

APR 28 1971

NTS. 82M12

HAIL HARPER CREEK

Noranda Mines Limited,

Noranda, Quebec.

*file Harper creek*

AURON MINES LTD.  
HAIL HARPER CREEK PROJECT

Harper Creek Project,

823846

Report No. 1.

PRELIMINARY FLOTATION TESTWORK ON HARPER CREEK COPPER PROPERTY ORE SAMPLES

Noranda Ore Dressing Laboratory,

April 27, 1971.

Summary

Grinds 626 - 200 mesh  
for estimation 25% concentrate  
@ 85% recovery.

*WI 9.6  
25% Cu @ 85% rec  
7.87 Kwh/t.  
poor rec moly.*

Distribution:  
Mr. R. L. Coleman  
Dr. A. M. Bell  
Mr. M.J.S. Bennett

*D. W. Mearns*  
.....  
D. W. Mearns,  
Technical Assistant.

*P. W. Godbehere*  
.....  
P. W. Godbehere,  
Mill Laboratory Metallurgist.

.....  
M.J.S. Bennett,  
General Mill Metallurgist.

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INTRODUCTION

This report covers the preliminary flotation testwork on two separate composites of ore from the Harper Creek Copper Property in British Columbia.

Composite A, containing 68 pounds of crushed diamond drill cores, was received on December 3, 1970.

Composite B, containing 300 pounds of crushed cores, was received on January 14, 1971. This sample consisted of six bags designated as follows:

DRILL HOLE NO. 5

- No. 1 (69H-19, 69H-8, 69H-22)
- No. 2 (67H-1, 69H-5, 67H-2)
- No. 3 (69H-3, 67H-6)
- No. 4 (69H-1, 69H-6)
- No. 5 (69H-13, 69H-15)
- No. 6 (69H-27, 69H-23)

Each composite was screened at four mesh and the oversize crushed to minus four mesh. Head sample of each composite analysed as follows:

CONCLUSIONS

1. GRINDING REQUIREMENTS

Both composites were found to exhibit a considerable degree of kaolinisation with the result that the ore was quite friable and relatively easy to grind. A series of grinding tests are summarized below and the work index for each grind is given in comparison to McIntyre gold ore (work index 13.4).

Per Cent Minus 200 Mesh in Product	Laboratory Grind Time (Mins.)	Work Index (kwhr./ton)
50	4.4	8.7
60	6.0	9.6
70	7.9	10.4
80	10.1	11.1
90	13.8	11.9

Flotation testwork (See Test H-31) indicated that a primary grind to about 62 per cent minus 200 mesh should be adequate for this ore.

The power requirements for grinding are calculated from the following data:

Work index at 62 per cent minus 200 mesh = 10 kWhr./ton  
80 per cent passing size of feed = 12,000 microns (1/2")  
(assuming approx. rod mill feed)  
80 per cent passing size of product = 132 microns

Using Bond's formula,

$$W = W_I \left( \frac{10}{\sqrt{P_{80}}} - \frac{10}{\sqrt{F_{80}}} \right)$$

$$\text{Power requirements} = 10.10 \left( \frac{1}{\sqrt{132}} - \frac{1}{\sqrt{12000}} \right)$$

Power requirements = 8.2 Kw hr./ton *7.87*

## 2. RECOVERY OF COPPER

The best test results achieved on a sample of Harper Creek ore are shown below:

### TEST H-31

Product	% Wt.	Assays		Distribution	
		% Cu	% Mo	Cu	Mo
2nd Clr. Conc.	1.2	27.63	0.020	78.7	5.8
2nd. Clr. Tail	0.3	8.20	0.091	5.8	6.4
1st. Clr. Conc.	1.5	23.75	0.034	84.5	12.2
1st. Clr. Tail	3.6	0.70	0.049	6.0	42.2
Rougher Conc.	5.1	7.48	0.045	90.5	54.4
Rougher Tail	94.9	0.042	0.002	9.5	45.6
Head	100.0	0.42	0.004	100.0	100.0


*Behavior of  
As?  
Zn?*

	<u>Composite A</u> (as per cent)	<u>Composite B</u> (as per cent)
Cu	0.46	0.42
Cu (as oxide)	0.012 <i>2.6% Cu</i>	0.015 <i>3.6% Cu</i>
Mo	0.016	0.017
Pb	<0.01	0.006
Zn	0.03	0.032
Ni	0.03	0.068
As	0.10 ←	0.01
Sb	0.01	0.012
Fe	4.8	4.2
S	1.69	1.66
Au	0.002 (oz./ton)	0.004 (oz./ton)
Ag	0.07 (oz./ton)	0.12 (oz./ton)
Py	4.80	3.23
Po (Magnetite) ? <i>Pyrrhotite</i>	3.38	-
CaO	3.8	1.5
MgO	3.2	1.8
Al <sub>2</sub> O <sub>3</sub>	9.82	3.5
SiO <sub>2</sub>	63.0	60.9
Insol.	79.8	79.5
Specific Gravity	2.78	2.85

From the grade-recovery curves on page 13 the above test results are equivalent to a final concentrate grade of 25.00 per cent copper at a recovery of 82.8 per cent. Recirculation of cleaner tailings would probably increase the overall recovery to at least 85 per cent.

