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L.R. 1784

MICROFILMED

An Investigation of

THE RECOVERY OF SULPHIDES

from an A.C.S. Feed sample

(E.L. 2/74) submitted by

CITIES SERVICE INTERNATIONAL INC.

Progress Report No. 4

Project No. L.R. 1784

NOTE:

This report refers to the samples as received.

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LAKEFIELD RESEARCH OF CANADA LIMITED
Lakefield, Ontario
May 12, 1976

I N T R O D U C T I O N

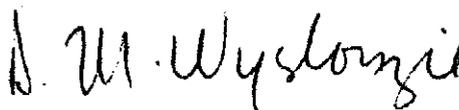
One March 29, 1976, Dr. D.D. Jinks advised via telephone that a small sample of ore was being shipped to Lakefield for testing. The objective of the testwork was to determine the amount of sulphides, in particular chalcopyrite, which could be recovered by flotation.

The sample, weighing 2.5 kg. represented typical feed from the Macquarie Harbour sulphide project, and was forwarded by Robertson Research (Australia) Pty. Limited, Bowral, N.S.W.

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A.G. Scobie, P. Eng.,
Manager



D.M. Wyslouzil, P. Eng.,
Chief Metallurgist

Investigation by: D.R. Shaw

S U M M A R Y1. Head Analysis

The analysis of the A.C.S. Head Feed sample, as calculated from the two flotation tests, was as follows:

Copper (Cu)	0.17 %
Sulphur (S, Total)	3.61 %

1.1. Size AnalysisA.C.S. Head Feed

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 20	0.1	0.1	99.9
28	0.2	0.3	99.7
35	1.1	1.4	98.6
48	9.2	10.6	89.4
65	25.1	35.7	64.3
100	34.0	69.7	30.3
150	16.7	86.4	13.6
200	8.0	94.4	5.6
270	3.1	97.5	2.5
400	1.3	98.8	1.2
- 400	1.2	100.0	-
Total	100.0	-	-

2. Metallurgical Results

Two tests were performed to evaluate the response of this material to flotation. In both tests a rougher concentrate was removed from the material "as received". As shown in the size analysis, the particle size distribution was typical of a deslimed feed, and hence the sulphides were present as coarse free particles or were finely disseminated in coarse quartz. The free sulphides floated rapidly.

Summary - Continued

2. Metallurgical ResultsTable 1Flotation of A.C.S. Feed (Test 41)

Product	Weight %	Assays, %		% Distribution	
		Cu	S	Cu	S
Concentrate	7.0	0.65	40.6	28.5	85.8
Tailing	93.0	0.12	0.51	71.5	14.2
Head	100.0	0.16	3.34	100.0	100.0

The total sulphur recovery of 85.8 % and the grade of 40.6 % S were satisfactory considering the coarseness of the feed, but the copper recovery was low.

To determine the amount of copper which could be recovered by regrinding and scavenging, the rougher tailings from Tests 40 and 41 were reground to 71 % and 87 % minus 200 mesh, respectively.

Low-grade scavenger concentrates were removed (low-grade with respect to sulphur analysis) but the tailings assays were lowered to 0.02 % Cu (Test 41) and 0.03 % Cu (Test 40), respectively. The combined rougher and scavenger concentrates had the following composition.

Table 2Combined Rougher and Scavenger Concentrate

Test No.	% -200 mesh after regrind	Weight %	Assays, %		% Recovery	
			Cu	S	Cu	S
40	71.6	15.3	0.99	24.1	84.6	95.0
41	87.4	23.8	0.61	13.7	90.5	97.9

In order to get maximum information from the two tests that could be performed with the available material, the cleaner circuits were carried out as follows:

Summary - Continued

2. Metallurgical Results

Test 40: Rougher concentrates 1 and 2 were combined and cleaned twice by reflation. The cleaner concentrate was then reground and again cleaned twice. The analyses of the concentrates after each stage are shown in Table 3. A complete flowsheet of this test is shown in Figure 1.

