O T T A W A November 6th, 1940.

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of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 910.

Sink-and-Float Tests, Followed by Indicative Concentration of Products, on Scheelite Ore from the Indian Path Mine, Lunenburg County, Nova Scotia.

BUREAU OF MINES
DIVISION OF METALLIC MINERALS
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CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

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Shipment:

Two bags of ore, total weight 100 pounds, were received on September 4th, 1940. The shipment was submitted by W. M. Goodwin, c/o R. B. Westhaver, Mahone Bay, Nova Scotia.

Location of Property:

The ore was taken from the Indian Path mine, in Lunenburg county, Nova Scotia.

Character of the Ore:

The ore contains irregular masses of scheelite along with some pyrite and arsenopyrite. The gangue consists of quartz and dark-coloured schist. No microscopic examination of this sample was made.

Although most of the scheelite occurred coarse, some isolated small particles were observed in the quartz and in association with the schist. The schist was graphitic and fairly heavy.

The size of the ore as received was approximately between 3 inches and ¼ inch; there was no fines except a little formed by attrition.

Experimental Tests:

The primary object of the tests was to determine the suitability of the ore for sink-and-float preconcentration; and, if suitable, to determine the metallurgical efficiency of the process. This work would be preliminary to recommending a full-scale plant test of several tons of the ore in the Huntington-Heberlein sink-and-float separator unit installed in the Bureau of Mines ore dressing laboratories at Ottawa.

In addition, since Sink-and-Float only effects preliminary rejection of gangue, the 'sink' and the

untreated fines were further examined by a scheme of gravity concentration and flotation. In this case the quantities available were too small for the tests to be more than indicative, the main object being to demonstrate that a marketable scheelite concentrate could be obtained without undue loss.

Part I. - Sink-and-Float Tests.

The tests described were all small-scale "bucket" tests, in which a density separation is effected under static conditions in a bath of substantially stable galena medium. The galena medium is a suspension of fine galena in water and the effective density of the medium can be controlled to an accuracy of less than 0.01 by alteration of the proportions of galena and water. The medium used is the same as would be used in the Huntington, Heberlein plant.

Preliminary Tests:

A series of "bucket" tests were first carried out to determine the best size range for treating the ore and the best medium density to use. These were determined to be:

(a) crush to minus $\frac{6}{4}$ inch or minus $\frac{1}{2}$ inch;

(b) screen out minus 8 mesh (3/32 inch) as untreatable fines;

(c) use a medium density of 2.675.

Main Tests:

Two tests were made using a medium density of 2.675. In the first case the ore separated was between $\frac{3}{4}$ inch and 8 mesh and in the second case it was between

½ inch and 8 mesh. A higher overall percentage elimination was obtained in the second case (½-inch crushing) and the metallurgical results of this test only are tabulated below:

Conditions of Test -

Ore crushed to minus ½ inch.

Size range treated by sink-and-float -- -½" + 8 mesh

Density of medium - 2.675.

Table I. - Distribution of Products from Crushing.

Product	Weight, per cent	Assays WO_3, per cent	Assays Au, oz./ton	Distribution, per cent WO_3	Distribution, per cent Au
S. F. feed	84.30	4.37	0.036	67.68	90.91
Fines (-8 mesh)	15.70	11.21	0.02	32.32	9.09
Head sample (cal.)	100.00	5.45	0.033	100.00	100.00

Table II. - Distribution of Products from S. F. Separation.

S. F. conc.	29.18	14.29	0.037	95.31	30.56
S. F. tailing	70.82	0.29	0.035	4.69	69.40
S. F. feed (cal.)	100.00	4.37	0.036	100.00	100.00

Table III. - Summary of Products from Pre-Concentration.

S. F. conc.	24.58	14.29	0.037	64.50	27.28
Fines (-8 mesh)	15.70	11.21	0.020	32.32	9.09
Product for further concentration (cal.)	40.28	13.09	0.030	96.82	36.37
S. F. tailing	59.72	0.29	0.035	3.18	63.63
Head sample (cal.)	100.00	5.45	0.033	100.00	100.00

(Continued on next page)

(Part I, cont'd) -

(Main tests, cont'd) -

These results may be summarized as follows:

Proportion of ore available for S. F. feed - 84.30 per cent.

