

TR2-156-162
R. 312

COPPER, NICKEL ORE—"5-MILE", ZEEHAN

MONTANA SILVER-LEAD, N.L.

Sample

A sample of copper-nickel ore was submitted by the Montana Company. The major copper and nickel minerals are chalcopyrite and millerite. Gangue is mainly pyrite.

Partial Analysis:

	%
Copper	5.6
Nickel	7.9
Iron	34.5
Sulphur	44.6

As seen from this analysis over 90% of the sample consists of sulphides. The majority of the minerals are fairly intimately associated with observed grain sizes ranging from 1 mm. to 0.01 mm. To determine the quantity of composite grains two sizings of ground ore were submitted to mineragraphic examination. The - 100 + 150-mesh fraction contained 55% and the - 150 + 200-mesh fraction contained 33% of composite grains. Composites of all minerals were observed although millerite-chalcopyrite predominated.

Investigation

This investigation was primarily directed to the selective flotation of the millerite and chalcopyrite as separate concentrates whilst depressing the pyrite. Secondly to produce a selective copper plus nickel concentrate selective from the pyrite.

No responsibility is accepted for the results shown in this report except in so far as they apply to the sample tested.

Summary

1. The ore sample contained millerite, chalcopyrite and pyrite with assay values shown under "Sample". It has been shown that a good deal of the valuable minerals are of small grain size which would require fine grinding to free them.

2. Various degrees of grinding with and without lime and cyanide have been tested. The degree of selectivity between the copper, nickel and iron minerals using lime and cyanide as depressants has been relatively minor. At 97% — 300-mesh grind about 37% was floated with assay values of 11.36% of copper and 16.52% of nickel with recoveries of 79.6 and 70.4% respectively. Results of Tests 10, 11, and 12 show details of flotation at grinds of — 100-mesh, 87% — 300-mesh and 97% — 300-mesh B.S. In the following table are shown selected results of reported tests. The Montana Company were interested in the Sherritt Gordon Lynn Lake Project where ore containing 0.8% of copper and 1.9% of nickel was ground to 70% — 200-mesh, and after production of bulk flotation concentrate of nickel and copper minerals the nickel was effectively depressed using 1.7 lb. of lime and up to 1 lb. of sodium cyanide. The copper concentrate contained 30% of copper and 0.5% of nickel.

The ore from "5-Mile" Zeehan has not shown any appreciable response to the lime-cyanide circuit as reported from Lynn Lake.

Test Results

<i>Test No.</i>	<i>Grinding</i>
3/1	Minus 100 mesh B.S., Natural pH 5.1
3/1 + 2	
6/1	Minus 100 mesh B.S., CaO 5 lb., NaCN 5 lb.
6/1 + 2	
10/1	Minus 100 mesh B.S., CaO 6 lb., NaCN 3 lb., AF25, 0.5
10/1 + 2	
10/1 + 2 + 3	
11/1	87 Percent minus 300 mesh B.S., otherwise ditto Test 10
11/1 + 2	
11/1 + 2 + 3	
12/1	97 Percent minus 300 mesh B.S., otherwise ditto Test 10
12/1 + 2	
12/1 + 2 + 3	
15	Minus 100 mesh, Natural pH. Cl Bulk float