Testwork has shown the following factors to be of importance in the treatment of Harper Creek ore:

- 1) The copper in Harper Creek ore is present in the form of fairly coarse grained chalcopyrite with minor amounts of bornite and covellite.
- 2) Testwork has shown a primary grind to about 62 per cent minus 200 mesh to be adequate for achieving overall copper recoveries of 91 to 92 per cent in a rougher concentrate assaying approximately 7.5 per cent copper.
- 3) Reagent requirements appear to be relatively simple. Acceptable results were achieved using:

0.10 lb./ton R-343	-	Rougher stage
0.03 lb./ton MIBC	-	Rougher stage
0.02 lb./ton Sodium Cyanide	-	Regrind stage <i>Zn/py depression</i>
0.01 lb./ton S-3302	-	Regrind stage
0.5 lb./ton Lime	-	Regrind stage
- 4)  Regrinding of the rougher concentrate was proved to be necessary for achieving high recoveries in the cleaning stages. Two stage cleaning was used throughout.

5) Flotation times were:

Rougher stage - 8 mins.

1st. Cleaner stage - 5 mins.

2nd. Cleaner stage - 4 mins.

- 6) Recovery of molybdenum, as can be seen from the metallurgical balance above, proved difficult. Even when specific molybdenum collectors were used (See Tests H-22 to H-24), low grades and recoveries were recorded. More work will be done on improving the molybdenum metallurgy.



TESTWORK PROCEDURE AND RESULTS

Testwork on Composite A (0.47 per cent copper)

A series of grinding and flotation tests were performed on 2,000 gram samples of Composite A to determine the optimum grinding time. A rougher concentrate was floated for four minutes using 0.10 pound per ton of AF-238 (sodium di-secondary butyl dithiophosphate). An additional 0.05 pounds per ton of AF-238 was added and a scavenger concentrate was floated for six minutes. Methyl isobutyl carbinol (M.I.B.C.) was used as the frother. The samples were treated at the natural pH of the ore which was 8.4. The results are tabulated below:

Test No.	Grind Time (Mins.)	%-200 M. in Product	O'All Rghr. + Scav. Conc. (% Cu)	O'All Rghr. + Scav. Recovery (%)
H-5	4	46.2	7.87	80.1
H-1	8	69.0	9.63	94.0
H-2	12	85.4	9.78	92.4
H-3	16	92.6	9.04	96.0
H-4	20	96.4	10.42	93.8

Testwork on Composite B (0.42 per cent copper)

The initial testwork on Composite B involved substantiating the earlier grinding tests performed on Composite A. Tests H-13 and H-14 were.

conducted on samples ground for sixteen minutes to 91 per cent minus 200 mesh. Using a similar procedure to test H-3, a comparison was made of the suitability of a xanthate collector, R-350, to the Aerofloat collector (AF-238) used previously. The results are summarized below:

Test No.	Collector Addition (Lb./ton)	O'All Ro + Scav. Conc. (% Cu)	O'All Rec. in Rghr. + Scav. Conc. (%)
H-13	0.15 AF-238	8.22	95.3
H-14	0.15 R-350	7.54	95.3

The results showed AF-238 to be slightly more selective than R-350.

A series of tests, H-15 to H-17, were carried out at varying grinds to further study the relationship between recovery of copper and fineness of grind. In each test a rougher concentrate was floated for eight minutes using 0.10 pounds per ton of AF-238. Two stage cleaning was employed, lime being added to maintain a pH of 10.5 in the first cleaning stage. The results follow:

Test No.	Grind Time (Mins.)	% -200 M. In Product	Ro. Conc. (% Cu)	% Recov. In Ro. Conc.	2nd. Cl. Conc. (% Cu)	% Recov. in 2nd. Cl. Conc.
H-15	6	53	7.74	83.9	14.25	75.7
H-16	9	71	8.61	90.7	13.57	86.5
H-17	12	83	8.32	93.2	14.82	84.7

The results at this stage indicated that a grind to between 70 and 80 per cent minus 200 mesh was probably optimum but cleaning of the rougher concentrates produced unacceptable grades of cleaner concentrates. Microscopic examination of the second cleaner concentrates showed the presence of large quantities of liberated pyrite with substantial amounts of quartz containing chalcopyrite inclusions.

For more effective depression of pyrite in the roughing stage, 0.5 pounds per ton of lime was added to the primary grinding stage in tests H-19 and H-20 to give a rougher pH of 9.5. Separate rougher and scavenger floats were carried out, with the first scavenger concentrate recycled to the succeeding rougher float of the double locked test. Two stage cleaning was again employed with additional lime being added to maintain a pH of 10.5 in the first cleaning stage. Test H-20 repeated the procedure of test H-19 with the exception that the rougher concentrate was reground. The results are given below:

Test No.	O'All Ro. + Scav. Conc. (% Cu)	O'All Recov. in Ro. + Scav. Conc.	2nd. Cl. Conc. (% Cu)	% Recov. in 2nd. Cl. Conc.
H-19	8.93	91.5	28.28	69.3
H-20	9.98	86.8	30.90	77.6

The results showed that:

- 1) Lime, added to the primary grind, was not effective in depressing pyrite in the roughing stage (compare tests H-17 and H-19).
- 2) Regrinding of the rougher concentrate gave substantial improvements in both grade and recovery of copper in the second cleaner concentrate (See grade-recovery curves on page 13.)

The preceding testwork results showed on average approximately 20 per cent of the molybdenum had been recovered in a rougher concentrate which analysed only 0.026 per cent molybdenum, from a head grade of 0.005 per cent. Attempts were therefore made to increase the molybdenum recovery by the use of specific molybdenum and copper/molybdenum collectors.

Tests H-22 to H-24 involved the use of fuel oil and Cyanamid reagent S-3302 as molybdenum promoters. The results (See Flotation Report Sheets on pages 14 to 35 ) showed the highest molybdenum content in a second cleaner concentrate to be 0.072 per cent at a recovery of 17.2 per cent. As the results were disappointing, attention was paid to improving the copper metallurgy in the remaining tests covered by this report.

