

An Investigation of  
THE RECOVERY OF LEAD AND ZINC  
from a Grum Deposit sample  
submitted by  
KERR ADDISON MINES LIMITED

Progress Report No. 2

014931

Project No. L.R. 1869

NOTE:

This report refers to the samples as received.

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LAKEFIELD RESEARCH OF CANADA LIMITED  
Lakefield, Ontario  
December 30, 1975

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

This report covers further testwork conducted on core Sample B to investigate the grades and recoveries of lead and zinc.

This testwork was directed towards investigation of the effects of recirculation of cleaner tailings in cycle tests and the effects of reduced  $\text{Na}_2\text{CO}_3$  and depressant additions in the rougher and cleaner flotation.

Results of the testwork as results became available were discussed in meetings and telephone conversations with Mr. E. Kirkpatrick of Kerr Addison Mines Limited.

LAKEFIELD RESEARCH OF CANADA LIMITED



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## S U M M A R Y

### 1. Head Sample Assays

#### Composite B

Lead (Pb)	4.75 %	4.68 %*
Zinc (Zn)	7.36 %	7.34 %*
Oxide Lead (Pb <sub>OX</sub> )	0.97 %	
Oxide Zinc (Zn <sub>OX</sub> )	0.26 %	
Copper (Cu)	0.137 %	
Iron (Fe)	20.0 %	
Sulphur (S)	26.0 %	
Magnesia (MgO)	1.20 %	
Gold (Au)	0.035 oz/ton	
Silver (Ag)	2.21 oz/ton	

\* Average head assay as calculated from test results.

### 2. Cycle Testwork

Two locked-cycle tests were conducted, following the procedure of Test 20 (P.R. No. 1) to investigate the effects of recycling the cleaner tailings on the grades and recoveries of lead and zinc. The flowsheet used for these tests is shown in Figure 1.

In Test 23 a four-stage locked-cycle test was carried out. The results were not steady after four cycles, with flotation tailing assays increasing and lead concentrate grade decreasing. The conditions of this test were repeated in Test 28, and was extended to six cycles. Zinc cleaner flotation times were increased slightly to reduce the circulating load in the zinc cleaner circuit. The projected results of the last two cycles, based on the average Pb and Zn assays of these cycles and the three-products formula, are shown below in Table 1. The concentrates and flotation tailings of the last two cycles were also assayed for Cu, Au and Ag.

Summary - Continued

Table No. 1

Test 28 - Projected Results

Product	Weight %	Assays, %			Assay oz/ton		% Distribution				
		Pb	Zn	Cu	Au	Ag	Pb	Zn	Cu	Au	Ag
Pb Cl. Conc.	6.75	61.8	7.73	0.25	0.080	20.07	89.6	7.2	12.7	28.7	64.4
Zn Cl. Conc.	10.98	0.98	56.5	0.80	0.010	4.20	2.3	85.4	66.2	5.9	21.9
Zn Ro. Tail.	82.27	0.46	0.65	0.034	0.015	0.35	8.1	7.4	21.1	65.4	13.7
Head (Calc.)	100.00	4.66	7.26	0.13	0.019	2.10	100.0	100.0	100.0	100.0	100.0

3. Effect of Reduced Depressant and Na<sub>2</sub>CO<sub>3</sub> Additions

3.1. Rougher Flotation

Testwork was carried out to investigate the effect of grinding with varying amounts of depressants and Na<sub>2</sub>CO<sub>3</sub> on rougher flotation. The results and conditions of this testwork, compared with Test 18 (Progress Report No. 1) are shown below in Table 2.

Table 2 - Rougher Flotation

Test No.	Reagents to Grind <sup>o</sup>			Collector <sup>o</sup>		pH	Flot. Time	Rougher Concentrate			
	Na <sub>2</sub> CO <sub>3</sub>	NaCN	ZnSO <sub>4</sub>	R-242	Z-11			Weight %	Assay % Pb	% Distribution Pb   Zn	
18	3.0	0.30	1.0	0.14	-	9.4	9	30.10	14.5	94.2	35.9
24	-	-	-	0.08	0.02*	7.0	10	45.85	9.19	92.2	64.6
25	-	0.10	0.30	0.02	0.04	7.4	6	31.16	13.1	88.8	41.9
26	-	0.20	0.60	0.025	0.05	7.4	8	26.07	15.6	88.4	38.1
27	-	0.20	0.60	0.04	0.08	7.2	8	36.79	11.1	90.5	50.0
29	3.0	0.10	0.30	0.03	0.06	8.9	8	29.78	14.3	93.8	37.1
30	1.5	0.10	0.30	0.03	0.06	8.2	8	30.81	13.5	89.5	35.6
31	4.0	-	-	0.03	0.06	9.2	8	33.95	12.5	91.9	44.0
32	4.0**	0.10**	0.30**	0.03	0.06	9.4	8	24.34	17.6	91.3	33.6
33	1.3	0.20	0.60	0.03	0.06	8.1	8	27.65	14.8	90.0	34.8
34	3.0	0.20	0.60	0.03	0.06	8.9	8	32.40	13.7	94.1	38.2

<sup>o</sup> lb/ton

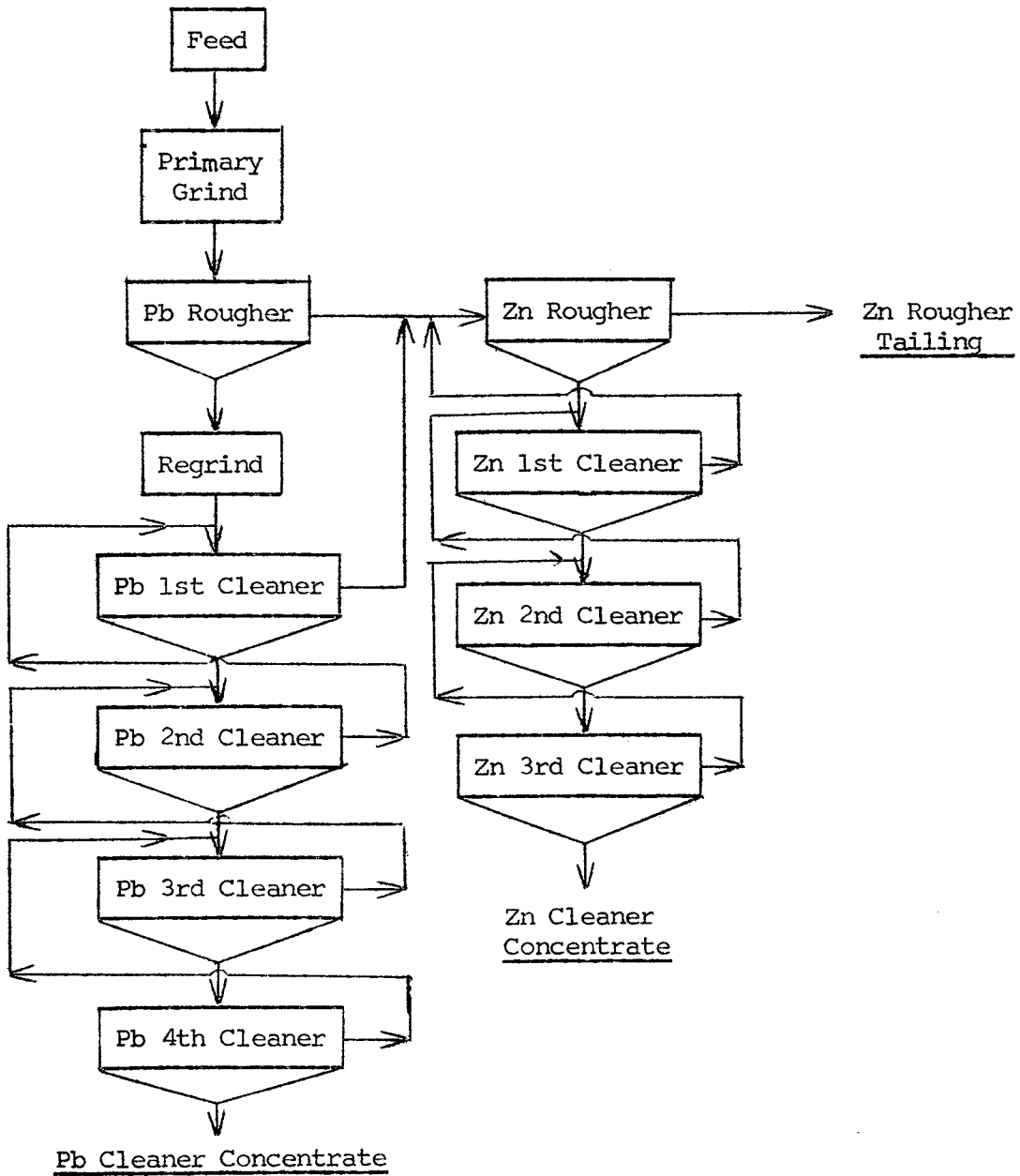
\* Z-4

\*\* Reagents added to conditioner

In these tests the ore was ground for 40 minutes at 60 percent solids in the laboratory rod mill (Power Consumption 9.2 kwh/ton, mill discharge 93.8% -200 mesh).

