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MINES BRANCH INVESTIGATION REPORT IR 61-105

BENEFICIATION OF MILL PRODUCTS PRODUCED BY LANGIS SILVER AND COBALT MINING CO. LTD., NEW LISKEARD, ONTARIO

by

T. F. BERRY

MINERAL PROCESSING DIVISION

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COPY NO. 18

SEPTEMBER 21, 1961

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T. F. Berry*

SUMMARY OF RESULTS

All attempts to recover a metallic silver concentrate from the flotation concentrate produced at the mine were unsuccessful.

The flotation concentrate produced at the mine can be up-graded by filtering, washing and refloating. The ultimate grade of final concentrate which can be realized will be dependent on the grade of the original concentrate, the recleaning time and the amount of reagents which are allowed to remain in the concentrate prior to recleaning.

A high grade metallic silver concentrate can be produced from the No. 3 Wilfley table concentrate. The following table shows the results obtained from batch grinding this concentrate and screening out the metallic silver.

Mesh Size	Cumulative Grade Ag, oz/ton	Cumulative Recovery Ag, %
+28	24,274.0	44.3
+35	24,274.0	48.0
+48	24,021.7	54.4
+65	23,279.0	60.9

The stamp tailing was not amenable to gravity concentration.

A flotation recleaner concentrate assaying 252.20 oz Ag/ton was produced from the stamp tailing.

Attempts to produce a flotation tailing below 1.0 oz Ag/ton were unsuccessful.

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INTRODUCTION

At the suggestion of A. H. Ross and Associates, Consulting Chemical and Metallurgical Engineers, Suite 1505, 80 Richmond Street West, Toronto, Ontario, the Langis Silver and Cobalt Mining Company Limited, Drawer 870, New Liskeard, Ontario, requested the services of an ore dressing engineer from the Mines Branch in Ottawa to carry out a test program on the ore and concentrate of the mine.

Thus, with the approval of the Director, Mines Branch, the author spent about five weeks in Haileybury conducting a series of tests on the Langis mill products in the laboratories of the Provincial Institute of Mining.

Location of Property

The Langis Silver and Cobalt Mining Co. Ltd., is a silver and cobalt producer presently operating at 80 tons per day. It is situated approximately 15 miles northeast of New Liskeard, Ontario.

Nature of Investigation Requested

1. To investigate the possibility of recovering a direct-refining metallic silver concentrate assaying a minimum of 22,000 oz Ag/ton, from the flotation concentrate produced at the mine.

2. Alternately, should the metallic silver in this concentrate prove not amenable to recovery, to produce as high grade a flotation concentrate as possible.

3. To recover, if possible, a metallic silver concentrate

assaying a minimum of 22,000 oz Ag/ton, from the No. 3 Wilfley table concentrate produced at the mine.

4. To determine the amenability to concentration of the silver-bearing minerals in a sample of stamp tailing.

Analysis

All of the assaying was done in the Bell-White Analytical Laboratories Ltd., Haileybury, Ontario.

DETAILS OF INVESTIGATION

PART I - Flotation Concentrate

Test 1 - Screening and Elutriation

Approximately 500 g of the flotation concentrate produced in the mill was repulped, filtered and washed. This concentrate was wet screened on a 100 M and a 200 M screen, thus producing three fractions, +100 M, -100+200 M, and -200 M.

Each fraction was elutriated separately to obtain a concentrate and a tailing. The concentrate in each case was elutriated again with the cleaner tailing being added to the original tailing.

The results of this test were as follows:

TABLE 1

Results of Screening and Elutriation

Product	Weight	Assays	Distribution
	%	Ag oz/ton	Ag %
+100M E1 concentrate	1.6	1901.3	7.0
+100M " tailing	8.3	327.6	6.2
Head (calcd)	9.9	582.0	13.2
-100+200M E1 concentrate	0.6	536.3	0.7
-100+200M E1 tailing	12.6	564.2	16.3
Head (calcd)	13.2	562.9	17.0
-200M E1 concentrate	0.3	698.3	0.5
-200M " tailing	76.6	393.4	69.3
Head (calcd)	76.9	394.6	69.8
Total E1 concentrate	2.5	1429.0	8.2
" " tailing	97.5	409.0	91.8
Total Head (calcd)	100.0	435.4	100.0

Test 2 - Flotation, Elutriation, Tabling

Approximately 500 g of freshly filtered flotation concentrate was repulped, filtered and washed. This concentrate was refloated for 8 min with 100 ml of original filtrate added. The concentrate thus produced was cleaned for 3 min in a flotation cell.

This flotation cleaner concentrate was elutriated and the elutriation concentrate was tabled. The following table shows the results which were obtained.

