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Lab data II

An Investigation of

THE RECOVERY OF SULPHIDES

from a slag sample

(E.L. 2/74) submitted by

CITIES SERVICE INTERNATIONAL INCORPORATED

Progress Report No. 1

Project No. L.R. 1903

**Note:**

This report refers to the samples as received.

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LAKEFIELD RESEARCH OF CANADA LIMITED  
Lakefield, Ontario  
February 9, 1976

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

A sample of sand (smelter slag) from Cities Service International Incorporated was received at Lakefield on December 19, 1975.

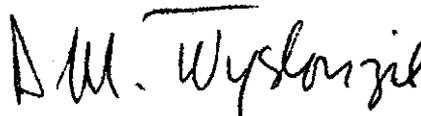
In a telephone conversation on January 5, 1976, Dr. D.D. Jinks of Cities Service International Incorporated, requested that a program of testwork should be conducted to investigate the recovery of sulphides by flotation.

The object of the testwork was to recover and concentrate the sulphides, particularly the copper sulphides, in a bulk concentrate for subsequent upgrading or leaching.

## LAKEFIELD RESEARCH OF CANADA LIMITED



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S U M M A R Y1. Head Analyses

Copper	(Cu)	0.55 %
Sulphur	(S)	1.71 %

2. Flotation Tests

Three flotation tests were carried out to determine the flotation characteristics of the sulphides, and to investigate the effect of fineness of grind on copper and sulphur recoveries. The individual tests are discussed below.

Tests No. 1 and 2

In Test No. 1 the sample was ground to 85.1 % minus 200 mesh. Three rougher concentrates and a scavenger concentrate were removed at natural pH with 0.40 pound per ton Z-6. The scavenger float was performed after conditioning with 0.20 pound per ton  $\text{CuSO}_4$ .

In Test No. 2 the sample was ground to 31.9 % passing 200 mesh, and flotation rougher and scavenger conditions were similar to those applied in Test 1. The rougher concentrates were combined and reground for 20 minutes in a pebble mill, conditioned with 3.0 pounds per ton  $\text{Ca(OH)}_2$  and cleaned twice at pH 11 with 0.02 pound per ton Z-200. The final tailing from Test 1 assayed 0.42 % Cu and that from Test 2 assayed 0.44 % Cu, equivalent to a copper loss of 46.3 % and 64.3 % respectively.

A mineralogical examination of the scavenger tailing showed that the low copper and sulphur recoveries obtained were caused by the extremely fine dispersion of the sulphides in the slag particles.

Summary - Continued

## 2. Flotation Tests - Continued

Test No. 3 was conducted in an attempt to liberate and collect the fine-grained sulphide particles. Increasing the grind from 30 to 60 minutes per kilogram and doubling the flotation time had little effect on the sulphide recovery.

Test procedures and results are summarized in the following table.

### Bulk Rougher Tests

Test No.	Grind			Flotation Reagents			Rougher Tailing				
	Time min.	% Minus 200 mesh	kwh/ton	Time min.	Z-6	CuSO <sub>4</sub>	Weight %	Assays % Cu   S		% Dist. Cu   S	
2	15	31.9	9.3	13	0.40	0.20	81.16	0.44	1.46	64.3	67.1
1	30	85.1	18.7	13	0.40	0.20	63.59	0.42	1.43	46.3	52.2
3	60	96.1	37.3	25	0.25	0.20	61.32	0.37	1.29	43.9	46.8

### 3. Microscopic Examination

The scavenger tailing from Test 2 was subjected to microscopic examination to determine the association and the mode of occurrence of the contained copper.

A portion of the sample was briquetted and polished for microscopic examination in reflected light.

Summary - Continued

3. Microscopic Examination - Continued

Copper was present as chalcopyrite and in grain-sizes measuring 7 micrometers and smaller. It occurred as inclusions in the silicate of the slag. More than 65 percent (estimated) of these inclusions were 2 micrometers in diameter and smaller, and when viewed under high magnification appeared as spherical-shaped particles dispersed throughout the host grain.

SAMPLE PREPARATION

On December 19, 1975, one pail of sand weighing approximately 20 pounds was received at Lakefield and given Reference No. 7520872.

The sample was dried and then screened on 10 mesh, and the oversize material was crushed to minus 10 mesh. The sample was then thoroughly mixed and riffled into 500 gram test charges. A sample for head assay was also prepared.

DETAILS OF TESTSTest No. 1

Purpose: A preliminary test to investigate the recovery of sulphides.

Procedure: Float three sulphide rougher concentrates using Z-6 and MIBC. Float one scavenger concentrate after conditioning with  $\text{CuSO}_4$ .

Feed: 1000 grams minus 10 mesh material.

Grind: 30 minutes at 65 percent solids in the laboratory ball mill.

