailings and is

(Purpose of Investigation, cont'd) -

conditioned with lime, with 1.5 pounds CuSO_4 and 0.15 pound xanthate per ton, and with pine oil. It is then floated for zinc. The rougher concentrates are cleaned twice.

It was desired by the mine management to find out, regarding the ore shipment:

The gold and silver recoveries that can be made on each flow-sheet, and whether any free gold will be tied up in the ball mill circuit by grinding in water.

Some possible means to reduce the fouling of the cyanide solution.

A method that will ensure that the arsenical content of the zinc concentrates will not be over 0.05 per cent arsenic.

On the zinc concentrate samples and the silver mineral sample the mine management is interested in finding out the nature of occurrence of the gold, silver, and arsenic. These occurrences are covered in the microscopic section of this report.

Sampling and Analysis:

After crushing, cutting and grinding of the ore sample by standard methods, a representative portion was obtained which assayed:

Gold	=	0.05 oz./ton.
Silver	=	1.70 "
Arsenic	=	0.08 per cent.
Copper	=	0.05 "
Lead	=	0.20 "
Zinc	=	7.22 "
Iron	=	17.00 "
Sulphur	=	21.98 "
Acid insoluble	=	47.89 "

Characteristics of Ore, Zinc Concentrates, and Hand-picked Silver Specimen:

Ore -

Microscopic study of polished sections of the ore reveals that the following minerals are present: pyrite, sphalerite, galena, chalcopyrite, arsenopyrite, tennantite-tetrahedrite, and native silver. No native gold was seen, but this is to be expected because of the very small amount of the metal in the ore.

Pyrite is the most abundant ore mineral; it is commonly fine-grained and disseminated along roughly parallel bands. In places, it is so abundant as to be almost massive. Sphalerite and galena usually occur together, as irregular grains and small masses in gangue; where they are associated also with pyrite they occur as fillings interstitial to the pyrite grains, and they are very often observed to enclose pyrite. Chalcopyrite is distributed as small irregular grains in the quartz, and is less often associated with the galena and sphalerite; some of the sphalerite is entirely free from the small dots of chalcopyrite so common in sphalerites, but some areas are encountered where the sphalerite contains these characteristic dots of the copper mineral. Occasional crystals of arsenopyrite are disseminated in the ore; it is obviously the oldest ore mineral, for where the other sulphides are associated with it they enclose it. Tennantite-tetrahedrite is present as small masses and grains, usually associated with galena; microchemical analysis indicates that it contains both arsenic and antimony with the former probably predominating, and hence it is thought to be a member of the isomorphous series nearer the tennantite end.

(Continued on next page)

(Characteristics of Ore, Zinc Concentrates, and Hand-picked Silver Specimen, cont'd) -

Zinc Concentrate -

Polished sections of the zinc concentrates show these to contain sphalerite, pyrite, chalcopyrite, tennantite-tetrahedrite, galena, native gold, and native silver. No arsenopyrite was detected. The sphalerite, which greatly predominates in quantity, is largely free; the pyrite grains usually have a small grain of sphalerite attached but are sometimes free; chalcopyrite is often attached to sphalerite; tennantite-tetrahedrite is sometimes attached to galena, sometimes free. Only one grain of native gold was seen--an irregular particle about 15 microns in longest dimension, free from attachment. Two small grains of free native silver were observed. In an attempt to detect the presence of arsenopyrite in the zinc concentrate, a polished section of a superpanner concentrate of this product was examined; an extremely small quantity of arsenopyrite was detected in this manner.

Spectrographic Analysis of the Zinc Concentrate -

A spectrographic analysis of the zinc concentrate was made with a view to determining the presence of any elements which might affect the treatment and subsequent refining of the zinc. The results follow:

Present as major constituents	-	Zn, Si, Fe.
" " accessory "	-	Cu, Pb, Ag, As, Sb, Mg, Al, Cd, Ca.
Traces	-	Au, Mn, V, T.
Nil	-	Ba, Cb, Ce, Co, Cr, Cs, Ga, Ge, Hg, In, Li, Mo, Ni, P, Pd, Pt, Sc, Sn, Sr, Ta, Te, Tl, W, Yb, Yt, Zr.