TABLE 2

Results of Flotation, Elutriation, Tabling

Product	Weight	Assay	Distribution
	%	Ag oz/ton	Ag %
Table concentrate	2.7	1656.0	11.7
" tailing	4.3	1304.0	14.7
Elutriation concentrate (calcd)	7.0	1439.7	26.4
Elutriation tailing	21.2	988.0	54.8
Flotation C1 concentrate (calcd)	28.2	1100.14	81.2
Flotation C1 tailing	12.5	306.0	10.0
" tailing	59.3	57.06	8.8
Head (calcd)	100.0	382.33	100.0

Test 3 - Flotation

In this test an attempt was made to upgrade a sample of freshly filtered flotation concentrate by refloating as was done in Test 6 of Mines Branch Investigation Report IR 61-92 by G. O. Hayslip.

The concentrate was repulped, filtered and thoroughly washed. The original filtrate was retained. The flotation time was 8 min with 100 ml of the filtrate added, followed by a 3 min cleaner flotation.

The results of this test may be seen as follows:

TABLE 3

Results of Refloating the Flotation Concentrate

Product	Weight	Assays	Distribution
	%	Ag oz/ton	Ag %
Flotation cl concentrate	32.0	1075.9	85.3
" " tailing	14.9	233.8	8.6
" tailing	53.1	46.34	6.1
Head (calcd)	100.0	403.73	100.0

A comparison of these results with those of Test 6 mentioned above indicates that with this flotation scheme, a concentrate assaying approximately 2.5 times the original feed may be obtained.

PART 2 - No. 3 Wilfley Table Concentrate

Test 4 - Sturtevant Rolls

A sample of Wilfley table concentrate was obtained, from which the coarse metallics had already been screened. This sample was riffled into two fractions, one of which was used for comparison purposes. The other sample was fed once through the Sturtevant rolls which were so tightly set as to be almost touching.

The following table gives the results of a screen test on this concentrate before and after treatment in the Sturtevant rolls:

TABLE 4

Results from Use of Sturtevant Rolls

Mesh Size	Weight %		Assays, Ag oz/ton		Distribution, Ag %	
	Comparison	Rolled	Comparison	Rolled	Comparison	Rolled
+14 mesh	11.0	3.9	7,318.5	18,980.2	17.9	16.5
-14+20 "	6.2	2.6	9,077.7	18,785.0	12.5	10.9
-20+28 "	7.9	3.7	8,012.5	15,089.0	14.1	12.4
-28+35 "	9.5	7.0	6,018.3	8,033.3	12.7	12.5
-35+48 "	10.5	12.7	4,250.0	4,119.8	9.9	11.6
-48+65 "	12.3	15.2	3,340.4	2,913.9	9.2	9.8
-65 "	42.6	54.9	2,486.4	2,146.0	23.7	26.3
Head (calcd)	100.0	100.0	4,488.9	4,493.5	100.0	100.0

Combined +28 mesh comparison concentrate (calcd) - 7,971.4 oz Ag/ton.

Combined +28 mesh rolled concentrate (calcd) - 17,518.9 oz Ag/ton.

Test 5 - Sturtevant Rolls

The concentrate used in this test was similar to that used in Test 4. The rolls were set as in the previous test and the sample was passed through the rolls four times. After each pass, the entire rolls product was screened on screens of mesh sizes indicated in the following table of results. The plus fractions were removed after each screening for assaying.

TABLE 5

Results of Use of Sturtevant Rolls

Pass No.	Mesh Size	Weight %	Assay Ag oz/ton	Distribution Ag %
1	+14 mesh	4.4	18,925.5	17.8
2	+14 "	0.5	21,139.5	2.3
	-14+20 "	2.3	21,541.3	10.6
3	-14+20 "	0.8	20,133.3	3.4
4	-14+20 "	0.6	15,886.3	2.0
	-20+28 "	1.9	21,095.0	8.6
	-28 "	89.5	2,873.7	55.3
Head (calcd)		100.0	4,663.0	100.0

Test 6 - Sturtevant Rolls

The grade of the samples of concentrate removed from No. 3 Wilfley table varied from day to day between quite wide limits. Therefore, in order to obtain a sample more nearly representative of a normal day's operation, the table launder was washed free of coarse silver and a pail placed to catch a 4-hr sample which included one jig discharge. This sample, weighing approximately 35 lb, was dried.

To offset errors resulting from the riffling of a test sample from this concentrate, the entire sample was used in the test.

The +10M, -10+14M, -14+20M and -20+28M fractions were screened out. Each fraction was treated separately in tightly set Sturtevant rolls and screened on the original screen with the minus fraction passing to the next finer size for passage through the rolls. Each fraction was rolled until no more material would pass through the screens.

The following table summarizes the results which were obtained in this test.

