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An Investigation of

THE RECOVERY OF LEAD AND ZINC

from a Grum Deposit Sample PPC

submitted by

NORANDA MINES LIMITED

Progress Report No. 5

Project No. L.R. 1868-B

Note:

This report refers to the samples as received.

LAKEFIELD RESEARCH OF CANADA LIMITED
Lakefield, Ontario
November 22, 1976

INTRODUCTION

This report contains the results of bench-scale testwork carried out on Sample PPC from the Grum deposit, submitted by Noranda Mines Limited.

Preliminary flotation tests on this sample indicated that the response of this sample to the developed standard flotation conditions was less satisfactory than that of Sample PPB, with lower Pb concentrate grades and recoveries. Further testwork was then conducted to investigate the effects of finer regrinding and reagent changes on the grade and recovery of lead.

The results of the testwork were frequently discussed in meetings and telephone conversations with Mr. P. Godbehere of Noranda Mines Limited, and Mr. E. Kirkpatrick of Kerr Addison Mines Limited.

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S U M M A R Y

1. Head Sample Assays

Sample PPC

Lead	Pb	-	6.94 %, 6.64 %*
Zinc	Zn	-	10.3 %, 10.0 %*
Oxide Lead	Pb ox.	-	1.59 %
Oxide Zinc	Zn ox.	-	0.39 %
Copper	Cu	-	0.19 %
Gold	Au	-	0.025 oz/ton
Silver	Ag	-	4.18 oz/ton

* Average head assay as calculated from test results

2. Preliminary Testwork

Two preliminary flotation tests were conducted on Sample PPC to compare its response with that of Samples PPA and PPB. The results and conditions of these tests, along with those of tests on Samples PPA and PPB are shown on the next page in Table 1.

Summary - Continued

Table 1 - Comparison of Samples

Test No.	Sample	Primary Grind, Min.	Regr.* Min.	Product	Weight %	Assays, %		% Dist.	
						Pb	Zn	Pb	Zn
32	A	30	30	Pb 4th Cl. Conc.	10.18	65.8	6.40	34.1	9.4
				Pb Rougher Tail.	65.16	0.60	5.31	4.9	50.2
22	B	40	30	Pb 4th Cl. Conc.	6.03	55.1	14.5	51.2	8.3
				Pb Rougher Tail.	56.48	0.74	6.7	6.4	36.5
72	B	60	60+30	Pb 5th Cl. Conc.	7.18	65.3	10.3	70.2	7.1
				Pb Rougher Tail.	58.40	0.77	6.82	6.7	33.1
78	C	40	40	Pb 4th Cl. Conc.	6.83	51.4	13.3	52.6	9.1
				Pb Rougher Tail.	68.24	2.11	7.08	21.5	48.5
79	C	60	60+30	Pb 5th Cl. Conc.	6.09	60.3	10.3	56.7	6.4
				Pb Rougher Tail.	61.67	0.94	7.02	9.0	44.0

* Rod Mill

The Pb grade-recovery curves for these tests are shown in Figure 1.

The response of Sample PPC to the applied flotation conditions was poorer than that of Sample PPB, with lower lead recoveries. Zn contents of the lead concentrates were similar.

Further testwork was conducted on Sample PPC to investigate the effect of finer regrinding, and various amounts and points of depressant additions.

3. Effect of Fineness of Regrind

Tests were conducted to investigate the effect of finer regrinding on the grade and recovery of lead. The results and conditions of this testwork are summarized in Table 2 on page 6.

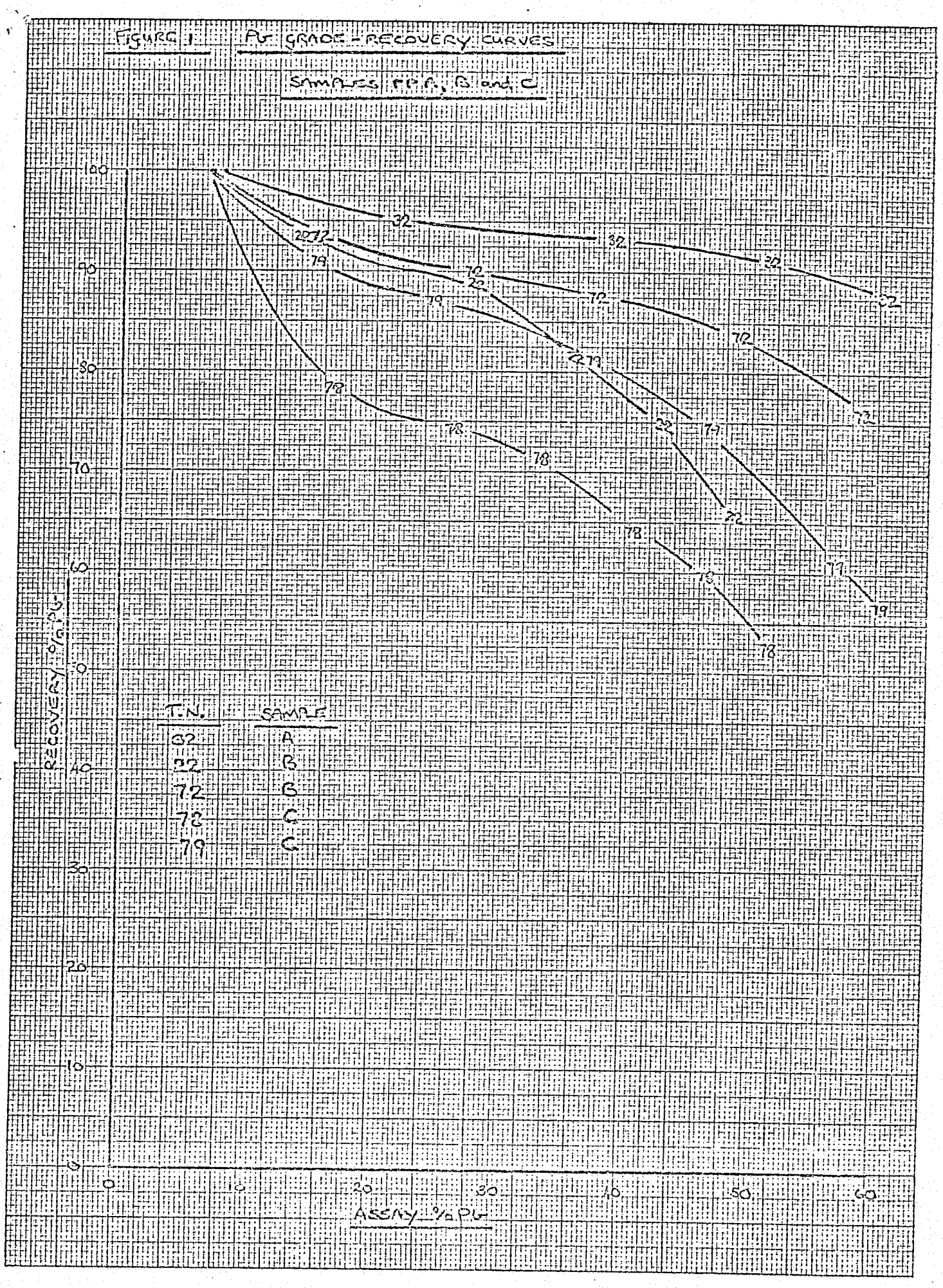


FIGURE 1
PG GRADE - RECOVERY CURVES
SAMPLES A, B and C
RECOVERY - % PG
ASSAY - % PG
T.N.
SAMPLE
82 A
82 B
72 B
73 C
79 C
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
50
60

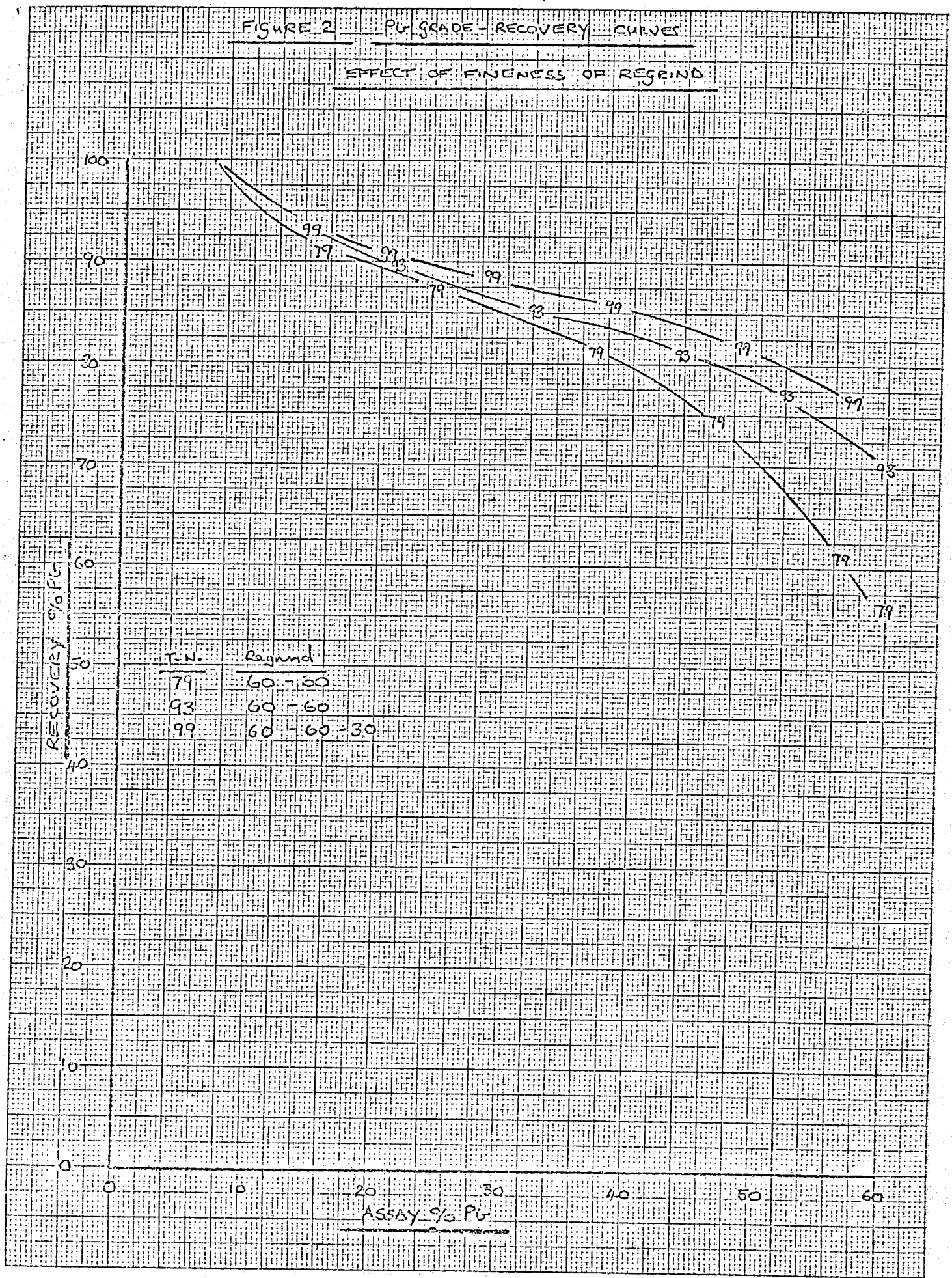


FIGURE 2 Pb GRADE - RECOVERY CURVES
EFFECT OF FINENESS OF REGRIND
RECOVERY % Pb
ASSAY % Pb
T.N. Regrind
79 60 - 50
93 60 - 60
99 60 - 60 - 30
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
50
60
99
79
93

Summary - Continued

Table 2 - Effect of Fineness of Regrind

Test No.	Regrind Time*			Product	Weight %	Assays,%		% Dist.	
	1st	2nd	3rd			Pb	Zn	Pb	Zn
79	60	30	-	Pb 5th Cleaner Conc.	6.09	60.3	10.3	56.7	6.4
93	60	60	-	Pb 5th Cleaner Conc.	7.80	60.1	10.1	70.2	8.2
99	60	60	30	Pb 5th Cleaner Conc.	8.98	57.4	11.0	76.8	10.1

* Rod Mill

The lead grade-recovery curves for these tests are shown in Figure 2.