(Continued on next page)

(Characteristics of Ore, Zinc Concentrates, and Hand-picked Silver Specimen, cont'd)

Hand-picked Silver Specimen

A macroscopic examination of the hand-picked silver mineral sample indicates that the mineral constituents are, largely, native silver and the silver-bearing minerals, tennantite-tetrahedrite and galena.

Conclusions from Microscopic Examination

The microscopic examination of the ore and concentrate brings out certain features which may be summarized as follows:

1. The association of the sphalerite with galena and with pyrite may be expected to carry some of these minerals into the zinc concentrate. The sections show that an appreciable proportion of the pyrite in the concentrate is due to sphalerite attached to the pyrite grains.

2. Arsenic is carried by two minerals, arsenopyrite and tennantite-tetrahedrite. The latter also contains antimony. It is estimated that most of the arsenopyrite has been eliminated from the concentrate, since none was detected until a superpanner concentrate was examined. On the other hand, the tennantite-tetrahedrite seems to report in the concentrate, and this may account for more arsenic in this product than does the arsenopyrite. In addition, this mineral introduces antimony, which also may have the effect of fouling solutions and of interfering with subsequent refining of the zinc.

3. Probably chalcopyrite is responsible for the larger part of the copper in the concentrate, but it is thought that tennantite-tetrahedrite is also responsible for an appreciable quantity.

4. The only native gold seen was a single free grain. This would indicate that at least a part of the gold had escaped dissolution during the cyanidation of the ore.

5. The distribution of the silver in the ore is not positively known. Two small grains of native silver were observed in the concentrate. It is quite safe to assume, however, that both the galena and tennantite-tetrahedrite carry a certain quantity of the silver in solid solution, as this is almost invariably the case where both of these minerals and native silver are present in the same ore.

Investigative Work on Ore Shipment:

The test work on the ore shipment shows that better recoveries of the gold and silver can be effected by using the 'previous' flow-sheet, of straight cyanidation followed by flotation of the zinc. As regards the possibilities of free gold being tied up in the ball mill circuit, this appears probable, as the microscope showed some free gold in the zinc concentrates, although it was not possible to ascertain from the test work anything definite in this respect owing to the low assay value (0.05 ounce gold per ton) and the small quantity of the shipment.

Regarding the fouling of the cyanide solutions, it was found that the addition of soluble lead salt ($PbNO_3$) to the grind lowered the reducing power from 230 to 156 in the case of straight cyanidation and from 320 to 180 in the cyanidation of the pyrite concentrates. Grinding in water, followed by aeration in a lime pulp prior to cyanidation, was also found to be beneficial in reducing the fouling of the cyanide solutions.

Better results were obtained through lowering the arsenical contents of the zinc concentrates, by using the 'previous' flow-sheet with a pH of 8.1 to 9.5 instead of 10.6 as used in the mill practice. In the 'present' flow-sheet, it was found that while the arsenical content of the zinc concentrate was satisfactory, the overall recoveries of gold, silver and zinc were lower than in the 'previous' flow-sheet. In this connection the use of sodium sulphide was tried in the flotation of the zinc concentrates. This reagent depressed the arsenopyrite and gave zinc concentrates which were up to grade. It also tended to depress the zinc, however, and the quantity used in conjunction with the other reagents would need careful handling in the flotation circuit. With the comparatively small amount of the shipment available it was not

(Investigative Work on Ore Shipment, cont'd) -

possible to work out these adjustments.

DETAILS OF TESTS:

Test No. 1 (A to D).

In this test the 'previous' flow-sheet was followed.

The ore was ground in cyanide solution to pass from 83 to 89 per cent minus 200 mesh. The pulp was then agitated at a 2:1 dilution for 24 hours, and was filtered, washed, and sampled. The cyanide tailing was then transferred to a Denver flotation machine, conditioned with various reagents, and a zinc concentrate floated. This concentrate was cleaned once in a smaller machine.

Cyanidation. (Feed: Au, 0.05 oz./ton; Ag, 1.70 lb./ton).

Test No.	Agitation, hours	Grind, % -200 mesh	Tailing assays, oz./ton		Recoveries, per cent	
			Au	Ag	Au	Ag
1-A	16	89.0	0.015	0.59	70.0	65.3
1-B	24	83.0	0.015	0.52	70.0	69.4
1-C	24	85.2	0.015	0.52	70.0	69.4
1-D	24	85.0	0.015	0.79	70.0	53.4

Reagent Data.

