

O T T A W A

November 1st, 1943.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1521.

(Canadian Industries Limited)
(Report No. O-431,)
(by J. S. Godard.*)

Flotation Tests on Nickel Ore from
Harlin Nickel Mines, Limited,
Porquis Junction, Ontario.

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(*) This report is the result
of a war-time co-operative
endeavour between Canadian
Industries Limited and the
Bureau of Mines, Ottawa.)

(Copy No. 7.)

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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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DESCRIPTION OF THE ORE

The sample submitted was one of a nickel ore. The principal mineral is pyrrhotite, which occurs as coarse and fine grains. Pentlandite is the next most abundant mineral, but its total quantity is comparatively small and it is intimately associated with the pyrrhotite. Other metallic minerals are chalcopyrite, magnetite, and some limonite. These are present in small quantities.

The gangue consists of a moderately soft dark grey rock.

The head sample contained

Ni - 1.69%

TESTS

Reagents - The xanthate used was a 50/50 mixture of amyl and ethyl. Creosote was Barrett's #4 coal tar creosote, Figures are in pounds per ton of ore.

Test No. 1.

Reagents:

To ball mill - Na_2CO_3 1.5, creosote 0.25,
xanthate 0.10, Tarol 0.05.

To cell - Xanthate 0.30, Hercules #80 0.05.

Time of flotation - 15 minutes.

pH - 9.1.

Froth unattractive looking, a black gangue slime being prominent.

Results

Product	Weight %	Assays Ni	Dist'n % Ni
Head	100.0	1.69	100.0
Conc.	41.7	3.48	85.9
Tail.	58.3	0.41	14.1

Test No. 2.

Reagents:

To ball mill - Orthosil 0.25, creosote 0.25,
xanthate 0.10, Tarol 0.05.

To cell - Xanthate 0.30, Hercules #80 0.05,
Minerac "B" 0.10.

Time of flotation - 15 minutes.

pH - 8.3.

Froth similar in appearance to that in Test No. 1.

Results

Product	Weight %	Assays Ni	Dist'n % Ni
Head	100.0	1.69	100.0
Conc.	35.1	3.81	79.3
Tail.	64.9	0.54	20.7

Test No. 3.

Reagents:

To ball mill - NaOH 0.10, creosote 0.25,
xanthate 0.10, Tarol 0.05.

To cell - Xanthate 0.30, pine oil 0.05

Time of flotation - 15 minutes.

pH - 8.3.

No improvement in the appearance of froth.

Results

Product	Weight %	Assays Ni	Dist'n % Ni
Head	100.0	1.69	100.0
Conc.	36.1	3.77	80.4
Tail.	63.9	0.52	19.6

Test No. 4.

Reagents:

To ball mill - Creosote 0.25, xanthate 0.10,
Resor 0.05.

To cell - Xanthate 0.30, Hercules #1090 0.05.

Time of flotation - 15 minutes.

pH - 8.3.

Slight overfrothing in this test.

Results

Product	Weight %	Assays Ni	Dist'n % Ni
Head	100.0	1.70	100.0
Conc.	34.5	3.89	78.9
Tail.	65.5	0.55	21.1

(Continued on next page)

Test No. 5.

Reagents:

To ball mill - Na_2CO_3 4.0, creosote 0.25,
xanthate 0.10, Tarol #1 0.05.

To cell - Xanthate 0.30, pine oil 0.05.

Time of flotation - 15 minutes.

pH - 9.6.

Some improvement in appearance of froth.

Results

Product	Weight %	Assays Ni	Dist'n % Ni
Head	100.0	1.66	100.0
Conc.	35.3	3.86	82.1
Tail.	64.7	0.46	17.9

Test No. 6.

Reagents:

To ball mill - Na_2CO_3 8.0, creosote 0.25,
xanthate 0.10, Tarol #1 0.05.

To cell - Xanthate 0.30, pine oil 0.05..

Time of flotation - 15 minutes.

pH - 10.7

Improvement in appearance of froth.

Results

Product	Weight %	Assays Ni	Dist'n % Ni
Head	100.0	1.65	100.0
Conc.	35.3	3.91	83.5
Tail.	64.7	0.42	16.5

(Continued on next page)

Test No. 7.

