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Report of Ore Dressing & Metallurgical Laboratories

Test No. 83

Molybdenite-Gold Ore from New Hazelton, B.C.

A shipment of 10 bags of Molybdenite Ore was received on November 21st, 1917 from the New Hazelton Gold and Cobalt Mines, Ltd., New Hazelton, B.C.

The ore consisted of Molybdenite, in fine flakes approaching the amorphous variety; Molybdite, the Molybdenum oxide; sulphides of Iron; Arsenopyrite; Cobalt, probably in the form of both Cobaltite and Smaltite and Erythrite, the Cobalt Bloom. Associated with these minerals are considerable values in gold. A small amount of silver is also present.

Gross Weight of Sample Received --- 870 pounds

This sample was crushed to 10 mesh in a small jaw crusher and set of rolls and a sample obtained for small scale tests and for analysis. The analysis of the sample showed the ore to contain:-

Molybdenite	(MoS_2)	---	1.98 %
Molybdite	(MoO_3)	---	0.10 %
Cobalt	(Co)	---	0.96 %
Arsenic	(As)	---	3.82 %
Gold	(Au)	---	1.32 ozs.
Silver	(Ag)	---	0.12 ozs.

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The tests on this ore were conducted to obtain a separation of the mineral constituents of the ore and so concentrate them into commercial products. This was done along the following lines:-

Firstly:- The separation of the Molybdenite values by Oil Flotation, to obtain a commercial molybdenite product.

Secondly:- The separation of the other sulphides from the gangue to obtain a smelter product, carrying the Arsenic, Cobalt and Gold values.

Thirdly:- The further recovery of the gold values if necessary in the Tailings after the separation of the above products.

Small Scale Test:- A sample of the ore cut out from the original head sample was ground to 48 mesh (Tyler's Standard). 1000 grams was taken and mixed in a pebble jar with Oil Mixture - 1 lb. Coal Oil per ton, ¼ lb. Crude Turpentine per ton and a little water, for 10 minutes. It was then added to the Laboratory Callow Flotation Machine from which three products were made, namely, a Molybdenite Concentrate, a Middling and Tailing. The Middling and Tailing were combined and run over a small Wilfley table to obtain a separation of the other sulphides. A table concentrate, a middling and tailing were made.

The results of this test are tabulated below:-

Product	Dry Wt. Gms.	ANALYSIS				CONTENT				PERCENTAGES			
		% MoS_2	% Co	% As	Ozs.Au	Gms.MoS_2	Gms.Co	Gms.As	Gram-oz. Au.	% MoS_2	% Co	% As	% Au
Molybdenite Conc tes.	31	50.00	0.80	2.45	3.60	15.5000	0.2480	0.7595	1.1160	78.28	2.58	1.99	8.45
Table Conc tes.	49	1.00	11.12	38.00	4.25	0.4900	5.4488	18.6200	2.0825	2.47	56.76	48.74	15.78
Table Mids	58	1.64	1.70	4.56	1.82	0.9512	0.9860	2.6448	1.0556	4.80	10.27	6.92	8.00
Table Tails	531	0.29	0.44	1.60	0.32	1.5399	2.3364	8.4960	1.6992	7.78	24.34	22.24	12.87
Slime Loss, etc.	331	0.40	0.18	23.20	2.19	1.3189	0.5808	7.6797	7.2467	6.66	6.05	20.11	54.90
Crude Ore	1000	1.98	0.96	3.82	1.32	19.8000	9.6000	38.2000	13.2000	99.99	100.00	100.00	100.00

Summary:- From the above results, the following deductions are made:-

Molybdenite:- The Molybdenite concentrate made gave an analysis of 50.00 % MoS_2. This low grade of concentrate is usual in test work on the laboratory machine. Much better results are always obtained in practice, the grade of the concentrate increasing with the better manipulation of the machines.

A recovery of 78.28 % of the Molybdenite values in the ore is contained in the concentrate. This recovery should easily be reached in actual practice.

Cobalt:- The table concentrates made gave an analysis of 11.12 % Co. with a recovery of 56.76 % of the Cobalt values in the ore. The table middlings made gave an analysis of 1.70 % Co, representing 10.27 % of the Cobalt values in the ore. This middling product would be returned to the circuit in practice. The total recovery of the Cobalt values in the concentrates would be around 65 %.

Arsenic:- The table concentrates made gave an analysis of 38.00 % As, with a recovery of 48.74 % of the Arsenic values in the ore. The table middlings made gave an analysis of 4.56 % As, representing 6.92 % of the Cobalt values in the ore. This middling product would be returned to the circuit in practice. The total recovery of the arsenic values in the concentrates would be around 55 %.