Test No.	Reagents consumed, lb./ton ore			Titration, lb./ton solution		Reducing power, ml. N/10 KMnO ₄ per litre
	NaCN	CaO	PbNO ₃	NaCN	CaO	
1-A	1.2	2.5	-	2.7	0.25	230
1-B	1.1	2.5	-	2.8	0.24	240
1-C	1.1	2.5	0.5	2.8	0.20	130
1-D	1.1	2.5	0.5	0.9	0.30	125

In Test No. 1-D the ore was ground in water and aerated in a lime pulp prior to cyanidation.

In Tests Nos. 1-A, 1-B and 1-C, the strength of cyanide solutions used was 3.0 pounds NaCN per ton. In Test No. 1-D it was 1 pound NaCN per ton.

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(Test No. 1 (A to D), cont'd) -

It is apparent from the above results that the addition of $PbNO_3$ reduces the fouling of the cyanide solutions.

When the strength of cyanide solution was reduced to 1.0 pound per ton in Test No. 1-D, the silver extraction fell off.

- Flotation of Cyanide Tailings -

Reagents Added (Lb./ton feed):

Test No.	Lime	Copper sulphate	Amyl xanthate	Pine oil	Sodium sulphide	pH
1-A	2.0	1.5	0.10	0.05	-	8.1
1-B	2.0	1.5	0.10	0.07	1.5	8.1
1-C	1.5	1.5	0.10	0.05	1.2	8.0
1-D	3.0	1.5	0.10	0.07	1.0	9.0

Flotation Results:

Test No. 1-A.

Product	Weight, per cent	Distribution of zinc, per cent					Ratio of concentration
		Au	Ag	Zn	As	S	
Feed	100.00	0.012 [⊙]	0.59 [⊙]	7.64 [⊙]			100.0
Zinc conc.	11.50	0.02	1.64	52.09	0.015		78.4
Zinc middling	12.35	0.02	0.94	7.63			12.3
Tailing	76.15	0.01	0.39	0.93			9.3

Test No. 1-B.

Feed	100.00	0.015	0.52	6.88 [⊙]			100.0
Zinc conc.	4.47	-	-	56.94	Nil		37.5
Zinc middling	3.06	-	-	21.48			9.7
Tailing	95.55	0.01	0.44	3.83			52.8

Test No. 1-C.

Feed	100.00	0.015	0.52	7.00 [⊙]			100.0
Zinc conc.	4.89	-	-	60.36	0.009		42.2
Zinc middling	5.36	-	-	22.38			10.7
Tailing	91.75	0.01	0.42	3.56			47.1

Test No. 1-D.

Feed	100.00	0.015	0.79	6.22 [⊙]			100.0
Zinc conc.	4.62	-	-	59.25	0.009		44.0
Zinc middling	3.57	-	-	12.97			9.6
Tailing	91.81	0.01	0.47	3.14			46.4

[⊙] Calculated.

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(Test No. 1 (A to D), cont'd) -

From the foregoing figures the effect of sodium sulphide, in lowering the arsenic content of the zinc concentrates while at the same time reducing the zinc recovery, is apparent. Also, the pH of the pulp, running from 8.0 to 9.0, was not high enough to float any large amount of arsenic.

Test No. 2 (A and B).

In this test the procedure follows the 'present' flow-sheet.

The ore was ground in water in a ball mill and a pyrite concentrate produced by flotation. This concentrate was agitated in cyanide solution for 24 hours, filtered, washed, and sampled, and the cyanide tailing was added to the first flotation tailing. A zinc concentrate was then floated from this product. This concentrate was cleaned once in a smaller flotation machine.

Flotation of Pyrite Concentrates:

Test No. 2-A.

Product	: Weight, : : per : : cent :	: A S S A Y S :			: Distribution, :			: Ratio of : concen- : tration :
		: Oz./ton :	: Zn, per :	: Distribution, :	: Au :	: Ag :	: Zn :	
Feed	: 100.00:	: 0.05 :	: 1.70:	: 7.22:	: 100.0:	: 100.0:	: 100.0:	
Pyrite conc.	: 33.50:	: 0.13 :	: 4.38:	: 11.07:	: 86.8:	: 86.3:	: 51.6:	: 3:1.
Tailing	: 66.50:	: 0.01 :	: 0.35:	: 5.25:	: 13.2:	: 13.7:	: 48.6:	

Test No. 2-B.