The results of test H-24 showed an overall copper recovery of 90.9 per cent at a grind of 57 per cent minus 200 mesh. The remaining testwork on Composite B was therefore aimed at producing an acceptable grade of

cleaner concentrate at this grind. Tests H-26 to H-31 involved the regrinding of rougher concentrates with combinations of lime and sodium cyanide. The results are shown in the grade-recovery curves on page 13.

Test No.	Grinding Time (Mins.)	% Minus 200 Mesh	Head Grade (% Cu)	Ro. + Scav. Conc. (% Cu)	Ro. + Scav. Recov. (%)	2nd. Clr. Conc. (% Cu)	2nd. Clr. Conc. Rec. (%)	Rghr.	Sc
H-1	8	69.0	0.47	9.63	94.0	-	-	4	
H-2	12	85.4	0.50	9.78	92.4	-	-	4	
H-3	16	92.6	0.48	9.04	96.0	-	-	4	
H-4	20	95.4	0.47	10.42	93.8	-	-	4	
H-5	4	46.2	0.46	7.87	80.1	-	-	4	
H-13	16	92.0	0.41	8.22	95.3	-	-	4	
H-14	16	91.1	0.40	7.54	95.3	-	-	4	
H-15	6	52.8	0.42	7.74	83.9	14.25	75.7	8	
H-16	9	71.2	0.41	8.61	90.7	13.57	86.5	8	
H-17	12	82.8	0.42	8.32	93.2	14.82	84.7	8	
H-19	12	84.6	0.45	8.93	91.5	28.28	69.3	3	
H-20	12	84.0	0.44	9.98	86.8	30.90	77.8	3	
H-22	12	84.6	0.43	5.94	95.7	16.84	86.5	4	
H-23	9	71.0	0.41	8.04	93.4	15.01	87.2	10	
H-24	6	54.8	0.42	6.86	90.9	27.81	73.7	10	
H-26	6	56.8	0.40	7.22	88.6	28.18	77.6	10	
H-28	6	54.8	0.42	7.70	85.6	31.43	74.3	7	
H-29	7	62.6	0.41	7.77	92.0	18.23	85.5	8	
H-30	7	61.2	0.41	7.75	91.1	19.74	82.2	8	
H-31	7	62.0	0.42	7.48	90.5	27.63	78.7	8	

SUMMARY OF HARPER CREEK TESTWORK

Test No.	Flotation Times				Rougher	Scav.	1st. Clnr.	Regrind Time (Mins.)
	Rghr.	Scav.	. Cl.	2nd. Cl.				
H-1	4	6	-	-	0.10 AF-238	0.05 AF-238	-	-
H-2	4	6	-	-	0.10 AF-238	0.05 AF-238	-	-
H-3	4	6	-	-	0.10 AF-238	0.05 AF-238	-	-
H-4	4	6	-	-	0.10 AF-238	0.05 AF-238	-	-
H-5	4	6	-	-	0.10 AF-238	0.05 AF-238	-	-
H-13	4	6	-	-	0.10 AF-238	0.05 AF-238	-	-
H-14	4	6	-	-	0.10 R-350	0.05 R-350	-	-
H-15	8	-	5	-	0.10 AF-238	-	0.0025 AF-238	-
H-16	8	-	5	-	0.10 AF-238	-	-	-
H-17	8	-	5	-	0.10 AF-238	-	-	-
H-19	3	5	5	-	0.05 AF-238	0.05 AF-238	-	-
H-20	3	5	5	-	0.10 AF-238	0.05 AF-238	-	5
H-22	4	4	5	-	0.10 AF-238	-	-	5
H-23	10	-	5	-	0.10 R-343	-	-	5
H-24	10	-	3	-	0.10 R-343	-	-	5
H-26	10	-	4	-	0.10 R-343	-	-	6
H-28	7	-	4	-	0.10 R-343	-	0.005 R-343	6
H-29	8	-	4	-	0.15 R-343	-	0.005 R-343	6
H-30	8	-	4	-	0.15 R-343	-	-	6
H-31	8	-	4	-	0.15 R-343	-	0.005 R-343	6

Test No.	Reagents to Re grind (Lb./ton)			pH Levels		
	Lime	NaCN	Collector	Rougher	1st. Clr.	2nd. Clr.
H-1	-	-	-	8.2	-	-
H-2	-	-	-	8.4	-	-
H-3	-	-	-	8.6	-	-
H-4	-	-	-	8.6	-	-
H-5	-	-	-	8.5	-	-
H-13	-	-	-	8.2	-	-
H-14	-	-	-	8.0	-	-
H-15	-	-	-	7.2	10.5	9.5
H-16	-	-	-	7.6	10.5	9.4
H-17	-	-	-	7.5	10.5	9.5
H-19	-	-	-	9.5	10.5	10.5
H-20	-	-	-	9.5	10.5	10.5
H-22	-	-	0.02 S-3302	9.5	10.5	10.5
H-23	0.45	-	-	8.0	10.5	10.5
H-24	0.40	0.05	-	8.0	10.4	9.8
H-26	0.50	0.02	-	7.6	11.0	10.3
H-28	0.50	0.02	-	7.6	10.8	9.5
H-29	0.50	0.01	-	7.9	10.8	10.4
H-30	1.00	-	-	7.9	11.2	10.6
H-31	0.50	0.02	0.01 S-3302	8.0	10.9	9.8

