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Rapportarkivet

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Tittel An investigation of : The recovery of copper, lead and zink from Skrattås Prosject samples.				
Forfatter Deane, R.W McCarthy, J		Dato 11.05 1977	Bedrift Lakefield Research	
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Fagområde Oppredning	Dokument type Rapport	Forekomster Skrattås		
Råstofftype Malm/metall	Emneord Cu Zn Pb Ag			
Sammendrag Orienterende flottasjonstest på 2 stk prøver av kobber-bly-sink malm som ble samlet på berghallen i 1976. Prøvene var merket: A) High-grade sample og B) Second-grade sample.				

An Investigation of
THE RECOVERY OF COPPER, LEAD AND ZINC
from Skrataas Project Samples
submitted by
A/S SULFIDMALM NORWAY
Progress Report No. 1

Project No. L.R. 1997

NOTE:

This report refers to the sample as received.

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LAKEFIELD RESEARCH OF CANADA LIMITED
Lakefield, Ontario
May 11, 1977

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

In a letter dated January 21, 1977, Mr. F. Nixon of A/S Sulfidmalm, Kristiansand, Norway, authorized a program of testwork on samples from the Skrataas property in south central Norway.

The primary objectives of the testwork were to conduct orientation flotation tests on two copper, lead zinc ore samples collected from the mine dumps. The samples were identified as (A) High-grade sample and (B) second grade sample.

LAKEFIELD RESEARCH OF CANADA LIMITED



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S U M M A R Y

1. Head Analyses

The head analysis of the samples prepared for laboratory test work were as follows:

Element	Sample A	Sample B
Copper (Cu) %	1.30	0.74
Lead (Pb) %	10.0	5.56
Zinc (Zn) %	31.40	19.00
Iron (Fe) %	8.4	6.4
Cadmium (Cd) %	0.11	0.07
Mercury (Hg) %	0.05	0.04
Silver (Ag)	7.46*	3.52*

* oz/ton

2. Mineralogy

A preliminary mineralogical examination was conducted on 10 mesh head samples to identify the major minerals. (See appendix No. 1)

Both sample A and sample B contained similar minerals, though in different amounts.

The minerals present in both samples were sphalerite, galena, chalcopyrite, pyrite, non-opaque gangue, and a trace of bornite. In general, more than 70 % of the sphalerite in both samples was liberated. Non-liberated sphalerite was present as middlings associated with galena, or with pyrite or gangue.

The most common occurrences of galena were as attachments or inclusions associated with sphalerite, and chalcopyrite occurred most commonly as liberated particles.

Summary - Continued

3. Flotation Results

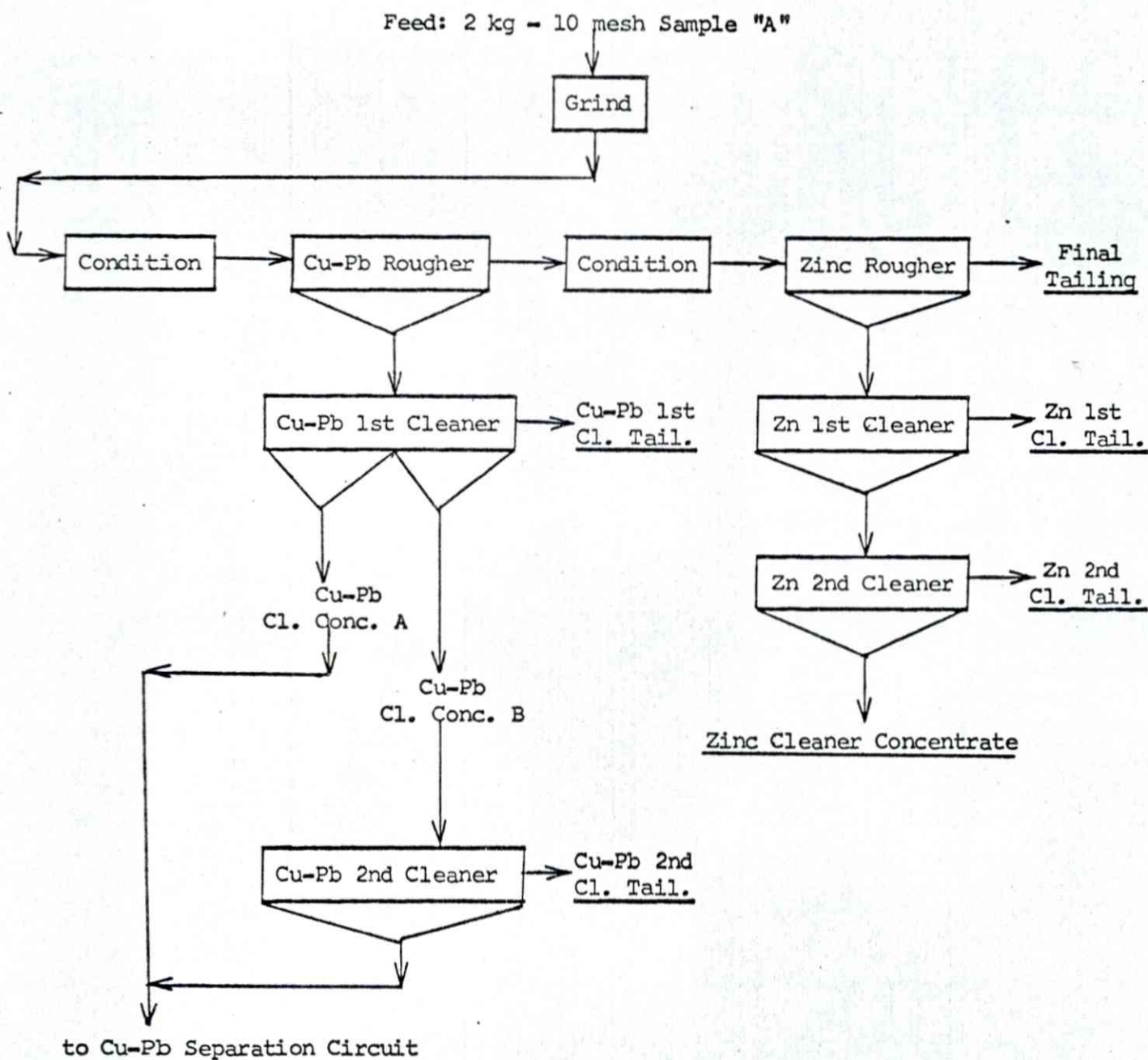
The orientation flotation tests performed on each sample consisted of the following procedure (Flowsheet 1).