Feed	: 100.00:	: 0.05 :	: 1.70:	: 7.22:	: 100.0:	: 100.0:	: 100.0:	
Pyrite conc.	: 33.00:	: 0.11 :	: 4.26:	: 10.43:	: 70.0:	: 82.6:	: 47.7:	: 3:1.
Tailing	: 67.00:	: 0.015 :	: 0.44:	: 5.64:	: 30.0:	: 17.4:	: 52.3:	

Reagents to Flotation (Lb./ton feed):

Test No.	: CaO :	: NaCO ₃ :	: ZnSO ₄ :	: Butyl xanthate:	: Amyl xanthate:	: Pine oil :	: pH :
2-A	: 4.0 :	: - :	: 1.0 :	: 0.05 :	: - :	: 0.05 :	: 8.2 :
2-B	: - :	: 4.0 :	: 1.0 :	: - :	: 0.03 :	: 0.05 :	: 8.2 :

(Test No. 2 (A and B), cont'd) -

Cyanidation of Pyrite Concentrate:

Test No.	Agitation, hours	Feed assays, oz./ton		Tailing assays, oz./ton		Extraction, per cent	
		Au	Ag	Au	Ag	Au	Ag
2-A	24	0.13	4.38	0.02	2.10	84.6	52.1
2-B	24	0.11	4.26	0.02	2.20	81.8	51.6

Reagent Consumptions and Titrations:

Test No.	Reagents consumed, lb./ton conc.			Titrations, lb./ton solution		Reducing power, ml. N/10 KMnO ₄ per litre
	NaCN	CaO	PbNO ₃	NaCN	CaO	
2-A	2.9	3.50	-	2.7	0.30	320
2-B	2.0	3.45	0.5	2.9	0.35	160

In Test No. 2-B the pyrite pulp was aerated and 0.5 pound of PbNO₃ per ton was added prior to cyanidation. This method lessened the consumption of cyanide and also reduced the fouling of the cyanide solution.

Flotation of 1st Flotation Tailing plus Cyanide Residue:

Test No. 2-A.

Product	Weight, per cent	Assays, per cent		Distribution, of zinc, per cent	Ratio of concentration
		Zn	As		
Feed	100.00	6.94 [Ⓢ]		100.0	
Zinc conc.	7.34	59.37	0.004	62.8	13.6:1.
Zinc middling	6.17	17.88		15.8	
Tailing	86.49	1.71		21.4	

Test No. 2-B.

Product	Weight, per cent	Assays, per cent		Distribution, of zinc, per cent	Ratio of concentration
		Zn	As		
Feed	100.00	6.91 [Ⓢ]		100.0	
Zinc conc.	7.54	60.08	Trace	65.6	13.3:1.
Zinc middling	6.48	19.06		17.9	
Tailing	85.98	1.33		16.5	

[Ⓢ] Calculated.

Reagents Added to Flotation (Lb./ton feed):

Test No.	CaO	CuSO ₄	Amyl xanthate	Pine oil	pH
2-B	2.5	1.8	0.10	0.10	8.5

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(Test No. 2 (A and B), cont'd) -

Summary of Test No. 2:

	Test No. 2-A	Test No. 2-B
Gold recovered by cyanidation	73.4	57.3
Silver " "	45.8	42.6
Zinc " " flotation	70.7	74.6

The low arsenical content of the zinc concentrates is probably due to the 8.1 and 8.5 pH used in flotation.

Test No. 3 (A and B).

In this test the ore was ground in water to pass 85 per cent minus 200 mesh. The pulp was then transferred to a Denver flotation cell and pyrite concentrate obtained. The pulp was then reconditioned and a zinc concentrate floated off. This latter concentrate was cleaned once in a smaller machine.

