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O T T A W A September 4th, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1292.

Concentration and Roasting Tests on a Sample of Arsenical Gold Ore from the Wampum Gold Mines Limited, at Flin Flon, Manitoba.

(Copy No. 4.)

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:

Fourteen sacks of ore, total weight 2,000 pounds, were received on July 5th, 1942. The shipment was submitted by A. J. McLaren, Consulting Engineer, 231 Glengrove Avenue West, Toronto, Ontario.

Location of Property:

This property is located at Douglas Lake, three miles west of Flin Flon, Manitoba.

Character of the Ore:

No microscopic examination was made of the present shipment but a former shipment of ore from this property was examined and described in Report of Investigation No. 675, issued in 1936. The character of the samples appears to be the same although the first sample was higher grade than the present one. They contain arsenopyrite, pyrite, chalcopyrite, and sphalerite. The two latter minerals appear to some extent in fractures in the arsenopyrite.

Sampling and Assaying:

The shipment was sampled, assayed, and reported as follows:

Gold	-	0.47 oz./ton
Silver	-	1.05 "
Copper	-	0.35 per cent
Zinc	-	3.75 "
Iron	-	18.00 "
Arsenic	-	13.24 "
Sulphur	-	11.60 "

Experimental Tests:

Concentration tests were conducted on samples of the ore to see how much of the gold, arsenic, and zinc could be recovered. The tests have shown that the arsenic and zinc are intimately associated and that a zinc concentrate of marketable grade cannot be produced. They also show that the gold, the majority of it at least, is not associated with the arsenic. About 90 per cent of the gold and almost 90 per cent of the arsenic can be recovered in a concentrate by flotation with the ore ground about 80 per cent finer than 200 mesh. By table concentration, with the ore ground through 20 mesh, 70 per cent of the gold and 75 per cent of the arsenic are recovered in the concentrate.

Details of Tests:

The following tests, typical of a number conducted, are described in detail as follows:

Test No. 1. - Flotation.

A sample of the ore was ground 70 per cent finer than 200 mesh and floated with the following reagents:

Charge to Ball Mill -

Ore	-	2,000 grams at -14 mesh.
Water	-	1,500 grams.

		Lb./ton
Sodium cyanide	-	0.10
Zinc sulphate	-	1.0
Aerofloat No. 31	-	0.07
Soda ash	-	2.0

Copper-Arsenic Flotation -

Amyl xanthate	-	0.20
Pine oil	-	0.05

Arsenic Cleaning Cell -

Pine oil	-	0.05

Zinc Flotation -

Copper sulphate	-	1.0
Amyl xanthate	-	0.10
Pine oil	-	0.05
Sodium aerofloat	-	0.10

Summary of Results:

Product	Weight, per cent	Assays, Oz./ton: Au	Assays, Per cent: Cu	Zn	As	Distribution, per cent: Au	Cu	Zn	As
Cu-As conc.	40.34	1.30	1.01	5.46	27.54	92.71	85.62	47.47	79.34
Cu-As midd.	5.38	0.19	0.03	3.49	12.93	1.80	0.34	4.05	4.97
Zinc conc.	10.56	0.19	0.26	18.57	16.13	3.56	5.77	42.26	12.16
Tailing	43.72	0.025	0.09	0.66	1.13	1.93	8.27	6.22	3.53
Feed (cal.)	100.00	0.57	0.48	4.64	14.00	100.00	100.00	100.00	100.00

(Details of Tests, cont'd) -

Test No. 2. - Flotation.

A sample of the ore was ground 70 per cent finer than 200 mesh and then floated. The products were assayed for gold, copper, zinc, and arsenic.

Charge to Ball Mill -

Ore	-	2,000 grams at -14 mesh.
Water	-	1,500 grams.