Figure 1

Cycle Test Flowsheet



Summary - Continued

3. Effect of Reduced Depressant and Na<sub>2</sub>CO<sub>3</sub> Additions - Cont.

3.1. Rougher Flotation

Comparison of the results of Test 18, 29 and 34 indicated that the level of NaCN and ZnSO<sub>4</sub> additions could be reduced by 0.30 and 1.0 lb/ton to 0.10 and 0.30\* respectively, with only a slight increase in the Zn content of the Pb rougher concentrate.

Sodium carbonate additions of 3 lb/ton to a pH of 8.9 in the rougher flotation resulted in the highest Pb recoveries. Omission or reduction of the amount of Na<sub>2</sub>CO<sub>3</sub> resulted in low lead recoveries.

Moving the point of addition of the depressants from the grind to a conditioner resulted in slightly improved selectivity, although the lead recovery was also slightly low.

3.2. Cleaner Flotation

The concentrates from the rougher flotation tests were reground for 40 minutes in laboratory rod mill, with further additions of Na<sub>2</sub>CO<sub>3</sub>, ZnSO<sub>4</sub> and NaCN. The results and conditions of the cleaner flotation are summarized below in Table 3, and the lead grade-recovery curves are shown in Figure 2.

\* lb/ton

Summary - Continued

3.2. Cleaner Flotation

Table 3

Lead Cleaner Flotation

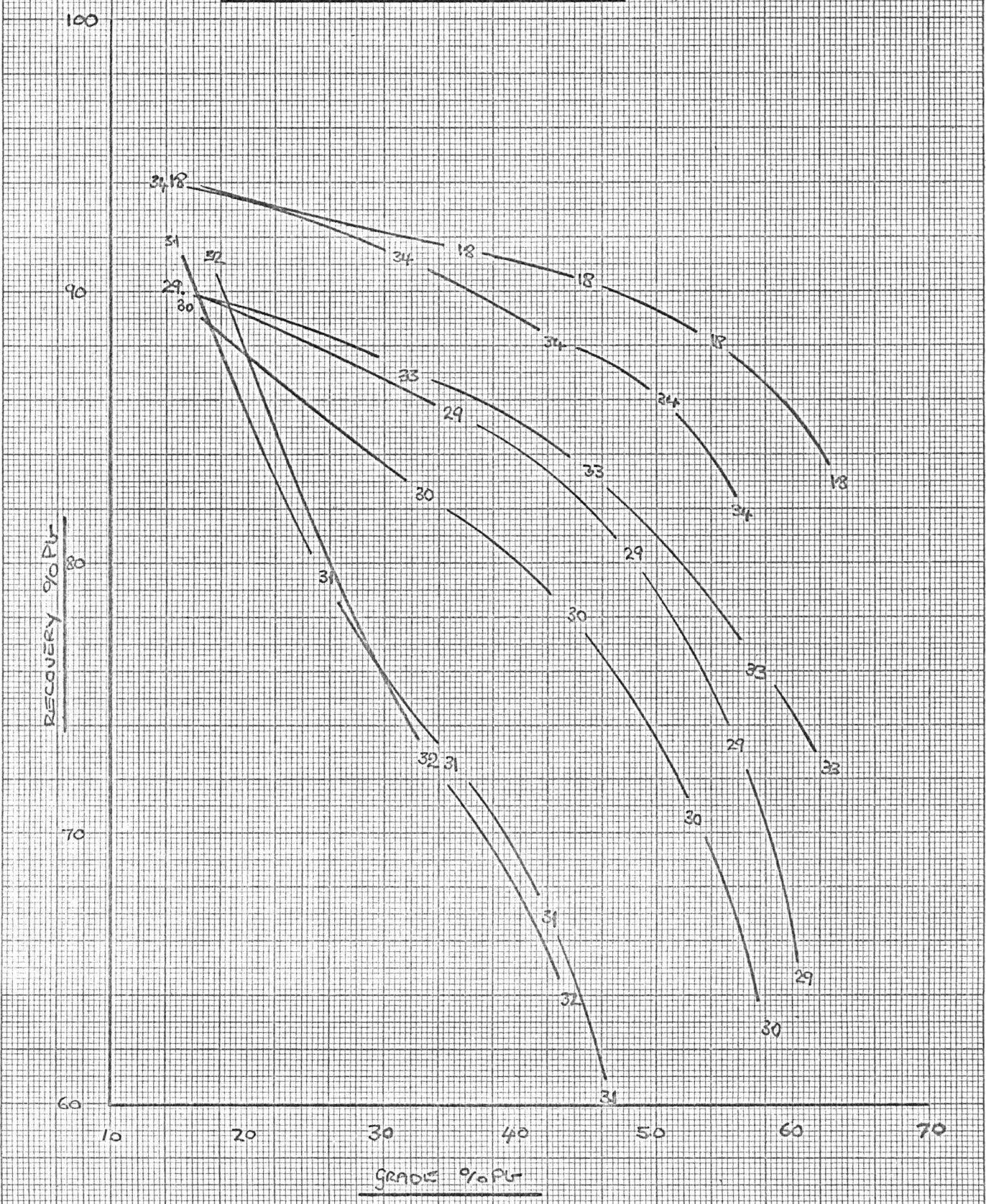
Test No.	Reagents in Cleaners			pH in Cleaners				Cleaner Concentrate				
	Na <sub>2</sub> CO <sub>3</sub>	ZnSO <sub>4</sub>	NaCN	1st	2nd	3rd	4th	Weight %	Assays %		% Distribution	
									Pb	Zn	Pb	Zn
18**	1.6	0.80	0.40	9.6	9.7	9.8	9.7	6.11	63.2	7.29	83.0	6.1
29	2.2	0.30	0.096	9.7	9.7	9.6	9.6	4.84	60.8	6.65	64.7	4.4
30	1.5	0.30	0.096	9.1	9.2	9.3	9.5	5.00	58.6	7.04	62.8	5.0
31	2.2	-	-	9.4	9.5	9.5	9.6	5.95	46.6	10.3	60.1	8.4
32*	1.7	0.30	0.096	9.3	9.5	9.6	9.6	3.65	56.9	6.24	44.2	3.1
33	1.45	0.525	0.175	9.1	9.2	9.3	9.5	5.37	61.4	7.09	72.4	5.3
34	1.7	0.525	0.175	9.4	9.5	9.5	9.6	6.83	56.4	8.12	81.9	7.5

\* No reagents to regrind

\*\* 30 minute regrind

Reduced depressant additions in the cleaner flotation resulted in poor selectivity and lower lead recovery. Conditioning with the depressants instead of as additions to the regrind in Test 32 resulted in poor selectivity and low lead recovery.

FIGURE 2  
Pb GRADE-RECOVERY CURVES



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Summary - Continued

4. Comparison of Ball and Rod Mill Grinds

In the previous testwork reported on core Composite B (Progress Report No. 1), the results of flotation after a ball mill primary grind and regrind showed lower- grade concentrates and lower pb recoveries. Reagent conditions were generally different, and the conditions of one of the rod mill primary grind and rod mill regrind tests was repeated with a ball mill grind in Test 35. The results of these tests are summarized in Table 4, and the grade recovery curves are shown in Figure 3.

Table 4 - Comparison of Rod Mill and Ball Mill Grinds

Test No.	Mill	kwh/ton		Product	Weight %	Assays, %		% Dist.	
		Primary	Regrind			Pb	Zn	Pb	Zn
18	Rod	9.2	6.9	5th Cl. Conc.	6.11	63.2	7.29	83.0	6.1
				Rougher Conc.	30.10	14.5	8.71	94.2	35.9
				Rougher Tail.	69.90	0.39	6.70	5.8	64.1
35	Ball	9.3	7.2	5th Cl. Conc.	6.62	54.0	8.26	76.6	7.5
				Rougher Conc.	29.73	15.0	9.62	95.3	39.3
				Rougher Tail.	70.27	0.31	6.27	4.7	60.7

Lead and zinc rougher recoveries were slightly higher after the ball mill grind than after the rod mill grind. However, the cleaner grade and recovery results were substantially better after the rod mill regrind than after the ball mill regrind.

The reason for this difference in results after the regrinds may be a result of:

- a) a difference in the size distribution after the regrind, and a possible sliming of galena in the ball mill regrind.
- b) different amounts of abraded iron in the pulp, because of the different steel compositions of the mills and mill loads of the ball and rod mills.

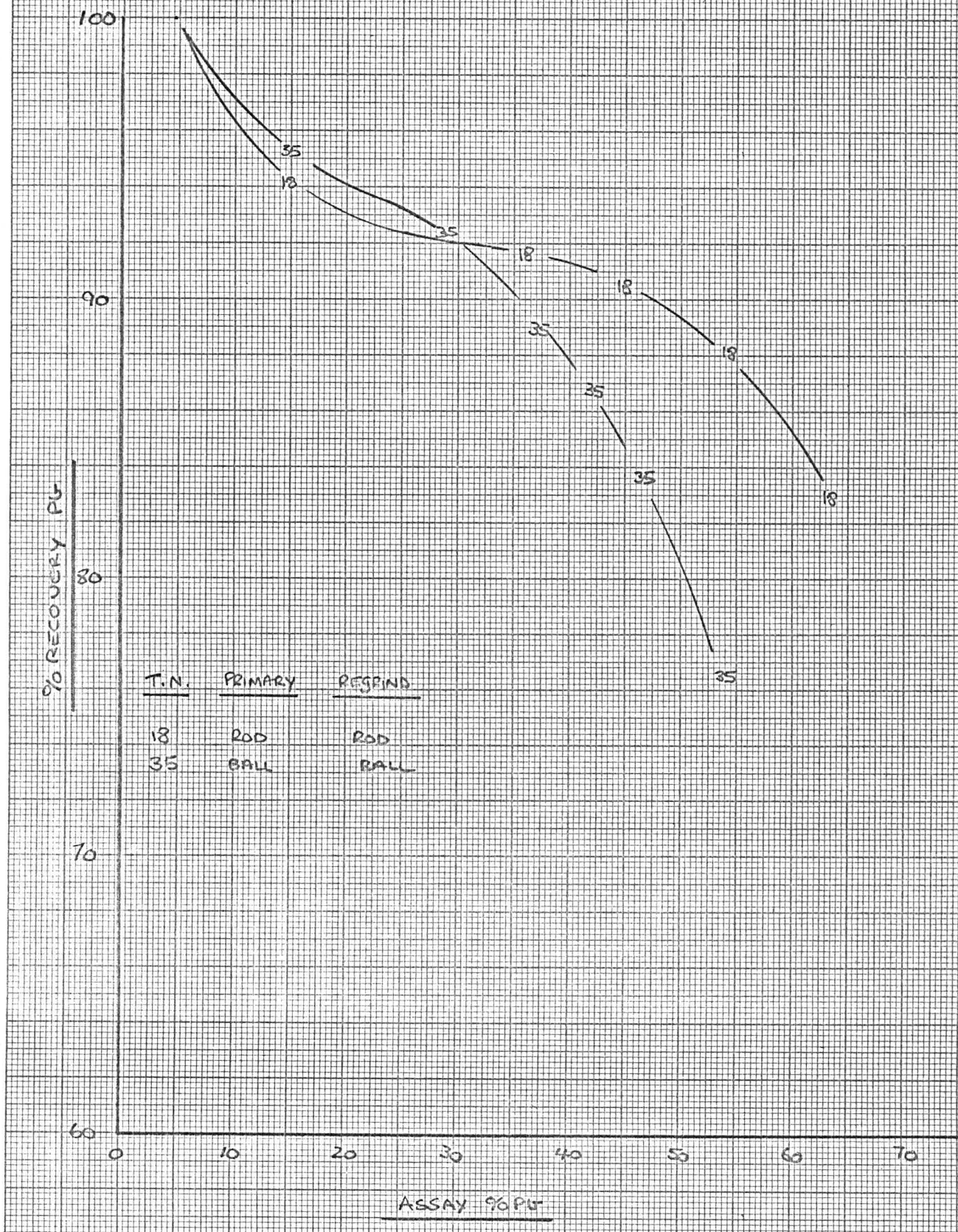
Summary - Continued

4. Comparison of Ball and Rod Mill Grinds - Cont.

The rod mill shell and rod load are made of mild steel, and the ball mill is made of cast steel. Further investigation of the reason for the differences in the response after a ball and a rod mill regrind is underway on samples of the bulk pilot plant ore (L.R. Project No. 1868).

FIGURE 3

EFFECT OF ROD MILL AND BALL MILL GRINDING



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SAMPLE PREPARATION

Four drums, weighing approximately 300 pounds, containing crushed drill core samples were received at Lakefield on August 13th, 1975, and given our Reference No. 7520755. The drums were described as B-1 to B-4.

The contents of each drum were jaw and cone-crushed to minus 1/4 inch, and one-quarter of each sample was riffled out. These one-quarter splits were then mixed, roll-crushed to minus 10 mesh, and riffled into 2 kg. charges for testwork, and a sample for screen analyses and head analysis.

Later the remainder of the minus 1/4 inch material was combined, crushed to minus 10 mesh and riffled into 2 kg. charges for further testwork.

Screen Analysis

Minus 10 Mesh Head Sample

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 14	5.4	5.4	94.6
20	16.1	21.5	78.5
28	15.5	37.0	63.0
35	11.5	48.5	51.5
48	9.3	57.8	42.2
65	6.5	64.3	35.7
100	6.0	70.3	29.7
150	4.9	75.2	24.8
200	5.1	80.3	19.7
270	3.7	84.0	16.0
400	4.2	88.2	11.8
- 400	11.8	100.0	-
Total	100.0	-	-

DETAILS OF TESTS

Test No. 23

Purpose: To perform a four-stage locked-cycle test following the procedure of Test No. 20.

Procedure: See flowsheet.

Feed: Four 2000 gram charges minus 10 mesh Composite B.

Grind: 40 minutes per charge at 65 percent solids in the laboratory rod mill.

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Na <sub>2</sub> CO <sub>3</sub>	ZnSO <sub>4</sub>	NaCN	R-242	R-404	Grind	Cond.	Froth	
<u>Primary Grind</u> <u>Pb Circuit</u>	3.0	1.0	0.30	0.08	-	40	-	-	-
Pb Rougher	1.0	-	-	0.01	0.02	-	1	3	9.3
	-	-	-	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 Cleaner	-	-	-	-	-	-	1	3	9.5
	-	-	-	0.01	0.01	-	1	3	-
Pb 2nd Cleaner	0.2	0.2	0.10	-	-	-	1	3	9.6
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	1	2½	9.7
Pb 4th Cleaner	0.2	-	0.05	-	-	-	1	2	9.6
<u>Zn Circuit</u>	Ca(OH) <sub>2</sub>	CuSO <sub>4</sub>	Z-200	MIBC					
Condition	2.0	1.0	-	-	-	-	2	-	-
Zn Rougher	-	-	0.08	0.02	-	-	1	3	10.5
	-	-	0.02	0.01	-	-	1	2	-
Zn 1st Cleaner	0.4	-	-	-	-	-	1	3	11.0
Zn 2nd Cleaner	0.3	-	-	-	-	-	1	2½	11.0
Zn 3rd Cleaner	0.3	-	-	-	-	-	1	2	11.0

Stage	Rougher	1st & 2nd Cl.	3rd & 4th Cl.	Pb Conc. Regrind
Equipment	1000 gram D-1	500 gram D-1	250 gram D-1	Rod Mill
Speed rpm	1800	1300	1000	-
% Solids	33	-	-	-

Stage	Rougher	Zn Cleaners
Equipment	1000 gram D-1	500 gram D-1
Speed rpm	1800	1300

Test No. 23 - Continued

Metallurgical Results

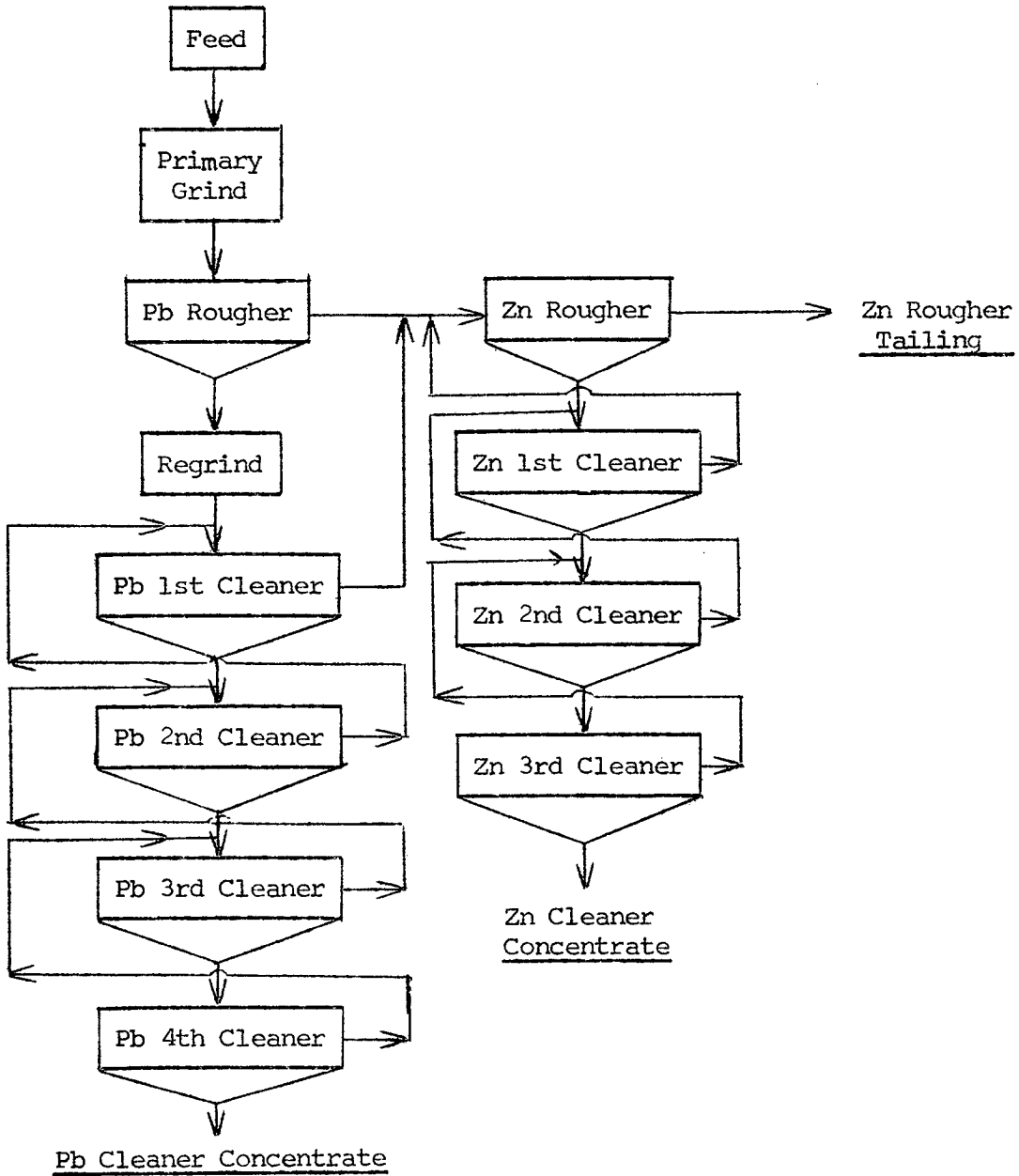
Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc. A	1.31	71.8	5.30	19.9	0.9
2. Pb Cleaner Conc. B	1.36	72.2	5.38	20.7	1.0
3. Pb Cleaner Conc. C	1.52	69.6	6.29	22.3	1.3
4. Pb Cleaner Conc. D	1.72	64.4	7.70	23.4	1.8
5. Pb 4th Cl. Tail. D	0.37	17.1	18.8	1.3	0.9
6. Pb 3rd Cl. Tail. D	0.65	9.92	19.2	1.4	1.7
7. Pb 2nd Cl. Tail. D	1.79	4.86	16.6	1.8	4.0
8. Pb 1st Cl. Tail. D	4.99	0.71	9.48	0.8	6.4
9. Zn Cleaner Conc. A	1.56	0.54	57.6	0.2	12.1
10. Zn Cleaner Conc. B	1.75	0.54	58.0	0.2	13.7
11. Zn Cleaner Conc. C	1.38	0.76	56.0	0.2	10.5
12. Zn Cleaner Conc. D	1.89	0.86	57.0	0.3	14.6
13. Zn 3rd Cl. Tail. D	1.12	1.02	46.0	0.2	7.0
14. Zn 2nd Cl. Tail. D	6.47	0.59	9.87	0.8	8.6
15. Zn 1st Cl. Tail. D	12.57	0.63	5.77	1.7	9.8
16. Zn Rougher Tail. A	10.65	0.31	0.50	0.7	0.7
17. Zn Rougher Tail. B	19.96	0.39	0.68	1.6	1.8
18. Zn Rougher Tail. C	13.54	0.36	0.75	1.1	1.4
19. Zn Rougher Tail. D	15.40	0.41	0.85	1.3	1.8
Head (Calculated)	100.00	4.73	7.40	100.0	100.0

Calculated Grades and Recoveries

Combined Pb Cl. Conc.	5.91	69.2	6.27	86.3	5.0
Combined Pb Cl. Tail.	7.80	3.21	12.37	5.4	13.0
Combined Zn Cl. Conc.	6.58	0.68	57.2	0.9	50.9
Combined Zn Cl. Tail.	20.16	0.64	9.32	2.7	25.4
Combined Zn Ro. Tail.	59.55	0.37	0.71	4.7	5.7

Test No. 23 - Continued

Cycle Test Flowsheet



Test No. 24

**Purpose:** To attempt to increase the Pb recovery obtained in Test No. 22 by adding R-242 and Z-4 to the grind.

**Procedure:** Grind and float a Pb rougher concentrate. Regrind and clean four times.

**Feed:** 2000 grams minus 10 mesh Composite B.

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

**Conditions:**

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Ca-(OH) <sub>2</sub>	R-242	Z-4	MIBC	NaCN	Na <sub>2</sub> -CO <sub>3</sub>	Grind	Cond.	Froth	
Primary Grind	-	0.08	0.02	-	-	-	40	-	-	-
<u>Pb Circuit</u>										
Pb Rougher	-	-	-	0.02	-	-	-	1	5	7.0
	-	0.02	0.01	-	-	-	-	1	3	-
	-	0.01	-	-	-	-	-	1	2	-
	-	0.01	-	-	-	-	-	1	3	-
Pb Conc. Regrind	-	0.02	-	-	-	-	20	-	-	-
Pb 1st Cleaner	-	-	-	0.008	-	-	-	1	3	-
	-	0.01	-	-	-	-	-	1	2	-
	-	0.02	-	-	-	-	-	1	2	-
Aerate 5 min.	-	0.02	-	-	-	-	-	1	1	-
Pb 2nd Cleaner	-	-	-	-	0.20	2.00	-	5	3½	9.8
Pb 3rd Cleaner	-	-	-	-	0.10	0.50	-	5	-	9.8
	-	-	-	-	-	-	-	1	3	-
Pb 4th Cleaner	0.60	-	-	-	-	-	-	2	2	10.9

Stage	Rougher	Pb Regrind	1st Cleaner	2nd & 3rd Cleaners
Equipment	1000 gram D-1	Rod Mill	500 g D-1	250 g D-1
Speed rpm	1800	-	1300	1000
% Solids	33	-	-	-

Test No. 24 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb 4th Cl. Conc.	6.47	41.9	9.86	59.3	9.0
2. Pb 4th Cl. Tail.	1.61	13.1	11.9	4.6	2.7
3. Pb 3rd Cl. Tail.	2.53	8.77	12.0	4.9	4.3
4. Pb 2nd Cl. Tail.	11.45	3.33	8.96	8.3	14.4
5. Pb 1st Cl. Tail.	23.79	2.89	10.2	15.1	34.2
6. Pb Rougher Tail.	54.15	0.66	4.65	7.8	35.4
Head (Calculated)	100.00	4.57	7.10	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	8.08	36.2	10.3	63.9	11.7
Products 1 to 3	10.61	29.6	10.7	68.8	16.0
Products 1 to 4	22.06	16.0	9.79	77.1	30.4
Products 1 to 5	45.85	9.19	10.00	92.2	64.6

Test No. 25

**Purpose:** To investigate the effect of omitting the  $\text{Na}_2\text{CO}_3$  from the rougher flotation on the grade and recovery of lead and zinc.

**Procedure:** Grind and float a Pb rougher concentrate. Regrind and clean once.

**Feed:** 2000 grams minus 10 mesh Composite B.

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

**Conditions:**

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Z-11	R-242	MIBC	NaCN	ZnSO <sub>4</sub>	Grind	Cond.	Froth	
Grind	-	-	-	0.10	0.30	40	-	-	-
Pb Rougher	0.02	0.01	0.02	-	-	-	1	2	7.4
	0.01	0.005	-	-	-	-	1	2	-
	0.01	0.005	0.012	-	-	-	1	2	-
Pb Scav. No. 1	0.01	0.005	-	-	-	-	1	2	-
Pb Scav. No. 2	0.01	0.005	-	-	-	-	1	2	-
Pb Conc. Regrind	-	-	-	0.05	0.15	20	-	-	-
Pb 1st Cleaner	0.01	0.005	0.008	-	-	-	1	3	7.7
	0.01	0.005	-	-	-	-	1	2	-

Stage	Rougher	Regrind	Pb 1st Cleaner
Equipment	1000 gram D-1	Lab. Rod Mill	500 gram D-1
Speed rpm	1800	-	1300

Test No. 25 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb 1st Cl. Conc.	10.44	23.7	8.72	53.8	12.7
2. Pb 1st Cl. Tail.	20.72	7.75	10.1	35.0	29.2
3. Pb Scav. Conc. No. 1	13.81	1.04	4.39	3.1	8.4
4. Pb Scav. Conc. No. 2	8.10	0.86	5.63	1.5	6.4
5. Scavenger Tailing	46.93	0.65	6.62	6.6	43.3
Head (Calculated)	100.00	4.60	7.17	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	31.16	13.1	9.64	88.8	41.9
Products 3 to 5	68.84	0.75	6.06	11.2	58.1

Test No. 26

Purpose: To repeat Test No. 25, but with increased additions of depressants to the grind.

Procedure: As for Test No. 25.

Feed: 2000 grams minus 10 mesh Composite B.

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

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Z-11	R-242	MIBC	NaCN	ZnSO <sub>4</sub>	Grind	Cond.	Froth	
Grind	-	-	-	0.20	0.60	40	-	-	-
Pb Rougher	0.02	0.01	0.02	-	-	-	1	2	7.4
	0.01	0.005	-	-	-	-	1	2	-
	0.01	0.005	0.012	-	-	-	1	2	-
	0.01	0.005	-	-	-	-	1	2	-
Pb Conc. Re grind	0.01	0.02	-	0.05	0.15	20	-	-	-
Pb 1st Cleaner	-	-	0.008	-	-	-	1	2	7.7
	0.01	0.005	-	-	-	-	1	2	-
	0.01	0.005	0.008	-	-	-	1	2	-
Pb 2nd Cleaner	-	-	-	0.10	-	-	1	4	8.0

Stage	Rougher	Regrind	Pb 1st Cleaner	Pb 2nd Cleaner
Equipment	1000 gram D-1	Lab Rod Mill	500 gram D-1	250 gram D-1
Speed rpm	1800	-	1300	1000

Test No. 26 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	8.00	33.6	10.7	58.4	11.7
2. Pb 2nd Cl. Tail.	6.44	7.07	11.0	9.9	9.7
3. Pb 1st Cl. Tail.	11.63	7.95	10.5	20.1	16.7
4. Pb Rougher Tail.	73.93	0.72	6.10	11.6	61.9
Head (Calculated)	100.00	4.60	7.30	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	14.44	21.8	10.8	68.3	21.4
Products 1 to 3	26.07	15.6	10.7	88.4	38.1

Test No. 27

**Purpose:** To investigate the effect of adding collector to the primary grind when following the procedure of Test 26, and also to investigate the effect of reduced Z-200 additions to the zinc rougher flotation.

**Procedure:** Grind and float a Pb rougher concentrate. Re grind and clean three times. Float a Zn rougher concentrate from the Pb rougher tailings and clean twice.

**Feed:** 2000 grams minus 10 mesh Composite B.

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

**Conditions:**

Stage	Reagents Added, pounds per ton								Time, minutes			pH
	Z-200	ZnSO <sub>4</sub>	NaCN	R-242	Z-11	MIBC	Ca-(OH) <sub>2</sub>	Cu-SO <sub>4</sub>	Grind	Cond.	Froth	
Grind	-	0.60	0.20	0.02	0.04	-	-	-	40	-	-	-
Pb Rougher	-	-	-	-	-	0.02	-	-	-	1	2	7.2
	-	-	-	0.015	0.03	-	-	-	-	1	3	-
	-	-	-	0.005	0.01	0.012	-	-	-	1	3	-
Zn Rougher	-	-	-	-	-	-	3.0	1.0	-	5	-	11.5
	0.02	-	-	-	-	-	-	-	-	1	2	-
	0.02	-	-	-	-	-	-	-	-	1	2	-
Pb Conc. Regrind	-	-	-	-	-	-	-	-	40	-	-	-
Pb 1st Cl.	-	0.30	0.10	-	-	-	-	-	-	2	2	6.9
	-	-	-	0.01	-	-	-	-	-	1	2	-
	-	-	-	0.01	-	-	-	-	-	1	2	-
Pb 2nd Cl.	-	-	0.20	-	-	-	-	-	-	2	4	7.0
	-	-	-	0.005	-	-	-	-	-	1	1	-
Pb 3rd Cl.	-	-	0.20	-	-	-	-	-	-	1	3	7.2
Zn 1st Cl.	-	-	-	-	-	-	0.5	-	-	1	3	11.5
	0.006	-	-	-	-	-	-	-	-	1	2	-
Zn 2nd Cl.	-	-	-	-	-	-	0.10	-	-	1	2	11.0
	-	-	-	-	-	0.008	-	-	-	1	1	-

Stage	Pb & Zn Ro.	Pb Conc. Regrind	Pb 1st Cl.	Pb 2nd & 3rd Cl.
Equipment	1000 g D-1	Lab Rod Mill	500 g D-1	500 g D-1
Speed rpm	1800	-	1300	1000
Stage	Zn 1st Cl.	Zn 2nd Cl.		
Equipment	500 g D-1	250 g D-1		
Speed rpm	1300	1000		

Test No. 27 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	10.71	30.8	10.6	72.9	15.9
2. Pb 3rd Cl. Tail.	4.39	8.82	11.7	8.5	7.2
3. Pb 2nd Cl. Tail.	4.35	4.12	11.7	4.0	7.1
4. Pb 1st Cl. Tail.	17.34	1.33	8.13	5.1	19.8
5. Zn Cleaner Conc.	6.47	0.79	47.2	1.1	42.9
6. Zn 2nd Cl. Tail.	0.58	2.89	14.2	0.4	1.2
7. Zn 1st Cl. Tail.	1.35	3.50	5.93	1.0	1.1
8. Zn Rougher Tail.	54.81	0.58	0.62	7.0	4.8
Head (Calculated)	100.00	4.53	7.12	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	15.10	24.4	10.9	81.4	23.1
Products 1 to 3	19.45	19.9	11.1	85.4	30.2
Products 1 to 4	36.79	11.1	9.70	90.5	50.0
Products 5 and 6	7.05	0.96	44.5	1.5	44.1
Products 5 to 7	8.40	1.37	38.3	2.5	45.2

Test No. 28

**Purpose:** To repeat Test No. 23, but extend the test to six cycles in an attempt to reach equilibrium.

**Procedure:** Flowsheet as for Test No. 23.

**Feed:** Six 2000 gram charges minus 10 mesh Composite B.

**Grind:** 40 minutes per charge at 65 percent solids in the laboratory rod mill.

**Conditions:**

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Na <sub>2</sub> CO <sub>3</sub>	ZnSO <sub>4</sub>	NaCN	R-242	R-404	Grind	Cond.	Froth	
<u>Primary Grind</u>	3.0	1.0	0.30	0.08	-	40	-	-	-
<u>Pb Circuit</u>									
Pb Rougher	1.0	-	-	0.01	0.02	-	1	3	9.2
	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	0.01	0.01	-	1	3	-
Pb Conc. Re grind	1.0	0.5	0.20	0.03	-	40	-	-	-
Pb 1st Cleaner	-	-	-	-	-	-	1	3	9.5
	-	-	-	0.01	0.01	-	1	3	-
Pb 2nd Cleaner	0.2	0.2	0.10	-	-	-	1	3	9.5
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	1	2½	9.7
Pb 4th Cleaner	0.2	-	0.05	-	-	-	1	2	9.7
<u>Zn Circuit</u>									
	Ca(OH) <sub>2</sub>	CuSO <sub>4</sub>	Z-200	MIBC					
Condition	3.0	1.0	-	-	-	-	2	-	10.9
Zn Rougher	-	-	0.06	0.02	-	-	1	3	-
	-	-	0.02	-	-	-	1	2	-
Zn 1st Cleaner	0.4	-	-	-	-	-	1	4	11.0
Zn 2nd Cleaner	0.3	-	-	-	-	-	1	3	11.1
Zn 3rd Cleaner	0.2	-	-	-	-	-	1	2½	11.1

Stage	Pb Rougher	Pb Conc. Re grind	Pb 1st & 2nd Cl.	Pb 3rd & 4th Cl.
Equipment	1000 gram D-1	Rod Mill	500 g D-1	250 g D-1
Speed rpm	1800	-	1300	1000

Stage	Rougher	Zn Cleaners
Flotation Cell	1000 gram D-1	500 g D-1
Speed rpm	1800	1300

Test No. 28 - Continued

Metallurgical Results

Product	Weight	Assays %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb Cleaner Conc. A	0.98	66.4	6.53	14.0	0.9
2. Pb Cleaner Conc. B	1.05	62.0	7.39	14.0	1.1
3. Pb Cleaner Conc. C	0.99	64.4	6.99	13.7	1.0
4. Pb Cleaner Conc. D	1.05	62.2	7.26	14.0	1.0
5. Pb Cleaner Conc. E	1.16	61.7	7.73	15.4	1.2
6. Pb Cleaner Conc. F	1.12	62.0	7.72	14.9	1.2
7. Pb 4th Cl. Tail. F	0.37	16.2	16.8	1.3	0.9
8. Pb 3rd Cl. Tail. F	0.66	8.32	16.8	1.2	1.5
9. Pb 2nd Cl. Tail. F	1.54	4.78	14.5	1.6	3.1
10. Pb 1st Cl. Tail. F	3.01	0.86	9.16	0.5	3.7
11. Zn Cleaner Conc. A	1.28	0.51	53.9	0.1	9.5
12. Zn Cleaner Conc. B	1.71	0.84	49.8	0.3	11.7
13. Zn Cleaner Conc. C	1.16	0.65	56.3	0.2	9.0
14. Zn Cleaner Conc. D	1.17	0.84	55.3	0.2	8.9
15. Zn Cleaner Conc. E	1.36	0.97	56.4	0.3	10.6
16. Zn Cleaner Conc. F	1.49	0.98	56.6	0.3	11.6
17. Zn 3rd Cl. Tail. F	0.66	1.54	47.9	0.2	4.4
18. Zn 2nd Cl. Tail. F	1.50	1.41	37.4	0.5	7.7
19. Zn 1st Cl. Tail. F	1.95	1.29	10.7	0.5	2.9
20. Zn Rougher Tail. A	9.86	0.33	0.67	0.7	0.9
21. Zn Rougher Tail. B	12.02	0.35	0.72	0.9	1.2
22. Zn Rougher Tail. C	13.14	0.45	0.79	1.3	1.4
23. Zn Rougher Tail. D	13.47	0.43	1.14	1.2	2.1
24. Zn Rougher Tail. E	13.65	0.50	0.68	1.5	1.3
25. Zn Rougher Tail. F	13.65	0.42	0.62	1.2	1.2
Head (Calculated)	100.00	4.66	7.26	100.0	100.0

Calculated Grades and Recoveries

Combined Pb Cl. Conc.	6.35	63.0	7.29	86.0	6.4
Combined Pb Cl. Tail.	5.58	3.84	12.04	4.6	9.2
Combined Zn Cl. Conc.	8.17	0.81	54.5	1.4	61.3
Combined Zn Cl. Tail.	4.11	1.37	26.4	1.2	15.0
Combined Zn Ro. Tail.	75.79	0.42	0.78	6.8	8.1

Test No. 28 - Continued

Projected Results of Cycles E and F (Three Product Formula)

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
Pb Cleaner Conc.	6.75	61.8	7.73	89.6	7.2
Zn Cleaner Conc.	10.98	0.98	56.5	2.3	85.4
Zn Rougher Tailing	82.27	0.46	0.65	8.1	7.4
Head (Calculated)	100.00	4.66	7.26	100.0	100.0

Projected Results of Cycles E and F - Cont.

Product	Weight %	Assays, %			% Distribution		
		Cu	Au*	Ag*	Cu	Au	Ag
Pb Cleaner Conc.	6.75	0.25	0.080	20.07	12.7	28.7	64.4
Zn Cleaner Conc.	10.98	0.80	0.010	4.20	66.2	5.9	21.9
Zn Rougher Tailing	82.27	0.034	0.015	0.35	21.1	65.4	13.7
Head (Calculated)	100.00	0.13	0.019	2.10	100.0	100.0	100.0

\* ounces per ton

Test No. 29

**Purpose:** To investigate the effect of grinding with depressants, but omit collector and float lead by adding Z-11 and 242 to the cell.

**Procedure:** Grind and float a lead rougher concentrate. Regrind the concentrate and clean four times.

**Feed:** 2000 grams minus 10 mesh Composite B.

**Grind:** 40 minutes at 67 percent solids in the laboratory rod mill.

**Conditions:**

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na <sub>2</sub> CO <sub>3</sub>	NaCN	ZnSO <sub>4</sub>	Z-11	R-242	MLBC	Grind	Cond.	Froth	
Primary Grind	3.0	0.10	0.30	-	-	-	40	-	-	-
Pb Rougher	-	-	-	0.02	0.01	0.02	-	1	2	8.9
	-	-	-	0.02	0.01	0.01	-	1	2	-
	-	-	-	0.01	0.005	0.01	-	1	2	-
	-	-	-	0.01	0.005	-	-	1	2	-
Pb Conc. Regrind	1.5	0.05	0.15	-	-	-	40	-	-	-
Pb 1st Cleaner	-	-	-	0.01	0.005	-	-	1	2	9.7
	-	-	-	0.01	0.005	-	-	1	2	-
	-	-	-	0.01	0.005	-	-	1	2	-
Pb 2nd Cleaner	0.2	0.03	0.10	-	-	-	-	1	2	9.7
	-	-	-	0.005	0.0025	-	-	1	2	-
Pb 3rd Cleaner	0.2	0.016	0.05	-	-	0.005	-	1	3	9.6
Pb 4th Cleaner	0.3	-	-	-	-	0.005	-	1	2	9.6

Stage	Rougher	Regrind	1st Cleaner	2nd to 4th Cleaner
Equipment	1000 gram D-1	Rod Mill	500 gram D-1	250 gram D-1
Speed rpm	1800	-	1300	1000
% Solids	33	-	-	-

Test No. 29 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	4.84	60.8	6.65	64.7	4.4
2. Pb 4th Cl. Tail.	1.13	34.7	11.6	8.6	1.8
3. Pb 3rd Cl. Tail.	1.62	20.0	13.2	7.1	3.0
4. Pb 2nd Cl. Tail.	3.49	6.68	11.8	5.1	5.7
5. Pb 1st Cl. Tail.	18.70	2.02	8.60	8.3	22.2
6. Pb Rougher Tail.	70.22	0.40	6.48	6.2	62.9
Head (Calculated)	100.00	4.55	7.24	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	5.97	55.9	7.59	73.3	6.2
Products 1 to 3	7.59	48.2	8.79	80.4	9.2
Products 1 to 4	11.08	35.1	9.73	85.5	14.9
Products 1 to 5	29.78	14.3	9.02	93.8	37.1

Test No. 30

Purpose: To repeat Test No. 29, but use only half the amount of soda ash.

Procedure: As for Test No. 29.

Feed: 2000 grams minus 10 mesh Composite B.

Grind: 40 minutes at 67 percent solids in the laboratory rod mill.

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na <sub>2</sub> CO <sub>3</sub>	NaCN	ZnSO <sub>4</sub>	Z-11	R-242	MIBC	Grind	Cond.	Froth	
Primary Grind	1.5	0.10	0.30	-	-	-	40	-	-	-
Pb Rougher	-	-	-	0.02	0.01	0.02	-	1	2	8.2
	-	-	-	0.02	0.01	0.01	-	1	2	-
	-	-	-	0.01	0.005	0.01	-	1	2	-
	-	-	-	0.01	0.005	-	-	1	2	-
Pb Conc. Re grind	0.8	0.05	0.15	-	-	-	40	-	-	-
Pb 1st Cleaner	-	-	-	0.01	0.005	0.005	-	1	2	9.1
	-	-	-	0.01	0.005	-	-	1	2	-
	-	-	-	0.01	0.005	-	-	1	2	-
Pb 2nd Cleaner	0.2	0.03	0.10	-	-	-	-	1	2	9.2
	-	-	-	0.005	0.0025	-	-	1	2	-
Pb 3rd Cleaner	0.2	0.016	0.05	-	-	0.005	-	1	3	9.3
Pb 4th Cleaner	0.3	-	-	-	-	0.005	-	1	2	9.5

Test No. 30 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	5.00	58.6	7.04	62.8	5.0
2. Pb 4th Cl. Tail.	1.24	29.3	11.2	7.8	2.0
3. Pb 3rd Cl. Tail.	2.01	17.3	11.5	7.5	3.3
4. Pb 2nd Cl. Tail.	3.41	6.14	10.7	4.5	5.1
5. Pb 1st Cl. Tail.	19.15	1.69	7.48	6.9	20.2
6. Pb Rougher Tail.	69.19	0.71	6.60	10.5	64.4
Head (Calculated)	100.00	4.66	7.09	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	6.24	52.8	7.87	70.6	7.0
Products 1 to 3	8.25	44.1	8.75	78.1	10.3
Products 1 to 4	11.66	33.0	9.32	82.6	15.4
Products 1 to 5	30.81	13.5	8.18	89.5	35.6

Test No. 31

Purpose: To investigate the effect of soda ash as the only depressant in flotation.

Procedure: As for Test No. 29.

Feed: 2000 grams minus 10 mesh Composite B.

Grind: 40 minutes at 67 percent solids in the laboratory rod mill.

Conditions:

Stage	Reagents Added, pounds per ton				Time, minutes			pH
	Na <sub>2</sub> CO <sub>3</sub>	Z-11	R-242	MIBC	Grind	Cond.	Froth	
Primary Grind	4.0	-	-	-	40	-	-	-
Pb Rougher	-	0.02	0.01	0.02	-	1	2	9.2
	-	0.02	0.01	0.01	-	1	2	-
	-	0.01	0.005	0.01	-	1	2	-
	-	0.01	0.005	-	-	1	2	-
Pb Conc. Re grind	1.5	-	-	-	40	-	-	-
Pb 1st Cleaner	-	0.01	0.005	-	-	1	2	9.4
	-	0.01	0.005	-	-	1	2	-
	-	0.01	0.005	-	-	1	2	-
Pb 2nd Cleaner	0.2	-	-	-	-	1	2	9.5
	-	0.005	0.0025	-	-	1	2	-
Pb 3rd Cleaner	0.2	-	-	0.005	-	1	3	9.5
Pb 4th Cleaner	0.3	-	-	0.005	-	1	2	9.6

Test No. 31 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	5.95	46.6	10.3	60.1	8.4
2. Pb 4th Cl. Tail.	1.33	23.2	13.2	6.7	2.4
3. Pb 3rd Cl. Tail.	2.27	11.8	11.8	5.8	3.7
4. Pb 2nd Cl. Tail.	4.56	6.98	10.6	6.9	6.6
5. Pb 1st Cl. Tail.	19.84	2.88	8.44	12.4	22.9
6. Pb Rougher Tail.	66.05	0.57	6.19	8.1	56.0
Head (Calculated)	100.00	4.62	7.30	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	7.28	42.3	10.8	66.8	10.8
Products 1 to 3	9.55	35.1	11.1	72.6	14.5
Products 1 to 4	14.11	26.0	10.9	79.5	21.1
Products 1 to 5	33.95	12.5	9.47	91.9	44.0

Test No. 32

**Purpose:** To investigate the effect of adding the depressants to the conditioner rather than to the mill.

**Procedure:** Grind, condition and float a lead rougher concentrate. Re grind the concentrate and clean four times.

**Feed:** 2000 grams minus 10 mesh Composite B.

**Grind:** 40 minutes at 67 percent solids in the laboratory rod mill.

**Conditions:**

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na <sub>2</sub> CO <sub>3</sub>	NaCN	ZnSO <sub>4</sub>	Z-11	R-242	MIBC	Grind	Cond.	Froth	
Grind	-	-	-	-	-	-	40	-	-	-
Condition	4.0	0.10	0.30	-	-	-	-	5	-	9.4
Pb Rougher	-	-	-	0.02	0.01	0.02	-	1	2	-
	-	-	-	0.02	0.01	0.01	-	1	2	-
	-	-	-	0.01	0.005	0.01	-	1	2	-
	-	-	-	0.01	0.005	-	-	1	2	-
Pb Conc. Regrind	-	-	-	-	-	-	40	-	-	-
Condition	1.0	0.05	0.15	-	-	-	-	5	-	-
Pb 1st Cl.	-	-	-	0.01	0.005	0.005	-	1	2	9.3
	-	-	-	0.01	0.005	-	-	1	2	-
	-	-	-	0.01	0.005	-	-	1	2	-
Pb 2nd Cl.	0.2	0.03	0.10	-	-	-	-	1	2	9.5
	-	-	-	0.005	0.0025	-	-	1	2	-
Pb 3rd Cl.	0.2	0.016	0.05	-	-	-	-	1	3	9.6
Pb 4th Cl.	0.3	-	-	-	-	-	-	1	2	9.6

