

*J. D. Johnston Copy*

O T T A W A

December 12th, 1941.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1127.

Sink-and-Float Tests on Samples of  
Gold Bearing Cobalt-Nickel Ore from  
Latchford, Ontario.

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(Copy No. 33.)

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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Gold Bearing Cobalt-Nickel Ore from  
Latchford, Ontario.

Shipment:

Four sacks of ore were received March 15th, 1941. They contained two samples of ore marked "average grade" and "low grade". The average grade sample weighed 124 pounds and the low grade sample 131 pounds. The samples were submitted by Mrs. H. Davis, H. Shakt Mine, Latchford, Ontario.



Location of Property:

This ore was taken from a property located 8 miles from Latchford, in the southwest corner of the township of Coleman, known as the Trout Lake area, Ontario.

Character of the Ore:

No microscopic examination of the present shipment was made but a former shipment of ore from this property was examined and described in Report No. 947, issued in January, 1941. The ore contains cobaltite, gersdorffite, niccolite and some gold.

Sampling and Assaying:

Owing to the nature of the tests conducted, which require coarse crushing, no assay samples were cut from the shipment. Assay values were calculated from the products of tests in the case of low grade ore as follows:

Cobalt	-	0.87 per cent
Nickel	-	1.82 "
Gold	-	0.15 oz./ton.

The average grade ore did not concentrate satisfactorily by this treatment and no assays could be calculated since a complete range of products was not obtained.

Experimental Tests:

Small scale sink-and-float tests were conducted on the samples of ore submitted to find out whether or not substantial fractions of the ores, too low grade to repay milling costs, could be rejected at coarsely crushed sizes, thus leaving a higher grade fraction containing most of the metals for further treatment by standard methods.

(Continued on next page)

(Experimental Tests, cont'd) -

A size-density analysis was conducted on a sample of each ore to determine optimum conditions at which further confirmatory tests would be conducted.

This is done by crushing a sample of ore finer than one inch and screening out all material finer than 8 mesh, this being the lower size-limit at which ore can be satisfactorily treated by this process. Ordinarily the fines are sent on to further treatment by standard methods along with the concentrate produced by the sink-and-float operation on the coarser material.

The coarse portion of the sample is then fractionated on a series of screens at 1/8 inch intervals starting with a 7/8 inch screen. A series of density separations are then made on each fraction in a bath of substantially stable galena-water suspension in which the lighter, lower grade portion of the ore floats and the heavier, richer portion sinks. The float is skimmed off, weighed and assayed while the "sink" is retreated at a slightly higher density producing an intermediate float and a second "sink". The process may be repeated as often as thought advisable, all products being finally weighed and assayed.

The weights and assays of the various size fractions are then used to determine the size range of ore to be treated by the process as well as the density at which the separation should be made.

Results of the size-density analysis are given in the following tables:

## SIZE-DENSITY ANALYSIS.

(S.F. Test No. 24 - H. Shakt)

Average Grade Ore

Size Fractions	-6+8 Mesh		-4+6 Mesh		-3+4 Mesh		-3/8"+3 Mesh		-1/2"+3/8"	
DENSITY FRACTIONS	- Weight Proportions -									
	% Size frac- tion	% S.F. feed	% Size frac- tion	% S.F. feed	% Size frac- tion	% S.F. feed	% Size frac- tion	% S.F. feed	% Size frac- tion	% S.F. feed
Float @ 2.825	45.63	1.00	38.89	0.99	37.56	1.54	29.75	1.67	25.34	2.04
Float @ 2.85; sink @ 2.825	13.10	0.29	9.73	0.25	7.04	0.29	7.26	0.41	8.32	0.67
Float @ 2.875; sink @ 2.85	10.44	0.23	8.49	0.22	5.83	0.24	5.73	0.32	4.31	0.35
Sink @ 2.875	30.83	0.68	42.89	1.08	49.57	2.04	57.26	3.20	62.03	5.00
TOTAL -	100.00	2.20	100.00	2.54	100.00	4.11	100.00	5.60	100.00	8.06
	Assays, per cent		Assays, per cent		Assays, per cent		Assays, per cent		Assays, per cent	
	Co	Ni	Co	Ni	Co	Ni	Co	Ni	Co	Ni
Float @ 2.825	1.11	1.50	0.89	0.93	0.67	0.64	0.64	0.38	0.55	0.35
Float @ 2.85; sink @ 2.825	2.30	4.90	1.80	2.54	1.20	1.38	0.80	0.75	0.98	1.24
Float @ 2.875; sink @ 2.85	3.01	6.46	1.50	2.61	0.70	1.00	0.50	0.69	1.40	1.63
Sink @ 2.875	3.78	11.32	2.20	7.37	2.20	7.17	3.97	9.78	1.13	5.24

(AVERAGE GRADE ORE)

SIZE-DENSITY ANALYSIS.