Table 3Cleaning of Concentrates of Test 40

Product	Regrinding	Weight %	Assays, %		% Distribution	
			Cu	S	Cu	S
Cleaner Conc.	No	10.3	1.4	35.5	80.9	94.2
Re-cleaner Conc.	Yes	6.3	1.75	48.2	68.6	79.6

The above products were the end-members of two-stage operations, and hence there are intermediate products available, containing sulphur and copper, which could be further processed to increase the recovery. It is clear, however, that from the original A.C.S. Feed, without further grinding, the copper recovery would be low.

Test 41: The rougher concentrate was reground and cleaned separately, whereas the scavenger concentrate was cleaned without further grinding. The results were interesting in that they showed that from the scavenger concentrate a copper concentrate could be produced assaying 5.64 % Cu and containing 54 % of the total copper. The reground rougher concentrate was upgraded to over 50 % S as shown in Table 4.

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Summary - Continued

2. Metallurgical ResultsTable 4Selected Products from Test 41

Product	Weight %	Assays, %		% Distribution	
		Cu	S	Cu	S
Rougher Concentrate 1	7.05	0.65	40.6	28.5	85.8
After regrinding and cleaning	4.43	0.93	51.3	25.6	68.1
Scavenger Concentrate	16.78	0.59	2.38	62.0	12.1
After cleaning	1.53	5.64	21.7	53.7	10.0
Combined rougher + scav. conc.	23.83	0.61	13.7	90.5	97.9
Combined cleaner concentrate	5.96	2.02	41.3	79.3	78.1

The final results of these two tests were similar. A satisfactory pyrite recovery was possible from the coarse feed material, but since the chalcopyrite was preferentially associated with gangue minerals in the form of fine inclusions, the recovery was low.

Grinding to about 70 % - 80 % minus 200 mesh would be required to achieve a good copper recovery. Regrinding of the concentrates would be required to obtain a high sulphur-low silica product.