Test No.	Flotation Reagents Lb. Per Short Ton	Concentrate				
		Percent Weight	Assays		Percent Distribution	
			Cu	Ni	Cu	Ni
3/1	CaO 4.6, NaCN 0.5, AF 25-0.37	30.4	9.12	10.4	46.4	33.6
3/1 + 2	S.E.X., 0.1	58.1	6.8	8.97	66.2	55.4
6/1	S.E.X. 0.4, Cresylic Acid 0.2	15.6	15.2	11.1	52.7	19.5
6/1 + 2	S.E.X., 0.25, Cresylic Acid 0.05	41.6	8.7	9.2	80.5	43.3
10/1	AF 238, 0.25	20.1	16.63	10.34	62.1	25.3
10/1 + 2	AF 238, 0.4	30.2	12.67	13.18	71.0	48.4
10/1 + 2 + 3	NaCN 1, S.E.X., 0.2, Cresylic 0.1	51.5	8.22	10.14	78.6	63.6
11/1	AF 238, 0.25	37.3	12.07	13.87	82.7	58.3
11/1 + 2	AF 238, 0.6, Cresylic 0.1	47.3	10.25	14.15	89.0	75.4
11/1 + 2 + 3	NaCN 1.0, S.E.X., 0.45, Cresylic 0.05	74.0	6.95	10.93	94.4	91.2
12/1	AF 238, 0.25	37.6	11.36	16.52	79.6	70.4
12/1 + 2	AF 238, 0.6, Cresylic 0.1	53.7	9.01	14.28	90.2	86.9
12/1 + 2 + 3	NaCN 1.0, S.E.X., 0.45, Cresylic 0.05	80.4	6.32	9.32	94.7	86.0
15	CuSO ₄ 1, Mixed Xanthates 0.7 and Cresylic	94.9	5.27	9.43	93.5	98.6

Test/1 represents 1st Concentrate, Test/1 + 2 represents the combined 1st and 2nd concentrates from the same test, and Test/1 + 2 + 3 is similarly three concentrates combined.

Test Results

ABBREVIATIONS USED

S.E.X. = Sodium Ethyl Xanthate
 K.A.X. = Potassium Amyl Xanthate
 Mixed Xanthate = 2 S.E.X. : 1 K.A.X.

TEST No. 3

Minus 100-mesh B.S. ball mill grind without reagents at a natural pH value of 5.1.

Reagents	Flotation Conditions	
	Lb. per Ton/Min.	
	Rougher Float 1	Rougher Float 2
Lime	4.6/5	..
Sodium Cyanide	0.5/5	..
AF25	0.37	..
S.E.X. .. .. .	..	0.1
Flotation Time	/10	/7
pH Value	8.8/8.5	/8.5

Product	Percent			Percent Distribution	
	Weight	Cu	Ni	Cu	Ni
Concentrate 1	30.4	9.12	10.4	46.4	33.6
Concentrate 2	27.7	4.26	7.4	19.8	21.8
Concentrate 1 + 2	58.1	6.8	8.97	66.2	55.4
Rougher Tailing	41.9	4.81	10.0	33.8	44.6
Composite Head	100.0	6.0	9.4	100.0	100.0

TEST No. 6

Minus 100-mesh B.S. ball mill grind with 5 lb. of lime and 5 lb. of sodium cyanide.

Reagents	Flotation Conditions	
	Lb. per Ton/Min.	
	Rougher Float 1	Rougher Float 2
S.E.X.	0.4	0.2
K.A.X. .. .. .	..	0.05
Cresylic Acid	0.2	0.05
Flotation Time	/10	/8
pH Value	+ 11	9.5

Product	Percent			Percent Distribution	
	Weight	Cu	Ni	Cu	Ni
Concentrate 1	15.6	15.2	11.1	52.7	19.5
Concentrate 2	26.0	4.8	8.1	27.8	23.8
Concentrate 1 + 2	41.6	8.7	9.2	80.5	43.3
Rougher Tailing	58.4	1.5	8.6	19.5	56.7
Composite Head	100.0	4.5	8.9	100.0	100.0

TEST No. 10

Minus 100-mesh B.S. ball mill grind with 6 lb. of lime and 3 lb. of sodium cyanide.

Reagents	Flotation Conditions Lb. per Ton/Min.		
	1	Rougher Floats 2	3
Sodium Cyanide .. ..	..	..	1/5
AF238	0.25	0.4	..
S.E.X. .. ..	..	..	0.2
Cresylic Acid .. ..	..	..	0.1
Flotation Time	/8	/8	/8
pH Value	11.0/10.4	/9.3	9/6

Product	Percent			Percent Distribution	
	Weight	Cu	Ni	Cu	Ni
Concentrate 1	20.1	16.63	10.34	62.1	25.3
Concentrate 2	10.1	4.76	18.8	8.9	23.1
Concentrate 3	21.3	1.93	5.85	7.6	15.2
Concentrate 1 + 2	30.2	12.67	13.18	71.0	48.4
Concentrate 1 + 2 + 3	51.5	8.22	10.14	78.6	63.6
Rougher Tailing	48.5	2.38	6.17	21.4	36.4
Composite Head	100.0	5.4	8.2	100.0	100.0

TEST No. 11

Similar to Test 10. Grind 87.1% — 300-mesh B.S. with 6 lb. of lime, 2.1 lb. of sodium cyanide and 0.5 lb. AF25.