		Lb./ton
Sodium cyanide	-	0.10
Zinc sulphate	-	1.0
Aerofloat No. 31	-	0.07
Soda ash	-	5.0

Copper-Arsenic Flotation -

Amyl xanthate	-	0.20
Pine oil	-	0.10

Zinc Flotation -

Copper sulphate	-	1.0
Amyl xanthate	-	0.10
Pine oil	-	0.05

Summary of Results:

Product	Weight, per cent	Assays, Oz./ton Au	Assays, Per cent Cu	Assays, Per cent Zn	Assays, Per cent As	Distribution, per cent Au	Distribution, per cent Cu	Distribution, per cent Zn	Distribution, per cent As
Cu-As conc.	14.46	2.48	2.56	6.48	14.44	64.81	84.74	17.13	14.97
Zn conc.	37.28	0.38	0.14	10.98	30.06	25.60	11.95	74.84	80.36
Tailing	48.26	0.11	0.03	0.91	1.35	9.59	3.31	8.03	4.67
Feed (cal.)	100.00	0.55	0.44	5.47	13.96	100.00	100.00	100.00	100.00

The higher soda ash seems to have depressed the arsenopyrite and carried the zinc and part of the gold with it.

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(Details of Tests, cont'd) -

Test No. 3. - Flotation.

A sample of the ore was ground 80 per cent finer than 200 mesh and floated with the following reagents:

Charge to Ball Mill -

Ore	-	2,000 grams at -14 mesh.
Water	-	1,500 grams.

		Lb./ton
Coal tar creosote No. 634	-	0.07
Caustic soda	-	1.0

Copper-Iron and Arsenic Flotation -

Amyl xanthate	-	0.20
Pine oil	-	0.05

Zinc Flotation -

Copper sulphate	-	1.0
Sodium aerofloat "3"	-	0.20

Summary of Results:

Product	Weight, per cent	Assays, Oz./ton: Au	Assays, Per cent: Cu	Zn	As	Distribution, per cent: Au	Cu	Zn	As
Cu-Fe-As conc.	35.22	1.26	1.07	10.35	9.85	89.28	90.60	67.93	27.50
Zinc conc.	12.00	0.40	0.15	13.68	18.83	9.66	4.32	30.59	17.91
Tailing	52.78	0.01	0.04	0.15	13.05	1.06	5.08	1.48	54.59
Feed (cal.)	100.00	0.50	0.42	5.37	12.62	100.00	100.00	100.00	100.00

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These tests have been conducted for the purpose of producing a zinc concentrate of marketable grade and a gold-arsenic product for roasting, the arsenic to be recovered and the calcines to be treated for their gold content. The tailing assay in Test No. 3 seems to indicate that the gold and arsenopyrite are not associated, while the first concentrates in Tests Nos. 1, 2 and 3 indicate some relationship between the

(Details of Tests, cont'd) -

gold and the chalcopyrite. The apparent copper-gold association, however, may be incidental to the occurrence of chalcopyrite in fractures in the arsenopyrite, as explained in the microscopic examination.

The majority of the zinc seems to occur in this manner also making it impossible to produce a zinc concentrate of marketable grade.

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Test No. 4. - Flotation.

The caustic soda appeared to depress the arsenic in Test No. 3, so in the following test the arsenic was floated in a natural circuit and the zinc in an acid circuit.

Charge to Ball Mill -

Ore	-	2,000 grams at -14 mesh.
Water	-	1,500 grams.
Coal Tar Creosote No. 634	-	0.07 lb./ton.

Arsenopyrite Flotation -

		Lb./ton
Amyl xanthate	-	0.20
Pine oil	-	0.10

Zinc Flotation -

Copper sulphate	-	1.0
Sodium Aerofloat "B"	-	0.20
Pine oil	-	0.10
Sulphuric acid	-	3.0

Summary of Results:

Product	Weight, per cent	Assays, Oz/ton Au	Assays, Per cent Cu	Assays, Per cent Zn	Assays, Per cent As	Distribution, per cent Au	Distribution, per cent Cu	Distribution, per cent Zn	Distribution, per cent As
Cu-Fe-As conc.	35.20	1.29	1.01	8.63	29.08	89.93	85.12	60.01	87.08
Zinc conc.	8.95	0.35	0.32	20.75	0.56	6.20	6.86	36.68	0.43
Tailing	55.85	0.035	0.06	0.30	2.63	3.87	8.02	3.31	12.49
Feed (cal.)	100.00	0.51	0.42	5.06	11.76	100.00	100.00	100.00	100.00

This test shows a reasonably good recovery of gold

(Test No. 4, cont'd) -

and arsenic in the concentrate but unfortunately the majority of the zinc is there also.

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Tests Nos. 5 and 6. - Table Concentration.