Finer regrinding resulted in higher lead recoveries during the cleaner flotation. Selectivity towards zinc was not improved by finer regrinding.

4. Investigation of Reagent Changes

A series of tests were conducted to investigate the effect of various reagent addition points on the grade and recovery of lead, after both rod mill and ball mill regrinding. This work was conducted in an attempt to improve the results after ball mill grinding. Previous testwork on Samples A and B had revealed a distinct difference in the metallurgical results after rod and ball regrinding.

On Sample A the screen analyses of the regrind mill discharge were similar, and the reason for the differences in metallurgical response was considered to be caused by the additional abraded iron in the pulp or by different oxygen conditions.

Summary - Continued

On Sample B with which finer regrinds were required, it was noted that the ball mill regrinds for a similar power input were not as efficient as rod mill regrinds, and in the tests with ball mill regrinding the feed to the cleaner flotation was coarser.

In test 82, the fineness of regrind by rod milling and ball milling were compared. The rougher concentrate was divided in two, and reground in the rod and in the ball mills:

Regrind Mill Discharge

	% Minus 8.9 Microns	% Minus 16.8 Microns
Rod Mill	71.3	95.5
Ball Mill	58.1	85.0

A series of tests were also conducted in which the order of addition of reagents to the regrind to 1st cleaner flotation were investigated. The concentrates after regrinding were then cleaned once or twice and the results were compared. The results and conditions of these tests are summarized in Tables 3 and 4, and the grade-recovery curves are shown in Figures 3 and 4.

Summary - Continued

Table 3 - Flotation Conditions

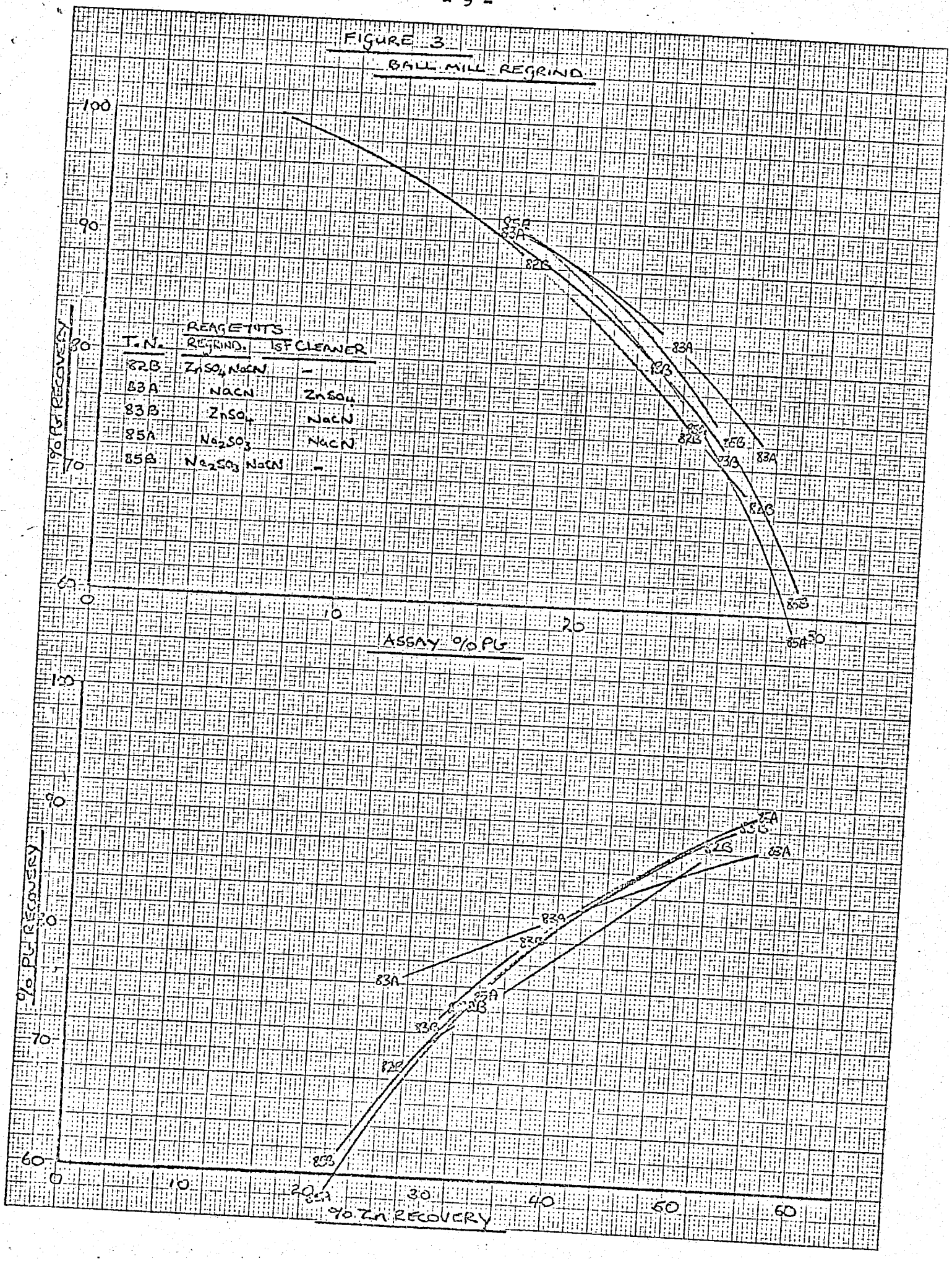
Test No.	Regrind Mill	Regrind, lb/ton				1st Cleaner, lb/ton			
		Na_2CO_3	$ZnSO_4$	NaCN	Na_2SO_3	Na_2CO_3	$ZnSO_4$	NaCN	Na_2SO_3
82-A	Rod	1.0	0.5	0.20	-	-	-	-	-
82-B	Ball	1.0	0.5	0.20	-	-	-	-	-
83-A	Ball	1.0	-	0.20	-	-	0.50	-	-
83-B	Ball	1.0	0.5	-	-	-	-	0.20	-
84-A	Rod	1.0	-	0.20	-	-	0.50	-	-
84-B	Rod	1.0	0.5	-	-	-	-	0.20	-
85-A	Ball	1.0	-	-	1.0	-	-	0.20	-
85-B	Ball	1.0	-	0.20	1.0	-	-	-	-
86-A	Rod	1.0	-	-	1.0	-	-	0.20	-
86-B	Rod	1.0	-	0.20	1.0	-	-	-	-

Table 4 - Flotation Results

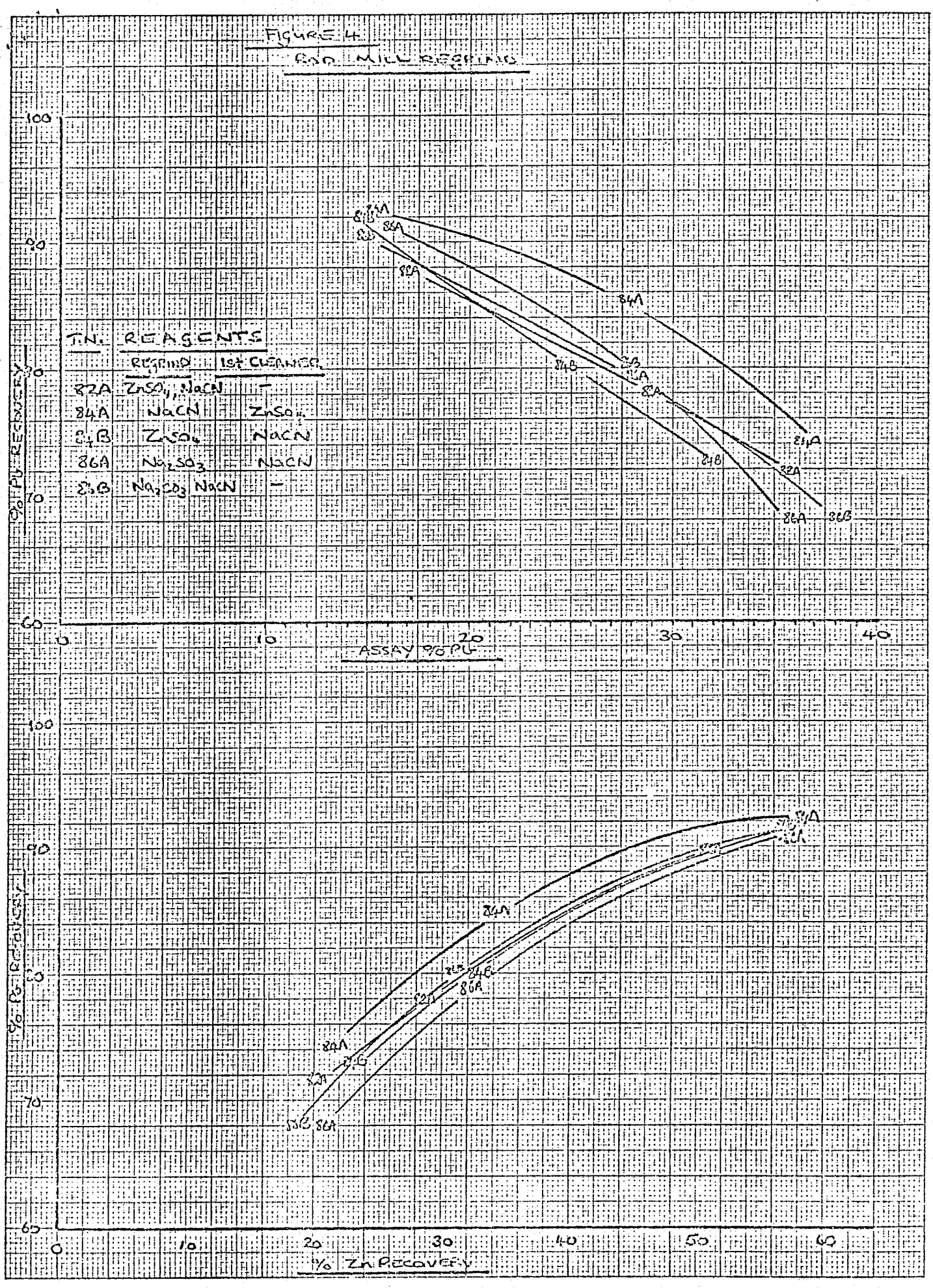
Test No.	Product	Weight %	Assays, %		% Dist.	
			Pb	Zn	Pb	Zn
82-A	Pb 1st Cleaner Concentrate	17.85	28.9	16.0	78.1	28.4
82-B	Pb 1st Cleaner Concentrate	21.07	24.3	16.2	74.4	33.1
83-A	Pb 1st Cleaner Concentrate	22.84	23.8	18.3	82.1	39.3
83-B	Pb 1st Cleaner Concentrate	23.32	22.8	16.5	80.1	37.8
84-A	Pb 1st Cleaner Concentrate	20.64	27.7	16.5	85.5	33.8
84-B	Pb 1st Cleaner Concentrate	20.74	24.6	15.4	80.3	32.5
85-A	Pb 1st Cleaner Concentrate	20.21	24.4	17.1	74.5	33.6
85-B	Pb 1st Cleaner Concentrate	19.93	26.0	16.4	74.2	31.9
86-A	Pb 1st Cleaner Concentrate	19.11	28.0	16.5	79.6	32.2
86-B	Pb 1st Cleaner Concentrate	18.45	27.6	16.1	80.3	31.0