Gold:- The above test shows that 8.45 % of the gold values remained in the Molybdenite Concentrate. These gold values are not in the Molybdenite but in the other sulphides and would report to a large extent in the Molybdenite Tails in raising the grade of the concentrates by

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wet screening in the Mill circuit, The Molybdenite flake staying on the screen while the fine iron sulphides pass through and back into the circuit. The table concentrates show a recovery of 15.78 % of the gold values while the losses show 54.90 % of the gold values. It was supposed that in crushing to 48 mesh the gold was freed and caught on the blankets of the flotation cells, and only the gold that was not freed from the sulphides was recovered. If this is the case, the Recovery of the gold values would show 70.68 %.

Large Scale Test:-

For the large scale test the ore was run through the Molybdenite circuit. The ore was already crushed to 10 mesh, so it was fed direct to the Ball Mill. Our practice is to first crush in a Jaw Crusher to 1½" and feed automatically to the Ball Mill. The oil mixture is added to the ball mill and enters the mill with the ore feed. The discharge from the ball mill runs down a launder to a 3" centrifugal pump which lifts the pulp onto one half of a Callow Screen fitted in this case with a 60 mesh ton-cap screen, the oversize from the screen being returned to the mill while the undersize goes direct to the Rougher Cell. This is not the common practice with Molybdenite ores. A Dorr Classifier is generally used instead of the screen after the Ball Mill. From the Rougher Cell a rougher concentrate and a Tailing is made, the Rougher Concentrate going to the cleaner cell while the tailing from this ore was held in a tank for further treatment on the concentrating tables. From the cleaner cell, the concentrates were drawn off over the front of the cell to an elevator and elevated onto the other half of the Callow Screen fitted with an 80

mesh

mesh ton-cap screen. The undersize from the screen going back to the Rougher Cell while the oversize was caught as Molybdenite Concentrates. The Tailings from the Cleaner Cell are also returned to the head of the Rougher Cell. The object of screening the Cleaner concentrates is to drop the fine iron sulphides through the screen, while the Molybdenite due to the coagulation of the particles by the oils is held on the screen. The oils used on Molybdenite ores, while having a preferential action for this mineral, is not complete and fine particles of other sulphides will float with the Molybdenite, hence the necessity for screening in this manner the cleaner concentrates.

Due to such a small amount of the ore on hand clean quartz was first added to the mill to help fill up the mill circuit before proceeding with the Molybdenite.

After the operation was complete, the Callow Cells were cleaned out as well as possible and this clean up dried, weighed and sampled.

The results of the test are tabulated below:-

Quartz added to Mill	-	373 pounds
Ore to Mill	-	765 "
Total		1138 "

Molybdenite Concentration of Crude Ore

Product	Dry Wt. Lbs.	ANALYSIS						CONTENT				PERCENTAGES			
		% MoS_2	% MoO_3	% Co	% As	Oz.Au	Oz.Ag	Lbs MoS_2	Lbs.Co	Lbs.As	Ozs.Au	% MoS_2	% Co	% As	% Au
Molybdenite Conc tes.	14.5	53.50		0.30	0.43	1.40		7.7575	0.0435	0.0624	0.01015	51.21	0.59	0.21	2.01
Clean up of Cell	83.	4.77		0.85	2.17	1.33		3.9591	0.3855	1.8011	0.05520	26.14	5.25	6.17	10.93
Molybdenite Tailings	1000.	0.35		0.70	1.55	0.30		3.5000	7.0000	15.5000	0.15000	23.11	95.31	53.04	29.71
Losses in Circuit	40.5				29.37	14.30		0.0696	0.0850	+11.8595	+0.28955	- 0.46	- 1.15	+40.58	+57.35
Crude Ore	765	1.98	0.10	0.96	3.82	1.32	0.12	15.1470	7.3440	29.2230	0.50490	100.00	100.00	100.00	100.00

Table Concentration of Molybdenite Tailing

Table Conc tes	25	2.97		9.30	33.56	7.55		0.7425	2.3250	8.3900	0.09437	4.90	31.66	28.71	18.69
Table Mids	26	1.25		1.55	4.32	0.89		0.3250	0.4030	1.1232	0.01157	2.14	5.49	3.84	2.29
Table Tails	949	0.26		0.27	0.39	0.08		2.4674	2.5623	3.7011	0.03796	16.22	34.90	12.67	7.52
Slime Loss								-0.0349	+1.7097	+2.2857	+0.00610	- 0.15	23.26	7.82	1.21
Molybdenite Tailings	1000	0.35		0.70	1.55	0.30		3.5000	7.0000	15.5000	0.15000	23.11	95.31	53.04	29.71