Reagents	Flotation Conditions		
	Lb. per Ton/Min. Rougher Floats		
	1	2	3
Sodium Cyanide .. ..	..	..	1/5
AF238	0.25	0.6	..
S.E.X. .. ..	..	..	0.45
Cresylic Acid .. ..	..	0.1	0.05
Flotation Time	/8	/8	/8
pH Value	11.1/10.4	/10.0	/10.4

Product	Percent			Percent Distribution	
	Weight	Cu	Ni	Cu	Ni
Concentrate 1	37.3	12.07	13.87	82.7	58.3
Concentrate 2	10.0	3.45	15.17	6.3	17.1
Concentrate 3	26.7	1.1	5.24	5.4	15.8
Concentrate 1 + 2	47.3	10.25	14.15	89.0	75.4
Concentrate 1 + 2 + 3	74.0	6.95	10.93	94.4	91.2
Rougher Tailing	26.0	1.17	3.02	5.6	8.8
Composite Head	100.0	5.4	8.9	100.0	100.0

TEST No. 12

Extremely fine grind with lime and cyanide. Grind 97.6% — 300-mesh B.S.

The — 6-mesh ore was stage ball mill ground with lime, cyanide and reagent AF25, and after each grind the — 300-mesh material was separated by time settling of pulp.

Total reagents used in the grinding were per ton: lime 6.7 lb., sodium cyanide 3.4 lb. and AF25 0.55 lb.

Reagents	Flotation Conditions		
	Lb. per Ton/Min. Rougher Floats		
	1	2	3
Lime	1	..	..
Sodium Cyanide .. ..	..	..	1/5
AF238	0.25	0.6	..
S.E.X. .. ..	..	..	0.45
Cresylic Acid .. ..	..	0.1	0.05
Flotation Time	/9	/8	/8
pH Value	10.9/10.7	/10.2	/10.4

Product	Percent			Percent Distribution	
	Weight	Cu	Ni	Cu	Ni
Concentrate 1	37.6	11.36	16.52	79.6	70.4
Concentrate 2	16.1	3.52	9.06	10.6	16.5
Concentrate 3	26.7	0.91	3.03	4.5	9.1
Concentrate 1 + 2	53.7	9.01	14.28	90.2	86.9
Concentrate 1 + 2 + 3	80.4	6.32	10.5	94.7	96.0
Rougher Tailing	19.6	1.45	1.79	5.3	4.0
Composite Head	100.0	5.4	8.8	100.0	100.0

TEST No. 15

Bulk Flotation

Minus 100-mesh B.S. ball mill grind at natural pH value of 4.7.

Reagents	Flotation Conditions	
	Lb. per Ton/Min.	
	Rougher	Cleaner
Copper Sulphate	1/5	0.5/5
Mixed Xanthates	0.7	0.25
Cresylic Acid	0.2	0.15
Flotation Time	/15	/10
pH Value	5	5

Product	Percent			Percent Distribution	
	Weight	Cu	Ni	Cu	Ni
Cleaner Concentrate	94.9	5.27	9.43	93.5	98.6
Cleaner Tailing	2.0	11.15	3.45	4.2	0.8
Rougher Tailing	3.1	4.06	1.93	2.3	0.6
Composite Head	100.0	5.35	9.08	100.0	100.0

Sizing Analyses

Fraction B.S.	Test Number			
	9	10	11	12
+ 120	4.2	..	..	..
+ 150	9.8	..	..	..
+ 200	11.5	..	..	..
- 200	74.5	..	..	..
+ 200 .. ..	..	26.4	2.6	0.3
+ 300 .. ..	..	15.2	10.3	2.1
- 300 .. ..	..	58.4	87.1	97.6