1 lb  
 /lbs  
 fue  
 1 lb



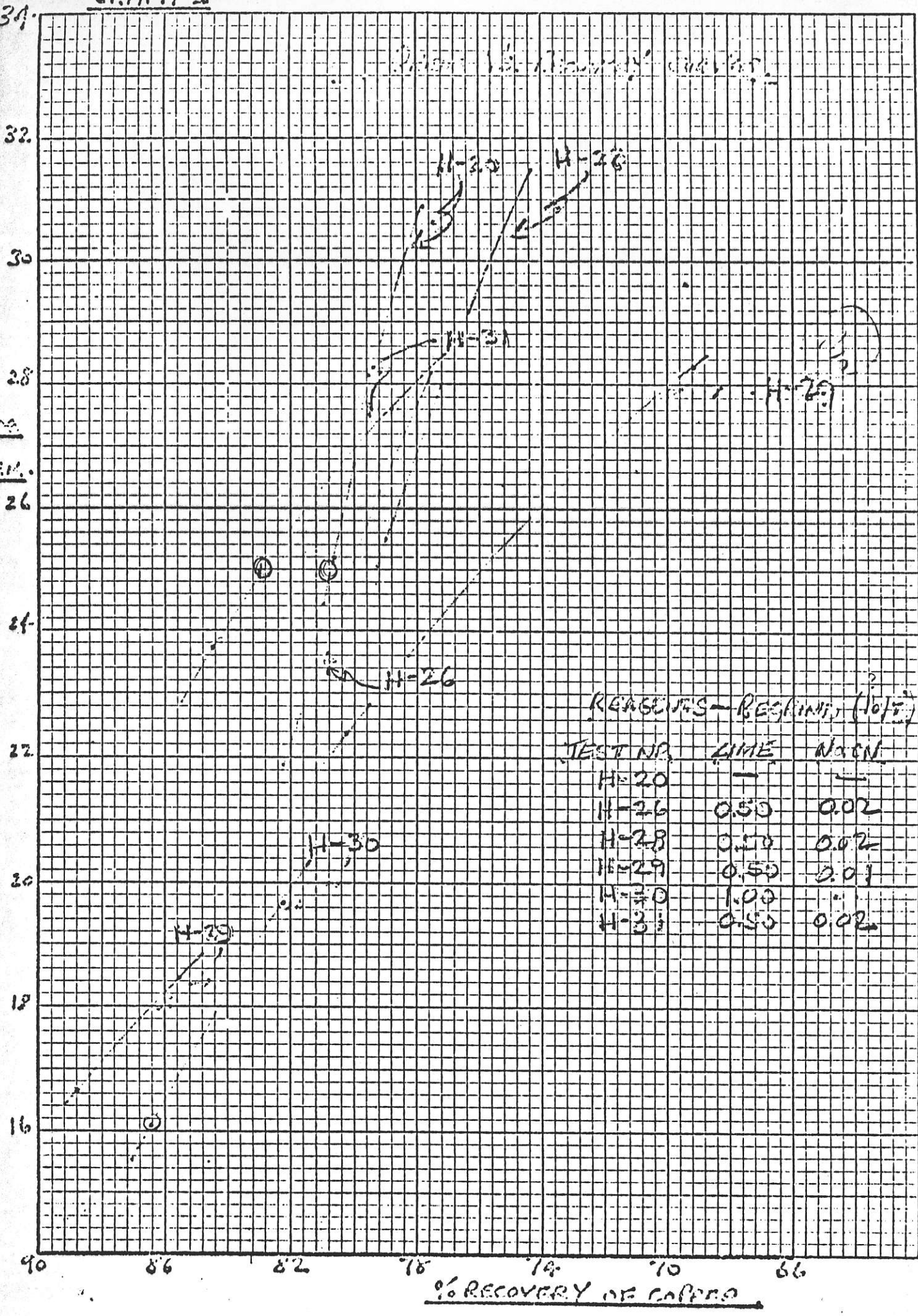
Test No.	Clr.	REMARKS
H-1	-	
H-2	-	
H-3	-	
H-4	-	
H-5	-	
H-13	-	
H-14	-	
H-15	9.5	
H-16	9.4	
H-17	9.5	
H-19	10.5	0.50 lbs./ton lime in primary grind
H-20	10.5	" " " " "
H-22	10.5	/lbs./ton 0.04 fuel oil, 0.01 lbs./ton fuel in rghr. + scav.flo
H-23	10.5	0.04 lbs./ton fuel oil in primary grind.
H-24	9.8	" " " " " "
H-26	10.3	
H-28	9.5	
H-29	10.4	
H-30	10.6	
H-31	9.8	

GRAPH 1

Dist. 13. Heavy Metals

DATE  
MEM.

HEUFFEL & ESSER CO.



REAGENTS - REAGENTS (10/11)

TEST NR.	TIME	NO. CN.
H-20	—	—
H-26	0.50	0.02
H-28	0.50	0.02
H-29	0.50	0.01
H-30	1.00	—
H-31	0.50	0.02

% RECOVERY OF COPPER

Date: December 7, 1970.

EXPERIMENTAL LABORATORY  
FLOTATION REPORT

TEST NO.

Sample: 2,000 g.

H-1

Point of Addition	CONDITIONS				REAGENTS POUNDS PER TON								
	Time Min.	% Solids	pH	AF238	MIBC								
Grind	8	64.5											
Condition	2		8.2	0.10									
Ro. Flt.	4				0.06								
Condition	2			0.05									
Scav. Flt.	6												

Remarks:

Product	% Weight	Assay oz./ton or %				% Distribution			
		Cu				Cu			
Ro. Conc. 0-2	2.9	13.43				82.7			
" " 2-4	0.7	5.61				8.3			
O'All Ro. Conc.	3.6	11.91				91.0			
Scav. Conc.	1.0	1.41				3.0			
O'All Conc.	4.6	9.63				94.0			
Tail	95.4	0.03				6.0			
Head	100.0	0.47				100.0			

Remarks:

Date: December 7, 1970.