" " " fed to subsequent processes - 40.28 "

Assays:	WO_3, per cent	Au, oz./ton
Ore received -	5.45	0.033
S. F. feed -	4.37	0.036
S.F. tailing ("float") produced -	0.29	0.035
S.F. concentrates ("sink") produced -	14.29	0.037
Ore fed to subsequent processes -	13.09	0.030

Weight elimination of S. F. feed - 70.82 per cent.
" " " whole ore - 59.72 "

Metal recovery from S. F. feed: WO_3 - 95.31 per cent.
Au - 30.56 "

Metal recovery from whole ore: WO_3 - 96.82 per cent.
Au - 36.37 "

The result of the sink-and-float operation is thus an elimination of 59.7 per cent of the total ore in the form of 'float' assaying 0.29 per cent WO_3 and 0.035 ounce gold per ton; the product for subsequent treatment ('sink' plus 'fines) is 40.28 per cent of the original ore, assays 13.09 per cent WO_3 and 0.030 ounce gold per ton, and represents a recovery of 96.8 per cent for WO_3 and 36.37 per cent for gold.

The following observations may be made:

(a) The scheelite is very soft, as may be seen by the high WO_3 assay of the fines (11.2 per cent).

(b) Gold is not concentrated at all but in any case the gold values in the ore probably do not alone justify grinding and flotation costs for their

(Part I, cont'd) -
(Main tests, cont'd) -

recovery.

(c) The scheelite has been satisfactorily concentrated with only a small loss.

(d) The 'sink' contained pyrite and arsenopyrite as well as scheelite and gangue minerals, so that sulphide flotation would have to be applied to any gravity concentrates obtained from the 'sink'.

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Subsidiary Test:

The softness of the scheelite was made use of in the following test.

A sample of the ore after crushing was shaken violently on a screen and fines made by this attrition screened out. The ore was then separated by the "bucket" test at the same density as was used in the main test (2.675). The 'float' from this operation assayed 0.07 per cent WO_3, which may be compared with the 0.29 per cent WO_3 of the 'float' in the main test.

This is apparently due to the fact that during the violent shaking some of the scheelite attached to gangue particles is knocked off, leaving such particles impoverished. These particles then appear in the 'float' with lowered assay values.

This is not 'straight' metallurgy and a complete quantitative test was not run; but it indicates that still better recovery of scheelite could in practice be obtained in a very simple manner.

Part II. - Gravity and Flotation Tests.

The material tested was a mixture of 'sink' and 'fines' from the pre-concentration operation and assayed 14.19 per cent WO_3 and 0.05 ounce gold per ton.

It was treated in the following manner:

1. Crushed to -4 mesh.
2. Screened on 8 mesh, 20 mesh, 48 mesh and 100 mesh, and the -100 mesh fraction was deslimed.
3. The -4 mesh +8 mesh fraction was jigged; the concentrate was assayed (No. 2) and the tailing (which carried scheelite and sulphides) was crushed to -8 mesh and added to the finer fractions.
4. The -8 mesh +20 mesh fraction was also jigged, giving concentrates, middling and tailing; tailing was assayed (No. 8), the concentrates were set aside for flotation treatments, the middling was ground to -20 mesh and added to the finer fractions.
5. The -20 mesh +48 mesh fraction, the -48 +100 mesh fraction, and the deslimed -100 mesh fraction were each tabled, making concentrates, middlings and tailings (Nos. 9, 10 and 11).
6. The concentrates from the operations 4 and 5 were reduced to -48 mesh and given a sulphide flotation treatment. The flotation concentrate was auriferous pyrite and arsenopyrite (No. 6) and the flotation tailings constituted the final marketable scheelite (No. 3).
7. The middlings from operation 5, together with the

(Continued on next page)

(Part II, cont'd) -

slime from operation 2, were ground to -48 mesh and given a double flotation treatment:

(a) sulphide flotation (sodium carbonate, frother 60, amyl xanthate), and
(b) scheelite flotation (sodium silicate, oleic acid).