Figure 1

Flowsheet Test 40

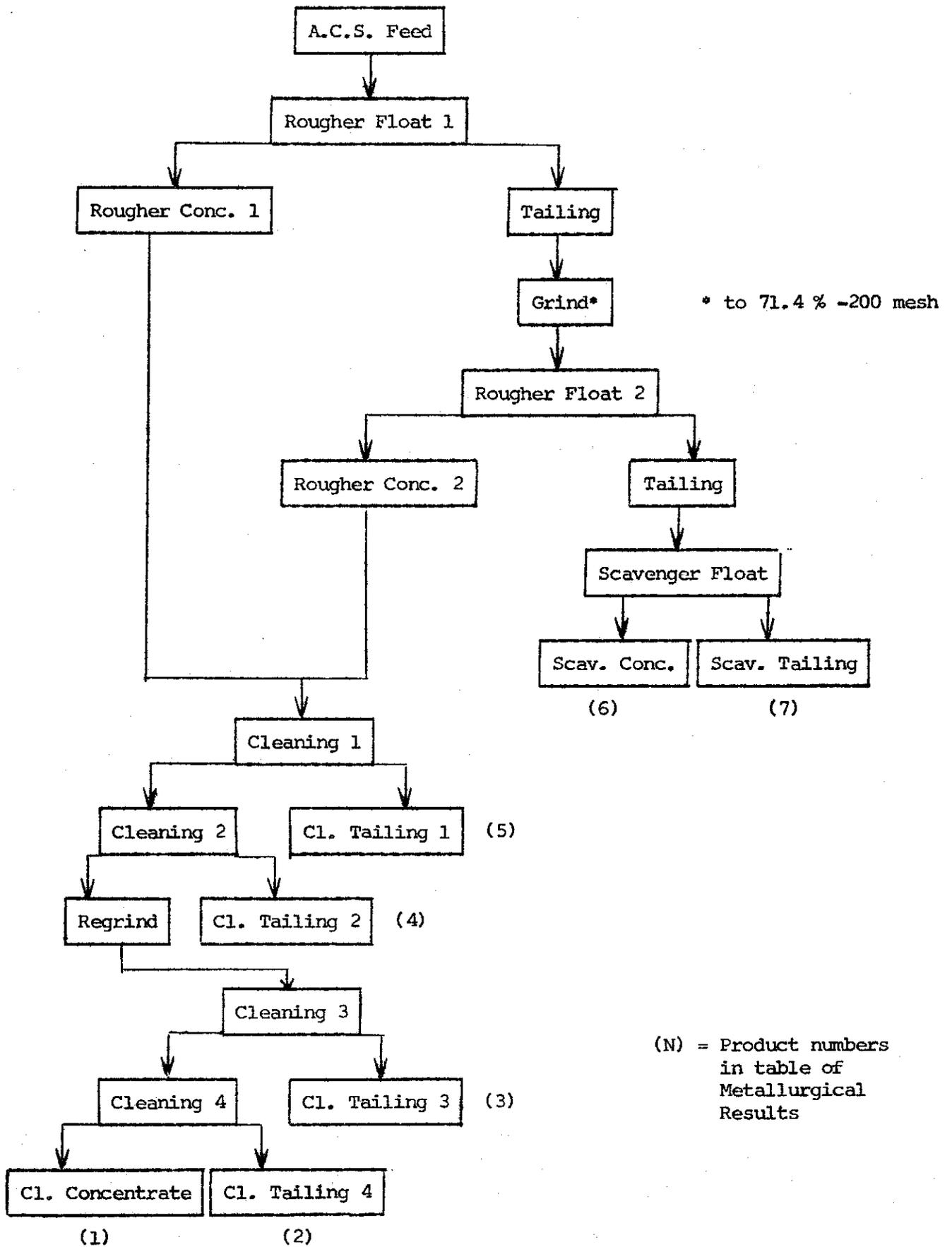
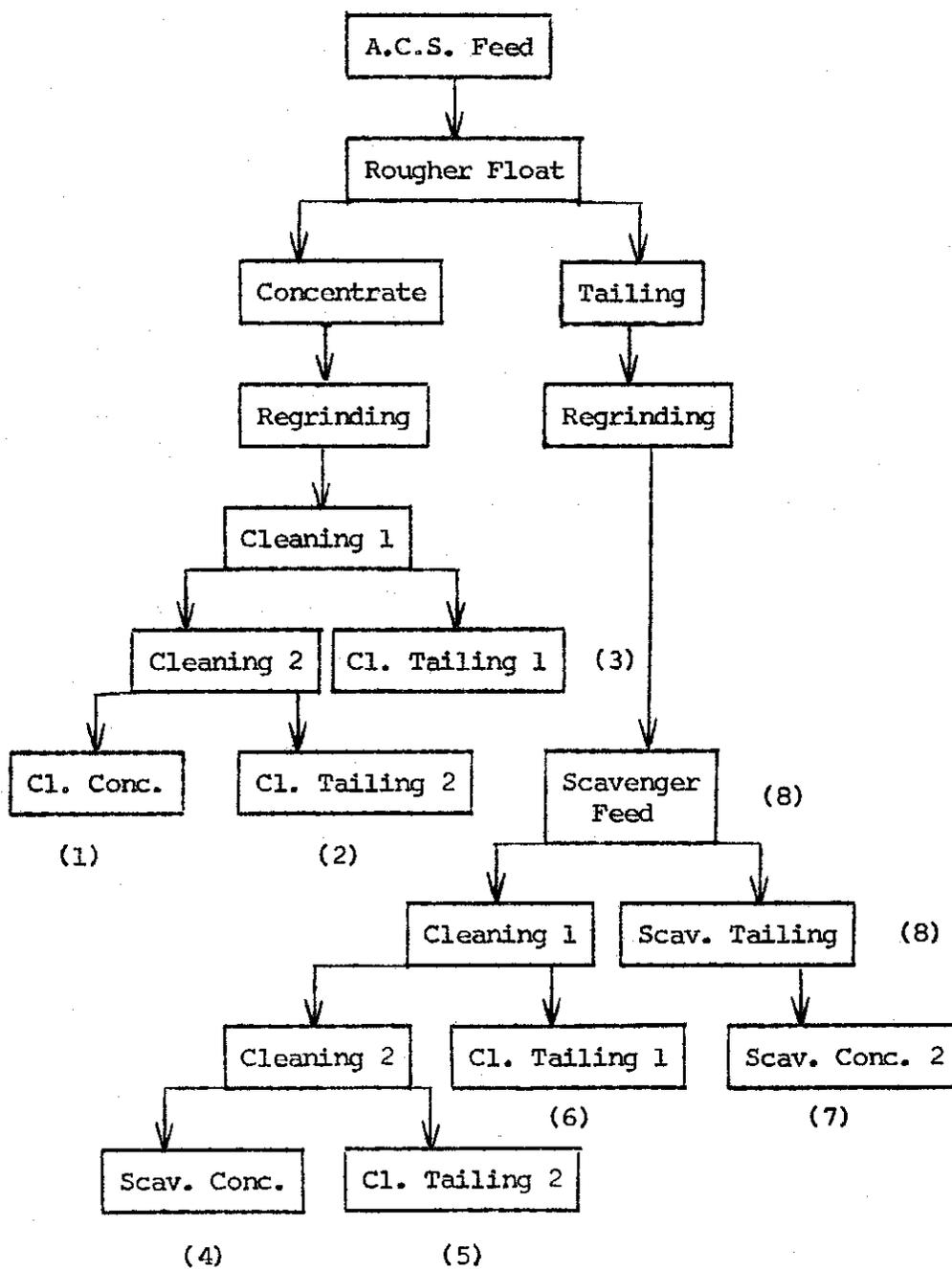