EXPERIMENTAL LABORATORY  
FLOTATION REPORT

TEST NO.

Sample: 2,000 g.

H-2

Point of Addition	CONDITIONS				REAGENTS POUNDS PER TON								
	Time Min.	% Solids	pH	AF238	MIBC								
Grind	12	64.5											
Condition	2		8.4	0.10									
Ro. Flt.	4				0.06								
Condition	2			0.05									
Scav. Flt.	6				0.02								

Remarks:

Product	% Weight	Assay oz./ton or %				% Distribution			
		Cu				Cu			
Ro. Conc. 0-2	3.2	13.59				87.4			
" " 2-4	0.5	3.08				3.1			
O'All Ro. Conc.	3.7	12.17				90.5			
Scav. Conc.	1.0	0.97				1.9			
O'All Conc.	4.7	9.78				92.4			
Tail	95.3	0.04				7.6			
Head	100.0	0.50				100.0			

Remarks:

Date: December 7, 1970.

EXPERIMENTAL LABORATORY  
FLOTATION REPORT

TEST NO.

Sample: 2,000 g.

H-3

Point of Addition	CONDITIONS				REAGENTS POUNDS PER TON								
	Time Min.	% Solids	PH	AF238	MIBC								
Grind	16	63.5											
Condition	2		8.6	0.10									
Ro. Flt.	4				0.08								
Condition	2			0.05									
Scav. Flt.	6												

Remarks:

Product	% Weight	Assay oz./ton or %				% Distribution			
		Cu				Cu			
Ro. Conc. 0-2	2.9	15.26				92.4			
2-4	0.7	1.50				2.0			
O'All Ro Conc.	3.6	12.60				94.4			
Scav. Conc.	1.5	0.50				1.6			
O'All Conc.	5.1	9.04				96.0			
Tail	94.9	0.02				4.0			
Head	100.0	0.48				100.0			

Remarks:

Date: December 7, 1970.

EXPERIMENTAL LABORATORY  
FLOTATION REPORT

TEST NO.

Sample: 2,000 g.

H-4

Point of Addition	CONDITIONS			REAGENTS POUNDS PER TON								
	Time Min.	% Solids	PH	AF238	MIBC							
Grind	20	62.5										
Condition	2		8.6	0.10								
Ro. Flt.	4				0.06							
Condition	2			0.05								
Scav. Flt.	6				0.02							

Remarks:

Product	% Weight	Assay oz./ton or %				% Distribution			
		Cu				Cu			
Ro. Conc. 0-2	2.8	15.20				91.3			
2-4	0.5	1.16				1.2			
O'All Ro Conc	3.3	13.10				92.5			
Scav. Conc.	0.9	0.69				1.3			
O'All Conc.	4.2	10.42				93.8			
Tail	95.8	0.03				6.2			
Head	100.0	0.47				100.0			

Remarks:

Date: December 7, 1970.

EXPERIMENTAL LABORATORY  
FLOTATION REPORT

TEST NO.

Sample: 2,000g.

H-5

Point of Addition	CONDITIONS				REAGENTS POUNDS PER TON								
	Time Min.	% Solids	pH	AF238	MIBC								
Grind	4	67											
Condition	2		8.5	0.10									
Ro. Flt.	4				0.08								
Condition	2			0.05									
Scav. Flt.	6												

Remarks:

Product	% Weight	Assay oz./ton or %				% Distribution			
		Cu				Cu			
Ro. Conc. 0-2	2.4	12.70				66.0			
2-4	0.9	4.68				9.1			
O'All Ro Conc	3.3	10.52				75.1			
Scav. Conc.	1.4	1.64				5.0			
O'All Conc.	4.7	7.87				80.1			
Tail	95.3	0.097				19.9			
Head	100.0	0.46				100.0			

Remarks:

Date: January 28, 1971.

EXPERIMENTAL LABORATORY  
FLOTATION REPORT

TEST NO.

Sample: 2,000 g. - new sample

H-13

Point of Addition	CONDITIONS			REAGENTS POUNDS PER TON											
	Time Min.	% Solids	pH	AF238	MIBC										
Grind	16	63.5													
Condition	2			0.10											
Ro. Flt.	4		8.2		0.06										
Condition	2			0.05											
Scav. Flt.	6		8.0												

Remarks: Repeat of H-7 to determine differences, if any. Ro. conc. only assayed for Mo.

Product	% Weight	Assay oz./ton or %				% Distribution			
		Cu		Mo		Cu			
Ro. Conc.	3.8	9.88		0.056		92.6			
Scav. Conc.	0.9	1.20				2.7			
O'All Conc.	4.7	8.22				95.3			
Tails	95.3	0.02				4.7			
Head	100.0	0.41				100.0			

Remarks:



Date: January 28, 1971.

EXPERIMENTAL LABORATORY  
FLOTATION REPORT

TEST NO.

Sample: 2,000 g. - new sample

H-14

Point of Addition	CONDITIONS				REAGENTS POUNDS PER TON								
	Time Min.	% Solids	pH	R-350	MIBC								
Grind	16	63.5											
Condition				0.10									
Ro. Flt.			8.0		0.08								
Condition				0.05									
Scav. Flt.			7.8										

Remarks: As H-13 only R-350 used instead of AF-238. Metallurgy not improved. Concentrate grade decreased.