FIGURE 3

BALL MILL REGRIND



T.N.	REAGENTS Regrind.	1st Cleaner
82B	$ZnSO_4$ NaCN	-
83A	NaCN	$ZnSO_4$
83B	$ZnSO_4$	NaCN
85A	Na_2SO_3	NaCN
85B	Na_2SO_3 NaCN	-



Summary - Continued

Slight improvements in lead recovery, and selectivity towards sphalerite resulted when the $ZnSO_4$ was added to the conditioner after the regrind instead of to the regrind. The other reagent changes investigated had little effect.

Further tests were also conducted in which the addition of SO_2 to the regrind was investigated. Both lead grades and recoveries were low in these tests.

Replacing Na_2CO_3 with $Ca(OH)_2$ in the lead cleaner flotation in Test 101 also resulted in a low-grade concentrate.

5. Grinding and Power Requirements

The grinding conditions used in Test 99 were:

Primary Grind: 60 minutes per 2000 grams at 65 percent solids in the laboratory ball mill. Power consumption 18.66 kWh/ton.

Pb 1st Regrind: 60 minutes at 50 percent solids in the laboratory rod mill Power consumption 32.4 kWh/ton rougher concentrate, 13.9 kWh/ton ore.

Pb 2nd Regrind: 60 minutes at 50 percent solids in the laboratory rod mill. Power consumption 47.3 kWh/ton 1st cleaner concentrate, 13.9 kWh/ton ore.

Pb 3rd Regrind: 30 minutes at 50 percent solids in the laboratory rod mill. Power consumption 33.8 kWh/ton 2nd cleaner concentrate, 7.0 kWh/ton ore.

Summary - Continued

The screen analyses of the primary grind and of the regrind mill discharges were:

Table 5 - 60 Minute Primary Grind Screen Analysis

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 150	0.1	0.1	99.9
200	1.0	1.1	98.9
270	2.1	3.2	96.8
400	7.2	10.4	89.6
- 400	89.6	100.0	-
Total	100.0	-	-

Table 6 - Test 99 Regrind Mill Discharges

1st Regrind				2nd Regrind				3rd Regrind			
Size µm	% Retained Ind.	% Retained Cum.	% Pass. Cum.	Size µm	% Retained Ind.	% Retained Cum.	% Pass. Cum.	Size µm	% Retained Ind.	% Retained Cum.	% Pass. Cum.
+31.1	0.8	0.8	99.2	+30.3	0.6	0.6	98.4	+29.7	1.3	1.3	98.7
24.1	0.9	1.7	98.3	23.5	1.0	1.6	98.4	23.0	1.5	2.8	97.2
16.8	2.8	4.5	95.5	16.4	2.4	4.0	96.0	16.1	1.9	4.7	95.3
11.6	10.8	15.3	84.7	11.3	8.6	12.6	87.4	11.0	2.5	7.2	92.8
8.9	13.4	28.7	71.3	8.7	13.4	26.0	74.0	8.5	6.6	13.8	86.2
- 8.9	71.3	-	-	- 8.7	74.0	-	-	- 8.5	86.2	-	-
Total	100.0	-	-	Total	100.0	-	-	Total	100.0	-	-
Specific Gravity 4.82				Specific Gravity 4.94				Specific Gravity 5.16			

SAMPLE PREPARATION

Two pails of ore sample weighing approximately 250 pounds were received at Lakefield on January 20, 1976, and given our Reference No. 7620900. The sample was designated Sample PPC.

The sample was jaw, cone and roll-crushed to minus 10 mesh, and riffled into 2-kilogram charges for testwork and a sample for head analysis.

DETAILS OF TESTS

Test No. 77

Purpose: A preliminary rougher flotation test to investigate the recovery of lead and zinc from ore sample C.

Procedure: Grind in the laboratory ball mill with Na_2CO_3, $ZnSO_4$, NaCN and R-242. Float a series of four lead rougher concentrates.

Feed: 2000 grams minus 10 mesh sample C.

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

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Na_2CO_3	$ZnSO_4$	NaCN	R-242	R-404	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.08	-	30	-	-	-
Pb Rougher No. 1	-	-	-	-	0.01	-	1	3	9.4
Pb Rougher No. 2	-	-	-	0.02	0.01	-	1	3	-
Pb Rougher No. 3	-	-	-	0.02	0.01	-	1	3	-
Pb Rougher No. 4	-	-	-	0.01	0.01	-	1	3	-

Stage	Rougher
Flotation Cell	1000 gram D-1
Speed: r.p.m.	1500
% Solids	33

Test No. 77 - Continued

Metallurgical Results

Products	Weight %	Assays, % Pb	Assays, % Zn	% Distribution Pb	% Distribution Zn
1. Pb Rougher Conc. No. 1	15.98	25.8	15.9	60.4	25.2
2. Pb Rougher Conc. No. 2	9.95	10.5	14.7	15.3	14.5
3. Pb Rougher Conc. No. 3	9.96	6.57	13.0	9.6	12.8
4. Pb Rougher Conc. No. 4	5.95	4.98	12.6	4.3	7.4
5. Rougher Tailing	58.16	1.22	6.93	10.4	40.1
Head (calculated)	100.00	6.83	10.1	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	25.93	19.9	15.4	75.7	39.7
Products 1 to 3	35.89	16.2	14.8	85.3	52.5
Products 1 to 4	41.84	14.6	14.5	89.6	59.9

Screen Analysis - 30 Minute Grind

Mesh Size (Tyler)	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 100	0.2	0.2	99.8
150	1.3	1.5	98.5
200	5.7	7.2	92.8
270	9.5	16.7	83.3
400	14.9	31.6	68.4
- 400	68.4	100.0	-
Total	100.0	-	-

Test No. 78

Purpose: To repeat the conditions of test No. 22 on ore sample C.

Procedure: Grind and float a lead concentrate and a zinc concentrate. Regrind the lead concentrate and clean five times. Clean the zinc concentrate three times.

Feed: 2000 grams minus 10 mesh ore sample C.

Grind: 40 minutes at 65 percent solids in the laboratory ball mill.

Conditions:

Stage	Reagents Added, pounds per ton							Time, minutes			pH
	Na_2CO_3	$ZnSO_4$	NaCN	R-242	R-404	MIBC	Ca-$(OH)_2$	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	0.08	-	-	-	30	-	-	-
Pb Circuit											8.3
Pb Rougher	1.0	-	-	-	0.02	0.008	-	-	1	3	9.1
	-	-	-	0.01	0.01	-	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	-	1	3	-
Pb Conc. Regrind	1.0	0.5	0.20	0.03	-	-	-	40	-	-	-
Pb 1st Cl.	-	-	-	-	-	-	-	-	1	3	9.6
	-	-	-	0.01	0.01	-	-	-	1	7	-
Pb 2nd Cl.	0.3	0.2	0.10	-	-	-	-	-	1	3	9.6
	-	-	-	0.005	-	-	-	-	1	3	-
Pb 3rd Cl.	0.2	0.1	0.05	-	-	-	-	-	1	4	9.5
Pb 4th Cl.	0.2	-	0.05	-	-	-	-	-	1	3	9.7
PbPb 5th Cl.	0.2	-	0.05	-	-	-	-	-	1	2	9.8
Zn Circuit											
Condition	$CuSO_4$	Z-200									
Condition	1.0	-	-	-	-	-	2.8	-	2	-	11.3
Zn Rougher	-	0.06	-	-	-	0.012	-	-	1	5	-
	-	0.02	-	-	-	-	-	-	1	3	-
Zn 1st Cl.	-	0.006	-	-	-	-	0.6	-	1	3	11.4
Zn 2nd Cl.	-	-	-	-	-	-	0.2	-	1	2½	11.5
Zn 3rd Cl.	-	-	-	-	-	-	0.1	-	1	2	11.6

Test No. 78 - Continued

Stage	Pb Rougher	Pb 1st, 2nd & 3rd Cleaners
Flotation Cell	1000 gram D-1	500 gram D-1
Speed, r.p.m.	1500	1100
% Solids	33	

Stage	Pb 4th & 5th Cl.	Pb Conc. Regrind
Equipment	250 gram D-1	Rod Mill
Speed: r.p.m.	900	

Stage	Zn Rougher	Zn 1st Cleaner
Flotation Cell	1000 gram D-1	500 gram D-1
Speed, r.p.m.	1500	1100

Stage	Zn 2nd & 3rd Cleaners
Flotation Cell	250 gram D-1
Speed: r.p.m.	900

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	6.83	51.4	13.3	52.6	9.1
2. Pb 5th Cleaner Tailing	1.75	27.3	18.6	7.2	3.3
3. Pb 4th Cleaner Tailing	1.87	15.7	20.6	4.4	3.9
4. Pb 3rd Cleaner Tailing	3.88	12.4	20.0	7.2	7.8
5. Pb 2nd Cleaner Tailing	4.57	4.25	17.0	2.9	7.8
6. Pb 1st Cleaner Tailing	12.86	2.17	15.3	4.2	19.7
7. Zn Cleaner Concentrate	3.89	3.65	43.9	2.1	17.1
8. Zn 3rd Cleaner Tailing	1.61	4.97	29.3	1.2	4.7
9. Zn 2nd Cleaner Tailing	1.84	4.83	18.8	1.3	3.5
10. Zn 1st Cleaner Tailing	4.05	3.37	7.19	2.0	2.9
11. Zn Rougher Tailing	56.85	1.74	3.54	14.9	20.2
Head (calculated)	100.00	6.67	9.97	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	8.58	46.5	14.4	59.8	12.4
Products 1 to 3	10.45	41.0	15.5	64.2	16.3
Products 1 to 4	14.33	33.2	16.7	71.4	24.1
Products 1 to 5	18.90	26.2	16.8	74.3	31.9
Products 1 to 6	31.76	16.5	16.2	78.5	51.6
Products 7 plus 8	5.50	4.04	39.6	3.3	21.8
Products 7 to 9	7.34	4.24	34.4	4.6	25.3
Products 7 to 10	11.39	3.93	24.7	6.6	28.3

Test No. 78 - Continued

Screen Analysis - Regrind Mill Discharge

Particle Size	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 31.1 µm	0.3	0.3	99.7
24.1	0.5	0.8	99.2
16.8	5.3	6.1	93.9
11.6	17.1	23.2	76.8
8.9	14.6	37.8	62.2
- 8.9	62.2	100.0	-
Total	100.0	-	-

Specific Gravity = 4.80

Test No. 79

Purpose: To repeat the conditions of test No. 72.

