A Pilot Plant Investigation of

THE RECOVERY OF LEAD AND ZINC

from Grum Deposit Samples

submitted by

KERR ADDISON MINES LIMITED

Progress Report No. 11, (Volume 2)

Project No. L.R. 2027

NOTE:

This report refers to the samples as received.

LAKEFIELD RESEARCH OF CANADA LIMITED
Lakefield, Ontario
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REPORT COMPOSITION

VOLUME 1 - Summary, Discussion, Description of Equipment
Appendix No. 1 and No. 2
Tests PP-1 to PP-6

VOLUME 2 - Tests PP-7 to PP-23

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Test No. PP8

1. Grinding

1.1. Purpose: To repeat conditions of test PP7.

1.2. Method: As for test PP6. The grinding circuit was operated for a period of 7.75 hours at a feed rate of 695 pounds per hour. Samples were taken every 30 minutes in the last 2 hours of operation.

1.2.1. Classification Equipment

Hendy Mill; P-50 Dorr Cyclone:

1 1/2 inch diameter
5/8 inch vortex
1/2 inch apex

Pb Regrind

Sala Mill; Krebs Cyclone:

1 inch diameter
1/4 inch vortex
1/8 inch apex

1.3. Flowsheet: As for test PP1.

1.4. Results: The grinding circuit was stable during the test run. Net power consumption in the Hendy Mill was 14.8 kilowatt-hours per ton of ½ inch feed. The cyclone overflow assayed 88.5 % minus 200 mesh.

Test No. PP8 - Continued

1.4. Results:

1.4.1. Ball Mill Report

Feed:	Minus ½ inch ore at 1.6 percent moisture content		
Feed Rate:	695 dry pounds per hour		
Mill Speed:	32 r.p.m., 80.5 percent of critical speed		
Mill Load:	3 inch balls	1000 pounds	
	1½ inch balls	600 pounds	
	1 inch balls	400 pounds	
	Total	2000 pounds	
Operating Time:	Total 7.75 hours, test period 2 hours		
Mill Feed:	Total 5386 pounds, test period 1390 pounds		
Circulating Load:	Cyclone underflow 542.0 percent		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2100	67
	Cyclone Overflow	1396	37
	Cyclone Underflow	2408	76
Average Power:	Gross	7.13 kilowatts	
	No Load	1.92 kilowatts	
	Net	5.21 kilowatts	
Net Power Consumption:	14.89 kilowatt-hours per ton of ½ inch feed		
Work Index:	11.48		

Test No. PP8 - Continued

1.4. Results:

1.4.2. Lead Regrinding Mill Report

Regrinding Mill:	Sala ball mill		
Feed:	Lead Rougher Concentrate and Pb 2nd Cleaner Tailings		
Feed Rate:	149.28 pounds per hour, 21.48 percent of the mill feed		
Mill Speed:	31 r.p.m., 73 percent of critical speed		
Mill Load:	2 inch balls	480 pounds	
	1 inch balls	720 pounds	
	Total	1200 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2458	75
	Cyclone Feed	1217	22.5
	Cyclone Overflow	1135	15.5
	Cyclone Underflow	2458	75
Average Power:	Gross	7.96 kilowatts	
	No Load	0.92 kilowatts	
	Net	7.04 kilowatts	
Net Power Consumption:	20.10 kilowatt-hours per ton of feed		

Test No. PP8 - Continued

1.4.3. Screen Analyses

Mill Feed

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 3/8	4.6	4.6	95.4
3	11.6	16.2	83.8
4	12.6	28.8	71.2
6	11.6	40.4	59.6
8	8.5	48.9	51.1
10	7.3	56.2	43.8
14	5.8	62.0	38.0
20	4.6	66.6	33.4
28	3.9	70.5	29.5
35	3.2	73.7	26.3
48	3.5	77.2	22.8
65	3.4	80.6	19.4
100	2.8	83.4	16.6
150	2.9	86.3	13.7
200	3.1	89.4	10.6
- 200	10.6	100.0	-
Total	100.0	-	-

Mill Discharge

+ 14	0.1	0.1	99.9
20	0.1	0.2	99.8
28	0.3	0.5	99.5
35	0.4	0.9	99.1
48	1.2	2.1	97.9
65	3.1	5.2	94.8
100	5.3	10.5	89.5
150	9.8	20.3	79.7
200	17.7	38.0	62.0
270	14.6	52.6	47.4
400	17.1	69.7	30.3
- 400	30.3	100.0	-
Total	100.0	-	-

Test No. PP8 - Continued

1.4.3. Screen Analyses

Cyclone Underflow

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 10	0.1	0.1	99.9
14	0.2	0.3	99.7
20	0.3	0.6	99.4
28	0.5	1.1	98.9
35	0.6	1.7	98.3
38	1.7	3.4	96.6
65	4.0	7.4	92.6
100	6.2	13.6	86.4
150	11.0	24.6	75.4
200	19.3	43.9	56.1
270	15.4	59.3	40.7
400	16.7	76.0	24.0
- 400	24.0	100.0	-
Total	100.0	-	-

Cyclone Overflow

+ 65	0.4	0.4	99.6
100	1.1	1.5	98.5
150	3.0	4.5	95.5
200	7.0	11.5	88.5
270	8.0	19.5	80.5
400	14.6	34.1	65.9
- 400	65.9	100.0	-
Total	100.0	-	-

Test No. PP8 - Continued

1.4.3. Screen Analyses

Pb Rougher Concentrate

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	5.6	5.6	94.4
270	6.6	12.2	87.8
27.2 µm	18.4	30.6	69.4
21.1	7.4	38.0	62.0
14.7	11.5	49.5	50.5
10.1	11.8	61.3	38.7
7.8	8.1	69.4	30.6
- 7.8	30.6	100.0	-
Total	100.0	-	-

Specific Gravity 4.66

Pb Regrind Cyclone Underflow

+ 200 mesh	3.6	3.6	96.4
270	4.6	8.2	91.8
26.9 µm	18.6	26.8	73.2
20.8	12.6	39.4	60.6
14.5	25.2	64.6	35.4
10.0	20.3	84.9	15.1
7.7	7.0	91.9	8.1
- 7.7	8.1	100.0	-
Total	100.0	-	-

Specific Gravity 4.82

Pb Regrind Discharge

+ 200 mesh	0.6	0.6	99.4
270	1.4	2.0	98.0
26.9 µm	14.7	16.7	83.3
20.8	13.2	29.9	70.1
14.5	25.6	55.5	44.5
10.0	17.5	73.0	27.0
7.7	6.4	79.4	20.6
- 7.7	20.6	100.0	-
Total	100.0	-	-

Specific Gravity 4.89

Test No. PP8 - Continued

1.4.3. Screen Analyses

Pb Regrind Cyclone Overflow

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 14.7 µm	2.0	2.0	98.0
10.1	10.4	12.4	87.6
7.8	12.9	25.3	74.7
- 7.8	74.7	100.0	-
Total	100.0	-	-

Specific Gravity 4.68

Pb 4th Cleaner Concentrate

+ 12.5 µm	4.6	4.6	95.4
8.6	19.6	24.2	75.8
6.7	18.2	42.4	57.6
- 6.7	57.6	100.0	-
Total	100.0	-	-

Specific Gravity 5.50

Zn Combined Tailings

+ 200 mesh	9.5	9.5	90.5
270	8.2	17.7	82.3
31.7 µm	13.5	31.2	68.8
24.6	9.3	40.5	59.5
17.2	12.5	53.0	47.0
11.8	10.4	63.4	36.6
9.1	6.3	69.7	30.3
- 9.1	30.3	100.0	-
Total	100.0	-	-

Specific Gravity 3.69

Test No. PP8 - Continued

1.4.3. Screen Analyses

Specific Gravity

Sample	Specific Gravity
Cyclone Overflow	3.91

Test No. PP8 - Continued

2. Flotation

2.1. Purpose:

1) To study the effect of omitting the aeration step from the Pb rougher circuit.
2) To improve lead cleaning
3) To study the effect of scavenging the zinc 1st cleaner tailing in open circuit.

2.2. Method:

The following changes in the circuits were made:

Pb Circuit

1) The aeration stage was omitted from the circuit.
2) The Z-6 additions to the mill was decreased.
3) Collector 242 was added to the 1st cleaner feed pump.

Zn Circuit

The zinc 1st cleaner tailing was scavenged in a bank of 6 Fagergren cells. The 1st cleaner scavenger concentrate was returned to the rougher feed, and the tailing was combined with the Zn scavenger tailing.

2.2.1. Flotation Equipment

As for test PP6, except that 6 Fagergren No. 12 cells were added to the zinc 1st cleaner circuit, and aerators were omitted from the lead circuit.

2.2.2. Flotation Reagents

See following page.

2.4. Results:

No improvement in the lead rougher and cleaning circuit resulted from the above changes. The zinc flotation improved when the Zn 1st cleaner tailing was retreated in open circuit.

Test No. PP8 - Continued

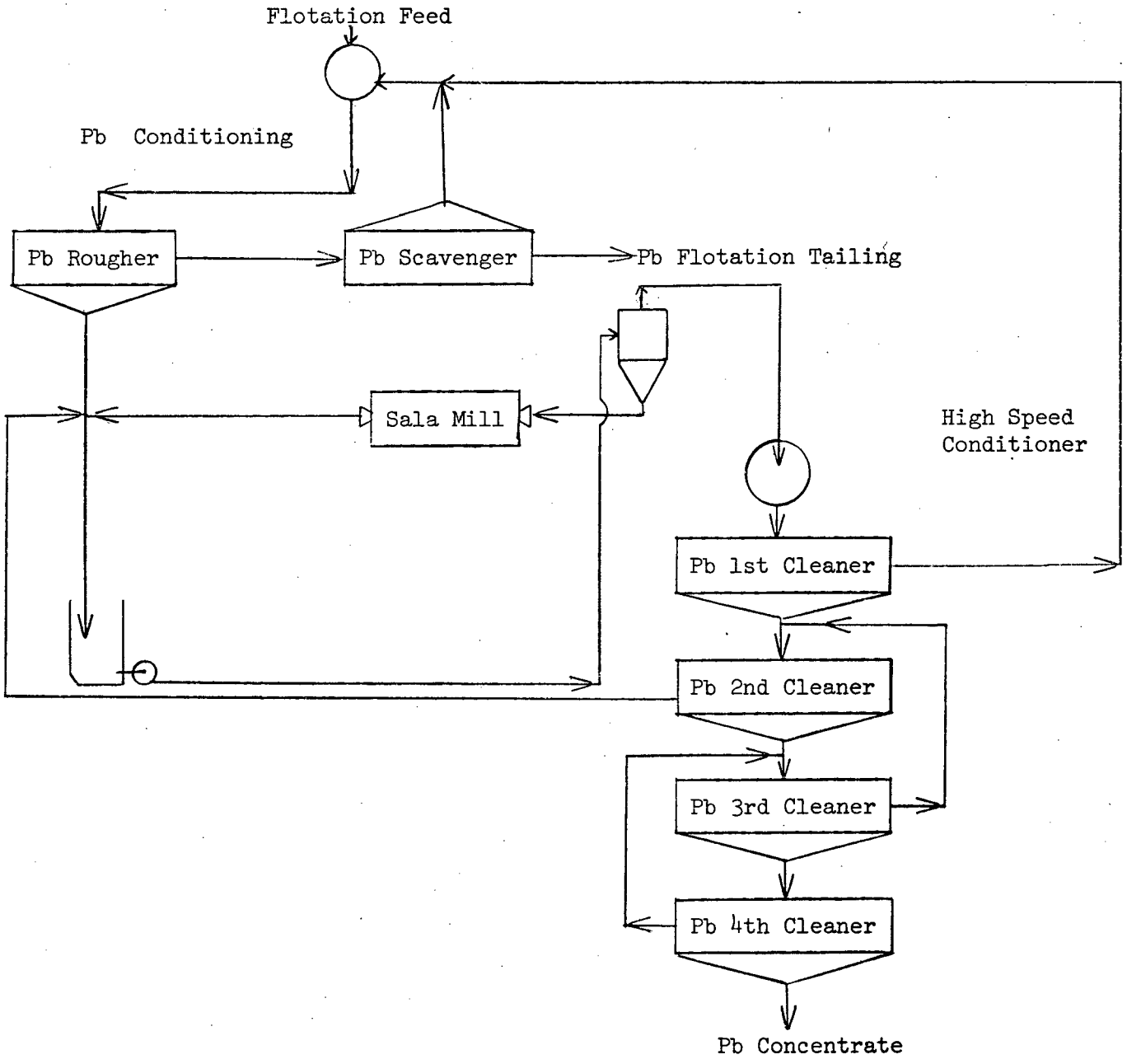
2.2.2. Reagent Additions

Type	Pounds Per Short Ton	Point of Addition
Na_2CO_3	3.00	Ball Mill Feed
NaCN	0.45	Ball Mill Feed
Na_2SO_3	0.98	Ball Mill Feed
Z-6	0.05	Ball Mill Feed
Z-6	0.03	Pb Conditioner
MIBC	0.075	Pb Rougher Feed Pump
MIBC	0.075	Pb Rougher 3rd Cell
Z-6	0.03	Pb Scavenger Feed
MIBC	0.027	Pb Scavenger Feed
NaCN	0.29	Pb Regrind Mill Feed
Na_2CO_3	0.56	Pb Regrind Mill Feed
$ZnSO_4$	0.56	Pb Regrind Mill Feed
R-242	0.02	Pb Cyclone Feed Pump
MIBC	0.055	Pb 1st Cl. Feed PUmp
Z-6	0.02	Pb 1st Cleaner 4th Cell
NaCN	0.11	Pb 2nd Cleaner Feed
NaCN	0.05	Pb 3rd Cleaner Feed
NaCN	0.05	Pb 4th Cleaner Feed
$Ca(OH)_2$	2.90	Zn Conditioner
$CuSO_4$	2.10	Zn Conditioner
M-748	0.075	Zn Conditioner
Z-6	0.10	Zn Rougher Feed Pump
DF-250	0.065	Zn Rougher Feed Pump
Z-6	0.04	Zn Scavenger Feed
Z-200	0.018	Zn Scavenger Feed
DF-250	0.030	Zn Scavenger Feed
$Ca(OH)_2$	0.40	Zn 1st Cleaner Feed
Z-200	0.03	Zn 1st Cleaner Feed
Z-6	0.03	Zn 1st Cleaner Feed
DF-250	0.030	Zn 1st Cleaner Feed
Z-6	0.02	Zn 1st Cl. Scavenger
Z-6	0.02	Zn 2nd Cleaner Feed
DF-250	0.015	Zn 2nd Cleaner Feed
$Ca(OH)_2$	0.30	Zn 2nd Cleaner Feed
$Ca(OH)_2$	0.20	Zn 3rd Cleaner Feed
DF-250	0.004	Zn 3rd Cleaner Feed
$Ca(OH)_2$	0.18	Zn 4th Cleaner Feed

Test No. PP8 - Continued

2.3. Flowsheet

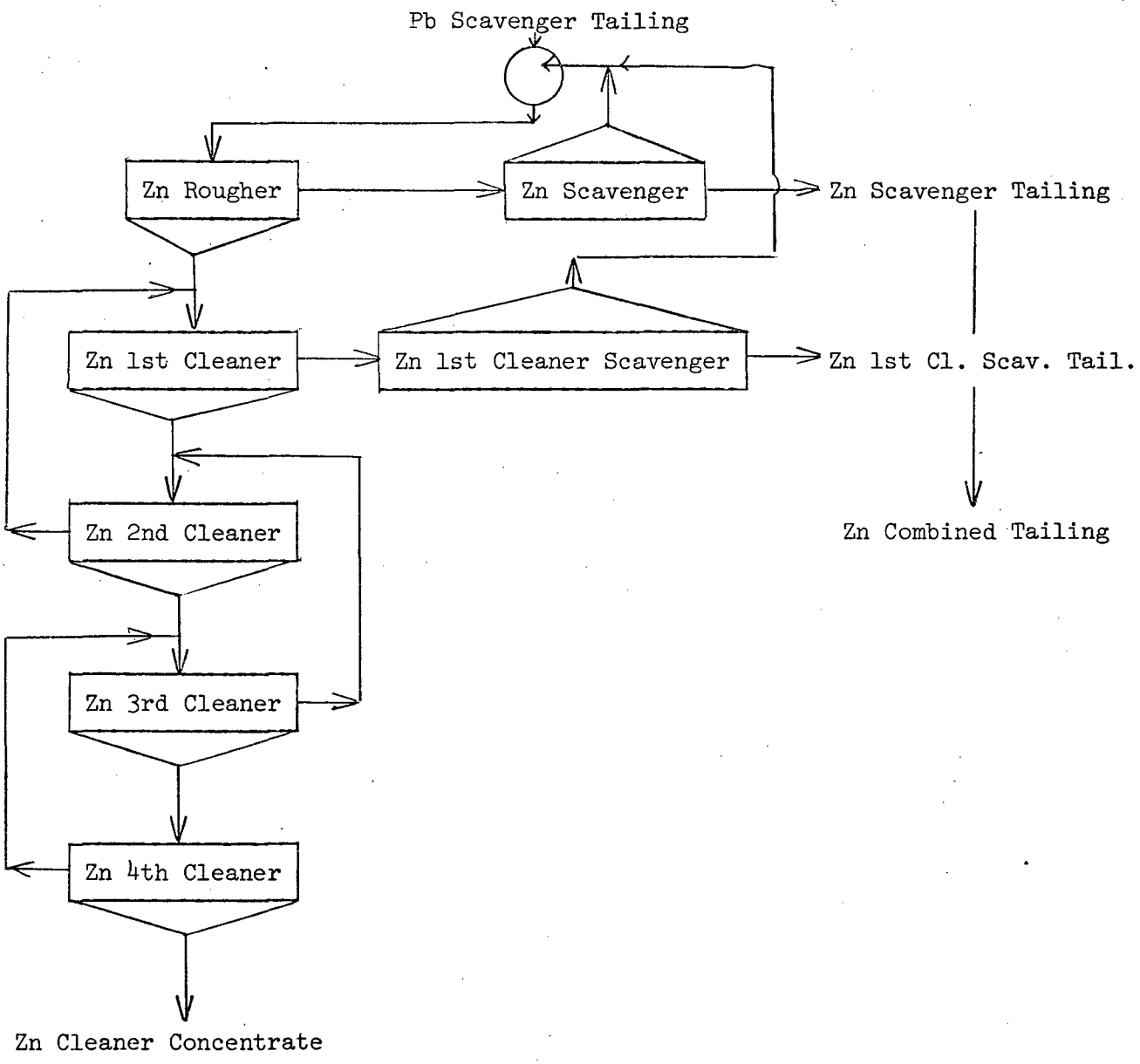
a) Pb Circuit



Test No. PP8 - Continued

2.3. Flowsheet

b) Zn Circuit



Test No. PP8 - Continued

2.4. Results:

2.4.1. pH

Product	pH
Cyclone Overflow	9.2
Pb Rougher Feed	9.1
Pb Scavenger Tailing	8.9
Pb Regrinding Mill Discharge	9.3
Pb 1st Cleaner Feed	9.4
Pb 2nd Cleaner Feed	9.4
Pb 3rd Cleaner Feed	9.2
Pb 4th Cleaner Feed	9.2
Zn Rougher Feed	10.3
Zn Scavenger Tailing	9.8
Zn 1st Cleaner Feed	10.8
Zn 2nd Cleaner Feed	10.8
Zn 3rd Cleaner Feed	10.9
Zn 4th Cleaner Feed	11.1

2.4.2. Pulp Densities

Product	Pulp Density gpl
Pb Rougher Feed	1247
Pb Scavenger Tailing	1215
Pb 1st Cleaner Feed	1135
Zn Rougher Feed	1145
Zn Scavenger Tailing	1120
Zn 1st Cleaner Feed	1197

2.4.3. Pulp Temperature

Product	^{o}C
Pb Rougher Feed	27
Pb Regrinding Mill Discharge	29
Zn Rougher Feed	25

Test No. PP8 - Continued

2.4.4. Chemical Analyses

Product	Assays, %	
	Pb	Zn
Cyclone Overflow	6.19	9.80
Pb Rougher Feed	5.89	11.5
Pb Rougher Concentrate	21.4	15.7
Pb Rougher Tailing	2.03	9.19
Pb Scavenger Concentrate	5.15	14.2
Pb Scavenger Tailing	1.22	8.05
Pb 1st Cleaner Concentrate	33.0	16.5
Pb 1st Cleaner Tailing	6.12	16.4
Pb Regrind Discharge	20.5	13.3
Pb Regrind Cyclone Underflow	18.2	12.9
Pb Regrind Cyclone Overflow	18.9	15.7
Pb Cleaner Concentrate	49.9	12.9
Zn Rougher Feed	1.61	7.89
Zn Rougher Concentrate	2.05	16.8
Zn Rougher Tailing	1.13	1.75
Zn Scavenger Concentrate	2.43	5.76
Zn Scavenger Tailing	0.99	1.06
Zn 1st Cleaner Tailing	2.38	4.37
Zn 1st Cleaner Concentrate	2.17	20.8
Zn 1st Cl. Scav. Tailing	2.55	1.72
Zn Combined Tailing	1.28	1.18
Zn 1st Cl. Scav. Concentrate	2.37	5.33
Zn Cleaner Concentrate	1.95	49.6

Test No. PP8 - Continued

2.4.5. Metallurgical Results

Two-Product Formula

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
Pb Ro. Concentrate	21.48	21.4	15.7	74.3	31.9
Pb Ro. Tailing	78.52	2.03	9.19	25.7	68.1
Cyclone Overflow (meas)	100.00	6.19	9.80	100.0	100.0
(Calc.)	-	6.19	10.6	-	-
Pb Scav. Concentrate	16.18	5.15	14.2	13.5	21.7
Pb Scav. Tailing	62.34	1.22	8.05	12.3	47.4
Pb Ro. Tailing (meas)	78.52	2.03	9.19	25.7	68.2
(Calc.)	-	2.03	9.32	25.7	69.1
Zn Ro. Concentrate	23.17	2.05	18.7	7.67	40.9
Zn Ro. Tailing	39.17	1.13	1.75	7.15	6.47
Pb Scav. Tailing(meas)	62.34	1.22	8.05	12.3	47.4
(Calc.)	-	1.47	8.05	14.8	47.4
Zn Scav. Concentrate	5.75	2.43	5.76	2.26	3.13
Zn Scav. Tailing	33.42	0.99	1.06	5.34	3.35
Zn Ro. Tailing (meas)	39.17	1.13	1.75	7.15	6.47
(Calc.)	-	1.20	1.75	7.60	6.48
Zn 1st Cl. Concentrate	20.20	2.17	20.8	7.08	39.7
Zn 1st Cl. Tailing	2.97	2.38	4.37	1.14	1.23
Zn Ro. Concentrate (meas)	23.17	2.05	18.7	7.67	40.9
(Calc.)	-	2.20	18.7	8.22	40.9
Zn 1st Cl. Scav. Conc.	2.18	2.37	5.33	0.83	1.10
Zn 1st Cl. Scav. Tail.	0.79	2.55	1.72	0.33	0.13
Zn 1st Cl. Tsil. (meas)	2.97	2.38	4.37	1.14	1.23
(Calc.)	-	2.42	4.37	1.16	1.23
Pb 1st Cl. Concentrate	12.21	33.0	16.5	65.1	19.0
Pb 1st Cl. Tailing	9.27	6.12	16.4	9.16	14.4
Pb Ro. Concentrate (meas)	21.48	21.4	15.7	74.3	32.0
(Calc.)	-	21.4	16.5	74.3	33.4

Test No. PP8 - Continued

2.4.5. Metallurgical Results

Three-Product Formula

Product	Weight	Assays, %		% Distribution	
	%	Pb	Zn	Pb	Zn
Pb Concentrate	9.89	49.9	12.9	79.70	13.00
Zn Concentrate	15.42	1.95	49.6	4.86	78.00
Zn Comb. Tailing	74.69	1.28	1.18	15.44	9.00
Cyclone Overflow	100.00	6.19	9.80	100.0	100.0

Zn Flotation Tailing

Distribution of Pb and Zn in the Size Fractions

1. + 200 Mesh	8.5	0.71	1.12	4.91	8.50
2. + 270 mesh	8.2	0.56	0.91	3.73	6.66
3. + 31.7 µm	13.5	0.46	0.75	5.05	9.04
4. + 24.6 µm	9.3	0.42	0.69	3.18	5.73
5. + 17.2 µm	12.5	0.37	0.66	3.77	7.36
6. + 11.8 µm	10.4	0.50	0.71	4.23	6.59
7. + 9.1 µm	6.3	0.67	0.84	3.43	4.72
8. - 9.1 µm	30.3	2.91	1.90	71.70	51.39
Total (Calc.)	100.0	1.23	1.12	100.0	100.0
(meas)	-	0.99	1.06	-	-

Test No. PP9

1. Grinding

1.1. Purpose: To repeat conditions of test No. PP8.

1.2. Method: As for test PP8. The grinding circuit was operated for a period of 7.75 hours at a feed rate of 692 pounds per hour. Samples were taken every 30 minutes in the last 2 hours of operation.

1.2.1. Classification Equipment

Hendy Mill; P-50 Dorr Cyclone:

1 1/2 inch diameter
5/8 inch vortex
1/2 inch apex

Pb Regrind

Sala Mill; Krebs Cyclone:

1 inch diameter
1/4 inch vortex
1/8 inch apex

1.3. Flowsheet: As for test PP1

1.4. Results: The grinding circuit was stable during the test run. Net power consumption in the Hendy mill was 14.9 kilowatt-hours per ton of ½ inch feed. The cyclone overflow assayed 88.6 % minus 200 mesh.

Test No. PP9 - Continued

1.4. Results:

1.4.1. Ball Mill Report

Feed:	Minus ½ inch ore at 1.6 percent moisture content		
Feed Rate:	692 dry pounds per hour		
Mill Speed:	32 r.p.m., 80.5 percent of critical speed		
Mill Load:	3 inch balls	1000 pounds	
	1½ inch balls	600 pounds	
	1 inch balls	400 pounds	
	Total	2000 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Mill Feed:	Total 5363 pounds, test period 1384 pounds		
Circulating Load:	Cyclone underflow 525.0 percent		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2090	68
	Cyclone Overflow	1384	36
	Cyclone Underflow	2436	77
Average Power:	Gross	7.13 kilowatts	
	No Load	1.92 kilowatts	
	Net	5.21 kilowatts	
Net Power Consumption:	14.89 kilowatt-hours per ton of ½ inch feed		
Work Index:	11.44		

Test No. PP9 - Continued

1.4. Results:

1.4.2. Lead Regrinding Mill Report

Regrinding Mill:	Sala Mill		
Feed:	Lead Rougher Concentrate and Pb 2nd Cleaner Tailings		
Feed Rate:	128.0 pounds per hour, 18.50 percent of the mill feed		
Mill Speed:	31 r.p.m., 73 percent of critical speed		
Mill Load:	2 inch balls	480 pounds	
	1 inch balls	720 pounds	
	Total	1200 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2474	74
	Cyclone Feed	1242	26
	Cyclone Overflow	1168	19
	Cyclone Underflow	2474	74
Average Power:	Gross	8.08 kilowatts	
	No Load	0.92 kilowatts	
	Net	7.16 kilowatts	
Net Power Consumption:	20.5 kilowatt-hours per ton of feed.		