Product	% Weight	Assay oz./ton or %				% Distribution			
		Cu	Mo			Cu			
Ro. Conc.	4.0	9.38	0.044			92.9			
Scav. Conc.	1.1	0.86				2.4			
O'All Conc.	5.1	7.54				95.3			
Tails	94.9	0.02				4.7			
HEAD	100.0	0.40				100.0			

Remarks:

Date: February 11, 1971.

EXPERIMENTAL LABORATORY  
FLOTATION REPORT

TEST NO.

Sample: 2 x 2,000 g.

H-15

Point of Addition	CONDITIONS				REAGENTS POUNDS PER TON								
	Time Min.	% Solids	pH	AF238	MIBC	Lime							
Grind	6	67											
Condition	2		7.2	0.05									
Ro. Flt.	8		7.2	0.05	0.02								
No. 1 Clnr.	8		10.5										
No. 2 Clnr.	5		10.5	0.0025									

Remarks: 2 Ro. Conc.'s combined for cleaning.

Product	% Weight	Assay oz./ton or %				% Distribution			
		Cu				Cu			
# 2 Cl. Conc.	2.2	14.25				75.7			
# 2 Cl. Tail	0.8	2.16				4.1			
#1 Cl. Conc.	3.0	11.03				79.8			
#1 Cl. Tails	1.5	1.16				4.1			
Ro. Conc.	4.5	7.74				83.9			
Tails	95.5	0.07				16.1			
Head	100.0	0.42				100.0			

Remarks:

Date: February 11, 1971.

EXPERIMENTAL LABORATORY  
FLOTATION REPORT

TEST NO.

Sample: 2 x 2,000 g.

H-16

Point of Addition	CONDITIONS			REAGENTS POUNDS PER TON											
	Time Min.	% Solids	PH	AF238	MIBC	Lime									
Grind	9	67													
Condition	2		7.2	0.05											
Ro. Flt.	8		7.2	0.05	0.02										
#1 Clnr.	5		10.5												
#2 Clnr.	5		9.4	0.0025											

Remarks: 2 Ro. Conc.'s combined for cleaning.

Product	% Weight	Assay oz./ton or %				% Distribution			
		Cu				Cu			
# 2 Cl. Conc.	2.6	13.57				86.5			
# 2 Cl. Tls.	0.5	1.68				2.0			
# 1 Cl. Conc.	3.1	11.65				88.5			
# 1 Cl. Tls.	1.2	0.76				2.2			
Ro. Conc.	4.3	8.61				90.7			
Tails	95.7	0.04				9.3			
Head	100.0	0.41				100.0			

Remarks:

Date: February 11, 1971.

EXPERIMENTAL LABORATORY  
FLOTATION REPORT

TEST NO.

Sample: 2 x 2,000 g.

H-17

Point of Addition	CONDITIONS			REAGENTS POUNDS PER TON								
	Time Min.	% Solids	pH	AF238	MIBC	Lime						
Grind	12	67										
Condition			7.5	0.05								
Ro. Flt.			7.5	0.05	0.02							
# 1 Clnr.			10.5									
# 2 Clnr.			9.4	0.0025								

Remarks: 2 Ro. conc's combined for cleaning.

Product	% Weight	Assay oz./ton or %				% Distribution			
		Cu				Cu			
# 2 Cl Conc.	2.4	14.82				84.7			
# 2 Cl Tls.	1.0	2.30				5.5			
# 1 Cl Conc.	3.4	11.14				90.2			
# 1 Cl. Tls.	1.3	0.96				3.0			
Ro. Conc.	4.7	8.32				93.2			
Tails	95.3	0.03				6.8			
Head	100.0	0.42				100.0			

Remarks:

Date: February 15, 1971.

EXPERIMENTAL LABORATORY  
FLOTATION REPORT

TEST NO.

Sample: 2 x 2,000 g.

H-19

Point of Addition	CONDITIONS			REAGENTS POUNDS PER TON										
	Time Min.	% Solids	pH	Lime	AF238	MIBC								
Grind	12	64.5		0.16										
Condition	2		9.5	0.15	0.05									
Ro. Flt.	3		9.5			0.04								
Condition	2		9.2		0.05									
Scav. Flt.	5		9.2			0.02								
# 1 Clnr.	5		10.5	0.07										
# 2 Clnr.	5		10.5	0.05										

Remarks: 2 Ro. conc's combined for cleaning.

Product	% Weight	Assay oz./ton or %				% Distribution			
		Cu				Cu			
# 2 Cl Conc.	1.1	28.28				69.3			
# 2 Cl Tls.	0.5	8.96				10.0			
# 1 Cl Conc.	1.6	22.24				79.3			
# 1 Cl Tls.	1.1	1.88				4.6			
Ro. Conc.	2.7	13.95				83.9			
Scav. Conc.	1.9	1.79				7.6			
O'All Conc.	4.6	8.93				91.5			
Tails	95.4	0.04				8.5			
Head	100.0	0.45				100.0			

Remarks:

FLOTATION REPORT

Sample: 2 x 2,000 g.

H-20

Point of Addition	CONDITIONS			REAGENTS POUNDS PER TON								
	Time Min.	% Solids	pH	Lime	AF238	MIBC						
Grind	12	64.5										
Condition	2		9.5	0.16	0.10							
Ro. Flt.	3		9.5			0.03						
Condition	2		9.3		0.05							
Scav. Flt.	5		9.3			0.01						
Regrind	5	20										
# 1 Clnr.	5		10.5	0.08		0.01						
# 2 Clnr.	5		10.5	0.04		0.01						

Remarks: 2 Ro. conc's combined for cleaning.