Table concentration tests were conducted on samples of the ore ground through 10 and 20 mesh respectively. The finer sample gave a slightly higher grade concentrate with appreciably higher recoveries. A roasting and cyanidation test was conducted on a sample of the finer concentrate.

The sample to be roasted was placed in a cold muffle furnace and heated up to 480° C. as quickly as possible. The temperature was kept there till all fuming had ceased, about 40 minutes, and then raised to 750° C. to break up sulphates. The total roasting period was about 2½ hours. The calcine was assayed and a sample reground and agitated in cyanide solution, 2.0 pounds NaCN per ton, for 48 hours at 2:1 dilution.

Summary of Test No. 5 (Grind, -10 mesh).

Product	Weight, per cent	Assays, Oz./ton Au	Assays, Per cent As	Assays, Per cent Zn	Distribution, per cent Au	Distribution, per cent As	Distribution, per cent Zn
Conc. -10+20 mesh	12.46	0.89	27.54	3.14	20.66	24.96	10.35
-20+35 "	8.77	0.92	28.28	3.34	15.03	18.04	7.75
-35 "	9.13	1.36	33.78	3.54	23.13	22.43	8.55
Middling -10+20 mesh	8.90	0.54	10.52	5.06	8.95	6.81	11.91
-20+35 "	3.59	0.42	9.79	4.75	2.81	2.56	4.51
-35 "	7.16	0.46	9.98	7.08	6.14	5.20	13.41
Tailing	49.99	0.25	5.50	3.29	23.28	20.00	43.52
Feed (cal.)	100.00	0.54	13.75	3.78	100.00	100.00	100.00
Average concs.	30.36	1.04	29.63	3.32	58.82	65.43	26.65

(Continued on next page)

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

Summary of Test No. 6 (Grind, -20 mesh).

Product	Weight, per cent	Assays Oz./ton: Au	Assays Per cent: As	Assays Per cent: Zn	Distribution, per cent: Au	Distribution, per cent: As	Distribution, per cent: Zn
Table conc.	34.40	1.07	29.34	3.74	70.45	75.01	36.37
Table middling	11.91	0.44	14.80	4.65	10.03	13.10	15.66
Table tailing	53.69	0.19	2.98	3.16	19.52	11.89	47.97
Feed (cal.)	100.00	0.52	13.46	3.54	100.00	100.00	100.00
Conc. roasted	22.44	1.58	0.25	5.77	67.87 @	0.64	-
Calcine cyanided	22.44	0.13	-	-	5.59	-	-

@ The difference between this figure and the gold content of the table concentrate represents the amount unaccounted for in roasting.

Extraction of gold by cyanidation - 62.28 per cent total

Recovery of arsenic by roasting - 74.37 " "

Loss in weight by roasting - 34.76 per cent.

Reagents -

Final Titration,	lb./ton solution:
NaCN -	1.80
CaO -	0.24

Consumed,	lb./ton calcine:
NaCN -	9.4
CaO -	13.5

The following additional assays were made on the table concentrate and calcine:

	Table concentrate	Calcine from table concentrate
Silver, oz./ton	1.74	2.59
Copper, per cent	0.37	0.61
Iron, "	30.65	45.90
Sulphur, "	21.06	1.55
Insoluble, "	11.39	-
Silica, "	-	18.29

Conclusions:

The foregoing tests have shown that the gold and arsenic can be concentrated. After roasting, to recover the arsenic as the oxide, the calcines can be treated for their gold content, either by smelting or in a cyanide plant. A zinc concentrate of marketable grade cannot be produced either from the ore direct or from the calcines.

Concentrates of approximately equal grade can be made by either flotation or tabling but higher recoveries of both gold and arsenic will be obtained by flotation. In view of the limited tonnage of ore to be treated, however, table concentration may be more practical owing to the lower capital expenditure.

Good practice in roasting arsenical ores is to bring the temperature up to 480° C. as quickly as possible and hold it there till all fuming ceases. This gives an efficient roast and prevents the formation of ferric arsenates. The temperature should then be raised quickly to 750° C. to break up sulphates. In this way, 99 per cent of the arsenic in the roaster feed will be recovered as the oxide. The oxide so recovered will be impure and will have to be refined further to produce the white oxide.

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