(S.F. Test No. 24 - H. Shakt, cont'd)

Average Grade Ore

Size Fractions	-5/8" + 1/2"		-1" + 5/8"		-7/8" + 3/4"		-1" + 7/8"		Total	
DENSITY FRACTIONS	- Weight Proportions -									
	% Size frac- tion	% S.F. feed	% Size frac- tion	% S.F. feed	% Size frac- tion	% S.F. feed	% Size frac- tion	% S.F. feed	% Size frac- tion	% S.F. feed
Float @ 2.825	20.72	2.31	16.55	2.31	15.82	2.78	10.08	3.25	17.89	17.90
Float @ 2.85; sink @ 2.825	3.98	0.45	5.77	0.80	4.66	0.93	2.44	0.79	4.88	4.87
Float @ 2.875; sink @ 2.85	5.40	0.60	5.09	0.71	5.27	1.06	2.01	0.65	4.38	4.38
Sink @ 2.875	69.90	7.81	72.59	10.12	76.25	15.35	85.47	27.57	72.85	72.85
TOTAL	100.00	11.17	100.00	13.94	100.00	20.12	100.00	32.26	100.00	100.00
	Assays, per cent		Assays, per cent		Assays, per cent		Assays, per cent			
	Co	Ni	Co	Ni	Co	Ni	Co	Ni		
Float @ 2.825	0.29	0.17	0.55	0.16	0.68	0.20	1.05	0.16		
Float @ 2.85; sink @ 2.825	0.87	0.45	0.51	0.23	0.55	0.30	0.50	0.22		
Float @ 2.875; sink @ 2.85	0.55	0.72	0.81	0.98	0.99	0.97	0.62	0.50		
Sink @ 2.875	3.52	8.48	3.23	8.63	2.94	7.90	5.36	7.38		

(AVERAGE GRADE ORE)

(Average Grade Ore, cont'd) -

From the weights and assays of the various fractions recorded in this table it is apparent that the rejected portions are too high grade, particularly in cobalt, to be discarded while at the same time the percentage elimination is rather too low. The figures in this table do not take into account the material finer than 8 mesh which amounts to 10 per cent of the weight of the original ore. The results of this test indicate that this particular ore is not suitable for treatment by the sink-and-float process and no further work was done on it.

SIZE-DENSITY ANALYSIS.

(S.F. Test No. 29 - H. Shakt)

Low Grade Ore

Size Fractions	-6+8 Mesh		-4+6 Mesh		-3+4 Mesh		-3/8"+3 Mesh		-1/2"+3/8"	
	- Weight Proportions -									
DENSITY FRACTIONS	% Size frac- tion	% S.F. feed	% Size frac- tion	% S.F. feed	% Size frac- tion	% S.F. feed	% Size frac- tion	% S.F. feed	% Size frac- tion	% S.F. feed
Float @ 2.825	93.2	3.96	90.2	3.76	90.3	5.14	89.2	3.15	84.4	11.26
Float @ 2.85; sink @ 2.825	1.3	0.06	1.2	0.05	1.3	0.07	1.7	0.12	1.8	0.24
Sink @ 2.85	5.5	0.23	8.6	0.36	8.4	0.48	9.1	0.63	13.8	1.85
TOTAL	100.0	4.25	100.0	4.17	100.0	5.69	100.0	5.69	100.0	13.35
	Assays, per cent		Assays, per cent		Assays, per cent		Assays, per cent		Assays, per cent	
	Co	Ni	Co	Ni	Co	Ni	Co	Ni	Co	Ni
Float @ 2.825	0.28	0.34	0.18	0.12	0.13	0.03	0.11	Trace	0.09	Trace
Float @ 2.85; sink @ 2.825	2.29	5.04	1.38	2.42	0.64	0.78	0.77	1.39	0.67	0.66
Sink @ 2.85	10.33	13.83	10.47	12.70	6.29	14.12	7.80	11.83	4.40	10.94

(LOW GRADE ORE)



SIZE-DENSITY ANALYSIS.

