O T T A W A February 19th, 1943.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1357.

IR 1357

Concentration Tests on a Molybdenite Ore from the La Corne Molybdenite Project of the Wartime Metals Corporation, Val d'Or, Quebec.

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Shipments:

A 62-pound lot of ore was received on December 1st, 1942, and two 25-pound lots of concentrates, designated "A" and "B" respectively, together with two cans of mine water (total weight 100 pounds), were received on December 14th, 1942. A third lot of concentrate, weight 80 pounds, was received January 18th, 1943, for special investigation to raise the grade.

The shipments were consigned to these laboratories by Mr. Paul Grieco, mill superintendent at the property of the La Corne Molybdenite Project, Val d'Or, Quebec, upon instructions from Mr. E. L. Longmore, General Manager, Wartime Metals Corporation, 637 Craig Street West, Montreal, Quebec.

Location of the Property:

The La Corne Molybdenite Project, which is operated by the Wartime Metals Corporation, consists of 1,225 acres situated at the intersection of Lamotte, La Corne, Varson and Malartic townships in northern Quebec.

Sampling and Analysis:

After crushing, cutting and grinding the ore shipment by standard methods, a representative sample was obtained, which assayed as follows:

		Per cent
MoS_2	-	0.59
Fe	-	2.48
Bi	-	0.08

After cutting the concentrate shipments, representative samples assayed:

	"A" shipment	"B" shipment
	- Per cent -	
MoS_2 -	68.70	- 76.00
Bi -	2.90	- 0.75
Fe -	2.41	- 1.30
Insol. -	14.30	- 8.87
Copper -	0.51	- 0.37

Screen tests on the two concentrate shipments resulted as follows:

Mesh	Weight, per cent	
	"A"	"B"
+ 35	3.6	0.8
- 35 + 48	8.0	2.3
- 48 + 65	10.9	4.9
- 65 +100	12.7	12.0
-100 +150	14.7	19.7
-150 +200	10.3	15.8
-200	39.8	44.5
	100.0	100.0

(Continued on next page)

(Sampling and Analysis, cont'd) -

The sample of mine water was analysed for hardness and alkalinity, with the following results:

63 parts per million of $CaCO_3$.
pH = 7.6.

The Ottawa river water used in the Ore Dressing Laboratories has:

53 parts per million of $CaCO_3$
and a pH of 8.6.

Investigative Work:

On the ore shipment it was required to ascertain whether molybdenite flotation concentrates can be obtained which will compare favourably in grade and recovery with those products at the La Corne property during former periods of operation; also, whether the same results can be obtained using Ottawa water as when using La Corne Mine water.

On the concentrate shipments, small-scale cleaning operations were required in order to bring, if possible, the concentrates up to grade.

In the test work on the ore shipments practically identical results were obtained when using Ottawa water as when using La Corne Mine water. Concentrates assaying 90 per cent MoS_2 and 0.85 per cent Bi were secured, with recoveries of 85 per cent of the MoS_2 in the ore. In the work on the concentrate shipments the grade was raised to between 82 and 85 per cent MoS_2 by the use of 80-mesh Callow screens. The bismuth contents, at 2.4 per cent Bi, were still somewhat high in the Sample A cleaned concentrates but assayed from 0.37 to 0.58 per cent Bi in the cleaned "B" sample.

In the record of the test work which follows, Part I covers the work done on the ore shipment and Part II that on the concentrate shipment.

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DETAILS OF TESTS:

PART I. - ORE SHIPMENT.

Test No. 1 (A, to, D).

In this test, portions of the ore shipment at minus 14 mesh were ground in a ball mill to different degrees of fineness and the pulp was then transferred to a Denver flotation cell where a rougher molybdenite concentrate was removed. This rougher concentrate was then transferred to a smaller flotation cell and cleaned. The cleaned concentrates were assayed for MoS_2, Bi, Fe, and acid insoluble, and the middlings and tailing products for MoS_2. An 80-mesh screen was not used in this test, during the cleaning operations. In Tests Nos. 1-A and 1-B Ottawa water was used and in Tests Nos. 1-C and 1-D, La Corne Mine water, in both grinding and flotation.