Summary:- From the above results the following deductions are made:-

Molybdenite:- The Molybdenite Concentrate made gave an analysis of 53.50 % MoS_2 with a recovery of 51.21 % of the Molybdenite Values in the ore. To this must be added the Molybdenite Values in the clean up of the cells, making a total recovery of Molybdenite Values 77.35 %. This recovery can be worked up in practice, as well as the grade of the concentrate. The low grade of the concentrate is due to having to run the cells so long in order to obtain as much of the Molybdenite Values as possible in the concentrates. The Cobalt, Arsenic and gold values in this concentrate can also be reduced by careful manipulation as they are contained in the fine sulphides other than Molybdenite in the concentrates. A screen test was made on a sample of the concentrates, and analysis of the screen sizes were made as follows:-

Screen Sizes.	Weight Grams.	ANALYSIS			
		% MoS_2.	% Co.	% As.	Ozs. Au.
+ 100	599	60.25	0.15	0.26	0.38
-100 + 150	209	54.35	0.18	0.24	0.35
-150 + 200	168	51.25	0.32	0.42	0.65
-200	615	49.70	0.48	0.61	3.00

From the above screen test it is shown that practically all the gold values can be eliminated from the Molybdenite Concentrates by careful work on the concentrate screen.

Cobalt:- The table concentrates gave a product 9.30 % Co. with a recovery of 31.66 % of the Cobalt values in the ore. To this is added the Cobalt in the middlings making the total recovery 37.15 %. From the above table

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of results it is shown that there has been a large loss in the tailings and in slime. This is very likely due to the Cobalt occurring as bloom, as the sulphide and arsenide would concentrate more readily from the gangue.

Arsenic:- The table concentrates gave a product - 33.56 % As with a recovery of only 28.71 % of the Arsenic Values in the ore. With the additional 3.84 % Arsenic in the middling, makes a total recovery of 32.55 %. From the above table of results it will be noted however that 40.58 % of the Arsenic Values were lost in the Mill circuit. The heavy Arsenopyrite and iron pyrites in the ore remained to this extent in the Ball Mill, pump and pipe lines, and so were not recoverable on the table. If this percentage is added, the total recovery of the Arsenic Values would be 73.13 %.

Gold:- The table concentrates gave a product - 7.55 ozs. gold to the ton. The recovery in this concentrate was only 18.69 % of the gold values in the ore. The remaining gold values are accounted for as follows:-

In the Molybdenite Concentrates	---	2.01 %
In the Clean up of the Cells	---	10.93 %
In the table middlings	---	2.29 %
Losses in Circuit	---	57.35 %
In the Tailings	---	8.73 %

The gold values in the heavy sulphides were held up with the Arsenopyrite and iron sulphides in the circuit along with any free gold. The free gold would also be caught in the canvas bottoms of the Flotation Cells. The actual losses of gold values not recoverable in actual practice would be the Loss in Molybdenite Concentrates, which in the above test was 2.01 % and the loss in table tailings which was 8.73 % making a total of 10.74 %. In actual practice a recovery of about 90 % of the

the gold values should be expected.

Conclusions:- From the test work conducted so far on this ore, it has been proven that the Molybdenite Values can be recovered by oil Flotation with a recovery of from 75% to 80 %; that the grade of the Molybdenite concentrate can be improved and practically all the gold values removed by careful screening of the cleaner cell concentrates.

It has also been proven that by table concentration of the Molybdenite tailing, the cobalt, arsenic and gold values can be concentrated into a smelter product. This product should contain in actual practice 90 % of the gold values, with a fair concentration of the cobalt and 73 % of the arsenic values.

Instead of table concentration of the Molybdenite Tailing it may be advisable to regrind and refloat in another set of cells, recovering the gold values in this manner, similar to the practice at Cobalt, Ontario. A comparison of the two methods of recovering the gold values in the ore should be made.

It has also been proven that the sample of ore submitted contains free gold. An amalgamation test was made to prove whether the ore could be amalgamated before concentration. It was found out however that trouble would be experienced as with the case of all arsenopyrite ores and should not be resorted to if a good recovery can be made by other methods. The results of the test work on this ore has been so encouraging, that it would be advisable to continue with it on a larger scale. With a run on a carload lot, the losses in circuit would be minimized, the Flotation cells would work more satisfactory and a comparison of table concentration of the Molybdenite Tailing and reflotation of these tailings to recover the gold values could be made.