TABLE 6

Results of Use of Sturtevant Rolls

Mesh Size	Weight %	Assay Ag oz/ton	Distribution Ag %
+10 mesh	5.2	20,871.1	30.6
-10+14 "	2.7	12,950.0	9.8
-14+20 "	7.5	6,875.0	14.5
-20+28 "	14.8	3,250.0	13.6
-28 "	69.8	1,600.2	31.5
Head (calcd)	100.0	3,548.51	100.0

Test 7 - Batch Grinding

The author had for some time considered the possibility of effecting a metallic silver separation by a process of batch grinding of the table concentrate followed by screening of the ground pulp. The thought was that the malleable metallic silver in the concentrate would be subjected to a flattening process while the more brittle arsenides and sulphides would tend to be finely ground.

Toward this end a 4-hr sample of No. 3 Wilfley table concentrate was obtained in the same manner as in Test 6.

This concentrate was dried, thoroughly mixed, and several 2000 g samples were riffled out. The test samples were ground in a ball mill using steel balls for 10, 20 and 30 min and the ground pulp was wet screened to obtain four screen fractions: +14M, -14+20M, -20+28M, -28M. Complete removal of the metallic iron was effected by hand magnet before assaying.

The following table summarizes the results obtained in this test.

TABLE 7

Results of Batch Grinding

No grind

Mesh Size	Weight %	Assay Ag oz/ton	Distribution Ag %
+14 mesh	24.2	6,516.5	34.5
-14+20 "	6.5	10,650.0	15.1
-20+28 "	9.3	5,946.4	12.1
-28 "	60.0	2,913.2	38.3
Head (calcd)	100.0	4,570.18	100.0

(Cont'd)

TABLE 7 (concl'd)

Results of Batch Grinding

10 min grind

Mesh Size	Weight %	Assay Ag oz/ton	Distribution Ag %
+14 mesh	9.6	13,728.3	28.7
-14+20 "	3.0	20,700.0	13.5
-20+28 "	1.2	18,400.0	4.8
-28 "	86.2	2,828.0	53.0
Head (calcd)	100.0	4,597.45	100.0

20 min grind

+14 mesh	5.7	21,930.1	26.8
-14+20 "	1.9	24,324.4	9.9
-20+28 "	1.1	23,893.2	5.6
-28 "	91.3	2,954.0	57.7
Head (calcd)	100.0	4,672.01	100.0

30 min grind

+14 mesh	5.0	23,868.9	25.6
-14+20 "	1.7	24,989.4	9.1
-20+28 "	1.3	24,904.0	6.9
-28 "	92.0	2,956.8	58.4
Head (calcd)	100.0	4,662.58	100.0

With the encouraging results obtained in the 30 min grind, a sample of the -28 mesh rejects was screened on 35, 48 and 65M screens and the results obtained in the 30 min grind were recalculated to include these three finer fractions.

TABLE 8

Results of 30 Min Batch Grinding

Mesh Size	Weight %	Assay Ag oz/ton	Distribution Ag %
+14 mesh	5.2	23,868.9	27.3
-14+20 "	1.8	24,989.4	9.9
-20+28 "	1.3	24,904.0	7.1
-28+35 "	0.7	24,277.4	3.7
-35+48 "	1.3	22,274.4	6.4
-48+65 "	1.6	18,497.7	6.5
-65 "	88.1	2,018.5	39.1
Head (calcd)	100.0	4,548.5	100.0

The following table was calculated to show the grades and recoveries which were realized in this test on the indicated screens.

TABLE 9

Summary of Results from Table 8

Mesh Size	Cumulative Grade Ag oz/ton	Cumulative Recovery Ag %
+28 mesh	24,274.0	44.3
+35 "	24,274.0	48.0
+48 "	24,021.7	54.4
+65 "	23,279.0	60.9

PART 3 - Stamp Tailing

Test 8 - Gravity Concentration

Approximately 50 lb of stamp tailing was obtained by coning and quartering a large sample taken from the tailing dam. Two samples were riffled out for jigging and tabling, the results of which may be seen in the following tables.

TABLE 10

Results of Jig Test

Product	Weight %	Assay Ag oz/ton	Distribution Ag %
Jig concentrate plus bed	3.7	7.66	6.5
Jig tailing	96.3	4.20	93.5
Head (calcd)	100.0	4.33	100.0

TABLE 11

Results of Table Test

Product	Weight %	Assay Ag oz/ton	Distribution Ag %
Table concentrate	25.8	6.10	31.9
" tailing	74.2	4.52	68.1
Head (calcd)	100.0	4.93	100.0

No concentration of any consequence was evident in either of these tests. No metallic silver was observed on the table.