Procedure: As for test No. 72.

Feed: 2000 grams minus 10 mesh ore sample C.

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

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Na_2CO_3	$ZnSO_4$	NaCN	R-242	R-404	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.08	-	60	-	-	-
Pb Rougher	-	-	-	-	0.01	-	1	3	9.5
	-	-	-	0.02	0.01	-	1	3	-
	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	0.01	0.01	-	1	3	-
Pb 1st Regrind	2.0	1.0	0.30	0.05	-	60	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	1	4	9.6
	-	-	-	0.01	0.01	-	1	4	-
Pb 2nd Regrind	1.5	1.0	0.20	0.03	-	30	-	-	-
Pb 2nd Cleaner	-	-	-	-	0.005	-	1	4	9.7
	-	-	-	0.005	0.005	-	1	4	-
Pb 3rd Cleaner	0.2	0.2	0.10	-	-	-	2	3	9.7
	-	-	-	0.005	-	-	1	3	-
Pb 4th Cleaner	0.2	0.10	0.10	-	-	-	2	3	9.6
	-	-	-	0.002	-	-	1	2	-
Pb 5th Cleaner	0.2	0.05	0.05	-	-	-	2	4	9.8

Stage	- Pb Rougher	1st, 2nd & 3rd Pb Cleaners
Flotation Cell	1000 gram D-1	500 gram D-1
Speed: r.p.m.	1500	1200
% Solids	33	

Stage	4th & 5th Cleaners	Pb Regrinds
Equipment	250 gram D-1	Laboratory Rod Mill
Speed: r.p.m.	900	

Test No. 79 - Continued

Metallurgical Results

Products	Weight	Assays, %			% Distribution		
	%	Pb	Zn	Ag*	Pb	Zn	Ag
1. Pb Cleaner Concentrate	6.09	60.3	10.3	21.0	56.7	6.4	34.0
2. Pb 5th Cleaner Tailing	0.86	31.5	19.5	13.8	4.2	1.7	3.2
3. Pb 4th Cleaner Tailing	3.38	26.0	20.2	12.3	13.6	6.9	11.1
4. Pb 3rd Cleaner Tailing	3.85	11.5	20.2	7.17	6.8	7.9	7.3
5. Pb 2nd Cleaner Tailing	8.83	4.32	16.6	4.72	5.9	14.9	11.1
6. Pb 1st Cleaner Tailing	15.32	1.60	11.7	3.52	3.8	18.2	14.3
7. Pb Rougher Tailing	61.67	0.94	7.02	1.16	9.0	44.0	19.0
Head (calculated)	100.00	6.47	9.84	3.76	100.0	100.0	100.0

* ounces per ton

Calculated Grades and Recoveries

Products 1 plus 2	6.95	56.7	11.4	20.1	60.9	8.1	37.2
Products 1 to 3	10.33	46.7	14.3	17.6	74.5	15.0	48.3
Products 1 to 4	14.18	37.1	15.9	14.7	81.3	22.9	55.6
Products 1 to 5	23.01	24.5	16.2	10.9	87.2	37.8	66.7
Products 1 to 6	38.33	15.4	14.4	7.95	91.0	56.0	81.0

Test No. 79 - Continued

Screen Analyses

60 Minute Primary Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 150	0.1	0.1	99.9
200	1.0	1.1	98.9
270	2.1	3.2	96.8
400	7.2	10.4	89.6
- 400	89.6	100.0	-
Total	100.0	-	-

Final Regrind Mill Discharge

Particle Size (Microns)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 31.1	0.9	0.9	99.1
24.1	0.8	1.7	98.3
16.8	2.5	4.2	95.8
11.6	8.4	12.6	87.4
8.9	11.9	24.5	75.5
- 8.9	75.5	100.0	-
Total	100.0	-	-

Specific Gravity = 4.77

Test No. 82

Purpose: To conduct a comparative test to study the effects of rod mill and of ball mill regrinding.

Procedure: Grind and float a lead rougher concentrate. Filter concentrate and split cake in two equal halves. Rod mill regrind one half, and ball mill regrind the other half and clean each product twice under the same conditions.

Feed: 2000 grams minus 10 mesh ore sample C.

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

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Na_2CO_3	$ZnSO_4$	NaCN	R-242	R-404	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.08	-	60	-	-	-
Pb Rougher	-	-	-	-	0.02	-	1	3	9.4
	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	0.01	0.01	-	1	3	-
Filter rougher concentrate, split cake into halves.									
A. Rod Mill Regrind	1.0	0.5	0.20	0.03	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.02	-	1	3	9.6
	-	-	-	0.01	0.01	-	1	5	-
Pb 2nd Cleaner	0.30	0.20	0.10	0-	-	-	2	3	9.7
	-	-	-	0.005	-	-	1	3	-
B. Ball Mill Regrind	1.0	0.5	0.20	0.03	-	23	-	-	-
Pb 1st Cleaner	-	-	-	-	0.02	-	1	3	9.5
	-	-	-	0.01	0.01	-	1	5	-
Pb 2nd Cleaner	-	0.20	0.10	-	-	-	2	3	9.7
	-	-	-	0.005	-	-	1	3	-

Test No. 82 - Continued

Metallurgical Results - Test A

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	13.30	35.7	15.4	71.8	20.4
2. Pb 2nd Cleaner Tailing	4.55	9.09	17.6	6.3	8.0
3. Pb 1st Cleaner Tailing	16.55	3.91	13.8	9.8	22.7
4. Pb Rougher Tailing	63.60	1.23	7.48	12.1	48.9
Head (calculated)	100.00	6.62	10.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	17.85	28.9	16.0	78.1	28.4
Products 1 to 3	34.40	16.9	14.9	87.9	51.1

Metallurgical Results - Test B

1. Pb Cleaner Concentrate	17.34	27.4	16.1	69.0	27.1
2. Pb 2nd Cleaner Tailing	3.73	10.0	16.5	5.4	6.0
3. Pb 1st Cleaner Tailing	13.50	7.04	14.7	13.9	19.4
4. Pb Rougher Tailing	65.33	1.23	7.48	11.7	47.5
Head (calculated)	100.00	6.89	10.3	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	21.07	24.3	16.2	74.4	33.1
Products 1 to 3	34.67	17.5	15.6	88.3	52.5

Test No. 82 - Continued

Size Analyses

Composite A

Particle Size (Microns)	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 31.1	0.8	0.8	99.2
24.1	0.9	1.7	98.3
16.8	2.8	4.5	95.5
11.6	10.8	15.3	84.7
8.9	13.4	28.7	71.3
- 8.9	71.3	100.0	-
Total	100.0	-	-

Specific Gravity = 4.82

Composite B

+ 31.1	1.2	1.2	98.8
24.1	2.8	4.0	96.0
16.8	11.0	15.0	85.0
11.6	15.6	30.6	69.4
8.9	11.3	41.9	58.1
- 8.9	58.1	100.0	-
Total	100.0	-	-

Specific Gravity = 4.81

Test No. 82

Purpose: To conduct a comparative test to study the effects of rod mill and of ball mill regrinding.

Procedure: Grind and float a lead rougher concentrate. Filter concentrate and split cake in two equal halves. Rod mill regrind one half, and ball mill regrind the other half and clean each product twice under the same conditions.

Feed: 2000 grams minus 10 mesh ore sample C.

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

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Na_2CO_3	$ZnSO_4$	NaCN	R-242	R-404	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.08	-	60	-	-	-
Pb Rougher	-	-	-	-	0.02	-	1	3	9.4
	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	0.01	0.01	-	1	3	-
Filter rougher concentrate, split cake into halves.									
A. Rod Mill Regrind	1.0	0.5	0.20	0.03	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.02	-	1	3	9.6
	-	-	-	0.01	0.01	-	1	5	-
Pb 2nd Cleaner	0.30	0.20	0.10	0-	-	-	2	3	9.7
	-	-	-	0.005	-	-	1	3	-
B. Ball Mill Regrind	1.0	0.5	0.20	0.03	-	23	-	-	-
Pb 1st Cleaner	-	-	-	-	0.02	-	1	3	9.5
	-	-	-	0.01	0.01	-	1	5	-
Pb 2nd Cleaner	-	0.20	0.10	-	-	-	2	3	9.7
	-	-	-	0.005	-	-	1	3	-

Test No. 82 - Continued

Metallurgical Results - Test A

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	13.30	35.7	15.4	71.8	20.4
2. Pb 2nd Cleaner Tailing	4.55	9.09	17.6	6.3	8.0
3. Pb 1st Cleaner Tailing	16.55	3.91	13.8	9.8	22.7
4. Pb Rougher Tailing	63.60	1.23	7.48	12.1	48.9
Head (calculated)	100.00	6.62	10.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	17.85	28.9	16.0	78.1	28.4
Products 1 to 3	34.40	16.9	14.9	87.9	51.1

Metallurgical Results - Test B

1. Pb Cleaner Concentrate	17.34	27.4	16.1	69.0	27.1
2. Pb 2nd Cleaner Tailing	3.73	10.0	16.5	5.4	6.0
3. Pb 1st Cleaner Tailing	13.50	7.04	14.7	13.9	19.4
4. Pb Rougher Tailing	65.33	1.23	7.48	11.7	47.5
Head (calculated)	100.00	6.89	10.3	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	21.07	24.3	16.2	74.4	33.1
Products 1 to 3	34.67	17.5	15.6	88.3	52.5

Test No. 82 - Continued

Size Analyses

Composite A

Particle Size (Microns)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 31.1	0.8	0.8	99.2
24.1	0.9	1.7	98.3
16.8	2.8	4.5	95.5
11.6	10.8	15.3	84.7
8.9	13.4	28.7	71.3
- 8.9	71.3	100.0	-
Total	100.0	-	-

Specific Gravity = 4.82

Composite B

+ 31.1	1.2	1.2	98.8
24.1	2.8	4.0	96.0
16.8	11.0	15.0	85.0
11.6	15.6	30.6	69.4
8.9	11.3	41.9	58.1
- 8.9	58.1	100.0	-
Total	100.0	-	-

Specific Gravity = 4.81

Test No. 83

Purpose: To conduct a comparative test to study the effect of eliminating the $ZnSO_4$, and the NaCN when regrinding in the ball mill.

Procedure: Grind and float a rougher concentrate. Filter concentrate and split cake into two halves. Ball mill regrind one half without $ZnSO_4$. Condition following regrind with the $ZnSO_4$ and clean twice. Repeat procedure on other half, but eliminate the NaCN in the regrind.

Feed: 2000 grams minus 10 mesh ore sample C.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na_2CO_3	$ZnSO_4$	NaCN	R-242	R-404	MIBC	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.08	0-	-	60	-	-	
Pb Rougher	-	-	-	-	0.02	0.008	-	1	3	9.5
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	0.004	-	1	3	-
Filter rougher concentrate, split into two halves.										
A. Rod Mill Regrind	1.0	-	0.20	0.03	-	-	23	-	-	-
Pb 1st Cleaner	-	0.50	-	-	-	-	-	5	-	9.6
	-	-	-	-	0.02	0.008	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	5	-
Pb 2nd Cleaner	0.2	0.20	0.10	-	-	0.004	-	2	3	9.5
	-	-	-	.005	-	-	-	1	3	-
B. Ball Mill Regrind	1.0	0.50	-	0.03	-	-	23	-	-	-
Pb 1st Cleaner	0.4	-	0.20	-	-	-	-	5	-	9.5
	-	-	-	-	0.02	0.008	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	5	-
Pb 2nd Cleaner	0.2	0.20	0.10	-	-	0.004	-	2	3	9.6
	-	-	-	.005	-	-	-	1	3	-

Test No. 83 - Continued

Metallurgical Results - Test A

Products	Weight %	Assays, % Pb	Assays, % Zn	% Distribution Pb	% Distribution Zn
1. Pb Cleaner Concentrate	17.65	27.5	15.8	73.4	26.2
2. Pb 2nd Cleaner Tailing	5.19	11.1	27.0	8.7	13.1
3. Pb 1st Cleaner Tailing	14.14	4.11	13.7	8.8	18.2
4. Rougher Tailing	63.02	0.95	7.19	9.1	42.5
Head (calculated)	100.00	6.61	10.7	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	22.84	23.8	18.3	82.1	39.3
Products 1 to 3	36.98	16.3	16.6	90.9	57.5

Metallurgical Results - Test B

1. Pb Cleaner Concentrate	18.55	25.9	16.2	72.5	29.6
2. Pb 2nd Cleaner Tailing	4.77	10.6	17.4	7.6	8.2
3. Pb 1st Cleaner Tailing	13.65	5.31	13.2	10.9	17.7
4. Rougher Tailing	63.02	0.95	7.19	9.0	44.5
Head (calculated)	100.00	6.63	10.2	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	23.32	22.8	16.45	80.1	37.8
Products 1 to 3	36.98	16.3	15.2	91.0	55.5

Test No. 84

Purpose: To repeat test No. 83, but investigate regrinding in the rod mill in place of regrinding in the ball mill.

Procedure: As for test No. 83, but with the regrind in the rod mill.

Feed: 2000 grams minus 10 mesh ore sample C.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na_2CO_3	$ZnSO_4$	NaCN	R-242	R-404	MIBC	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.08	-	-	60	-	-	-
Pb Rougher	-	-	-	-	0.02	0.008	-	1	3	9.5
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	0.004	-	1	3	-
Filter rougher concentrate, split into two halves										
A. Rod Mill Regrind	1.0	-	0.20	0.03	-	-	30	-	-	-
Pb 1st Cleaner	-	0.50	-	-	-	-	-	5	-	9.5
	-	-	-	-	0.02	0.008	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	5	-
Pb 2nd Cleaner	0.2	0.20	0.10	-	-	0.009	-	2	3	9.5
	-	-	-	0.005	-	-	-	1	3	-
B. Ball Mill Regrind	1.0	0.50	-	0.03	-	-	30	-	-	-
Pb 1st Cleaner	0.4	-	0.20	-	-	-	-	5	-	9.6
	-	-	-	-	0.20	0.008	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	5	-
Pb 2nd Cleaner	0.2	0.20	0.10	-	-	0.004	-	2	3	9.5
	-	-	-	0.005	-	-	-	1	3	-

Test No. 84 - Continued

Metallurgical Results - Test A

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	13.64	36.4	15.8	74.3	21.4
2. Pb 2nd Cleaner Tailing	7.00	10.7	17.9	11.2	12.4
3. Pb 1st Cleaner Tailing	18.97	2.51	13.0	7.1	24.4
4. Rougher Tailing	60.39	0.82	6.99	7.4	41.8
Head (calculated)	100.00	6.69	10.1	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	20.64	27.7	16.5	85.5	33.8
Products 1 to 3	39.61	15.6	14.8	92.6	58.2

Metallurgical Results - Test B

1. Pb Cleaner Concentrate	14.55	31.9	15.5	73.1	22.9
2. Pb 2nd Cleaner Tailing	6.19	7.38	15.3	7.2	9.6
3. Pb 1st Cleaner Tailing	18.86	4.00	12.9	11.9	24.7
4. Rougher Tailing	60.40	0.82	6.99	7.8	42.8
Head (calculated)	100.00	6.35	9.86	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	20.74	24.6	15.4	80.3	32.5
Products 1 to 3	39.60	14.8	14.2	92.2	57.2

Test No. 85

Purpose: A comparative test to study the effect of sodium sulphite with and without NaCN when regrinding in the ball mill.

Procedure: As for test No. 83, but in test A use Na_2SO_3 in regrind. Condition with NaCN and clean twice. In test B use Na_2SO_3 and NaCN in regrind and clean twice.

Feed: 2000 grams minus 10 mesh ore sample C.

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

Conditions:

Stage	Reagents Added, pounds per ton							Time, minutes			pH
	Na_2CO_3	$ZnSO_4$	Na_2SO_3	NaCN	R-242	R-404	MIBC	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	-	0.30	0.08	-	-	60	-	-	-
Pb Rougher	-	-	-	-	-	0.02	0.008	-	1	3	9.5
	-	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	-	0.01	0.01	0.004	-	1	3	-
Filter rougher concentrate, split cake into two halves.											
A. Ball Mill Regrind	1.0	-	1.0	-	0.03	-	-	23	-	-	-
Pb 1st Cleaner	-	-	-	0.20	-	-	-	-	5	-	9.7
	-	-	-	-	-	0.02	0.008	-	1	3	-
	-	-	-	-	0.01	0.01	-	-	1	5	-
Pb 2nd Cleaner	0.2	-	0.20	0.10	-	-	0.004	-	2	3	-
	-	-	-	-	0.005	-	-	-	1	3	-
B. Ball Mill Regrind	1.0	-	1.0	0.20	0.03	-	-	23	-	-	-
Pb 1st Cleaner	-	-	-	-	-	0.02	0.008	-	1	3	9.7
	-	-	-	-	0.01	0.01	-	-	1	5	-
Pb 2nd Cleaner	-	-	-	-	-	-	0.004	-	2	3	-
	-	-	-	-	0.005	-	-	-	1	3	-

Test No. 85 - Continued

Metallurgical Results - Test A

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	13.19	29.1	16.5	58.0	21.2
2. Pb 2nd Cleaner Tailing	7.02	15.6	18.2	16.5	12.4
3. Pb 1st Cleaner Tailing	17.14	6.49	13.7	16.8	22.9
4. Pb Rougher Tailing	62.65	0.92	7.13	8.7	43.5
Head (calculated)	100.00	6.62	10.3	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	20.21	24.4	17.1	74.5	33.6
Products 1 to 3	37.35	16.2	15.5	91.3	56.5

Metallurgical Results - Test B

1. Pb Cleaner Concentrate	14.20	29.1	15.9	61.2	22.0
2. Pb 2nd Cleaner Tailing	5.73	15.3	17.8	13.0	9.9
3. Pb 1st Cleaner Tailing	17.42	6.70	14.5	17.3	24.6
4. Pb Rougher Tailing	62.65	0.92	7.13	8.5	43.5
Head (calculated)	100.00	6.75	10.3	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	19.93	26.0	16.4	74.2	31.9
Products 1 to 3	37.35	17.0	15.5	91.5	56.5

Test No. 86

Purpose: To repeat test No. 85, but investigate regrinding in the rod mill in place of regrinding in the ball mill.

Procedure: As for test No. 85, but with the regrind in the rod mill.

Feed: 2000 grams minus 10 mesh ore sample C.

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

Conditions:

Stage	Reagents Added, pounds per ton							Time, minutes			pH
	Na_2CO_3	$ZnSO_4$	Na_2SO_3	NaCN	R-242	R-404	MIBC	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	-	0.30	0.08	-	-	60	-	-	-
Pb Rougher	-	-	-	-	-	0.02	0.008	-	1	3	9.5
	-	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	-	0.01	0.01	0.004	-	1	3	-
Filter rougher concentrate, split cake into two halves.											
A. Rod Mill Regrind	1.0	-	1.0	-	0.03	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	0.20	-	-	-	-	-	-	-
	-	-	-	-	-	0.02	0.004	-	1	3	9.6
Pb 2nd Cleaner	0.2	-	0.20	0.10	0.01	0.01	-	-	1	5	-
	-	-	-	-	-	-	0.004	-	2	3	9.7
B. Rod Mill Regrind					0.005	-	-	-	1	3	-
	1.0	-	1.0	0.20	0.03	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	-	0.02	0.004	-	1	3	9.5
	-	-	-	-	0.01	0.01	-	-	1	5	-
Pb 2nd Cleaner	0.20	-	0.20	0.10	-	-	0.004	-	2	3	9.7
	-	-	-	-	0.005	-	-	-	1	3	-

Test No. 86 - Continued

Metallurgical Results - Test A

Products	Weight %	Assays, % Pb	Assays, % Zn	% Distribution Pb	% Distribution Zn
1. Pb Cleaner Concentrate	12.79	35.9	15.8	68.2	20.7
2. Pb 2nd Cleaner Tailing	6.32	12.1	17.8	11.4	11.5
3. Pb 1st Cleaner Tailing	19.17	4.14	12.9	11.8	25.3
4. Pb Rougher Tailing	61.71	0.95	6.75	8.6	42.5
Head (calculated)	100.00	6.74	9.78	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	19.11	28.0	16.5	79.6	32.2
Products 1 to 3	38.29	16.1	14.7	91.4	57.5

Metallurgical Results - Test B

1. Pb Cleaner Concentrate	11.38	38.1	15.7	68.3	18.7
2. Pb 2nd Cleaner Tailing	7.07	10.8	16.7	12.0	12.3
3. Pb 1st Cleaner Tailing	19.84	3.35	12.3	10.5	25.5
4. Pb Rougher Tailing	61.71	0.95	6.75	9.2	43.5
Head (calculated)	100.00	6.35	9.57	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	18.45	27.6	16.1	80.3	31.0
Products 1 to 3	38.29	15.1	14.1	90.8	56.5

Test No. 87

Purpose: To repeat the conditions of test No. 79, and attempt to improve lead recovery.

Procedure: As for test No. 79.