Conditions:

Stage	Reagents Added, pounds per ton			Time, minutes		pH
	Z-6	MIBC	$\text{CuSO}_4$	Cond.	Froth	
Rougher Conc. No. 1	0.10	0.024	-	2	3	6.4
2	0.10	-	-	2	3	-
3	0.10	0.012	-	2	3	-
Scav. Conc. No. 1	0.10	-	0.20	3	4	6.7

Stage	Rougher & Scavenger
Flotation Cell	500 gram D-1
Speed rpm	1100
% Solids	33

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Cu	S	Cu	S
1. Rougher Concentrate 1	11.51	1.64	3.83	32.7	25.3
2. Rougher Concentrate 2	10.48	0.52	1.68	9.4	10.1
3. Rougher Concentrate 3	6.09	0.48	1.58	5.1	5.5
4. Scavenger Concentrate	8.33	0.45	1.45	6.5	6.9
5. Scavenger Tailing	63.59	0.42	1.43	46.3	52.2
Head (Calculated)	100.00	0.58	1.74	100.0	100.0

Test No. 1 - Continued

Screen Analysis

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	0.1	0.1	99.9
100	0.5	0.6	99.4
150	3.3	3.9	96.1
200	11.0	14.9	85.1
270	13.9	28.8	71.2
400	18.5	47.3	52.7
- 400	52.7	100.0	-
Total	100.0	-	-

Test No. 2

Purpose: As for Test No. 1, except at a coarser grind.

Procedure: Float a bulk sulphide concentrate and a scavenger concentrate. The bulk sulphide concentrate was reground for 20 minutes in the Abbe pebble mill, and cleaned twice.

Feed: 1000 grams minus 10 mesh material.

Grind: 15 minutes at 65 percent solids in a laboratory ball mill.

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes		pH
	Z-6	MIBC	Z-200	CuSO <sub>4</sub>	Ca(OH) <sub>2</sub>	Cond.	Froth	
Ro. Conc. No. 1	0.10	0.024	-	-	-	2	3	6.6
2	0.10	-	-	-	-	2	3	-
3	0.10	0.012	-	-	-	2	3	-
Scav. Conc. 1	0.10	-	-	0.20	-	3	4	6.8
Rougher concentrates combined and reground for 20 minutes in Abbe pebble mill.								
1st Cl. Conc.	-	-	-	-	3.0	2	2	11.0
	-	-	0.02	-	0.6	2	2	11.3
2nd Cl. Conc.	-	-	-	-	1.0	2	2	-

Stage	Rougher & Scavenger	Cleaner
Flotation Cell	500 gram D-1	250 gram D-1
Speed rpm	1100	900
% Solids	33	-

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Test No. 2 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Cu	S	Cu	S
1. 2nd Cleaner Conc.	2.02	5.83	13.2	21.2	15.1
2. 2nd Cleaner Tail.	3.10	0.77	3.02	4.3	5.3
3. 1st Cleaner Tail.	11.12	0.41	1.69	8.2	10.6
4. Scavenger Conc.	2.60	0.42	1.28	2.0	1.9
5. Scavenger Tail.	81.16	0.44	1.46	64.3	67.1
Head (Calculated)	100.00	0.56	1.77	100.0	100.0

Screen Analysis - Scavenger Tailing

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	16.5	16.5	83.5
100	17.7	34.2	65.8
150	18.1	52.3	47.7
200	15.8	68.1	31.9
270	9.4	77.5	22.5
400	9.1	86.6	13.4
- 400	13.4	100.0	-
Total	100.0	-	-

Test No. 3

Purpose: As for Test No. 2, but at a finer grind.

Procedure: As for Test No. 2.

Feed: 1000 grams minus 10 mesh material.

Grind: 60 minutes at 65 percent solids in the laboratory ball mill.

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes		pH
	Z-6	MIBC	Z-200	CuSO <sub>4</sub>	Ca(OH) <sub>2</sub>	Cond.	Froth	
Rougher 1	0.05	0.024	-	-	-	2	6	6.9
2	0.05	-	-	-	-	2	5	-
3	0.05	0.012	-	-	-	2	5	-
4	0.05	-	-	-	-	2	5	-
Scav. Conc. 1	0.05	-	-	0.20	-	3	4	-
Regrind rougher concentrate for 20 minutes in Abbe pebble mill.								
1st Cl. Conc.	-	0.01	-	-	3.0	2	2	11.1
	-	-	0.02	-	0.6	2	2	11.3
2nd Cl. Conc.	-	-	-	-	0.6	2	1½	11.4

Stage	Rougher & Scavenger	1st Cleaner	2nd Cleaner
Flotation Cell	500 g D-1	500 g D-1	250 g D-1
Speed rpm	1100	1100	900
% Solids	33	-	-

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Test No. 3 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Cu	S	Cu	S
1. Cu Cleaner Conc.	1.50	7.09	14.1	20.6	12.5
2. Cu 2nd Cl. Tail.	4.22	0.87	3.26	7.1	8.2
3. Cu 1st Cl. Tail.	20.95	0.47	1.79	19.1	22.2
4. Cu Scavenger Conc.	12.01	0.40	1.45	9.3	10.3
5. Cu Scavenger Tail.	61.32	0.37	1.29	43.9	46.8
Head (Calculated)	100.00	0.52	1.69	100.0	100.0

Screen Analysis - Cu Scavenger Tailing

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 150	0.2	0.2	99.8
200	0.8	1.0	99.0
270	2.9	3.9	96.1
400	12.1	16.0	84.0
- 400	84.0	100.0	-
Total	100.0	-	-