The ore was ground in a laboratory ball mill to 83 % minus 200 mesh with Na_2CO_3 , ZnSO_4 , and KCN, followed by Cu-Pb bulk flotation with collectors Z-11 and R-241. The Cu-Pb bulk concentrate after two cleaning stages was treated in the Cu-Pb separation circuit and the Pb dezincing circuit. (See flowsheet)

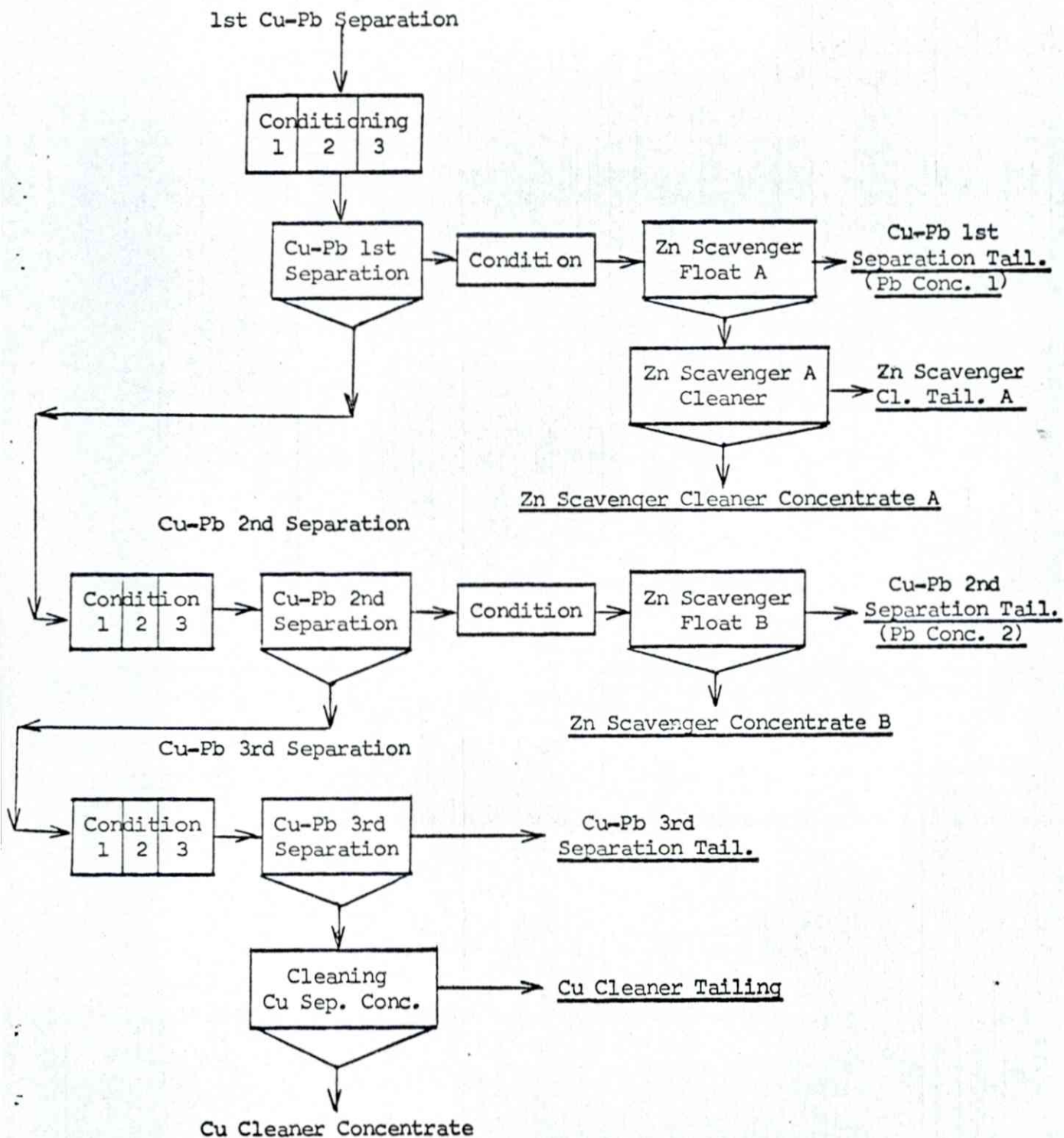
The zinc was activated by additions of CuSO_4 . Lime was added to the Cu-Pb rougher tailing as pH modifier. The zinc concentrate was recovered with collectors Z-6 and Z-200. The data on the main products from these tests are shown in table No. 1 following.