Feed: 2000 grams minus 10 mesh ore sample C.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na_2CO_3	$ZnSO_4$	NaCN	R-242	R-404	MIBC	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.10	-	-	60	-	-	-
Pb Rougher	-	-	-	-	0.02	0.004	-	1	3	9.5
	-	-	-	0.02	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	0.004	-	1	4	-
Pb 1st Regrind	2.0	1.0	0.30	0.05	-	-	60	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	4	9.8
	-	-	-	0.01	0.01	0.004	-	1	6	-
Pb 2nd Regrind	1.0	1.0	0.20	0.03	-	-	30	-	-	-
Pb 2nd Cleaner	-	-	-	-	0.01	-	-	1	4	9.7
	-	-	-	0.01	0.01	0.004	-	1	4	-
Pb 3rd Cleaner	0.2	0.20	0.10	-	-	-	-	2	3	9.6
	-	-	-	0.01	-	-	-	1	3	-
Pb 4th Cleaner	0.2	0.10	0.10	-	-	-	-	2	3	9.6
	-	-	-	0.005	-	-	-	1	2	-
Pb 5th Cleaner	0.2	0.05	0.05	-	-	-	-	2	4	9.7

Stage	Pb Rougher	1st to 4th Cleaners
Equipment	1000 gram D-1	500 gram D-1
Speed: r.p.m.	1500	1200
% Solids	33	
Stage	5th Cleaner	Pb Regrind
Equipment	250 gram D-1	Laboratory rod mill
Speed: r.p.m.	900	

To investigate the effect of grinding in the pebble mill.

As for test No. 87, but replace ball and rod milling with pebble milling.

2000 grams minus 20 mesh ore sample C.

45 minutes at 65 percent solids in the 12 inch by 15 inch Abbe ceramic pebble mill.

Reagents Added, pounds per ton						Time, minutes			pH
Na_2CO_3	$ZnSO_4$	NaCN	R-242	R-404	MIBC	Grind	Cond.	Froth	
5.0	1.0	0.30	0.10	-	-	45	-	-	-
-	-	-	-	0.02	0.004	-	1	3	9.5
-	-	-	0.02	0.01	-	-	1	3	-
-	-	-	0.01	0.01	-	-	1	3	-
-	-	-	0.01	0.01	-	-	1	4	-
1.5	1.0	0.30	0.05	-	-	45	-	-	-
-	-	-	-	0.01	-	-	1	4	9.4
-	-	-	0.01	0.01	-	-	1	6	-
1.0	1.0	0.20	0.03	-	-	20	-	-	-
-	-	-	-	0.01	-	-	1	4	9.4
-	-	-	0.01	0.01	-	-	1	4	-
0.20	0.20	0.10	-	-	-	-	2	3	9.5
-	-	-	0.01	-	-	-	-	3	-
0.20	0.10	0.10	-	-	-	-	2	3	9.6
-	-	-	0.005	-	-	-	-	2	-
0.20	0.05	0.03	-	-	-	-	2	4	9.7

Test No. 88 - Continued

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	7.00	49.4	12.6	52.5	8.9
2. Pb 5th Cleaner Tailing	1.28	30.9	18.1	6.0	2.3
3. Pb 4th Cleaner Tailing	1.83	23.8	18.7	6.6	3.4
4. Pb 3rd Cleaner Tailing	3.42	15.9	19.0	8.2	6.5
5. Pb 2nd Cleaner Tailing	6.20	9.56	17.6	9.0	11.0
6. Pb 1st Cleaner Tailing	16.87	3.80	14.1	9.7	24.0
7. Pb Rougher Tailing	63.40	0.83	6.87	8.0	43.9
Head (calculated)	100.00	6.59	9.93	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	8.28	46.5	13.5	58.5	11.2
Products 1 to 3	10.11	42.4	14.4	65.1	14.6
Products 1 to 4	13.53	35.7	15.6	73.3	21.1
Products 1 to 5	19.73	27.5	16.2	82.3	32.1
Products 1 to 6	36.60	16.6	15.2	92.0	56.1

Screen Analysis - Pb Rougher Tailing

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 200	0.2	0.2	99.8
270	0.6	0.8	99.2
400	2.8	3.6	96.4
- 400	96.4	100.0	-
Total	100.0	-	-

Test No. 88 - Continued

Size Analysis - Composite

Particle Size (Microns)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 16.3	1.0	1.0	99.0
11.2	5.6	6.6	93.4
8.7	8.6	15.2	84.8
- 8.7	84.8	100.0	-
Total	100.0	-	-

Specific Gravity = 4.99

Test No. 89

Purpose: To repeat test No. 88, but attempt to increase lead recovery in cleaner flotation.

Procedure: As for test No. 88, with following modifications:
1) eliminate 2nd lead regrind
2) reduce 1st regrind from 45 to 23 minutes
3) reduce NaCN addition in lead cleaners by 50 %
4) replace R-404 with Z-11.

Feed: 2000 grams minus 20 mesh ore sample C.

Grind: 45 minutes at 65 percent solids in the 12 inch by 15 inch ceramic pebble mill.

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na_2CO_3	$ZnSO_4$	NaCN	R-242	R-404	Z-11	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.10	-	-	45	-	-	-
Pb Rougher	-	-	-	-	0.02	-	-	1	3	9.5
	-	-	-	0.02	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	4	-
Regrind	1.5	1.0	0.15	0.035	-	-	22	-	-	9.2
Pb 1st Cleaner	0.3	-	-	-	-	0.01	-	1	4	9.4
	-	-	-	0.01	-	0.01	-	1	6	-
Pb 2nd Cleaner	0.30	0.20	0.10	-	-	-	-	2	3	9.5
	-	-	-	0.01	-	0.005	-	1	3	-
Pb 3rd Cleaner	0.20	0.10	0.075	-	-	-	-	2	3	9.5
	-	-	-	0.01	-	-	-	1	3	-
Pb 4th Cleaner	0.20	0.10	0.05	-	-	-	-	2	3	9.6
	-	-	-	0.003	-	-	-	1	2	-
Pb 5th Cleaner	0.10	0.05	0.03	-	-	-	-	1	4	9.5

Stage	Pb Rougher	Pb Cleaner	Regrind
Equipment	1000 gram D-1	500 gram D-1	12 inch by 15 inch ceramic pebble mill
speed, r.p.m.	1400	1150	
% Solids	33		

Example 39 - Continued

Typical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1st Cleaner Concentrate	11.08	38.0	14.2	63.7	15.8
2nd Cleaner Tailing	1.44	25.7	17.6	5.6	2.5
3rd Cleaner Tailing	1.98	19.0	18.5	5.7	3.7
4th Cleaner Tailing	2.46	13.0	18.3	4.8	4.5
5th Cleaner Tailing	6.25	7.13	16.2	6.7	10.2
Last Cleaner Tailing	15.67	2.67	12.8	6.4	20.1
Rougher Tailing	61.12	0.76	7.04	7.1	43.2
(Calculated)	100.00	6.61	9.96	100.0	100.0

Combined Grades and Recoveries

Products 1 plus 2	12.52	36.6	14.6	69.3	18.3
Products 1 to 3	14.50	34.2	15.1	75.0	22.0
Products 1 to 4	16.96	31.1	15.6	79.8	26.5
Products 1 to 5	23.21	24.7	15.8	86.5	36.7
Products 1 to 6	38.88	15.8	14.6	92.9	56.8

Screen Analysis - Composite

Screen Size (Microns)	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+[illegible]	0.4	0.4	99.6
[illegible]	0.9	1.3	98.7
[illegible]	6.0	7.3	92.7
[illegible]	12.7	20.0	80.0
[illegible]	11.2	31.2	68.8
[illegible]	68.8	100.0	-
[illegible]	100.0	-	-

[illegible] Gravity = 4.75

Test No. 90

Purpose: To repeat test No. 89, but investigate the effect of a coarser primary pebble mill grind.

Procedure: As for test No. 89, but reduce primary grind time to 30 minutes from 45 minutes.

Feed: 2000 grams minus 20 mesh ore sample C.

Grind: 30 minutes at 65 percent solids in the 12 inch by 15 inch ceramic pebble mill.

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na_2CO_3	$ZnSO_4$	NaCN	R-242	R-404	Z-11	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	-	0.01	-	-	1	3	9.5
	-	-	-	0.02	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Regrind	1.8	1.0	0.15	0.03	-	-	22	-	-	-
Pb 1st Cleaner	-	-	-	-	-	0.01	-	1	4	9.4
	-	-	-	-	0.01	0.01	-	1	6	-
Pb 2nd Cleaner	0.30	0.20	0.10	-	-	-	-	2	3	9.6
	-	-	-	0.01	-	0.005	-	1	3	-
Pb 3rd Cleaner	0.30	0.10	0.07	-	-	-	-	2	3	9.5
	-	-	-	0.01	-	-	-	1	3	-
Pb 4th Cleaner	0.20	0.10	0.05	-	-	-	-	2	3	9.6
	-	-	-	0.005	-	-	-	1	2	-
Pb 5th Cleaner	0.10	0.05	0.03	-	-	-	-	2	4	9.6

Stage: Regrind
Equipment: 12 inch by 15 inch ceramic pebble mill

Test No. 90 - Continued

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	11.71	33.4	15.3	59.8	18.1
2. Pb 5th Cleaner Tailing	2.45	23.4	18.1	8.8	4.5
3. Pb 4th Cleaner Tailing	1.96	19.0	19.2	5.7	3.8
4. Pb 3rd Cleaner Tailing	3.28	12.3	18.1	6.2	6.0
5. Pb 2nd Cleaner Tailing	5.76	6.22	15.8	5.5	9.2
6. Pb 1st Cleaner Tailing	12.67	2.70	12.4	5.2	15.8
7. Pb Rougher Tailing	62.17	0.94	6.81	8.8	42.6
Head (calculated)	100.00	6.55	9.92	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	14.16	31.7	15.8	68.6	22.6
Products 1 to 3	16.12	30.1	16.2	74.3	26.4
Products 1 to 4	19.40	27.1	16.5	80.5	32.4
Products 1 to 5	25.16	22.3	16.4	86.0	41.6
Products 1 to 6	37.83	15.8	15.0	91.2	57.4

Size Analysis - Composite

Particle Size (Microns)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 31.1	2.5	2.5	97.5
24.1	2.9	5.4	94.6
16.8	10.5	15.9	84.1
11.6	15.5	31.4	68.6
8.9	11.2	42.6	57.4
- 8.9	57.4	100.0	-
Total	100.0	-	-

Specific Gravity = 4.74

Test No. 92

Purpose: To repeat test No. 87, but include a $ZnSO_4$ conditioning stage following regrinds, in place of $ZnSO_4$ addition to regrinds.

Procedure: As for test No. 87, but omit $ZnSO_4$ additions to regrinds and include a $ZnSO_4$ conditioning stage following both regrinds.