Results:

Product	Test No. 3-A					Distribution,		
	Weight, per cent	Oz./ton		Per cent		per cent		
		Au	Ag	Zn	As	Au	Ag	Zn
Feed	100.00	0.07 ^⓪	1.72 ^⓪	6.80 ^⓪		100.0	100.0	100.0
Pyrite conc.	29.27	0.20	4.64	8.55	0.13	83.1	78.7	36.7
Zinc "	6.13	0.04	1.34	60.86	0.33	3.6	4.8	55.3
Zinc middling	6.13	0.06	1.78	5.00		5.1	6.3	4.5
Tailing	58.42	0.01	0.30	0.41		8.2	10.2	3.5

Test No. 3-B								
Product	Weight, per cent	Oz./ton		Per cent		Distribution, per cent		
		Au	Ag	Zn	As	Au	Ag	Zn
Feed	100.00	0.085 ^⓪	1.71 ^⓪	7.22 ^⓪		100.0	100.0	100.0
Pyrite conc.	32.53	0.10	4.24	9.61	0.15	60.0	80.4	43.3
Zinc conc.	6.13	0.05	1.67	56.21	0.28	5.5	6.0	48.1
Zinc middling	7.40	0.18	1.84	5.11		24.5	7.9	5.2
Tailing	53.89	0.01	0.18	0.46		10.0	5.7	3.4

^⓪ Calculated.

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(Test No. 3 (A and B), cont'd) -

Reagents Added to Flotation (Lb./ton Ore):

Test No.	To grind		To pyrite float		To zinc float			Final pH	
	CaO	NaCO ₃	Butyl xanthate	Cresylic acid	CaO	CuSO ₄	Amyl xanthate		Pine oil
3-A	2.0	-	0.05	0.10	2.0	1.2	0.10	0.10	9.4
3-B	-	1.0	0.05	0.10	2.0	1.2	0.10	0.10	9.5

From these tests it appears likely that the comparatively high final pH used and the lack of cyanidation tend to float the arsenic along with the zinc.

Test No. 4.

The ore was ground in a ball mill in a lime pulp to pass 85 per cent minus 200 mesh. The pulp was then transferred to a flotation machine and a pyrite concentrate was floated off as in Test No. 3. A zinc concentrate was then obtained. The initial pyrite concentrate was then agitated in cyanide solution for 24 hours and the cyanide residue floated for zinc.

Results:

Product	Weight, per cent	A S S A Y S				Distribution, per cent		
		O ₂ ,/ton Au	Ag	Zn	As	Au	Ag	Zn
Feed	100.00	0.05	1.70	7.22	100.0	100.0	100.0	
Pyrite conc.	34.79	0.10 [Ⓞ]	4.10 [Ⓞ]	11.68	70.2	83.8	56.3	
Zinc conc.	5.27	0.03	1.81	45.58	0.09	3.2	5.6	
Zinc middling	6.64	0.04	1.26	7.92	5.2	4.9	7.3	
Tailing	53.30	0.02	0.18	0.43	21.4	5.7	3.1	

[Ⓞ] Calculated.

Reagents Added to Flotation (Lb./ton feed):

Added to grind		Added to pyrite float		Added to zinc float			pH
CaO	ZnSO ₄	CaO	Butyl xanthate	Cresylic acid	CaO	CuSO ₄	
1.0	1.0	1.0	0.05	0.10	2.0	1.8	9.1

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(Test No. 4, cont'd)

Cyanidation of Pyrite Concentrate.

Agitation, hours	Assays, oz./ton	Reagents consumed, lb./ton conc.	Reducing power, ml. N/10 KMnO ₄ per litre
Au	Ag	NaCN	CaO
24	0.02	1.97	80
		52	5.20
		5.60	0.50
			190

The strength of solution was 3.0 pounds NaCN and 0.30 pound lime per ton.

Zinc Flotation from Pyrite Concentrate.

Product	Weight, per cent	Assays, per cent		Distribution of zinc, per cent	pH of pulp
		Zn	As		
Feed	100.00	10.50 ^φ	-	100.0	
Zinc conc.	12.84	54.57	0.06	66.7	
Pyrite tailing	87.16	4.01	0.18	33.3	8.9

^φ Calculated.

The zinc flotation was conditioned with 2.0 pounds of lime, and the zinc concentrate was floated off by the addition of 1.8 pounds CuSO₄, 0.05 pound amyl xanthate and 0.05 pound pine oil per ton.

Summary of Results, Test No. 4:

	Per cent
Gold recovered by cyanidation	56.2
Silver " " "	43.5
Zinc " " flotation	74.6

Test No. 5.