Figure No. 1

Flowsheet: a) Cu-Pb Rougher and Zinc Circuit



Flowsheet: b) Cu-Pb Separation and Pb Dezincing Circuit



Summary - Continued

3. Flotation Results

Table No. 1

Flotation Results - Selected Test Products

Test No.	Sample No.	Product	Weight %	Assays, %				% Distribution			
				Cu	Pb	Zn	Ag*	Cu	Pb	Zn	Ag
1	B	Cu Concentrate	1.75	25.1	5.96	11.0	26.31	61.3	1.9	1.0	13.1
		Pb Concentrate	7.46	1.07	52.70	16.7	20.45	11.2	71.6	6.6	43.3
		Cu-Pb Ro. Conc.	14.92	4.01	32.3	25.2	18.71	83.6	87.7	19.9	79.3
		Zn Cl. Conc.	24.32	0.21	1.51	59.7	1.68	7.1	6.7	76.5	11.6
		Comb. Zn Conc.	26.75	0.24	1.60	56.4	1.79	8.8	7.6	77.7	13.3
		Zn Ro. Conc.	28.56	0.25	3.01	55.6	2.82	10.4	15.7	83.7	22.9
		Zn Flot. Tailing	58.95	0.092	0.44	0.76	0.44	7.6	4.7	2.4	7.4
2	A	Cu Concentrate	2.10	24.9	12.8	6.06	44.50	39.6	2.7	11.6	13.2
		Pb Concentrate	7.90	0.70	72.8	3.44	29.63	4.1	58.1	0.9	33.0
		Cu-Pb Ro. Conc.	24.72	3.04	36.7	26.3	21.4	56.6	91.7	20.2	74.6
		Zn Cl. Conc.	41.61	0.24	1.18	58.8	2.45	7.5	5.0	75.7	14.4
		Comb. Zn Conc.	47.44	0.26	3.26	57.6	3.55	9.3	15.7	84.6	23.8
		Zn Ro. Conc.	-	-	-	-	-	-	-	-	-
		Zn Flot. Tailing	27.87	0.047	0.43	0.50	0.36	1.1	1.2	0.3	1.3
3	A	Cu Concentrate	4.70	23.6	5.05	14.2	30.26	83.8	2.5	2.1	20.2
		Pb Concentrate	7.92	0.28	55.10	10.8	27.40	1.7	46.3	2.6	30.9
		Cu-Pb Ro. Conc.	29.41	4.29	29.3	25.1	20.80	95.3	91.1	22.9	87.3
		Zn Concentrate	39.74	0.091	1.59	59.2	1.76	2.7	6.7	72.9	9.9
		Zn Comb. Conc.	46.50	0.11	5.24	56.6	3.64	4.0	25.8	81.5	24.0
		Zn Ro. Conc.	-	-	-	-	-	-	-	-	-
		Zn Flot. Tailing	24.87	0.033	0.34	0.43	0.34	0.6	0.9	0.3	1.2

* oz/ton

The above test results indicated that beneficiation of the Scrataas ore was possible, but that more detailed testwork would be required for improvement in the Cu-Pb separation circuit and dezincing circuit. The systematic study should begin with a thorough investigation of the Cu-Pb rougher conditions with respect to lowering the zinc content of the Cu-Pb concentrate.

The Cu-Pb separation circuit and Pb dezincing circuit should then be examined to a) improve selectivity in the Cu-Pb separation circuit, and b) improve effectiveness of zinc rejection from the lead concentrate in the dezincing circuit.

SAMPLE PREPARATION

Two bags, weighing approximately 150 pounds, were received at Lakefield on March 4, 1977 and given our Reference No. 7721251. The samples were identified as Sample A and Sample B.

Each sample was cone and roll-crushed to minus 10 mesh, and riffled into 2 kilogram charges for testwork. A sample for head analysis and mineralogical examination was also removed.

Test No. 1 - Continued

Stage	Cu-Pb & Zn Rougher	Cu-Pb 1st & 2nd Cleaner	Cu-Pb 1st Separation
Flotation Cell	1000 g D - 1	500 g D - 1	Same Cell
Speed: r.p.m.	1700	1200	-
% - 200 mesh	83.4	-	-
% - 400 mesh	54.9	-	-

Conditions:

Stage	Reagents Added, pounds per ton							Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	H-31	SO ₂	Z-200	MIIBC	DF-250	Grind	Cond.	Froth	
Zn Scav. Conc.	3.5	-	-	-	-	-	-	-	3	-	12.5
	-	0.2	-	-	-	-	-	-	5	-	-
	-	-	-	-	0.008	0.004	-	-	1	2	-
	-	-	-	-	-	-	0.004	-	1	3	-
Cu-Pb 2nd Sep.	-	-	0.10	-	-	-	-	-	5	-	6.8
	-	-	-	0.5	-	-	-	-	5	-	4.5
	-	-	-	-	0.008	-	0.004	-	3	2	-
	-	-	-	-	0.008	-	0.004	-	2	3	-
Filter and reserve separately - Cu cleaner concentrate											
Cu-Pb 1st separation tailing											
Zinc scavenger concentrate (from Cu-Pb 1st sep. tailing)											
Zinc Flotation (on Cu-Pb rougher tailing)											
Condition 1	2.0	-	-	-	-	-	-	-	2	-	11.0
Condition 2	-	2.5	-	-	-	-	-	-	5	-	9.5
						Z-6					
Zn Ro. Conc.	0.2	-	-	-	0.04	0.04	0.016	-	2	6	-
Cleaning Zn rougher concentrate.											
	2.5	-	-	-	-	-	-	-	5	3	12.4
	-	-	-	-	0.02	-	0.004	-	1	3	-

Stage	Cu-Pb 2nd Separation	Zn Cleaner
Flotation Cell	250 g D - 1	500 g D - 1
Speed: r.p.m.	1100	1300

Test No. 1 - Continued

Metallurgical Results

Product	Weight %	Assays, %					% Distribution				
		Cu	Pb	Zn	Au*	Ag*	Cu	Pb	Zn	Au	Ag
1. Cu Cl. Conc.	1.39	25.9	3.62	12.0	0.210	22.35	50.3	0.9	0.9	10.5	8.8
2. Cu-Pb 2nd Sep. Tail.	0.36	21.8	15.0	7.15	0.262	41.59	11.0	1.0	0.1	3.4	4.3
3. Pb Conc.	7.46	1.07	52.7	16.7	0.010	20.45	11.2	71.6	6.6	2.7	43.3
4. Cu-Pb 2nd Cl. Tail.	1.51	1.87	9.24	45.9	0.300	12.10	4.0	2.5	3.7	16.2	5.2
5. Cu-Pb 1st Cl. Tail.	1.77	2.22	11.1	28.1	0.349	16.13	5.5	3.6	2.6	22.2	8.1
6. Zn Conc.No. 2 (from Pb Conc.)	2.43	0.48	18.2	46.8	0.510	13.90	1.6	8.1	6.0	44.4	9.6
7. Zn Cl. Conc.	24.32	0.21	1.51	59.7	<0.005	1.68	7.1	6.7	76.5	-	11.6
8. Zn Cl. Tail.	1.81	0.69	2.79	12.6	0.010	3.21	1.7	0.9	1.2	0.6	1.7
9. Zn Flot. Tail.	58.95	0.092	0.44	0.76	<0.005	0.445	7.6	4.7	2.4	-	7.4
Head (Calc.)	100.00	0.72	5.49	19.0	0.028	3.52	100.0	100.0	100.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 + 2	1.75	25.1	5.96	11.0	0.221	26.31	61.3	1.9	1.0	13.9	13.1
Products 1 - 3	9.21	5.63	43.8	15.6	0.050	21.56	72.5	73.5	7.6	16.6	56.4
Products 1-3+6	11.64	4.55	38.5	22.1	0.146	19.96	74.1	81.6	13.6	61.0	66.0
Products 1-4+6	13.15	4.25	35.1	24.9	0.164	19.06	78.1	84.1	17.3	77.2	71.2
Products 1-4,5,6	14.92	4.01	32.3	25.2	0.186	18.71	83.6	87.7	19.9	99.4	79.3
Products 6 + 7	26.75	0.23	3.03	58.5	0.046	2.790	8.7	14.8	82.5	44.4	21.2
Products 7 + 8	26.13	0.24	1.60	56.4	0.001	1.786	8.8	7.6	77.7	0.6	13.3
Products 6 - 8	28.56	0.26	3.01	55.6	0.044	2.817	10.4	15.7	83.7	45.0	22.9
Products 1 - 8	41.05	1.61	12.75	45.1	0.068	7.938	92.4	95.3	97.6	100.0	92.6