Reagents added to grind, lb./ton feed:

Test No.	Coal oil	Grind, % -200 mesh
1-A	2.0	61.8
B	2.0	59.4
C	2.0	67.6
D	2.0	68.2

Reagents added to cell, lb./ton feed:

Test No.	Sodium cyanide	Sodium silicate	Pine oil
1-A	0.10	0.5	0.05
B	"	0.5	0.05
C	"	0.5	0.07
D	"	0.5	0.07

(Continued on next page)

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

Results of Flotation:

Test No. 1-A (Ottawa water).

Product	Weight, per cent	ASSAYS, per cent				Distribution of MoS_2, per cent	Ratio of concentration	Grind, % -200 mesh
		MoS_2	Bi	Fe	Insol.			
Feed	100.00	0.57*	-	-	-	100.0		
Flot. conc.	00.63	79.14	0.93	1.90	15.40	87.4	159:1.	61.8
" middling	6.90	0.38	-	-	-	4.6		
" tailing	92.47	0.05	-	-	-	8.0		

Test No. 1-B (Ottawa water).

Feed	100.00	0.58*	-	-	-	100.0		
Flot. conc.	0.69	73.98	0.96	1.61	19.40	88.5	145:1.	59.4
" middling	5.24	0.36	-	-	-	3.3		
" tailing	94.07	0.05	-	-	-	8.2		

Test No. 1-C (La Corne Mine water).

Feed	100.00	0.62*	-	-	-	100.0		
Flot. conc.	0.58	82.32	0.58	1.20	10.18	77.1	172:1.	67.6
" middling	4.47	0.62	-	-	-	4.5		
" tailing	94.95	0.12	-	-	-	18.4		

Test No. 1-D (La Corne Mine water).

Feed	100.00	0.575*	-	-	-	100.0		
Flot. conc.	0.63	78.94	1.41	1.20	13.68	86.3	159:1.	68.2
" middling	3.32	0.35	-	-	-	2.1		
" tailing	96.05	0.07	-	-	-	11.6		

* Calculated.

As stated previously, the Callow 80-mesh screen was not used in this test in cleaning the concentrates.

While there is no great apparent difference, the results of the above tests indicate that slightly better results were obtained with mine water. The fact that Ottawa water had a pH of 8.6, as against a pH of 7.6 for the mine water, indicates that some slight saponification of kerosene may have occurred. This would result in a dirtier froth. This conclusion is borne out by the required increase of pine oil from

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

0.05 pound per ton for Ottawa water as against 0.07 pound for the mine water. The insoluble in the Ottawa water tests is also higher than in the mine water tests. Therefore, it is desirable to maintain the flotation circuit as nearly neutral as possible.

Operation of the cells also has a bearing on the grade of concentrate. In Test No. 1-C, a higher-grade concentrate was obtained and a higher tailing than in Test No. 1-D. No benefit was indicated by the use of cyanide. The iron content of the concentrate obtained in Test No. 1-A, where cyanide was used, is somewhat higher than in Test No. 1-B.

Test No. 2 (A to C).

In this test the ore was ground in a ball mill and the pulp floated in a Denver cell, as in the previous test. The rougher concentrate was cleaned in a smaller cell and the cleaner concentrate was passed over an 80-mesh screen. The minus 80 mesh material was combined with the cleaner tailing to form the middling product, while the plus 80 mesh material formed the finished molybdenite concentrate. In Test No. 2-A La Corne Mine water was used in grinding and flotation and in Tests Nos. 2-B and 2-C, Ottawa water.

Reagents added to grind, lb./ton feed:

Test No.	Coal oil	Sodium silicate	Sodium cyanide	Grind, % -200 mesh
2-A	1.0	2.0	0.20	51.4
2-B	2.0	2.0	-	53.4
2-C	2.0	2.0	0.20	58.8

(Continued on next page)

(Test No. 2 (A to C), cont'd) -

Reagents added to cell, lb./ton feed:

Test No.	Pine oil
2-A	0.10
2-B	0.10
2-C	0.13

Results of Flotation:

Test No. 2-A (La Corne Mine water).

Product	Weight, per cent	ASSAYS, per cent				Distribution of MoS_2, per cent	Ratio of concentration
		MoS_2	Bi	Fe	Insol.		
Feed	100.00	0.575*	-	-	-	100.0	
+80 mesh conc.	0.48	91.48	0.85	0.79	4.10	76.4	208:1.
Middling	3.58	1.92	-	-	-	12.0	
Flot. tailing	95.94	0.07	-	-	-	11.6	

Test No. 2-B (Ottawa water).