This gave three products, sulphides (No. 7), scheelite (No. 4), and tailing (No. 12). Graphite material was floated with the sulphides, which were auriferous; the scheelite constituted additional recovery.

The assay values of the various products obtained were:

	Products.	Per cent WO_3	Per cent As	Per cent S	Au, oz./ton
1.	Heads	14.19	-	-	0.03
	Scheelite Concentrates -				
2.	-4 mesh +8 mesh from jig	74.52	0.80	0.31	0.005
3.	Tailings from sulphide flotation	72.22	0.28	0.42	0.005
4.	Concs. from scheelite flotation	36.46	0.02	0.42	0.01
5.	Average concentrates	61.30	-	-	0.0066
	Sulphide Concentrates -				
6.	Flotation of gravity concs.	18.73	-	-	0.46
7.	Flotation of gravity middling and slime	2.84	-	-	0.23
	Average sulphide	10.14	-	-	0.36
	Tailings -				
8.	-8 mesh +20 mesh from jig	0.99	-	-	0.01
9.	-20 " +48 " " table	0.89	-	-	0.01
10.	-48 " +100 " " "	0.33	-	-	0.01
11.	-100 " (deslimed) from table	2.24	-	-	0.02
12.	From scheelite flotation	3.11	-	-	0.01
	Average tailing	1.18	-	-	0.01

(Continued on next page)

(Part II, cont'd) -

The following notes apply to the results of gravity and flotation tests:

Scheelite Concentrates.

1. The concentrate -4 mesh +8 mesh (No. 2) was a direct jig product and it is evident that it would require removal of arsenic and sulphur by roasting or flotation.

2. The tailings from the sulphide flotation (No. 3) are high grade and marketable but carry some sulphur and arsenic. If this occurred in practice the concentrates could be improved by roasting if economic.

3. The scheelite flotation concentrate (No. 4) is somewhat low grade but in practice it would be cleaned in a cleaner cell. It represents about 17 per cent of the total WO_3 recovered.

Sulphide Concentrates.

4. The sulphide from flotation of gravity concentrate (No. 6) carries high WO_3 values. In practice this would be improved either by a cleaner cell in the sulphide circuit or the scheelite recovered by scheelite flotation with the middlings. The assay of the sulphide from the last-named (No. 7) indicates that much of the scheelite could be recovered.

5. These sulphide concentrates carry good gold values.

Tailings.

6. None of the tailings assays is particularly low, but in practice better figures could be expected.

(Part II, cont'd) -

It is emphasized that the above results are not final. They represent only a first examination and there was insufficient material to continue testing on the basis of these results. Nevertheless, they show

(a) that a high grade scheelite can be readily obtained;

(b) a recovery of 85 to 90 per cent may be expected for the WO_3 in the gravity treatment feed; and

(c) a sulphide concentrate was obtained incidentally which carries gold representing 90 cents per ton of the gravity treatment feed.

General Conclusions and Recommendations:

1. The ore, which is high grade at 5.45 per cent WO_3, is amenable to sink-and-float treatment, 59 per cent of the total ore being rejected assaying 0.29 per cent WO_3, with an indication of a possible assay of 0.07 per cent WO_3.

2. After sink-and-float treatment the ore ('sink' and 'fines') can be treated by a combination of standard gravity concentration and flotation to produce marketable scheelite concentrates and auriferous sulphide concentrate. The bulk of the scheelite concentrates assays over 72 per cent WO_3, but a small portion obtained by scheelite flotation would probably be lower grade.

3. An overall recovery of 80 per cent to 85 per cent of the scheelite in the ore can be expected.

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(General Conclusions and Recommendations, cont'd) -

4. It is recommended that a larger parcel (5 to 8 tons) be forwarded for a plant test; assuming that the parcel submitted is characteristic of run-of-mine ore, successful treatment would be expected.

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