Product	% Weight	Assay oz./ton or %				% Distribution			
		Cu		Mo		Cu		Mo	
# 2 Cl Conc.	1.1	30.90		0.018		77.8		4.1	
# 2 Cl Tls.	0.3	4.28		0.035		2.9		2.2	
# 1 Cl Conc.	1.4	25.19		0.022		80.7		6.3	
# 1 Cl Tls.	1.2	0.52		0.040		1.5		9.9	
Ro. Conc.	2.6	13.80		0.030		82.2		16.2	
Scav. Conc.	1.2	1.68		0.016		4.6		4.0	
O'All Conc.	3.8	9.98		0.026		86.8		20.2	
Tails	96.2	0.06		0.004		13.2		79.8	
Head	100.0	0.44		0.005		100.0		100.0	

Remarks:

Date: March 3, 1971.

EXPERIMENTAL LABORATORY  
FLOTATION REPORT

TEST NO.

Sample: 2 x 2,000 g.

H-22

Point of Addition	CONDITIONS			REAGENTS POUNDS PER TON							
	Time Min.	% Solids	pH	Lime	3302	AF238	MIBC	Fuel Oil			
Grind	12	64.5		0.16	0.05						
Condition	2		9.5	0.20		0.10					
Ro. Flt.	4		9.5				0.06	0.04			
Condition	2		9.0			0.05					
Scav. Flt.	4		9.0				0.04	0.02			
Regrind	5	30			0.02						
# 1 Clnr.	5		10.5	0.10							
# 2 Clnr.	5		10.5	0.03			0.02				
# 3 Clnr.	3		10.5					0.02			

Remarks:

Product	% Weight	Assay oz./ton or %				% Distribution			
		Cu		Mo		Cu		Mo	
# 3 Cl. Conc.	1.8	19.80		0.066		83.2		29.2	
# 3 Cl. Tls.	0.4	3.50		0.027		3.3		2.7	
# 2 Cl. Conc.	2.2	16.84		0.059		86.5		31.9	
# 2 Cl. Tls.	0.6	0.82		0.019		1.1		2.7	
# 1 Cl. Conc.	2.8	13.40		0.050		87.6		34.6	
# 1 Cl. Tls.	2.4	0.37		0.018		2.1		10.6	
Ro. Conc.	5.2	7.39		0.035		89.7		45.2	
Scav. Conc.	1.7	1.50		0.022		6.0		9.1	
O'All Conc.	6.9	5.94		0.032		95.7		54.3	
Scav. Tls.	93.1	0.02		0.003		4.3		45.7	
Head	100.0	0.43		0.004		100.0		100.0	

Remarks:

Date: March 18, 1971.

EXPERIMENTAL LABORATORY  
FLOTATION REPORT

TEST NO.

Sample: 2 x 2,000 g.

H-23

Point of Addition	CONDITIONS			REAGENTS POUNDS PER TON								
	Time Min.	% Solids	pH	Fuel Oil	R-343	MIBC	Limc					
Grind	9	64.5		0.04								
Condition	5		8.0		0.06	0.12						
Ro. Flt.	10				0.04							
Regrind	5	50					0.15					
# 1 Clnr.	5		10.5				0.25					
# 2 Clnr.	5		10.6				0.25					

Remarks:

Product	% Weight	Assay oz./ton or %				% Distribution			
		Cu		Mo		Cu		Mo	
2nd. Cl Conc.	2.4	15.01		0.034		87.2		14.0	
2nd. Cl Tls.	0.8	2.14		0.068		4.1		9.2	
1st. Cl Conc.	3.2	11.79		0.043		91.3		23.2	
1st. Cl Tls.	1.6	0.54		0.043		2.1		11.8	
Ro Conc.	4.8	8.05		0.043		93.4		35.0	
Ro Tail	95.2	0.029		0.004		6.6		65.0	
Head	100.0	0.41		0.006		100.0		100.0	

Remarks:



Date: March 18, 1971.

EXPERIMENTAL LABORATORY  
FLOTATION REPORT

TEST NO.

Sample: 2 x 2,000 g.

H-24

Point of Addition	CONDITIONS				REAGENTS POUNDS PER TON								
	Time Min.	% Solids	pH	Fuel Oil	R-343	MIBC	Lime	NaCN					
Grind	6	64.5		0.04									
Condition	5		8.0		0.06	0.12							
Ro. Flt.	10				0.04								
Regrind	5	50					0.4						
# 1 Clnr.	5		10.4					0.02					
# 2 Clnr.	3		9.8					0.03					

Remarks: # 1 and # 2 Clnr. were conditioned for 2 minutes after NaCN addition.

Product	% Weight	Assay oz./ton or %				% Distribution			
		Cu		Mo		Cu		Mo	
#2 Cl Conc.	1.1	27.81		0.072		73.7		17.2	
#2 Cl Tls.	1.5	4.19		0.030		15.2		9.8	
#1 Cl Conc.	2.6	14.19		0.048		88.9		27.0	
#1 Cl Tls.	2.9	0.29		0.018		2.0		11.2	
Ro Conc.	5.5	6.86		0.032		30.9		38.2	
Ro Tls.	94.5	0.04		0.003		9.1		61.8	
Head	100.0	0.415		0.005		100.0		100.0	

Remarks:

Sample: 2 x 2,000 g.