* oz/ton

Test No. 1 - Continued

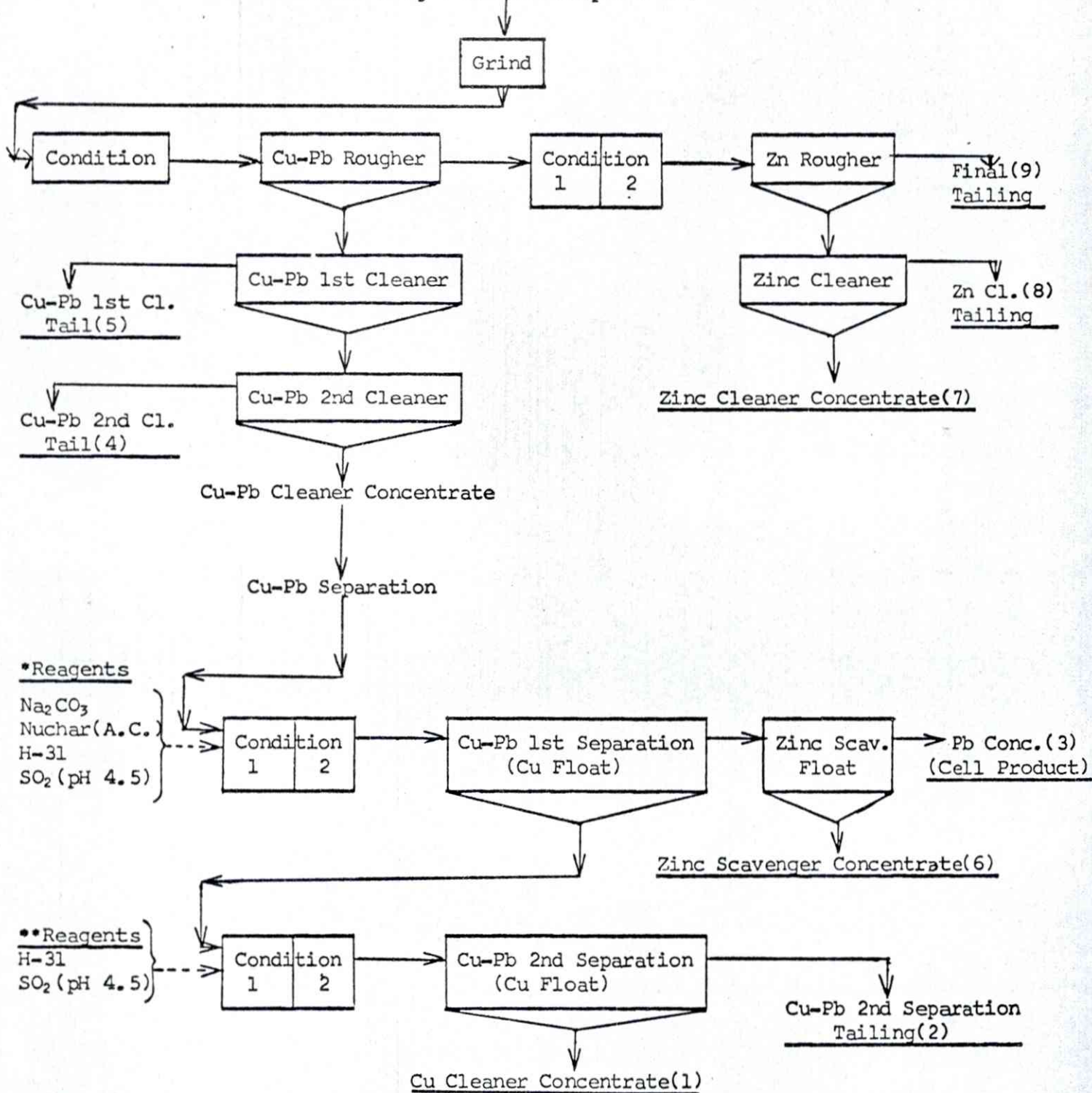
Screen Analysis

Flotation Feed

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 100	1.0	1.0	99.0
150	3.7	4.7	95.3
200	11.9	16.6	83.4
270	13.0	29.6	70.4
400	15.5	45.1	54.9
- 400	54.9	100.0	-
Total	100.0	-	-

Flowsheet

Feed: 2 Kg - 10 mesh Sample B ore



Note: * Reagents added to Cu-Pb 1st separation in 2 stages

** Reagents added to Cu-Pb 2nd Separation in 2 stages

(1)-(9) - Products numbered as on Metallurgical Balance Sheet.

Test No. 2

Purpose: A preliminary flotation test on the high grade A sample, in order to study the flotation response.

Procedure: As for test No. 1 except as noted.

Feed: 2000 grams minus 10 mesh sample A ore.

Grind: 20 minutes at 65 percent solids in a laboratory ball mill (g).