Figure 2

Flowsheet Test 41



DETAILS OF TESTSTest No. 40

Purpose: To investigate the recovery of a sulphide concentrate from the A.C.S. head feed sample.

Procedure: Float a sulphide rougher concentrate. Grind tailing float a second rougher concentrate and scavenge once. Clean the combined rougher concentrate twice.

Feed: 500 grams A.C S. Head Feed sample.

Observations: Feed - 50 - 60 % coarse grained free pyrite
 ~ 20 % coarse middling
 ~ 20 % fine inclusions inclusions in non-sulphide gangue (quartz) considerable tarnished pyrite, especially in finer sizes and middlings.

Ro. 1 - Pyrite responded well, free and coarser middlings.
 Ro. 2 - Pyrite responded well more (tarnished) and finer pyrite
 Scav. Conc. - Few sulphide (chalcopyrite)
 Scav. Tail. - Clean of sulphide, except for very fine inclusion in quartz.

Cleaning - good

Conditions:

Stage	Reagents Added, pounds per ton		Time, minutes			pH
	Z - 6	DF-250	Grind	Cond.	Froth	
Sulphide Rougher (1)	0.04	0.02	-	2	3	6.5
Grind - rougher tailing	-	-	20	-	-	-
Sulphide Rougher (2)	0.04	0.02	-	1	4	-
Scavenger	0.02	0.01	-	1	2	-
<u>Cleaning Combined Rougher Concentrates</u>						
1st Cleaner	0.01	0.01	-	1	3	-
2nd Cleaner	-	0.01	-	1	2	-
45.0 grams 2nd cleaner concentrate reground and cleaned further						
Regrind	-	-	5	-	-	-
3rd Cleaner	0.01	0.01	-	1	2	-
4th Cleaner	-	-	-	1	1½	-

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Test No. 40 - Continued

Conditions:

Stage	Flotation	Grind and Regrind
Equipment	250 g D-1	Abbe Pebble Mill
Speed: r.p.m.	950	-
% Solids	Ro. - 30	-

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Cu	S	Cu	S
1. Re Cleaner Conc.	6.33	1.75	48.2	68.9	79.6
2. Cleaner Tailing 4	0.89	1.06	27.0	5.9	6.3
3. Cleaner Tailing 3	3.05	0.32	10.5	6.0	8.3
4. Cleaner Tailing 2	0.99	0.30	1.73	1.7	0.4
5. Cleaner Tailing 1	4.00	0.09	0.38	2.0	0.4
6. Scavenger Conc.	4.90	0.12	0.39	3.3	0.5
7. Scavenger Tailing	78.81	0.027	0.22	12.1	4.5
Head (Calculated)	100.00			100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	7.22	1.66	45.6	74.8	85.9
Products 1 to 3	10.30	1.40	35.5	80.9	94.2
Products 1 to 4	11.29	1.30	32.5	82.6	94.6
Products 1 to 5	15.29	0.99	24.1	84.6	95.0
Products 1 to 6	20.19	0.76	18.4	87.9	95.5
Products 6 and 7	84.71	0.03	0.23	15.4	5.0