(S.F. Test No. 29 - H. Shakt, cont'd)

Low Grade Ore

Size Fractions	-5/8" + 1/2"		-3/4" + 5/8"		-7/8" + 3/4"		-1" + 7/8"		Total	
	- Weight Proportions -									
DENSITY FRACTIONS	% Size frac- tion	% S.F. feed	% Size frac- tion	% S.F. feed	% Size frac- tion	% S.F. feed	% Size frac- tion	% S.F. feed	% Size frac- tion	% S.F. feed
Float @ 2.825	78.9	9.99	71.5	9.09	64.1	16.33	62.2	9.20	74.88	74.88
Float @ 2.85; sink @ 2.825	4.7	0.59	4.1	0.53	3.2	0.81	1.1	0.17	2.64	2.64
Sink @ 2.85	16.4	2.07	24.4	3.10	32.7	8.34	36.7	5.42	22.48	22.48
TOTAL -	100.0	12.65	100.0	12.72	100.0	25.48	100.0	14.79	100.00	100.00
	Assays, per cent		Assays, per cent		Assays, per cent		Assays, per cent			
	Co	Ni	Co	Ni	Co	Ni	Co	Ni		
Float @ 2.825	0.12	Trace	0.09	Trace	0.11	Trace	0.07	Trace		
Float @ 2.85; sink @ 2.825	0.30	0.35	0.09	Trace	0.46	0.27	0.09	Trace		
Sink @ 2.85	6.08	10.00	6.26	11.42	5.00	10.57	5.81	13.00		

(Low Grade Ore, cont'd) -

The weights and assays recorded in this table indicate that a satisfactory separation can be made at 2.825 density or thereabouts on the full size range of ore treated in this test. Two confirmatory tests were conducted, one of which gave a satisfactory result but the other did not.

In the case of the unsatisfactory test it was found that the sample of ore worked with was lower grade than the average of the shipment and this will in some measure account for the higher percentage of cobalt lost in the rejects.

These tests are described in detail as follows:

Test No. 2.

In this test the ore was crushed to minus  $\frac{3}{4}$  inch and screened on 8 mesh. The finer crushing was tried in this test to see if it would bring about any increase in elimination. Apparently it did not. A density separation was made at 2.825 the results of which are tabulated below.

Table I. - Distribution of Products from Crushing.

Product	Weight, per cent	A s s a y s			Distribution, per cent		
		Per cent Co	Per cent Ni	Au, oz./ton	Co	Ni	Au
S.F. feed	84.56	0.89	2.24	0.22	90.65	91.41	87.62
Fines -8 mesh	15.44	0.50	1.15	0.17	9.35	8.59	12.38
Feed sample (cal.)	100.00	0.83	2.07	0.21	100.00	100.00	100.00

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

S.F. conc.	26.21	3.13	8.42	0.81	92.56	98.73	97.00
S.F. tailing	73.79	0.09	0.04	0.009	7.44	1.27	3.00
S.F. feed (cal.)	100.00	0.89	2.24	0.22	100.00	100.00	100.00

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(Test No. 2, cont'd) -

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

Product	Weight, per cent	A s s a y s			Distribution, per cent		
		Per cent Co	Ni	Au, oz./ton	Co	Ni	Au
S.F. conc.	22.16	3.13	8.42	0.81	83.91	90.25	84.99
Fines -8 mesh	15.44	0.50	1.15	0.17	9.35	8.59	12.38
Product to further treatment	37.60	2.05	5.44	0.55	93.26	98.84	97.37
S.F. tailing	62.40	0.09	0.04	0.009	6.74	1.16	2.63
Feed sample (cal.)	100.00	0.83	2.07	0.21	100.00	100.00	100.00

Summary of Results, Test No. 2:

Proportion of ore available for  
sink-and-float feed - 84.56 per cent.

Proportion of ore available to  
further treatment - 37.60 per cent.