Conditions:

Stage	Reagents Added, pounds per ton							Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	KCN	CuSO ₄	Z-11	R-241	MIIBC	Grind	Cond.	Froth	
Grind	3.0	3.0	0.08	-	-	-	-	20	-	-	8.2
Cu-Pb Flot.	0.5	-	-	-	-	-	-	-	3	-	9.4
Cu-Pb Ro. Conc. 1	-	-	-	-	0.01	0.02	0.02	-	1	5	-
Cu-Pb Ro. Conc. 2	-	-	-	-	0.005	0.005	0.004	-	1	4	-
Cu-Pb Ro. Conc. 3	-	-	-	-	0.003	0.005	0.004	-	5	3	-
				Z-200							
Cu-Pb Scav. Conc.	-	-	-	0.008	0.005	-	0.004	-	10	3	-
Combine Cu-Pb concentrates 1 - 3 for cleaning prior to Cu-Pb separation.											
Cu-Pb 1st Cl.	0.3	0.3	0.02	-	-	-	-	-	5	-	8.8
	-	-	-	-	0.002	-	0.004	-	1	4	-
	-	-	-	-	0.002	0.002	0.004	-	1	2	-
				ZnSO ₄ / NaCN							
Cu-Pb 2nd Cl.	0.2	0.3	-	-	-	-	0.004	-	5	4	9.0
	-	-	-	-	0.002	0.002	0.004	-	1	-	-
	0.3	0.4	-	0.10	-	-	0.004	-	5	2	-
	-	-	-	-	0.002	0.002	0.004	-	1	3	-
Copper-Lead Separation		Nuchar	H-31	SO ₂	Z-200						
Cu-Pb 1st Sep.	0.5	0.3	-	-	-	-	-	-	5	-	10.7
	-	-	0.3	-	-	-	-	-	5	-	-
	-	-	-	1.6	-	-	-	-	2	-	4.3-
	-	-	-	0.6	-	-	-	-	3	-	6.0
	-	-	-	-	0.008	-	0.004	-	5	4	4.0
	-	-	-	-	0.004	-	0.004	-	3	3	5.6
	-	-	-	-	0.004	-	0.004	-	3	3	-

* High speed 1800 RPM conditionign and extra collector before Zn Ro. Flot. to recover Cu

Test No. 2 - Continued

Conditions:

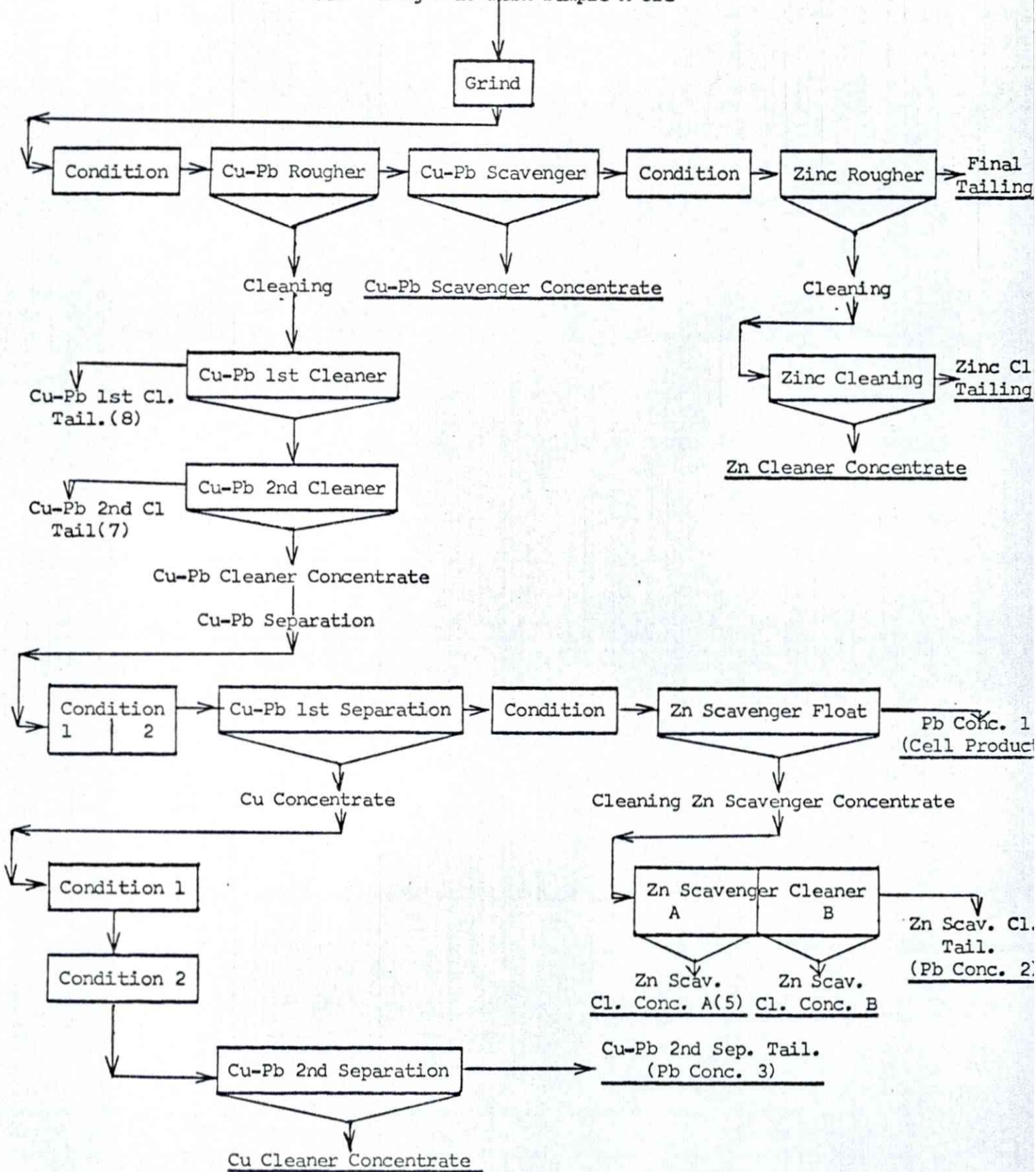
Stage	Cu-Pb & Zn Rougher	Cu-Pb 1st & 2nd Cleaner	Cu-Pb Separation
Flotation Cell	1000 g D - 1	500 g D - 1	500 g D - 1
Speed: r.p.m.	1700	1300	1300
% - 200 mesh	89.7	-	-
% - 400 mesh	65.9	-	-