Feed: 2000 grams minus 10 mesh ore sample PPC.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na_2CO_3	$ZnSO_4$	NaCN	R-242	R-404	MIBC	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.10	-	-	60	-	-	-
	-	-	-	-	0.02	0.004	-	1	3	9.4
	-	-	-	0.02	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	0.004	-	1	4	-
Pb 1st Regrind	2.0	-	0.30	0.05	-	-	60	-	-	-
Condition	-	1.0	-	-	-	-	-	5	-	10.1
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	4	9.6
	-	-	-	0.01	0.01	0.004	-	1	6	-
Pb 2nd Regrind	1.0	-	0.20	0.03	-	-	30	-	-	-
Condition	-	1.0	-	-	-	-	-	5	-	9.9
Pb 2nd Cleaner	-	-	-	-	0.01	0.004	-	1	4	9.5
	-	-	-	0.01	0.01	-	-	1	4	-
Pb 3rd Cleaner	0.2	0.20	0.10	-	-	-	-	2	3	9.6
	-	-	-	0.01	-	-	-	1	3	-
Pb 4th Cleaner	0.2	0.10	0.10	-	-	-	-	2	3	9.6
	-	-	-	0.005	-	-	-	1	2	-
Pb 5th Cleaner	0.2	0.05	0.05	-	-	-	-	2	4	9.5

Stage	Pb Rougher	Pb 1st to 4th Cl.	Pb 5th Cleaner
Flotation Cell	1000 gram D-1	500 gram D-1	250 gram D-1
Speed: r.p.m.	1500	1150	900
% Solids	33		

Test No. 92 - Continued

Metallurgical Results

Products	Weight	Assays, %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	10.34	49.1	13.0	76.1	13.9
2. Pb 5th Cleaner Tailing	2.28	15.5	21.6	5.3	5.1
3. Pb 4th Cleaner Tailing	2.63	8.48	20.8	3.3	5.6
4. Pb 3rd Cleaner Tailing	4.29	4.45	17.6	2.9	7.8
5. Pb 2nd Cleaner Tailing	8.68	2.04	13.7	2.7	12.3
6. Pb 1st Cleaner Tailing	12.93	1.04	10.9	2.0	14.5
7. Pb Rougher Tailing	58.85	0.87	6.74	7.7	40.8
Head (calculated)	100.00	6.67	9.70	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	12.62	43.0	14.55	81.4	19.0
Products 1 to 3	15.35	36.8	15.53	84.7	24.6
Products 1 to 4	19.54	29.9	16.06	87.6	32.4
Products 1 to 5	28.22	21.3	15.34	90.3	44.7
Products 1 to 6	41.15	15.0	13.90	92.3	59.2

Test No. 93

Purpose: To repeat test No. 87, but increase lead 2nd regrind time.

Procedure: As for test No. 87, but increase lead 2nd regrind time from 30 to 60 minutes.

Feed: 2000 grams minus 10 mesh ore sample PPC.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na_2CO_3	$ZnSO_4$	NaCN	R-242	R-404	MIBC	Grind	Cond.	Froth	
Primary Grind	6.0	1.0	0.30	0.10	-	-	60	-	-	-
Pb Rougher	-	-	-	-	0.02	0.004	-	1	3	9.6
	-	-	-	0.02	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	0.004	-	1	4	-
Pb 1st Regrind	2.0	1.0	0.30	0.05	-	-	60	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	4	9.7
	-	-	-	0.01	0.01	0.004	-	1	6	-
Pb 2nd Regrind	1.0	1.0	0.20	0.03	-	-	60	-	-	9.2
Pb 2nd Cleaner	0.3	-	-	-	0.01	-	-	1	4	9.5
	-	-	-	0.01	0.01	0.004	-	1	4	-
Pb 3rd Cleaner	0.2	0.20	0.10	-	-	-	-	2	3	9.5
	-	-	-	0.01	-	-	-	1	3	-
Pb 4th Cleaner	0.2	0.10	0.10	-	-	-	-	2	3	9.6
	-	-	-	0.005	-	-	-	1	2	-
Pb 5th Cleaner	0.2	0.05	0.05	-	-	-	-	2	4	9.5

Stage	Pb Rougher	Pb 1st to 4th Cleaners
Equipment	1000 gram D-1	500 gram D-1
Speed: r.p.m.	1500	1150
% Solids	33	

Stage	Pb 5th Cleaner	Pb Regrind
Equipment	250 gram D-1	Laboratory rod mill
Speed: r.p.m.	900	

Test No. 93 - Continued

Metallurgical Results

Products	Weight %	Assays, % Pb	Assays, % Zn	% Distribution Pb	% Distribution Zn
1. Pb Cleaner Concentrate	7.86	60.1	10.1	70.2	8.2
2. Pb 5th Cleaner Tailing	2.12	22.6	20.1	7.1	4.4
3. Pb 4th Cleaner Tailing	2.44	10.5	20.4	3.8	5.1
4. Pb 3rd Cleaner Tailing	5.31	5.10	17.7	4.0	9.7
5. Pb 2nd Cleaner Tailing	10.30	3.25	16.2	5.0	17.2
6. Pb 1st Cleaner Tailing	13.55	1.16	10.7	2.3	14.9
7. Pb Rougher Tailing	58.42	0.87	6.74	7.6	40.5
Head (calculated)	100.00	6.73	9.71	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	9.98	52.1	12.2	77.3	12.6
Products 1 to 3	12.42	44.0	13.8	81.1	17.7
Products 1 to 4	17.73	32.3	15.0	85.1	27.4
Products 1 to 5	28.03	21.6	15.4	90.1	44.6
Products 1 to 6	41.58	15.0	13.9	92.4	59.5

Size Analysis - Composite

Particle Size (Microns)	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 30.3	0.6	0.6	99.4
23.5	1.0	1.6	98.4
16.4	2.4	4.0	96.0
11.3	8.6	12.6	87.4
8.7	13.4	26.0	74.0
- 8.7	74.0	100.0	-
Total	100.0	-	-

Specific Gravity = 4.94

Test No. 96

Purpose: To investigate the effect of SO_2 in lead cleaner flotation.

Procedure: Grind and float a lead rougher concentrate. Regrind with SO_2 and clean three times.

Feed: 2000 grams minus 10 mesh ore sample PPC.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na_2CO_3	$ZnSO_4$	NaCN	SO_2	R-242	R-404	Grind	Cond.	Froth	
Primary Grind	6.0	1.0	0.30	-	0.10	-	60	-	-	-
Pb Rougher	-	-	-	-	-	0.02	-	1	3	9.6
	-	-	-	-	0.02	0.01	-	1	3	-
	-	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	-	0.01	0.01	-	1	4	-
Pb Regrind	-	1.0	0.30	7.0	0.05	-	45	-	-	-
	-	-	-	-	-	-	-	-	-	9.5
Aerate	-	-	-	-	-	-	-	2	-	6.2
Pb 1st Cleaner	10.0	-	-	-	-	0.01	-	1	3	9.0
	-	-	-	-	0.01	0.01	-	1	4	-
Pb 2nd Cleaner	2.0	0.20	0.10	-	-	0.01	-	1	3	9.2
	-	-	-	-	0.01	0.01	-	1	3	-
Pb 3rd Cleaner	1.0	0.20	0.10	-	-	-	-	1	3	9.2
	-	-	-	-	0.01	-	-	1	3	-

Note: Pb is very slow to float, too much SO_2 to regrind

Stage: Pb Regrind
Equipment: Laboratory Ball Mill

Test No. 96 - Continued

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb 3rd Cleaner Concentrate	5.50	29.4	16.1	23.8	8.8
2. Pb 3rd Cleaner Tailing	4.62	21.1	16.8	14.4	7.7
3. Pb 2nd Cleaner Tailing	8.93	15.5	15.1	20.4	13.4
4. Pb 1st Cleaner Tailing	21.51	10.8	13.3	34.3	28.5
5. Pb Rougher Tailing	59.44	0.81	7.04	7.1	41.6
Head (calculated)	100.00	6.78	10.1	100.0	100.00

Calculated Grades and Recoveries

Products 1 plus 2	10.12	25.6	16.4	38.2	16.5
Products 1 to 3	19.05	20.9	15.8	58.6	29.9
Products 1 to 4	40.56	15.5	14.5	92.9	58.4

Test No. 97

Purpose: To repeat test No. 96, but decrease SO_2 addition to regrind, followed by conditioning with depressants instead of adding to the regrind.

Procedure: As for test 96, but with reduced SO_2 to the regrind, and with above-noted change in point of depressant additions.

Feed: 2000 grams minus 10 mesh ore sample PPC.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na_2CO_3	$ZnSO_4$	NaCN	SO_2	R-242	R-404	Grind	Cond.	Froth	
Primary Grind	6.0	1.0	0.3	-	0.10	-	60	-	-	-
Pb Rougher	-	-	-	-	-	0.02	-	1	3	9.6
	-	-	-	-	0.02	0.01	-	1	3	-
	-	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	-	0.01	0.01	-	1	4	-
Pb Regrind	-	-	-	2.5	-	-	45	-	-	6.7
Condition	4.0	0.5	0.25	-	-	-	-	5	-	9.2
Pb 1st Cleaner	-	-	-	-	-	0.01	-	1	4	-
	-	-	-	-	0.01	0.01	-	1	4	-
Pb 2nd Cleaner	0.5	0.20	0.20	-	-	-	-	1	3	9.3
	-	-	-	-	0.01	-	-	1	3	-
Pb 3rd Cleaner	0.2	0.10	0.10	-	-	-	-	1	3	9.4
	-	-	-	-	0.01	-	-	1	2	-
Pb 4th Cleaner	0.2	0.10	0.10	-	-	-	-	1	4	9.4

Stage: Pb Regrind
Equipment: Laboratory Ball Mill

Test No. 97 - Continued

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb 4th Cleaner Concentrate	8.85	32.7	17.0	43.5	15.0
2. Pb 4th Cleaner Tailing	1.17	23.8	18.2	4.2	2.1
3. Pb 3rd Cleaner Tailing	3.74	20.2	17.5	11.3	6.5
4. Pb 2nd Cleaner Tailing	6.30	12.7	15.2	12.0	9.6
5. Pb 1st Cleaner Tailing	21.59	7.02	12.8	22.8	27.6
6. Pb Rougher Tailing	58.35	0.71	6.71	6.2	39.2
Head (calculated)	100.00	6.66	10.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	10.02	31.7	17.1	47.7	17.1
Products 1 to 3	13.76	28.5	17.2	59.0	23.6
Products 1 to 4	20.06	23.6	16.6	71.1	33.2
Products 1 to 5	41.65	15.0	14.6	93.8	60.8

Test No. 99

Purpose: To repeat test No. 93, but with a 3rd regrind stage.

Procedure: As for test 93.