<u>Assays:</u>		<u>Cobalt,</u> per cent	<u>Nickel,</u> per cent	<u>Gold,</u> oz./ton
Ore treated	-	0.83	2.07	0.21
S.F. feed	-	0.89	2.24	0.22
S.F. tailing	-	0.09	0.04	0.009
S.F. concentrate	-	3.13	8.42	0.81
Ore to further treatment	-	2.05	5.44	0.55

Elimination by weight from  
sink-and-float feed - 73.79 per cent.

Elimination by weight from  
whole ore - 62.40 per cent.

Metal recovery:

		-(Per cent)-		
		<u>Cobalt</u>	<u>Nickel</u>	<u>Gold</u>
From S. F. feed	-	92.56	98.73	97.00
From whole ore	-	93.26	98.84	97.37

Test No. 3.

In this test the size range of ore treated was -1"+8 mesh. Separation was made at 2,825. Results of this test are tabulated below:

Table I. - Distribution of Products from Crushing.

Product	Weight, : per cent	A s s a y s			Distribution,		
		Co	Ni	Au, : oz./ton	Co	Ni	Au
S.F. feed	: 88.97	: 0.59	: 1.12	: 0.077	: 92.58	: 92.27	: 84.97
Fines -8 mesh	: 11.03	: 0.38	: 0.76	: 0.11	: 7.42	: 7.73	: 15.03
Feed sample (cal.)	: 100.00	: 0.57	: 1.08	: 0.081	: 100.00	: 100.00	: 100.00

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

S.F. conc.	: 12.34	: 3.22	: 8.77	: 0.57	: 67.53	: 96.23	: 90.60
S.F. tailing	: 87.66	: 0.22	: 0.05	: 0.008	: 32.47	: 3.77	: 9.40
S.F. feed (cal.)	: 100.00	: 0.59	: 1.12	: 0.077	: 100.00	: 100.00	: 100.00

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

S.F. conc.	: 10.98	: 3.22	: 8.77	: 0.57	: 62.52	: 88.79	: 76.98
Fines -8 mesh	: 11.03	: 0.38	: 0.76	: 0.11	: 7.42	: 7.73	: 15.03
Product to further treatment	: 22.01	: 1.80	: 4.75	: 0.34	: 69.94	: 96.52	: 92.01
S.F. tailing	: 77.99	: 0.22	: 0.05	: 0.008	: 30.06	: 3.48	: 7.99
Feed sample (cal.)	: 100.00	: 0.57	: 1.08	: 0.081	: 100.00	: 100.00	: 100.00

Summary of Results, Test No. 3:

Proportion of ore available for  
sink-and-float feed - 88.97 per cent.  
Proportion of ore available to  
further treatment - 22.01 per cent

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(Summary of Results, Test No. 3, cont'd) -

<u>Assays:</u>		<u>Cobalt,</u> <u>per cent</u>	<u>Nickel,</u> <u>per cent</u>	<u>Gold,</u> <u>oz./ton</u>
Ore treated	-	0.57	1.08	0.081
S.F. feed	-	0.59	1.12	0.077
S.F. tailing	-	0.22	0.05	0.008
S.F. concentrate	-	3.22	8.77	0.57
Ore to further treatment	-	1.80	4.75	0.34

Elimination by weight from

sink-and-float feed - 87.66 per cent.

Elimination by weight from

whole ore - 77.99 per cent.

Metal recovery:

		-(Per cent)-		
		<u>Cobalt</u>	<u>Nickel</u>	<u>Gold</u>
From S.F. feed	-	67.53	96.23	90.60
From whole ore	-	69.94	96.52	92.01

Conclusions:

Tests conducted on these samples of ore indicate that the average grade ore is not at all suitable for treatment by this process. The percentage elimination is too low and at the same time the reject is too rich in cobalt to be lost in a pre-concentrating operation.

The results on the low-grade ore were more promising at the beginning but fell down somewhat in Test No. 3 when 30 per cent of the cobalt was found to be in the reject. This particular lot of the low grade sample was very low grade and may not be representative of any body of ore intended for treatment.

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(Conclusions, cont'd) -

In view of the conflicting results and the difference in grade of the lots of ore treated, it would be unwise to state any final conclusion as to possibilities of treating this particular ore. If further information is desired a new sample should be submitted.

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