Stage	Reagents Added, pounds per ton								Time, minutes		pH
	Ca(OH) ₂	CuSO ₄	H-31	SO ₂	Z-200	Z - 6	MIBC	DF-250	Cond.	Froth	
Zn Scav. Conc.	1.8	-	-	-	-	-	-	-	3	-	12.
	-	0.3	-	-	-	-	-	-	5	-	12.
	-	-	-	-	0.008	-	0.004	0.004	1	½	-
	-	-	-	-	0.004	0.005	-	0.004	1	5	-
Filter and reserve Zn scavenger tailing as Pb cleaner concentrate.											
Clean zinc scavenger concentrate (once)											
(0.1 lb Nuchar)	0.2	-	-	-	-	-	-	-	5	-	12.
	-	-	0.10	-	-	-	-	-	5	-	-
	-	0.2	-	-	0.004	-	-	0.004	5	-	-
Zn Scav. Cl. Conc. A	-	-	-	-	0.004	0.002	-	0.004	3	5	-
Zn Scav. Cl. Conc. B	-	-	-	-	0.004	0.002	-	-	3	4	-
Save Zn Scavenger Cleaner concentrate A & B separately.											
Filter Zn scavenger tailing as Pb concentrate.											
Cu-Pb 2nd Sep.	-	-	0.10	-	-	-	-	-	5	-	-
	-	-	-	0.20	0.008	-	0.004	-	5	3	-
	-	-	-	-	0.004	0.002	0.004	-	2	2	-
Zinc rougher flotation (on Cu-Pb scavenger tailing)											
Condition	0.8	-	-	-	-	-	-	-	3	-	11.4
	-	3.0	-	-	-	-	-	-	5	-	-
Zn Ro. Conc. 1	1.0	-	-	-	0.06	0.03	0.02	-	2	3	10.5
Zn Ro. Conc. 2	-	-	-	-	0.04	0.02	-	0.02	1	5	-
Zn Ro. Conc. 3	-	0.3	-	-	-	-	-	-	3	-	-
	-	-	-	-	0.004	0.005	-	0.008	1	3	-
Zn Ro. Conc. 4	-	-	-	-	-	0.005	-	0.004	1	2	-
Combine Zn rougher concentrates 1 - 4 for cleaning.											
Zn Cleaner	0.4	-	-	-	-	-	-	-	3	-	11.4
	-	-	-	-	0.004	-	-	0.004	1	10	-
	-	-	-	-	0.004	-	-	0.004	1	2	-

Stage	Zn Rougher	Zn Cleaner
Flotation Cell	1000 g D - 1	Same Cell
Speed: r.p.m.	1700	-

Flowsheet

Feed: 2 Kg - 10 mesh Sample A ore



Test No. 2 - Continued

Metallurgical Results

Product	Weight %	Assays, %					% Distribution				
		Cu	Pb	Zn	Au*	Ag*	Cu	Pb	Zn	Au	Ag
*1. Cu Cl. Conc.	1.86	28.0	6.45	5.54	0.050	42.75	39.3	1.2	0.3	10.3	11.2
2. Pb Conc. 1	4.85	0.67	71.0	3.41	<0.005	28.08	2.4	34.8	0.5	2.8	19.2
3. Pb Conc. 2 (Zn Scav. Cl. Tail.)	2.80	0.65	77.0	2.85	0.010	29.85	1.4	21.8	0.3	3.1	11.8
*4. Pb Conc. 3 (2nd Cu-Pb Sep. Tail.)	0.25	1.85	60.3	10.6	0.048	57.11	0.3	1.5	0.1	1.3	2.0
5. Zn Scav. Cl. Conc. A	5.83	0.41	18.1	49.3	0.070	11.40	1.8	10.7	8.9	45.4	9.4
6. Zn Scav. Cl. Conc. B	3.83	0.96	30.6	36.4	0.020	17.65	2.8	11.8	4.3	8.6	9.5
7. Cu-Pb 2nd Cl. Tail.	3.66	2.19	17.7	38.6	0.020	14.28	6.0	6.5	4.4	8.1	7.4
8. Cu-Pb 1st Cl. Tail.	1.64	2.12	20.1	27.2	-	17.65	2.6	3.3	1.4	-	4.1
9. Cu-Pb Scav. Concentrate	3.13	14.4	4.59	25.4	0.010	19.07	34.0	1.5	2.4	3.4	8.4
10. Zn Cl. Conc.	41.61	0.24	1.18	58.8	-	2.45	7.5	5.0	75.7	-	14.4
11. Zn Cl. Tail.	2.67	0.42	2.55	15.8	<0.005	3.46	0.8	0.7	1.3	1.5	1.3
12. Final Tail.	27.87	0.047	0.43	0.50	<0.005	0.36	1.1	1.2	0.3	15.5	1.3
Head (Calc.)	100.00	1.33	9.90	32.32	0.009	7.10	100.0	100.0	100.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 + 4	2.11	24.9	12.8	6.06	0.050	44.50	39.6	2.7	0.4	11.6	13.2
Products 5 + 6	9.66	0.63	23.1	44.2	0.050	13.88	4.6	22.5	13.2	54.0	18.9
Products 3,5,6	12.46	0.63	18.0	34.9	0.040	17.47	6.0	44.3	13.5	57.1	30.7
Products 1 - 6	19.42	3.28	41.7	23.9	0.033	23.05	48.0	81.8	14.4	71.5	63.1
Products 1 - 7	23.07	3.11	37.9	26.2	0.031	21.67	54.0	88.3	18.8	79.6	70.5
Products 1 - 8	24.72	3.04	36.7	26.3	0.029	21.40	56.6	91.7	20.2	79.6	74.6
Products 1 - 9	27.85	4.32	33.1	26.2	0.027	21.13	90.6	93.2	22.6	83.1	83.0
Products 2 + 3	7.65	0.66	73.2	3.21	0.007	28.73	3.8	56.6	0.8	5.9	31.0
Products 2 - 4	7.90	0.70	72.8	3.44	0.008	29.63	4.1	58.1	0.9	7.2	33.0
Products 5 + 10	47.44	0.26	3.25	57.6	0.009	3.55	9.3	15.7	84.6	45.4	23.8
Products 5,6,10	51.27	0.31	5.30	56.0	0.009	4.60	12.1	27.5	88.9	54.0	33.3
Products 10 + 11	44.28	0.25	1.26	55.3	-	2.51	8.3	5.7	77.0	1.5	15.7
Products 3,5,6, 10,11,	56.74	0.38	8.71	50.8	0.009	5.80	14.3	71.8	90.5	58.6	46.4
Products 2,3,5,6	17.31	0.64	38.4	26.1	0.031	20.4	8.4	79.1	14.0	59.9	49.9
Products 1 - 11	72.13	1.82	13.6	44.6	0.011	9.70	98.9	98.8	99.7	84.5	98.7