H-26

Point of Addition	CONDITIONS				REAGENTS POUNDS PER TON								
	Time Min.	% Solids	pH	R-343	MIBC	Lime	NaCN						
Grind	6	64.5											
Condition	2		7.6	0.10									
Ro. Flt.	10		7.6		0.10								
Regrind	6	50				0.5	0.02						
# 1 Clnr.	4		11.0		0.04								
# 2 Clnr.	4		10.3										

Remarks:

Product	% Weight	Assay oz./ton or %				% Distribution			
		Cu		Mo		Cu		Mo	
# 2 Cl Conc.	1.1	28.18		0.043		77.6		9.0	
# 2 Cl Fl.	0.4	4.58		0.101		4.6		7.6	
# 1 Cl Conc.	1.5	21.89		0.058		82.2		16.6	
# 1 Cl Fl.	3.4	0.75		0.045		6.4		29.1	
Ro Conc.	4.9	7.22		0.049		88.6		45.7	
Ro Tail.	95.1	0.048		0.003		11.4		54.3	
Head	100.0	0.40		0.005		100.0		100.0	

Remarks:

Date: March 24, 1971.

EXPERIMENTAL LABORATORY  
FLOTATION REPORT

TEST NO.

Sample: 2 x 2,000 g.

H-28

Point of Addition	CONDITIONS			REAGENTS POUNDS PER TON									
	Time Min.	% Solids	pH	R343	MIBC	Lime	NaCN						
Grind	6	64.5											
Condition	2		7.6	0.10									
Ro. Flt.	7		7.6		0.10								
Regrind	6	55				0.5	0.02						
# 1 Clnr.	3		10.8	0.005	0.04								
# 2 Clnr.	4		9.5		0.02								

Remarks: Ro. conc. filtered and repulped with 150 cc. H<sub>2</sub>O.

Product	% Weight	Assay oz./ton or %				% Distribution			
		Cu		Mo		Cu		Mo	
# 2 Cl Conc.	1.0	31.43		0.046		74.3		8.2	
# 2 Cl Tls.	0.3	6.77		0.140		4.8		7.4	
# 1 Cl Conc	1.3	25.74		0.068		79.1		15.6	
# 1 Cl Tls.	3.4	0.81		0.056		6.5		33.7	
Ro. Conc.	4.7	7.70		0.059		85.6		49.3	
Ro. Tail	95.3	0.064		0.003		14.4		50.7	
Head	100.0	0.42		0.006		100.0		100.0	

Remarks:

Date: March 30, 1971.

EXPERIMENTAL LABORATORY  
FLOTATION REPORT

TEST NO.

Sample: 2 x 2,000 g.

H-29

Point of Addition	CONDITIONS			REAGENTS POUNDS PER TON								
	Time Min.	% Solids	pH	R-343	MIBC	Lime	NaCN					
Grind	7	64.5										
Condition	2		7.9	0.15								
Ro Flt.	8				0.12							
Regrind	6	50				0.5	0.01					
# 1 Clnr.	5		10.8	0.005	0.04							
# 2 Clnr.	4		10.4									

Remarks:

Product	% Weight	Assay oz./ton or %				% Distribution			
		Cu		Mo		Cu		Mo	
# 2 Cl Conc.	1.9	18.23		0.034		85.5		11.3	
# 2 Cl Tl.	0.3	4.34		0.116		3.2		6.1	
# 1 Cl Conc.	2.2	16.34		0.045		88.7		17.4	
# 1 Cl Tl.	2.6	0.52		0.055		3.3		24.8	
Ro Conc.	4.8	7.77		0.051		92.0		42.2	
Ro Tail	95.2	0.034		0.0035		8.0		57.8	
Head	100.0	0.405		0.006		100.0		100.0	

Remarks:

Date: March 30, 1971.

FLOTATION REPORT

Sample: 2 x 2,000 g.

H-30

Point of Addition	CONDITIONS			REAGENTS POUNDS PER TON								
	Time Min.	% Solids	pH	R-343	MIBC	Lime						
Grind	7	64.5										
Condition	2		7.9	0.15								
Ro. Flt.	8				0.12							
Regrind	6	50				1.0						
# 1 Clnr.	5		11.2									
# 2 Clnr.	4		10.6									

Remarks:

Product	% Weight	Assay oz./ton or %				% Distribution			
		Cu		Mo		Cu		Mo	
# 2 Cl Conc.	1.7	19.74		0.014		82.2		3.7	
# 2 Cl Tl.	0.5	3.39		0.057		4.2		4.5	
# 1 Cl. Conc.	2.2	16.03		0.024		86.4		8.2	
# 1 Cl Tl.	2.6	0.75		0.081		4.7		32.7	
Ro Conc.	4.8	7.75		0.055		91.1		40.9	
Ro Tail	95.2	0.038		0.004		8.9		59.1	
Head	100.0	0.408		0.006		100.0		100.0	

Remarks:

Date: March 30, 1971.

EXPERIMENTAL LABORATORY  
FLOTATION REPORT

TEST NO.

Sample: 2 x 2,000 g.

H-31

Point of Addition	CONDITIONS				REAGENTS POUNDS PER TON							
	Time Min.	% Solids	pH	R-343	MIBC	S3302	Lime	NaCN				
Grind	7	64.5										
Condition	2		7.9	0.15								
Ro Flt.	8				0.12							
Regrind	6	50				0.01	0.5	0.02				
# 1 Clnr.	5		10.9	0.005								
# 2 Clnr.	4		9.8									

Remarks:

Product	% Weight	Assay oz./ton or %				% Distribution			
		Cu		Mo		Cu		Mo	
# 2 Cl Conc.	1.2	27.63		0.020		78.7		5.8	
# 2 Cl Tl.	0.3	8.20		0.091		5.8		6.4	
# 1 Cl. Conc.	1.5	23.75		0.034		84.5		12.2	
# 1 Cl. Tl.	3.6	0.70		0.049		6.0		42.2	
Ro Conc.	5.1	7.48		0.045		90.5		54.4	
Ro Tail	94.9	0.042		0.002		9.5		45.6	
Head	100.0	0.421		0.004		100.0		100.0	

Remarks: