An Investigation of

THE RECOVERY OF LEAD AND ZINC

from a Grum deposit sample, Sample PPA

submitted by

NORANDA MINES LIMITED

Progress Report No. 3

Project No. L.R. 1868

Note:

This report refers to the samples as received.

LAKEFIELD RESEARCH OF CANADA LIMITED
Lakefield, Ontario
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I N D E X

INTRODUCTION

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

Initially the testwork was directed toward providing information on reagent levels and grinding requirements for the pilot plant run. At the conclusion of the pilot plant run, further testwork was conducted to investigate the reasons for the difference between the results obtained on the bench and in the pilot plant.

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.

LAKEFIELD RESEARCH OF CANADA LIMITED

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

K.W. Sarbutt,
Project Metallurgist

Investigation by: A.E. Carr
C.W. Payne

S U M M A R Y

1. Head Sample Assays

Sample PPA

Lead	Pb	8.08	%
Zinc	Zn	7.14	%
Oxide Lead	Pb ox.	1.66	%
Oxide Zinc	Zn ox.	0.12	%
Copper	Cu	0.15	%
Oxide Copper	Cu ox.	0.03	%
Iron	Fe	23.0	%
Bismuth	Bi	0.020	%
Cadmium	Cd	0.012	%
Mercury	Hg	0.0035	%
Arsenic	As	0.081	%
Antimony	Sb	0.026	%
Sulphur	S	29.3	%
Evolution Sulphur	Evol. S	1.83	%
Silica	SiO_2	3.87	%
Alumina	Al_2O_3	1.69	%
Lime	CaO	3.59	%
Magnesia	MgO	0.43	%
Barium	BaO	6.76	%
Gold	Au	0.026	oz/t
Silver	Ag	3.22	oz/t

2. Pb Rougher Flotation

2.1. $Ca(OH)_2$, Na_2S, Na_2SO_3, NaCN Depressant System

Prior to the pilot plant start-up, a series of bench tests were conducted using the reagent schedule developed by Noranda. This involved grinding with Na_2S, Na_2SO_3 and NaCN, conditioning with $Ca(OH)_2$, and recovering a lead rougher concentrate using Aero Xanthate 325 as collector. Pb recoveries were low in the preliminary tests using this reagent schedule, and a series of tests were conducted to investigate the effects of varying the reagent additions. Both rod mill and ball mill grinding were used in these tests. The results and conditions of these tests are summarized in Table No. 1.

Summary - Continued

2.1. $Ca(OH)_2$, Na_2S, Na_2SO_3, NaCN Depressant System - Continued

Table No. 1 - Pb Rougher Flotation

Test No.	Grind		Reagents lb/ton					Rougher Concentrate			
	Mill	Time min.	$Ca(OH)_2$	Na_2S	Na_2SO_3	NaCN	AX325	Weight %	Assay % Pb	% Dist. Pb	% Dist. Zn
1	Ball	60	0.15	0.5*	1.0*	0.30*	0.13	17.15	12.1	25.6	18.2
2	Ball	60	0.15	0.25*	0.5*	0.30*	0.13	20.70	31.1	78.6	28.4
4	Ball	30	0.15	0.5*	1.0*	0.30*	0.13	19.17	26.0	59.7	23.3
6	Ball	60	0.15	-	1.0*	0.30*	0.16	33.28	21.9	88.8	41.8
8	Ball	30	0.15	0.5*	1.0	0.30	0.13	15.26	17.1	31.5	18.0
9	Ball	30	-	-	1.0	0.30	0.18	18.71	21.9	50.4	23.3
10	Ball	30	-	-	1.0	0.30	0.15**	41.95	19.0	96.2	63.3
12	Rod	40	0.5	-	0.5*	0.15*	0.13	40.10	19.2	94.8	66.5
14	Ball	30	0.50	-	0.5*	0.15*	0.13	32.00	23.9	93.3	52.8
15	Rod	40	0.2	0.5*	1.0*	0.30*	0.13	33.58	23.2	94.8	59.1
16	Rod	40	0.2	0.5*	1.0*	0.30*	0.10	26.29	27.9	91.0	45.0
17	Rod	40	1.0	-	1.0*	0.30*	0.12	28.64	26.6	93.9	62.8

* Reagents added to grind. Other reagents to flotation cell
** R-242

Ball 30 minute grind : 72 percent passing 400 mesh, 9.3 kwh/ton
Ball 60 minute grind : 90 percent passing 400 mesh, 18.7 kwh/ton
Rod 40 minute grind : 77 percent passing 400 mesh, 9.2 kwh/ton

Generally low lead recoveries resulted after the ball mill primary grind, with the exceptions of Tests 10 and 14. In Test 10 the $Ca(OH)_2$ and Na_2S additions were omitted, Na_2SO_3 and NaCN were added to the flotation cell and not to the grind, and R-242 replaced AX325 as collector. The Na_2S addition was also omitted in Test 14, and the other depressant additions were reduced by half.

Summary - Continued

2.1. $Ca(OH)_2$, Na_2S, Na_2SO_3, NaCN Depressant System - Continued

Comparison of rod mill and ball mill grinding in Tests 15 and 4, and in Tests 14 and 12 indicated that when the full series of depressants were added to the grind much higher Pb recovery was obtained after rod mill grinding. However, when the Na_2S additions were omitted and the additions of the other depressants were reduced by half, similar Pb recoveries were achieved after both rod and ball mill grinding, with the ball mill grinding showing improved selectivity towards pyrite and sphalerite.

Two further flotation tests were conducted using Na_2CO_3 as the pH modifier in place of $Ca(OH)_2$. The results and conditions of these tests are summarized in Table 2.

Table No. 2 - Na_2CO_3 as pH Modifier

Test No.	Grind		Reagents lb/ton					Pb Rougher Concentrate			
	Mill	Time min.	Na_2CO_3	Na_2S	Na_2SO_3	NaCN	AX325	Weight %	Assay % Pb	% Dist. Pb	% Dist. Zn
11	Ball	30	3.0*	-	1.0	0.30	0.13	28.13	27.2	93.2	42.8
13	Ball	30	3.0*	0.50*	1.0*	0.30*	0.07	26.98	28.1	92.9	49.7

*Reagents added to grind. Other reagents added to flotation cell.

The use of Na_2CO_3 in place of $Ca(OH)_2$ as the pH modifier resulted in high Pb recoveries with good zinc rejection after ball mill grinding with the full amount of depressant.

Summary - Continued

2.2. Na_2CO_3, $ZnSO_4$, NaCN Depressant System

A series of flotation tests were conducted to investigate the effect of fineness of primary grind on the grades and recoveries of Pb and Zn, when using Na_2CO_3, $ZnSO_4$ and NaCN as depressants and R-242 and R-404 as collectors. The depressants added to the primary grind in this series of testwork were;

Na_2CO_3	3.0 lb/ton	
$ZnSO_4$	1.0 lb/ton	
NaCN	0.40 lb/ton (Tests 3 & 5)	0.30 lb/ton (Tests 7,18,19,20)

The other conditions and results of the testwork are summarized in Table 3.

Table No. 3 - Effect of Fineness of Primary Grind

Test No.	Primary Grind			Collector*		Froth Time	Rougher Concentrate				
	Mill	Time min.	% minus 400 mesh	R-242	R-404		Weight %	Assays %		% Dist.	
								Pb	Zn	Pb	Zn
18	Ball	15	54.7	0.08	0.04	9	36.64	20.5	9.98	95.2	52.2
19	Ball	20	61.2	0.09	0.04	9	36.83	20.5	9.79	95.7	51.6
20	Ball	25	67.2	0.10	0.04	9	36.96	21.2	9.64	96.2	50.4
3	Ball	30	73.5	0.11	0.03	6	36.33	21.9	9.52	96.5	48.6
5	Ball	60	90.1	0.12	0.04	9	37.20	21.5	9.08	97.2	47.2
7	Rod	40	77.0	0.14	0.04	9	39.23	20.2	9.11	97.2	50.8

*lb/ton

Finer primary grinding resulted in slightly higher lead recovery and slightly improved Zn rejection. Pb recoveries were generally higher than when using the $Ca(OH)_2$, Na_2S, Na_2SO_3 depressant systems. Zn rejection was also slightly better. Rod mill grinding resulted in results similar to the ball mill grinding.

Summary - Continued

3. Pb Cleaner Flotation

Throughout the bench testwork on samples from the Grum deposit, differences have been apparent in the cleaner flotation response after rod mill regrinding as compared with ball mill regrinding. After rod mill regrinding higher grade concentrates at higher recoveries resulted than after ball mill grinding. Two comparison tests were conducted on Sample PPA using the Na_2CO_3, $ZnSO_4$, NaCN depressant system and these results are shown in Table 4.

Table No. 4 - Comparison of Ball and Rod Mill Regrinding

Test No.	Primary Grind & Regrind	Product	Weight %	Assays %		% Dist.	
				Pb	Zn	Pb	Zn
24	Ball	Pb 3rd Cl. Conc.	11.17	57.2	8.18	79.9	12.4
		Pb 1st Cl. Tail.	11.65	2.85	11.0	4.2	17.5
		Pb Rougher Conc.	29.02	26.0	10.6	94.6	41.8
25	Rod	Pb 3rd Cl. Conc.	9.05	69.6	6.09	79.6	7.9
		Pb 1st Cl. Tail.	12.67	1.36	13.6	2.2	24.6
		Pb Rougher Conc.	30.05	25.0	12.0	94.8	51.0

During these flotation tests oxygen demand measurements were made by the Noranda Research Centre, and consequently long periods of aeration in the rougher and cleaner flotation could have had some effects on the results.

The recovery of lead in the rougher concentrate was similar, but more zinc reported to the rougher concentrate in Test 25 with the rod mill primary grind.

Summary - Continued

3. Pb Cleaner Flotation - Continued

However, after regrinding in the rod mill and cleaning, zinc rejection in the cleaning stages was better in Test 25 than in Test 24.

A series of four tests was then conducted to investigate the rod mill, ball mill and the primary grind-regrind variations. Conditions were kept as similar as possible, and oxygen demand measurements of the primary mill discharges and regrind mill discharges were made after 30 seconds aeration only. The results of these tests are summarized in Table No. 5.

Table No. 5 - Effect of Rod Mill-Ball Mill Grinding Combinations

Test No.	Primary Grind		Regrind		Product	Weight %	Assays %		% Dist.	
	Mill	O_2 * Demand	Mill	O_2 * Demand			Pb	Zn	Pb	Zn
30	Ball	1.8	Ball	1.1	Pb 4th Cl. Conc.	9.82	60.0	7.36	75.7	10.4
					Pb 1st Cl. Tail.	14.65	1.94	9.53	3.7	20.1
					Pb Rougher Conc.	33.33	22.2	9.89	95.3	47.5
31	Rod	9.0	Rod	21.0	Pb 4th Cl. Conc.	9.18	68.1	6.40	77.6	8.7
					Pb 1st Cl. Tail.	17.70	1.33	11.2	2.9	29.3
					Pb Rougher Conc.	35.70	21.3	10.49	94.5	55.4
32	Ball	1.5	Rod	1.3	Pb 4th Cl. Conc.	10.18	65.8	6.40	84.1	9.4
					Pb 1st Cl. Tail.	15.82	0.93	9.85	1.8	22.6
					Pb Rougher Conc.	34.84	21.7	9.87	95.1	49.8
33	Rod	9.0	Ball	5.2	Pb 4th Cl. Conc.	10.38	59.8	7.42	76.7	11.1
					Pb 1st Cl. Tail.	16.08	1.59	10.8	3.2	25.1
					Pb Rougher Conc.	37.05	20.9	10.66	95.6	57.1

*ppm/min. after 30 sec. aeration

Summary - Continued

3. Pb Cleaner Flotation - Continued

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

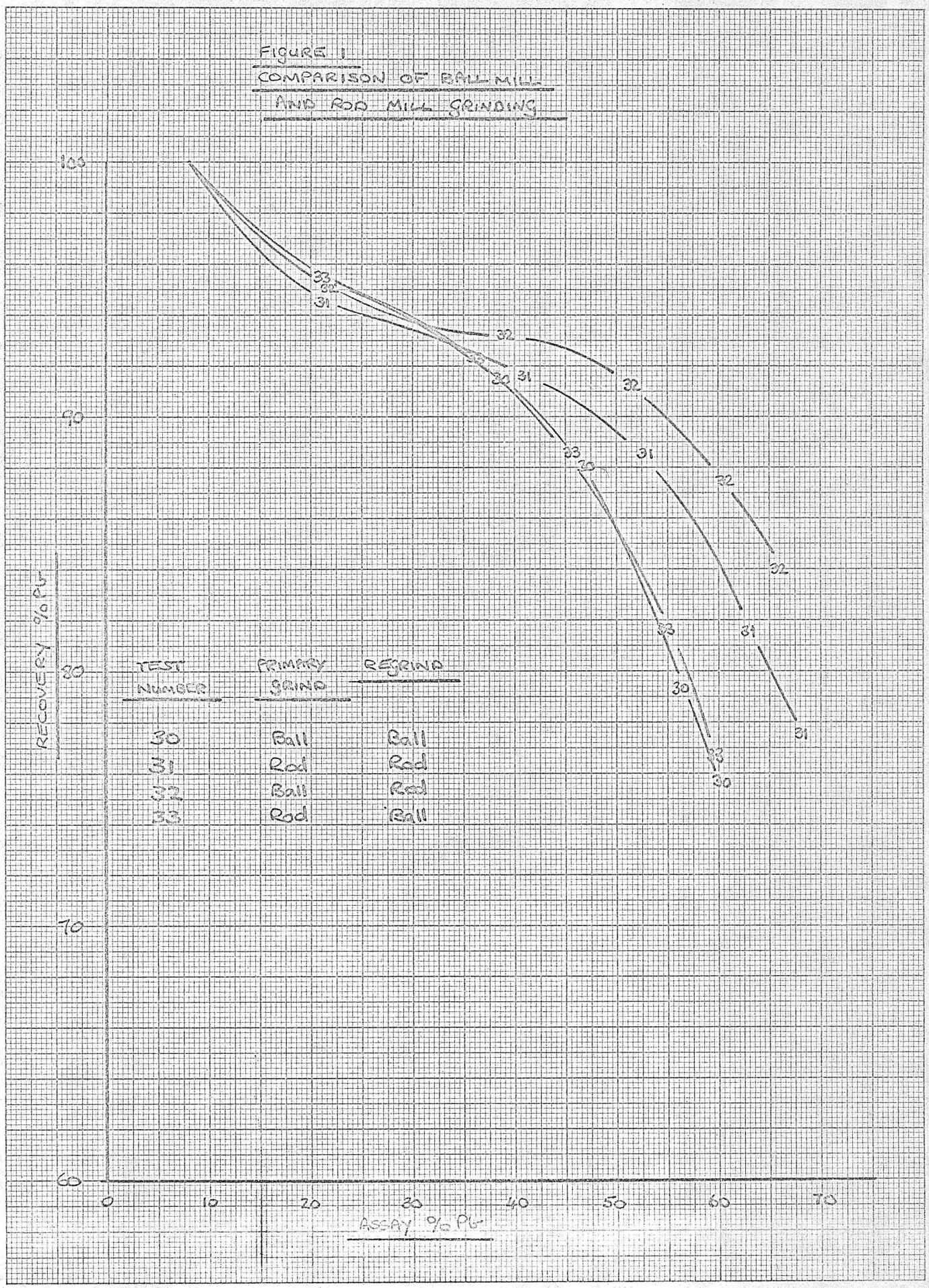
The best results were achieved in Test 32 with a ball mill primary grind and a rod mill regrind. In Test 31, a rod mill primary grind and rod mill regrind gave the next best results. Both tests with the ball mill regrind resulted in higher lead losses to the cleaner tailings and lower-grade concentrates.

More weight and zinc were recovered in the rougher concentrates after the rod mill primary grinds than after the ball mill primary grinds.

The oxygen demand measurements showed that after the rod mill primary grinds the oxygen demand of the flotation feed was high (9.0 ppm/min.), as compared to the ball mill primary grind (1.5-1.8 ppm/min.). Regrinding in the rod mill after the rod mill primary grind resulted in an increase in oxygen demand in the regrind mill discharge to 21.0 ppm/min. Regrinding in the rod mill after the ball mill primary grind did not increase the oxygen demand of the pulp, and the oxygen demand of the regrind mill discharge was 1.3 ppm/min. The combination of ball mill primary grinding and regrinding resulted in the lowest oxygen demand in the regrind mill discharge pulp (1.1 ppm/min.). Ball mill regrinding after the rod mill regrind resulted in the regrind mill discharges having an oxygen demand of 5.2 ppm/min. The best cleaner flotation results were therefore obtained with feed pulps to the cleaner flotation having oxygen demands of 21.0 ppm/min. and 1.3 ppm/min.

FIGURE 1

COMPARISON OF BALL MILL AND ROD MILL GRINDING



Summary - Continued

3. Pb Cleaner Flotation - Continued

Oxygen demand could be considered as a measurement of the degree of oxidation of the sulphide surfaces in the pulp. The amount of abraded iron from the mill also would consume oxygen and so affect the oxygen demand. More abraded iron was present in the pulp after rod mill grinding than after ball mill grinding (see Section 3.3), and hence the oxygen demand of the rod mill primary grind discharge was high. However, it cannot be concluded that the state of oxidation of the sulphide surfaces is any different after the rod mill grind than the ball mill grind, and the variations in oxygen demand in the tests possibly may be just a measurement of the amounts of unoxidized abraded iron in the pulp.

The results of this testwork firmly indicated that better cleaner flotation results were obtained after rod mill regrinding than ball mill regrinding. The two major factors which could be responsible for these differences are:

(1) Differences in fineness of grind, degree of sliming of galena, or a physical difference in particle shape or type of liberation after rod mill and after ball mill regrinding.

(2) Differences in the amount of abraded iron in the pulp which may cause differences in the oxygen content or oxygen demand of the pulp, and possibly may affect the degree of oxidation of the sulphide surfaces.

Physical differences in the regrinding were investigated by size analysis and Pb assays of the size fractions, and by conducting the grinding in different mills and by finer grinding. Attempts were also made to alter the oxidation conditions in the pulp during regrind by varying the types and amounts of reagent additions, and by varying the order of conditioning of reagents.

Summary - Continued

3.1. Analyses of Size Fractions of Primary Grind & Regrind Products

Rod mill and ball mill primary grinds equivalent to those used in Tests 30, 31, 32 and 33 were conducted, the mill discharge was cyclosized, and the size fractions were submitted for analysis. The results are summarized in Table 6, and depicted graphically in Figure 2.

Table No. 6 - Analyses of Size Fractions - Primary Grind

Size Fraction	30 Minute Ball Mill Grind Surface Area = 2206.7 cm^2/g			40 Minute Rod Mill Grind Surface Area = 2099 cm^2/g		
	Weight %	Assay % Pb	% Dist. Pb	Weight %	Assay % Pb	% Dist. Pb
plus 200 mesh	4.9	3.75	2.4	-	-	-
minus 200 plus 270 mesh	8.5	4.46	4.9	3.2	2.00	0.8
minus 270 plus 31.9 µm	23.2	9.12	27.4	29.0	7.63	28.3
minus 31.9 plus 24.7 µm	8.9	6.80	7.8	12.8	6.52	10.7
minus 24.7 plus 17.2 µm	10.8	7.64	10.7	13.2	8.12	13.7
minus 17.2 plus 11.9 µm	12.4	7.76	12.5	12.6	8.50	13.7
minus 11.9 plus 9.2 µm	6.2	8.28	6.6	6.2	9.13	7.2
minus 9.2 µm	25.1	8.51	27.7	23.0	8.72	25.6
Head (Calculated)	100.0	7.72	100.0	100.0	7.83	100.0

The size analyses revealed a small difference in the grinds, with more weight in the coarser size fractions and slightly more weight in the finer size fractions after ball mill grinding as compared to rod mill grinding.

Composites of the cleaner products from Tests 30, 31, 32 and 33 were also cyclosized, and the size fractions were assayed for Pb. The results are summarized in Table 7 and in Figure 3.

Summary - Continued

3.1. Analyses of Size Fractions - Continued

Table No. 7 - Analyses of Size Fractions - Regrind

Test No. 30 Ball Mill Primary Grind Ball Mill Regrind Surface Area = 3423 cm^2/gram				Test No. 31 Rod Mill Primary Grind Rod Mill Regrind Surface Area = 3078 cm^2/gram			
Size Fraction	Weight %	Assay % Pb	% Dist. Pb	Size Fraction	Weight %	Assay % Pb	% Dist. Pb
+29.0 µm	8.2	19.6	7.6	+29.1 µm	3.4	14.3	2.4
-29.0 + 22.5 µm	7.8	19.2	7.0	-29.1 + 22.6 µm	8.2	14.8	5.9
-22.5 + 15.7 µm	13.7	21.6	13.9	-22.6 + 15.8 µm	19.6	17.8	17.0
-15.7 + 10.8 µm	18.2	23.7	20.3	-15.8 + 10.8 µm	22.6	21.5	23.7
-10.8 + 8.3 µm	10.2	23.1	11.1	-10.8 + 8.4 µm	10.6	23.2	12.0
- 8.3 µm	41.9	20.4	40.1	- 8.4 µm	35.6	22.5	39.0
Head (Calc.)	100.0	21.3	100.0	Head (Calc.)	100.0	20.5	100.0

Test No. 32 Ball Mill Primary Grind Rod Mill Regrind Surface Area = 3306 cm^2/gram				Test No. 33 Rod Mill Primary Grind Ball Mill Regrind Surface Area = 3110 cm^2/gram			
Size Fraction	Weight %	Assay % Pb	% Dist. Pb	Size Fraction	Weight %	Assay % Pb	% Dist. Pb
+29.5 µm	1.9	11.1	1.1	+29.5 µm	12.0	16.8	10.7
-29.5 + 22.9 µm	5.9	15.5	4.6	-29.5 + 22.9 µm	8.8	16.3	7.6
-22.9 + 15.9 µm	17.2	19.3	16.6	-22.9 + 15.9 µm	14.2	18.7	14.0
-15.9 + 11.0 µm	23.2	20.9	24.2	-15.9 + 11.0 µm	17.8	20.9	19.7
-11.0 + 8.5 µm	11.2	21.6	12.1	-11.0 + 8.5 µm	9.7	21.0	10.8
- 8.5 µm	40.6	20.4	41.4	- 8.5 µm	37.5	18.8	37.2
Head (Calc.)	100.0	20.0	100.0	Head (Calc.)	100.0	18.9	100.0

After ball mill regrinding, more weight was in the coarser size fractions as compared to the rod mill regrinding. Lead distribution closely followed the weight distribution.

FIGURE 2

SIZE FRACTION ANALYSIS OF ROD MILL AND BALL MILL PRIMARY GRINDING

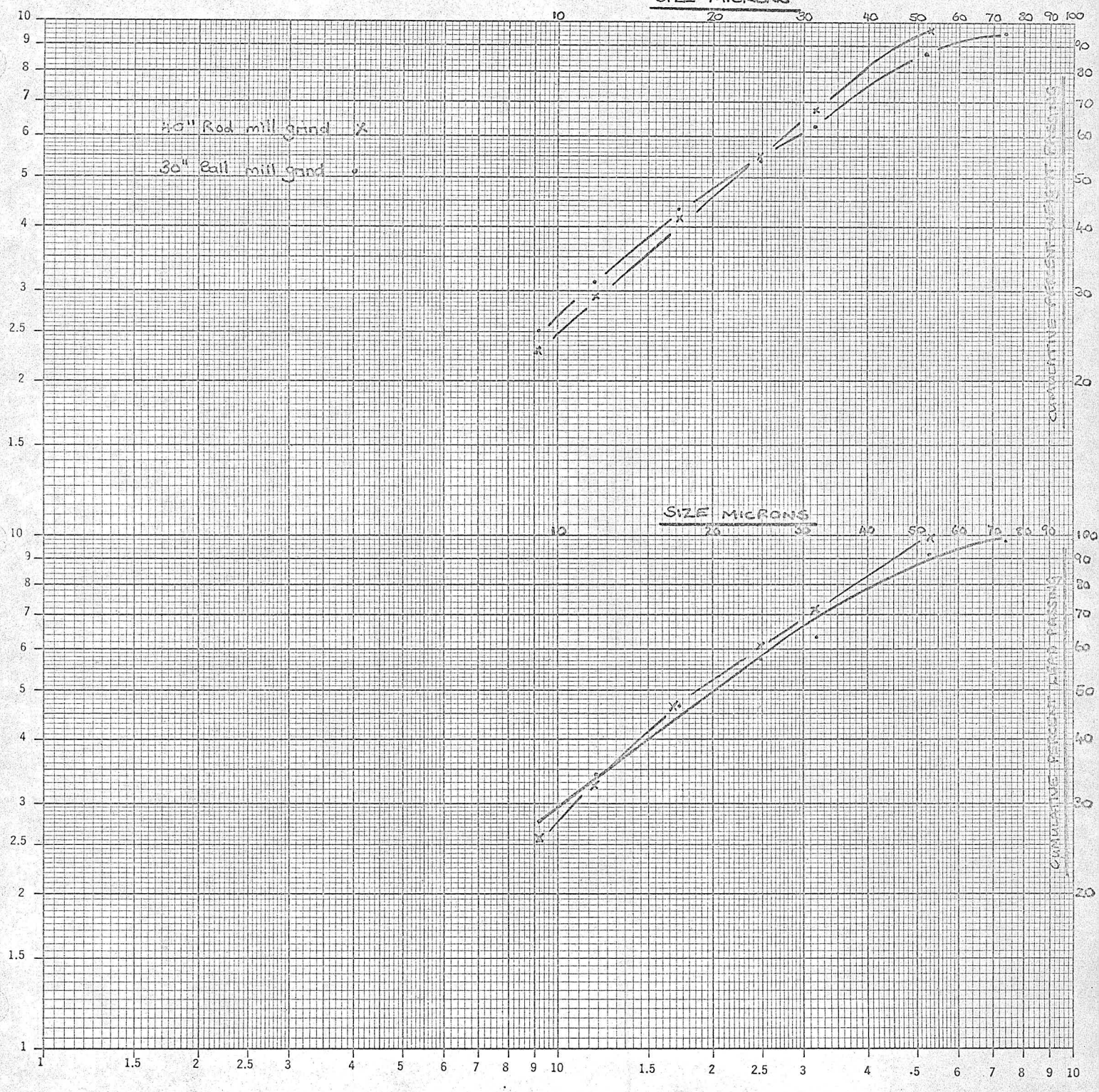
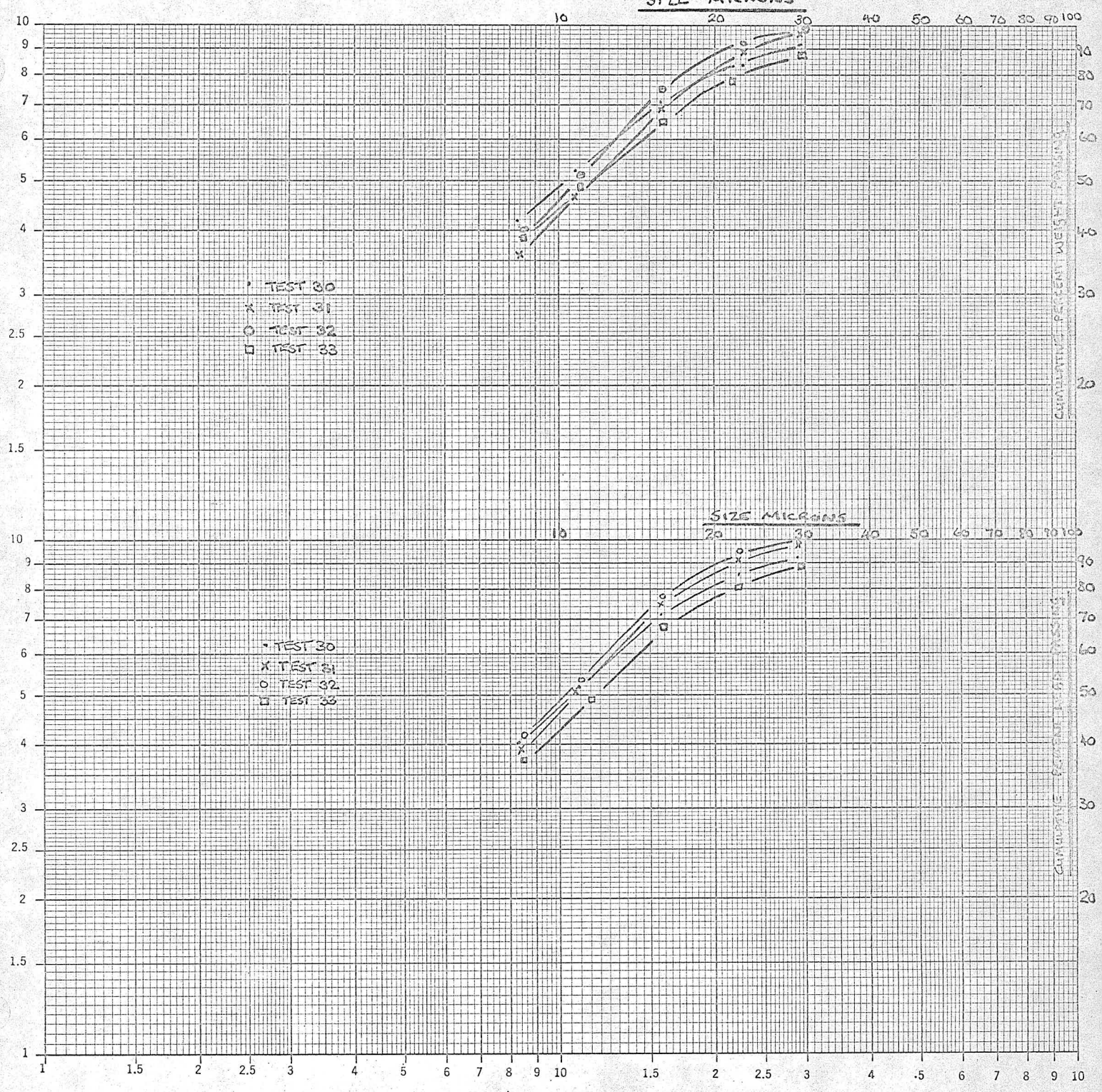


FIGURE 3.

SIZE FRACTION ANALYSES OF ROD MILL AND BALL MILL REGRINDING



Summary - Continued

3.2. Regrinding in Small Ball Mill and Pebble Mill

Test 70 was conducted using a different ball mill for regrinding to attempt to reproduce the size analysis of the rod mill regrind more closely. The size analysis of this test is plotted in Figure 4, along with those of the rod mill and ball mill regrinds. There was not so much weight in the coarse size fractions from this mill as in the normal ball mill regrind, and in the coarser size fractions the distribution was close to the rod mill regrind. There was more minus 15 micrometer-size material after regrinding in the small ball mill, than in either the rod mill or ball mill regrind.

The grade-recovery curve for this test is shown in Figure 5, along with those for Tests 30 and 32. The results were very similar to those of Test 30, in which the normal ball mill regrind was employed.

The effect of the fineness of regrind and the type of regrind mill were also investigated in Tests 74 and 91. In Test 74 the Pb 1st cleaner concentrate was reground for 15 minutes in the ball mill prior to three further stages. Pebble primary grinding and regrinding were used in Test 91. Both these tests were conducted using a second batch of pilot plant sample, which gave slightly reduced Pb recoveries (see Section 3.4). The grade-recovery curves for these tests on this second batch of sample are comapred in Figure 6 against those from the standard tests, Tests 105 and 110. The size analyses of the regrind mill discharge for Tests 74 and 91 are also shown in Figure 4.

Both the two-stage ball mill regrind and the pebble mill grinding test resulted in improved Pb recovery in the cleaner flotation, as compared to the standard ball mill regrind. Recoveries however were still lower than with the standard rod mill regrind. The two-stage ball mill regrind and pebble mill regrind were both substantially finer than the standard ball and rod mill regrinds.

FIGURE 4

SIZE ANALYSIS OF REGRIND MILL DISCHARGE

SMALL BALL MILL AND PEBBLE MILL

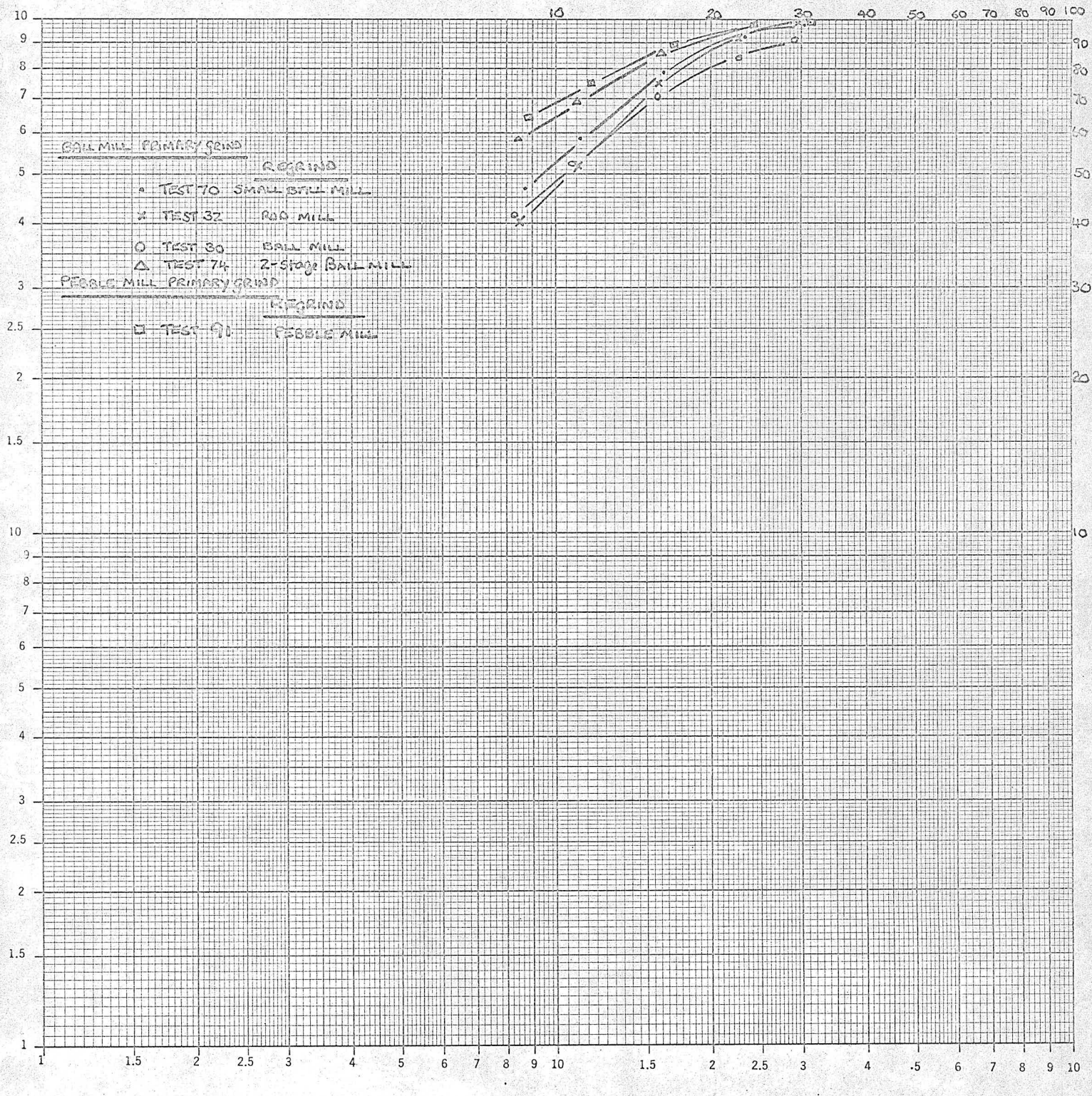
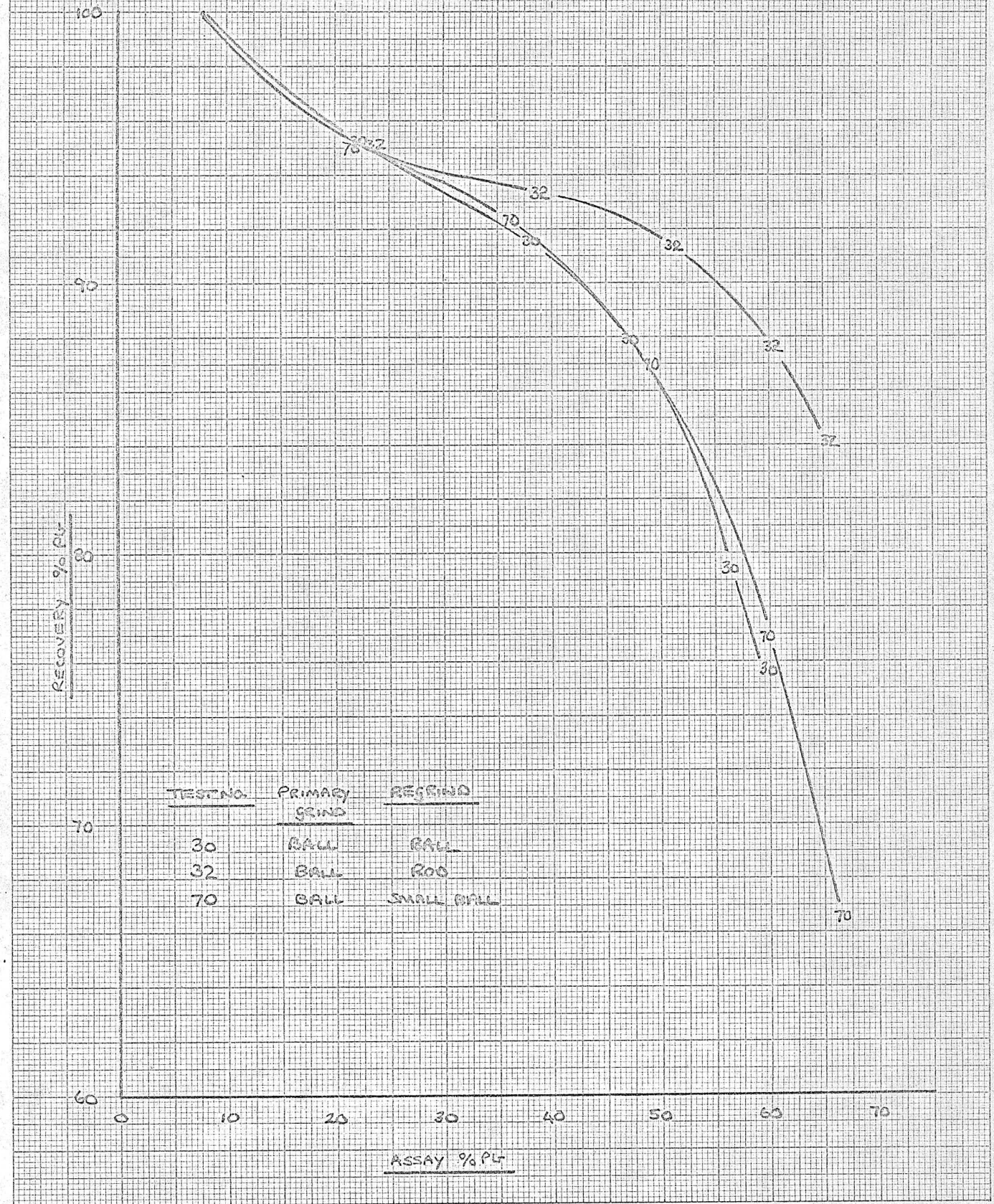


FIGURE 5

Pb GRADE - RECOVERY CURVES

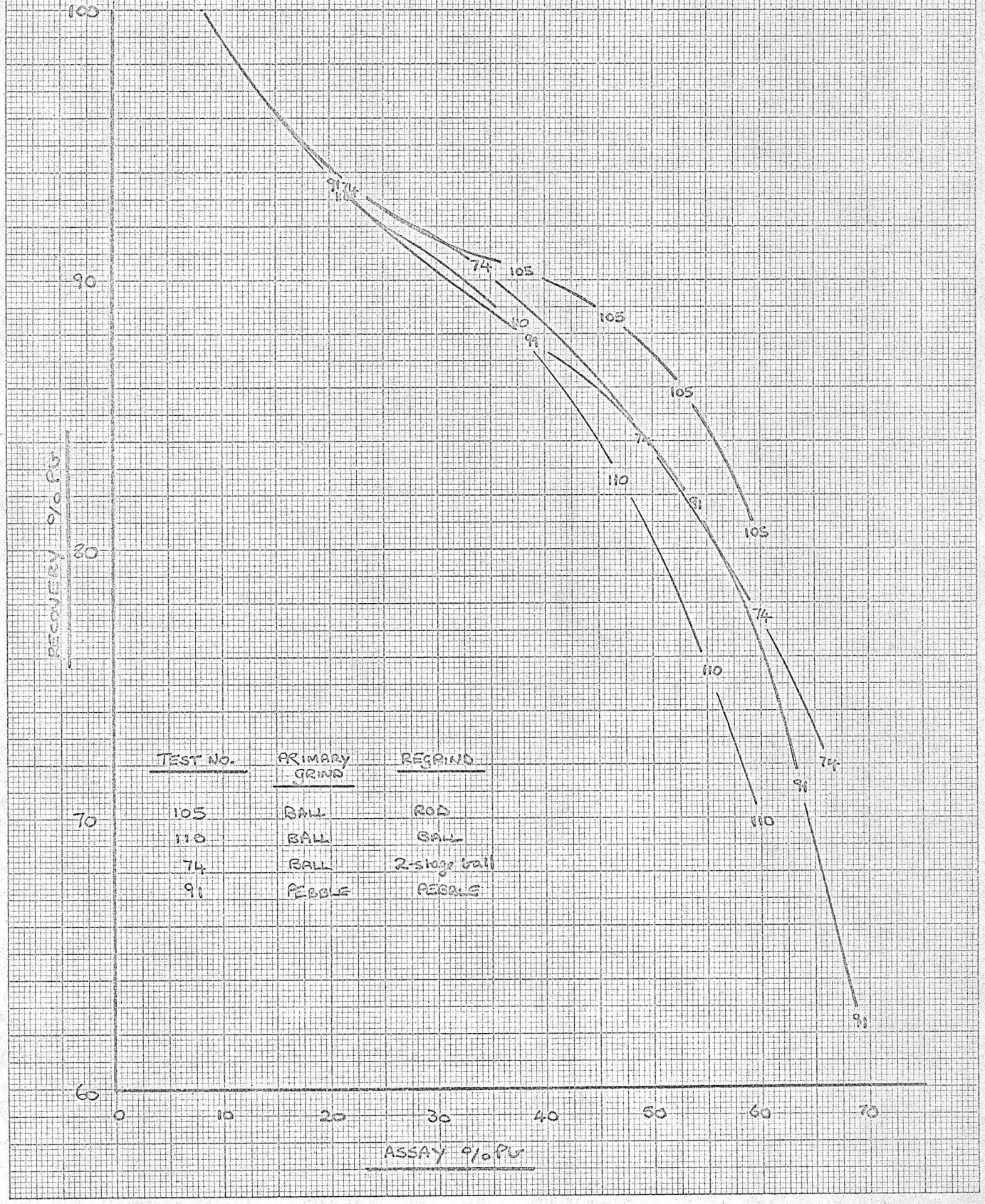
SMALL BALL MILL



TEST NO.	PRIMARY GRIND	REGRIND
30	BALL	BALL
32	BALL	ROD
70	BALL	SMALL BALL

FIGURE 6

PEBBLE MILL AND FINER BALL MILL REGRINDING



TEST NO.	PRIMARY GRIND	REGRIND
105	BALL	ROD
110	BALL	BALL
74	BALL	2-stage ball
91	PEBBLE	PEBBLE

Summary - Continued

3.3. Iron Abrasion in Rod Mill and Ball Mill Grinding

Samples of nepheline syenite each were ground in the rod mill and in the ball mill for 30 minutes, and the solutions and sands were assayed for Fe. The iron abraded from the rod mill amounted to 17.4 pounds of iron per ton of sand, and from the ball mill 3.0 pounds of iron per ton of sand was abraded.

3.4. Investigation of Various Reagent Changes

Testwork was conducted to investigate the effect of various reagent changes after ball mill regrinding on the grade and recovery of lead. In this series of tests the ball mill primary grind and rougher flotation were maintained at the standard conditions, and variations were made in the types, amounts and order of conditioning of reagents in the cleaner flotation. During this testwork the original sample which had been removed from the pilot plant ore for laboratory testwork was used up, and a further sample of ore was removed from the minus ½ inch ore remaining after the pilot plant testwork. The response of this sample to the standard flotation conditions was different, with slightly lower lead recoveries in both the rougher and cleaner flotation. Standard rod mill and ball mill regrinding tests were later conducted on this second sample to compare the flotation response of this sample to the previous one. The results of these tests along with the earlier ones are shown in Table 8 and the grade-recovery curves are illustrated in Figure 7.

Summary - Continued

3.4. Investigation of Various Reagent Changes - Continued

Table No. 8 - Comparison of Sample 1st Lot & 2nd Lot

Test No.	Sample	Mill		Product	Weight %	Assay %		% Dist.	
		Primary	Regrind			Pb	Zn	Pb	Zn
30	PPA-1st lot	Ball	Ball	Pb 4th Cl. Conc.	9.82	60.0	7.36	75.7	10.4
				Pb Rougher Conc.	33.33	22.2	9.89	95.3	47.5
32	PPA-1st lot	Ball	Rod	Pb 4th Cl. Conc.	10.18	65.8	6.40	84.1	9.4
				Pb Rougher Conc.	34.84	21.7	9.87	95.1	49.8
105	PPA-2nd lot	Ball	Rod	Pb 4th Cl. Conc.	10.92	59.2	7.32	80.6	11.5
				Pb Rougher Conc.	37.01	20.3	9.07	93.4	48.3
110	PPA-2nd lot	Ball	Ball	Pb 4th Cl. Conc.	9.39	59.9	7.24	69.9	9.7
				Pb Rougher Conc.	34.58	21.7	9.33	93.2	45.9

Pb rougher recoveries were approximately 2 percent lower from the Sample PPA-2nd lot. Zn recoveries in the Pb rougher concentrate were similar. Pb recoveries from the second sample in the cleaner concentrate were approximately 6 percent lower after both rod mill and ball mill regrinding.

The results and conditions of the testwork on Sample PPA-1st lot are summarized in Tables 9 and 10.

Summary - Continued

3.4. Investigation of Various Reagent Changes - Continued

Table No. 9 - Flotation Conditions - Sample PPA-1st lot

Test No.	Reagents to Regrind & 1st Cl. lb/ton						Reagents to 2nd - 4th Cl. lb/ton		
	Na_2CO_3	$ZnSO_4$	NaCN	$FeSO_4$	Na_2S	R-242	Na_2CO_3	$ZnSO_4$	NaCN
32**	1.0	0.5	0.2	-	-	0.03	0.6	0.3	0.2
30	1.0	0.5	0.2	-	-	-	0.6	0.3	0.2
54	1.0	0.5*	0.2*	-	-	0.02*	0.7	0.3	0.2
55	1.5	-	0.2*	1.0*	-	0.02*	0.7	0.3	0.2
59	1.0	0.5*	0.2*	-	0.5	0.02*	0.7	0.3	0.2
60	1.0	0.5	0.2	-	0.5	0.03	0.6	0.3	0.2
69	-	0.5*	0.2*	-	3.0	0.02*	0.4	0.3	0.2

* Reagents added to conditioner-remainder to regrind
** Rod Mill regrind

Table No. 10 - Flotation Results - Sample PPA-1st lot

Test No.	Product	Weight %	Assay %		% Dist.	
			Pb	Zn	Pb	Zn
32	Pb 4th Cl. Conc.	10.18	65.8	6.40	84.1	9.4
30	Pb 4th Cl. Conc.	9.82	60.0	7.36	75.7	10.4
54	Pb 4th Cl. Conc.	9.42	60.6	7.58	71.0	10.1
55	Pb 4th Cl. Conc.	8.62	57.8	7.78	61.9	9.7
59	Pb 4th Cl. Conc.	9.17	58.0	7.80	66.2	10.2
60	Pb 4th Cl. Conc.	8.54	60.0	7.28	64.5	9.0
69	Pb 4th Cl. Conc.	6.90	60.4	7.50	51.8	7.4

The Pb grade-recovery curves for these tests are shown in Figure 9. None of the reagent changes or changes in the order of conditioning of reagents investigated resulted in any improvement in the grade and recovery of lead. Results were worse in fact, particularly with $FeSO_4$ and high Na_2S additions.

Further testwork was conducted on Sample PPA-2nd lot and the results and conditions of this testwork are summarized in Tables 11 and 12.

Summary - Continued

3.4. Investigation of Various Reagent Changes - Continued

Table No. 11 - Flotation Conditions - Sample PPA- 2nd Lot

Test No.	Reagents to Regrind & 1st Cl. lb/ton							Reagents to 2nd-4th Cleaner lb/ton		
	Na_2CO_3	$ZnSO_4$	NaCN	Na_2SO_3	Fe Powder	SO_2	R-242	Na_2CO_3	$ZnSO_4$	NaCN
105**	1.5	0.50	0.20	-	-	-	0.04	0.70	0.30	0.20
110	2.0	0.5	0.20	-	-	-	0.04	0.70	0.30	0.20
80	1.5	-	0.20	0.5	-	-	0.04	0.70	0.30	0.20
81	1.0	-	0.20	1.5	-	-	0.04	0.70	0.30	0.20
94	1.0	1.0	0.40	-	-	-	0.04	0.80	0.60	0.40
95	1.2	2.0	0.40	-	-	-	0.04	0.80	0.60	0.40
98	2.0	0.5	0.20	-	30	-	0.04	0.80	0.30	0.20
100	2.0	0.5	0.20	-	60	-	0.03	0.80	0.30	0.20
106	2.0	0.50	0.20	-	-	-	0.05***	0.70	0.30	0.20
107	4.0	0.50	0.20	-	-	2.0	0.04	1.00	0.30	0.20
108	3.5*	0.50*	0.20*	-	-	2.0	0.03*	0.90	0.30	0.20
111	2.0	0.50	0.20	-	-	-	0.02	0.70	0.30	0.20
112	2.0	0.50	0.20	-	-	-	0.02 + 0.04***	0.70	0.30	0.20

* Reagents added to conditioner, remainder to regrind
** Rod Mill Regrind
***Z-4

Table No. 12 - Flotation Results - Sample PPA-2nd Lot

Test No.	Product	Weight %	Assays %		% Dist.	
			Pb	Zn	Pb	Zn
105	Pb 4th Cleaner Conc.	10.92	59.2	7.32	80.6	11.5
110	Pb 4th Cleaner Conc.	9.39	59.9	7.24	69.9	9.7
80	Pb 4th Cleaner Conc.	10.73	56.8	7.86	75.7	12.0
81	Pb 4th Cleaner Conc.	10.10	56.7	8.36	70.0	11.7
94	Pb 4th Cleaner Conc.	10.26	56.5	7.68	72.5	11.1
95	Pb 4th Cleaner Conc.	9.30	56.6	7.46	66.9	10.0
98	Pb 4th Cleaner Conc.	10.73	57.0	7.50	78.0	11.9
100	Pb 4th Cleaner Conc.	9.44	57.7	7.28	71.7	10.3
106	Pb 4th Cleaner Conc.	7.21	65.5	6.44	58.9	6.6
107	Pb 4th Cleaner Conc.	7.82	57.0	7.84	55.8	8.6
108	Pb 4th Cleaner Conc.	5.65	58.4	8.14	42.3	6.5
111	Pb 4th Cleaner Conc.	6.33	66.5	6.18	52.8	5.6
112	Pb 4th Cleaner Conc.	8.52	63.0	6.61	66.9	8.0

Summary - Continued

3.4. Investigation of Various Reagent Changes - Continued

Slightly higher recoveries after ball mill regrinding resulted from the addition of iron powder to the regrind, replacing R-242 with Z-4 as collector, and the addition of Na_2SO_3 to the regrind as compared to the standard ball mill regrind test. None of the reagent changes investigated in the ball mill regrinding tests resulted in Pb cleaner flotation results as good as the standard rod mill regrinding test.

4. Discussion and Recommendations

Pb rougher flotation results in the bench-scale testwork were similar to those achieved in the pilot plant run:

Table No. 13 - Comparison of Pb Rougher Results - Pilot Plant and Laboratory

Test No.	Sample	Scale	Product	Weight %	Assays, %		% Dist.	
					Pb	Zn	Pb	Zn
30	PPA-1st lot	Bench	Pb Ro. Conc.	33.33	22.2	9.89	95.3	47.5
			Pb Ro. Tail.	66.67	0.55	5.48	4.7	52.5
110	PPA-2nd lot	Bench	Pb Ro. Conc.	34.58	21.7	9.33	93.2	45.9
			Pb Ro. Tail.	65.42	0.84	5.83	6.8	54.1
PP-11	PPA	Pilot Plant	Pb Ro. Conc.	25.72	30.1	10.5	93.6	37.8
			Pb Ro. Tail.	74.28	0.71	5.98	6.4	62.2

FIGURE 7

COMPARISON OF SAMPLE LOTS 1 and 2

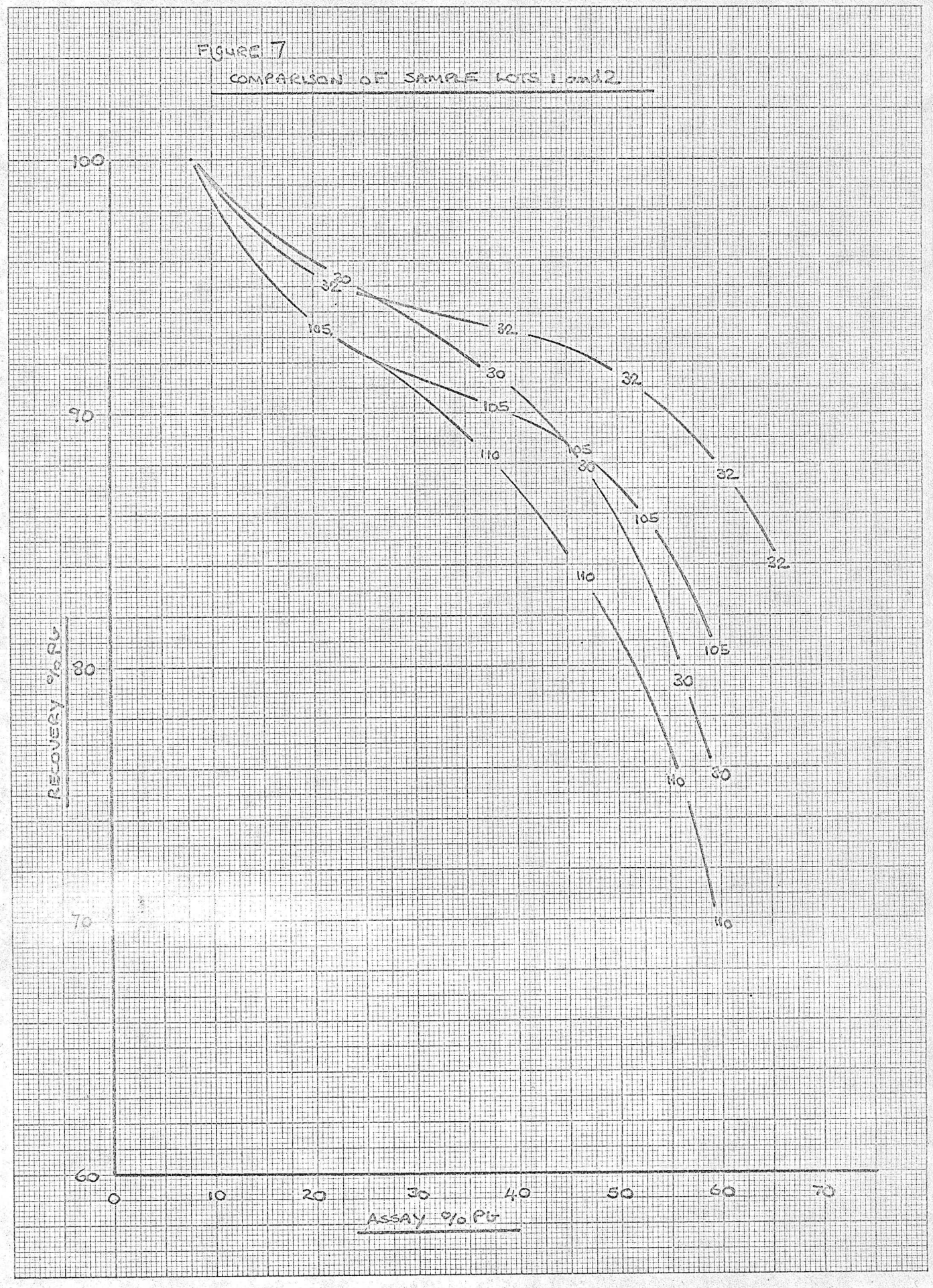
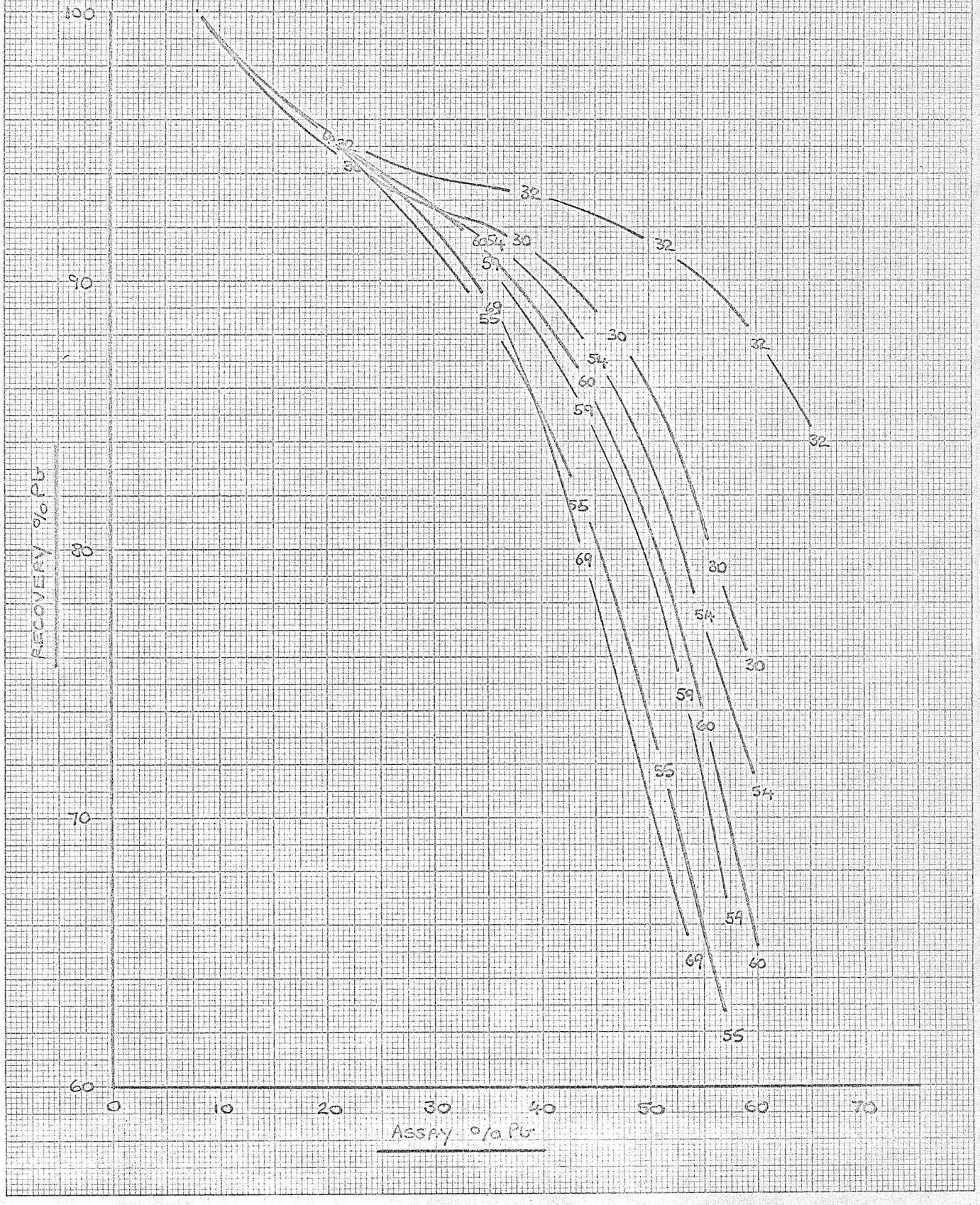
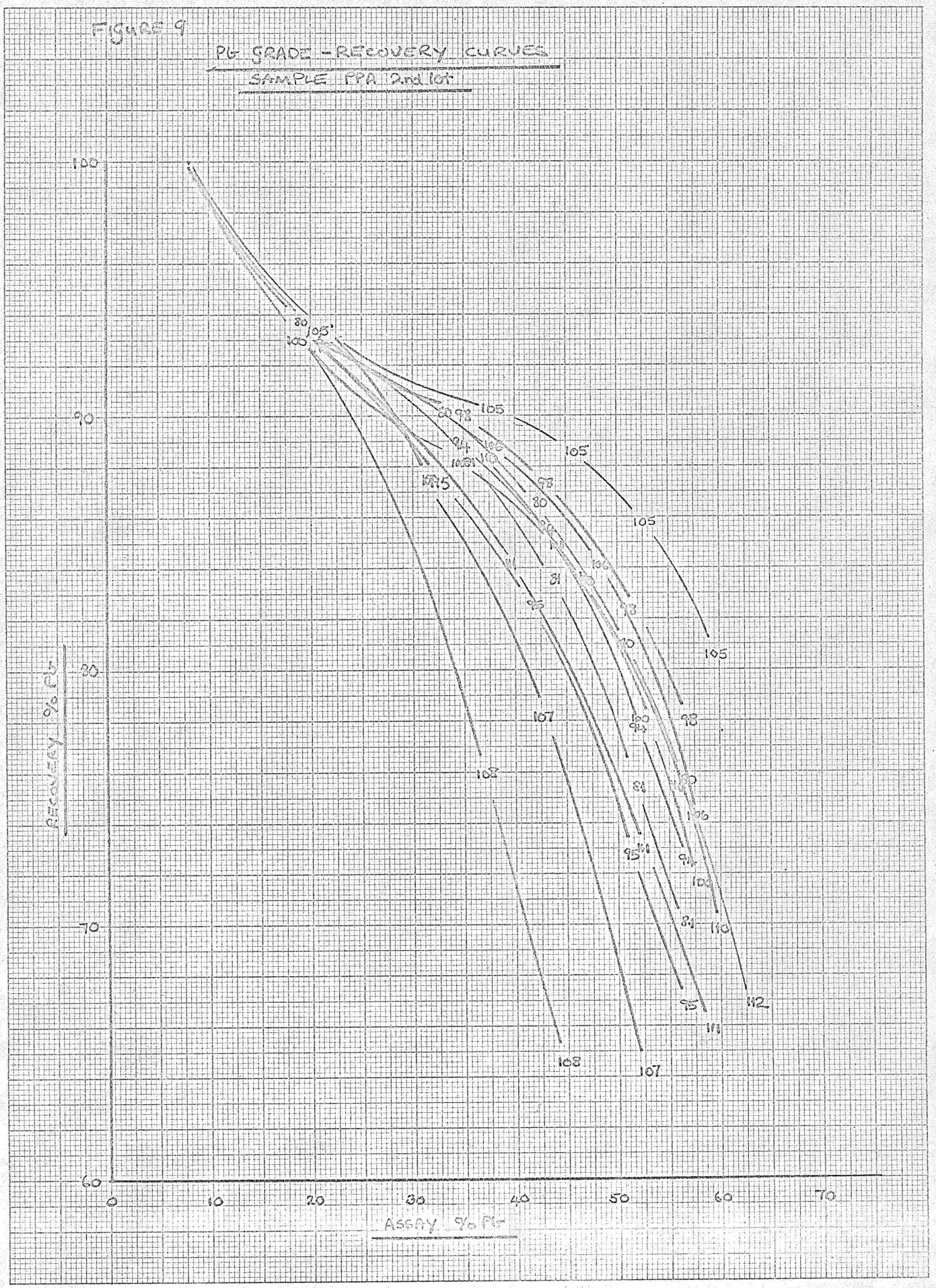


FIGURE 8

Pb GRADE - RECOVERY CURVES

SAMPLE PPIA - 1st lot





Summary - Continued

4. Discussion and Recommendations - Continued

In the pilot plant run high lead losses with little upgrading resulted from the 1st cleaner flotation stage. Fineness of regrind was similar in both the bench and pilot plant work. It was considered that the poor flotation response in the pilot plant showed some similarities to the metallurgy with the ball mill regrind in the laboratory, i.e. Pb flotation appeared to be slow after the regrind. Bench-scale testwork was therefore conducted to attempt to determine the reason for the difference in the Pb flotation after ball mill regrinding as compared to rod mill regrinding.

Finer regrinding in the ball mill or pebble mill resulted in slightly improved flotation results, as compared to the standard ball mill regrind. Flotation results were still not as good as after the rod mill regrind, and differences in the fineness of regrind between the standard rod mill and ball mill regrinds did not appear to be the cause of the differences in flotation response. Physical differences in the particle shape and type of liberation after rod mill and after ball mill regrinding could have some effect on the results.

The major noticeable difference between rod mill and ball mill grinding was the amount of abraded iron present in the pulp after grinding: 17.4 lb/ton from the rod mill, 3.0 lb/ton from the ball mill. Additions of Fe powder to the ball mill regrind resulted in a slight improvement in results. Na_2SO_3 additions also resulted in some improvement. The function of the abraded iron and Na_2SO_3 possibly would be to consume oxygen during the grinding and reduce the oxygen content of the pulp during the grind. Better Pb flotation and slightly improved zinc depression appeared to result under these conditions. Continuous closed-

Summary - Continued

4. Discussion and Recommendations - Continued

circuit regrinding in the pilot plant would result in high oxygen contents of the pulp during regrinding, and this possibly could have been the reason for the unsatisfactory flotation response in the 1st cleaner. Investigation of the use of Na_2SO_3 and possibly also the order of conditioning of reagents in the regrind and 1st cleaner circuit might result in some improvement in the pilot plant results.

Locked-cycle testwork should be conducted with both rod mill and ball mill regrinding, with and without recirculation of the cleaner tailing to the Pb rougher flotation, to investigate whether the difference in flotation response resulting from rod mill and from ball mill regrinding may be affected by recirculation of cleaner tailings.

SAMPLE PREPARATION

Sample PPA (1st lot) was removed from the crushed (-½ inch) pilot plant feed prior to the start-up of the pilot plant (November 5th, 1975).

Sample PPA (2nd lot) was removed from the minus ½ inch crushed ore remaining from the pilot plant on January 8th, 1976.

Both samples were cone and roll-crushed to minus 10 mesh, and riffled into 2 kg charges for testwork.

Size Analysis

Minus 10 Mesh Head Sample PPA 1st Lot

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 10	0.4	0.4	99.6
14	8.7	9.1	90.9
20	14.2	23.3	76.7
28	11.5	34.8	65.2
35	9.1	43.9	56.1
48	8.1	52.0	48.0
65	5.6	57.6	42.4
100	7.0	64.6	35.4
150	4.4	69.0	31.0
200	4.9	73.9	26.1
270	3.4	77.3	22.7
400	3.9	81.2	18.8
- 400	18.8	100.0	-
Total	100.0	-	-

Sample Preparation - Continued

Analyses of Size Fractions - Sample PPA (1st lot)

Product	Weight %	Assays, % Pb	% Distribution Pb
+ 65 mesh	57.6	6.83	48.6
- 65 + 100	7.0	6.82	5.9
- 100 + 150	4.4	7.18	3.9
- 150 + 200	4.9	8.16	4.9
- 200 + 270	3.4	8.30	3.5
- 270 + 400	3.9	9.45	4.6
- 400	18.8	12.3	28.6
Head (Calc.)	100.0	8.09	100.0

DETAILS OF TESTS

Test No. 1

Purpose: To perform a test employing the Noranda reagent balance and procedure.

Procedure: Grind and float a lead rougher concentrate and a zinc rougher concentrate. Regrind lead rougher and clean once. Regrind zinc rougher concentrates and clean three times.

Feed: 2000 grams minus 10 mesh PPA (1st lot).

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

Conditions:

Stage	Reagents Added, pounds per ton							Time, minutes			pH
	Na_2S	Na_2SO_3	NaCN	$Ca(OH)_2$	AX325	MIBC	$ZnSO_4$	Grind	Cond.	Froth	
Primary Grind	0.5	1.0	0.30	-	-	-	-	60	-	-	-
Pb Circuit											
Pb Rougher	-	-	-	0.15	0.03	0.04	-	-	2	3	9.0
	-	1.0	-	-	0.04	0.02	-	-	1	3	-
	-	-	-	-	0.03	0.02	-	-	1	3	-
	-	-	-	-	0.03	0.02	-	-	1	5	-
Pb Conc. Regrind	-	-	0.08	0.25	-	-	-	15	-	-	-
Pb 1st Cleaner	-	-	-	0.35	0.03	0.004	0.30	-	1	4	10.7
	-	-	-	-	0.03	-	-	-	1	3	-
		$K_2Cr_2O_7$			AX343		$CuSO_4$				
Zn Circuit											
Zn Condition	-	-	-	2.5	-	-	1.0	-	2	-	11.0
Zn Rougher	-	-	-	-	0.05	0.02	-	-	1	3	-
	-	-	-	-	0.02	0.01	-	-	1	3	-
	-	-	-	-	0.01	0.01	-	-	1	3	-
Zn Conc. Regrind	-	1.5	-	0.5	-	-	-	7½	-	-	-
Zn 1st Cleaner	-	-	-	0.25	0.01	0.005	0.25	-	1	4	11.0
	-	-	-	-	0.01	-	-	-	1	3	-
Zn 2nd Cleaner	-	0.10	-	0.15	-	-	-	-	1	2½	11.0
	-	-	-	-	0.01	-	-	-	1	2	-
Zn 3rd Cleaner	-	0.05	-	0.10	0.01	-	-	-	1	3	11.0

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

Stage	Zn Rougher	Zn Conc. Regrind	Zn 1st & 2nd Cl.	Zn 3rd Cleaner
Equipment	1000 g D-1	Abbe pebble mill	500 g D-1	250 g D-1
Speed rpm	1800	-	1300	1000

Test No. 1 - Continued

Metallurgical Results

Product	Weight	Assays %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	5.08	29.9	7.88	18.7	5.5
2. Pb Cleaner Tail.	12.07	4.64	7.66	6.9	12.7
3. Zn Cleaner Conc.	6.87	6.83	55.4	5.8	52.4
4. Zn 3rd Cl. Tail.	0.76	18.2	30.0	1.7	3.1
5. Zn 2nd Cl. Tail.	0.99	17.3	10.8	2.1	1.5
6. Zn 1st Cl. Tail.	5.67	11.9	4.43	8.3	3.5
7. Zn Rougher Tail.	68.56	6.68	2.26	56.5	21.3
Head (Calculated)	100.00	8.11	7.27	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	17.15	12.1	7.73	25.6	18.2
Products 3 and 4	7.63	7.96	52.9	7.5	55.5
Products 3 to 5	8.62	9.03	48.0	9.6	57.0
Products 3 to 6	14.29	10.2	30.7	17.9	60.5

Test No. 2

Purpose: To investigate the effect of reducing the amounts of depressants in the rougher flotation on the grade and recovery of lead.

Procedure: Grind and float a lead rougher concentrate.

Feed: 2000 grams minus 10 mesh PPA (1st lot).

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes		pH
	Na_2S	Na_2SO_3	NaCN	$Ca(OH)_2$	AX-325	MIBC	Cond.	Froth	
Primary Grind Pb Circuit	0.25	0.5	0.30	-	-	-	-	-	-
Pb Rougher 1	-	-	-	0.15	0.03	0.04	2	3	9.0
2	-	-	-	-	0.04	0.02	1	3	-
3	-	-	-	-	0.03	0.02	1	3	-
4	-	-	-	-	0.03	0.02	1	5	-

Stage	Pb Rougher
Flotation Cell	1000 gram D-1
Speed rpm	1800
% Solids	33

Metallurgical Results

Product	Weight	Assays, %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb Rougher Conc.	20.70	31.1	9.66	78.6	28.4
2. Pb Rougher Tail.	79.30	2.21	6.37	21.4	71.6
Head (Calculated)	100.00	8.19	7.05	100.0	100.0

Test No. 2 - Continued

Screen Analysis

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 200	0.7	0.7	99.3
270	1.9	2.6	97.4
400	7.3	9.9	90.1
- 400	90.1	100.0	-
Total	100.0	-	-

Test No. 3

Purpose: To investigate the use of Na_2CO_3, $ZnSO_4$, NaCN depressant system.

Procedure: Grind and float a series of lead rougher concentrates.

Feed: 2000 grams minus 10 mesh, Sample PPA (1st lot).

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	
Grind	3.0	1.0	0.40	0.10	-	30	-	-	-
Pb Rougher 1	-	-	-	-	0.02	-	1	3	9.5
2	-	-	-	0.01	0.01	-	1	3	-
3	-	-	-	0.01	0.01	-	1	3	-

Stage Pb Rougher
Flotation Cell 1000 gram D-1
Speed rpm 1800
% Solids 33

Metallurgical Results

Product	Weight	Assays %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb 1st Ro. Conc.	28.49	27.1	9.55	93.6	38.2
2. Pb 2nd Ro. Conc.	7.84	3.09	9.43	2.9	10.4
3. Pb 3rd Ro. Conc.	6.47	1.27	8.05	1.0	7.3
4. Pb Rougher Tail.	57.20	0.35	5.50	2.5	44.1
Head (Calculated)	100.00	8.25	7.13	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	36.33	21.9	9.52	96.5	48.6
Products 1 to 3	42.80	18.8	9.30	97.5	55.9

Test No. 3 - Continued

Screen Analysis - 30 Minutes

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 100	0.1	0.1	99.9
150	0.6	0.7	99.3
200	4.1	4.8	95.2
270	7.0	11.8	88.2
400	14.7	26.5	73.5
- 400	73.5	100.0	-
Total	100.0	-	-

Test No. 4

Purpose: To repeat Test No. 1, but with a coarser grind.

Procedure: Grind and float a lead rougher concentrate.

Feed: 2000 grams minus 10 mesh PPA (1st lot).

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes		pH
	Na_2S	Na_2SO_3	NaCN	$Ca(OH)_2$	AX-325	MIBC	Cond.	Froth	
Grind	0.5	1.0	0.30	-	-	-	-	-	-
Pb Rougher 1	-	-	-	0.15	0.03	0.04	2	3	9.0
2	-	1.0	-	-	0.04	0.02	1	3	-
3	-	-	-	-	0.03	0.02	1	3	-
4	-	-	-	-	0.03	0.02	1	5	-

Stage	Pb Rougher
Flotation Cell	1000 gram D-1
Speed rpm	1800
% Solids	33

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb 1st Ro. Conc.	7.22	25.0	9.03	21.6	9.1
2. Pb 2nd Ro. Conc.	6.45	43.4	8.98	33.5	8.1
3. Pb 3rd Ro. Conc.	2.50	9.41	8.45	2.8	2.9
4. Pb 4th Ro. Conc.	3.00	5.06	7.74	1.8	3.2
5. Pb Rougher Tail.	80.83	4.17	6.81	40.3	76.7
Head (Calculated)	100.00	8.36	7.18	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	13.67	33.7	9.01	55.1	17.2
Products 1 to 3	16.17	29.9	8.92	57.9	20.1
Products 1 to 4	19.17	26.0	8.74	59.7	23.3

Test No. 5

Purpose: To investigate the effect of a finer primary grind when using the Na_2CO_3, $ZnSO_4$, NaCN depressant system on the grade and recovery of lead.

Procedure: As for Test No. 3.

Feed: 2000 grams minus 10 mesh PPA (1st lot).

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	Cond.	Froth	
Grind	3.0	1.0	0.40	0.10	-	-	-	-	-
Pb Rougher 1	-	-	-	-	0.02	-	1	3	9.4
2	-	-	-	0.01	0.01	0.012	1	3	-
3	-	-	-	0.01	0.01	0.012	1	3	-

Stage	Pb Rougher
Flotation Cell	1000 gram D-1
Speed rpm	1800
% Solids	33

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb 1st Ro. Conc.	20.82	36.1	9.03	91.2	26.3
2. Pb 2nd Ro. Conc.	9.42	4.18	9.74	4.8	12.8
3. Pb 3rd Ro. Conc.	6.96	1.41	8.34	1.2	8.1
4. Pb Rougher Tail.	62.80	0.37	6.01	2.8	52.8
Head (Calculated)	100.00	8.24	7.15	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	30.24	26.2	9.25	96.0	39.1
Products 1 to 3	37.20	21.5	9.08	97.2	47.2

Test No. 6

Purpose: To investigate the effect of omitting the Na_2S addition on the grade and recovery of lead.

Procedure: Grind and float a lead rougher concentrate.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Na_2SO_3	NaCN	$Ca(OH)_2$	AX-325	MIBC	Grind	Cond.	Froth	
Grind	1.0	0.30	-	-	-	60	-	-	-
Pb Rougher 1	-	-	0.15	0.03	0.04	-	2	3	9.0
2	1.0	-	-	0.04	0.02	-	1	3	-
3	-	-	-	0.03	0.02	-	1	3	-
4	-	-	-	0.03	0.02	-	1	5	-
5	-	-	-	0.03	0.02	-	10	3	-

Stage Pb Rougher
Flotation Cell 1000 gram D-1
Speed rpm 1800
% Solids 33

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb 1st Ro. Conc.	6.84	15.6	8.98	13.0	8.8
2. Pb 2nd Ro. Conc.	4.63	14.6	7.78	8.2	5.1
3. Pb 3rd Ro. Conc.	7.56	27.8	7.95	25.6	8.6
4. Pb 4th Ro. Conc.	8.40	32.8	9.33	33.5	11.2
5. Pb 5th Ro. Conc.	5.85	11.9	9.69	8.5	8.1
6. Pb Rougher Tail.	66.72	1.39	6.10	11.2	58.2
Head (Calculated)	100.00	8.22	7.00	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	11.47	15.2	8.50	21.2	13.9
Products 1 to 3	19.03	20.2	8.28	46.8	22.5
Products 1 to 4	27.43	24.1	8.60	80.3	33.7
Products 1 to 5	33.28	21.9	8.79	88.8	41.8

Test No. 7

Purpose: To investigate the effect of grinding and regrinding in the rod mill.

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 Sample PPA (1st lot).

Grind: 40 minutes at 65 percent solids in the laboratory rod 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	3.0	1.0	0.30	0.10	-	40	-	-	-
Pb Circuit									
Pb Rougher	-	-	-	0.01	0.02	-	1	3	9.1
	-	-	-	0.02	0.01	-	1	3	-
	-	-	-	0.01	0.01	-	1	3	-
Pb Conc. Regrind	1.0	0.5	0.20	0.04	-	40	-	-	-
Pb 1st Cleaner	-	-	-	-	-	-	1	3	9.1
	-	-	-	0.01	0.01	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	1	3	9.4
	-	-	-	0.005	-	-	1	1	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	1	3	9.5
Pb 4th Cleaner	0.2	-	0.05	-	-	-	1	2½	9.5
Pb 5th Cleaner	0.2	-	0.025	-	-	-	1	2	9.4
		$Ca(OH)_2$	$CuSO_4$	Z-200	MIBC				
Zn Circuit									
Condition	-	2.5	1.0	-	-	-	2	-	10.8
Zn Rougher	-	-	-	0.06	0.02	-	1	3	-
	-	-	-	0.02	0.02	-	1	2	-
Zn 1st Cleaner	-	0.3	-	0.005	-	-	1	3	11.0
Zn 2nd Cleaner	-	0.2	-	-	-	-	1	2½	11.1
Zn 3rd Cleaner	-	0.2	-	-	-	-	1	2	11.2

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

Test No. 7 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	12.23	61.3	7.08	92.0	12.3
2. Pb 5th Cl. Tail.	1.06	10.6	14.1	1.4	2.1
3. Pb 4th Cl. Tail.	0.76	7.22	13.6	0.7	1.5
4. Pb 3rd Cl. Tail.	1.34	3.88	13.5	0.6	2.6
5. Pb 2nd Cl. Tail.	4.77	1.97	12.0	1.2	8.1
6. Pb 1st Cl. Tail.	19.07	0.58	8.93	1.3	24.2
7. Zn Cleaner Conc.	5.39	0.42	57.5	0.3	44.1
8. Zn 3rd Cl. Tail.	0.55	1.04	19.3	0.1	1.5
9. Zn 2nd Cl. Tail.	1.15	0.94	7.81	0.1	1.3
10. Zn 1st Cl. Tail.	3.10	0.81	2.36	0.3	1.0
11. Zn Rougher Tail.	50.58	0.33	0.16	2.0	1.3
Head (Calculated)	100.00	8.15	7.02	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	13.29	57.3	7.64	93.4	14.4
Products 1 to 3	14.05	54.6	7.96	94.1	15.9
Products 1 to 4	15.39	50.1	8.45	94.7	18.5
Products 1 to 5	20.16	38.7	9.29	95.9	26.6
Products 1 to 6	39.23	20.2	9.11	97.2	50.8
Products 7 and 8	5.94	0.48	54.0	0.4	45.6
Products 7 to 9	7.09	0.55	46.5	0.5	46.9
Products 7 to 10	10.19	0.63	33.1	0.8	47.9

Test No. 8

Purpose: To perform a flotation test employing Noranda reagent balance, except that Na_2S and depressants were added to rougher flotation.

Procedure: Grind and float a series of lead rougher concentrates.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes		pH
	Na_2SO_3	NaCN	$Ca(OH)_2$	Na_2S	AX-325	MIBC	Cond.	Froth	
Grind	-	-	-	0.50	-	-	-	-	-
Pb Rougher 1	1.0	0.30	-	-	-	-	5	-	8.4
	-	-	0.15	-	-	-	5	-	9.0
	-	-	-	-	0.03	0.04	1	3	-
2	-	-	-	-	0.04	0.02	1	3	-
3	1.0	-	-	-	0.03	0.02	1	3	-
4	-	-	-	-	0.03	0.02	1	3	-

Stage	Pb Roughers
Flotation Cell	1000 gram D-1
Speed rpm	1800
% Solids	33

Metallurgical Results

Product	Weight	Assays %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb 1st Ro. Conc.	4.83	13.2	8.94	7.7	6.0
2. Pb 2nd Ro. Conc.	5.43	27.9	8.75	18.3	6.6
3. Pb 3rd Ro. Conc.	2.48	10.7	7.82	3.2	2.7
4. Pb 4th Ro. Conc.	2.52	7.69	7.81	2.3	2.7
5. Pb Rougher Tail.	84.74	6.69	6.95	68.5	82.0
Head (Calculated)	100.00	8.28	7.19	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	10.26	21.0	8.84	26.0	12.6
Products 1 to 3	12.74	19.0	8.64	29.2	15.3
Products 1 to 4	15.26	17.1	8.50	31.5	18.0

Test No. 9

Purpose: To investigate the effect of omitting the Na_2S and $Ca(OH)_2$ additions on the grade and recovery of lead.

Procedure: As for Test No. 8.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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

Conditions:

Stage	Reagents Added, pounds per ton				Time, minutes		pH
	Na_2SO_3	NaCN	AX-325	MIBC	Cond.	Froth	
Pb Rougher No. 1	1.0	0.30	-	-	5	-	8.4
2	-	-	0.03	0.04	1	3	-
3	-	-	0.05	0.02	1	3	-
4	1.0	-	0.05	0.02	1	3	-
	-	-	0.05	0.02	1	3	-

Stage	Pb Roughers
Flotation Cell	1000 gram D-1
Speed rpm	1800
% Solids	33

Metallurgical Results

Product	Weight	Assays %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb Ro. Conc. No. 1	5.73	13.3	8.72	9.4	7.1
2. Pb Ro. Conc. No. 2	6.83	38.7	9.26	32.6	9.0
3. Pb Ro. Conc. No. 3	3.73	13.8	8.57	6.3	4.5
4. Pb Ro. Conc. No. 4	2.42	6.96	7.96	2.1	2.7
5. Pb Rougher Tailing	81.29	4.95	6.67	49.6	76.7
Head (Calculated)	100.00	8.11	7.07	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	12.56	27.1	9.01	42.0	16.1
Products 1 to 3	16.29	24.1	8.91	48.3	20.6
Products 1 to 4	18.71	21.9	8.79	50.4	23.3

Test No. 10

Purpose: To repeat Test No. 9, except R-242 used as collector.

Procedure: As for Test No. 8.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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

Conditions:

Stage	Reagents Added, lb/ton				Time, minutes		pH
	Na_2SO_3	NaCN	MIBC	R-242	Cond.	Froth	
Pb Rougher No. 1	1.0	0.30	-	-	5	-	-
	-	-	0.04	0.03	1	3	8.4
2	1.0	-	0.016	0.04	1	3	-
3	-	-	-	0.04	1	3	-
4	-	-	-	0.04	1	3	-

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Ro. Conc. No. 1	2.61	22.2	11.3	7.0	4.1
2. Pb Ro. Conc. No. 2	13.82	31.0	12.1	51.6	23.4
3. Pb Ro. Conc. No. 3	14.50	18.4	11.1	32.2	22.5
4. Pb Ro. Conc. No. 4	11.02	4.04	8.60	5.4	13.3
5. Pb Rougher Tailing	58.05	0.55	4.51	3.8	36.7
Head (Calculated)	100.00	8.30	7.14	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	16.43	29.6	12.0	58.6	27.5
Products 1 to 3	30.93	24.4	11.6	90.8	50.0
Products 1 to 4	41.95	19.0	10.8	96.2	63.3

Test No. 11

Purpose: To investigate the effect of using only Na_2CO_3 in the grind, and Na_2SO_3 and NaCN added to rougher flotation on lead grade and recovery.

Procedure: As for Test No. 8.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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	Na_2SO_3	NaCN	AX-325	MIBC	Grind	Cond.	Froth	
Grind	3.0	-	-	-	-	30	-	-	9.4
Pb Rougher No. 1	-	1.0	0.30	-	-	-	5	-	9.4
	-	-	-	0.03	0.04	-	1	3	-
2	-	-	-	0.04	-	-	1	3	-
3	-	-	-	0.03	-	-	1	3	-
4	-	-	-	0.03	0.016	-	1	3	-

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Ro. Conc. No. 1	10.30	30.8	10.6	38.6	15.3
2. Pb Ro. Conc. No. 2	7.17	39.7	10.5	34.7	10.6
3. Pb Ro. Conc. No. 3	4.94	20.1	11.7	12.1	8.1
4. Pb Ro. Conc. No. 4	5.72	11.2	11.0	7.8	8.8
5. Pb Rougher Tailing	71.87	0.78	5.67	6.8	57.2
Head (Calculated)	100.00	8.21	7.13	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	17.47	34.5	10.6	73.3	25.9
Products 1 to 3	22.41	31.3	10.8	85.4	34.0
Products 1 to 4	28.13	27.2	10.8	93.2	42.8

Test No. 12

Purpose: To repeat Test No. 4, but grind in the rod mill, omit Na_2S and reduce Na_2SO_3 and NaCN additions.

Procedure: Grind and float a series of lead concentrates.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes		pH
	Na_2SO_3	NaCN	$Ca(OH)_2$	AX-325	MIBC	Cond.	Froth	
Grind	0.5	0.15	-	-	-	-	-	-
Pb Rougher No. 1	-	-	0.5	0.03	0.04	2	3	9.2
2	0.5	-	-	0.04	0.02	1	3	-
3	-	-	-	0.03	0.02	1	3	-
4	-	-	-	0.03	0.02	1	5	8.5

Metallurgical Results

Product	Weight	Assays %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb Ro. Conc. No. 1	6.24	54.0	9.48	41.6	8.5
2. Pb Ro. Conc. No. 2	14.80	25.8	15.9	47.2	33.7
3. Pb Ro. Conc. No. 3	7.16	4.33	14.0	3.8	14.3
4. Pb Ro. Conc. No. 4	11.90	1.53	5.89	2.2	10.0
5. Pb Rougher Tailing	59.90	0.70	3.91	5.2	33.5
Head (Calculated)	100.00	8.10	6.99	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	21.04	34.2	14.0	88.8	42.2
Products 1 to 3	28.20	26.6	14.0	92.6	56.5
Products 1 to 4	40.10	19.2	11.6	94.8	66.5

Test No. 13

Purpose: To perform a test employing the Noranda procedure, but add 3.0 pounds Na_2CO_3 per ton ore to grind and omit $Ca(OH)_2$.

Procedure: As for Test No. 12.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, min.		pH
	Na_2S	Na_2SO_3	Na_2CO_3	NaCN	AX-325	MIBC	Cond.	Froth	
Grind	0.50	1.0	3.0	0.30	-	-	-	-	-
Pb Rougher No. 1	-	-	-	-	0.03	0.02	1	3	9.7
2	-	1.0	-	-	0.04	-	1	3	-
3	-	-	-	-	0.03	0.02	1	3	-
4	-	-	-	-	0.03	0.02	1	3	9.4

Metallurgical Results

Product	Weight	Assays %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb Ro. Conc. No. 1	18.27	36.0	12.7	80.5	33.0
2. Pb Ro. Conc. No. 2	8.71	11.6	13.5	12.4	16.7
3. Pb Ro. Conc. No. 3	5.14	4.04	12.6	2.5	9.2
4. Pb Ro. Conc. No. 4	3.29	2.44	11.3	1.0	5.3
5. Pb Rougher Tailing	64.59	0.46	3.89	3.6	35.8
Head (Calculated)	100.00	8.17	7.03	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	26.98	28.1	13.0	92.9	49.7
Products 1 to 3	32.12	24.3	12.9	95.4	58.9
Products 1 to 4	35.41	22.2	12.8	96.4	64.2

Test No. 14

Purpose: To repeat Test No. 12, but grind in the laboratory ball mill.

Procedure: As for Test No. 12.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes		pH
	$Ca(OH)_2$	Na_2SO_3	NaCN	AX-325	MIBC	Cond.	Froth	
Grind	-	0.50	0.15	-	-	-	-	-
Pb Rougher No. 1	0.50	-	-	0.03	0.04	2	3	9.0
2	-	-	-	0.04	0.02	1	3	-
3	-	-	-	0.03	0.02	1	3	-
4	-	-	-	0.03	0.02	1	5	-

Metallurgical Results

Product	Weight	Assays %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb Ro. Conc. No. 1	3.30	24.2	8.55	9.7	4.0
2. Pb Ro. Conc. No. 2	11.70	42.5	12.9	60.7	21.4
3. Pb Ro. Conc. No. 3	8.38	16.8	14.2	17.2	16.9
4. Pb Ro. Conc. No. 4	8.62	5.42	8.56	5.7	10.5
5. Pb Rougher Tailing	68.00	0.81	4.89	6.7	47.2
Head (Calculated)	100.00	8.20	7.04	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	15.00	38.5	11.9	70.4	25.4
Products 1 to 3	23.38	30.7	12.8	87.6	42.3
Products 1 to 4	32.00	23.9	11.6	93.3	52.8

Test No. 15

Purpose: To repeat Test No. 1, but grind in the rod mill.

Procedure: Grind and f oat a series of lead concentrates.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, min.		pH
	Na_2S	Na_2SO_3	NaCN	$Ca(OH)_2$	AX-325	MIBC	Cond.	Froth	
Grind	0.5	1.0	0.30	-	-	-	-	-	-
Pb Rougher No. 1	-	-	-	0.2	0.03	0.04	2	3	9.2
2	-	1.0	-	-	0.04	0.02	1	3	-
3	-	-	-	-	0.03	0.02	1	3	-
4	-	-	-	-	0.03	0.02	1	5	8.8

Metallurgical Results

Product	Weight	Assays %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb Ro. Conc. No. 1	3.96	38.6	8.04	18.6	4.5
2. Pb Ro. Conc. No. 2	14.17	38.6	11.8	66.6	23.8
3. Pb Ro. Conc. No. 3	7.99	6.72	12.9	6.5	14.6
4. Pb Ro. Conc. No. 4	7.46	3.37	15.3	3.1	16.2
5. Pb Rougher Tailing	66.42	0.64	4.33	5.2	40.9
Head (Calculated)	100.00	8.21	7.04	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	18.13	38.6	11.0	85.2	28.3
Products 1 to 3	26.12	28.8	11.6	91.7	42.9
Products 1 to 4	33.58	23.2	12.4	94.8	59.1

Test No. 16

Purpose: To repeat the lead rougher procedure of Test No. 15, then regrind and clean the lead and add a zinc circuit.

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

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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

Conditions:

Stage	Reagents Added, pounds per ton							Time, minutes			pH
	Na_2S	Na_2SO_3	NaCN	$Ca(OH)_2$	AX325	MIBC	$ZnSO_4$	Grind	Cond.	Froth	
Primary Grind	0.5	1.0	0.30	-	-	-	-	40	-	-	-
Pb Circuit											
Pb Rougher	-	-	-	0.20	0.03	0.04	-	-	2	3	9.2
	-	1.0	-	-	0.04	0.02	-	-	1	3	-
	-	-	-	-	0.03	0.02	-	-	1	3	-
Pb Conc. Regrind	-	-	0.08	0.25	-	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	0.20	0.03	0.01	0.30	-	1	4	9.5
	-	-	-	-	0.02	0.005	-	-	1	3	-
Pb 2nd Cleaner	-	-	0.06	0.20	0.01	-	0.20	-	1	3	10.4
	-	-	-	-	0.01	0.005	-	-	1	3	-
Pb 3rd Cleaner	-	-	0.04	0.10	-	-	0.10	-	1	2	10.8
	-	-	-	-	0.01	-	-	-	1	2	-
Pb 4th Cleaner	-	-	0.02	0.10	-	-	-	-	1	3	11.0
Zn Circuit		$K_2Cr_2O_7$			AX343		$CuSO_4$				
Zn Condition	-	-	-	2.5	-	-	1.0	-	2	-	10.8
Zn Rougher	-	-	-	-	0.05	0.02	-	-	1	3	-
	-	-	-	-	0.02	0.01	-	-	1	3	-
	-	-	-	-	0.01	0.01	-	-	1	3	-
Zn Conc. Regrind	-	0.5	-	0.5	-	-	-	10	-	-	-
Zn 1st Cleaner	-	-	-	0.5	0.01	0.005	0.3	-	1	4	11.0
	-	-	-	-	0.01	-	-	-	1	3	-
Zn 2nd Cleaner	-	0.1	-	0.2	-	-	-	-	1	2½	11.1
	-	-	-	-	0.01	-	-	-	1	2	-
Zn 3rd Cleaner	-	0.05	-	0.10	0.005	-	-	-	1	3	11.1

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

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

Test No. 16 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	5.39	69.0	5.82	46.1	4.4
2. Pb 4th Cl. Tail.	2.00	46.3	13.0	11.5	3.7
3. Pb 3rd Cl. Tail.	1.00	32.4	16.2	4.0	2.3
4. Pb 2nd Cl. Tail.	3.79	22.4	15.8	10.5	8.4
5. Pb 1st Cl. Tail.	14.11	10.8	13.2	18.9	26.2
6. Zn Cleaner Conc.	6.30	1.88	54.6	1.5	48.5
7. Zn 3rd Cl. Tail.	0.81	7.42	17.0	0.7	1.9
8. Zn 2nd Cl. Tail.	2.13	5.24	5.83	1.4	1.8
9. Zn 1st Cl. Tail.	8.92	1.24	0.72	1.4	0.9
10. Zn Rougher Tail.	55.55	0.57	0.23	4.0	1.9
Head (Calculated)	100.00	8.06	7.09	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	7.39	62.9	7.76	57.6	8.1
Products 1 to 3	8.39	59.2	8.77	61.6	10.4
Products 1 to 4	12.18	47.8	10.9	72.1	18.8
Products 1 to 5	26.29	27.9	12.2	91.0	45.0
Products 6 and 7	7.11	2.51	50.3	2.2	50.4
Products 6 to 8	9.24	3.14	40.1	3.6	52.2
Products 6 to 9	18.16	2.21	20.7	5.0	53.1

Test No. 17

Purpose: To repeat Test No. 16, but omit Na_2S to grind, clean lead at slightly lower pH, and omit $K_2Cr_2O_7$ from zinc circuit.

Procedure: As for Test No. 16.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na_2SO_3	NaCN	$Ca(OH)_2$	AX-325	MIBC	$ZnSO_4$	Grind	Cond.	Froth	
Primary Grind	1.0	0.30	-	-	-	-	40	-	-	-
Pb Circuit										
Pb Rougher	-	-	1.0	0.05	0.04	-	-	2	3	8.7
	-	-	-	0.04	0.02	-	-	1	3	-
	-	-	-	0.03	0.02	-	-	1	3	-
Pb Conc. Regrind	-	0.08	0.50	-	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	0.03	0.01	0.30	-	1	4	9.2
	-	-	-	0.02	0.005	-	-	1	3	-
Pb 2nd Cleaner	-	0.06	0.10	0.01	-	0.20	-	1	3	9.5
	-	-	-	0.01	0.005	-	-	1	3	-
Pb 3rd Cleaner	-	0.04	0.10	-	-	0.10	-	1	2	9.9
	-	-	-	0.01	-	-	-	1	2	-
Pb 4th Cleaner	-	0.02	0.05	0.005	-	-	-	1	3	9.9
				AX-343		$CuSO_4$				
Zn Circuit										
Zn Conditioner	-	-	3.0	-	-	1.0	-	2	-	10.8
Zn Rougher	-	-	-	0.05	0.02	-	-	1	3	-
	-	-	-	0.02	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	2	-
Zn Conc. Regrind	-	-	1.0	-	-	-	10	-	-	-
Zn 1st Cleaner	-	-	-	0.01	0.005	0.2	-	1	3	10.9
	-	-	-	0.01	-	-	-	1	3	-
Zn 2nd Cleaner	-	-	0.2	-	-	-	-	1	2	11.0
	-	-	-	0.01	-	-	-	1	2	-
Zn 3rd Cleaner	-	-	0.2	0.005	-	-	-	1	2½	11.2

Test No. 17 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	5.92	68.0	6.80	49.6	5.7
2. Pb 4th Cl. Tail.	1.10	42.9	14.7	5.8	2.3
3. Pb 3rd Cl. Tail.	1.37	31.6	18.4	5.3	3.6
4. Pb 2nd Cl. Tail.	4.79	21.7	19.9	12.8	13.7
5. Pb 1st Cl. Tail.	15.46	10.7	17.1	20.4	37.5
6. Zn Cleaner Conc.	4.56	2.14	50.7	1.2	32.9
7. Zn 3rd Cl. Tail.	0.48	4.60	13.5	0.3	0.9
8. Zn 2nd Cl. Tail.	1.12	2.85	4.71	0.4	0.8
9. Zn 1st Cl. Tail.	9.51	1.07	1.04	1.3	1.4
10. Zn Rougher Tail.	55.69	0.42	0.17	2.9	1.2
Head (Calculated)	100.00	8.11	7.04	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	7.02	64.1	8.04	55.4	8.0
Products 1 to 3	8.39	58.8	9.73	60.7	11.6
Products 1 to 4	13.18	45.3	13.4	73.5	25.3
Products 1 to 5	28.64	26.6	15.4	93.9	62.8
Products 6 and 7	5.04	2.38	47.2	1.5	33.8
Products 6 to 8	6.16	2.46	39.4	1.9	34.6
Products 6 to 9	15.67	1.62	16.1	3.2	36.0

Test No. 18

Purpose: The first in a series of tests to investigate the effect of a coarser primary grind.

Procedure: Grind and float a series of Pb rougher concentrates.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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

Conditions:

Stage	Reagents Added, pounds per ton					Time, min.		pH
	Na_2CO_3	$ZnSO_4$	NaCN	R-242	R-404	Cond.	Froth	
Grind	3.0	1.0	0.30	0.05	-	-	-	-
Pb Rougher No. 1	-	-	-	0.01	0.02	1	3	9.1
2	-	-	-	0.01	0.01	1	3	-
3	-	-	-	0.01	0.01	1	3	-

Stage	Flotation
Flotation Cell	1000 gram D-1
Speed rpm	1800
% Solids	33

Metallurgical Results

Product	Weight	Assays %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb Ro. Conc. No. 1	26.73	25.8	9.65	87.5	36.8
2. Pb Ro. Conc. No. 2	6.95	7.03	11.07	6.2	11.0
3. Pb Ro. Conc. No. 3	2.96	4.10	10.37	1.5	4.4
4. Pb Rougher Tailing	63.36	0.59	5.28	4.8	47.8
Head (Calculated)	100.00	7.88	7.00	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	33.68	21.9	9.94	93.7	47.8
Products 1 to 3	36.64	20.5	9.98	95.2	52.2

Test No. 18 - Continued

Screen Analysis

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	0.2	0.2	99.8
100	1.8	2.0	98.0
150	5.0	7.0	93.0
200	12.3	19.3	80.7
270	11.3	30.6	69.4
400	14.7	45.3	54.7
- 400	54.7	100.0	-
Total	100.0	-	-

Test No. 19

Purpose: To repeat Test No. 18, but with a slightly finer grind.

Procedure: As for Test No. 18.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

Grind: 20 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	Cond.	Froth	
Grind	3.0	1.0	0.30	0.06	-	-	-	-
Pb Rougher No. 1	-	-	-	0.01	0.02	1	3	9.0
2	-	-	-	0.01	0.01	1	3	-
3	-	-	-	0.01	0.01	1	3	-

Metallurgical Results

Product	Weight	Assays %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb Ro. Conc. No. 1	25.52	27.3	9.47	88.2	34.6
2. Pb Ro. Conc. No. 2	6.75	6.44	10.85	5.5	10.5
3. Pb Ro. Conc. No. 3	4.56	3.50	10.00	2.0	6.5
4. Pb Rougher Tailing	63.17	0.53	5.35	4.3	48.4
Head (Calculated)	100.00	7.90	6.98	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	32.27	22.9	9.76	93.7	45.1
Products 1 to 3	36.83	20.5	9.79	95.7	51.6

Test No. 19 - Continued

Screen Analysis

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 100	0.6	0.6	99.4
150	2.7	3.3	96.7
200	8.3	11.6	88.4
270	11.4	23.0	77.0
400	15.8	38.8	61.2
- 400	61.2	100.0	-
Total	100.0	-	-

Test No. 20

Purpose: To repeat Test No. 18 and 19, but with a still finer grind.

Procedure: As for Test No. 18.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

Grind: 25 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	Cond.	Froth	
Grind	3.0	1.0	0.30	0.07	-	-	-	-
Pb Rougher No. 1	-	-	-	0.01	0.02	1	3	9.0
2	-	-	-	0.01	0.01	1	3	-
3	-	-	-	0.01	0.01	1	3	-

Metallurgical Results

Product	Weight	Assays %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb Ro. Conc. No. 1	24.97	29.0	9.31	89.0	32.9
2. Pb Ro. Conc. No. 2	8.11	5.57	10.40	5.6	11.9
3. Pb Ro. Conc. No. 3	3.88	3.28	10.14	1.6	5.6
4. Pb Rougher Tailing	63.04	0.50	5.57	3.8	49.6
Head (Calculated)	100.00	8.13	7.07	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	33.08	23.3	9.58	94.6	44.8
Products 1 to 3	36.96	21.2	9.64	96.2	50.4

Test No. 20 - Continued

Screen Analysis

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 100	0.3	0.3	99.7
150	1.4	1.7	98.3
200	6.4	8.1	91.9
270	9.0	17.1	82.9
400	15.7	32.8	67.2
- 400	67.2	100.0	-
Total	100.0	-	-

Test No. 21

Purpose: To repeat the Pb rougher procedure of Test No. 20, but regrind and clean the lead rougher concentrate.

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

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

Grind: 25 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	3.0	1.0	0.30	0.07	-	25	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	1	3	8.9
	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	0.01	0.01	-	1	3	-
Pb Conc. Regrind	1.0	0.5	0.20	0.02	-	15	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	1	3	9.4
	-	-	-	0.01	0.01	-	1	3	-
Pb 2nd Cleaner	0.2	0.2	0.10	-	-	-	1	3	9.6
	-	-	-	0.005	-	-	1	1	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	1	3	9.6
Pb 4th Cleaner	0.2	-	0.05	-	-	-	1	2	9.6

Stage	Rougher	Regrind	1st to 3rd Cl.	4th Cleaner
Equipment	1000 g D-1	Ball Mill	500 g D-1	250 g D-1
Speed rpm	1800	-	1300	1000
% Solids	33	-	-	-

Test No. 21 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	9.83	59.3	7.66	73.4	10.7
2. Pb 4th Cl. Tail.	2.36	28.4	11.74	8.4	4.0
3. Pb 3rd Cl. Tail.	4.35	14.5	11.88	7.9	7.4
4. Pb 2nd Cl. Tail.	5.04	5.58	11.90	3.5	8.6
5. Pb 1st Cl. Tail.	14.67	1.56	9.05	2.9	18.9
6. Pb Rougher Tail.	63.75	0.48	5.54	3.9	50.4
Head (Calculated)	100.00	7.95	7.01	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	12.19	53.3	8.45	81.8	14.7
Products 1 to 3	16.54	43.1	9.35	89.7	22.1
Products 1 to 4	21.58	34.3	9.95	93.5	30.7
Products 1 to 5	36.25	21.1	9.58	96.1	49.6

Screen Analysis - Regrind Mill Discharge

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 150	0.2	0.2	99.8
200	0.7	0.9	99.1
270	2.0	2.9	97.1
400	6.6	9.5	90.5
- 400	90.5	100.0	-
Total	100.0	-	-

Test No. 24

Purpose: To perform a flotation test using the pilot plant lead circuit reagent balance.

Procedure: Grind and float a lead rougher concentrate. Regrind the concentrate and clean three times. Ball Mill regrind.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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	R242	R242/R404*	Grind	Cond.	Froth	
Primary Grind	3.0	0.75	0.25	-	-	30	-	-	-
Pb Rougher	2.0**	-	-	0.04	-	-	2	3	9.0
	-	-	-	-	0.04	-	1	3	-
	-	-	-	-	0.04	-	1	3	-
Pb Conc. Regrind	1.0	1.2	0.40	-	0.04	20	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	1	3	9.8
	-	-	-	-	0.01	-	1	3	-
Pb 2nd Cleaner	0.2	0.4	0.20	-	-	-	1	3	10.0
Pb 3rd Cleaner	0.2	0.2	0.10	-	-	-	1	2	10.0

* 1:1 mixture

** extra Na_2CO_3 necessary after lengthy aeration during oxygen readings.

Metallurgical Results

Product	Weight	Assays %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	11.17	57.2	8.18	79.9	12.4
2. Pb 3rd Cl. Tail.	2.09	18.8	14.2	4.9	4.0
3. Pb 2nd Cl. Tail.	4.11	10.8	14.2	5.6	7.9
4. Pb 1st Cl. Tail.	11.65	2.85	11.0	4.2	17.5
5. Pb Rougher Tail.	70.98	0.62	6.01	5.4	58.2
Head (Calculated)	100.00	8.00	7.34	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	13.26	51.1	9.13	84.8	16.4
Products 1 to 3	17.37	41.6	10.3	90.4	24.3
Products 1 to 4	29.02	26.0	10.6	94.6	41.8

Test No. 25

Purpose: To repeat Test No. 24, but grind and regrind in the rod mill.

Procedure: As for Test No. 24.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Na_2CO_3	$ZnSO_4$	NaCN	R242	R242/R404	Grind	Cond.	Froth	
Primary Grind	3.0	0.75	0.25	-	-	40	-	-	-
Pb Rougher	2.0*	-	-	0.04	-	-	2	3	9.3
	-	-	-	-	0.04	-	1	3	-
	-	-	-	-	0.04	-	1	3	-
Pb Conc. Regrind	1.0	1.2	0.40	-	0.04	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	1	3	9.8
	-	-	-	-	0.01	-	1	3	-
Pb 2nd Cleaner	0.2	0.4	0.20	-	-	-	1	3	10.0
Pb 3rd Cleaner	0.2	0.2	0.10	-	-	-	1	2	10.0

*extra Na_2CO_3 necessary after lengthy aeration during oxygen determinations.

Metallurgical Results

Product	Weight	Assays %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	9.05	69.6	6.09	79.6	7.9
2. Pb 3rd Cl. Tail.	2.30	23.8	15.6	6.9	5.1
3. Pb 2nd Cl. Tail.	6.03	8.03	16.2	6.1	14.0
4. Pb 1st Cl. Tail.	12.67	1.36	13.6	2.2	24.6
5. Pb Rougher Tail.	69.95	0.58	4.84	5.2	48.4
Head (Calculated)	100.00	7.91	7.00	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	11.35	60.3	8.02	86.5	13.0
Products 1 to 3	17.38	42.2	10.9	92.6	27.0
Products 1 to 3	30.05	25.0	12.0	94.8	51.6

Test No. 30

Purpose: The first of a series of tests to compare rod mill and ball mill grinding.

Procedure: Grind and float a lead rougher concentrate. Regrind the concentrate and clean four times.
Primary grind in ball mill.
Regrind in ball mill.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH	O_2 Demand ppm
	Na_2 - CO_3	Zn- SO_4	NaCN	R-242	R-404	Grind	Cond.	Froth		
Primary Grind	3.0	1.0	0.30	0.07	-	30	-	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	1	3	9.1	1.8
	-	-	-	0.01	0.01	-	1	3	-	-
	-	-	-	0.01	0.01	-	1	3	-	-
Pb Conc. Regrind	1.0	0.5	0.20	0.03	-	23	-	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	1	3	9.3	1.1
	-	-	-	0.01	0.01	-	1	3	-	-
Pb 2nd Cleaner	0.2	0.2	0.10	-	-	-	1	3	9.4	-
	-	-	-	0.005	-	-	1	1	-	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	1	3	9.5	-
Pb 4th Cleaner	0.2	-	0.05	-	-	-	1	2	9.6	-

Stage	Rougher	Regrind	1st to 3rd Cl.	4th Cleaner
Equipment	1000 g D-1	Ball Mill	500 g D-1	250 g D-1
Speed rpm	1800	-	1300	1000
% Solids	33	-	-	-

Test No. 30 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	9.82	60.0	7.36	75.7	10.4
2. Pb 4th Cl. Tail.	1.14	25.5	12.6	3.7	2.1
3. Pb 3rd Cl. Tail.	3.52	18.9	13.6	8.6	6.9
4. Pb 2nd Cl. Tail.	4.20	6.68	13.2	3.6	8.0
5. Pb 1st Cl. Tail.	14.65	1.94	9.53	3.7	20.1
6. Pb Rougher Tail.	66.67	0.55	5.48	4.7	52.5
Head (Calculated)	100.00	7.78	6.95	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	10.96	56.4	7.91	79.4	12.5
Products 1 to 3	14.48	47.3	9.29	88.0	19.4
Products 1 to 4	18.68	38.2	10.17	91.6	27.4
Products 1 to 5	33.33	22.2	9.89	95.3	47.5

Analyses of Size Fractions - 30 Minute Ball Mill Primary Grind

Product	Weight %	Assays, % Pb	% Distribution Pb
+ 200 mesh	4.9	3.75	2.4
- 200 + 270 mesh	8.5	4.46	4.9
- 270 + 31.9 µm	23.2	9.12	27.4
-31.9 + 24.7 µm	8.9	6.80	7.8
-24.7 + 17.2 µm	10.8	7.64	10.7
-17.2 + 11.9 µm	12.4	7.76	12.5
-11.9 + 9.2 µm	6.2	8.28	6.6
- 9.2 µm	25.1	8.51	27.7
Head (Calc.)	100.0	7.72	100.0

Test No. 30 - Continued

Analyses of Size Fractions - Regrind Mill Discharge

Product	Weight %	Assays, % Pb	% Distribution Pb
+29.0 µm	8.2	19.6	7.6
-29.0 + 22.5 µm	7.8	19.2	7.0
-22.5 + 15.7 µm	13.7	21.6	13.9
-15.7 + 10.8 µm	18.2	23.7	20.3
-10.8 + 8.3 µm	10.2	23.1	11.1
-8.3 µm	41.9	20.4	40.1
Head (Calc.)	100.0	21.3	100.0

Size Analyses

30 Minute Ball Mill Primary Grind

Mesh Size (Tyler)	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 150 mesh	0.6	0.6	99.4
200	4.3	4.9	95.1
270	8.5	13.4	86.6
31.9 µm	23.2	36.6	63.4
24.7	8.9	45.5	54.5
17.2	10.8	56.3	43.7
11.9	12.4	68.7	31.3
9.2	6.2	74.9	25.1
- 9.2	25.1	100.0	-
Total	100.0	-	-

Specific Gravity = 4.22

Composite Cleaner Products

+ 29.0 µm	8.2	8.2	91.8
22.5	7.8	16.0	84.0
15.7	13.7	29.7	70.3
10.8	18.2	47.9	52.1
8.3	10.2	58.1	41.9
- 8.3	41.9	100.0	-
Total	100.0	-	-

Specific Gravity = 4.88

Test No. 31

Purpose: The second in a series of tests to compare rod mill and ball mill grinding.

Procedure: As for Test No. 30.
Primary grind in rod mill.
Regrind in rod mill.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH	O_2 Demand ppm
	Na_2-CO_3	Zn-SO_4	NaCN	R-242	R-404	Grind	Cond.	Froth		
Primary Grind	3.0	1.0	0.30	0.07	-	40	-	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	1	3	9.1	9.0
	-	-	-	0.01	0.01	-	1	3	-	-
	-	-	-	0.01	0.01	-	1	3	-	-
Pb Conc. Regrind	1.0	0.5	0.20	0.03	-	30	-	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	1	3	9.2	21.0
	-	-	-	0.01	0.01	-	1	3	-	-
Pb 2nd Cleaner	0.2	0.2	0.10	-	-	-	1	3	9.3	-
	-	-	-	0.005	-	-	1	1	-	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	1	3	9.5	-
Pb 4th Cleaner	0.2	-	0.05	-	-	-	1	2	9.9	-

Test No. 31 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	9.18	68.1	6.40	77.6	8.7
2. Pb 4th Cl. Tail.	1.21	26.9	13.4	4.0	2.4
3. Pb 3rd Cl. Tail.	3.11	18.0	14.5	7.0	6.7
4. Pb 2nd Cl. Tail.	4.50	5.42	12.5	3.0	8.3
5. Pb 1st Cl. Tail.	17.70	1.33	11.2	2.9	29.3
6. Pb Rougher Tail.	64.30	0.69	4.68	5.5	44.6
Head (Calculated)	100.00	8.06	6.76	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	10.39	63.3	7.21	81.6	11.1
Products 1 to 3	13.50	52.9	8.89	88.6	17.8
Products 1 to 4	18.00	41.0	9.80	91.6	26.1
Products 1 to 5	35.70	21.3	10.49	94.5	55.4

Analyses of Size Fractions - 40 Minute Rod Mill Primary Grind

Product	Weight %	Assays, % Pb	% Distribution Pb
+270 mesh	3.2	2.00	0.8
-270 + 31.9 µm	29.0	7.63	28.3
-31.9 + 24.7 µm	12.8	6.52	10.7
-24.7 + 17.2 µm	13.2	8.12	13.7
-17.2 + 11.9 µm	12.6	8.50	13.7
-11.9 + 9.2 µm	6.2	9.13	7.2
-9.2 µm	23.0	8.72	25.6
Head (Calc.)	100.0	7.83	100.0

Test No. 31 - Continued

Analyses of Size Fractions - Continued

30 Minute Rod Mill Regrind Cleaner Products

Product	Weight %	Assays, % Pb	% Distribution Pb
+29.1 µm	3.4	14.3	2.4
-29.1 + 22.6 µm	8.2	14.8	5.9
-22.6 + 15.8 µm	19.6	17.8	17.0
-15.8 + 10.8 µm	22.6	21.5	23.7
-10.8 + 8.4 µm	10.6	23.2	12.0
-8.4 µm	35.6	22.5	39.0
Head (Calc.)	100.0	20.5	100.0

Screen Analyses - 40 Minute Rod Mill Primary Grind

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 270 mesh	3.2	3.2	96.8
31.9 µm	29.0	32.2	67.8
24.7	12.8	45.0	55.0
17.2	13.2	58.2	41.8
11.9	12.6	70.8	29.2
9.2	6.2	77.0	23.0
- 9.2	23.0	100.0	-
Total	100.0	-	-

Specific Gravity = 4.22

Cleaner Products

+ 29.1 µm	3.4	3.4	96.6
22.6	8.2	11.6	88.4
15.8	19.6	31.2	68.8
10.8	22.6	53.8	46.2
8.4	10.6	64.4	35.6
- 8.4	35.6	100.0	-
Total	100.0	-	-

Specific Gravity = 4.92

Test No. 32

Purpose: The third in a series of tests to compare rod mill and ball mill grinding.

Procedure: As for Test No. 30.
Primary grind in ball mill.
Regrind in rod mill.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH	O_2 Demand ppm
	Na_2 - CO_3	Zn- SO_4	NaCN	R-242	R-404	Grind	Cond.	Froth		
Primary Grind	3.0	1.0	0.30	0.07	-	30	-	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	1	3	9.0	1.5
	-	-	-	0.01	0.01	-	1	3	-	-
	-	-	-	0.01	0.01	-	1	3	-	-
Pb Conc. Regrind	1.0	0.5	0.20	0.03	-	30	-	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	1	3	9.3	1.3
	-	-	-	0.01	0.01	-	1	3	-	-
Pb 2nd Cleaner	0.2	0.2	0.10	-	-	-	1	3	9.5	-
	-	-	-	0.005	-	-	1	1	-	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	1	3	-	-
Pb 4th Cleaner	0.2	-	0.05	-	-	-	1	2	9.7	-

Test No. 32 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	10.18	65.8	6.40	84.1	9.4
2. Pb 4th Cl. Tail.	1.35	20.5	14.4	3.5	2.8
3. Pb 3rd Cl. Tail.	2.62	11.4	14.8	3.8	5.6
4. Pb 2nd Cl. Tail.	4.87	3.11	13.3	1.9	9.4
5. Pb 1st Cl. Tail.	15.82	0.93	9.85	1.8	22.6
6. Pb Rougher Tail.	65.16	0.60	5.31	4.9	50.2
Head (Calculated)	100.00	7.96	6.90	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	11.53	60.5	7.34	87.6	12.2
Products 1 to 3	14.15	51.4	8.72	91.4	17.8
Products 1 to 4	19.02	39.0	9.89	93.3	27.2
Products 1 to 5	34.84	21.7	9.87	95.1	49.8

Analysis of Size Fractions - Regrind Mill Discharge

Product	Weight %	Assays, % Pb	% Distribution Pb
+29.5 µm	1.9	11.1	1.1
-29.5 + 22.9 µm	5.9	15.5	4.6
-22.9 + 15.9 µm	17.2	19.3	16.6
-15.9 + 11.0 µm	23.2	20.9	24.2
-11.0 + 8.5 µm	11.2	21.6	12.1
-8.5 µm	40.6	20.4	41.4
Head (Calc.)	100.0	20.0	100.0

Test No. 32 - Continued

Size Analysis - Composite (Cleaner Products)

Particle Size	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 29.5 µm	1.9	1.9	98.1
22.9	5.9	7.8	92.2
15.9	17.2	25.0	75.0
11.0	23.2	48.2	51.8
8.5	11.2	59.4	40.6
- 8.5	40.6	100.0	-
Total	100.0	-	-

Specific Gravity = 4.82

Test No. 33

Purpose: The fourth in a series of tests to compare rod mill and ball mill grinding.

Procedure: As for Test No. 30.
Primary grind in rod mill.
Regrind in ball mill.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH	O_2 Demand ppm
	Na_2 - CO_3	Zn- SO_4	NaCN	R-242	R-404	Grind	Cond.	Froth		
Primary Grind	3.0	1.0	0.30	0.07	-	40	-	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	1	3	9.0	9.0
	-	-	-	0.01	0.01	-	1	3	-	-
	-	-	-	0.01	0.01	-	1	3	-	-
Pb Conc. Regrind	1.0	0.5	0.20	0.03	-	23	-	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	1	3	9.1	5.2
	-	-	-	0.01	0.01	-	1	3	-	-
Pb 2nd Cleaner	0.2	0.2	0.10	-	-	-	1	3	9.4	-
	-	-	-	0.005	-	-	1	1	-	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	1	3	9.4	-
Pb 4th Cleaner	0.2	-	0.05	-	-	-	1	2	9.8	-

Test No. 33 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	10.38	59.8	7.42	76.7	11.1
2. Pb 4th Cl. Tail.	1.73	23.6	12.7	5.0	3.2
3. Pb 3rd Cl. Tail.	3.64	15.3	13.7	6.9	7.2
4. Pb 2nd Cl. Tail.	5.22	5.84	13.9	3.8	10.5
5. Pb 1st Cl. Tail.	16.08	1.59	10.8	3.2	25.1
6. Pb Rougher Tail.	62.95	0.58	4.71	4.4	42.9
Head (Calculated)	100.00	8.10	6.92	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	12.11	54.6	8.17	81.7	14.3
Products 1 to 3	15.75	45.5	9.45	88.6	21.5
Products 1 to 4	20.97	35.7	10.56	92.4	32.0
Products 1 to 5	37.05	20.9	10.66	95.6	57.1

Size Analysis - Composite (Cleaner Products)

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 29.5 µm	12.0	12.0	88.0
22.9	8.8	20.8	79.2
15.9	14.2	35.0	65.0
11.0	17.8	52.8	47.2
8.5	9.7	62.5	37.5
- 8.5	37.5	100.0	-
Total	100.0	-	-

Specific Gravity = 4.79

Test No. 33 - Continued

Analyses of Size Fractions - Regrind Mill Discharge

Product	Weight %	Assays, % Pb	% Distribution Pb
+29.5 µm	12.0	16.8	10.7
-29.5 + 22.9 µm	8.8	16.3	7.6
-22.9 + 15.9 µm	14.2	18.7	14.0
-15.9 + 11.0 µm	17.8	20.9	19.7
-11.0 + 8.5 µm	9.7	21.0	10.8
-8.5 µm	37.5	18.8	37.2
Head (Calc.)	100.0	18.9	100.0

Test No. 54

Purpose: To repeat Test No. 30, but omit reagents from the lead regrind.

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

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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	3.0	1.0	0.30	0.07	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	1	3	8.9
	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	0.01	0.01	-	1	3	-
Pb Conc. Regrind	1.0	-	-	-	-	23	-	-	-
Condition	-	0.5	0.20	-	-	-	5	-	9.4
Pb 1st Cleaner	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	0.01	0.01	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	1	3	9.5
	-	-	-	0.005	-	-	1	1	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	1	3	-
Pb 4th Cleaner	0.2	-	0.05	-	-	-	1	2	9.7

Stage	Rougher	Regrind	1st to 3rd Cl.	4th Cleaner
Equipment	1000 g D-1	Lab. Ball Mill	500 g D-1	250 g D-1
Speed rpm	1800	-	1300	1000
% Solids	33	-	-	-

Test No. 54 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	9.42	60.6	7.58	71.0	10.1
2. Pb 4th Cl. Tail.	1.87	28.6	11.9	6.6	3.2
3. Pb 3rd Cl. Tail.	4.26	17.9	12.5	9.5	7.6
4. Pb 2nd Cl. Tail.	5.10	7.01	12.3	4.4	8.9
5. Pb 1st Cl. Tail.	15.76	2.01	9.20	4.0	20.5
6. Pb Rougher Tail.	63.59	0.57	5.51	4.5	49.7
Head (Calculated)	100.00	8.04	7.05	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	11.29	55.3	8.29	77.6	13.3
Products 1 to 3	15.55	45.1	9.45	87.1	20.9
Products 1 to 4	20.65	35.7	10.2	91.5	29.8
Products 1 to 5	36.41	21.1	9.74	95.5	50.3

Test No. 55

Purpose: To repeat Test No. 54, but substitute $FeSO_4$ for $ZnSO_4$ in the Pb 1st cleaner.

Procedure: As for Test No. 54.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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	Zn-SO_4	NaCN	$FeSO_4$ *	R-242	R-404	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	-	0.07	-	30	-	-	-
Pb Rougher	-	-	-	-	0.01	0.02	-	1	3	8.9
	-	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	-	0.01	0.01	-	1	3	-
Pb Conc. Regrind	1.0	-	-	-	-	-	23	-	-	-
Condition	0.5	-	0.20	1.0	-	-	-	5	-	9.3
Pb 1st Cleaner	-	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	-	0.01	0.01	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3	9.4
	-	-	-	-	0.005	-	-	1	1	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	3	9.5
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	9.7

*$FeSO_4 : 7H_2O$

Test No. 55 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	8.62	57.8	7.78	61.9	9.7
2. Pb 4th Cl. Tail.	2.63	30.4	10.8	9.9	4.1
3. Pb 3rd Cl. Tail.	3.86	20.4	11.5	9.8	6.4
4. Pb 2nd Cl. Tail.	5.17	10.9	11.8	7.0	8.8
5. Pb 1st Cl. Tail.	17.79	3.15	8.98	7.0	23.1
6. Pb Rougher Tail.	61.93	0.58	5.36	4.4	47.9
Head (Calculated)	100.00	8.05	6.93	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	11.25	51.4	8.49	71.8	13.8
Products 1 to 3	15.11	43.5	9.26	81.6	20.2
Products 1 to 4	20.28	35.2	9.90	88.6	29.0
Products 1 to 5	38.07	20.2	9.47	95.6	52.1

Test No. 59

Purpose: To repeat Test No. 54, but add 0.5 lb/ton Na_2S to regrind.

Procedure: As for Test No. 54.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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	Zn-SO_4	NaCN	R-242	R-404	Na_2S	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	-	1	3	8.9
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb Conc. Regrind	1.0	-	-	-	-	0.5	23	-	-	-
Condition	-	0.5	0.20	-	-	-	-	5	-	9.6
Pb 1st Cleaner	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3	9.5
	-	-	-	0.005	-	-	-	1	1	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	3	9.5
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	9.6

Stage Pb Regrind
Equipment Laboratory ball mill
Speed rpm -

Test No. 59 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	9.17	58.0	7.80	66.2	10.2
2. Pb 4th Cl. Tail.	2.03	33.3	11.3	8.4	3.3
3. Pb 3rd Cl. Tail.	4.34	19.6	13.0	10.6	8.1
4. Pb 2nd Cl. Tail.	4.95	8.84	12.6	5.5	8.9
5. Pb 1st Cl. Tail.	15.61	2.36	8.70	4.6	19.4
6. Pb Rougher Tail.	63.90	0.59	5.49	4.7	50.1
Head (Calculated)	100.00	8.03	7.00	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	11.20	53.5	8.43	74.6	13.5
Products 1 to 3	15.54	44.0	9.71	85.2	21.6
Products 1 to 4	20.49	35.5	10.4	90.7	30.5
Products 1 to 5	36.10	21.2	9.67	95.3	49.9

Test No. 60

Purpose: To repeat Test No. 59, but add all depressants to the regrind mill.

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

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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	Zn-SO_4	NaCN	R-242	R-404	Na_2S	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	-	1	3	8.9
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb Conc. Regrind	1.0	0.5	0.20	0.03	-	0.5	23	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	9.6
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3	9.6
	-	-	-	0.005	-	-	-	1	1	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	3	9.6
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	9.7

Stage Pb Regrind
Equipment Laboratory ball mill

Test No. 60 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	8.54	60.0	7.28	64.5	9.0
2. Pb 4th Cl. Tail.	2.06	34.3	10.5	8.9	3.1
3. Pb 3rd Cl. Tail.	4.83	21.0	11.8	12.8	8.2
4. Pb 2nd Cl. Tail.	5.56	7.74	11.9	5.4	9.5
5. Pb 1st Cl. Tail.	16.36	1.81	8.86	3.7	20.9
6. Pb Rougher Tail.	62.65	0.59	5.47	4.7	49.3
Head (Calculated)	100.00	7.94	6.95	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	10.60	55.0	7.91	73.4	12.1
Products 1 to 3	15.43	44.4	9.12	86.2	20.3
Products 1 to 4	20.99	34.7	9.86	91.6	29.8
Products 1 to 5	37.35	20.3	9.42	95.3	50.7

Test No. 69

Purpose: To repeat Test No. 59, but increase the Na_2S addition to the Pb regrind to 3 lb/ton.

Procedure: As for Test No. 54.

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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	Zn-SO_4	NaCN	R-242	R-404	Na_2S	Grind	Cond.	Froth	
Primary Grind	4.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	-	1	3	9.1
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb Conc. Regrind	-	-	-	-	-	3.0	23	-	-	-
Condition	-	0.5	0.20	-	-	-	-	5	-	10.5
Pb 1st Cleaner	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 2nd Cleaner	-	0.2	0.10	-	-	-	-	1	3	9.7
	-	-	-	0.005	-	-	-	1	1	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	3	9.4
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	9.5

Stage Pb Regrind
Equipment Laboratory ball mill

Test No. 69 - Continued

Metallurgical Results

Product	Weight	Assays %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	6.90	60.4	7.50	51.8	7.4
2. Pb 4th Cl. Tail.	2.72	38.1	10.6	12.9	4.1
3. Pb 3rd Cl. Tail.	4.94	24.2	11.8	14.9	8.3
4. Pb 2nd Cl. Tail.	5.72	13.0	11.1	9.2	9.1
5. Pb 1st Cl. Tail.	14.89	3.77	9.07	7.0	19.3
6. Pb Rougher Tail.	64.83	0.52	5.60	4.2	51.8
Head (Calculated)	100.00	8.04	7.00	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	9.62	54.1	8.38	64.7	11.5
Products 1 to 3	14.56	44.0	9.54	79.6	19.8
Products 1 to 4	20.28	35.2	9.98	88.8	28.9
Products 1 to 5	35.17	21.9	9.59	95.8	48.2

Test No. 70

Purpose: To repeat the standard procedure on sample A, but investigate the effect of regrinding in a smaller ball mill.

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

Feed: 2000 grams minus 10 mesh Sample PPA (1st lot).

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	4.0	1.0	0.30	0.07	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	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	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	1	3	9.3
	-	-	-	0.01	0.01	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	1	3	9.4
	-	-	-	0.005	-	-	1	1	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	1	3	9.5
Pb 4th Cleaner	0.2	-	0.05	-	-	-	1	2	9.5

Stage Pb Regrind
Equipment 8x8 inch ball mill, 20 lb. steel balls

Test No. 70 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	8.20	66.2	6.28	66.6	7.4
2. Pb 4th Cl. Tail.	2.31	36.5	11.5	10.3	3.8
3. Pb 3rd Cl. Tail.	4.01	20.6	13.2	10.1	7.6
4. Pb 2nd Cl. Tail.	6.14	6.97	12.1	5.3	10.7
5. Pb 1st Cl. Tail.	15.52	1.72	9.10	3.3	20.3
6. Pb Rougher Tail.	63.82	0.56	5.49	4.4	50.2
Head (Calculated)	100.00	8.15	6.97	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	10.51	59.7	7.43	76.9	11.2
Products 1 to 3	14.52	48.9	9.02	87.0	18.8
Products 1 to 4	20.66	36.4	9.94	92.3	29.5
Products 1 to 5	36.18	21.5	9.58	95.6	49.8

Size Analysis - Composite Cleaner Products

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 30.1 µm	2.8	2.8	97.2
23.3	5.0	7.8	92.2
16.3	12.9	20.7	79.3
11.2	20.4	41.1	58.9
8.7	11.9	53.0	47.0
- 8.7	47.0	100.0	-
Total	100.0	-	-

Specific Gravity = 4.83

Test No. 74

Purpose: To investigate the effect on Sample A of a two-stage regrind in the small ball mill on lead grade and recovery.

Procedure: Grind and float a lead rougher concentrate. Regrind the concentrate and clean once. Regrind the 1st cleaner concentrate and clean three more times.

Feed: 2000 grams minus 10 mesh Sample PPA (2nd lot).

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	4.0	1.0	0.30	0.07	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	1	3	9.1
	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	0.01	0.01	-	1	3	-
Pb 1st Regrind	1.5	0.5	0.20	0.03	-	30	-	-	-
Pb 1st Cleaner	-	-	-	0.005	0.01	-	1	4	9.4
	-	-	-	0.01	0.01	-	1	3	-
Pb 2nd Regrind	1.0	0.3	0.15	0.015	-	15	-	-	-
Pb 2nd Cleaner	-	-	-	-	0.005	-	1	3	9.5
	-	-	-	0.005	0.005	-	1	3	-
Pb 3rd Cleaner	0.3	0.1	0.10	-	-	-	1	3	9.5
	-	-	-	0.005	-	-	1	1	-
Pb 4th Cleaner	0.2	-	0.05	-	-	-	1	3	9.6

Stage Pb Regrinds
Equipment 8x8 inch ball mill, 20 lb. steel balls.

Test No. 74 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	8.80	66.4	6.66	72.1	8.4
2. Pb 4th Cl. Tail.	1.65	26.8	12.4	5.5	2.9
3. Pb 3rd Cl. Tail.	3.41	15.5	12.2	6.5	5.9
4. Pb 2nd Cl. Tail.	7.63	6.90	11.1	6.5	12.1
5. Pb 1st Cl. Tail.	13.15	1.78	8.64	2.9	16.2
6. Pb Rougher Tail.	65.36	0.82	5.83	6.5	54.5
Head (Calculated)	100.00	8.11	7.00	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	10.45	60.1	7.57	77.6	11.3
Products 1 to 3	13.86	49.2	8.71	84.1	17.2
Products 1 to 4	21.49	34.2	9.56	90.6	29.3
Products 1 to 5	34.64	21.9	9.21	93.5	45.5

Size Analysis - 2nd Regrind Mill Discharge

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 29.2 µm	1.0	1.0	99.0
22.6	2.2	3.2	96.8
15.8	10.6	13.8	86.2
10.9	17.0	30.8	69.2
8.4	12.0	42.8	57.2
- 8.4	57.2	100.0	-
Total	100.0	-	-

Specific Gravity = 5.28

Test No. 80

Purpose: To investigate the effect with Sample A of replacing $ZnSO_4$ with Na_2SO_3 in the regrind.

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

Feed: 2000 grams minus 10 mesh Sample PPA (2nd lot).

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	Zn-SO_4	NaCN	R-242	R-404	Na_2SO_3	O_2 %*	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.07	-	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	-	-	1	3	9.6
	-	-	-	0.01	0.01	-	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	-	1	3	-
Pb Conc. Regrind	1.5	-	0.20	0.03	-	0.5	-	23	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	40	-	1	3	9.9
	-	-	-	0.01	0.01	-	-	-	1	3	-
Pb 2nd Cleaner	0.2	0.2	0.10	-	-	-	-	-	1	3	9.8
	-	-	-	0.005	-	-	-	-	1	1	-
Pb 3rd Cleaner	0.3	0.1	0.05	-	-	-	-	-	1	3	9.9
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	-	1	2	9.9

*dissolved O_2

Stage	Rougher	Pb Regrind	1st to 3rd Cl.	4th Cleaner
Equipment	1000 g D-1	Laboratory Ball mill	500 g D-1	250 g D-1
Speed rpm	1800	-	1200	1000
% Solids	33	-	-	-

Test No. 80 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	10.73	56.8	7.86	75.7	12.0
2. Pb 4th Cl. Tail.	2.13	19.9	12.0	5.3	3.7
3. Pb 3rd Cl. Tail.	3.50	12.8	12.9	5.6	6.5
4. Pb 2nd Cl. Tail.	5.42	5.20	11.0	3.5	8.5
5. Pb 1st Cl. Tail.	17.28	1.68	7.51	3.6	18.5
6. Pb Rougher Tail.	60.94	0.84	5.84	6.3	50.8
Head (Calculated)	100.00	8.05	7.00	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	12.86	50.7	8.53	81.0	15.7
Products 1 to 3	16.36	42.5	9.48	86.6	22.2
Products 1 to 4	21.78	33.3	9.86	90.1	30.7
Products 1 to 5	39.06	19.3	8.82	93.7	49.2

Test No. 81

Purpose: To repeat Test No. 80, but increase the Na_2SO_3 addition to the lead regrind.

Procedure: As for Test No. 80.

Feed: 2000 grams minus 10 mesh Sample PPA (2nd lot).

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	Zn-SO_4	NaCN	R-242	R-404	Na_2SO_3	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	-	1	3	9.6
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb Conc. Regrind	1.0	-	0.20	0.03	-	1.5	23	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	9.9
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 2nd Cleaner	0.2	0.2	0.10	-	-	-	-	1	3	9.9
	-	-	-	0.005	-	-	-	1	1	-
Pb 3rd Cleaner	0.3	0.1	0.05	-	-	-	-	1	3	9.9
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	9.8

Stage Pb Regrind
Equipment Laboratory Ball Mill

Test No. 81 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	10.10	56.7	8.36	70.0	11.7
2. Pb 4th Cl. Tail.	1.70	25.8	11.1	5.4	2.6
3. Pb 3rd Cl. Tail.	3.73	17.9	13.2	8.1	6.8
4. Pb 2nd Cl. Tail.	4.77	8.15	11.2	4.7	7.4
5. Pb 1st Cl. Tail.	16.00	2.54	8.09	5.0	18.1
6. Pb Rougher Tail.	63.70	0.87	6.03	6.8	53.4
Head (Calculated)	100.00	8.18	7.20	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	11.80	52.2	8.76	75.4	14.3
Products 1 to 3	15.53	44.0	9.82	83.5	21.1
Products 1 to 4	20.30	35.6	10.15	88.2	28.5
Products 1 to 5	36.30	21.0	9.24	93.2	46.6

Test No. 91

Purpose: To investigate the effect of pebble mill grinding on Sample A.

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

Feed: 2000 grams minus 20 mesh Sample PPA (2nd lot).

Grind: 25 minutes at 60 percent solids in the 12 x 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	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.07	-	25	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	1	3	9.4
	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	0.01	0.01	-	1	3	-
Pb Conc. Regrind	2.0	0.5	0.20	0.03	-	20	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	1	3	9.7
	-	-	-	0.01	0.01	-	1	3	-
Pb 2nd Cleaner	0.2	0.2	0.10	-	-	-	1	3	9.8
	-	-	-	0.005	-	-	1	1	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	1	3	9.8
Pb 4th Cleaner	0.2	-	0.05	-	-	-	1	2	9.9

Stage	Rougher	Regrind
Equipment	1000 gram D-1	12 x 15 inch ceramic pebble mill
Speed rpm	1700	-

Test No. 91 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	7.01	69.0	5.11	62.3	5.2
2. Pb 4th Cl. Tail.	1.63	42.0	10.3	8.8	2.4
3. Pb 3rd Cl. Tail.	3.18	25.9	11.9	10.6	5.5
4. Pb 2nd Cl. Tail.	5.69	8.35	11.5	6.1	9.5
5. Pb 1st Cl. Tail.	17.60	2.54	9.28	5.8	23.6
6. Pb Rougher Tail.	64.89	0.77	5.75	6.4	53.8
Head (Calculated)	100.00	7.77	6.92	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	8.64	63.9	6.09	71.1	7.6
Products 1 to 3	11.82	53.7	7.65	81.7	13.1
Products 1 to 4	17.51	39.0	8.90	87.8	22.6
Products 1 to 5	35.11	20.7	9.09	93.6	46.2

Size Analysis

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 31.1 µm	0.8	0.8	99.2
24.1	1.4	2.2	97.8
16.8	7.9	10.1	89.9
11.6	14.3	24.4	75.6
8.9	11.3	35.7	64.3
- 8.9	64.3	100.0	-
Total	100.0	-	-

Specific Gravity = 4.79

Test No. 94

Purpose: To investigate the effect on PP sample A of doubling the $ZnSO_4$ and NaCN to the lead cleaners.

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

Feed: 2000 grams minus 10 mesh Sample PPA (2nd lot).

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	0.07	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	1	3	9.4
	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	0.01	0.01	-	1	3	-
Pb Conc. Regrind	1.0	1.0	0.40	0.03	-	23	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	1	3	9.5
	-	-	-	0.01	0.01	-	1	3	-
Pb 2nd Cleaner	0.3	0.4	0.20	-	-	-	1	3	9.6
	-	-	-	0.005	-	-	1	1	-
Pb 3rd Cleaner	0.3	0.2	0.10	-	-	-	1	3	9.7
Pb 4th Cleaner	0.2	-	0.10	-	-	-	1	2	9.7

Stage	Rougher	Pb Regrind	1st to 3rd Cl.	4th Cleaner
Equipment	1000 g D-1	Lab. Ball Mill	500 g D-1	250 g D-1
Speed rpm	1700	-	1200	1000
% Solids	33	-	-	-

Test No. 94 - Continued

Metallurgical Results

Product	Weight	Assays %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	10.26	56.5	7.68	72.5	11.1
2. Pb 4th Cl. Tail.	1.75	23.9	10.5	5.2	2.6
3. Pb 3rd Cl. Tail.	3.86	16.3	12.2	7.9	6.7
4. Pb 2nd Cl. Tail.	4.85	5.51	10.9	3.4	7.5
5. Pb 1st Cl. Tail.	16.05	2.06	8.33	4.1	18.9
6. Pb Rougher Tail.	63.23	0.87	5.95	6.9	53.2
Head (Calculated)	100.00	7.99	7.07	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	12.01	51.8	8.09	77.7	13.7
Products 1 to 3	15.87	43.1	9.09	85.6	20.4
Products 1 to 4	20.72	34.3	9.51	89.0	27.9
Products 1 to 5	36.77	20.2	9.00	93.1	46.8

Test No. 95

Purpose: To repeat Test No. 94, but increase the $ZnSO_4$ addition to the lead rougher concentrate regrind.

Procedure: As for Test No. 94.

Feed: 2000 grams minus 10 mesh Sample PPA (2nd lot).

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	0.07	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	1	3	9.4
	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	0.01	0.01	-	1	3	-
Pb Conc. Regrind	1.0	2.0	0.40	0.03	-	23	-	-	-
Pb 1st Cleaner	0.2	-	-	-	0.01	-	1	3	9.5
	-	-	-	0.01	0.01	-	1	3	-
Pb 2nd Cleaner	0.3	0.4	0.20	-	-	-	1	3	9.6
	-	-	-	0.005	-	-	1	1	-
Pb 3rd Cleaner	0.3	0.2	0.10	-	-	-	1	3	9.6
Pb 4th Cleaner	0.2	-	0.10	-	-	-	1	2	9.7

Test No. 95 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	9.30	56.6	7.46	66.9	10.0
2. Pb 4th Cl. Tail.	1.86	25.1	10.6	5.9	2.9
3. Pb 3rd Cl. Tail.	4.36	17.6	11.7	9.7	7.4
4. Pb 2nd Cl. Tail.	5.47	7.05	10.4	4.9	8.2
5. Pb 1st Cl. Tail.	16.16	2.80	8.36	5.8	19.5
6. Pb Rougher Tail.	62.85	0.85	5.72	6.8	52.0
Head (Calculated)	100.00	7.87	6.92	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	11.16	51.4	7.98	72.8	12.9
Products 1 to 3	15.52	41.9	9.03	82.5	20.3
Products 1 to 4	20.99	32.8	9.39	87.4	28.5
Products 1 to 5	37.15	19.7	8.94	93.2	48.0

Test No. 98

Purpose: To investigate the effect of adding iron powder to the ball mill regrind.

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

Feed: 2000 grams minus 10 mesh Sample PPA (2nd lot).

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	Iron Powder	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	-	1	3	9.4
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb Conc. Regrind	2.0	0.5	0.20	0.03	-	30	23	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	10.1
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3	10.0
	-	-	-	0.005	-	-	-	1	1	-
Pb 3rd Cleaner	0.3	0.1	0.05	-	-	-	-	1	3	9.9
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	9.9

Stage Pb Regrind
Equipment Lab. Ball Mill

Test No. 98 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	10.73	57.0	7.50	78.0	11.9
2. Pb 4th Cl. Tail.	1.96	17.5	11.6	4.4	3.4
3. Pb 3rd Cl. Tail.	3.31	11.6	12.0	4.9	5.8
4. Pb 2nd Cl. Tail.	4.20	4.96	10.4	2.7	6.4
5. Pb 1st Cl. Tail.	14.17	1.53	7.96	2.8	16.6
6. Pb Rougher Tail.	65.63	0.87	5.78	7.2	55.9
Head (Calculated)	100.00	7.84	6.79	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	12.69	50.9	8.13	82.4	15.3
Products 1 to 3	16.00	42.8	8.93	87.3	21.1
Products 1 to 4	20.20	34.9	9.24	90.0	27.5
Products 1 to 5	34.37	21.1	8.71	92.8	44.1

Test No. 100

Purpose: To repeat Test No. 98, but increase the iron powder addition to the lead regrind.

Procedure: As for Test No. 98.

Feed: 2000 grams minus 10 mesh Sample PPA (2nd lot).

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	Iron Powder	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	-	1	3	9.4
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb Conc. Regrind	2.0	0.5	0.20	0.03	-	60	23	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	10.0
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3	9.9
	-	-	-	0.005	-	-	-	1	1	-
Pb 3rd Cleaner	0.3	0.1	0.05	-	-	-	-	1	3	9.9
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	9.8

Stage Pb Regrind
Equipment laboratory ball mill

Test No. 100 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	9.44	57.7	7.28	71.7	10.3
2. Pb 4th Cl. Tail.	2.02	23.6	11.4	6.3	3.4
3. Pb 3rd Cl. Tail.	3.32	15.9	12.0	6.9	6.0
4. Pb 2nd Cl. Tail.	4.85	6.66	10.5	4.3	7.6
5. Pb 1st Cl. Tail.	18.23	1.59	6.89	3.8	18.8
6. Pb Rougher Tail.	62.14	0.86	5.81	7.0	53.9
Head (Calculated)	100.00	7.60	6.69	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	11.46	51.7	8.01	78.0	13.7
Products 1 to 3	14.78	43.7	8.90	84.9	19.7
Products 1 to 4	19.63	34.5	9.30	89.2	27.3
Products 1 to 5	37.86	18.7	8.14	93.0	46.1

Test No. 105

Purpose: To repeat Test No. 32, but use the recently-prepared PPA sample.

Procedure: As for Test No. 32.

Feed: 2000 grams minus 10 mesh Sample PPA (2nd lot).

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	0.07	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	1	3	9.0
	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	0.01	0.01	-	1	3	-
Pb Conc. Regrind	1.5	0.5	0.20	0.03	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	1	3	9.5
	-	-	-	0.01	0.01	-	1	3	-
Pb 2nd Cleaner	0.3	0.20	0.10	-	-	-	1	3	9.6
	-	-	-	0.005	-	-	1	1	-
Pb 3rd Cleaner	0.2	0.10	0.05	-	-	-	1	3	9.6
Pb 4th Cleaner	0.2	-	0.05	-	-	-	1	2	9.7

Stage Regrind
Equipment laboratory rod mill

Test No. 105 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	10.92	59.2	7.32	80.6	11.5
2. Pb 4th Cl. Tail.	2.22	18.9	12.5	5.2	4.0
3. Pb 3rd Cl. Tail.	2.38	9.43	12.9	2.8	4.4
4. Pb 2nd Cl. Tail.	3.82	3.55	11.3	1.7	6.2
5. Pb 1st Cl. Tail.	17.67	1.42	8.72	3.1	22.2
6. Pb Rougher Tail.	62.99	0.83	5.70	6.6	51.7
Head (Calculated)	100.00	8.02	6.95	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	13.14	52.4	8.19	85.8	15.5
Products 1 to 3	15.52	45.8	8.92	88.6	19.9
Products 1 to 4	19.34	37.5	9.39	90.3	26.1
Products 1 to 5	37.01	20.3	9.07	93.4	48.3

Test No. 106

Purpose: To investigate the effect in the ball mill regrind flowsheet of replacing R-242 and R-404 with Z-4 as lead collector.

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

Feed: 2000 grams minus 10 mesh Sample PPA (2nd lot).

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	Z-4	MIBC	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.08	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.06	-	1	3	9.4
	-	-	-	0.02	0.01	-	1	3	-
	-	-	-	0.02	0.01	-	1	3	-
Pb Conc. Regrind	2.0	0.5	0.20	0.03	-	23	-	-	-
Pb 1st Cleaner	-	-	-	0.01	0.01	-	1	3	9.8
	-	-	-	0.01	-	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	1	3	9.9
	-	-	-	0.005	-	-	1	1	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	0.005	-	1	3	9.9
Pb 4th Cleaner	0.2	-	0.05	-	-	-	1	2	9.9

Stage Pb Conc. Regrind
Equipment laboratory ball mill

Test No. 106 - Continued

Metallurgical Results

Product	Weight	Assays %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	7.21	65.5	6.44	58.9	6.6
2. Pb 4th Cl. Tail.	3.17	38.8	10.8	15.4	4.9
3. Pb 3rd Cl. Tail.	3.64	22.2	11.4	10.1	5.9
4. Pb 2nd Cl. Tail.	4.86	7.23	11.0	4.4	7.6
5. Pb 1st Cl. Tail.	17.94	2.13	8.51	4.8	21.8
6. Pb Rougher Tail.	63.18	0.82	5.91	6.4	53.2
Head (Calculated)	100.00	8.01	7.02	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	10.38	57.3	7.77	74.3	11.5
Products 1 to 3	14.02	48.2	8.71	84.4	17.4
Products 1 to 4	18.88	37.7	9.30	88.8	25.0
Products 1 to 5	36.82	20.4	8.92	93.6	46.8

Test No. 107

Purpose: To investigate the effect of adding SO_2 to the lead regrind.

Procedure: As for Test No. 106.

Feed: 2000 grams minus 10 mesh Sample PPA (2nd lot).

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	SO_2	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	-	1	3	9.2
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb Conc. Regrind	2.0	0.5	0.20	0.03	-	2.0	23	-	-	7.7
Pb 1st Cleaner	2.0	-	-	-	0.01	-	-	1	3	9.2
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 2nd Cleaner	0.5	0.2	0.10	-	-	-	-	1	3	9.5
	-	-	-	0.005	-	-	-	1	1	-
Pb 3rd Cleaner	0.3	0.1	0.05	-	-	-	-	1	3	9.7
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	9.7

Test No. 107 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	7.82	57.0	7.84	55.8	8.6
2. Pb 4th Cl. Tail.	1.94	34.6	10.5	8.4	2.9
3. Pb 3rd Cl. Tail.	5.06	22.1	11.5	14.0	8.1
4. Pb 2nd Cl. Tail.	7.13	10.5	10.2	9.4	10.2
5. Pb 1st Cl. Tail.	11.86	4.04	8.87	6.0	14.7
6. Pb Rougher Tail.	66.19	0.78	5.99	6.4	55.5
Head (Calculated)	100.00	7.99	7.14	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	9.76	52.5	8.37	64.2	11.5
Products 1 to 3	14.82	42.2	9.44	78.2	19.6
Products 1 to 4	21.95	31.9	9.69	87.6	29.8
Products 1 to 5	33.81	22.1	9.40	93.6	44.5

Test No. 108

Purpose: To repeat Test No. 107, but omit the usual reagent additions to the regrind mill, aerate and condition with reagents before the 1st cleaner stage.

Procedure: Grind and float a lead concentrate. Regrind the concentrate, aerate and condition, then clean four times.

Feed: 2000 grams minus 10 mesh Sample PPA (2nd lot).

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	SO_2	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	-	1	3	9.2
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb Conc. Regrind	-	-	-	-	-	2.0	23	-	-	-
Aeration	-	-	-	-	-	-	-	5	-	6.8
Condition	3.5	0.5	0.20	-	-	-	-	5	-	9.3
Pb 1st Cleaner	-	-	-	0.02	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 2nd Cleaner	0.4	0.2	0.10	-	-	-	-	1	3	9.6
	-	-	-	0.005	-	-	-	1	1	-
Pb 3rd Cleaner	0.3	0.1	0.05	-	-	-	-	1	3	9.8
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	9.8

Test No. 108 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	5.65	58.4	8.14	42.3	6.5
2. Pb 4th Cl. Tail.	3.26	33.5	10.9	14.0	5.0
3. Pb 3rd Cl. Tail.	2.41	26.9	10.7	8.3	3.7
4. Pb 2nd Cl. Tail.	4.81	18.4	10.2	11.4	7.0
5. Pb 1st Cl. Tail.	19.30	7.11	8.75	17.6	24.0
6. Pb Rougher Tail.	64.57	0.77	5.87	6.4	53.8
Head (Calculated)	100.00	7.79	7.04	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	8.91	49.3	9.15	56.3	11.5
Products 1 to 3	11.32	44.5	9.48	64.6	15.2
Products 1 to 4	16.13	36.7	9.69	76.0	22.2
Products 1 to 5	35.43	20.6	9.18	93.6	46.2

Test No. 110

Purpose: To perform the standard test with ball mill regrind for comparison to previous results.

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

Feed: 2000 grams minus 10 mesh Sample PPA (2nd lot).

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	0.07	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	1	3	9.4
	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	0.01	0.01	-	1	3	-
Pb Conc. Regrind	2.0	0.5	0.20	0.03	-	23	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	1	3	9.7
	-	-	-	0.01	0.01	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	1	3	9.8
	-	-	-	0.005	-	-	1	1	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	1	3	9.8
Pb 4th Cleaner	0.2	-	0.05	-	-	-	1	2	9.9

Stage	Pb Regrind	Pb 1st to 3rd Cl.	Pb 4th Cleaner
Equipment	Lab. Ball Mill	500 g D-1	250 g D-1
Speed rpm	-	1200	1000

Test No. 110 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	9.39	59.9	7.24	69.9	9.7
2. Pb 4th Cl. Tail.	1.59	28.2	11.3	5.6	2.6
3. Pb 3rd Cl. Tail.	3.49	18.7	12.4	8.1	6.1
4. Pb 2nd Cl. Tail.	4.54	8.50	11.6	4.8	7.5
5. Pb 1st Cl. Tail.	15.57	2.50	9.05	4.8	20.0
6. Pb Rougher Tail.	65.42	0.84	5.83	6.8	54.1
Head (Calculated)	100.00	8.05	7.04	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	10.98	55.3	7.83	75.5	12.3
Products 1 to 3	14.47	46.5	8.93	83.6	18.4
Products 1 to 4	19.01	37.4	9.57	88.4	25.9
Products 1 to 5	34.58	21.7	9.33	93.2	45.9

Test No. 111

Purpose: To repeat Test No. 110, but reduce collector additions to lead regrind and lead cleaners.

Procedure: As for Test No. 110.

Feed: 2000 grams minus 10 mesh Sample PPA (2nd lot).

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	0.07	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	1	3	9.4
	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	0.01	0.01	-	1	3	-
Pb Conc. Regrind	2.0	0.5	0.20	0.015	-	23	-	-	-
Pb 1st Cleaner	-	-	-	-	0.005	-	1	3	9.6
	-	-	-	0.005	0.005	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	1	4	9.7
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	1	3	9.8
Pb 4th Cleaner	0.2	-	0.05	-	-	-	1	2	9.8

Stage	Pb Regrind	1st & 2nd Cleaners	3rd & 4th Cleaners
Equipment	Ball Mill	500 g D-1	250 g D-1
Speed rpm	-	1200	1000

Test No. 111 - Continued

Metallurgical Results

Product	Weight	Assays %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	6.33	66.5	6.18	52.8	5.6
2. Pb 4th Cl. Tail.	2.58	40.5	10.3	13.1	3.8
3. Pb 3rd Cl. Tail.	2.27	25.0	11.8	7.1	3.8
4. Pb 2nd Cl. Tail.	5.83	15.1	11.4	11.1	9.5
5. Pb 1st Cl. Tail.	17.47	3.97	9.27	8.7	23.1
6. Pb Rougher Tail.	65.52	0.87	5.81	7.2	54.2
Head (Calculated)	100.00	7.97	7.02	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	8.91	59.0	7.37	65.9	9.4
Products 1 to 3	11.18	52.1	8.27	73.0	13.2
Products 1 to 4	17.01	39.4	9.34	84.1	22.7
Products 1 to 5	34.48	21.4	9.31	92.8	45.8

Test No. 112

Purpose: To repeat Test No. 110, but increase collector additions with Z-4 added to lead regrind and lead cleaners.

Procedure: As for Test No. 110.

Feed: 2000 grams minus 10 mesh Sample PPA (2nd lot).

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	Z-4	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	-	-	1	3	9.5
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb Conc. Regrind	2.0	0.5	0.20	0.02	-	0.03	23	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	9.7
	-	-	-	-	0.01	0.01	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3	9.8
	-	-	-	-	-	0.01	-	1	1	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	0.005	-	1	3	9.8
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	9.7

Test No. 112 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	8.52	63.0	6.61	66.9	8.0
2. Pb 4th Cl. Tail.	2.36	30.6	11.3	9.0	3.8
3. Pb 3rd Cl. Tail.	3.59	17.7	12.0	7.9	6.2
4. Pb 2nd Cl. Tail.	5.38	6.87	11.1	4.6	8.6
5. Pb 1st Cl. Tail.	14.70	2.32	8.72	4.3	18.4
6. Pb Rougher Tail.	65.45	0.89	5.86	7.3	55.0
Head (Calculated)	100.00	8.02	6.98	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	10.88	56.0	7.63	75.9	11.8
Products 1 to 3	14.47	46.5	8.71	83.8	18.0
Products 1 to 4	19.85	35.7	9.36	88.4	26.6
Products 1 to 5	34.55	21.5	9.09	92.7	45.0

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