Test No. PP9 - Continued

1.4.3. Screen Analyses

Hendy Mill Feed

Mesh Size (Tyler)	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 3/8	4.1	4.1	95.9
3	14.9	19.0	81.0
4	14.6	33.6	66.4
6	11.2	44.8	55.2
8	8.8	53.6	46.4
10	7.6	61.2	38.8
14	5.5	66.7	33.3
20	4.2	70.9	29.1
28	3.4	74.3	25.7
35	2.6	76.9	23.1
48	3.0	79.9	20.1
65	2.8	82.7	17.3
100	2.4	85.1	14.9
150	2.4	87.5	12.5
200	2.5	90.0	10.0
- 200	10.0	100.0	-
Total	100.0	-	-

Hendy Mill Discharge

+ 10	0.1	0.1	99.9
14	0.2	0.3	99.7
20	0.2	0.5	99.5
28	0.4	0.9	99.1
35	0.6	1.5	98.5
48	1.5	3.0	97.0
65	3.0	6.0	94.0
100	5.0	11.0	89.0
150	9.5	20.5	79.5
200	17.5	38.0	62.0
270	14.3	52.3	47.7
400	17.9	70.2	29.8
- 400	29.8	100.0	-
Total	100.0	-	-

Test No. PP9 - Continued

1.4.3. Screen Analyses

Cyclone Underflow

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 10	0.1	0.1	99.9
14	0.2	0.3	99.7
20	0.3	0.6	99.4
28	0.5	1.1	98.9
35	0.8	1.9	98.1
48	1.9	3.8	96.2
65	3.6	7.4	92.6
100	5.9	13.3	86.7
150	10.8	24.1	75.9
200	19.5	43.6	56.4
270	15.4	59.0	41.0
400	18.2	77.2	22.8
- 400	22.8	100.0	-
Total	100.0	-	-

Cyclone Overflow

+ 65	0.4	0.4	99.6
100	1.0	1.4	98.6
150	2.8	4.2	95.8
200	7.2	11.4	88.6
270	8.1	19.5	80.5
400	15.1	34.6	65.4
- 400	65.4	100.0	-
Total	100.0	-	-

Test No. PP9 - Continued

1.4.3. Metallurgical Results

Pb Regrind Discharge

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	0.4	0.4	99.6
270	1.0	1.4	98.6
26.6 µm	13.3	14.7	85.3
20.6	11.5	26.2	73.8
14.4	26.0	52.2	47.8
9.9	18.3	70.5	29.5
7.6	6.8	77.3	22.7
- 7.6	22.7	100.0	-
Total	100.0	-	-

Specific Gravity 4.92

Pb Regrind Cyclone Overflow

+ 27.8 µm	0.8	0.8	99.2
21.5	1.0	1.8	98.2
15.0	6.5	8.3	91.7
10.3	15.1	23.4	76.6
8.0	15.4	38.8	61.2
- 8.0	61.2	100.0	-
Total	100.0	-	-

Specific Gravity 4.55

Pb Rougher Concentrate

+ 200 mesh	4.1	4.1	95.9
270	5.7	9.8	90.2
27.0 µm	18.2	28.0	72.0
20.9	7.5	35.5	64.5
14.6	11.9	47.4	52.6
10.0	13.0	60.4	39.6
7.8	9.3	69.7	30.3
- 7.8	30.3	100.0	-
Total	100.0	-	-

Specific Gravity 4.27

Test No. PP9 - Continued

1.4.3. Metallurgical Results

Pb Regrind Cyclone Underflow

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	2.8	2.8	97.2
270	4.5	7.3	92.7
26.6 µm	21.3	28.6	71.4
20.6	14.7	43.3	56.7
14.4	27.0	70.3	29.7
9.9	16.6	86.9	13.1
7.6	4.6	91.5	8.5
- 7.6	8.5	100.0	-
Total	100.0	-	-

Specific Gravity 4.93

Pb 4th Cleaner Concentrate

+ 12.8 µm	3.6	3.6	96.4
8.8	20.2	23.8	76.2
6.8	18.7	42.5	57.5
- 6.8	57.5	100.0	-
Total	100.0	-	-

Specific Gravity 5.87

Zn Combined Tailings

+ 200 mesh	12.4	12.4	87.6
270	9.2	21.6	78.4
32.3 µm	14.9	36.5	63.5
25.0	9.2	45.7	54.3
17.5	11.9	57.6	42.4
12.0	9.6	67.2	32.8
9.3	5.8	73.0	27.0
- 9.3	27.0	100.0	-
Total	100.0	-	-

Specific Gravity 3.63

Test No. PP9 - Continued

2. Flotation

2.1. Purpose:

1) To improve zinc depression in the lead rougher circuit.
2) To improve zinc concentrate grade.

2.2. Method:

Reagent additions and pH were modified as follows:

Pb Circuit

1) $ZnSO_4$ was added to the Hendy mill at a rate of 0.8 lb/ton, and to the lead rougher tailing at a rate of 0.5 lb/ton.

2) The NaCN additions to the ball mill, were decreased. Cyanide was added to the lead rougher tailing.

Zinc Circuit

1) Slightly increased pH in the Zn rougher and in the cleaning stages.

2.2.1. Flotation Equipment

As for test PP8.

2.2.2. Flotation Reagents

See following pages.

2.3. Flowsheet:

As for test PP8.

2.4. Results:

The lead flotation results were similar to test PP6, but with a slightly lower recovery. In the zinc circuit the zinc was less responsive to flotation at the higher pH than at the lower pH in earlier tests.

Test No. PP9 - Continued

2.2.2. Reagent Additions

Type	Pounds Per Ton of Feed	Point of Addition
Na_2CO_3	3.76	Ball Mill Feed
NaCN	0.18	Ball Mill Feed
$ZnSO_4$	0.98	Ball Mill Feed
Z-11	0.09	Ball Mill Feed
Z-6	0.04	Pb Conditioner
MIBC	0.076	Pb Ro. Feed Pump
MIBC	0.075	Pb Ro. 3rd Cell
NaCN	0.14	Pb Ro. Tailing
$ZnSO_4$	0.50	Pb Ro. Tailing
Z-11	0.03	Pb Scavenger Feed
MIBC	0.023	Pb Scavenger Feed
NaCN	0.32	Pb Regrind Mill
Na_2CO_3	0.54	Pb Regrind Mill
$ZnSO_4$	0.54	Pb Regrind Mill
R-242	0.02	Pb Cyclone Feed Pump
MIBC	0.036	Pb 1st Cl. Feed Pump
Z-11	0.02	Pb 1st Cl. 4th Cell
NaCN	0.14	Pb 2nd Cleaner Feed
NaCN	0.05	Pb 3rd Cleaner Feed
NaCN	0.025	Pb 4th Cleaner Feed
$Ca(OH)_2$	2.74	Zn Ro. Conditioner
$CuSO_4$	2.10	Zn Ro. Conditioner
M-748	0.073	Zn Ro. Conditioner
Z-6	0.175	Zn Ro. Feed Pump
DF-250	0.064	Zn Ro. Feed Pump
Z-6	0.03	Zn Scavenger Feed
Z-200	0.019	Zn Scavenger Feed
DF-250	0.030	Zn Scavenger Feed
Z-6	0.02	Zn 1st Cl. Scavenger
$Ca(OH)_2$	1.14	Zn 1st Cl. Pump
Z-200	0.03	Zn 1st Cl. Pump
Z-6	0.03	Zn 1st Cl. Feed
DF-250	0.031	Zn 1st Cl. Feed
Z-6	0.02	Zn 2nd Cl. Feed
$Ca(OH)_2$	0.54	Zn 2nd Cl. Feed
$Ca(OH)_2$	0.50	Zn 3rd Cl. Feed
DF-250	0.006	Zn 3rd Cl. Feed
$Ca(OH)_2$	0.30	Zn 4th Cl. Feed

Test No. PP9 - Continued

2.4. Results:

2.4.1. pH

Product	pH
Cyclone Overflow	9.1
Pb Rougher Feed	9.1
Pb Scavenger Tailing	8.7
Pb Regrinding Mill Discharge	8.8
Pb 1st Cleaner Feed	9.5
Pb 2nd Cleaner Feed	9.6
Pb 3rd Cleaner Feed	9.4
Pb 4th Cleaner Feed	9.5
Zn Rougher Feed	10.5
Zn Scavenger Tailing	10.1
Zn 1st Cl. Scav. Tailing	11.1
Zn 1st Cleaner Feed	11.2
Zn 2nd Cleaner Feed	11.2
Zn 3rd Cleaner Feed	11.4
Zn 4th Cleaner Feed	11.4

2.4.2. Pulp Densities

Product	Pulp Density gpl
Pb Rougher Feed	1242
Pb Scavenger Tailing	1197
Pb 1st Cleaner Feed	1168
Zn Rougher Feed	1135
Zn Scavenger Tailing	1137
Zn 1st Cleaner Feed	1125

2.4.3. Pulp Temperature

Product	^{o}C
Pb Rougher Feed	27
Pb Regrinding Mill Discharge	30
Zn Rougher Feed	26

Test No. PP9 - Continued

2.4.4. Chemical Analyses

Product	Assays, %	
	Pb	Zn
Cyclone Overflow	6.04	10.1
Pb Rougher Feed	6.09	11.3
Pb Rougher Concentrate	23.4	16.0
Pb Rougher Tailing	2.09	10.2
Pb Scavenger Concentrate	6.17	15.0
Pb Scavenger Tailing	1.44	9.63
Pb 1st Cleaner Concentrate	37.8	15.60
Pb 1st Cleaner Tailing	8.64	18.5
Pb Regrind Cyclone Underflow	21.8	13.5
Pb Regrind Cyclone Overflow	22.3	17.4
Pb Regrind Mill Discharge	21.8	13.3
Pb Cleaner Concentrate	62.4	8.78
Zn Rougher Feed	1.87	11.1
Zn Rougher Concnetrate	2.47	27.9
Zn Rougher Tailing	1.43	2.86
Zn Scavenger Concentrate	2.78	8.22
Zn Scavenger Tailing	1.18	1.51
Zn 1st Cleaner Tailing	2.70	17.40
Zn 1st Cleaner Concentrate	2.53	36.7
Zn 1st Cl. Scavenger Conc.	2.68	20.1
Zn 1st Cl. Scavenger Tail.	2.54	11.1
Zn Combined Tailing	1.35	2.53
Zn Cleaner Concentrate	2.03	55.1

Test No. PP9 - Continued

2.4.5. Metallurgical Results

Two-Product Formula

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
Pb Ro. Concentrate	18.50	23.4	16.0	71.8	26.3
Pb Ro. Tailing	81.50	2.09	10.20	28.2	73.7
Cyclone Overflow (meas)	100.00	6.04	10.10	100.0	100.0
(Calc.)	-	6.04	11.27	-	-
Pb Scav. Concentrate	11.32	6.17	15.00	11.6	15.1
Pb Scav. Tailing	70.18	1.44	9.63	16.6	59.8
Pb Ro. Tailing (meas)	81.50	2.09	10.20	28.2	73.7
(Calc.)	-	2.09	10.37	28.2	74.9
Pb 1st Cl. Concnetrate	9.36	37.8	15.60	58.6	13.0
Pb 1st Cl. Tailing	9.14	8.64	18.50	13.2	15.0
Pb Ro. Concentrate (meas)	18.50	23.4	16.0	71.8	26.3
(Calc.)	-	23.4	17.03	71.8	28.0
Zn Ro. Concentrate	18.97	2.47	27.9	7.8	46.9
Zn Ro. Tailing	51.21	1.43	2.86	12.1	12.9
Pb Scav. Tailin (meas)	70.18	1.44	9.63	16.6	59.8
(Calc.)	-	1.71	9.63	19.9	59.8
Zn Scav. Concentrate	12.90	2.78	8.22	5.9	8.4
Zn Scav. Tailing	38.31	1.18	1.51	7.5	4.5
Zn Ro. Tailing (meas)	51.21	1.43	2.86	12.1	12.9
(Calc.)	-	1.58	2.86	13.4	12.9
Zn 1st Cl. Concentrate	10.32	2.53	36.7	4.3	33.6
Zn 1st Cl. Tailing	8.65	2.70	17.4	3.9	13.4
Zn Ro. Concentrate (meas)	18.97	2.47	27.9	7.8	46.9
(Calc.)	-	2.60	27.9	8.2	47.0
Zn 1st Cl. Scav. Conc.	6.05	2.68	20.1	2.7	10.7
Zn 1st Cl. Scav. Tail.	2.60	2.54	11.1	1.1	2.7
Zn 1st Cl. Tail. (meas)	8.65	2.70	17.4	3.9	13.4
(Calc.)	-	2.64	17.40	3.8	13.4

Test No. PP9 - Continued

2.4.5. Metallurgical Results

Three-Product Formula

Product	Weight	Assays, %		% Distribution	
	%	Pb	Zn	Pb	Zn
Pb 4th Cl. Concentrate	7.53	62.4	8.78	77.81	6.55
Zn 4th Cl. Concentrate	13.50	2.03	55.1	4.54	73.67
Zn Comb. Tailing	78.97	1.35	2.53	17.65	19.78
Cyclone Overflow	100.00	6.04	10.1	100.0	100.0

Combined Tailings

Pb and Zn Distribution in Size Fractions

1. + 200 mesh	12.4	1.18	4.51	10.4	23.3
2. + 270 mesh	9.2	0.82	3.99	5.37	15.3
3. + 32.3 µm	14.9	0.64	2.56	6.79	15.9
4. + 25.0 µm	9.2	0.55	1.32	3.60	3.06
5. + 17.5 µm	11.9	0.44	0.93	3.73	4.61
6. + 12.0 µm	9.6	0.54	0.87	3.69	3.48
9. + 9.3 µm	5.8	0.68	0.95	2.80	2.30
8. - 9.3 µm	27.0	3.31	2.67	63.6	30.0
Head (Calc.)	100.0	1.40	2.40	100.0	100.0

Test No. PP10

1. Grinding

1.1. Purpose: To repeat conditions of test No. PP8.

1.2. Method: As for test PP8. The grinding circuit was operated for a period of 7.75 hours at a feed rate of 697 pounds per hour. Samples were taken every 30 minutes in the last 2 hours of operation.

1.2.1. Classification Equipment

Hendy Mill; P-50 Dorr Cyclone:

1 1/2 inch diameter
5/8 inch vortex
1/2 inch apex

1.3. Flowsheet: As for test PP1.

1.4. Results: The grinding circuit was stable during the test run. Net power consumption in the Hendy Mill was 14.93 kilowatt-hours per ton of ½ inch feed. The cyclone overflow assayed 87.4 % minus 200 mesh.

Test No. PP10 - Continued

1.4. Results:

1.4.1. Ball Mill Report

Feed:	Minus ½ inch ore at 1.6 percent moisture content		
Feed Rate:	697 dry pounds per hour		
Mill Speed:	32 r.p.m., 80.5 percent of critical speed		
Mill Load:	3 inch balls	1000 pounds	
	1½ inch balls	600 pounds	
	1 inch balls	400 pounds	
	Total	2000 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Mill Feed:	Total 5402 pounds, test period 1394 pounds		
Circulating Load:	Cyclone underflow 590.0 percent		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2096	67
	Cyclone Overflow	1380	36
	Cyclone Underflow	2442	77
Average Power:	Gross	7.13 kilowatts	
	No Load	1.92 kilowatts	
	Net	5.21 kilowatts	
Net Power Consumption:	14.87 kilowatt-hours per ton of ½ inch feed.		
Work Index:	11.33		

Test No. PP10 - Continued

1.4.2. Screen Analyses

Hendy Mill Feed

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 3/8	4.0	4.0	96.0
3	14.1	18.1	81.9
4	14.3	32.4	67.6
6	11.5	43.9	56.1
8	9.6	53.5	46.5
10	7.0	60.5	39.5
14	5.8	66.3	33.7
20	4.4	70.7	29.3
28	3.4	74.1	25.9
35	2.8	76.9	23.1
48	3.1	80.0	20.0
65	2.9	82.9	17.1
100	2.4	85.3	14.7
150	2.4	87.7	12.3
200	2.5	90.2	9.8
- 200	9.8	100.0	-
Total	100.0	-	-

Hendy Mill Discharge

+ 10	0.1	0.1	99.9
14	0.2	0.3	99.7
20	0.3	0.6	99.4
28	0.4	1.0	99.0
35	0.7	1.7	98.3
48	1.6	3.3	96.7
65	3.2	6.5	93.5
100	5.5	12.0	88.0
150	10.2	22.2	77.8
200	18.3	40.5	59.5
270	14.5	55.0	45.0
400	17.5	72.5	27.5
- 400	27.5	100.0	-
Total	100.0	-	-

Test No. PP10 - Continued

1.4.2. Screen Analyses

Cyclone Underflow

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 10	0.2	0.2	99.8
14	0.2	0.4	99.6
20	0.3	0.7	99.3
28	0.5	1.2	98.8
35	0.8	2.0	98.0
48	2.0	4.0	96.0
65	3.9	7.9	92.1
100	6.4	14.3	85.7
150	11.4	25.7	74.3
200	19.7	45.4	54.6
270	15.1	60.5	39.5
400	18.7	79.2	20.8
- 400	20.8	100.0	-
Total	100.0	-	-

Cyclone Overflow

+ 65	0.5	0.5	99.5
100	1.2	1.7	98.3
150	3.1	4.8	95.2
200	7.8	12.6	87.4
270	8.4	21.0	79.0
400	14.3	35.3	64.7
- 400	64.7	100.0	-
Total	100.0	-	-

Test No. PP10 - Continued

1.4.2. Screen Analyses

Pb Rougher Concentrate

Particle Size	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 200 mesh	8.3	8.3	91.7
270	8.8	17.1	82.9
27.0 µm	22.0	39.1	60.9
20.9	9.6	48.7	51.3
14.6	13.4	62.1	37.9
10.0	7.9	70.0	30.0
7.8	6.2	76.2	23.8
- 7.8	23.8	100.0	-
Total	100.0	-	-

Specific Gravity 4.73

Zn Rougher Concentrate

+ 200 mesh	13.5	13.5	86.5
270	10.6	24.1	75.9
25.3 µm	17.0	41.1	58.9
19.6	9.0	50.1	49.9
13.7	11.9	62.0	38.0
9.4	8.6	70.6	29.4
7.3	5.0	75.6	24.4
- 7.3	24.2	100.0	-
Total	100.0	-	-

Specific Gravity 4.13

Test No. PP10 - Continued

1.4.2. Screen Analyses

Pb 4th Cleaner Concentrate

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 270 mesh	0.8	0.8	99.2
25.3 µm	18.4	19.2	80.8
19.6	11.6	30.8	69.2
13.7	19.0	49.8	50.2
9.4	15.8	65.6	34.4
7.3	8.8	74.4	25.6
- 7.3	25.6	100.0	-
Total	100.0	-	-

Specific Gravity 5.25

Zn Combined Tailings

+ 200 mesh	11.6	11.6	88.4
270	9.4	21.0	79.0
32.2 µm	14.4	35.4	64.6
25.0	10.6	46.0	54.0
17.5	13.1	59.1	40.9
12.0	9.8	68.9	31.1
9.3	5.7	74.6	25.4
- 9.3	25.4	100.0	-
Total	100.0	-	-

Specific Gravity 3.65

Test No. PP10 - Continued

2. Flotation

2.1. Purpose:

1) To investigate the effect of omitting the lead concentrate regrind stage.
2) To investigate the effect of collector 241 additions to the lead rougher circuit.

2.2. Method:

The lead regrind stage was omitted from the circuit. $ZnSO_4$, NaCN and Na_2CO_3 were added to the lead 1st cleaner conditioner, and collector R-242 and MIBC to the lead 1st cleaner feed pump.

The collector R-241 was added to the Hendy mill, and Z-11, at lower additions than in test PP9, was added to the cylone feed pump.

2.2.1. Flotation Equipment

As for test PP8.

2.2.2. Flotation Reagents

See following pages.

2.4. Results:

The omission of lead concentrate regrind resulted in poor lead and zinc concentrate grades.

Additions of collector M-748 to the zinc conditioner improved froth conditions slightly.

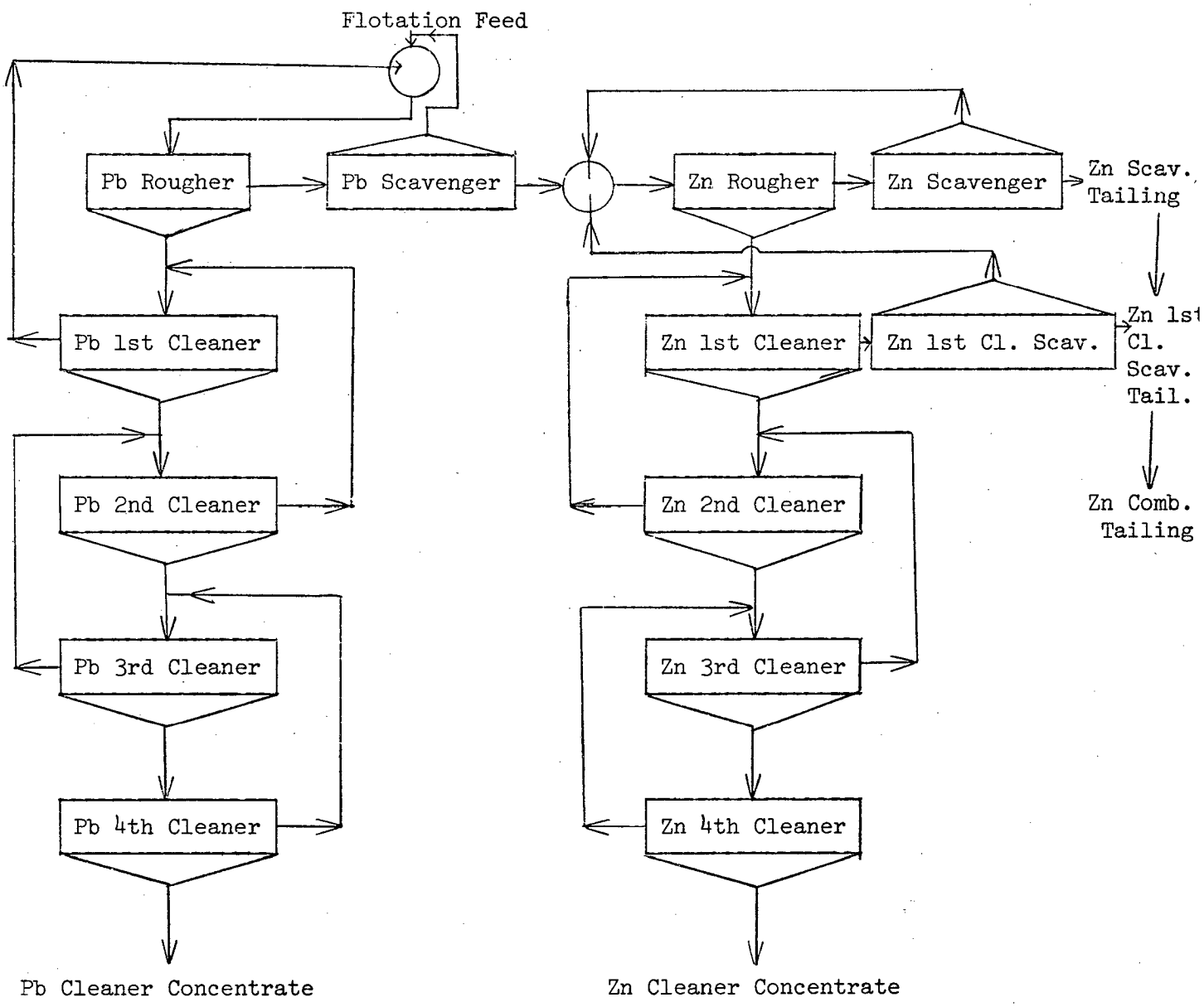
Test No. PP10 - Continued

2.2.2. Reagent Additions

Type	Pounds of Reagent per ton of feed	Point of Addition
Na_2CO_3	3.75	Ball Mill Feed
NaCN	0.160	Ball Mill Feed
$ZnSO_4$	0.98	Ball Mill Feed
R-241	0.03	Ball Mill Feed
Z-11	0.04	Ball Mill Feed
Z-11	0.03	Pb Conditioner
MIBC	0.054	Pb Ro. Feed Pump
MIBC	0.075	Pb Ro. 3rd Cell
NaCN	0.15	Pb Ro. Tailing
$ZnSO_4$	0.24	Pb Ro. Tailing
Z-11	0.03	Pb Scav. Feed
MIBC	0.023	Pb Scav. Feed
NaCN	0.31	Pb 1st Cl. Conditioner
Na_2CO_3	0.66	Pb 1st Cl. Conditioner
$ZnSO_4$	0.54	Pb 1st Cl. Conditioner
MIBC	0.036	Pb 1st Cl. Feed Pump
R-242	0.02	Pb 1st Cl. Feed Pump
Z-11	0.02	Pb 1st Cl. 4th Cell
NaCN	0.10	Pb 2nd Cl. Feed
NaCN	0.05	Pb 3rd Cl. Feed
NaCN	0.05	Pb 4th Cl. Feed
$Ca(OH)_2$	2.74	Zn Ro. Conditioner
$CuSO_4$	2.10	Zn Ro. Conditioner
M-748	0.075	Zn Ro. Conditioner
Z-6	0.18	Zn Ro. Feed Pump
DF-250	0.063	Zn Ro. Feed Pump
Z-6	0.03	Zn Scav. Feed
Z-200	0.018	Zn Scav. Feed
DF-250	0.030	Zn Scav. Feed
Z-6	0.022	Zn 1st Cl. Scavenger
$Ca(OH)_2$	0.70	Zn 1st Cl. Pump
Z-200	0.030	Zn 1st Cl. Pump
Z-6	0.03	Zn 1st Cl. Feed
DF-250	0.029	Zn 1st Cl. Feed
Z-6	0.02	Zn 2nd Cl. Feed
$Ca(OH)_2$	0.40	Zn 2nd Cl. Feed
DF-250	0.007	Zn 3rd Cl. Feed
$Ca(OH)_2$	0.26	Zn 3rd Cl. Feed
$Ca(OH)_2$	0.16	Zn 4th Cl. Feed

Test No. PP10 - Continued

2.3. Flowsheet



Test No. PP10 - Continued

2.4. Results:

2.4.1. pH

Product	pH
Cyclone Overflow	9.0
Pb Rougher Feed	9.0
Pb Scavenger Tailing	8.7
Pb 1st Cleaner Feed	9.3
Pb 2nd Cleaner Feed	9.3
Pb 3rd Cleaner Feed	9.1
Pb 4th Cleaner Feed	9.1
Zn Rougher Feed	10.0
Zn Scavenger Tailing	9.5
Zn 1st Cleaner Feed	10.9
Zn 2nd Cleaner Feed	10.9
Zn 3rd Cleaner Feed	10.8
Zn 4th Cleaner Feed	10.9

2.4.2. Pulp Densities

Product	Pulp Density gpl
Pb Rougher Feed	1202
Pb Scavenger Tailing	1172
Pb 1st Cleaner Feed	1192
Zn Rougher Feed	1105
Zn Scavenger Tailing	1098
Zn 1st Cleaner Feed	1103

2.4.3. Pulp Temperature

Product	°C
Pb Rougher Feed	25
Zn Rougher Feed	24

Test No. PP10 - Continued

2.4.4. Chemical Analyses

Product	Assays, %	
	Pb	Zn
Cyclone Overflow	5.93	9.82
Pb Rougher Feed	5.96	10.4
Pb Rougher Concentrate	21.7	14.0
Pb Rougher Tailing	1.95	9.35
Pb Scavenger Concentrate	6.14	13.1
Pb Scavenger Tailing	1.37	8.67
Pb 1st Cleaner Concentrate	2.13	24.2
Pb 1st Cleaner Tailing	3.94	12.0
Pb Cleaner Concentrate	44.9	15.2
Zn Rougher Feed	1.56	7.23
Zn Rougher Concentrate	2.13	24.2
Zn Rougher Tailing	1.22	2.19
Zn Scavenger Concentrate	1.69	4.50
Zn Scavenger Tailing	0.98	1.22
Zn 1st Cleaner Tailing	2.12	2.59
Zn 1st Cleaner Concentrate	2.07	26.4
Zn 1st Cl. Scav. Concentrate	1.89	2.87
Zn 1st Cl. Scav. Tailing	2.39	1.83
Zn Cleaner Concentrate	2.09	36.9

Test No. PP10 - Continued

2.4.5. Metallurgical Results

Two-Product Formula

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
Pb Ro. Concentrate	20.15	21.7	14.0	73.7	27.4
Pb Ro. Tailing	79.85	1.95	9.35	26.3	72.6
Cyclone Overflow (meas)	100.00	5.93	9.82	100.0	100.0
(Calc.)	-	5.93	10.3	-	-
Pb Scav. Concentrate	9.71	6.14	13.1	10.1	12.4
Pb Scav. Tailing	70.14	1.37	8.67	16.2	59.1
Pb Ro. Tailing (meas)	79.85	1.95	9.35	26.3	72.6
(Calc.)	-	1.95	9.21	26.3	71.5
Zn Ro. Concentrate	20.65	2.13	24.2	7.4	48.6
Zn Ro. Tailing	49.49	1.22	2.19	10.2	10.5
Pb Scav. Tailing (meas)	70.14	1.37	8.67	16.2	59.1
(Calc.)	-	1.49	8.67	17.6	59.1
Zn Scav. Concentrate	14.63	1.69	4.50	4.2	6.4
Zn Scav. Tailing	34.86	0.98	1.22	5.8	4.1
Zn Ro. Tailing (meas)	49.49	1.22	2.19	10.2	10.5
(Calc.)	-	1.19	2.19	10.0	10.5
Zn 1st Cl. Conc.	18.74	2.07	26.4	6.5	48.1
Zn 1st Cl. Tailing	1.91	2.12	2.59	0.7	0.5
Zn Ro. Concentrate (meas)	20.65	2.13	24.2	7.4	48.6
(Calc.)	-	2.07	24.2	7.2	48.6
Zn 1st Cl. Scav. Conc.	1.41	1.89	2.86	0.4	0.4
Zn 1st Cl. Scav. Tail.	0.50	2.39	1.83	0.2	0.1
Zn 1st Cl. Tailing (meas)	1.91	2.12	2.59	0.7	0.5
(Calc.)	-	2.03	2.59	0.6	0.5

Three-Product Formula

Pb 4th Cl. Concentrate	10.45	44.9	15.2	79.2	16.2
Zn 4th Cl. Concentrate	19.69	2.09	36.9	6.95	74.0
Zn Comb. Tailing	69.62	1.18	1.38	13.9	9.8
Cyclone Overflow	100.00	5.93	9.82	100.0	100.0

Test No. PP10 - Continued

2.4.5. Metallurgical Results

Pb and Zn Distribution in Combined Tailings

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. + 200 Mesh	11.6	0.68	1.04	6.52	8.9
2. + 270 Mesh	9.4	0.58	0.95	4.51	6.6
3. + 32.2 µm	14.4	0.52	0.80	6.19	8.5
4. + 25.0 µm	10.6	0.40	0.73	3.51	5.7
5. + 17.5 µm	13.1	0.38	0.69	4.17	6.7
6. + 12.0 µm	9.8	0.51	0.79	4.13	5.7
7. + 9.3 µm	5.7	0.77	1.02	3.63	4.31
8. - 9.3 µm	25.4	3.21	2.84	67.4	53.6
Head (Calc.)	100.0	1.21	1.35	100.0	100.0

Test No. PP11

1. Grinding

1.1. Purpose: To repeat conditions of test PP10.

1.2. Method: As for test PP10. The grinding circuit was operated for a period at 7.75 hours at a feed rate of 693 pounds per hour. Samples were taken every 30 minutes in the last 2 hours of operation.

1.2.1. Classification Equipment

Hendy Mill; P-50 Dorr Cyclone:

1 1/2 inch diameter
5/8 vortex
1/2 inch apex

Pb Regrind:

Sala Mill; Krebs Cyclone:

1 1/2 inch diameter
1/2 inch vortex
1/4 inch apex

1.3. Flowsheet: As for test PP1.

1.4. Results: The grinding circuit was stable during the test run. Net power consumption in the Hendy mill was 14.53 kilowatt-hours per ton of ½ inch feed. The cyclone overflow assayed 87.0 % minus 200 mesh.

Test No. PP11 - Continued

1.4. Results:

1.4.1. Ball Mill Report

Feed:	Minus ½ inch ore at 1.6 percent moisture content.		
Feed Rate:	693 dry pounds per hour		
Mill Speed:	32 r.p.m., 80.5 percent of critical speed		
Mill Load:	3 inch balls	1000 pounds	
	1½ inch balls	600 pounds	
	1 inch balls	400 pounds	
	Total	2000 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Mill Feed:	Total 5371 pounds, test period 1386 pounds		
Circulating Load:	Cyclone underflow 579.0 percent		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2078	68
	Cyclone Overflow	1384	36
	Cyclone Underflow	2406	76
Average Power:	Gross	7.01 kilowatts	
	No Load	1.92 kilowatts	
	Net	5.09 kilowatts	
Net Power Consumption:	14.53 kilowatt-hours per ton of ½ inch feed.		
Work Index:	11.11		

Test No. PP11 - Continued

1.4. Results

1.4.2. Lead Regrinding Mill Report

Regrinding Mill:	Sala Mill		
Feed:	Lead Rougher Concentrate and Pb 2nd Cleaner Tailings		
Feed Rate:	188 pounds per hour, 27.09 percent of the mill feed		
Mill Speed:	31 r.p.m., 73 percent of critical speed		
Mill Load:	1 inch balls	500 pounds	
	Total	500 pounds	
Operating Time:	Total 7.50 hours, test period 2.0 hours		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2076	66
	Cyclone Feed	1158	17.5
	Cyclone Overflow	1113	13.0
	Cyclone Underflow	2076	66
Average Power:	Gross	4.51 kilowatts	
	No Load	0.92 kilowatts	
	Net	3.59 kilowatts	
Net Power Consumption:	10.26 kilowatt-hours per ton of feed		

Test No. PP11 - Continued

1.4.3. Screen Analyses

Hendy Mill Feed

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 3/8	6.1	6.1	93.9
3	19.2	25.3	74.7
4	14.9	40.2	59.8
6	11.0	51.2	48.8
8	7.7	58.9	41.1
10	6.2	65.1	34.9
14	4.9	70.0	30.0
20	3.7	73.7	26.3
28	2.9	76.6	23.4
35	2.5	79.1	20.9
48	2.7	81.8	18.2
65	2.6	84.4	15.6
100	2.1	86.5	13.5
150	2.1	88.6	11.4
200	2.3	90.9	9.1
- 200	9.1	100.0	-
Total	100.0	-	-

Hendy Mill Discharge

+ 10	0.1	0.1	99.9
14	0.2	0.3	99.7
20	0.2	0.5	99.5
28	0.4	0.9	99.1
35	0.7	1.6	98.4
48	1.8	3.4	96.6
65	3.2	6.6	93.4
100	5.5	12.1	87.9
150	10.0	22.1	77.9
200	17.8	39.9	60.1
270	14.0	53.9	46.1
400	17.5	71.4	28.6
- 400	28.6	100.0	-
Total	100.0	-	-

Test No. PP11 - Continued

1.4.3. Screen Analyses

Cyclone Underflow

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 10	0.1	0.1	99.9
14	0.2	0.3	99.7
20	0.3	0.6	99.4
28	0.6	1.2	98.8
35	0.9	2.1	97.9
48	2.1	4.2	95.8
65	3.8	8.0	92.0
100	6.1	14.1	85.9
150	11.2	25.3	74.7
200	19.5	44.8	55.2
270	14.9	59.7	40.3
400	17.5	77.2	22.8
- 400	22.8	100.0	-
Total	100.0	-	-

Cyclone Overflow

+ 65	0.6	0.6	99.4
100	1.3	1.9	98.1
150	3.3	5.2	94.8
200	7.8	13.0	87.0
270	8.3	21.3	78.7
400	15.7	37.0	63.0
- 400	63.0	100.0	-
Total	100.0	-	-

Test No. PP11 - Continued

1.4.3. Screen Analyses

Pb Rougher Concentrate

Particle Size	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 200 mesh	6.7	6.7	93.3
270	6.7	13.4	86.6
28.3 µm	17.2	30.6	69.4
22.0	8.3	38.9	61.1
15.3	13.3	52.2	47.8
10.5	12.4	64.6	35.4
8.1	7.6	72.2	27.8
- 8.1	27.8	100.0	-
Total	100.0	-	-

Specific Gravity 4.48

Pb Regrind Discharge

+ 200 mesh	2.6	2.6	97.4
270	6.6	9.2	90.8
28.1 µm	26.5	35.7	64.3
21.8	17.0	52.7	47.3
15.2	21.1	73.8	26.2
10.4	9.0	82.8	17.2
8.1	3.6	86.4	13.6
- 8.1	13.6	100.0	-
Total	100.0	-	-

Specific Gravity 4.62

Test No. PP11 - Continued

1.4.3. Screen Analysis

Pb Regrind Cyclone Underflow

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	7.3	7.3	92.7
270	9.5	16.8	83.2
27.2 µm	14.0	30.8	69.2
21.1	28.5	59.3	40.7
14.7	19.0	78.3	21.7
10.1	4.5	82.8	17.2
7.8	1.4	84.2	15.8
- 7.8	15.8	100.0	-
Total	100.0	-	-

Specific Gravity 4.77

Pb Regrind Cyclone Overflow

+ 270 mesh	0.4	0.4	99.6
28.2 µm	6.3	6.7	93.3
21.9	4.6	11.3	88.7
15.3	15.2	26.5	75.5
10.5	18.3	44.8	55.2
8.1	11.6	56.4	43.6
- 8.1	43.6	100.0	-
Total	100.0	-	-

Specific Gravity 4.49

Pb 4th Cleaner Concentrate

+ 270 mesh	0.6	0.6	99.4
26.0 µm	11.1	11.7	88.3
20.2	8.9	20.6	79.4
14.1	18.9	39.5	60.5
9.7	19.0	58.5	41.5
7.5	10.9	69.4	30.6
- 7.5	30.6	100.0	-
Total	100.0	-	-

Specific Gravity 5.15

Test No. PP11 - Continued

1.4.3. Screen Analyses

Zn Rougher Concentrate

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	21.0	21.0	79.0
270	10.0	31.0	69.0
30.5 µm	14.0	45.0	55.0
23.7	7.6	52.6	47.4
16.5	9.8	62.4	37.6
11.3	7.8	70.2	29.8
8.8	4.6	74.8	25.2
- 8.8	25.2	100.0	-
Total	100.0	-	-

Specific Gravity 4.03

Zn Combined Tailing

+ 200 mesh	12.2	12.2	87.8
270	12.7	24.9	75.1
33.0 µm	9.0	33.9	66.1
25.6	9.1	43.0	57.0
17.9	13.2	56.1	43.8
12.3	10.2	66.3	33.6
9.5	5.8	72.1	27.8
- 9.5	27.8	100.0	-
Total	100.0	-	-

Specific Gravity 3.54

Test No. PP11 - Continued

2. Flotation

2.1. Purpose:

1) To repeat conditions of test PP10, but slightly regrind the Pb concentrate.
2) To investigate the effect of zinc rougher feed conditioning with collector.

2.2. Method:

The following changes in the circuit were made:
1) The lead rougher concentrate was reground in the Sala Mill.
2) The zinc rougher feed was conditioned in the 20-gallon conditioner with collector M-748.

2.2.1. Flotation Equipment

As for test PP8, except that a 20-gallon zinc conditioner was added to the zinc rougher circuit.

2.2.2. Flotation Reagents

See following page.

2.3. Flowsheet:

As for test PP9.

2.4. Results:

Changes in the lead and zinc circuits improved Pb and zinc flotation. However, the lead concentrate grade was low and contained a large amount of zinc.

Test No. PP11 - Continued

2.2.2. Reagent Additions

Type	Pounds of Reagent per Ton of Feed	Point of Addition
Na_2CO_3	3.52	Ball Mill Feed
NaCN	0.18	Ball Mill Feed
$ZnSO_4$	0.90	Ball Mill Feed
R-241	0.03	Ball Mill Feed
Z-11	0.03	Cyclone Feed Pump
Z-11	0.03	Pb Ro. Conditioner
MIBC	0.054	Pb Ro. Feed Pump
MIBC	0.075	Pb Ro. 3rd Cell
NaCN	0.14	Pb Ro. Tailing
$ZnSO_4$	0.24	Pb Ro. Tailing
Z-11	0.04	Pb Scav. Feed
MIBC	0.023	Pb Scav. Feed
NaCN	0.30	Pb Regrind Mill
Na_2CO_3	0.60	Pb Regrind Mill
$ZnSO_4$	0.50	Pb Regrind Mill
R-242	0.02	Cyclone Feed Pump
MIBC	0.037	Pb 1st Cl. Feed Pump
Z-11	0.02	Pb 1st Cl. 4th Cell
NaCN	0.10	Pb 2nd Cl. Feed
NaCN	0.05	Pb 3rd Cl. Feed
NaCN	0.10	Pb 4th Cl. Feed
$Ca(OH)_2$	3.00	Zn Ro. Conditioner
$CuSO_4$	2.10	Zn Ro. Conditioner
M-748	0.075	Zn Ro. Conditioner
Z-6	0.180	Zn Ro. Feed Pump
DF-250	0.063	Zn Ro. Feed Pump
Z-6	0.03	Zn Scav. Feed
Z-200	0.016	Zn Scav. Feed
DF-250	0.03	Zn Scav. Feed
Z-6	0.02	Zn 1st Cl. Scavenger
$Ca(OH)_2$	0.40	Zn 1st Cl. Feed Pump
Z-200	0.03	Zn 1st Cl. Feed Pump
Z-6	0.03	Zn 1st Cl. Feed
DF-250	0.030	Zn 1st Cl. Feed
$Ca(OH)_2$	0.26	Zn 2nd Cl. Feed
Z-6	0.02	Zn 2nd Cl. Feed
$Ca(OH)_2$	0.16	Zn 3rd Cl. Feed
DF-250	0.006	Zn 3rd Cl. Feed
$Ca(OH)_2$	0.20	Zn 4th Cl. Feed

Test No. PP11 - Continued

2.4. Results:

2.4.1. pH

Product	pH
Cyclone Overflow	9.1
Pb Rougher Feed	9.1
Pb Scavenger Tailing	8.8
Pb Regrinding Mill Discharge	9.7
Pb 1st Cleaner Feed	9.3
Pb 2nd Cleaner Feed	9.2
Pb 3rd Cleaner Feed	9.2
Pb 4th Cleaner Feed	9.1
Zn Rougher Feed	10.3
Zn Scavenger Tailing	9.8
Zn 1st Cleaner Feed	10.9
Zn 2nd Cleaner Feed	10.9
Zn 3rd Cleaner Feed	10.8
Zn 4th Cleaner Feed	10.8

2.4.2. Pulp Densities

Product	Pulp Density gpl
Pb Rougher Feed	1235
Pb Scavenger Tailing	1200
Pb 1st Cleaner Feed	1113
Zn Rougher Feed	1138
Zn Scavenger Tailing	1133
Zn 1st Cleaner Feed	1130

2.4.3. Pulp Temperature

Product	^{o}C
Pb Rougher Feed	26
Pb Regrinding Mill Discharge	25
Zn Rougher Feed	25

Test No. PP11 - Continued

2.4.4. Chemical Analyses

Product	Assays, %	
	Pb	Zn
Cyclone Overflow	5.92	9.90
Pb Rougher Feed	5.45	10.7
Pb Rougher Concentrate	17.6	14.1
Pb Rougher Tailing	1.58	9.68
Pb Scavenger Concentrate	5.26	14.1
Pb Scavenger Tailing	1.25	9.32
Pb 1st Cleaner Concentrate	27.7	15.6
Pb 1st Cleaner Tailing	2.86	13.7
Pb Regrinding Cyclone Overflow	16.3	14.8
Pb Regrinding Cyclone Underflow	12.0	12.9
Pb Regrinding Mill Discharge	11.7	12.9
Pb Cleaner Concentrate	42.2	16.0
Zn Rougher Feed	1.39	7.79
Zn Rougher Concentrate	1.93	26.0
Zn Rougher Tailing	1.25	1.92
Zn Scavenger Concentrate	2.03	4.32
Zn Scavenger Tailing	1.04	1.20
Zn 1st Cleaner Tailing	2.29	3.38
Zn 1st Cleaner Concentrate	2.13	17.8
Zn 1st Cleaner Scav. Concentrate	2.18	3.76
Zn 1st Cleaner Scav. Tailings	2.86	1.78
Zn Combined Tailing	1.07	1.22
Zn Cleaner Concentrate	1.92	42.6

Test No. PP11 - Continued

2.4.5. Metallurgical Results

Two-Product Formula

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
Pb Ro. Concentrate	27.09	17.6	14.1	80.5	35.1
Pb Ro. Tailing	72.91	1.58	9.68	19.5	64.9
Cyclone Overflow (meas)	100.0	5.92	9.90	100.0	100.0
(Calc.)	-	5.92	10.9	-	-
Pb Scav. Concentrate	6.00	5.26	14.1	5.33	7.78
Pb Scav. Tailing	66.91	1.25	9.32	14.1	57.3
Pb Ro. Tailing (meas)	72.91	1.58	9.68	19.5	64.9
(Calc.)	-	1.58	9.71	19.5	65.1
Zn Ro. Concentrate	20.56	1.93	26.0	6.70	49.1
Zn Ro. Tailing	46.35	1.25	1.92	9.79	8.18
Pb Scav. Tailing (meas)	66.91	1.25	9.32	14.1	57.3
(Calc.)	-	1.46	9.32	16.5	57.3
Zn Scav. Concentrate	2.59	5.26	14.1	2.30	3.36
Zn Scav. Tailing	43.76	1.04	1.20	7.69	4.83
Zn Ro. Tailing (meas)	46.35	1.25	1.92	9.79	8.18
(Calc.)	-	1.28	1.92	9.98	8.18
Pb 1st Cl. Concentrate	16.08	27.7	15.6	75.2	23.1
Pb 1st Cl. Tailing	11.01	2.86	13.7	5.32	13.9
Pb Ro. Concentrate (meas)	27.09	17.6	41.1	80.5	35.1
(Calc.)	-	17.6	14.8	80.5	36.9

Three-Product Formula

Pb 4th Cl. Concentrate	11.44	42.2	16.0	81.6	18.5
Zn 4th Cl. Concentrate	16.89	1.92	42.6	5.44	72.7
Zn Combined Tailing	71.67	1.07	1.22	13.0	8.83
Cyclone Overflow	100.0	5.92	9.90	100.0	100.0

Test No. PP11 - Continued

2.4.5. Metallurgical Results

Zn Combined Tailing

Distribution of Pb and Zn in the Size Fractions

Product	Weight	Assays, %		% Distribution	
	%	Pb	Zn	Pb	Zn
1. + 200 Mesh	12.2	0.65	1.09	6.75	10.2
2. + 270 Mesh	12.7	0.52	0.90	5.62	8.76
3. + 33.0 µm	9.0	0.45	0.78	3.45	5.38
4. + 25.6 µm	9.1	0.40	0.78	3.10	5.44
5. + 17.9 µm	13.2	0.38	0.74	4.27	7.49
6. + 12.3 µm	10.2	0.47	0.79	4.08	6.18
7. + 9.5 µm	5.8	0.65	0.98	3.21	4.35
8. - 9.5 µm	27.8	2.94	2.45	69.5	52.2
Head (Calc.)	100.0	1.18	1.30	100.0	100.0

Test No. PP12

1. Grinding

1.1. Purpose: To repeat conditions of test PP11.

1.2. Method: As for test PP11. The grinding circuit was operated for a period of 7.75 hours at a feed rate of 684 pounds per hour. The samples were taken every 30 minutes in the last 2 hours of operation.

1.2.1. Classification Equipment

Hendy Mill; P-50 Dorr Cyclone:

1 1/2 inch diameter
5/8 inch vortex
1/2 inch apex

Pb Regrind

Sala Mill: 1 1/2 inch Krebs Cyclone:

1 1/2 inch diameter
1/2 inch vortex
1/4 inch apex

1.3. Flowsheet: As for test PP1.

1.4. Results: The grinding circuit was stable throughout the test run. Net power consumption in the Hendy mill was 15.5 kilowatt-hours per ton of ½ inch feed. The cyclone overflow assayed 88.1 % minus 200 mesh.

Test No. PP12 - Continued

1.4. Results:

1.4.1. Ball Mill Report

Feed:	Minus ½ inch ore at 1.6 percent moisture content		
Feed Rate:	684 dry pounds per hour		
Mill Speed:	32 r.p.m., 80.5 percent of critcal speed		
Mill Load:	3 inch balls	1000 pounds	
	1½ inch balls	600 pounds	
	1 inch balls	400 pounds	
	Total	2000 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Mill Feed:	Total 5301 pounds, test period 1368 pounds		
Circulating Load:	Cyclone underflow 582 percent		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2082	68
	Cyclone Overflow	1382	36
	Cyclone Underflow	2396	76
Average Power:	Gross	7.01 kilowatts	
	No Load	1.92 kilowatts	
	Net	5.09 kilowatts	
Net Power Consumption:	15.54 kilowatt-hours per ton of ½ inch feed.		
Work Index:	11.46		

Test No. PP12 - Continued

1.4. Results:

1.4.2. Lead Regrinding Mill Report

Regrinding Mill:	Sala Mill		
Feed:	Lead Rougher Concentrate and Lead 2nd Cleaner Tailings		
Feed Rate:	96.9 pounds per hour, 14.17 percent of the mill feed		
Mill Speed:	31 r.p.m., 73 percent of critical speed		
Mill Load:	1 inch balls	720 pounds	
	Total	720 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Pulp Densities:		gpl	% Solids
	Mill Discharge	1960	62
	Cyclone Feed	1173	20
	Cyclone Overflow	1087	10.5
	Cylcone Underflow	1960	62
Average Power:	Gross	5.11 kilowatts	
	No Load	0.92 kilowatts	
	Net	4.19 kilowatts	
Net Power Consumption:	11.97 kilowatt-hours per ton of feed.		

Test No. PP12 - Continued

1.4.3. Screen Analyses

Hendy Mill Feed

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 3/8	3.5	3.5	96.5
3	12.1	15.6	84.4
4	12.5	28.1	71.9
6	12.1	40.2	59.8
8	10.8	51.0	49.0
10	8.4	59.4	40.6
14	6.7	66.1	33.9
20	4.7	70.8	29.2
28	3.7	74.5	25.5
35	3.0	77.5	22.5
48	3.0	80.5	19.5
65	2.9	83.4	16.6
100	2.4	85.8	14.2
150	2.3	88.1	11.9
200	2.4	90.5	9.5
- 200	9.5	100.0	-
Total	100.0	-	-

Cyclone Underflow

+ 10	0.1	0.1	99.9
14	0.2	0.3	99.7
20	0.3	0.6	99.4
28	0.5	1.1	98.9
35	0.8	1.9	98.1
48	1.9	3.8	94.3
65	3.7	7.5	92.5
100	6.2	13.7	86.3
150	11.3	25.0	75.0
200	19.9	44.9	55.1
270	15.2	60.1	39.9
400	18.1	78.2	21.8
- 400	21.8	100.0	-
Total	100.0	-	-

Test No. PP12 - Continued

1.4.3. Screen Analyses

Hendy Mill Discharge

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 10	0.1	0.1	99.9
14	0.1	0.2	99.8
20	0.2	0.4	99.6
28	0.4	0.8	99.2
35	0.7	1.5	98.5
48	1.6	3.1	96.9
65	3.1	6.2	93.8
100	5.4	11.6	88.4
150	10.0	21.6	78.4
200	17.9	39.5	60.5
270	14.2	53.7	46.3
400	18.0	71.7	28.3
- 400	28.3	100.0	-
Total	100.0	-	-

Cyclone Overflow

+ 65	0.5	0.5	99.5
100	1.1	1.6	98.4
150	2.9	4.5	95.5
200	7.4	11.9	88.1
270	8.1	20.0	80.0
400	15.1	35.1	64.9
- 400	64.9	100.0	-
Total	100.0	-	-

Test No. PP12 - Continued

1.4.3. Screen Analyses

Pb Rougher Concentrate

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	6.1	6.1	93.9
270	8.0	14.1	85.9
27.1 µm	21.2	35.3	64.7
21.0	9.2	44.5	55.5
14.7	13.4	57.9	42.1
10.1	11.5	69.4	30.6
7.8	7.2	76.6	23.4
- 7.8	23.4	100.0	-
Total	100.0	-	-

Specific Gravity 4.81

Pb Regrind Cyclone Underflow

+ 200 mesh	5.2	5.2	94.8
270	7.4	12.6	87.4
26.8 µm	29.8	42.4	57.6
20.8	17.3	59.7	40.3
14.5	23.0	82.7	17.3
10.0	9.2	91.9	8.1
7.7	2.4	94.3	5.7
- 7.7	5.7	100.0	-
Total	100.0	-	-

Specific Gravity 4.87

Pb Regrind Discharge

+ 200 mesh	0.6	0.6	99.4
270	2.1	2.7	97.3
26.8 µm	8.1	10.8	89.2
20.8	15.5	26.3	73.7
14.5	24.4	50.7	49.3
10.0	13.0	63.7	36.3
7.7	5.2	68.9	31.1
- 7.7	31.1	100.0	-
Total	100.0	-	-

Specific Gravity 4.84

Test No. PP12 - Continued

1.4.3. Screen Analysis

Pb Regrind Cyclone Overflow

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 270 mesh	0.2	0.2	99.8
27.2 µm	2.2	2.4	97.6
21.1	3.4	5.8	94.2
14.7	11.8	17.6	82.4
10.1	19.0	36.6	63.4
7.8	13.5	50.1	49.9
- 7.8	49.9	100.0	-
Total	100.0	-	-

Specific Gravity 4.68

Pb 4th Cleaner Concentrate

+ 25.6 µm	16.0	16.0	84.0
19.8	5.3	21.3	78.7
13.8	17.1	38.4	61.6
9.5	23.0	61.4	38.6
7.4	13.8	75.2	24.8
- 7.4	24.8	100.0	-
Total	100.0	-	-

Specific Gravity 5.33

Zn Rougher Concentrate

+ 200 mesh	22.6	22.6	77.4
270	10.0	32.6	67.4
30.5 µm	14.8	47.4	52.6
23.7	7.2	54.6	45.4
16.5	9.0	63.6	36.4
11.3	7.5	71.1	28.9
8.8	4.6	75.7	24.3
- 8.8	24.3	100.0	-
Total	100.0	-	-

Specific Gravity 4.00

Test No. PP12 - Continued

1.4.3. Screen Analyses

Zn Combined Tailings

Particle Size	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 200 mesh	12.0	12.0	88.0
270	9.0	21.0	79.0
32.2 µm	13.6	34.6	65.4
24.9	9.7	44.3	55.7
17.4	12.4	56.7	43.3
12.0	9.8	66.5	33.5
9.2	5.6	72.1	27.9
- 9.2	27.9	100.0	-
Total	100.0	-	-

Specific Gravity 3.64

1.4.4. Specific Gravity

Sample	Specific Gravity
Cyclone Overflow	3.84

Test No. PP12 - Continued

2. Flotation

2.1. Purpose:

1) To study the effect of finer regrinding of lead rougher concentrate on lead and zinc flotation.
2) To study the effect of zinc rougher conditioning with collectors Z-6 and M-748.

2.2. Method:

Similar to test PP11, except that the steel ball load of the Sala mill was increased by 200 lb, and collector Z-6 was removed from the zinc rougher feed pump and added to the zinc 2nd conditioner.

2.2.1. Flotation Equipment

As for test PP11.

2.2.2. Flotation Reagents

See following page.

2.3. Flowsheet:

As for test PP8.

2.4. Results:

A higher grade lead concentrate than in previous tests was obtained. Higher dilution of pulp in the lead 1st cleaner resulted in poor froth conditions.

The large amount of middlings in the zinc circuit produced a high recirculation load in the zinc 1st and 2nd cleaners, resulting in poor cleaning conditions and high losses of zinc in the final tailing.

Test No. PPl2 - Continued

2.2.2. Reagent Additions

Type	Pounds of Reagent per Short Ton	Point of Addition
Na_2CO_3	3.60	Ball Mill Feed
NaCN	0.24	Ball Mill Feed
$ZnSO_4$	0.90	Ball Mill Feed
R-241	0.04	Ball Mill Feed
Z-11	0.03	Cyclone Feed Pump
Z-11	0.03	Pb Ro. Conditioner
MIBC	0.053	Pb Ro. Feed Pump
MIBC	0.075	Pb Ro. 3rd Cell
NaCN	0.15	Pb Ro. Tailing
$ZnSO_4$	0.46	Pb Ro. Tailing
Z-11	0.03	Pb Scav. Feed
MIBC	0.023	Pb Scav. Feed
NaCN	0.31	Pb Regrind Mill
Na_2CO_3	0.60	Pb Regrind Mill
$ZnSO_4$	0.52	Pb Regrind Mill
R-242	0.02	Pb Cyclone Feed Pump
MIBC	0.053	Pb 1st Cl. Feed Pump
Z-11	0.02	Pb 1st Cl. 4th Cell
NaCN	0.10	Pb 2nd Cl. Feed
NaCN	0.06	Pb 3rd Cl. Feed
NaCN	0.06	Pb 4th Cl. Feed
$Ca(OH)_2$	3.00	Zn Ro. Conditioner
$CuSO_4$	2.10	Zn Ro. Conditioner
M-748	0.075	Zn Ro. Conditioner
Z-6	0.18	Zn Ro. Feed Pump
DF-250	0.065	Zn Ro. Feed Pump
Z-6	0.03	Zn Scav. Feed
Z-200	0.018	Zn Scav. Feed
DF-250	0.030	Zn Scav. Feed
$Ca(OH)_2$	0.36	Zn 1st Cleaner Feed Pump
Z-200	0.03	Zn 1st Cleaner Feed Pump
Z-6	0.03	Zn 1st Cleaner Feed
DF-250	0.030	Zn 1st Cleaner Feed
Z-6	0.02	Zn 1st Cl. Scavenger
$Ca(OH)_2$	0.32	Zn 2nd Cleaner Feed
Z-6	0.02	Zn 2nd Cleaner Feed
$Ca(OH)_2$	0.28	Zn 3rd Cleaner Feed
DF-250	0.006	Zn 3rd Cleaner Feed
$Ca(OH)_2$	0.18	Zn 4th Cleaner Feed

Test No. PP12 - Continued

2.4. Results:

2.4.1. pH

Product	pH
Cyclone Overflow	9.1
Pb Rougher Feed	9.0
Pb Scavenger Tailing	8.8
Pb Regrinding Mill Discharge	9.7
Pb 1st Cleaner Feed	9.1
Pb 2nd Cleaner Feed	9.2
Pb 3rd Cleaner Feed	9.2
Pb 4th Cleaner Feed	9.2
Zn Rougher Feed	10.0
Zn Scavenger Tailing	9.6
Zn 1st Cleaner Feed	10.8
Zn 2nd Cleaner Feed	10.8
Zn 3rd Cleaner Feed	11.0
Zn 4th Cleaner Feed	11.0

2.4.2. Pulp Densities

Product	Pulp Density gpl
Pb Rougher Feed	1173
Pb Scavenger Tailing	1132
Pb 1st Cleaner Feed	1087
Zn Rougher Feed	1112
Zn Scavenger Tailing	1123
Zn 1st Cleaner Feed	1140

2.4.3. Pulp Temperature

Product	^{o}C
Pb Rougher Feed	23
Pb Regrinding Mill Discharge	26
Zn Rougher Feed	23

Test No. PP12 - Continued

2.4. Results:

2.4.4. Chemical Analyses

Product	Assays, %	
	Pb	Zn
Cyclone Overflow	5.99	10.3
Pb Rougher Feed	6.04	11.2
Pb Rougher Concentrate	27.0	14.6
Pb Rougher Tailing	2.52	10.8
Pb Scavenger Concentrate	6.59	14.6
Pb Scavenger Tailing	1.61	9.95
Pb 1st Cleaner Concentrate	33.4	15.2
Pb 1st Cleaner Tailing	7.65	15.6
Regrind Cyclone Overflow	24.1	15.5
Regrind Cyclone Underflow	22.3	13.9
Regrind Discharge	21.9	13.9
Pb Cleaner Concentrate	47.9	13.7
Zn Rougher Feed	1.80	8.87
Zn Rougher Concentrate	2.63	25.9
Zn Rougher Tailing	1.53	2.69
Zn Scavenger Concentrate	2.76	6.96
Zn Scavenger Tailing	1.30	1.58
Zn 1st Cleaner Tailing	2.77	4.32
Zn 1st Cleaner Concentrate	2.41	18.8
Zn 1st Cleaner Scavenger Conc.	2.37	4.95
Zn 1st Cleaner Scavenger Tail.	3.80	2.82
Zn Combined Tailing	1.37	1.58
Zn Cleaner Concentrate	2.34	38.2

Test No. PP12 - Continued

2.4.5. Metallurgical Results

Two-Product Formula

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
Pb Ro. Concentrate	14.17	27.0	14.6	63.9	18.2
Pb Ro. Tailing	85.83	2.52	10.8	36.1	81.8
Cyclone Overflow (meas)	100.0	5.99	10.3	100.0	100.0
(Calc.)	-	5.99	11.3	-	-
Pb Scav. Concentrate	15.68	6.59	14.6	17.3	20.2
Pb Scav. Tailing	70.15	1.61	9.95	18.9	61.6
Pb Ro. Tailing (meas)	85.83	2.52	10.8	36.1	81.8
(Calc.)	-	2.52	10.8	36.1	81.8
Zn Ro. Concentrate	21.94	2.63	25.9	9.63	50.1
Zn Ro. Tailing	48.21	1.53	2.69	12.3	11.4
Pb Scav. Tailing (meas)	70.15	1.61	9.95	18.9	61.6
(Calc.)	-	1.87	9.95	22.0	61.6
Zn Scav. Concentrate	9.95	2.76	6.96	4.59	6.11
Zn Scav. Tailing	38.26	1.30	1.58	8.31	5.33
Zn Ro. Tailing (meas)	48.21	1.53	2.69	12.3	11.4
(Calc.)	-	1.60	2.69	12.9	11.4
Pb 1st Cl. Conc.	10.65	33.4	15.2	59.4	14.3
Pb 1st Cl. Tail.	3.52	7.65	15.6	4.50	4.84
Pb Ro. Conc. (meas)	14.17	27.0	14.6	63.9	18.2
(Calc.)	-	27.0	15.3	63.9	19.1

Three-Product Formula

Pb 4th Cl. Conc.	9.32	47.9	13.7	74.5	12.4
Zn 4th Cl. Conc.	20.61	2.34	38.2	8.10	76.4
Zn Comb. Tailing	70.07	1.49	1.64	17.4	11.2
Cyclne Overflow	100.0	5.99	10.3	100.0	100.0

Test No. PP12 - Continued

2.4.5. Metallurgical Results

Zn Combined Tailings - Distribution of Pb and Zn in the Size Fractions

Product	Weight	Assays, %		% Distribution	
	%	Pb	Zn	Pb	Zn
Zn Comb. Tail. + 200 Mesh	12.0	0.71	1.36	5.59	9.80
Zn Comb. Tail. + 270 Mesh	9.0	0.51	1.04	3.01	5.62
Zn Comb. Tail. + 32.2 µm	13.6	0.58	0.91	5.18	7.44
Zn Comb. Tail. + 24.9 µm	9.7	0.50	0.90	3.18	5.24
Zn Comb. Tail. + 17.4 µm	12.4	0.50	0.83	4.07	6.18
Zn Comb. Tail. + 12.0 µm	9.8	0.63	0.92	4.05	5.42
Zn Comb. Tail. + 9.2 µm	5.6	0.87	1.14	3.19	3.83
Zn Comb. Tail. - 9.2 µm	27.9	3.92	3.37	71.8	56.5
Head (Calculated)	100.0	1.52	1.67	100.0	100.0

Test No. PP13

1. Grinding

1.1. Purpose: To repeat conditions of test PP12.

1.2. Method: As for tests PP1 - 12. The grinding circuit was operated for a period of 7.75 hours at a feed rate of 692 pounds per hour. The samples were taken every 30 minutes in the last 2hours of operation.

1.2.1. Classification Equipment

Hendy Mill: P-50 Dorr Cyclone

1 1/2 inch diameter
5/8 inch vortex
1/2 inch apex

Pb Regrind

Sala Mill; 1 inch Krebs Cyclone:

1 inch diameter
1/4 inch vortex
1/8 inch apex

1.3. Flowsheet: As for test PP1.

1.4. Results: The grinding circuit was stable during the test run. Net power consumption in the Hendy mill was 14.9 kilowatt-hours per ton of ½ inch feed. The cyclone overflow assayed 87.4 % minus 200 mesh.

Test No. PP13 - Continued

1.4. Results:

1.4.1. Ball Mill Report

Feed:	Minus ½ inch ore at 1.5 percent moisture content.		
Feed Rate:	692 dry pounds per hour		
Mill Speed:	32 r.p.m., 80.5 percent of critical speed		
Mill Load:	3 inch balls	1000 pounds	
	1 ½ inch balls	600 pounds	
	1 inch balls	400 pounds	
	Total	2000 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Mill Feed:	Total 5363 pounds, test period 1384 pounds		
Circulating Load:	Cyclone Underflow 552 percent		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2076	68
	Cyclone Overflow	1380	36
	Cyclone Underflow	2402	76
Average Power:	Gross	7.13 kilowatts	
	No Load	1.92 kilowatts	
	Net	5.21 kilowatts	
Net Power Consumption:	14.89 kilowatt-hours per ton of ½ inch feed.		
Work index:	11.43		

Test No. PP13 - Continued

1.4. Results:

1.4.2. Lead Regrinding Mill Report

Regrinding Mill:	Sala Mill		
Feed:	Lead Rougher Concentrate and lead 2nd cleaner tailings.		
Feed Rate:	148 pounds per hour, 21.4 percent of the mill feed		
Mill Speed:	31 r.p.m., 73 percent of critcal speed		
Mill Load:	1 inch balls	720 pounds	
	Total	720 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2456	74
	Cyclone Feed	1232	24
	Cyclone Overflow	1103	12
	Cyclone Underflow	2456	74
Average Power:	Gross	5.58 kilowatts	
	No Load	0.92 kilowatts	
	net	4.66 kilowatts	
Net Power Consumption:	13.3 kilowatt-hours per ton of feed.		

Test No. PP13 - Continued

1.4.3. Screen Analyses

Hendy Mill Feed

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 3/8	3.8	3.8	96.2
3	13.4	17.2	82.8
4	13.0	30.2	69.8
6	10.4	40.6	59.4
8	9.0	49.6	50.4
10	7.0	56.6	43.4
14	6.0	62.6	37.4
20	4.5	67.1	32.9
28	3.7	70.8	29.2
35	3.1	73.9	26.1
48	3.4	77.3	22.7
65	3.2	80.5	19.5
100	2.7	83.2	16.8
150	2.7	85.9	14.1
200	2.8	88.7	11.3
- 200	11.3	100.0	-
Total	100.0	-	-

Hendy Mill Discharge

+ 14	0.1	0.1	99.9
20	0.2	0.3	99.7
28	0.4	0.7	99.3
35	0.6	1.3	98.7
48	1.5	2.8	97.2
65	3.0	5.8	94.2
100	5.3	11.1	88.9
150	9.9	21.0	79.0
200	18.2	39.2	60.8
270	14.6	53.8	46.2
400	17.5	71.3	28.7
- 400	28.7	100.0	-
Total	100.0	-	-

Test No. PP13 - Continued

1.4.3. Screen Analyses

Cyclone Underflow

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 10	0.1	0.1	99.9
14	0.1	0.2	99.8
20	0.3	0.5	99.5
28	0.5	1.0	99.0
35	0.8	1.9	98.2
48	2.0	3.8	96.2
65	3.7	7.5	92.5
100	6.1	13.6	86.4
150	11.2	24.8	75.2
200	19.4	44.2	55.8
270	15.1	59.3	40.7
400	18.4	77.7	22.3
- 400	22.3	100.0	-
Total	100.0	-	-

Cyclone Overflow

+ 65	0.5	0.5	99.5
100	1.2	1.7	98.3
150	3.1	4.8	95.2
200	7.8	12.6	87.4
270	8.6	21.2	78.8
400	15.5	36.7	63.3
- 400	63.3	100.0	-
Total	100.0	-	-

Test No. PP13 - Continued

1.4.3. Screen Analyses

Pb Rougher Concentrate

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	6.8	6.8	93.2
270	7.0	13.8	86.2
27.7 µm	19.0	32.8	67.2
21.4	8.2	41.0	59.0
15.0	12.2	53.2	46.8
10.3	11.3	64.5	35.5
8.1	7.4	71.9	28.1
- 8.1	28.1	100.0	-
Total	100.0	-	-

Specific Gravity 4.71

Pb Regrind Discharge

+ 200 mesh	0.6	0.6	99.4
270	2.0	2.6	97.4
26.8 µm	16.8	19.4	80.6
20.8	14.0	33.4	66.6
14.5	26.9	60.3	39.7
10.0	15.9	76.2	23.8
7.7	5.4	81.6	18.4
- 7.7	18.4	100.0	-
Total	100.0	-	-

Specific Gravity 4.87

Pb Regrind Cyclone Underflow

+ 200 mesh	4.2	4.2	95.8
270	5.6	9.8	90.2
25.2 µm	24.0	33.8	66.2
19.5	16.6	50.4	49.6
13.6	28.4	78.8	21.2
9.4	12.8	91.6	8.4
7.2	2.5	94.1	5.9
- 7.2	5.9	100.0	-
Total	100.0	-	-

Specific Gravity 5.46

Test No. PP13 - Continued

1.4.3. Screen Analyses

Pb Regrind Cyclone Overflow

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 15.3 µm	2.4	2.4	97.6
10.5	16.6	19.0	81.0
8.1	15.9	34.9	65.1
- 8.1	65.1	100.0	-
Total	100.0	-	-

Specific Gravity 4.50

Pb 4th Cleaner Concentrate

+ 20.2 µm	4.0	4.0	96.0
14.1	5.2	9.2	90.8
9.7	20.4	29.6	70.4
7.5	17.4	47.0	53.0
- 7.5	53.0	100.0	-
Total	100.0	-	-

Specific Gravity 5.22

Zn Rougher Concentrate

+ 200 mesh	24.8	24.8	75.2
270	12.9	37.7	62.3
30.5 µm	6.8	44.5	55.5
23.7	26.2	70.7	29.3
16.5	6.1	76.8	23.2
11.3	4.2	81.0	19.0
8.8	2.5	83.5	16.5
- 8.8	16.5	100.0	-
Total	100.0	-	-

Specific Gravity 4.06

Test No. PP13 - Continued

1.4.3. Screen Analyses

Zn Combined Tailing

Particle Size	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 200 mesh	12.5	12.5	87.5
270	9.9	22.4	77.6
32.6 µm	14.5	36.9	63.1
25.3	10.1	47.0	53.0
17.6	13.0	60.0	40.0
12.1	10.0	70.0	30.0
9.4	5.7	75.7	24.3
- 9.4	24.3	100.0	-
Total	100.0	-	-

Specific Gravity 3.67

1.4.5. Specific Gravity

Sample	Specific Gravity
Cyclone Overflow	3.85

Test No. PP13 - Continued

2. Flotation

2.1. Purpose:

1) To study the effect of a finer lead concentrate regrind than in test PP12.

2) To study the effect of higher pH in the zinc 3rd and 4th cleaners.

2.2. Method:

The fineness of the lead rougher concentrate was increased by adjusting the cyclone in the regrinding circuit. The pH in the zinc 3rd and 4th cleaner stages were increased from pH 10.5 to 11.9.

2.2.1. Flotation Equipment

As for test PP11.

2.2.2. Flotation Reagents

See following page.

2.4. Results:

The circuit was not stable during the test period. The paddle drive of the lead cleaner cells broke (Pb 2nd cleaner) and pyrite and middlings were building up in the zinc cleaning circuit.

In the Pb 4th cleaner concentrate considerable amount of coarse pyrite was observed.

Test No. PP13 - Continued

2.2.2. Reagent Additions:

Type	Pounds of Reagent per Short Ton	Point of Addition
Na_2CO_3	3.44	Ball Mill Feed
NaCN	0.23	Ball Mill Feed
$ZnSO_4$	0.90	Ball Mill Feed
R-241	0.03	Ball Mill Feed
Z-11	0.03	Cyclone Feed Pump
Z-11	0.03	Pb Rougher Conditioner
MIBC	0.053	Pb Ro. Feed Pump
MIBC	0.075	Pb Ro. 3rd Cell
NaCN	0.15	Pb Rougher Tailing
$ZnSO_4$	0.46	Pb Rougher Tailing
Z-11	0.03	Pb Scav. Feed
MIBC	0.026	Pb Scav. Feed
Na_2CO_3	0.50	Pb Regrind Mill
$ZnSO_4$	0.52	Pb Regrind Mill
NaCN	0.32	Pb Regrind Mill
R-242	0.03	Pb Cyclone Feed Pump
MIBC	0.054	Pb 1st Cl. Feed Pump
Z-11	0.02	Pb 1st Cl. 4th Cell
NaCN	0.10	Pb 2nd Cl. Feed
NaCN	0.03	Pb 3rd Cl. Feed
NaCN	0.03	Pb 4th Cl. Feed
$Ca(OH)_2$	2.80	Zn Ro. Conditioner Feed
$CuSO_4$	2.12	Zn Ro. Conditioner No. 1
M-748	0.075	Zn Ro. Conditioner No. 2
Z-6	0.18	Zn Ro. Feed Pump
DF-250	0.065	Zn Ro. Feed Pump
Z-6	0.03	Zn Scavenger Feed
Z-200	0.017	Zn Scavenger Feed
DF-250	0.030	Zn Scavenger Feed
$Ca(OH)_2$	0.36	Zn 1st Cleaner Feed Pump
Z-200	0.03	Zn 1st Cleaner Feed Pump

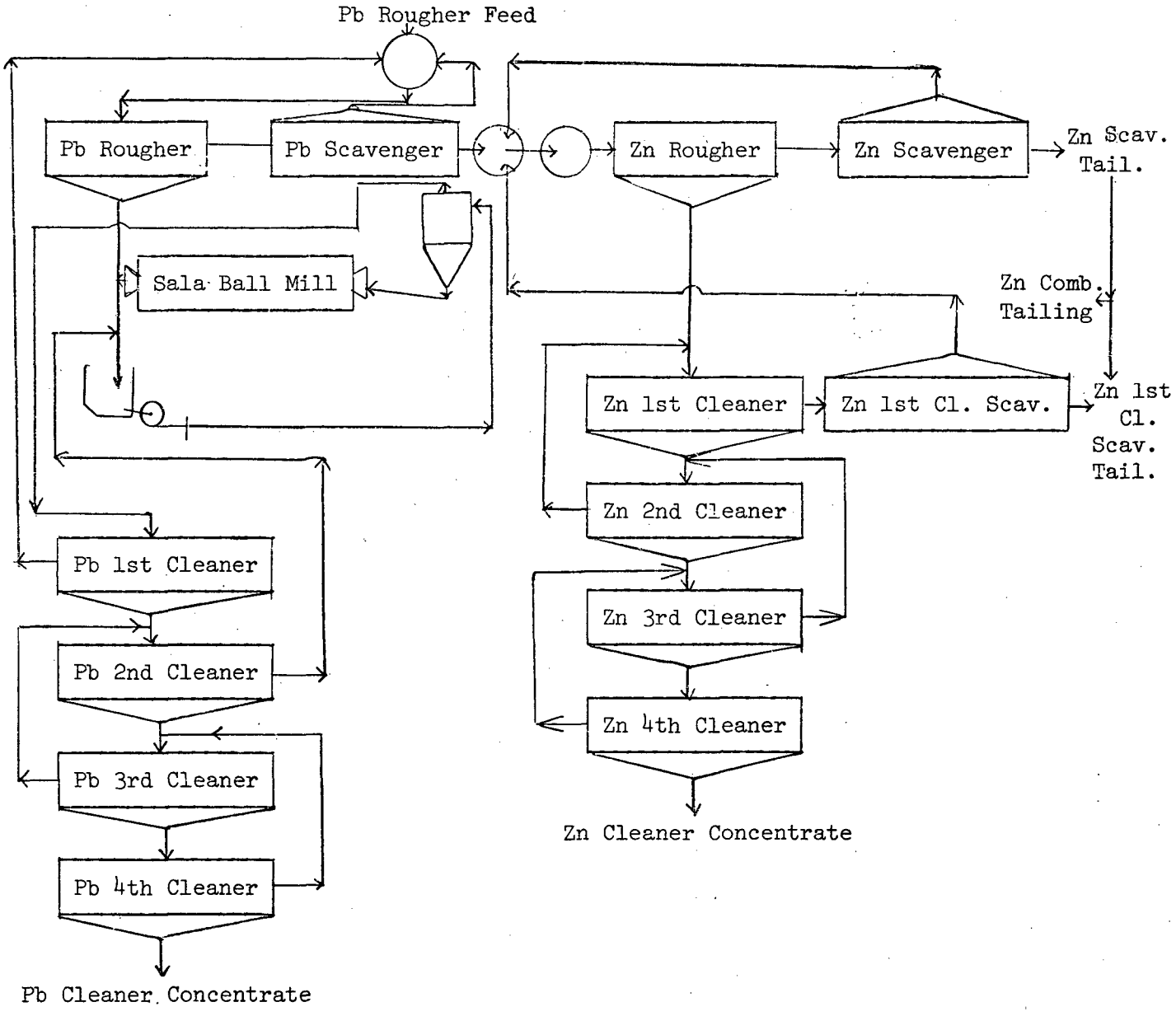
Test No. PP13 - Continued

2.2.2. Reagent Additions:

Type	Pounds of Reagent per Short Ton	Point of Addition
Z-6	0.03	Zn 1st Cleaner Feed
DF-250	0.032	Zn 1st Cleaner Feed
Z-6	0.02	Zn 1st Cleaner Scavenger
Z-6	0.02	Zn 2nd Cleaner Feed
$Ca(OH)_2$	1.28	Zn 3rd Cleaner Feed
DF-250	0.006	Zn 3rd Cleaner Feed
Z-6	0.01	Zn 3rd Cleaner Feed
$Ca(OH)_2$	0.50	Zn 4th Cleaner Feed

Test No. PP13 - Continued

2.3. Flowsheet



Test No. PP13 - Continued

2.4.1. pH

Product	pH
Cyclone Overflow	9.0
Pb Rougher Feed	8.9
Pb Scavenger Tailing	8.8
Pb Regrinding Mill Discharge	9.3
Pb 1st Cleaner Feed	9.1
Pb 2nd Cleaner Feed	9.3
Pb 3rd Cleaner Feed	9.4
Pb 4th Cleaner Feed	9.4
Zn Rougher Feed	10.3
Zn Scavenger Tailing	9.8
Zn 1st Cleaner Feed	11.1
Zn 2nd Cleaner Feed	11.4
Zn 3rd Cleaner Feed	11.8
Zn 4th Cleaner Feed	11.8

2.4.2. Pulp Densities

Product	Pulp Density gpl
Pb Rougher Feed	1220
Pb Scavenger Tailing	1237
Pb 1st Cleaner Feed	1103
Zn Rougher Feed	1202
Zn Scavenger Tailing	1170
Zn 1st Cleaner Feed	1303

2.4.3. Pulp Temperature

Product	°C
Pb Rougher Feed	26
Pb Regrinding Mill Discharge	26
Zn Rougher Feed	26

Test No. PP13 - Continued

2.4.4. Chemical Analyses

Product	Assays, %	
	Pb	Zn
Cyclone Overflow	5.95	10.0
Pb Rougher Feed	5.76	10.9
Pb Rougher Concentrate	20.7	14.6
Pb Rougher Tailing	1.93	10.2
Pb Scavenger Concentrate	5.85	14.2
Pb Scavenger Tailing	1.51	9.55
Pb 1st Cleaner Concentrate	28.2	16.5
Pb 1st Cleaner Tailing	4.66	15.5
Pb Regrind Cyclone Overflow	17.9	16.1
Pb Regrind Cylcone Underflow	20.1	13.0
Pb Regrind Discharge	19.3	12.9
Pb Cleaner Concentrate	46.4	13.6
Zn Rougher Feed	1.80	10.3
Zn Rougher Concentrate	2.30	20.2
Zn Rougher Tailing	1.30	1.86
Zn Scavenger Concentrate	2.24	4.38
Zn Scavenger Tailing	1.06	1.19
Zn 1st Cleaner Tailing	2.13	13.5
Zn 1st Cleaner Concentrate	2.06	33.7
Zn 1st Cleaner Scav. Conc.	2.18	14.7
Zn 1st Cleaner Scav. Tail.	1.64	2.86
Zn 2nd Cleaner Tailing	1.89	31.8
Zn Combined Tailing	1.07	1.21
Zn Cleaner Concentrate	3.18	46.0

Test No. PP13 - Continued

2.4.5. Metallurgical Results

Two-Product Formula

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
Pb Ro. Concentrate	21.40	20.7	14.6	74.5	29.0
Pb Ro. Tailing	78.60	1.93	10.2	25.5	72.0
Cyclones Overflow (meas)	100.0	5.95	10.0	100.0	100.0
(Calc.)	-	5.95	11.1	-	-
Pb Scav. Concentrate	7.60	5.85	14.2	7.48	9.69
Pb Scav. Tailing	71.00	1.51	9.55	18.0	60.9
Pb Ro. Tailing (meas)	78.6	1.93	10.2	25.5	72.0
(Calc.)	-	1.93	10.0	25.5	70.5
Zn Ro. Concentrate	17.15	2.06	33.7	5.92	51.9
Zn Ro. Tailing	53.85	1.30	1.86	11.8	8.99
Pb Scav. Tailing (meas)	71.00	1.51	9.55	18.0	60.9
(Calc.)	-	1.48	9.55	17.7	60.9
Zn Scav. Concentrate	11.31	2.24	4.38	4.26	4.45
Zn Scav. Tailing	42.54	1.06	1.19	7.58	4.54
Zn Ro. Tailing (meas)	53.85	1.30	1.86	11.8	8.99
(Calc.)	-	1.31	1.86	11.8	8.99
Zn 1st Cl. Concentrate	5.69	2.06	33.7	1.97	17.2
Zn 1st Cl. Tailing	11.46	2.13	13.5	4.10	13.9
Zn Ro. Concentrate (meas)	17.15	2.30	20.2	6.63	31.1
(Calc.)	-	2.11	20.2	6.08	31.1
Zn 1st Cl. Scav. Conc.	10.30	2.18	14.7	3.78	13.6
Zn 1st Cl. Scav. Tail.	1.16	1.64	2.86	0.32	0.3
Zn 1st Cl. Tail. (meas)	11.46	2.13	13.5	4.10	13.5
(Calc.)	-	2.12	13.5	4.10	13.9
Pb 1st Cl. Concentrate	14.58	29.2	16.5	69.1	21.6
Pb 1st Cl. Tailing	6.82	4.66	15.5	5.34	9.49
Pb Ro. Concentrate (meas)	21.40	20.7	14.6	74.5	28.0
(Calc.)	-	20.7	16.2	74.5	31.1

Test No. PP13 - Continued

Metallurgical Results

Three-Product Formula

Product	Weight	Assays, %		% Distribution	
	%	Pb	Zn	Pb	Zn
Pb 4th Cl. Concentrate	9.98	46.4	13.6	77.8	13.6
Zn 4th Cl. Concentrate	16.87	3.18	46.0	9.0	77.6
Zn Combined Tailing	73.15	1.07	1.21	13.2	8.8
Cyclone Overflow	100.0	5.95	10.0	100.0	100.0
	-	—	—	-	-

Lead and Zinc Distribution in the Lead 4th Cleaner Concentrate

Pb 4th Cl. Conc. + 20.2 µm	4.0	32.0	13.0	2.73	3.95
Pb 4th Cl. Conc. + 14.1 µm	5.2	30.7	19.9	3.40	7.87
Pb 4th Cl. Conc. + 9.7 µm	20.4	38.4	19.0	16.7	29.5
Pb 4th Cl. Conc. + 7.5 µm	17.4	43.2	17.0	16.0	22.5
Pb 4th Cl. Conc. - 7.5 µm	53.0	54.2	8.99	61.2	36.2
Head (Calculated)	100.0	47.0	13.2	100.0	100.0

Lead and Zinc Distribution in the Zinc Combined Tailing

Zn Comb. Tail. + 200 Mesh	12.5	0.66	1.26	8.36	13.1
Zn Comb. Tail. + 270 Mesh	9.9	0.51	1.04	5.12	8.58
Zn Comb. Tail. + 32.6 µm	14.5	0.44	0.86	6.46	10.4
Zn Comb. Tail. + 25.3 µm	10.1	0.39	0.78	3.99	6.57
Zn Comb. Tail. + 17.6 µm	13.0	0.41	0.76	5.40	8.23
Zn Comb. Tail. + 12.1 µm	10.0	0.51	0.81	5.17	6.75
Zn Comb. Tail. + 9.4 µm	5.7	0.77	0.94	4.45	4.47
Zn Comb. Tail. - 9.4 µm	24.3	2.48	2.07	61.1	41.7
Head (Calculated)	100.0	0.99	1.20	100.0	100.0

Test No. PP14

1. Grinding

1.1. Purpose: To repeat conditions of test PP13.

1.2. Method: As for test PP1 - 13. The grinding circuit was operated for a period of 7.75 hours at a feed rate of 698 pounds per hour. The samples were taken every 30 minutes in the last 2 hours of operation.

1.2.1. Classification Equipment

Hendy Mill:	1 1/2 inch Dorr Cyclone
	1 1/2 inch diameter 5 /8 inch vortex 1/2 inch apex
Pb 1st Regrind	Sala Mill; 1 1/2 inch Krebs Cyclone
	1 1/2 inch diameter 1/2 inch vortex 1/4 inch apex
Pb 2nd Regrind	Denver Mill 1 inch Krebs Cyclone
	1 inch diameter 1/4 inch vortex 1/8 inch apex

1.3. Flowsheet: As for test PP1.

1.4. Results: The grinding circuit was stable throughout the test run. Net power consumption in the Hendy mill was 14.9 kilowatt-hours per ton of ½ inch feed. The Dorr cyclone analysed 87.6 % minus 200 mesh.

Test No. PP14 - Continued

1.4. Results:

1.4.1. Ball Mill Report

Feed:	Minus ½ inch ore at 1.5 percent moisture content		
Feed Rate:	698 dry pounds per hour		
Mill Speed:	32 r.p.m., 80.5 percent of critical speed		
Mill Load:	3 inch balls	1000 pounds	
	1¼ inch balls	600 pounds	
	1 inch balls	400 pounds	
	Total	2000 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Mill Feed:	Total 5410 pounds, test period 1396 pounds		
Circulating Load:	Cyclone Underflow 546.0 percent		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2154	70
	Cyclone Overflow	1410	38
	Cyclone Underflow	2440	77
Average Power:	Gross	7.13 kilowatts	
	No Load	1.92 kilowatts	
	Net	5.21 kilowatts	
Net Power Consumption:	14.89 kilowatt-hours per ton of ½ inch feed.		
Work Index:	11.23		

Test No. PP14 - Continued

1.4. Results:

1.4.2. Lead Regrinding Mill Report

Regrinding Mill:	Sala Mill		
Feed:	Lead Rougher Concentrate and Pb 2nd cleaner tailings		
Feed Rate:	139 pounds per hour, 19.90 percent of the mill feed		
Mill Speed:	31 r.p.m., 73 percent of critical speed		
Mill Load:	1 inch balls	720 pounds	
	Total	720 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Pulp Densities:		gpl	% Solids
	Mill Discharge	1895	60
	Cyclone Feed	1185	20
	Cyclone Overflow	1117	13.5
	Cyclone Underflow	1895	60
Average Power:	Gross	5.34 kilowatts	
	No Load	0.92 kilowatts	
	Net	4.42 kilowatts	
Net Power Consumption:	12.63 kilowatt-hours per ton of feed.		

Test No. PP14 - Continued

1.4. Results:

1.4.3. Screen Analyses

Hendy Mill Feed

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 3/8	2.7	2.7	97.3
3	11.3	14.0	86.0
4	12.4	26.4	73.6
6	11.0	37.4	62.6
8	10.0	47.4	52.6
10	8.0	55.4	44.6
14	6.6	62.0	38.0
20	4.8	66.8	33.2
28	4.0	70.8	29.2
35	3.4	74.2	25.8
48	3.5	77.7	22.3
65	3.4	81.1	18.9
100	2.7	83.8	16.2
150	2.8	86.6	13.4
200	2.8	89.4	10.6
- 200	10.6	100.0	-
Total	100.0	-	-

Hendy Mill Discharge

+ 10	0.1	0.1	99.9
14	0.1	0.2	99.8
20	0.2	0.4	99.6
28	0.4	0.8	99.2
35	0.7	1.5	98.5
48	1.6	3.1	96.9
65	3.2	6.3	93.7
100	5.2	11.5	88.5
150	9.6	21.1	78.9
200	17.4	38.5	61.5
270	13.8	52.3	47.7
400	17.6	69.9	30.1
- 400	30.1	100.0	-
Total	100.0	-	-

Test No. PP14 - Continued

1.4. Results:

1.4.3. Screen Analyses

Cyclone Underflow

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 10	0.1	0.1	99.9
14	0.2	0.3	99.7
20	0.3	0.6	99.4
28	0.4	1.0	99.0
35	0.8	1.8	98.2
48	1.9	3.7	96.3
65	3.6	7.3	92.7
100	6.0	13.3	86.7
150	10.9	24.2	75.8
200	19.3	43.5	56.5
270	14.6	58.1	41.9
400	18.1	76.2	23.8
- 400	23.8	100.0	-
Total	100.0	-	-

Cyclone Overflow

+ 65	0.5	0.5	99.5
100	1.2	1.7	98.3
150	3.1	4.8	95.2
200	7.6	12.4	87.6
270	8.3	20.7	79.3
400	15.3	36.0	64.0
- 400	64.0	100.0	-
Total	100.0	-	-

Test No. PP14 - Continued

1.4.3. Screen Analysis

Pb Rougher Concentrate

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	7.6	7.6	92.4
270	7.5	15.1	84.9
27.6 µm	19.5	34.6	65.4
21.4	8.0	42.6	57.4
14.9	12.8	55.4	44.6
10.3	11.4	66.8	33.2
7.9	7.2	74.0	26.0
- 7.9	26.0	100.0	-
Total	100.0	-	-

Specific Gravity 4.69

Pb 1st Regrind Discharge

+ 200 mesh	1.0	1.0	99.0
270	2.5	3.5	96.5
27.6 µm	19.3	22.8	77.2
21.4	13.2	36.0	64.0
14.9	21.9	57.9	42.1
10.3	14.2	72.1	27.9
7.9	6.2	78.3	21.7
- 7.9	21.7	100.0	-
Total	100.0	-	-

Specific Gravity 4.71

Pb 1st Regrind Cyclone Underflow

+ 200 mesh	7.4	7.4	92.6
270	11.0	18.4	81.6
27.5 µm	24.0	42.4	57.6
21.3	14.3	56.7	43.3
14.9	19.9	76.6	23.4
10.2	11.0	87.6	12.4
7.9	4.1	91.7	8.3
- 7.9	8.3	100.0	-
Total	100.0	-	-

Specific Gravity 4.80

Test No. PP15 - Continued

1.4.3. Screen Analyses

Pb 2nd Regrind Cyclone Overflow

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 14.7 µm	4.7	4.7	95.3
10.1	21.3	26.0	74.0
7.8	17.0	43.0	57.0
- 7.8	57.0	100.0	-
Total	100.0	-	-

Specific Gravity 4.74

Pb 4th Cl. Concentrate

+ 200 Mesh	0.2	0.2	99.8
270	0.1	0.3	99.7
24.8 µm	0.6	0.9	99.1
19.2	0.9	1.8	98.2
13.4	8.2	10.0	90.0
9.2	22.1	32.1	67.9
7.1	16.7	48.8	51.2
- 7.1	51.2	100.0	-
Total	100.0	-	-

Specific Gravity 5.63

Zn Rougher Concentrate

+ 200 mesh	29.2	29.2	70.8
270	14.4	43.6	56.4
30.8 µm	4.6	48.2	51.8
23.9	25.1	73.3	26.7
16.6	6.2	79.5	20.5
11.4	4.3	83.8	16.2
8.8	2.6	86.4	13.6
- 8.8	13.6	100.0	-
Total	100.0	-	-

Specific Gravity 4.01

Test No. PP14 - Continued

1.4.3. Screen Analysis

Zn Combined Tailing

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	10.5	10.5	89.5
270	9.0	19.5	80.5
32.8 µm	13.7	33.2	66.8
25.5	9.7	42.9	57.1
17.8	13.5	56.4	43.6
12.2	10.6	67.0	33.0
9.4	6.2	73.2	26.8
- 9.4	26.8	100.0	-
Total	100.0	-	-

Specific Gravtiy 3.66

Pb 1st Cleaner Concentrate

+ 270 mesh	0.4	0.4	99.6
27.4 µm	5.2	5.6	94.4
21.2	4.5	10.1	89.9
14.8	12.5	22.6	77.4
10.2	18.9	41.5	58.5
7.9	13.9	55.4	44.6
- 7.9	44.6	100.0	-
Total	100.0	-	-

Specific Gravity 4.78

Pb 1st Regrind Cyclone Overflow

+ 270 mesh	0.4	0.4	99.6
27.7 µm	3.6	4.0	96.0
21.4	3.2	7.2	92.8
15.0	9.8	17.0	83.0
10.3	16.3	33.3	66.7
7.9	13.6	46.9	53.1
- 7.9	53.1	100.0	-
Total	100.0	-	-

Specific Gravity 4.72

Test No. PP14 - Continued

1.4. Results:

1.4.4. Specific Gravity

Sample	Specific Gravity
Cyclone Overflow	4.01

Test No. PP14 - Continued

2. Flotation

2.1. Purpose: To introduce multiple-stage regrinding of the lead rougher concentrate.

2.2. Method: The lead rougher concentrate was reground in the Sala mill to 80 % passing minus 20 microns. The lead reground concentrate was cleaned once, and this concentrate was reground in the small Denver mill. (See flowsheet) No changes were made in the zinc circuit.

2.2.1. Flotation Equipment

As for test PP11.

2.2.2. Flotation Reagents

See following page.

2.4. Results: Poor frothing conditions were obtained in the lead cleaning, caused by variations in pulp density. Finer lead concentrate regrinding improved lead grade, but recovery was low. In the zinc circuit no improvement in pyrite rejection was obtained with a finer lead concentrate regrind.

Test No. PP14 - Continued

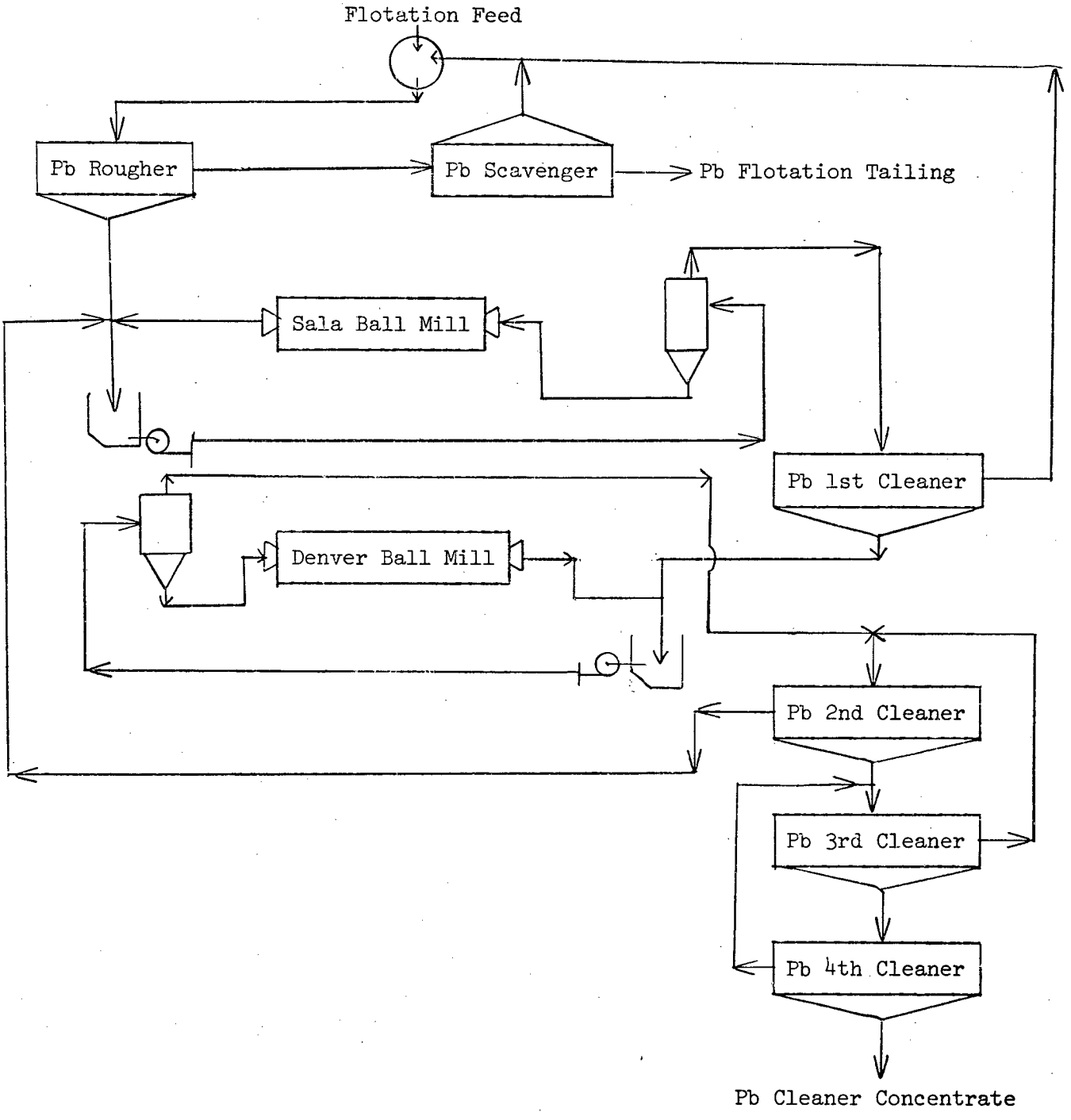
2.2.2. Reagent Additions:

Type	Pounds of Reagent Per Ton	Point of Addition
Na_2CO_3	3.50	Ball Mill Feed
NaCN	0.23	Ball Mill Feed
$ZnSO_4$	1.00	Ball Mill Feed
R-241	0.03	Ball Mill Feed
Z-11	0.05	Cyclone Feed Pump
Z-11	0.03	Pb Ro. Conditioners
MIBC	0.053	Pb Ro. Feed Pump
MIBC	0.078	Pb Ro. 3rd Cell
NaCN	0.15	Pb Rougher Tailing
$ZnSO_4$	0.46	Pb Rougher Tailing
Z-11	0.03	Pb Scav. Feed
MIBC	0.023	Pb Scav. Feed
NaCN	0.31	Pb Regrind Mill
Na_2CO_3	0.50	Pb Regrind Mill
$ZnSO_4$	0.54	Pb Regrind Mill
R-242	0.02	Pb Cyclone Feed Pump
MIBC	0.053	Pb 1st Cl. Feed Pump
Z-11	0.02	Pb 1st Cl. 4th Cell
NaCN	0.10	Pb 2nd Regrind Mill
NaCN	0.10	Pb 3rd Cl. Feed
NaCN	0.06	Pb 4th Cl. Feed
$Ca(OH)_2$	3.40	Zn Ro. Conditioner No. 1
$CuSO_2$	2.10	Zn Ro. Conditioner No. 1
M-748	0.075	Zn Ro. Conditioner No. 2
Z-6	0.18	Zn Ro. Feed Pump
DF-250	0.063	Zn Ro. Feed Pump
Z-6	0.03	Zn Scavenger Feed
Z-200	0.015	Zn Scavenger Feed
DF-250	0.029	Zn Scavenger Feed
Z-200	0.03	Zn 1st Cl. Feed Pump
Z-6	0.03	Zn 1st Cl. Feed
DF-250	0.03	Zn 1st Cl. Feed
Z-6	0.02	Zn 1st Cl. Scavenger
Z-6	0.02	Zn 2nd Cl. Feed
DF-250	0.008	Zn 2nd Cl. Feed
$Ca(OH)_2$	1.46	Zn 3rd Cl. Feed
Z-6	0.02	Zn 3rd Cl. Feed
$Ca(OH)_2$	0.52	Zn 4th Cl. Feed

Test No. PP14 - Continued

2.3. Flowsheet

a) Pb Circuit



b) Zinc Circuit - As for test PP13.

Test No. PP14 - Continued

2.4. Results:

2.4.1. pH

Product	pH
Cyclone Overflow	9.0
Pb Rougher Feed	8.9
Pb Scavenger Tailing	8.9
Pb Regrinding Mill Discharge	9.4
Pb 1st Cleaner Feed	9.1
Pb 2nd Cleaner Feed	9.2
Pb 3rd Cleaner Feed	9.3
Pb 4th Cleaner Feed	9.5
Zn Rougher Feed	9.9
Zn Scavenger Tailing	9.4
Zn 1st Cleaner Feed	10.7
Zn 2nd Cleaner Feed	11.1
Zn 3rd Cleaner Feed	11.7
Zn 4th Cleaner Feed	11.8

2.4.2. Pulp Densiites

Product	Pulp Density gpl
Pb Rougher Feed	1197
Pb Scavenger Tailing	1168
Pb 1st Cleaner Feed	1117
Zn Rougher Feed	1158
Zn Scavenger Tailing	1122
Zn 1st Cleaner Feed	1523

2.4.3. Pulp Temperature

Product	°C
Pb Rougher Feed	26
Pb Regrinding Mill Discharge	28
Zn Rougher Feed	25

Test No. PP14 - Continued

2.4. Results:

2.4.4. Chemical Analyses

Product	Assays, %	
	Pb	Zn
Cyclone Overflow	6.14	10.2
Pb Rougher Feed	6.06	11.5
Pb Rougher Concentrate	23.0	14.6
Pb Rougher Tailing	1.95	10.6
Pb Scavenger Concentrate	5.38	14.5
Pb Scavenger Tailing	1.49	9.71
Pb 1st Cleaner Concentrate	27.1	17.0
Pb 1st Cleaner Tailing	4.96	15.8
Pb 1st Regrind Cyclone Overflow	20.4	16.6
Pb 2nd Regrind Cyclone Overflow	27.1	17.9
Pb 1st Regrind Cyclone Underflow	14.2	14.8
Pb 1st Regrind Discharge	15.0	14.7
Pb Cleaner Concentrate	52.8	13.0
Zn Rougher Feed	1.87	9.80
Zn Rougher Concentrate	2.23	19.8
Zn Rougher Tailing	1.42	2.26
Zn Scavenger Concentrate	2.07	4.37
Zn Scavenger Tailing	1.19	1.33
Zn 1st Cleaner Tailing	2.25	13.0
Zn 1st Cleaner Concentrate	1.95	34.8
Zn 2nd Cleaner Tailing	1.89	34.4
Zn Combined Tailing	1.22	1.37
Zn 1st Cl. Scavenger Concentrate	2.37	15.4
Zn 1st Cl. Scavenger Tailing	1.33	1.34
Zn Cleaner Concentrate	2.87	47.0

Test No. PP14 - Continued

2.4.5. Metallurgical Results

Two-Product Formula

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
Pb Rougher Concentrate	19.90	23.0	14.6	74.6	25.5
Pb Rougher Tailing	80.10	1.95	10.6	25.4	74.5
Cyclone Overflow (meas)	100.00	6.14	10.2	100.0	100.0
(Calc.)	100.00	6.14	11.40	100.0	100.0
Pb Scavenger Conc.	9.47	5.38	14.5	8.30	12.0
Pb Scavenger Tail.	70.63	1.49	9.71	17.1	60.2
Pb Rougher Tailing (meas)	80.10	1.95	10.6	25.44	83.2
(Calc.)	-	1.95	12.2	25.40	72.2
Pb 1st Cl. Concentrate	16.21	27.1	17.0	71.6	24.2
Pb 1st Cl. Tailing	2.69	4.96	15.8	2.17	0.64
Pb Rougher Conc. (meas)	19.90	23.0	14.6	74.5	25.5
(Calc.)	-	22.7	14.2	73.8	24.8
Zn Rougher Concentrate	30.60	2.23	19.8	10.9	52.1
Zn Rougher Tailing	40.63	1.42	2.26	9.40	8.06
Pb Scav. Tailing (meas)	70.63	1.49	9.71	17.1	67.2
(Calc.)	-	1.76	9.71	20.3	60.2
Zn Scavenger Conc.	12.43	2.07	4.37	4.19	4.77
Zn Scavenger Tail.	28.20	1.19	1.33	5.47	3.29
Zn Rougher Tail. (meas)	40.63	1.42	2.26	9.40	9.00
(Calc.)	-	1.46	2.26	9.66	8.06
Zn 1st Cl. Concentrate	9.36	1.95	34.8	2.97	28.6
Zn 1st Cl. Tailing	20.64	2.25	13.0	7.56	23.5
Zn Ro. Conc. (meas)	30.00	2.23	19.8	10.9	58.2
(Calc.)	-	1.94	19.8	10.5	52.1
Zn 1st Cl. Scav. Conc.	17.12	2.37	15.4	6.61	23.1
Zn 1st Cl. Scav. Tail.	3.52	1.33	1.34	0.76	0.41
Zn 1st Cl. Tail. (meas)	20.64	2.25	13.0	7.56	26.3
(Calc.)	-	2.19	13.0	7.37	23.5

Three-Product Formula

Pb 4th Cl. Concentrate	8.99	52.8	13.0	77.3	11.5
Zn 4th Cl. Cl. Conc.	17.06	2.87	47.0	7.98	78.6
Zn Combined Tailing	73.95	1.22	1.37	14.7	9.9
Cyclone Overflow	100.00	6.14	10.2	100.0	100.0

Test No. PP15

1. Grinding

1.1. Purpose: To repeat conditions of test PP14.

1.2. Method: As for test PP1 to 14. The grinding circuit was operated for a period of 7.75 hours at a feed rate of 703 pounds per hour. The samples were taken every 30 minutes in the last 2 hours of operation.

1.2.1. Classification Equipment

Hendy Mill; P-50 Dorr Cyclone:	1 1/2 inch diameter 5/8 inch vortex 1/2 inch apex

Pb 1st Regrind

Sala Mill; Krebs Cyclone	1 1/2 inch diameter 1/2 inch vortex 1/4 inch apex

Pb 2nd Regrind

Denver Mill; Krebs Cyclone	1 inch diameter 1/4 inch vortex 1/8 inch apex

Zn Regrind

Conical Mill; Goodwin Cyclone	1 inch diameter 1/2 inch vortex 1/4 inch apex

1.3. Flowsheet: As for test PP1.

Test No. PP15 - Continued

1.4. Results: The grinding circuit was stable during the test run. Net power consumption in the Hendy mill was 15.54 kilowatt-hours per ton of ½ inch feed. The cyclone overflow assayed 87.5 % minus 200 mesh.
Power in the Denver mill was not calculated.

1.4.1. Ball Mill Report

Feed: Minus ½ inch ore at 1.5 percent moisture content.

Feed Rate: 703 dry pounds per hour

Mill Speed: 32 r.p.m., 80.5 percent of critical speed

Mill Load:

3 inch balls	1000 pounds
2 inch balls	600 pounds
1 inch balls	400 pounds
Total	2000 pounds

Operating Time: Total 7.50 hours, test period 2.0 hours

Mill Feed: Total 5273 pounds, test period 1406 pounds

Circulating Load: Cyclone underflow 548 percent

Pulp Densities:

	gpl	% Solids
Mill Discharge	2158	70
Cyclone Overflow	1404	38
Cyclone Underflow	2433	77

Average Power:

Gross	7.36 kilowatts
No Load	1.92 kilowatts
Net	5.44 kilowatts

Net Power Consumption: 15.54 kilowatt-hours per ton of ½ inch feed

Work Index: 12.82

Test No. PP15 - Continued

1.4. Results: 1.4.2. Lead Regrinding Mill Report

Regrinding Mill: Sala Ball Mill

Feed: Lead Rougher Concentrate and Pb 2nd Cleaner Tailings

Feed Rate: 130 pounds per hour 18.29 percent of the mill feed

Mill Speed: 31 r.p.m., 73 percent of critical speed

Mill Load:

1 inch balls	720 pounds
Total	720 pounds

Operating Time: Total 7.5 hours, test period 2.0 hours

Pulp Densities:

	gpl	% Solids
Mill Discharge	2133	69.5
Cyclone Feed	1168	16.7
Cyclone Overflow	1113	31.3
Cyclone Underflow	2133	69.5

Average Power:

Gross	5.58 kilowatts
No Load	0.92 kilowatts
Net	4.66 kilowatts

Net Power Consumption: 13.31 kilowatt-hours per ton of feed

Test No. PP15 - Continued

1.4. Results:

1.4.3.Zinc Regrinding Mill Report

Regrinding Mill:	Conical Ball Mill	
Feed:	Zinc Scavenger Concentrate and Zn 1st Cl. Tailings	
Mill Speed:	32 r.p.m., 75 percent of critical speed	
Mill Load:	1 inch balls	100 pounds
	½ inch balls	220 pounds
	Total	320 pounds
Operating Time:	Total 7.5 hours, test period 2.0 hours	
Average Power:	Gross	2.97 kilowatts
	No Load	0.92 kilowatts
	Net	2.05 kilowatts
Net Power Consumption:	5.86 kilowatt-hours per ton of feed	

Test No. PP15 - Continued

1.4.4. Screen Analysis

Hendy Mill Feed

Mesh Size (Tyler)	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 3/8	2.4	2.4	97.6
3	11.1	13.5	86.5
4	10.6	24.1	75.9
6	11.3	35.4	64.6
8	9.4	44.8	55.2
10	8.4	53.2	46.8
14	7.0	60.2	39.8
20	5.3	65.5	34.5
28	4.2	69.7	30.3
35	3.5	73.2	26.8
48	3.6	76.8	23.2
65	3.4	80.2	19.8
100	2.8	83.0	17.0
150	2.8	85.8	14.2
200	2.9	88.7	11.3
- 200	11.3	100.0	-
Total	100.0	-	-

Hendy Mill Discharge

+ 10	0.1	0.1	99.9
14	0.1	0.2	99.8
20	0.2	0.4	99.6
28	0.4	0.8	99.2
35	0.7	1.5	98.5
48	1.8	3.3	96.7
65	3.2	6.5	93.5
100	5.5	12.0	88.0
150	9.8	21.8	78.2
200	17.3	39.1	60.9
270	13.5	52.6	47.4
400	17.4	70.0	30.0
- 400	30.0	100.0	-
Total	100.0	-	-

Test No. PP15 - Continued

1.4.4. Screen Analyses

Cyclone Underflow

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 10	0.1	0.1	99.9
14	0.2	0.3	99.7
20	0.3	0.6	99.4
28	0.5	1.1	98.9
35	0.8	1.9	98.1
48	1.9	3.8	96.2
65	3.7	7.5	92.5
100	6.1	13.6	86.4
150	11.0	24.6	75.4
200	19.2	43.8	56.2
270	14.2	58.0	42.0
400	18.2	76.2	23.8
- 400	23.8	100.0	-
Total	100.0	-	-

Cyclone Overflow

+ 65	0.5	0.5	99.5
100	1.2	1.7	98.3
150	3.0	4.7	95.3
200	7.8	12.5	87.5
270	8.5	21.0	79.0
400	14.8	35.8	64.2
- 400	64.2	100.0	-
Total	100.0	-	-

Test No. PP15 - Continued

1.4.4. Screen Analysis

Pb 1st Cleaner Concentrate

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 27.8 µm	1.4	1.4	98.6
21.5	1.5	2.9	97.1
15.0	6.4	9.3	90.7
10.3	17.0	26.3	73.7
8.0	16.1	42.4	57.6
- 8.0	57.6	100.0	-
Total	100.0	-	-

Specific Gravity 4.66

Pb 1st Regrind Cyclone Overflow

+ 28.2 µm	1.8	1.8	98.2
21.9	1.6	3.4	96.6
15.3	6.1	9.5	90.5
10.5	16.3	25.8	74.2
8.1	15.2	41.0	59.0
- 8.1	59.0	100.0	-
Total	100.0	-	-

Specific Gravity 4.58

Pb 2nd Regrind Cyclone Overflow

+ 21.5 µm	0.4	0.4	99.6
15.0	2.1	2.5	97.5
10.3	15.7	18.2	81.8
8.0	18.0	36.2	63.8
- 8.0	63.8	100.0	-
Total	100.0	-	-

Specific Gravity 4.67

Test No. PP15 - Continued

1.4.4. Screen Analyses

Pb 4th Cleaner Concentrate

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 18.7 µm	1.4	1.4	98.6
13.0	5.0	6.4	93.6
8.9	19.2	25.6	74.4
6.9	17.6	43.2	56.8
- 6.9	56.8	100.0	-
Total	100.0	-	-

Specific Gravity 5.85

Zn Regrind Cyclone Overflow

+ 200 Mesh	1.0	1.0	99.0
270	2.5	3.5	96.5
29.8 µm	10.1	13.6	86.4
23.1	7.3	20.9	79.1
16.2	13.2	34.1	65.9
11.1	12.0	46.1	53.9
8.6	7.2	53.3	46.7
- 8.6	46.7	100.0	-
Total	100.0	-	-

Specific Gravity 4.12

Zn Regrind Cyclone Underflow

+ 100 Mesh	0.8	0.8	99.2
150	2.2	3.0	97.0
200	9.2	12.2	87.8
270	13.4	25.6	74.4
29.2 µm	15.6	41.2	58.8
22.7	44.7	85.9	14.1
15.8	8.8	94.7	5.3
10.8	1.6	96.3	3.7
8.4	0.4	96.7	3.3
- 8.4	3.3	100.0	-
Total	100.0	-	-

Specific Gravity 4.34

Test No. PP15 - Continued

1.4.4. Screen Analyses

Zn Regrind Discharge

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 Mesh	8.2	8.2	91.8
270	12.0	20.2	79.8
29.2 µm	14.8	35.0	65.0
22.7	43.2	78.2	21.8
15.8	11.4	89.6	10.4
10.8	3.6	93.2	6.8
8.4	1.5	94.7	5.3
- 8.4	5.3	100.0	-
Total	100.0	-	-

Specific Gravity 4.32

Zn 4th Cleaner Concentrate

+ 200 Mesh	10.2	10.2	89.8
270	10.4	20.6	79.4
30.3 µm	15.8	36.4	63.6
23.5	8.8	45.2	54.8
16.4	11.4	56.6	43.4
11.3	10.0	66.6	33.4
8.7	6.4	73.0	27.0
- 8.7	27.0	100.0	-
Total	100.0	-	-

Specific Gravity 4.07

Pb 1st Regrind Discharge

+ 200 Mesh	0.8	0.8	99.2
270	2.2	3.0	97.0
26.9 µm	18.6	21.6	78.4
21.0	14.2	35.8	64.2
14.6	25.2	61.0	39.0
10.0	14.5	75.5	24.5
7.7	5.0	80.5	19.5
- 7.7	19.5	100.0	-
Total	100.0	-	-

Specific Gravity 4.92

Test No. PP15 - Continued

1.4.4. Screen Analyses

Zn Scavenger Tailing

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200	9.2	9.2	90.8
270	7.4	16.6	83.4
32.3 µm	11.2	27.8	72.2
25.1	9.7	37.5	62.5
17.5	13.6	51.1	48.9
12.0	11.3	62.4	37.6
9.2	6.6	69.0	31.0
- 9.2	31.0	100.0	-
Total	100.0	-	-

Specific Gravity 3.71

Pb 1st Regrind Cyclone Underflow

+ 200 Mesh	5.2	5.2	94.8
270	6.2	11.4	88.6
27.8 µm	10.7	22.1	77.9
21.5	29.1	51.2	48.8
15.0	23.2	74.4	25.6
10.3	12.4	86.8	13.2
8.0	4.1	90.9	9.1
- 8.0	9.1	100.0	-
Total	100.0	-	-

Specific Gravity 4.83

Pb Rougher Concentrate

+ 200 Mesh	6.4	6.4	93.6
270	7.0	13.4	86.6
27.8 µm	18.3	31.7	68.3
21.5	8.2	39.9	60.1
15.0	12.3	52.2	47.8
10.3	12.0	64.2	35.8
8.0	8.2	72.4	27.6
- 8.0	27.6	100.0	-
Total	100.0	-	-

Specific Gravity 4.74

Test No. PP15 - Continued

2. Flotation

2.1. Purpose: 1) To obtain steady conditions in the lead cleaning.
2) To improve zinc concentrate grade and recovery.

2.2. Method: The pulp densities in the lead regrinding and cleaning were adjusted. In the zinc circuit the zinc scavenger concentrate and zinc 1st cleaner tailing were reground in the conical ball mill and refloated in the zinc scavenger cleaner stage. The scavenger cleaner concentrate was recycled to the zinc rougher feed and tailing to the zinc scavenger feed.

2.2.1. Flotation Equipment

As for test PP11.

2.2.2. Flotation Reagents

See following page.

2.3. Flowsheets: See following pages.

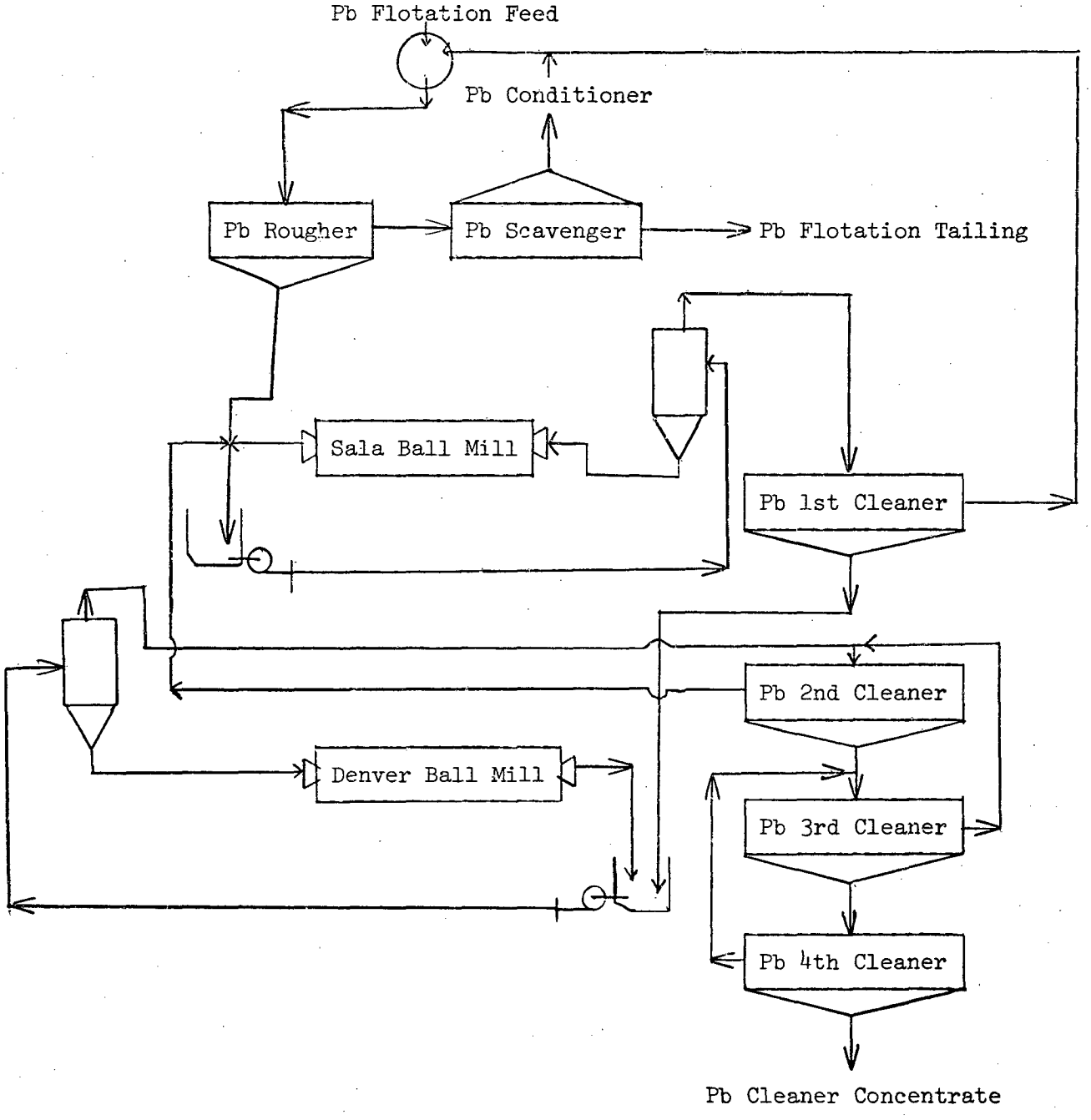
Test No. PP15 - Continued

2.2.2. Reagent Addition

Type	Pounds of Reagent per Short Ton	Point of Addition
Na_2CO_3	3.84	Ball Mill Feed
NaCN	0.22	Ball Mill Feed
$ZnSO_4$	1.00	Ball Mill Feed
R-241	0.03	Ball Mill Feed
Z-11	0.06	Cyclone Feed Pump
Z-11	0.03	Pb Ro. Conditioner
MIBC	0.053	Pb Ro. Feed Pump
MIBC	0.075	Pb Ro. 3rd Cell
NaCN	0.14	Pb Ro. Tailing
$ZnSO_4$	0.46	Pb Ro. Tailing
Z-11	0.03	Pb Scav. Feed
MIBC	0.023	Pb Scav. Feed
Na_2CO_3	0.46	Pb 1st Regrind Mill
$ZnSO_4$	0.54	Pb 1st Regrind Mill
NaCN	0.31	Pb 1st Regrind Mill
R-242	0.02	Pb Cyclone Feed Pump
MIBC	0.054	Pb 1st Cl. Feed Pump
Z-11	0.02	Pb 1st Cl. 4th Cell
NaCN	0.10	Pb 2nd Regrind Mill
NaCN	0.08	Pb 3rd Cl. Feed
NaCN	0.04	Pb 4th Cl. Feed
$Ca(OH)_2$	3.28	Zn Ro. Cond. Feed
$CuSO_4$	2.10	Zn Ro. Conditioner 1
M-748	0.074	Zn Ro. Conditioner 2
Z-6	0.18	Zn Ro. Feed Pump
DF-250	0.065	Zn Ro. Feed Pump
Z-6	0.03	Zn Scavenger Feed
Z-200	0.018	Zn Scavenger Feed
DF-250	0.030	Zn Scavenger Feed
$Ca(OH)_2$	1.00	Zn Regrind Mill
M-748	0.015	Zn Regrind Mill
$CuSO_4$	0.20	Zn Regrind Mill
Z-200	0.014	Zn 1st Cl. Feed
Z-6	0.01	Zn 1st Cl. Feed
DF-250	0.030	Zn 1st Cl. Feed
Z-6	0.02	Zn 1st Cl. Scavenger
$Ca(OH)_2$	0.36	Zn 2nd Cl. Feed
DF-250	0.005	Zn 2nd Cl. Feed
Z-6	0.02	Zn 2nd Cl. Feed
$Ca(OH)_2$	0.36	Zn 3rd Cl. Feed
$Ca(OH)_2$	0.24	Zn 4th Cl. Feed

Test No. PP15 - Continued

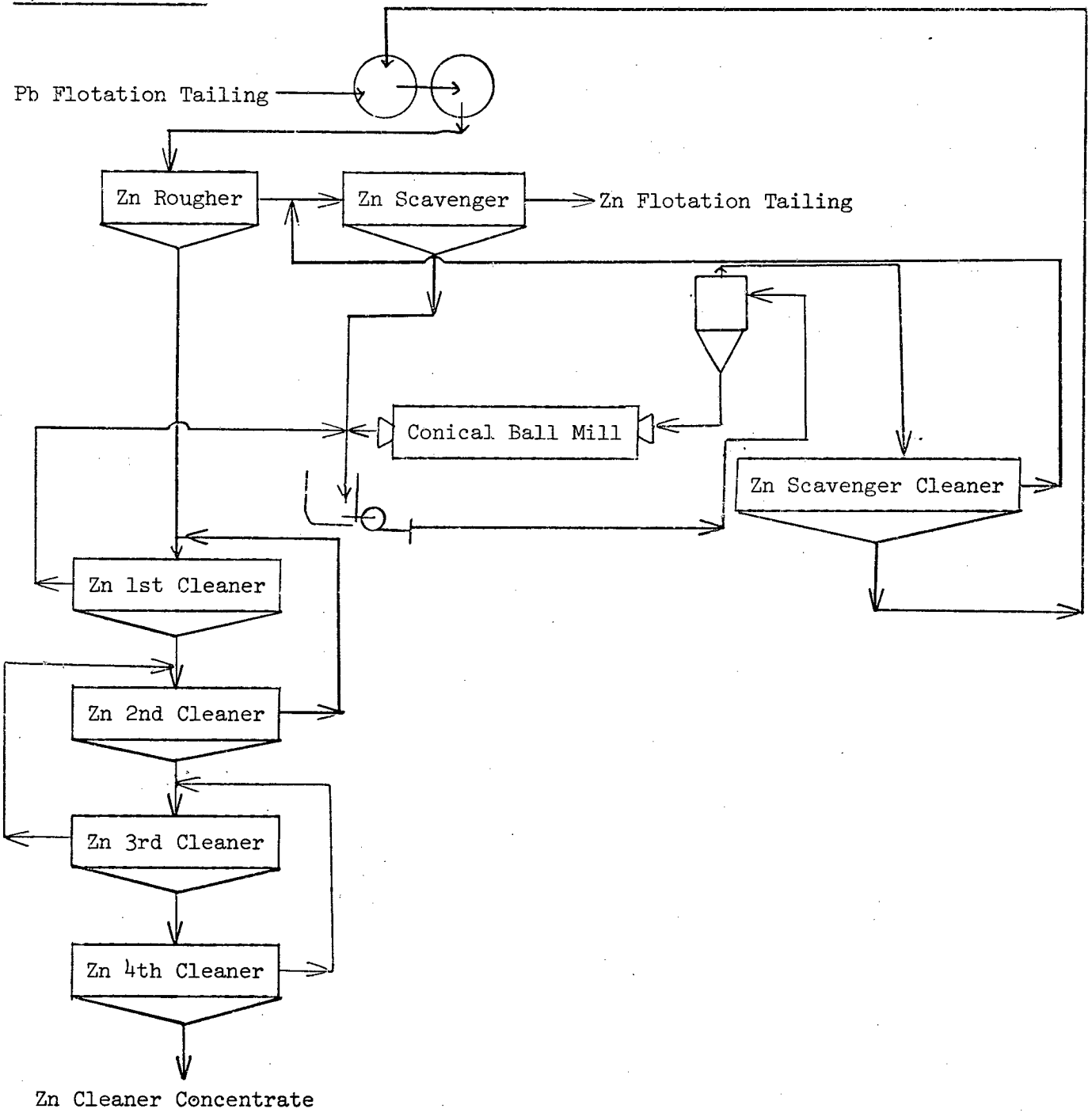
2.3. Flowsheet
a) Lead Circuit



Test No. PP15 - Continued

2.3. Flowsheet

b) Zinc Circuit



Test No. PP15 - Continued

2.4. Results: The lead flotation circuit was steady and high lead concentrate-grade was obtained at recovery of 74.8 % Pb. Although the zinc scavenger concentrate and zinc 1st cleaner tailing was reground the zinc concentrate grade was poor and problems with pyrite depression in the zinc cleaning continued.

2.4.1. pH

Product	pH
Cyclone Overflow	8.7
Pb Rougher Feed	8.8
Pb Scavenger Tailing	8.6
Pb Regrinding Mill Discharge	9.4
Pb 1st Cleaner Feed	9.0
Pb 2nd Cleaner Feed	9.0
Pb 3rd Cleaner Feed	9.5
Pb 4th Cleaner Feed	9.5
Zn Rougher Feed	10.1
Zn Scavenger Tailing	9.6
Zn Regrinding Mill Discharge	11.9
Zn 1st Cleaner Feed	10.4
Zn 2nd Cleaner Feed	10.7
Zn 3rd Cleaner Feed	10.9
Zn 4th Cleaner Feed	11.0

2.4.2. Pulp Densities

Product	Pulp Density gpl
Pb Rougher Feed	1173
Pb Scavenger Tailing	1177
Pb 1st Cleaner Feed	1113
Zn Rougher Feed	1120
Zn Scavenger Tailing	1068
Zn 1st Cleaner Feed	1058

2.4.3. Pulp Temperature

Product	°C
Pb Rougher Feed	24
Pb Regrinding Mill Discharge	25
Zn Rougher Feed	24
Zn Regrinding Mill Discharge	25

Test No. PP15 - Continued

2.4. Results:

2.4.4. Chemical Analyses

Product	Assays, %	
	Pb	Zn
Cyclone Overflow	6.07	10.2
Pb Rougher Feed	5.82	11.4
Pb Rougher Concentrate	23.2	14.9
Pb Rougher Tailing	2.21	10.3
Pb Scavenger Concentrate	5.77	14.9
Pb Scavenger Tailing	1.57	9.79
Pb 1st Cleaner Concentrate	28.8	16.30
Pb 1st Cleaner Tailing	5.37	16.20
Pb 1st Regrind Cyclone Overflow	20.4	16.80
Pb 1st Regrind Cyclone Underflow	18.9	14.5
Pb 1st Regrind Mill Discharge	19.6	13.7
Pb 2nd Regrind Cyclone Overflow	28.3	17.2
Pb Cleaner Concentrate	57.2	10.5
Zn Rougher Feed	1.76	10.3
Zn Rougher Concentrate	2.83	33.3
Zn Rougher Tailing	1.44	2.49
Zn Scavenger Concentrate	2.89	8.63
Zn Scavenger Tailing	1.51	1.83
Zn 1st Cleaner Tailing	4.15	6.64
Zn 1st Cleaner Concentrate	2.58	34.80
Zn Regrinding Cyclone Overflow	3.37	8.58
Zn Regrinding Cyclone Underflow	1.12	2.93
Zn 1st Cl. Scav. Concentrate	3.51	13.90
Zn 1st Cl. Scav. Tailing	2.94	3.50
Zn 2nd Cl. Tailing	3.74	10.30
Zn Cleaner Concentrate	2.24	42.30

Test No. PP15 - Continued

2.4. Results:

2.4.5. Metallurgical Results

Two Product Formula

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
Pb Rougher Concentrate	18.39	23.2	14.9	70.3	24.6
Pb Rougher Tailing	81.61	2.21	10.3	29.7	75.4
Cyclone Overflow (meas)	100.0	6.07	10.2	100.0	100.0
(Calc.)	100.0	6.07	11.1	-	-
Pb Scavenger Concentrate	12.44	5.77	14.9	11.8	16.6
Pb Scavenger Tailing	69.17	1.57	9.79	17.9	60.8
Pb Rougher Tail. (meas)	81.61	2.21	10.3	29.7	82.4
(Calc.)	-	2.21	10.6	29.7	77.4
Pb 1st Cl. Conc.	13.99	28.8	16.6	66.4	20.8
Pb 1st Cl. Tail.	4.40	5.37	16.2	3.89	6.40
Pb Ro. Concentrate (meas)	18.39	23.2	14.9	70.3	26.9
(Calc.)	-	23.2	16.5	70.3	27.2
Zn Rougher Concentrate	16.39	2.83	33.3	7.64	49.0
Zn Rougher Tailing	52.78	1.44	2.49	12.5	11.8
Pb Scav. Tailing (meas)	69.17	1.57	9.79	17.9	66.4
(Calc.)	—	1.77	9.79	20.1	60.8
Zn Scav. Concentrate	5.12	2.89	8.63	2.44	3.96
Zn Scav. Tailing	47.66	1.51	1.83	11.9	7.83
Zn Ro. Tailing (meas)	52.78	1.44	2.49	12.5	12.9
(Calc.)	—	1.64	2.49	14.3	11.8
Zn 1st Cl. Concentrate	15.52	2.55	34.8	6.52	48.5
Zn 1st Cl. Tailing	0.87	4.15	6.64	0.60	0.52
Zn Ro. Conc. (meas)	16.39	2.83	33.3	7.64	53.5
(Calc.)	-	2.63	33.3	7.12	49.0
Zn Scav. Cl. Conc.	2.23	3.51	13.9	1.29	2.78
Zn Scav. Cl. Tail.	3.76	2.94	3.50	1.82	1.18
Zn Scav. Cl. Feed (meas)	5.99	3.07	7.37	3.03	4.33
(Calc.)	-	3.15	7.37	3.11	3.97

Test No. PP15 - Continued

2.4. Results:

2.4.5. Metallurgical Results

Three-Product Formula

Product	Weight	Assays, %		% Distribution	
	%	Pb	Zn	Pb	Zn
Pb 4th Cl. Conc.	7.94	57.2	10.5	74.8	8.17
Zn 4th Cl. Conc.	18.98	2.24	42.3	7.00	78.7
Zn Scav. Tailing	73.08	1.51	1.83	18.2	13.1
Cyclone Overflow	100.00	6.07	10.2	100.0	100.0

Test No. PP16

1. Grinding

1.1. Purpose: To repeat the conditions of test 15.

1.2. Method: As for test PP1 - 15. The grinding circuit was operated for a period of 7.75 hours at a feed rate of 690 pounds per hour. Samples were taken every 30 minutes during the last two hours of operation.

1.2.1. Classification Equipment

Hendy Mill; P-50 Dorr Cyclone:

1 1/2 inch diameter
5/8 inch vortex
1/2 inch apex

Pb 1st Regrind

Sala Mill; Krebs Cyclone:

1 1/2 inch diameter
1/2 inch vortex
1/4 inch apex

Pb 2nd Regrind

Denver Mill; Krebs Cyclone:

1 inch diameter
1/4 inch vortex
1/8 inch apex

Zinc Regrind

Conical Mill; Goodwin Cyclone:

2 inch diameter
1/2 inch vortex
1/4 inch apex

1.3. Flowsheet: As for test PP1.

1.4. Results: The grinding circuit was stable during the test run. Net power consumption in the Hendy mill was 14.2 kilowatt-hours per ton of ½ inch feed. The cyclone overflow was 86.2 % minus 200 mesh. Power consumption in the Denver mill was not calculated.

Test No. PP16 - Continued

1.4. Results:

1.4.1. Ball Mill Report

Feed:	Minus ½ inch ore at 1.5 percent moisture content		
Feed Rate:	690 dry pounds per hour		
Mill Speed:	32 r.p.m., 80.5 percent of critical speed		
Mill Load:	3 inch balls	1000 pounds	
	1½ inch balls	600 pounds	
	1 inch balls	400 pounds	
	Total	2000 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Mill Feed:	Total 5348 pounds, test period 1380 pounds		
Circulating Load:	Cyclone underflow 552.0 percent		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2082	69
	Cyclone Overflow	1372	36
	Cyclone Underflow	2390	77
Average Power:	Gross	6.89 kilowatts	
	No Load	1.92 kilowatts	
	Net	4.97 kilowatts	
Net Power Consumption:	14.2 kilowatt-hours per ton of ½ inch feed.		
Work Index:	11.78		

Test No. PP16 - Continued

1.4. Results:

1.4.2. Lead Regrind Mill Report

Regrinding Mill:	Sala Ball Mill		
Feed:	Lead Rougher Concentrate and Pb 2nd Cleaner Tailings		
Feed Rate:	121.0 pounds per hour 19.8 percent of the mill feed		
Mill Speed:	31 r.p.m., 73 percent of critical speed		
Mill Load:	1 inch balls	720 pounds	
	Total	720 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2094	66
	Cyclone Feed	1193	20
	Cyclone Overflow	1093	11.5
	Cyclone Underflow	2094	66
Average Power:	Gross	4.99 kilowatts	
	No Load	0.92 kilowatts	
	Net	4.07 kilowatts	
Net Power Consumption:	11.63 kilowatt-hours per ton of feed		

Test No. PP16 - Continued

1.4. Results:

1.4.3. Zinc Regrind Mill Report

Regrind Mill:	Conical Ball Mill	
Feed:	Zinc Scavenger concentrate and zinc 1st cleaner tailings	
Mill Speed:	31 r.p.m., 73 percent of critical speed	
Mill Load:	1 inch balls	100 pounds
	½ inch balls	220 pounds
	Total	320 pounds
Operating Time:	Total 7.75 hours, test period 2.0 hours	
Average Power:	Gross	1.31 kilowatts
	No Load	0.92 kilowatts
	Net	0.39 kilowatts
Net Power Consumption:	1.11 kilowatt-hours per ton of feed.	

Test No. PP16 - Continued

1.4.4. Screen Analyses

Hendy Mill Feed

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 3/8	3.0	3.0	97.0
3	13.3	16.3	83.7
4	12.9	29.2	70.8
6	11.5	40.7	59.3
8	10.4	51.1	48.9
10	8.4	59.5	40.5
14	6.4	65.9	34.1
20	4.4	70.3	29.7
28	3.8	74.1	25.9
35	2.9	77.0	23.0
48	3.0	80.0	20.0
65	3.0	83.0	17.0
100	2.3	85.3	14.7
150	2.3	87.6	12.4
200	2.5	90.1	9.9
- 200	9.9	100.0	-
Total	100.0	-	-

Hendy Mill Discharge

+ 10	0.1	0.1	99.9
14	0.1	0.2	99.8
20	0.2	0.4	99.6
28	0.4	0.8	99.2
35	0.7	1.5	98.5
48	1.7	3.2	96.8
65	3.2	6.4	93.6
100	5.5	11.9	88.1
150	10.2	22.1	77.9
200	18.0	40.1	59.9
270	13.8	53.9	46.1
400	18.0	71.9	28.1
- 400	28.1	100.0	-
Total	100.0	-	-

Test No. PP16 - Continued

1.4.4. Screen Analyses

Cyclone Underflow

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 10	0.1	0.1	99.9
14	0.2	0.3	99.7
20	0.3	0.6	99.4
28	0.5	1.1	98.9
35	0.9	2.0	98.0
48	2.1	4.1	95.9
65	3.9	8.0	92.0
100	6.5	14.5	85.5
150	11.6	26.1	73.9
200	19.8	45.9	54.1
270	15.0	60.9	39.1
400	17.3	78.2	21.8
- 400	21.8	100.0	-
Total	100.0	-	-

Cyclone Overflow

+ 65	0.7	0.7	99.3
100	1.4	2.1	97.9
150	3.4	5.5	94.5
200	8.3	13.8	86.2
270	8.8	22.6	77.4
400	15.5	38.1	61.9
- 400	61.9	100.0	-
Total	100.0	-	-

Test No. PP16 - Continued

1.4.4. Screen Analyses

Pb Rougher Concentrate

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	7.7	7.7	92.3
270	7.3	15.0	85.0
27.8 µm	17.6	32.6	67.4
21.5	8.0	40.6	59.4
15.0	12.0	52.6	47.4
10.3	11.4	64.0	36.0
7.9	7.8	71.8	28.2
- 7.9	28.2	100.0	-
Total	100.0	-	-

Specific Gravity 4.70

Pb 1st Regrind Discharge

+ 200 mesh	0.8	0.8	99.2
270	2.5	3.3	96.7
27.4 µm	19.3	22.6	77.4
21.2	13.2	35.8	64.2
14.8	23.2	59.0	41.0
10.2	14.2	73.2	26.8
7.9	5.7	78.9	21.1
- 7.9	21.1	100.0	-
Total	100.0	-	-

Specific Gravity 4.75

Pb 1st Regrind Cyclone Underflow

+ 200 mesh	5.4	5.4	94.6
270	6.0	11.4	88.6
27.4 µm	11.8	23.2	76.8
21.2	30.3	53.5	46.5
14.8	22.2	75.7	24.3
10.2	11.8	87.5	12.5
7.9	3.9	91.4	8.6
- 7.9	8.6	100.0	-
Total	100.0	-	-

Specific Gravity 4.78

Test No. PP16 - Continued

1.4.4. Screen Analyses

Pb 1st Cleaner Concentrate

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 27.8 µm	1.8	1.8	98.2
21.5	2.1	3.9	96.1
15.0	7.5	11.4	88.6
10.3	16.5	27.9	72.1
7.9	15.3	43.2	56.8
- 7.9	56.8	100.0	-
Total	100.0	-	-

Specific Gravity 4.63

Pb 1st Regrind Cyclone Overflow

+ 28.6 µm	1.2	1.2	98.8
22.2	1.8	3.0	97.0
15.8	7.3	10.3	89.7
10.6	17.6	27.9	72.1
8.2	14.8	42.7	57.3
- 8.2	57.3	100.0	-
Total	100.0	-	-

Specific Gravity 4.47

Pb 2nd Regrind Cyclone Overflow

+ 21.5 µm	0.4	0.4	99.6
15.0	2.8	3.2	96.8
10.3	16.3	19.5	80.5
7.9	16.0	35.5	64.5
- 7.9	64.5	100.0	-
Total	100.0	-	-

Specific Gravity 4.65

Test No. PP16 - Continued

1.4.4. Screen Analyses

Pb 4th Cleaner Concentrate

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 19.1 µm	1.2	1.2	98.8
13.3	5.6	6.8	93.2
9.2	21.6	28.4	71.6
7.1	18.0	46.4	53.6
- 7.1	53.6	100.0	-
Total	100.0	-	-

Specific Gravity 5.58

Zn Regrind Cyclone Overflow

+ 200 mesh	1.1	1.1	98.9
270	1.8	2.9	97.1
30.7 µm	8.1	11.0	89.0
23.8	5.9	16.9	83.1
16.6	11.4	28.3	71.7
11.4	10.5	38.8	61.2
8.8	6.8	45.6	54.4
- 8.8	54.4	100.0	-
Total	100.0	-	-

Specific Gravity 4.04

Zn 4th Cleaner Concentrate

+ 200 mesh	4.7	4.7	95.3
270	6.0	10.6	89.4
30.7 µm	13.1	23.8	76.2
23.8	8.9	32.7	67.3
16.6	13.7	46.4	53.6
11.4	12.3	58.7	41.3
8.8	8.0	66.7	33.3
- 8.8	33.3	100.0	-
Total	100.0	-	-

Specific Gravity 4.06

Test No. PP16 - Continued

1.4.4. Screen Analyses

Zn Scavenger Tailing

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	12.2	12.2	87.8
270	8.7	20.9	79.1
33.2 µm	12.0	32.9	67.1
25.7	9.6	42.5	57.5
17.9	13.1	55.6	44.4
12.3	10.4	66.0	34.0
9.5	6.1	72.1	27.9
- 9.5	27.9	100.0	-
Total	100.0	-	-

Specific Gravity 3.61

Zn Regrind Discharge

+ 200 mesh	9.4	9.4	90.6
270	11.6	21.0	79.0
30.3 µm	13.4	34.4	65.6
23.5	44.6	79.0	21.0
16.4	10.6	89.6	10.4
11.3	3.0	92.6	7.4
8.7	1.2	93.8	6.2
- 8.7	6.2	100.0	-
Total	100.0	-	-

Specific Gravity 4.08

Zn Regrind Cyclone Underflow

+ 100 mesh	1.6	1.6	98.4
150	4.5	6.1	93.9
200	11.4	17.5	82.5
270	13.6	31.1	68.9
30.3 µm	12.2	43.3	56.7
23.5	44.0	87.3	12.7
16.4	7.2	94.5	5.5
11.3	1.2	95.7	4.3
8.7	0.4	96.1	3.9
- 8.7	3.9	100.0	-
Total	100.0	-	-

Specific Gravity 4.11

Test No. PP16 - Continued

2. Flotation

2.1. Purpose:

1) To improve lead recovery.
2) To improve zinc concentrate grade.

2.2. Method:

No changes were made to the flowsheet. The pH in the zinc cleaning was increased from pH 10.5 to 11.0. To obtain good froth conditions and control in the lead cleaning circuit, it was found necessary to increase the recirculating load in the lead 2nd, 3rd and 4th cleaners. The circuit was operated for 7.75 hours at a feed rate of 690 pounds per hour. Samples were taken every 20 minutes during the last two hours of operation.

2.2.1. Flotation Equipment

As for test PP11.

2.2.2. Flotation Reagents

See following page.

2.3. Flowsheet:

As for test PP15.

2.4. Results:

Lead grade and recovery was very similar to those of the previous test.

Zinc grade improved with the higher pH in the cleaning with no loss in recovery. The unselective froth condition dominated in the zinc cleaning.

Test No. PP16 - Continued

2.2.2. Reagent Additions

Type	Pounds of Reagent per Short Ton	Point of Addition
Na_2CO_3	3.56	Ball Mill Feed
NaCN	0.22	Ball Mill Feed
$ZnSO_4$	0.98	Ball Mill Feed
R-241	0.03	Ball Mill Feed
Z-11	0.05	Cyclone Feed Pump
Z-11	0.03	Pb Ro. Conditioner
MIBC	0.054	Pb Ro. Feed Pump
MIBC	0.076	Pb Ro. 3rd Cell
NaCN	0.14	Pb Rougher Tailings
$ZnSO_4$	0.44	Pb Rougher Tailings
Z-11	0.03	Pb Scavenger Feed
MIBC	0.023	Pb Scavenger Feed
Na_2CO_3	0.46	Pb 1st Regrind Mill
$ZnSO_4$	0.50	Pb 1st Regrind Mill
NaCN	0.32	Pb 1st Regrind Mill
R-242	0.02	Pb Cyclone Feed Pump
MIBC	0.038	Pb 1st Cl. Feed Pump
Z-11	0.02	Pb 1st Cl. 4th Cell
NaCN	0.10	Pb 2nd Regrind Mill
NaCN	0.10	Pb 3rd Cleaner Feed
NaCN	0.04	Pb 4th Cleaner Feed
$Ca(OH)_2$	2.60	Zn Rougher Cond. Feed
$CuSO_4$	2.10	Zn Ro. Conditioner No. 1
M-748	0.11	Zn Ro. Conditioner No. 2
Z-6	0.13	Zn Rougher Feed Pump
DF-250	0.076	Zn Rougher Feed Pump
Z-6	0.03	Zn Scavenger Feed
Z-200	0.016	Zn Scavenger Feed
DF-250	0.030	Zn Scavenger Feed
$Ca(OH)_2$	3.00	Zn Regrind Mill
M-748	0.015	Zn Regrind Mill
$CuSO_4$	0.20	Zn Regrind Mill
DF-250	0.029	Zn 1st Cleaner Feed
Z-200	0.031	Zn 1st Cleaner Feed
Z-6	0.02	Zn 1st Cl. Scavenger
$Ca(OH)_2$	0.38	Zn 2nd Cl. Feed
DF-250	0.006	Zn 2nd Cl. Feed
Z-6	0.07	Zn 2nd Cl. Feed
$Ca(OH)_2$	0.42	Zn 3rd Cl. Feed
$Ca(OH)_2$	0.18	Zn 4th Cl. Feed

Test No. PP16 - Continued

2.4. Results:

2.4.1. pH

Product	pH
Cyclone Overflow	8.9
Pb Rougher Feed	8.9
Pb Scavenger Tailing	8.8
Pb Regrinding Mill Discharge	9.4
Pb 1st Cleaner Feed	9.1
Pb 2nd Cleaner Feed	9.2
Pb 3rd Cleaner Feed	9.3
Pb 4th Cleaner Feed	9.4
Zn Rougher Feed	10.4
Zn Scavenger Tailing	10.8
Zn Scavenger Feed	11.5
Zn 1st Cleaner Feed	10.8
Zn 2nd Cleaner Feed	11.1
Zn 3rd Cleaner Feed	11.0
Zn 4th Cleaner Feed	11.0

2.4.2. Pulp Densities

Product	Pulp Density gpl
Pb Rougher Feed	1180
Pb Scavenger Tailing	1175
Pb 1st Cleaner Feed	1093
Zn Rougher Feed	1115
Zn Scavenger Tailing	1057
Zn 1st Cleaner Feed	1067

2.4.3. Pulp Temperature

Product	^{o}C
Pb Rougher Feed	25
Pb Regrinding Mill Discharge	26
Zn Rougher Feed	25
Zn Regrinding Mill Discharge	27

Test No. PP16 - Continued

2.4.4. Chemical Analyses

Product	Assays, %	
	Pb	Zn
Cyclone Overflow	5.89	10.2
Pb Rougher Feed	5.56	11.1
Pb Rougher Concentrate	21.2	15.0
Pb Rougher Tailing	2.11	10.3
Pb Scavenger Concentrate	5.43	14.4
Pb Scavenger Tailing	1.49	9.60
Pb 1st Cleaner Concentrate	25.4	17.4
Pb 1st Cleaner Tailing	5.10	16.1
Pb 1st Regrind Discharge	18.3	13.7
Pb 1st Regrind Cyclone Overflow	18.2	17.1
Pb 1st Regrind Cyclone Underflow	17.9	14.0
Pb 2nd Regrind Cyclone Overflow	25.4	17.4
Pb Cleaner Concentrate	56.2	12.1
Zn Rougher Feed	1.72	10.1
Zn Rougher Concentrate	2.50	40.2
Zn Rougher Tailing	1.48	2.96
Zn Scavenger Concentrate	3.46	13.0
Zn Scavenger Tailing	1.44	1.97
Zn 1st Cleaner Tailing	3.74	9.12
Zn 1st Cleaner Concentrate	2.45	37.9
Zn Regrinding Cyclone Overflow	3.71	10.6
Zn Regrinding Cyclone Underflow	1.28	5.32
Zn 1st Cl. Scavenger Concentrate	4.67	16.2
Zn 1st Cl. Scavenger Tailing	2.78	3.98
Zn 2nd Cl. Tailing	3.25	13.5
Zn Cleaner Concentrate	1.92	49.3

Test No. PP16 - Continued

2.4.5. Metallurgical Results

Two-Product Formula

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
Pb Ro. Concentrate	19.80	21.2	15.0	71.3	26.4
Pb Ro. Tailing	80.20	2.11	10.3	28.7	73.6
Cyclone Overflow (meas)	100.00	5.89	10.2	100.0	100.0
(Calc.)	-	5.89	11.2	-	-
Pb Scav. Concentrate	12.62	5.43	14.4	11.6	16.2
Pb Scav. Tailing	67.58	1.49	9.60	17.1	57.8
Pb Ro. Tailing (meas)	80.20	2.11	10.3	28.7	81.0
(Calc.)	-	2.11	10.4	28.7	74.0
Pb 1st Cl. Concentrate	15.70	25.4	17.4	67.6	24.3
Pb 1st Cl. Tailing	4.10	5.10	16.1	3.55	5.88
Pb Ro. Concentrate (meas)	19.80	21.2	15.0	71.3	29.1
(Calc.)	-	21.2	17.1	71.2	30.2
Zn Ro. Concentrate	12.50	2.50	40.2	5.31	44.7
Zn Ro. Tailing	55.08	1.48	2.96	13.8	14.5
Pb Scav. Tailing (meas)	67.58	1.49	9.60	17.1	63.6
(Calc.)	-	1.67	9.85	19.1	59.2
Zn Scav. Concentrate	4.94	3.46	13.0	2.90	5.72
Zn Scav. Tailing	50.14	1.44	1.97	12.3	8.80
Zn Ro. Tailing (meas)	55.08	1.48	2.96	13.8	16.0
(Calc.)	-	1.62	2.96	15.2	14.5

Three-Product Formula

Pb 4th Cl. Concentrate	7.99	56.2	12.1	76.2	9.5
Zn 4th Cl. Concentrate	15.68	1.92	49.3	5.1	75.8
Zn Scav. Tailings	76.33	1.44	1.97	18.7	14.7
Cyclone Overflow (meas)	100.00	5.89	10.2	100.0	100.0
(Calc.)	-	5.89	10.2	-	-

Test No. PP17

1. Grinding

1.1. Purpose: To increase the fineness of cyclone overflow product to 90 % minus 200 mesh.

1.2. Method: Similar to tests PP1 - 16, except that 50 lb 3" balls and 25 lb 1½" balls were added to the Hendy mill to make-up for ball consumption in previous tests. The grinding circuit was operated for a period of 7.75 hours at a feed rate of 690 pounds per hour. The samples were taken every 30 minutes during the last 2 hours of operation.

1.2.1. Classification Equipment

Hendy Mill; P-50 Dorr Cyclone:

1 1/2 inch diameter
5/8 inch vortex
1/2 inch apex

Pb 1st Regrind

Sala Mill; Krebs Cyclone:

1 inch diameter
1/4 inch vortex
1/8 inch apex

Zinc Regrind

Conical Mill; Goodwin Cyclone:

1 1/2 inch diameter
1/2 inch vortex
1/4 inch apex

1.3. Flowsheet: As for test PP1.

1.4. Results: The grinding circuit was stable during the test run. Net power consumption in the Hendy mill was 14.9 kilowatt-hours per ton of ½ inch feed. The cyclone overflow was 87.6 % minus 200 mesh.

Test No. PP17 - Continued

1.4. Results:

1.4.1. Ball Mill Report

Feed:	Minus ½ inch ore at 1.5 percent moisture content		
Feed Rate:	690 dry pounds per hour		
Mill Speed:	32 r.p.m., 80.5 percent of critical speed		
Mill Load:	3 inch balls	1000 pounds	
	1½ inch balls	600 pounds	
	1 inch balls	400 pounds	
	Total	2000 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Mill Feed:	Total 5348 pounds, test period 1380 pounds		
Circulating Load:	Cyclone underflow 562 percent		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2080	69
	Cyclone Overflow	1392	38
	Cyclone Underflow	2364	77
Average Power:	Gross	7.13 kilowatts	
	No Load	1.92 kilowatts	
	Net	5.21 kilowatts	
Net Power Consumption:	14.9 kilowatt-hours per ton of ½ inch feed.		
Work Index:	12.08		

Test No. PP17 - Continued

1.4. Results:

1.4.2. Lead Regrinding Mill Report

Regrinding Mill:	Sala Mill		
Feed:	Lead Rougher Concentrate and Pb 2nd Cleaner Tailing		
Feed Rate:	128.5 pounds per hour, 18.37 percent of the mill feed		
Mill Speed:	31 r.p.m., 73 percent of critical speed		
Mill Load:	2 inch balls	380 pounds	
	1 inch balls	820 pounds	
	Total	1200 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2420	77.5
	Cyclone Feed	1280	31.3
	Cyclone Overflow	1095	10.5
	Cyclone Underflow	2420	77.5
Average Power:	Gross	7.24 kilowatts	
	No Load	0.92 kilowatts	
	Net	6.32 kilowatts	
Net Power Consumption:	18.06 kilowatt-hours per ton of feed.		

Test No. PP17 - Continued

1.4. Results:

1.4.3. Zinc Regrinding Mill Report

Regrinding Mill:	Conical Mill	
Feed:	Zinc Scavenger Concnetrate and Zn 1st Cleaner Tailings	
Mill Speed:	32 r.p.m., 75 percent of critical speed	
Mill Load:	1 inch balls	320 pounds
	½ inch balls	220 pounds
	Total	540 pounds
Operating Time:	Total 7.75 hours, test period 2.0 hours	
Average Power:	Gross	1.54 kilowatts
	No Load	0.92 kilowatts
	Net	0.62 kilowatts
Net Power Consumption:	1.77 kilowatt-hours per ton of feed	

Test No. PP17 - Continued

1.4.4. Screen Analyses

Hendy Mill Feed

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 3/8	3.6	3.6	96.4
3	10.5	14.1	85.9
4	11.9	26.0	74.0
6	10.6	36.6	63.4
8	8.8	45.4	54.6
10	7.5	52.9	47.1
14	6.4	59.3	40.7
20	4.9	64.2	35.8
28	4.1	68.3	31.7
35	3.4	71.7	28.3
48	3.7	75.4	24.6
65	3.6	79.0	21.0
100	2.9	81.9	18.1
150	2.9	84.8	15.2
200	3.2	88.0	12.0
- 200	12.0	100.0	-
Total	100.0	-	-

Cyclone Underflow

+ 10	0.1	0.1	99.9
14	0.2	0.3	99.7
20	0.3	0.6	99.4
28	0.4	1.0	99.0
35	0.8	1.8	98.2
48	1.7	3.5	96.5
65	3.3	6.8	93.2
100	5.7	12.5	87.5
150	10.2	22.7	77.3
200	18.5	41.2	58.8
270	14.6	55.8	44.2
400	18.6	74.4	25.6
- 400	25.6	100.0	-
Total	100.0	-	-

Test No. PP17 - Continued

1.4.4. Screen Analyses

Hendy Mill Discharge

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 10	0.1	0.1	99.9
14	0.1	0.2	99.8
20	0.2	0.4	99.6
28	0.3	0.7	99.3
35	0.6	1.3	98.7
48	1.4	2.7	97.3
65	2.7	5.4	94.6
100	4.8	10.2	89.8
150	9.1	19.3	80.7
200	16.8	36.1	63.9
270	13.8	49.9	50.1
400	18.0	67.9	32.1
- 400	32.1	100.0	-
Total	100.0	-	-

Cyclone Overflow

+ 65	0.5	0.5	99.5
100	1.2	1.7	98.3
150	3.0	4.7	95.3
200	7.7	12.4	87.6
270	8.5	20.9	79.1
400	15.7	36.6	63.4
- 400	63.4	100.0	-
Total	100.0	-	-

Test No. PP17 - Continued

1.4.4. Screen Analyses

Pb Rougher Concentrate

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	7.3	7.3	92.7
270	7.8	15.1	84.9
27.8 µm	19.0	34.1	65.9
21.5	8.2	42.3	57.7
15.0	12.1	54.4	45.6
10.3	10.4	64.8	35.2
8.0	7.2	72.0	28.0
- 8.0	28.0	100.0	-
Total	100.0	-	-

Specific Gravity 4.68

Pb Regrind Discharge

+ 270 mesh	1.1	1.1	98.9
27.1 µm	10.4	11.5	88.5
21.0	9.0	20.5	79.5
14.6	21.5	42.0	58.0
10.1	22.4	64.4	35.6
7.8	10.5	74.9	25.1
- 7.8	25.1	100.0	-
Total	100.0	-	-

Specific Gravity 4.82

Pb Regrind Cyclone Underflow

+ 200 mesh	3.0	3.0	97.0
270	4.1	7.1	92.9
27.1 µm	16.4	23.5	76.5
21.0	10.8	34.3	65.7
14.6	21.8	56.1	43.9
10.1	21.8	77.9	22.1
7.8	10.7	88.6	11.4
- 7.8	11.4	100.0	-
Total	100.0	-	-

Specific Gravity 4.77

Test No. PP17 - Continued

1.4.4. Screen Analsyes

Pb Regrind Cyclone Overflow

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 15.7 µm	0.8	0.8	99.2
10.8	2.4	3.2	96.8
8.3	9.4	12.6	87.4
- 8.3	87.4	100.0	-
Total	100.0	-	-

Pb 4th Cleaner Concentrate

Specific Gravity 4.40

+ 24.2 µm	1.0	1.0	99.0
18.8	0.8	1.8	98.2
13.1	4.4	6.2	93.8
9.0	11.0	17.2	82.8
7.0	15.2	32.4	67.6
- 7.0	67.6	100.0	-
Total	100.0	-	-

Specific Gravity 5.67

Zn Regrind Cyclone Underflow

+ 150 mesh	1.6	1.6	98.4
200	4.0	5.6	94.4
270	7.3	12.9	87.1
28.3 µm	16.4	29.3	70.7
22.0	41.0	70.3	29.7
15.3	24.4	94.7	5.3
10.5	1.8	96.5	3.5
8.1	0.2	96.7	3.3
- 8.1	3.3	100.0	-
Total	100.0	-	-

Specific Gravity 4.47

Test No. PP17 - Continued

1.4.4. Screen Analyses

Zn Regrind Cyclone Overflow

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 29.6 µm	9.8	9.8	90.2
22.9	3.1	12.9	87.1
16.0	8.8	21.7	78.3
11.1	12.6	34.3	65.7
8.6	8.6	42.9	57.1
- 8.6	57.1	100.0	-
Total	100.0	-	-

Specific Gravity 4.13

Zn Regrind Discharge

+ 200 Mesh	3.4	3.4	96.6
270	5.3	8.7	91.3
29.0 µm	13.4	22.1	77.9
22.5	47.0	69.1	30.9
15.7	20.8	89.9	10.1
10.8	3.4	93.3	6.7
8.3	1.1	94.4	5.6
- 8.3	5.6	100.0	-
Total	100.0	-	-

Specific Gravity 4.38

Test No. PP17 - Continued

1.4.4. Screen Analyses

Zn 4th Cleaner Concentrate

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	9.6	9.6	90.4
270	8.2	17.8	82.2
29.9 µm	14.8	32.6	67.4
23.2	8.0	40.6	59.4
16.2	11.2	51.8	48.2
11.1	9.5	61.3	38.6
8.6	6.6	67.9	36.1
- 8.6	32.1	100.0	-
Total	100.0	-	-

Specific Gravity 4.07

Zn Scavenger Tailing

+ 200 mesh	9.0	9.0	91.0
270	6.9	15.9	84.1
33.2 µm	11.0	26.9	73.1
25.7	9.0	35.9	64.1
17.9	12.9	48.8	51.2
12.3	11.0	59.8	40.2
9.5	6.8	66.6	33.4
- 9.5	33.4	100.0	-
Total	100.0	-	-

Specific Gravity 3.62

Test No. PP17 - Continued

2. Flotation

2.1. Purpose:

1) To repeat lead circuit conditions of test PP9.
2) To repeat zinc circuit conditions of test PP16.

2.2. Method:

In the lead circuit the 2nd regrind stage of lead concentrate was omitted, and the fineness of regrind was increased in the 1st regrind stage by the addition of 480 pounds of steel balls. In the zinc regrind circuit the 2 inch Goodwin cyclone was replaced by a 1½ inch cyclone. The circuit was operated for a period of 7.75 hours at a feed rate 695 pounds per hour. The samples were taken every 20 minutes durang the last 1.2 hours of operation.

2.2.1. Flotation Equipment

As for test PP11.

2.2.2. Flotation Reagents

See following page.

2.3. Flowsheet:

a) Lead circuit; as for test PP9
b) Zinc Circuit; as for test PP15

2.4. Results:

After the above changes, conditions in the lead circuit improved slightly. No improvement in the zinc grade was achieved in this test.