Feed	100.00	0.575*	-	-	-	100.0	
+80 mesh conc.	0.50	90.88	0.80	0.79	3.30	79.0	200:1.
Middling	3.76	1.44	-	-	-	9.4	
Flot. tailing	95.74	0.07	-	-	-	11.6	

Test No. 2-C (Ottawa water).

Feed	100.00	0.59*	-	-	-	100.0	
+80 mesh conc.	0.47	91.66	0.80	0.89	2.80	73.3	212:1.
Middling	3.24	2.78	-	-	-	15.3	
Flot. tailing	96.29	0.07	-	-	-	11.4	

* Calculated.

In these tests, both the grade of concentrates and the recovery of MoS_2 are satisfactory. As previously stated, the flotation concentrates were finally cleaned on an 80-mesh screen. No noticeable difference is apparent in the results obtained from using the La Corne Mine water in Test No. 2-A or the Ottawa water in Tests Nos. 2-B and 2-C. The middling in each case is composed of the minus 80 mesh portion plus the flotation middlings resulting from one cleaning of the rougher concentrate. In practice these products are returned to the flotation circuit for further treatment.

(Details of Tests, cont'd) -

PART II. - CONCENTRATES.

Test No. 3 (A to D).

In this test, cleaning operations were made on the shipments "A" and "B" of flotation concentrates. Portions of the concentrates were conditioned with different reagents, as noted, and a flotation concentrate obtained. This concentrate was cleaned on an 80-mesh screen. The minus 80 mesh product was added to the flotation tailing and constituted the tailing product.

The plus 80 mesh material was the final molybdenite concentrate.

Reagents added to cell, lb./ton feed:

Test No.	Sodium cyanide	Soda ash	Sodium silicate	Pine oil
3-A	0.20	0.50	1.00	0.10
B	-	0.50	1.00	0.10
C	0.20	0.50	1.00	0.10
D	-	0.50	1.00	0.10

Results of Flotation:

Test No. 3-A (On "A" Concentrate).

Product	Weight, per cent	ASSAYS, per cent				Distribution of MoS_2, per cent
		MoS_2	Bi	Fe	Insol.	
Feed	100.00	67.95	-	-	-	100.0
+80 mesh conc.	64.48	83.70	2.71	2.21	5.66	79.4
Flot. tailing	35.52	39.36	-	-	-	20.6

Test No. 3-B (On "A" Concentrate).

Feed	100.00	69.13	-	-	-	100.0
+80 mesh conc.	65.66	82.10	2.41	2.11	6.30	78.0
Flot. tailing	34.34	44.33	-	-	-	22.0

Calculated.

(Continued on next page)

(Test No. 3 (A to D), cont'd) -

Results of Flotation, cont'd.:

Test No. 3-C (On "B" Concentrate).

Product	Weight, per cent	ASSAYS, per cent				Distribution of MoS_2, per cent
		MoS_2	Bi	Fe	Insol.	
Feed	100.00	78.58	-	-	-	100.0
+80 mesh conc.	68.69	85.28	0.58	2.11	7.24	74.5
Flot. tailing	31.31	64.01	-	-	-	25.5

Test No. 3-D (On "B" Concentrate).

Feed	100.00	77.07	-	-	-	100.0
+80 mesh conc.	65.14	83.10	0.37	1.71	6.90	70.2
Flot. tailing	34.86	65.80	-	-	-	29.8

Calculated.

Assuming that the grade of mill feed was the same when concentrates A and B were produced, the degree of grinding would appear to have an important bearing on the bismuth content of the concentrate. Sample "A", where 22.5 per cent of the concentrate is coarser than 65 mesh, contains 2.90 per cent bismuth, while Sample "B", with 8 per cent +65 mesh, has a bismuth content of 0.75 per cent. No great reduction of the bismuth is noted after screening Sample "A" on 80 mesh, while a reduction of 50 per cent is effected on Sample "B". However, contradictory evidence is presented by an examination of the third lot of concentrate produced at the mill January 3rd, 1943. See Test No. 4-C.

Test No. 4 (A to C).

In Tests 4-A and 4-B, portions of Sample "A" concentrate were reground in a ball mill to pass 64 per cent minus 200 mesh. The pulp was then refloated and cleaned on an 80-mesh screen as in Test No. 3.