A portion of the ore at minus 14 mesh was ground in a ball mill to pass 84 per cent minus 200 mesh. A pyrite concentrate was then obtained and agitated in cyanide for 24 hours. The cyanide residue was floated for zinc. In both the initial flotation and the flotation of the zinc from the pyrite concentrate, the lime was kept comparatively high,

(Test No. 5, cont'd) -

with a pH of 9.5 and 9.4 for the pulp.

Results:

Product	Weight, per cent	A S S A Y S			Distribution, per cent		
		Oz./ton Au	Oz./ton Ag	Zinc, per cent	Au	Ag	Zn
Feed	100.00	0.05	1.70	7.22	100.0	100.0	100.0
Pyrite conc.	39.30	0.10	3.88	11.54	31.8	89.6	62.8
Tailing	60.70	0.015	0.22	4.42	18.2	10.4	37.2

It appears, from the above, that a high pH (9.5) tends to throw the zinc into the pyrite concentrate.

Reagents Added to Flotation (Lb./ton ore):

To Grind -		To Cell -	
Line	- 4.0	Line	- 2.0
ZnSO ₄	- 1.0	Butyl xan-	- 0.05
		thate	- 0.05
		Pine oil	- 0.05

Cyanidation of Pyrite Concentrate.

Agitation, hours	Tailing assays, oz./ton		Extraction, per cent		Reagents consumed, lb./ton conc.			Reducing power, ml. N/10 KMnO ₄ per litre
	Au	Ag	Au	Ag	NaCN	CaO	PbNO ₃	
24	0.02	1.79	80.0	53.9	4.00	7.10	0.5	190

Flotation of Cyanide Tailing.

Product	Weight, per cent	Assays, per cent		Distribution, of zinc, per cent	pH
		Zn	As		
Feed	100.00	10.64 ^o		100.0	(The pH of the
Zinc conc.	10.54	57.64	0.01	57.1	(pulp was 9.4.
Zinc middling	10.00	23.95	0.14	27.2	(
Tailing	79.46	2.10		15.7	(

^o Calculated.

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(Test No. 5, cont'd) -

Reagents Added to Cell:

		Lb./ton conc.
Lime	-	2.0
CuSO ₄	-	1.7
Amyl xanthate	-	0.10
Pine oil	-	0.10

Summary of Results, Test No. 5:

		Per cent
Gold recovered by cyanidation	-	65.4
Silver " " "	-	48.3
Zinc " " flotation	-	44.4

SUMMARY AND CONCLUSIONS:

Regarding the Extraction of the
Gold and Silver in the Ore.

In the cyanidation of both the pyrite concentrate and the mill feed, it was shown that the addition of a lead salt reduces the fouling of the cyanide solutions. It was also shown that the 'previous' flow-sheet, consisting of straight cyanidation of the gold and silver, gives a better extraction than does the 'present' flow-sheet, i. e., agitation of the pyrite concentrate. This result is partly due to the initial losses in the flotation tailing and also to the added loss in the cyanide residue of the pyrite concentrate. Increasing the strength of the cyanide solution from 1.0 to 3.0 pounds NaCN per ton gave a small additional extraction of the silver, as shown in Test No. 1, although it is questionable whether so strong a solution is necessary in the 'previous' flow-sheet.

(Continued on next page)

(Summary and Conclusions, cont'd) -

Regarding the Recovery of the Zinc in the Ore and
the Amount of Arsenic in the Zinc Concentrate.

The test work shows a higher recovery of the zinc by the 'previous' method when the flotation of the zinc is made from the cyanide residue of the mill feed. The arsenical contents of the zinc concentrates are shown to be lower when a cyanide tailing is used for the flotation of the zinc. In this connection, the test work indicated that both in the 'previous' flow-sheet and in the 'present' flow-sheet the pH of the pulp used for the flotation of the pyrite and zinc concentrates is quite important. In the 'previous' flow-sheet, of straight cyanidation followed by zinc flotation of the cyanide tailing, a comparatively low pH, 8.0 to 8.5, is advisable in order to depress the arsenic, while in the 'present' flow-sheet, where a pyrite concentrate is obtained prior to flotation of the zinc, the pH should be raised to 9.5 in order to float off the arsenic along with the pyrite.

In the test work, the quantity of material available was too small for any extended examination of the results obtained.

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HLB: GHB.