Reagents:

To ball mill - Na_2CO_3 12.0, creosote 0.25,
xanthate 0.10, Tarol #1 0.05.

To cell - Xanthate 0.30, pine oil 0.05.

Time of flotation - 15 minutes.

pH - 10.8

Best appearing froth of any up to this stage.

Results

Product	Weight %	Assay Ni	Dist'n % Ni
Head	100.0	1.63	100.0
Conc.	36.7	3.90	88.0
Tail.	63.3	0.31	12.0

Test No. 8.

Reagents:

To ball mill - Na_2CO_3 2.0, creosote 0.25,
xanthate 0.10

To cell - Condition 10 minutes (no air) then add
 CuSO_4 1.0 #/T and condition 10
minutes (no air).
Add xanthate 0.10, condition 3 minutes
(no air).
Hercules #80 - 0.05, condition 1
minute (no air).
During flotation add xanthate 0.20.

Time of flotation - 15 minutes.

pH - 8.3.

Froth black in colour and generally unattractive in appearance.

Results

Product	Weight %	Assays Ni	Dist'n % Ni
Head	100.0	1.70	100.0
Conc.	41.3	3.68	89.6
Tail.	58.7	0.30	10.4

Test No. 9.

Ferric chloride was added to learn the effect of the presence of a ferric ion on flotation.

Reagents:

To ball mill - Creosote 0.25, xanthate 0.10,
ferric chloride 2.0

To cell - Xanthate 0.05, condition 3 minutes
(no air). Hercules #1090 0.05,
condition 1 minute (no air).

Time of flotation - 15 minutes.

pH - 8.3.

Froth black in colour. Slight excess of froth.

Results

Product	Weight %	Assays Ni	Dist'n % Ni
Head	100.0	1.68	100.0
Conc.	34.2	3.94	80.4
Tail.	65.8	0.50	19.6

Test No. 10.

Reagents:

To ball mill - H_2SO_4 0.50, creosote 0.25,
xanthate 0.10, Tarol #1 - 0.05.

To cell - xanthate 0.23, pine oil 0.05.

Time of flotation - 15 minutes.

pH - 8.2.

Froth unattractive in appearance.

Results

Product	Weight %	Assays Ni	Dist'n % Ni
Head	100.0	1.64	100.0
Conc.	30.4	4.14	77.0
Tail.	69.6	0.54	23.0

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Test No. 11.

Reagents:

To ball mill - H₂SO₄ 1.50, creosote 0.25,
xanthate 0.10, Tarol #1 0.05.

To cell - Xanthate 0.30, pine oil 0.05.

Time of flotation - 15 minutes.

No visible improvement in froth compared to

Test No. 10.

Results

Product	Weight %	Assays Ni	Dist'n % Ni
Head	100.0	1.70	100.0
Conc.	32.2	4.14	78.5
Tail.	67.8	0.54	21.5

Test No. 12.

Reagents:

To ball mill - H₂SO₄ 3.0, creosote 0.25,
xanthate 0.10, Tarol #1 - 0.05.

To cell - Xanthate 0.30, pine oil 0.10.

Time of flotation - 15 minutes.

pH - 7.3.

Froth well mineralized and of good colour,
particularly in the early stages.

Results

Product	Weight %	Assays Ni	Dist'n % Ni
Head	100.0	1.69	100.0
Conc.	40.8	3.67	88.5
Tail.	59.2	0.33	11.5

(Continued on next page)

Test No. 13.

Reagents:

To ball mill - H_2SO_4 6.0, creosote 0.25,
xanthate 0.10.

To cell - Xanthate 0.30, pine oil 0.10.

Time of flotation 15 minutes.

pH - 6.0.

Froth well mineralized, especially in the
earlier stages.

Results

Product	Weight %	Assays Ni	Dist'n % Ni
Head	100.0	1.65	100.0
Conc.	41.7	3.62	91.5
Tail.	58.3	0.24	8.5

Test No. 14. - Two-Stage Flotation.

Reagents:

To ball mill - No. 1 Grind: H_2SO_4 3.0,
creosote 0.20, xanthate 0.08,
Tarol 0.04.
Ore ground to 35 mesh.

To cell - No. 1 Float: Xanthate 0.04,
pine oil 0.04.