* oz/ton

Test No. 2 - Continued

Screen Analysis

Flotation Feed

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	0.1	0.1	99.9
100	0.7	0.8	99.2
150	2.2	3.0	97.0
200	7.3	10.3	89.7
270	9.8	20.1	79.9
400	14.0	34.1	65.9
- 400	65.9	100.0	-
Total	100.0	-	-

[illegible]

Test No. 3 - Continued

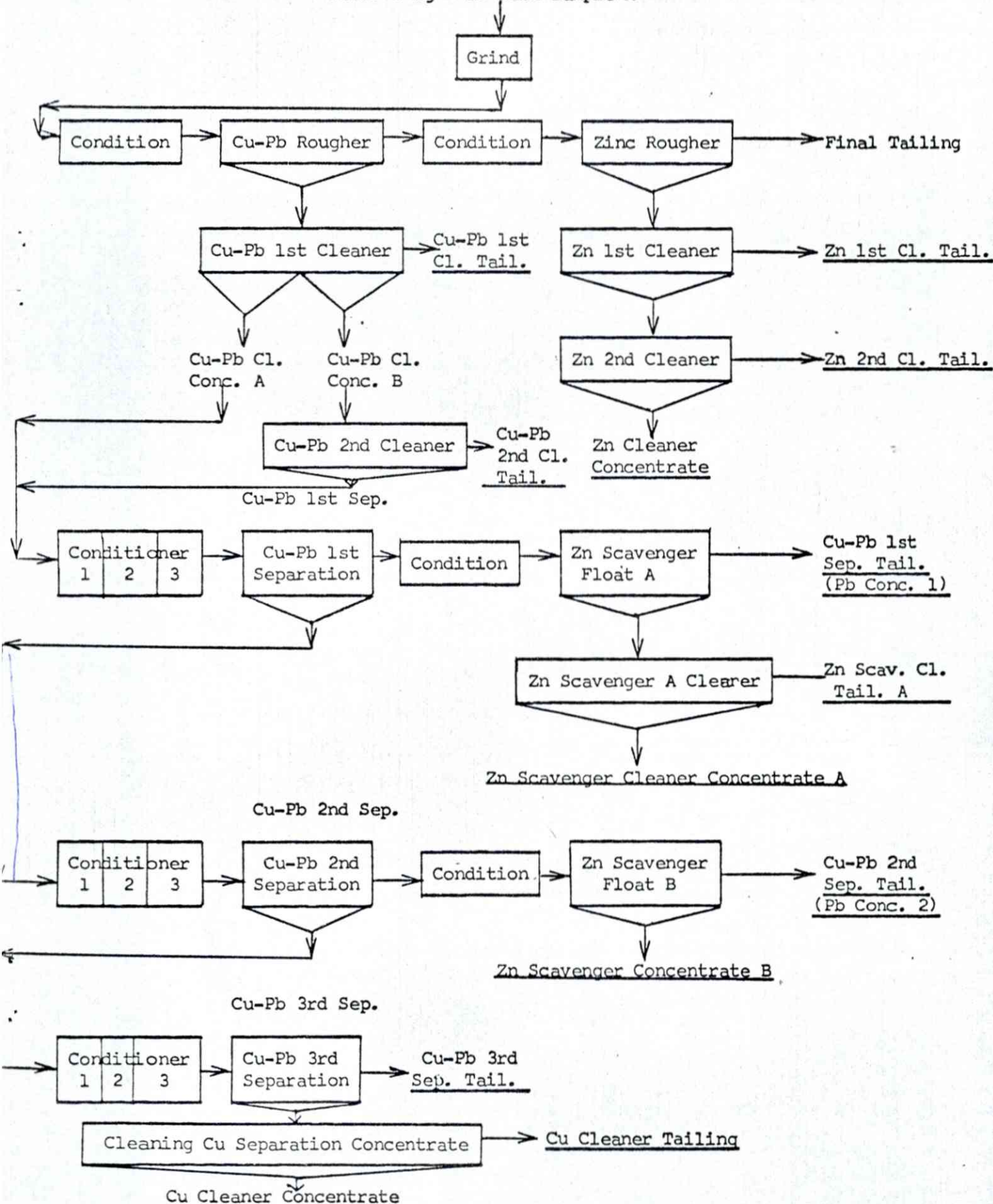
Conditions:

Stage	Reagents Added, pounds per ton								Time, minutes		pH
	Ca(OH) ₂	CuSO ₄	H-31	SO ₂	Z-200	Z-6	DF-250	MIBC	Cond.	Froth	
Zn Scav. Conc. B	1.0	-	-	-	-	-	-	-	3	-	12.2
	-	0.2	-	-	-	-	-	-	5	-	-
	-	-	-	-	0.004	-	0.004	-	1	1	-
	-	-	-	-	0.004	0.002	0.001	-	1	3	-
Cu-Pb 3rd Sep.	Na ₂ CO ₃	Nuchar									
	0.5	0.2	-	-	-	-	-	-	5	-	-
	-	-	0.05	-	-	-	-	-	5	-	-
	-	-	-	0.40	0.004	-	-	0.004	3	4	5.5
	-	-	-	-	0.004	0.002	-	0.004	1	3	-
Cleaning Cu Float concentrate from Cu-Pb 3rd Separation (once)											
	0.2	-	-	-	-	-	-	-	3	4	12.5
	-	-	-	-	-	0.002	-	0.004	1	-	-

Stage	Cu-Pb & Zn Rougher	Zn 1st & 2nd Cleaner
Flotation Cell	1000 g D - 1	Same Cell
Speed: r.p.m.	1700	-