Test No. 32 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	3.65	56.9	6.24	44.2	3.1
2. Pb 4th Cl. Tail.	1.29	34.4	9.88	9.4	1.7
3. Pb 3rd Cl. Tail.	1.90	25.7	11.2	10.4	2.9
4. Pb 2nd Cl. Tail.	3.36	12.3	11.3	8.8	5.2
5. Pb 1st Cl. Tail.	14.14	6.13	10.7	18.5	20.7
6. Pb Rougher Tail.	75.66	0.54	6.41	8.7	66.4
Head (Calculated)	100.00	4.70	7.31	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	4.94	51.0	7.19	53.6	4.8
Products 1 to 3	6.84	44.0	8.31	64.0	7.7
Products 1 to 4	10.20	33.6	9.29	72.8	12.9
Products 1 to 5	24.34	17.6	10.1	91.3	33.6

Test No. 33

**Purpose:** To repeat Test No. 30, but double the cyanide and zinc sulphate additions.

**Procedure:** As for Test No. 29.

**Feed:** 2000 grams minus 10 mesh Composite B.

**Grind:** 40 minutes at 67 percent solids in the laboratory rod mill.

**Conditions:**

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na <sub>2</sub> CO <sub>3</sub>	NaCN	ZnSO <sub>4</sub>	Z-11	R-242	MIBC	Grind	Cond.	Froth	
Primary Grind	1.5	0.20	0.60	-	-	-	40	-	-	-
Pb Rougher	-	-	-	0.02	0.01	0.02	-	1	2	8.1
	-	-	-	0.02	0.01	0.01	-	1	2	-
	-	-	-	0.01	0.005	0.01	-	1	2	-
	-	-	-	0.01	0.005	-	-	1	2	-
Pb Conc. Re grind	0.75	0.10	0.30	-	-	-	40	-	-	-
Pb 1st Cleaner	-	-	-	0.01	0.005	-	-	1	2	9.1
	-	-	-	0.01	0.005	-	-	1	2	-
	-	-	-	0.01	0.005	-	-	1	2	-
Pb 2nd Cleaner	0.2	0.05	0.15	-	-	-	-	1	2	9.2
	-	-	-	0.005	0.0025	-	-	1	2	-
Pb 3rd Cleaner	0.2	0.025	0.075	-	-	-	-	1	3	9.3
Pb 4th Cleaner	0.3	-	-	-	-	-	-	1	2	9.5

Test No. 33 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	5.37	61.4	7.09	72.4	5.3
2. Pb 4th Cl. Tail.	0.67	25.1	13.3	3.7	1.2
3. Pb 3rd Cl. Tail.	2.39	14.0	12.9	7.3	4.3
4. Pb 2nd Cl. Tail.	4.06	3.65	11.1	3.3	6.3
5. Pb 1st Cl. Tail.	15.16	0.99	8.38	3.3	17.7
6. Pb Rougher Tail.	72.35	0.63	6.48	10.0	65.2
Head (Calculated)	100.00	4.55	7.19	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	6.04	57.4	7.78	76.1	6.5
Products 1 to 3	8.43	45.1	9.23	83.4	10.8
Products 1 to 4	12.49	31.6	9.84	86.7	17.1
Products 1 to 5	27.65	14.8	9.04	90.0	34.8

Test No. 34

Purpose: To repeat Test No. 29, but double all depressant additions.

Procedure: As for Test No. 29.

Feed: 2000 grams minus 10 mesh Composite B.

Grind: 40 minutes at 67 percent solids in the laboratory rod mill.

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na <sub>2</sub> CO <sub>3</sub>	NaCN	ZnSO <sub>4</sub>	Z-11	R-242	MIBC	Grind	Cond.	Froth	
Primary Grind	3.0	0.20	0.60	-	-	-	40	-	-	-
Pb Rougher	-	-	-	0.02	0.01	0.02	-	1	2	8.9
	-	-	-	0.02	0.01	0.01	-	1	2	-
	-	-	-	0.01	0.005	0.01	-	1	2	-
	-	-	-	0.01	0.005	-	-	1	2	-
Pb Conc. Re grind	1.0	0.10	0.30	-	-	-	40	-	-	-
Pb 1st Cleaner	-	-	-	0.01	0.005	-	-	1	2	9.4
	-	-	-	0.01	0.005	-	-	1	2	-
	-	-	-	0.01	0.005	-	-	1	2	-
Pb 2nd Cleaner	0.2	0.05	0.15	-	-	-	-	1	2	9.5
	-	-	-	0.005	0.0025	-	-	1	2	-
Pb 3rd Cleaner	0.2	0.025	0.075	-	-	-	-	1	3	9.5
Pb 4th Cleaner	0.3	-	-	-	-	-	-	1	2	9.6

Test No. 34 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	6.83	56.4	8.12	81.9	7.5
2. Pb 4th Cl. Tail.	1.12	17.1	13.8	4.1	2.1
3. Pb 3rd Cl. Tail.	1.90	7.71	12.5	3.1	3.2
4. Pb 2nd Cl. Tail.	3.83	2.68	10.5	2.2	5.4
5. Pb 1st Cl. Tail.	18.72	0.70	7.93	2.8	20.0
6. Pb Rougher Tail.	67.60	0.41	6.79	5.9	61.8
Head (Calculated)	100.00	4.70	7.42	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	7.95	50.9	8.92	86.0	9.6
Products 1 to 3	9.85	42.5	9.61	89.1	12.8
Products 1 to 4	13.68	31.4	9.86	91.3	18.2
Products 1 to 5	32.40	13.7	8.75	94.1	38.2

Test No. 35

**Purpose:** To make a direct comparison between rod and ball mill grinds by repeating Test No. 21, but grind in the ball mill.

**Procedure:** Grind and float a lead rougher concentrate. Re grind the concentrate and clean five times.

**Feed:** 2000 grams minus 10 mesh Composite B.

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

**Conditions:**

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Na <sub>2</sub> CO <sub>3</sub>	ZnSO <sub>4</sub>	NaCN	R-242	R-404	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.40	0.10	-	30	-	-	-
<u>Pb Circuit</u>									
Pb Rougher	1.0	-	-	-	0.02	-	1	3	9.4
	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	0.01	0.01	-	1	3	-
Pb Conc. Re grind	1.0	0.5	0.30	0.02	-	23	-	-	-
Pb 1st Cleaner	-	-	-	-	-	-	1	3	9.6
	-	-	-	0.005	0.005	-	1	3	-
Pb 2nd Cleaner	0.2	0.2	0.15	-	-	-	1	3	9.6
	-	-	-	0.005	-	-	1	1	-
Pb 3rd Cleaner	0.2	0.1	0.10	-	-	-	1	3	9.7
Pb 4th Cleaner	0.2	-	0.10	-	-	-	1	2½	9.7
Pb 5th Cleaner	0.2	-	0.05	-	-	-	1	2	9.6

Stage	Rougher	Conc. Re grind	1st & 2nd Cl.	3rd to 5th Cl.
Equipment	1000 gram D-1	Ball Mill	500 g D-1	250 g D-1
Speed rpm	1800	-	1300	1000
% Solids	33	-	-	-

Test No. 35 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	6.62	54.0	8.26	76.6	7.5
2. Pb 5th Cl. Tail.	1.73	19.2	13.2	7.1	3.1
3. Pb 4th Cl. Tail.	1.28	11.4	12.9	3.1	2.3
4. Pb 3rd Cl. Tail.	1.48	6.87	13.1	2.2	2.7
5. Pb 2nd Cl. Tail.	3.97	3.99	11.9	3.4	6.5
6. Pb 1st Cl. Tail.	14.65	0.92	8.55	2.9	17.2
7. Pb Rougher Tail.	70.27	0.31	6.27	4.7	60.7
Head (Calculated)	100.00	4.66	7.26	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	8.35	46.8	9.28	83.7	10.6
Products 1 to 3	9.63	42.1	9.76	86.8	12.9
Products 1 to 4	11.11	37.4	10.21	89.0	15.6
Products 1 to 5	15.08	28.6	10.65	92.4	22.1
Products 1 to 6	29.73	15.0	9.62	95.3	39.3