Time of No. 1 Float - 5 minutes.

pH - 7.8.

No. 1 flotation concentrate.

Tailing deslimed. Sand reground with the following reagents: H_2SO_4 2.0, creosote 0.20, Tarol 0.04. Slime then added to ball mill with H_2SO_4 1.0, xanthate 0.04, Tarol 0.04, and the whole subjected to a short regrind to ensure mixing.

To cell - No. 2 Float: xanthate 0.12,
pine oil 0.04.

Time of second flotation - 15 minutes.

pH - 6.6.

Froths in both flotations were well mineralized and bright in colour.

(Continued on next page)

Test No. 15 (cont'd).

Results

FLOTATION			
Product	Weight %	Assays Ni	Dist'n % Ni
Head	100.0	1.68	100.0
No. 1 Conc.	22.9	4.20	57.4
No. 2 Conc.	9.4	3.86	21.7
Mid.	6.1	1.96	7.2
Tail.	61.6	0.374	13.7

⊕ Calculated from screen analysis.

SCREEN ANALYSIS ON FLOTATION TAILING

Head	100.0	0.374	100.0
+ 65 Mesh	9.4	0.41	10.3
+100 "	16.7	0.44	19.6
+150 "	24.1	0.35	22.5
+200 "	16.1	0.33	14.2
-200 "	33.7	0.37	33.4

TABLING FLOTATION TAILING

Head	100.0	0.374	100.0
Conc.	6.0	1.03	16.6
Tail.	76.9	0.27	55.5
Slime	17.1	0.61	27.9

Test No. 16. - Jigging and Flotation.

The purpose of this test was to learn the effect of jigging previous to flotation.

The ore was wet ground and passed through a jig. The jig tailing was reground and subjected to flotation. Flotation was divided into two parts: a clean flotation concentrate was first removed, then the cell was well roughed and a rougher concentrate removed (No. 2 Concentrate).

The final flotation tailing was screened.

Reagents:

To ball mill - regrind of jig tails.
H₂SO₄ 3.0, creosote 0.20,
xanthate 0.05, Tarol 0.05.

To cell - No. 1 Flotation - pine oil 0.05.

Test No. 16 (cont'd)

Time of No. 1 Flotation - 3 minutes.

pH at end of No. 1 Flotation - 7.4.

No. 1 Concentrate clean and bright in colour.

Roughing reagents - Xanthate 0.13, pine oil 0.10.

Time of roughing - 10 minutes.

Results

Product	CONCENTRATION		
	Weight %	Assays Ni	Dist'n % Ni
Head	100.0	1.72	100.0
Jig Conc.	15.0	1.75	15.3
No. 1 Flot. Conc.	14.9	4.70	40.8
No. 2 Flot. Conc.	16.6	3.20	30.8
Tail	53.5	0.42	13.1

* Calculated from screen analysis.

SCREEN ANALYSIS ON TAILING

Head	100.0	0.42	100.0
+ 65 Mesh	0.9	0.24	0.5
+100 "	6.2	0.44	6.4
+150 "	22.1	0.54	28.0
+200 "	26.1	0.44	27.1
-200 "	44.7	0.36	38.0

REMARKS:

Grinding to 65 mesh appears to be sufficiently fine for the concentration of this ore.

The highest recovery obtained in any of the tests was 91.5%, (Test No. 13). In this test the grade of concentrate was Ni 3.62% and the ratio of concentration was 2.4:1.

There is very little evidence that a concentrate of over four per cent nickel may be obtained without making a sacrifice in recovery.

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(REMARKS, cont'd) -

Considerable difficulty was experienced in obtaining an attractive appearing concentrate. The bubbles were usually covered with a fine black scum, which was present when the pH was within the range 7.6 - 10.0. When the pH was above or below this range the bubbles were bright in colour and the black scum was not seen. There were wide fluctuations in the pH of the water used for testing and it is possible that with different water it may not be encountered or it may be overcome by the additions of lesser quantities of acid or alkali than were necessary in our work.

This black scum apparently exerts very little influence on the recovery (reference Test No. 8), but it detracts from the appearance of flotation.

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Ottawa, Oct. 23, 1943.
JSG:GHB(LB).