Test 9

A 4000 g sample of the stamp tailing was ground to 44.0% -200 M in lots of 2000 g each. The entire sample was tabled and a concentrate, middling and tailing were recovered for assaying. The results were as follows:

TABLE 12

Results of Table Test

Product	Weight	Assay	Distribution
	%	Ag oz/ton	Ag %
Table concentrate	13.0	9.81	18.5
" middling	19.4	3.15	8.9
" tailing	67.6	7.41	72.6
Head (calcd)	100.0	6.89	100.0

Test 10

A 1000 g sample of stamp tailing was ground to 44.0% -200 M. The pulp was conditioned for 10 min with 0.1 lb Z-6/ton of feed and floated for 7 min with 0.05 lb Aerofloat 31/ton of feed. The pulp appeared somewhat coarse for good flotation. The results were as follows:

TABLE 13

Results of Flotation Test 10

Product	Weight %	Assay Ag oz/ton	Distribution Ag %
Flotation concentrate	7.3	34.24	57.2
" tailing	92.7	2.02	42.8
Head (calcd)	100.0	4.37	100.0

Test 11

Three 1000 g lots of stamp tailing were riffled out and ground separately to 76.3% -200 M. Each sample of pulp was conditioned separately for 10 min and floated for 7 min in a Fagergren flotation cell.

The reagents used were as follows:

To conditioning - 0.1 lb Z-6/ton feed

To flotation - 0.05 lb Aerofloat 31/ton feed

The three rougher concentrates were combined, filtered and given a 4 min cleaner float using approximately 200 ml of filtrate. The results were as follows:

TABLE 14

Results of Flotation Test 11

Product	Weight %	Assay Ag oz/ton	Distribution Ag %
Flotation cl concentrate	1.4	176.40	50.0
" cl tailing	21.2	5.98	25.6
" tailing	77.4	1.56	24.4
Head (calcd)	100.0	4.94	100.0

Test 12

Three 1000 g samples of stamp tailing were ground to approximately 76.0% -200 M with 0.2 lb Aero Xanthate 350/ton of feed added to the mill.

The ground pulp was conditioned for 10 min in a flotation cell with 0.2 lb of Aero Xanthate 350 and 0.04 lb of Aerofloat 31/ton of feed. The flotation time was 10 minutes. The three rougher concentrates were combined, filtered and washed to remove excess reagents and given a 5 min cleaner flotation followed by 3 min of recleaning. The results were as follows:

TABLE 15

Results of Flotation Test 12

Product	Weight %	Assay Ag oz/ton	Distribution Ag %
Flotation Recl concentrate	1.0	252.20	56.4
" " tailing	4.7	10.46	11.0
" cl "	16.5	3.16	11.6
" tailing	77.8	1.21	21.0
Head (calcd)	100.0	4.48	100.0

Test 13

A special effort was made in this test to reduce the high flotation tailing shown in previous flotation tests.

Two 2000 g samples of stamp tailing were ground to 78.4% -200 M with 0.3 lb Aero Xanthate 350/ton added to the grind. The pulp was conditioned for 20 min with the following reagents:

Aero Xanthate 350 - 0.2 lb/ton feed
Aerofloat 25 - 0.06 " "

Flotation of each 2000 g sample was carried on for 10 min after which 0.1 lb Aero Xanthate 350 and 0.02 lb Aerofloat 25/ton was added and flotation continued for a further 10 min.

The rougher concentrates were combined for a 10 min cleaning stage with no reagents being added. The results were as follows:

TABLE 16

Results of Flotation Test 13

Product	Weight %	Assay Ag oz/ton	Distribution Ag %
Flotation cl concentrate	2.9	99.30	60.7
" cl tailing	4.5	10.72	10.2
" tailing	92.6	1.49	29.1
Head (calcd)	100.0	4.74	100.0

CONCLUSIONS

A high grade metallic silver concentrate assaying a minimum of 22,000 oz Ag/ton can be produced from the No. 3 Wilfley table concentrate by batch grinding followed by screening of the ground pulp and the removal of the magnetic iron from the metallic silver. The recovery which may be realized by this treatment should be in excess of 55% of the silver in the table concentrate.

In the operation of this process in a mill it will be necessary to carry out a series of tests to determine the optimum grinding time and the finest mesh size which will deliver a concentrate of the highest grade and recovery.

In the laboratory the up-grading of a flotation concentrate produced at the mine was best handled by washing out the excess reagents and filtering before refloating. In the mill a change from parallel to series flotation, coupled with adequate reagent control, should allow for the necessary number of cells for recleaning the flotation concentrate now being produced.

It appears likely that the recovery of silver from the stamp tailing may not exceed 80%. There is a strong possibility that the silver-bearing minerals in this material are highly oxidized, thus accounting for the high tailing in the flotation tests conducted.

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