Stage	Cu-Pb Cleaners
Flotation Cell	500 g D - 1
Speed: r.p.m.	1300

Feed: 2 Kg - 10 mesh sample A



Test No. 3 - Continued

Metallurgical Results

Product	Weight %	Assays, %					% Distribution				
		Cu	Pb	Zn	Au*	Ag*	Cu	Pb	Zn	Au	Ag
1. Cu Cl. Conc.	4.70	23.6	5.05	14.2	0.120	30.26	83.8	2.5	2.1	42.9	20.2
2. Cu Cl. Tail.	1.65	4.29	9.27	28.7	0.030	19.97	5.4	1.6	1.4	3.8	4.7
3. Cu-Pb 3rd Sep. Tail.	0.62	1.28	25.3	10.1	0.016	24.12	0.8	1.7	0.2	0.7	2.1
4. Pb Conc. 2 (2nd Cu-Pb Sep. Tail.)	1.93	0.25	26.7	19.0	0.020	31.75	0.4	5.5	1.1	3.0	8.7
5. Zn Scav. Conc. B(ex 2nd Sep. Tail.)	0.86	0.59	49.3	19.5	0.020	30.75	0.4	4.5	0.5	1.3	3.8
6. Zn Scav. Cl. Conc. A(ex 1st Sep. Tail.)	6.76	0.25	26.7	41.3	0.020	14.70	1.3	19.1	8.6	10.3	14.1
7. Zn Scav. Cl. Tail. A(ex 1st Sep. Tail.)	4.03	0.30	35.9	33.0	<0.005	15.41	0.9	15.3	4.1	1.5	8.8
8. Pb Conc. 1 (1st Cu-Pb Sep. Tail.)	5.13	0.24	66.8	6.29	0.020	25.20	0.9	36.3	1.0	7.8	18.4
9. Cu-Pb 2nd Cl. Tail.	1.32	0.54	12.4	32.7	0.010	13.01	0.5	1.7	1.3	1.0	2.4
10. Cu-Pb 1st Cl. Tail.	2.40	0.47	11.5	32.4	<0.005	11.33	0.9	2.9	2.4	0.9	3.9
11. Zn Cl. Conc.	39.74	0.091	1.59	59.2	<0.005	1.76	2.7	6.7	72.9	15.1	9.9
12. Zn 2nd Cl. Tail.	2.56	0.41	2.49	30.1	<0.005	2.40	0.8	0.7	2.4	1.0	0.9
13. Zn 1st Cl. Tail.	3.42	0.22	1.68	13.6	<0.005	1.45	0.6	0.6	1.4	1.3	0.7
14. Final Tail.	24.87	0.033	0.34	0.43	<0.005	0.34	0.6	0.9	0.3	9.4	1.2
Head (Calc.)	100.00	1.32	9.44	32.3	0.013	7.02	100.0	100.0	100.0	100.0	100.0

* oz/ton

Test No. 3 - Continued

Metallurgical Results

Calculated Grades and Recoveries

Product	Weight	Assays, %					% Distribution				
	%	Cu	Pb	Zn	Au*	Ag*	Cu	Pb	Zn	Au	Ag
Product 1 + 2	6.35	18.6	6.15	18.0	0.097	27.59	89.2	4.1	3.5	46.7	24.9
Products 1 - 3	6.97	17.1	7.85	17.3	0.090	27.28	90.0	5.8	3.7	47.4	27.1
Products 1 - 5	9.76	12.3	15.2	17.8	0.070	28.5	90.8	15.7	5.4	51.7	39.6
Products 4 + 5	2.79	0.36	33.7	19.2	0.020	31.4	0.8	10.0	1.6	4.3	12.5
Products 6 + 7	10.79	0.27	30.1	38.2	0.014	15.0	2.2	34.4	12.7	11.8	22.9
Products 6 - 8	15.92	0.26	42.0	27.9	0.016	18.3	3.1	70.7	13.7	19.6	41.3
Products 1 - 8	25.69	4.84	31.8	24.1	0.037	22.1	93.9	86.5	19.2	71.3	80.9
Products 4, 5, 8	7.92	0.28	55.1	10.8	0.020	27.4	1.7	46.3	2.6	12.1	30.9
Products 4, 5, 7, 8	11.95	0.29	48.6	18.3	0.015	23.4	2.6	61.6	6.7	13.6	39.7
Products 1 - 9	27.01	4.62	30.8	24.5	0.035	21.7	94.4	88.2	20.5	72.3	83.3
Products 1 - 10	29.41	4.29	29.3	25.1	0.033	20.8	95.3	91.1	22.9	73.2	87.3
Products 1 - 13	75.13	1.75	12.5	42.8	0.016	9.24	99.4	99.1	99.7	90.6	98.8
Products 11 + 12	42.30	0.11	1.64	57.4	0.005	1.80	3.5	7.4	75.3	16.1	10.8
Products 6 + 11	46.50	0.11	5.24	56.6	0.007	3.64	4.0	25.8	81.5	25.4	24.0
Products 11 - 13	45.72	0.12	1.65	54.2	0.005	1.77	4.1	8.0	76.7	17.4	11.5
Products 6+7, 11-13	56.51	0.15	7.09	51.1	0.007	4.29	6.3	42.4	78.3	29.2	34.4

* oz/ton

APPENDIX

Mineralogy

Mineralogy

The two Skrataas Project samples were identified as (A) a high-grade and (B) low-grade zinc sample respectively.

The mineralogy with respect to the mineral species present, and the mineral associations were similar for both samples. The average particle size of the minerals in the low-grade sample was smaller than that of the similar minerals in the high-grade sample.

The minerals present in both samples were sphalerite, pyrite, chalcopyrite, galena, non-opaque gangue and a trace of bornite. In general more than 70 percent of the sphalerite in both samples was liberated. Non-liberated sphalerite was present as middlings associated with galena, or pyrite, or gangue, and rarely with chalcopyrite or combinations of two or more of these minerals.

The most common occurrences of galena were as attachments or inclusions associated with sphalerite, and for chalcopyrite as liberated particles and as attachments or inclusions associated with pyrite.

The grain sizes are shown below as the maximum observed grain size, and the average grain size of approximately 60 to 70 percent of each mineral in each sample.

Mineral	Grain Size (μm)			
	High Grade		Low Grade	
	Max.	Avg.	Max.	Avg.
Sphalerite	84	35	77	20
Chalcopyrite	35	20	119	15
Galena	35	15	35	10
Pyrite	77	45	105	40
Gangue	70	50		

The results of the examination indicated that neither sample should present insoluble problems in beneficiation.