(Continued on next page)

(Test No. 4 (A to C), cont'd) -

Reagents added to cell, lb./ton feed:

Test No.	Soda ash	Sodium silicate	Pine oil	Ph of pulp
4-A	-	1.00	0.10	7.4
4-B	0.50	1.00	0.10	8.5

Results of Recleaning:

Test No. 4-A.

Product	Weight, per cent	ASSAYS, per cent				Distribution of MoS_2, per cent
		MoS_2	Bi	Fe	Insol.	
Feed	100.00	68.52[b]	2.90	2.41	14.30	100.0
+80 mesh conc.	50.90	86.10	1.67	0.90	4.95	64.0
-80 " "	49.10	50.30	-	3.92	-	36.0

Test No. 4-B.

Feed	100.00	67.61[b]	2.90	2.41	14.30	100.0
+80 mesh conc.	45.67	89.65	1.13	0.60	3.75	60.6
-80 " "	54.33	49.10	-	3.71	--	39.4

[b] Calculated.

Test No. 4-C.

This concentrate was produced after the installation of an 80-mesh Callow screen at the property and represents the material remaining on the screen after feeding the final flotation concentrate to it.

Reflotation of this product recovered 99.5 per cent of the molybdenite as a concentrate assaying 88.55 per cent MoS_2. This constituted 96.9 per cent of the weight of the flotation feed.

A screen analysis of the material as received, assaying 83.81 per cent MoS_2 and 1.61 per cent Bi, is as follows:

(Continued on next page)

(Test No. 4-C, cont'd) -

Mesh	Weight, per cent	Assay, Bi, per cent	Distribution of Bi, per cent
+48	18.8	0.18	2.8
-48+65	14.0	0.22	2.5
-65+100	15.6	0.51	6.5
-100+150	14.7	1.12	13.4
-150+200	9.3	2.22	16.8
-200	27.6	2.58	58.0
	100.0		100.0

These results show that with a grind of 32.8 per cent plus 65 mesh the bismuth content of the +80 mesh Callow screen product is 1.61 per cent. However, only 5.3 per cent of the bismuth is found in the sizes coarser than 65 mesh. Microscopic examination of +28 mesh concentrate showed the presence of several spherules of agglomerated bismuth minerals. These were composed of fine mineral particles held together by a sticky resinous material. Therefore, it can be assumed that the fine bismuth in the concentrate is present as agglomerated masses, or adhering to molybdenite particles. This condition probably is the result of over-agglomeration caused by the excessive use of kerosene and pine oil, coupled with the quantity of water added to the Callow screen.

In Tests Nos. 4-A and 4-B, where the concentrate was reground and refloated, the reduction in bismuth content doubtless is due to a freeing of agglomerated mineral particles rather than to freeing attached molybdenite-bismuth grains.

SUMMARY AND CONCLUSIONS:

On the ore shipment the test work shows that molybdenite concentrates can be obtained assaying over 90 per cent MoS_2. These concentrates were made using either Ottawa water or La Corne Mine water in the grind and flotation circuits; the recovery of the MoS_2 was over 85 per cent in each case. Indications were that the pH should be maintained as nearly neutral as possible. In Test No. 1 the flotation of the molybdenite was made without the use of an 80-mesh screen and concentrates were produced assaying from 73 to 82 per cent MoS_2. In Test No. 2, where the 80-mesh screen was incorporated in the flotation circuit, concentrates assaying over 90 per cent MoS_2 were obtained. The use of cyanide in the circuit was not necessary and the tests made with and without show no appreciable difference. It might also be noted that the amounts of flotation reagents used in this small-scale test work should not be followed in mill practice as in the case of coal oil and pine oil a percentage of these reagents from the middling product reports back in the rougher concentrate circuit.

In the test work on the two concentrate shipments, it was shown that by refloating and then screening on an 80-mesh Callow screen, these concentrates can be cleaned up to a grade of 83 to 85 per cent MoS_2.

Off-grade concentrates stored at the property should be fed into the classifier and refloated. Should unsatisfactory results be obtained, the material could be fed to the ball mill.

Should the specifications for molybdenite concentrates become more stringent as to bismuth content, a study of the agglomerating effect of varying quantities of kerosene and pine oil should be undertaken. At the same time, the amount of

(Summary and Conclusions, cont'd) -

water added to the Callow screen should be varied and attention should be paid to the quantity and force of spray water used on the screen.

The results of the investigation show that the ore as represented by the samples furnished is readily amenable to flotation, producing a high-grade molybdenite concentrate.

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