Feed: 2000 grams minus 10 mesh ore sample PPC.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na_2CO_3	$ZnSO_4$	NaCN	R-242	R-404	MIBC	Grind	Cond.	Froth	
Primary Grind	6.0	1.0	0.30	0.10	-	-	60	-	-	-
Pb Rougher	-	-	-	-	0.02	0.004	-	1	3	9.6
	-	-	-	0.02	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	0.004	-	1	4	-
Pb 1st Regrind	2.0	1.0	0.30	0.05	-	-	60	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	4	9.7
	-	-	-	0.01	0.01	-	-	1	6	-
Pb 2nd Regrind	1.5	1.0	0.20	0.03	-	-	60	-	-	-
Pb 2nd Cleaner	-	-	-	-	0.01	-	-	1	4	9.5
	-	-	-	0.01	0.01	-	-	1	4	-
Pb 3rd Regrind	1.0	1.0	0.15	-	-	-	30	-	-	-
Pb 3rd Cleaner	-	-	-	-	0.01	-	-	1	3	9.6
	-	-	-	0.01	0.005	-	-	1	3	-
Pb 4th Cleaner	0.2	0.20	0.10	-	-	-	-	2	3	-
	-	-	-	0.075	-	-	-	1	3	9.6
Pb 5th Cleaner	0.2	0.10	0.10	-	-	-	-	2	4	-
	-	-	-	-	-	-	-	-	-	9.5

Stage Regrind
Equipment Laboratory Rod Mill

Test No. 99 - Continued

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	8.98	57.4	11.0	76.8	10.1
2. Pb 5th Cleaner Tailing	2.29	14.9	21.1	5.1	4.9
3. Pb 4th Cleaner Tailing	3.76	6.79	19.8	3.8	7.6
4. Pb 3rd Cleaner Tailing	5.70	3.77	16.9	3.2	9.9
5. Pb 2nd Cleaner Tailing	8.65	1.65	14.4	2.1	12.8
6. Pb 1st Cleaner Tailing	13.55	1.09	10.3	2.2	14.3
7. Pb Rougher Tailing	57.07	0.80	6.89	6.8	40.4
Head (calculated)	100.00	6.71	9.75	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	11.27	48.8	13.1	81.9	15.0
Products 1 to 3	15.03	38.3	14.7	85.7	22.6
Products 1 to 4	20.73	28.8	15.3	88.9	32.5
Products 1 to 5	29.38	20.8	15.1	91.0	45.3
Products 1 to 6	42.93	14.6	13.6	93.2	59.6

Size Analysis - Final Regrind Mill Discharge

Particle Size (Microns)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 29.7	1.3	1.3	98.7
23.0	1.5	2.8	97.2
16.1	1.9	4.7	95.3
11.0	2.5	7.2	92.8
8.5	6.6	13.8	86.2
- 8.5	86.2	100.0	-
Total	100.0	-	-

Specific Gravity = 5.16

Test No. 101

Purpose: To investigate the effect of a lime circuit in lead cleaner flotation.

Procedure: As for test No. 87, but use $Ca(OH)_2$ in place of Na_2CO_3 and xanthate in place of R-242 and 404 in lead cleaner flotation.

Feed: 2000 grams minus 10 mesh ore sample PPC.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na_2CO_3	$ZnSO_4$	NaCN	R-242	R-404	MIBC	Grind	Cond.	Froth	
Primary Grind	6.0	1.0	0.30	0.10	-	-	60	-	-	-
Pb Rougher	-	-	-	-	0.02	0.004	-	1	3	9.6
	-	-	-	0.02	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	0.004	-	1	4	-
	$Ca(OH)_2$				Z-4/ Z-11					
Pb 1st Regrind	1.0	1.0	0.30	0.04	0.02	-	60	-	-	9.3
Pb 1st Cleaner	0.3	-	-	-	0.01	-	-	1	4	10.6
	-	-	-	0.01	0.01	-	-	1	6	-
Pb 2nd Regrind	1.2	1.0	0.20	0.01	0.02	-	-	-	-	-
Pb 2nd Cleaner	-	-	-	-	0.01	-	-	1	4	10.8
	-	-	-	0.01	0.01	-	-	1	4	-
Pb 3rd Cleaner	0.3	0.20	0.10	-	-	-	-	2	3	11.0
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 4th Cleaner	0.3	0.10	0.10	-	-	-	-	2	3	11.2
	-	-	-	0.005	0.005	-	-	1	2	-
Pb 5th Cleaner	0.3	0.05	0.05	-	-	-	-	2	4	11.3

Stage Regrinds
Equipment Laboratory Rod Mill

- Continued

Results

	Weight	Assays, %		% Distribution	
	%	Pb	Zn	Pb	Zn
Concentrate	10.80	43.4	14.3	70.2	15.8
leaner Tailing	2.07	17.6	19.0	5.5	4.0
leaner Tailing	2.40	11.0	18.3	4.0	4.5
leaner Tailing	4.18	6.82	16.9	4.3	7.2
leaner Tailing	6.81	4.26	15.0	4.3	10.5
leaner Tailing	16.01	2.04	10.9	4.9	17.9
Tailing	57.73	0.79	6.78	6.8	40.1
ulated)	100.00	6.67	9.76	100.0	100.0

Grades and Recoveries

plus 2	12.87	39.3	15.1	75.7	19.8
to 3	15.27	34.8	15.6	79.7	24.3
to 4	19.45	28.8	15.9	84.0	31.5
to 5	26.26	22.4	15.6	88.3	42.0
to 6	42.27	14.7	13.8	93.2	59.9

Test No. 103

Purpose: To investigate the effect of eliminating Na_2CO_3 from lead rougher flotation.

Procedure: As for test No. 101, but omit Na_2CO_3 addition to primary grind.

Feed: 2000 grams minus 10 mesh PPC ore sample.

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

Conditions:

Stage	Reagents Added, pounds per ton							Time, minutes			pH
	$Ca(OH)_2$	$ZnSO_4$	NaCN	R-242	R-404	Z-4/ Z-11	MIBC	Grind	Cond.	Froth	
Primary Grind	-	1.0	0.30	0.10	-	-	-	60	-	-	-
Pb Rougher	-	-	-	-	0.02	-	0.02	-	1	3	7.8
	-	-	-	0.02	0.01	-	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	-	1	4	-
Pb 1st Regrind	2.0	1.0	0.30	0.04	-	0.02	-	60	-	-	-
Pb 1st Cleaner	-	-	-	-	-	0.01	-	-	1	4	10.9
	-	-	-	0.01	-	0.01	-	-	1	6	-
Pb 2nd Regrind	1.0	1.0	-	-	-	-	-	30	-	-	-
Pb 2nd Cleaner	-	-	-	-	-	0.01	-	-	1	4	11.0
	-	-	-	0.01	-	0.01	-	-	1	4	-
Pb 3rd Cleaner	0.3	0.20	0.10	-	-	-	-	-	2	3	11.1
	-	-	-	0.01	-	0.01	-	-	1	3	-
Pb 4th Cleaner	0.3	0.10	0.10	-	-	-	-	-	2	3	11.2
	-	-	-	0.005	-	0.005	-	-	1	2	-
Pb 5th Cleaner	0.3	0.05	0.05	-	-	-	-	-	2	4	11.3

Stage Regrinds
Equipment Laboratory Rod Mill

Test No. 103 - Continued

Metallurgical Results

Products	Weight	Assays, %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	7.02	45.8	14.3	48.5	10.0
2. Pb 5th Cleaner Tailing	2.40	25.6	17.3	9.3	4.2
3. Pb 4th Cleaner Tailing	2.03	15.7	17.6	4.8	3.5
4. Pb 3rd Cleaner Tailing	3.60	10.9	17.4	5.9	6.3
5. Pb 2nd Cleaner Tailing	8.74	6.93	17.1	9.1	15.0
6. Pb 1st Cleaner Tailing	14.62	3.17	13.3	7.0	19.5
7. Pb Rougher Tailing	61.59	1.66	6.73	15.4	41.5
Head (calculated)	100.00	6.63	9.99	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	9.42	40.7	15.1	57.8	14.2
Products 1 to 3	11.45	36.2	15.5	62.6	17.7
Products 1 to 4	15.05	30.2	16.0	68.5	24.0
Products 1 to 5	23.79	21.6	16.4	77.6	39.0
Products 1 to 6	38.41	14.6	15.2	84.6	58.5

Test No. 109

Purpose: To investigate the flotation of zinc.

Procedure: Grind, lead rougher flotation, lead 1st regrind and 1st cleaner flotation as per standard conditions, except increase Na_2CO_3 in rougher to saturation level. Combine lead 1st cleaner tailing and lead rougher tailing as zinc circuit feed and float as indicated below.

Feed: 2000 grams minus 10 mesh C ore sample.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na_2CO_3	$ZnSO_4$	NaCN	R-242	R-404	MIBC	Grind	Cond.	Froth	
Primary Grind	8.0	1.0	0.30	0.10	-	-	60	-	-	-
Pb Circuit										
Pb Rougher	0.5	-	-	-	-	-	-	1	-	10.1
Pb Rougher (1)	-	-	-	-	0.02	0.004	-	1	3	10.1
Pb Rougher (2)	-	-	-	0.02	0.01	-	-	1	3	-
Pb Rougher (3)	-	-	-	0.01	0.01	-	-	1	3	-
Pb Rougher (4)	-	-	-	0.01	0.01	0.004	-	1	4	-
Pb 1st Regrind	2.0	1.0	0.30	0.05	-	-	60	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	-	-	-
	-	-	-	0.01	0.01	-	-	-	-	-
Zn Circuit	Ca-$(OH)_2$	$CuSO_4$	K_2-Cr_2O_2	Z-11-Z-6						
Zn Rougher	3.0	1.5	-	-	-	-	-	3	-	11.5
	-	-	0.05	-	-	-	-	2	-	-
Zn Rougher (1)	-	-	-	0.08	0.012	-	-	1	4	-
Zn Rougher (2)	-	-	-	0.03	0.02	-	-	1	4	-
Zn Regrind	1.0	-	0.04	0.01	-	-	20	-	-	-
Zn 1st Cleaner	-	-	-	-	-	-	-	1	2	11.4
	-			-	-	0.004	-	1	3	-
Pb 2nd Cleaner	0.3	-	-	-	-	-	-	1	2	11.4
	-	-	-	0.005	-	-	-	1	2	-
Zn 3rd Cleaner	0.2	-	-	-	-	-	-	1	3	11.5
Zn 4th Cleaner	0.2	-	-	-	-	-	-	1	3	11.6

Stage	Pb Regrinds	Zn 1st-3rd Cl.	Zn 4th Cl.	Zn Regrind
Equipment	Lab. Rod Mill	500 g D-1	250 g D-1	Abbe Pebble Mill
Speed: r.p.m.		1200	900	

Test No. 109 - Continued

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb 1st Cleaner Concentrate	24.01	23.7	17.0	88.1	40.5
2. Zn Cleaner Concentrate	5.85	1.13	52.2	1.0	30.3
3. Zn 4th Cleaner Tailing	0.74	1.84	41.5	0.2	3.0
4. Zn 3rd Cleaner Tailing	2.31	2.07	36.0	0.7	8.3
5. Zn 2nd Cleaner Tailing	2.53	2.32	18.0	0.9	4.5
6. Zn 1st Cleaner Tailing	5.63	1.90	8.59	1.7	4.8
7. Zn Rougher Tailing	58.93	0.81	1.46	7.4	8.6
Head (calculated)	100.00	6.46	10.1	100.0	100.0

Calculated Grades and Recoveries

Products 2 plus 3	6.59	1.21	51.0	1.2	33.3
Products 2 to 4	8.90	1.43	47.1	1.9	41.6
Products 2 to 5	11.43	1.63	40.7	2.8	46.1
Products 2 to 6	17.06	1.72	30.1	4.5	50.9

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