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Test No. 40 - Continued

Screen Analysis

Scavenger Tailing

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	0.2	0.2	99.8
100	1.7	1.9	98.1
150	7.1	9.0	91.0
200	19.4	28.4	71.6
270	18.1	46.5	53.5
400	16.7	63.2	36.8
- 400	36.8	100.0	-
Total	100.0	-	-

Test No. 41

Purpose: To investigate the effects of regrinding the first sulphide rougher concentrate and of a longer grinding time for the rougher tailing on the recovery of copper and pyrite.

Procedure: As for Test No. 40, but with following modifications:
 1) regrind first sulphide rougher concentrate
 2) increase rougher tailing regrind time from 20 to 30 minutes.
 3) clean rougher and scavenger concentrate separately.

Feed: 500 grams A.C.S. Head Feed sample.

Conclusions: Rougher and scavenger similar to Test 40, except that with increased fineness of tailing grind more obvious chalcopyrite response. Copper seems to respond well to cleaning, but pyrite recovery may be significantly lower due to dilution. Considerable silica in scavenger cleaner concentrates, may need further cleaning conditions (larger feed sample) or require small addition of fines depressants (Na_2SiO_3).

Conditions:

Stage	Reagents Added, pounds per ton		Time, minutes			pH
	Z - 6	DF-250	Grind	Cond.	Froth	
Sulphide Rougher	0.04	0.02	-	2	3	6.6
Grind - rougher tailing	-	-	30	-	-	-
Scavenger (1)	0.04	0.02	-	1	4	-
(2)	0.02	0.01	-	1	3	-
Regrind Rougher Concentrate	-	-	5	-	-	-
Clean rougher and scavenger (1) concentrates separately						
Ro. 1st Cleaner	0.01	-	-	1	2	-
Ro. 2nd Cleaner	-	0.01	-	1	2	-
Scav. 1st Cleaner	0.01	-	-	1	2	-
Scav. 2nd Cleaner	-	-	-	1	2	-

Stage	Flotation	Grind
Equipment	250 g D-1	Abbe Pebble Mill
Speed: r.p.m.	950	-
% Solids	Ro. - 30	-

Test No. 41 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Cu	S	Cu	S
1. Rougher Cleaner Conc.	4.43	0.93	51.3	25.6	68.1
2. Rougher 2nd Cl. Tail.	0.29	0.34	29.5	0.6	2.6
3. Rougher 1st Cl. Tail.	2.33	0.16	21.6	2.3	15.1
4. Scavenger Cl. Conc.	1.53	5.64	21.7	53.7	10.0
5. Scavenger 2nd Cleaner Tailing	0.98	0.24	1.19	1.5	0.4
6. Scavenger 1st Cleaner Tailing	5.02	0.07	0.32	2.2	0.5
7. Scavenger Conc. No. 2	9.25	0.08	0.42	4.6	1.2
8. Scavenger Tailing	76.17	0.020	0.10	9.5	2.1
Head (Calculated)	100.00	0.16	3.34	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	4.72	0.89	50.0	26.2	70.7
Products 1 to 3	7.05	0.65	40.6	28.5	85.8
Products 4 and 5	2.51	3.53	13.7	55.2	10.4
Products 4 to 6	7.53	1.22	4.78	57.4	10.9
Products 4 to 7	16.78	0.59	2.38	62.0	12.1
Products 1 to 7	23.83	0.61	13.7	90.5	97.9

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Test No. 41 - Continued

Screen Analysis

Scavenger Flotation Tailing

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	0.1	0.1	99.9
100	0.4	0.5	99.5
200	2.2	2.7	97.3
200	9.9	12.6	87.4
270	16.0	28.6	71.4
400	20.7	49.3	50.7
- 500	50.7	100.0	-
Total	100.0	-	-

LAKEFIELD RESEARCH OF CANADA LIMITED
 Lakefield, Ontario
 May 12, 1976 / dmm