Test No. PP17 - Continued

2.2.2. Reagent Additions

Type	Pounds of Reagent per Short Ton	Point of Addition
Na_2CO_3	3.84	Ball Mill Feed
NaCn	0.22	Ball Mill Feed
$ZnSO_4$	0.95	Ball Mill Feed
R-241	0.03	Ball Mill Feed
Z-11	0.05	Cyclone Feed Pump
Z-11	0.03	Pb Ro. Conditioner
MIBC	0.053	Pb Ro. Feed Pump
MIBC	0.075	Pb Ro. 3rd Cell
NaCN	0.15	Pb Rougher Tailing
$ZnSO_4$	0.48	Pb Rougher Tailing
Z-11	0.03	Pb Scavenger Feed
MIBC	0.023	Pb Scavenger Feed
Na_2CO_3	0.30	Pb Regrind Mill
$ZnSO_4$	0.56	Pb Regrind Mill
NaCN	0.31	Pb Regrind Mill
R-242	0.02	Pb Cyclone Feed Pump
MIBC	0.041	Pb 1st Cl. Feed Pump
Z-11	0.02	Pb 1st Cl. 4th Cell
NaCN	0.11	Pb 2nd Cleaner Feed
NaCN	0.05	Pb 3rd Cleaner Feed
$Ca(OH)_2$	3.08	Zn Ro. Conditioner Feed
$CuSO_4$	2.10	Zn Ro. Conditioner No. 1
M-748	0.12	Zn Ro. Conditioner No. 2
Z-6	0.13	Zn Ro. Feed Pump
DF-250	0.075	Zn Ro. Feed Pump
Z-6	0.03	Zn Scavenger Feed
Z-200	0.018	Zn Scavenger Feed
DF-250	0.030	Zn Scavenger Feed
$Ca(OH)_2$	0.46	Zn Regrind Mill
M-748	0.013	Zn Regrind Mill
$CuSO_4$	0.20	Zn Regrind Mill
DF-250	0.030	Zn 1st Cl. Feed
Z-200	0.030	Zn 1st Cl. Feed
DF-250	0.006	Zn 2nd Cl. Feed
$Ca(OH)_2$	0.20	Zn 2nd Cl. Feed
Z-200	0.033	Zn 2nd Cl. Feed
$Ca(OH)_2$	0.40	Zn 3rd Cl. Feed
$Ca(OH)_2$	0.10	Zn 4th Cl. Feed

Test No. PP17 - Continued

2.4. Results:

2.4.1. pH

Product	pH
Cyclone Overflow	8.8
Pb Rougher Feed	8.7
Pb Scavenger Tailing	8.5
Pb Regrinding Mill Discharge	8.8
Pb 1st Cleaner Feed	9.1
Pb 2nd Cleaner Feed	9.4
Pb 3rd Cleaner Feed	9.5
Pb 4th Cleaner Feed	9.3
Zn Rougher Feed	10.1
Zn Scavenger Tailing	9.5
Zn Regrinding Mill Feed	10.6
Zn 1st Cleaner Feed	10.8
Zn 2nd Cleaner Feed	10.8
Zn 3rd Cleaner Feed	11.0
Zn 4th Cleaner Feed	10.8

2.4.2. Pulp Densities

Product	Pulp Density gpl
Pb Rougher Feed	1205
Pb Scavenger Tailing	1238
Pb 1st Cleaner Feed	1095
Zn Rougher Feed	1220
Zn Scavenger Tailing	1102
Zn 1st Cleaner Feed	1060

2.4.3. Pulp Temperature

Product	°C
Pb Rougher Feed	27
Pb Regrinding Mill Discharge	30
Zn Rougher Feed	27
Zn Regrinding Mill Discharge	32

Test No. PP17 - Continued

2.4.4. Chemical Analyses

Product	Assays, %	
	Pb	Zn
Cyclone Overflow	6.04	10.1
Pb Rougher Feed	5.52	11.5
Pb Rougher Concentrate	22.7	14.6
Pb Rougher Tailing	2.29	10.9
Pb Scavenger Concentrate	4.56	13.6
Pb Scavenger Tailing	1.65	9.85
Pb 1st Cleaner Concentrate	26.4	16.4
Pb 1st Cleaner Tailing	5.42	16.2
Pb Regrind Discharge	20.3	14.6
Pb Regrind Cyclone Overflow	19.3	16.6
Pb Regrind Cyclone Underflow	20.2	14.7
Pb Cleaner Concentrate	59.2	9.79
Zn Rougher Feed	1.76	10.3
Zn Rougher Concentrate	2.66	35.9
Zn Rougher Tailing	1.38	2.16
Zn Scavenger Concentrate	3.11	7.93
Zn Scavenger Tailing	1.41	1.52
Zn 1st Cleaner Tailing	5.12	2.93
Zn 1st Cleaner Concentrate	2.68	37.1
Zn Regrinding Cyclone Overflow	3.83	7.88
Zn Regrinding Cyclone Underflow	0.89	2.47
Zn Regrind Discharge	0.86	2.44
Zn 1st Cl. Scavenger Concentrate	5.18	17.6
Zn 1st Cl. Scavenger Tailing	3.08	2.93
Zn 2nd Cleaner Tailing	4.47	11.3
Zn Cleaner Concentrate	2.13	43.3

Test No. PP17 - Continued

2.4.5 Metallurgical Results

Two-Product Formula

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
Pb Ro. Concentrate	18.37	22.7	14.6	69.0	23.2
Pb Ro. Tailing	81.63	2.29	10.9	31.0	76.8
Cyclone Overflow (meas)	100.00	6.04	10.1	100.0	100.0
(Calc.)	-	6.04	11.6	-	-
Pb Scav. Concentrate	17.95	4.56	13.6	13.6	21.1
Pb Scav. Tailing	63.68	1.65	9.85	17.4	54.2
Pb Ro. Tailing (meas)	81.63	2.29	10.9	30.9	88.1
(Calc.)	-	2.29	10.7	31.0	75.3
Pb 1st Cl. Conc.	15.13	26.4	16.4	66.1	21.4
Pb 1st Cl. Tail.	3.24	5.42	16.2	2.91	4.53
Pb Ro. Conc. (meas)	18.37	22.7	14.6	69.0	26.6
(Calc.)	-	22.7	16.4	69.0	25.9
Zn Ro. Concentrate	14.51	2.66	35.9	6.4	45.0
Zn Ro. Tailing	49.17	1.38	2.16	11.2	9.2
Pb Scav. Tailing (meas)	63.68	1.65	9.65	17.4	62.1
(Calc.)	-	1.67	9.85	17.6	54.2
Zn Scav. Concentrate	4.91	3.11	7.93	2.5	3.4
Zn Scav. Tailing	44.26	1.41	1.52	10.3	5.8
Zn Ro. Tailing (meas)	49.17	1.38	2.16	11.2	10.5
(Calc.)	-	1.58	2.16	12.8	9.2
Zn 1st Cl. Conc.	14.00	2.68	37.1	6.2	44.9
Zn 1st Cl. Tail.	0.51	5.12	2.93	0.4	0.1
Zn Ro. Conc. (meas)	14.51	2.66	35.9	6.4	51.6
(Calc.)	-	2.77	35.9	6.6	45.0
Zn 1st Cl. Scav. Conc.	0.16	5.18	17.6	0.1	0.2
Zn 1st Cl. Scav. Tail.	0.35	3.08	2.93	0.2	0.1
Zn 1st Cl. Tail. (meas)	0.51	3.30	7.46	0.3	0.4
(Calc.)	-	3.62	7.53	0.3	0.3

Test No. PP17 - Continued

2.4.5. Metallurgical Results

Three-Product Formula

Product	Weight	Assays, %		% Distribution	
	%	Pb	Zn	Pb	Zn
Pb 4th Cl. Concentrate	7.78	59.2	9.79	76.2	7.6
Zn 4th Cl. Concentrate	19.00	2.13	43.3	6.70	81.4
Zn Scav. Tailing	73.22	1.41	1.52	17.1	11.0
Cyclone Overflow (meas)	100.00	6.04	10.1	100.0	100.0
(Calc.)	-	6.04	10.1	-	-

2.4.6. Water Analyses

Product	Assays S_2O_3 PPM	pH
Hendy Cyclone Overflow	124	8.30
Pb Scav. Tailing	116	10.50
Zn Scav. Tailing	86	8.85
Tailing Pond H_2O	59	8.53

Test No. PP18

1. Grinding

1.1. Purpose: To increase the fineness of primary grind to 90 % minus 200 mesh.

1.2. Method: The ball charge of the Hendy mill was increased by 60 pounds (i.e. 40 lb 3 inch balls and 20 lb 1½ inch balls). The grinding circuit was operated for a period of 7.75 hours at a feed rate of 701 pounds per hour. The samples were taken every 30 minutes during the last 2 hours of operation.

1.2.1. Classification Equipment

Hendy Mill; P-50 Dorr Cyclone:

1 1/2 inch diameter
3/8 inch vortex
1/2 inch apex

Pb Regrind

Sala Mill; Krebs Cyclone:

1 inch diameter
1/4 inch vortex
1/8 inch apex

Zn Regrind

Conical Mill; Goodwin Cyclone:

1 1/2 inch diameter
1/2 inch vortex
3/16 inch apex

1.3. Flowsheet: As for test PP1.

1.4. Results: The grinding circuit was quite stable during the test run. Net power consumption in the Hendy mill was 18.06 kilowatt-hours per ton of ½ inch feed. The cyclone overflow was 87.2 % minus 200 mesh.

Test No. PP18 - Continued

1.4. Results:

1.4.1. Ball Mill Report

Feed:	Minus ½ inch ore at 0.5 percent moisture content		
Feed Rate:	701 dry pounds per hour		
Mill Speed:	32 r.p.m., 80.5 percent of critical speed		
Mill Load:	3 inch balls	1000 pounds	
	1½ inch balls	600 pounds	
	1 inch balls	400 pounds	
	Total	2000 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Mill Feed:	Total 5438 pounds, test period 1402 pounds		
Circulating Load:	Cyclone underflow 538 percent		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2088	69
	Cyclone Overflow	1392	37.5
	Cyclone Underflow	2344	76
Average Power:	Gross	7.13 kilowatts	
	No Load	1.92 kilowatts	
	Net	5.21 kilowatts	
Net Power Consumption:	14.9 kilowatt-hours per ton of ½ inch feed.		
Work Index:	11.54		

Test No. PP18 - Continued

1.4. Results:

1.4.2. Lead Regrinding Mill Report

Regrinding Mill:	Sala Mill		
Feed:	Lead Rougher Concentrate		
Feed Rate:	157 pounds per hour, 22.39 percent of the mill feed		
Mill Speed:	31 r.p.m., 73 percent of critical speed		
Mill Load:	2 inch balls	380 pounds	
	1 inch balls	820 pounds	
	Total	1200 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2372	73
	Cyclone Feed	1187	20.0
	Cyclone Overflow	1142	15.5
	Cyclone Underflow	2373	73
Average Power:	Gross	7.24 kilowatts	
	No Load	0.92 kilowatts	
	Net	6.32 kilowatts	
Net Power Consumption:	18.06 kilowatt-hours per ton of feed.		

Test No. PP18 - Continued

1.4. Results:

1.4.3. Zinc Regrinding Mill Report

Regrinding Mill:	Conical Mill		
Feed:	Zinc Rougher Concentrate and Zn 2nd cleaner tailing		
Feed Rate:	131 pounds per hour, 18.64 percent of the mill feed		
Mill Speed:	32 r.p.m., 75 percent of critical speed		
Mill Load:	1 inch balls	320 pounds	
	½ inch balls	220 pounds	
	Total	540 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2182	71.8
	Cyclone Overflow	1122	14.0
	Cyclone Underflow	2182	71.8
Average Power:	Gross	1.54 kilowatts	
	No Load	0.92 kilowatts	
	Net	0.62 kilowatts	
Net Power Consumption:	1.77 kilowatt-hours per ton of feed.		

Test No. PP18 - Continued

1.4.4. Screen Analyses

Hendy Mill Feed

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 3/8	4.8	4.8	95.2
3	11.8	16.6	83.4
4	16.3	32.9	67.1
6	11.8	44.7	55.3
8	8.8	53.5	46.5
10	6.9	60.4	39.6
14	5.9	66.3	33.7
20	4.3	70.6	29.4
28	3.4	74.0	26.0
35	2.8	76.8	23.2
48	3.0	79.8	20.2
65	2.8	82.6	17.4
100	2.3	84.9	15.1
150	2.3	87.2	12.8
200	2.6	89.8	10.2
- 200	10.2	100.0	-
Total	100.0	-	-

Hendy Mill Discharge

+ 10	0.2	0.2	99.8
14	0.2	0.4	99.6
20	0.2	0.6	99.4
28	0.4	1.0	99.0
35	0.6	1.6	98.4
48	1.7	3.3	96.7
65	3.2	6.5	93.5
100	5.6	12.1	87.9
150	10.0	22.1	77.9
200	17.5	39.6	60.4
270	13.7	53.3	46.7
400	17.7	71.0	29.0
- 400	29.0	100.0	-
Total	100.0	-	-

Test No. PP18 - Continued

1.4.4. Screen Analyses

Cyclone Underflow

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 10	0.2	0.2	99.8
14	0.2	0.4	99.6
20	0.3	0.7	99.3
28	0.5	1.2	98.8
35	0.8	2.0	98.0
48	2.1	4.1	95.9
65	3.8	7.9	92.1
100	6.4	14.3	85.7
150	11.4	25.7	74.3
200	19.6	45.3	54.7
270	14.6	59.9	40.1
400	17.8	77.7	22.3
- 400	22.3	100.0	-
Total	100.0	-	-

Cyclone Overflow

+ 65	0.6	0.6	99.4
100	1.2	1.8	98.2
150	3.2	5.0	95.0
200	7.8	12.8	87.2
270	8.3	21.1	78.9
400	15.3	36.4	63.6
- 400	63.6	100.0	-
Total	100.0	-	-

Test No. PP18 - Continued

1.4.4. Screen Analyses

Pb Rougher Concentrate

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	6.1	6.1	93.9
270	6.2	12.3	87.7
28.7 µm	15.4	27.7	72.3
22.3	7.1	34.8	65.2
15.5	11.6	46.4	53.6
10.7	13.3	59.7	40.3
8.3	9.0	68.7	31.3
- 8.3	31.3	100.0	-
Total	100.0	-	-

Specific Gravity 4.48

Pb Regrind Cyclone Underflow

+ 200 mesh	5.6	5.6	94.4
270	7.0	12.6	87.4
27.0 µm	22.0	34.6	65.4
20.9	15.0	49.6	50.4
14.6	26.9	76.5	23.5
10.0	12.9	89.4	10.6
7.7	2.9	92.3	7.7
- 7.7	7.7	100.0	-
Total	100.0	-	-

Specific Gravity 4.86

Pb Regrind Discharge

+ 200 mesh	0.4	0.4	99.6
270	1.2	1.6	98.4
27.0 µm	13.4	15.0	85.0
20.9	12.1	27.1	72.9
14.6	25.8	52.9	47.1
10.0	15.4	68.3	31.7
7.7	6.2	74.5	25.5
- 7.7	25.5	100.0	-
Total	100.0	-	-

Specific Gravity 4.86

Test No. PP18 - Continued

1.4.4. Screen Analyses

Pb Regrind Cyclone Overflow

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 28.2 µm	0.5	0.5	99.5
21.9	0.6	1.1	98.9
15.3	5.0	6.1	93.9
10.5	19.2	25.3	74.7
8.1	15.0	40.3	59.7
- 8.1	59.7	100.0	-
Total	100.0	-	-

Specific Gravity 4.58

Pb 4th Cleaner Concentrate

+ 24.1 µm	1.7	1.7	98.3
18.7	1.3	3.0	97.0
13.0	8.8	11.8	88.2
8.9	4.2	16.0	84.0
6.9	16.3	32.3	67.7
- 6.9	67.7	100.0	-
Total	100.0	-	-

Specific Gravity 5.88

Zn Regrind Discharge

+ 200 mesh	8.2	8.2	91.8
270	12.8	21.0	79.0
29.4 µm	13.8	34.8	65.2
22.9	44.5	79.3	20.7
15.9	11.6	90.9	9.1
10.9	2.0	92.9	7.1
8.5	1.0	93.9	6.1
- 8.5	6.1	100.0	-
Total	100.0	-	-

Specific Gravity 4.33

Test No. PP18 - Continued

1.4.4. Screen Analyses

Zn Regrind Cyclone Underflow

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 100 mesh	0.8	0.8	99.2
150	2.2	3.0	97.0
200	8.8	11.8	88.2
270	14.8	26.6	73.4
29.4 µm	13.2	39.8	60.2
22.8	46.2	86.0	14.0
15.9	8.9	94.9	5.1
10.9	0.6	95.5	4.5
8.5	0.3	95.8	4.2
- 8.5	4.2	100.0	-
Total	100.0	-	-

Specific Gravity 4.35

Zn Regrind Cyclone Overflow

+ 30.3 µm	6.2	6.2	93.8
23.5	10.0	16.2	83.8
16.4	16.2	32.4	67.6
11.3	13.2	45.6	54.4
8.7	8.0	53.6	46.4
- 8.7	46.4	100.0	-
Total	100.0	-	-

Specific Graivyt 4.08

Zn 4th Cleaner Concentrate

+ 30.3 µm	6.0	6.0	94.0
23.5	10.1	16.1	83.9
16.4	17.8	33.9	66.1
11.3	15.0	48.9	51.1
8.7	9.2	58.1	41.9
- 8.7	41.9	100.0	-
Total	100.0	-	-

Specific Gravity 4.10

Test No. PP18 - Continued

1.4.4. Screen Analyses

Zn Combined Tailing

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	10.6	10.6	89.4
270	8.0	18.6	81.4
33.2 µm	11.4	30.0	70.0
25.7	10.0	40.0	60.0
17.9	13.2	53.2	46.8
12.3	10.8	64.0	36.0
9.5	6.3	70.3	29.7
- 9.5	29.7	100.0	-
Total	100.0	-	-

Specific Gravity 3.62

Test No. PP18 - Continued

2. Flotation

2.1. Purpose:

1) To improve lead recovery.
2) To improve zinc grade.

2.2. Method:

The following reagent and circuit changes were made:

Pb Circuit

1) Omitted NaCN and $ZnSO_4$ additions to Pb scavenger feed.
2) The NaCN addition to the lead 2nd cleaner was reduced to 0.06 lb/ton.
3) Returned Pb 2nd cleaner tailing to the lead 1st cleaner conditioner instead of to the Pb cyclone feed pump.

Zn Circuit

1) The Z-6 additions to the Zn rougher feed were increased to 0.19 lb/ton. Collector Z-200 was added to the zinc rougher feed.
2) $CuSO_4$ addition to the Zn conditioner was reduced from 2.0 lb/ton to 1.5 lb/ton.
3) The zinc rougher concentrate was reground in the Conical mill, and the Zn 1st cleaner tailing was scavenged in open circuit.

2.2.1. Flotation Equipment

As for test PP11.

2.2.2. Flotation Reagents

See following page.

2.4. Results:

Changes in the lead cleaning circuit did not produce any improvement in the lead recovery. In the zinc circuit, after the zinc rougher concentrate was reground, improvement in the zinc grade was achieved.

Test No. PP18 - Continued

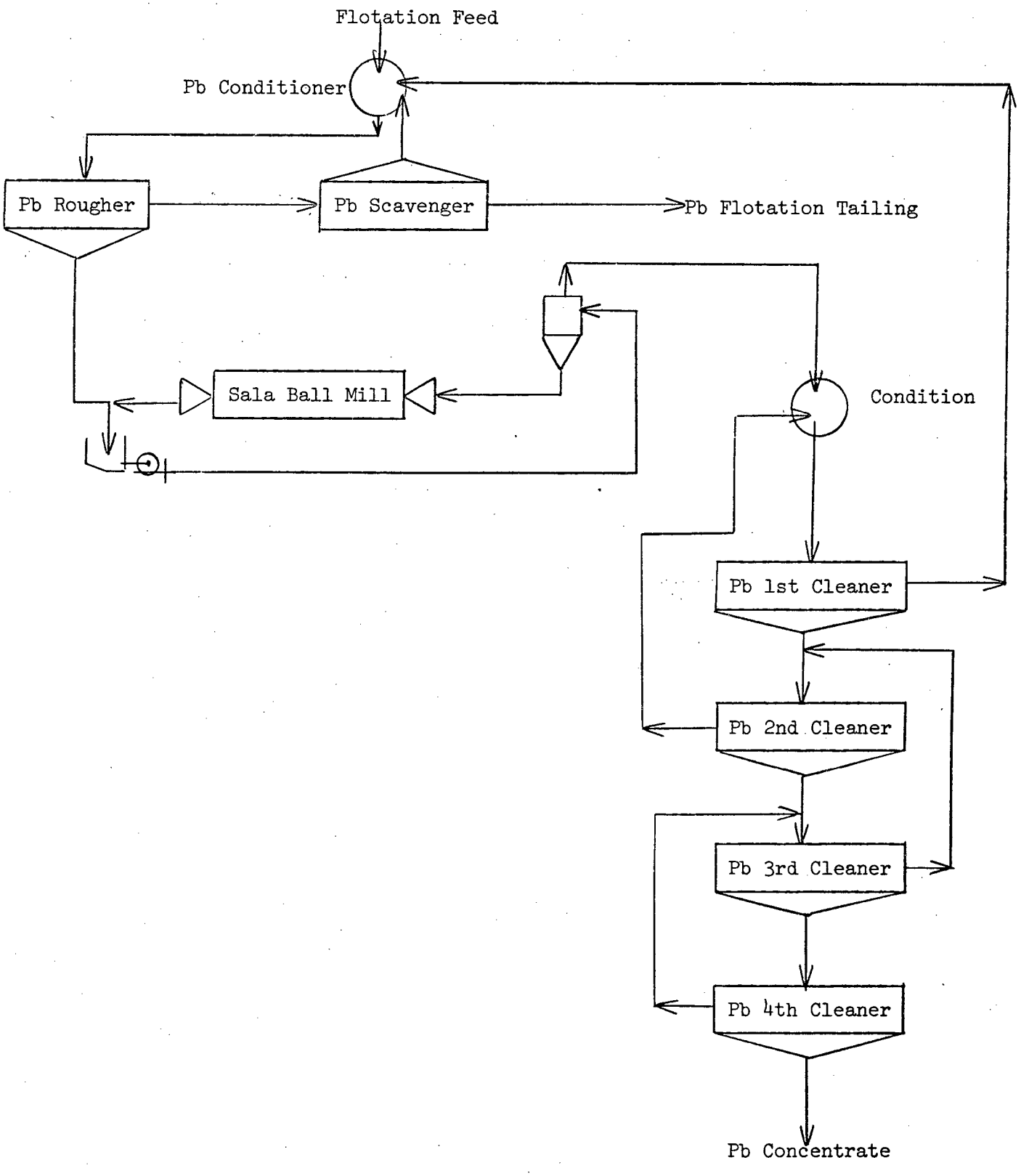
2.2.2. Reagent Additions

Type	Pounds of Reagent per Ton of Feed	Point of Addition
Na_2CO_3	4.00	Ball Mill Feed
NaCN	0.22	Ball Mill Feed
$ZnSO_4$	0.95	Ball Mill Feed
R-241	0.03	Ball Mill Feed
Z-11	0.05	Cyclone Feed Pump
Z-11	0.03	Pb Ro. Conditioner
MIBC	0.053	Pb Ro. Feed Pump
MIBC	0.075	Pb Ro. 3rd Cell
Z-11	0.03	Pb Scavenger Feed
MIBC	0.023	Pb Scavenger Feed
Na_2CO_3	0.46	Pb Regrind Mill
$ZnSO_4$	0.52	Pb Regrind Mill
NaCN	0.31	Pb Regrind Mill
R-242	0.02	Pb Cylone Feed Pump
MIBC	0.030	Pb 1st Cleaner Feed Pump
Z-11	0.02	Pb 1st Cl. 4th Cell
NaCN	0.07	Pb 2nd Cleaner Feed
NaCN	0.05	Pb 3rd Cleaner Feed
$Ca(OH)_2$	3.22	Zn Ro. Conditioner Feed
$CuSO_4$	1.50	Zn Ro. Conditioner No. 1
M-748	0.11	Zn Ro. Conditioner No. 2
Z-6	0.19	Zn Rougher Feed Pump
DF-250	0.073	Zn Rougher Feed Pump
Z-6	0.03	Zn Scavenger Feed
Z-200	0.019	Zn Scavenger Feed
DF-250	0.032	Zn Scavenger Feed
$Ca(OH)_2$	0.90	Zn Regrind Mill
Z-200	0.040	Zn Regrind Mill
$CuSO_4$	0.20	Zn Regrind Mill
DF-250	0.030	Zn 1st Cleaner Feed
Z-6	0.02	Zn 1st Cl. Scavenger
$Ca(OH)_2$	0.30	Zn 2nd Cl. Feed
Z-200	0.033	Zn 2nd Cl. Feed
DF-250	0.006	Zn 2nd Cl. Feed
$Ca(OH)_2$	0.10	Zn 3rd Cl. Feed
$Ca(OH)_2$	0.14	Zn 4th Cl. Feed

Test No. PP18 - Continued

2.3. Flowsheet

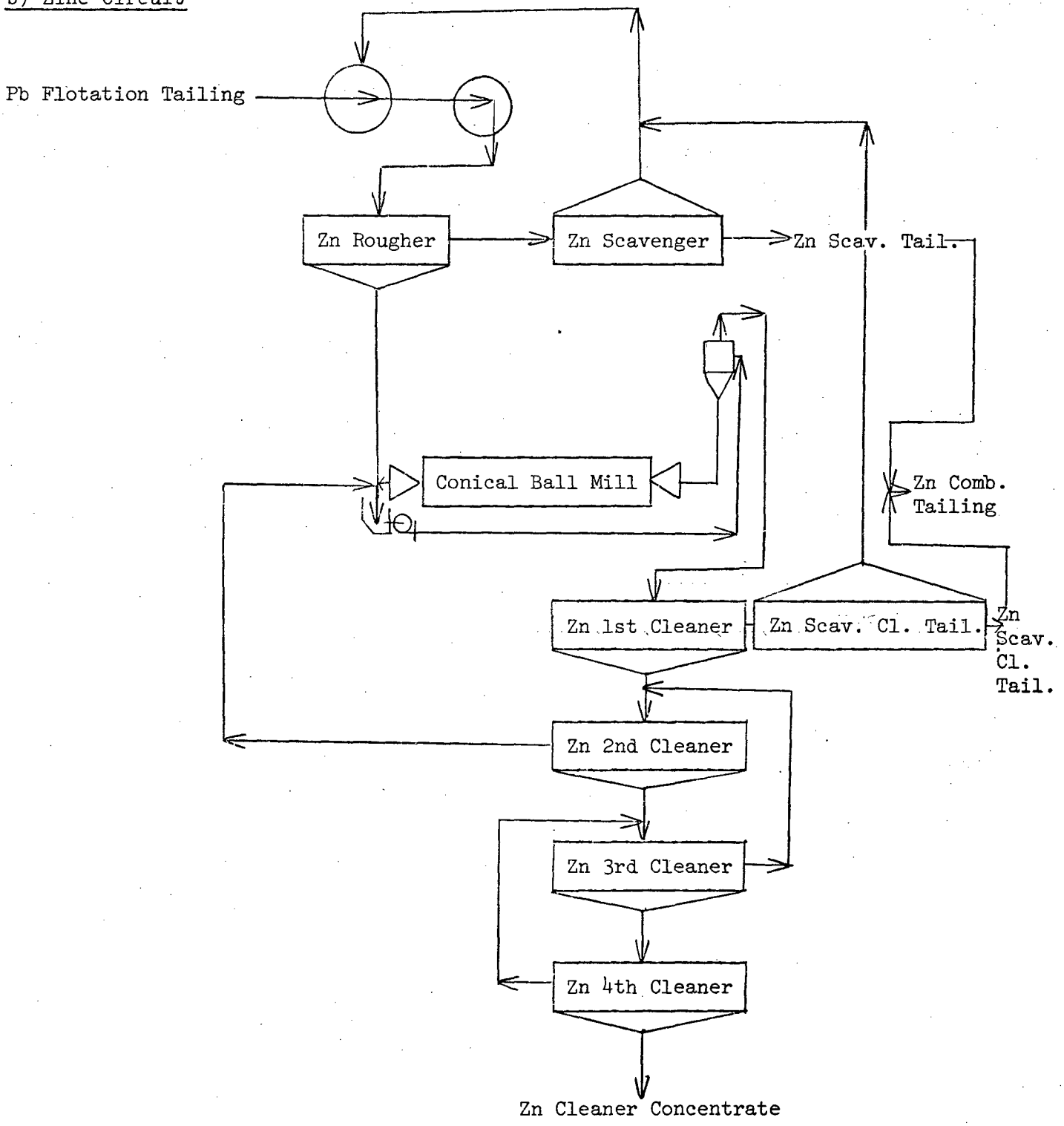
a) Pb Circuit



Test No. PP18 - Continued

2.3. Flowsheet

b) Zinc Circuit



Test No. PP18 - Continued

2.4. Results:

2.4.1. pH

Product	pH
Cyclone Overflow	8.9
Pb Rougher Feed	8.9
Pb Scavenger Tailing	8.8
Pb Regrinding Mill Discharge	9.0
Pb 1st Cleaner Feed	9.2
Pb 2nd Cleaner Feed	9.2
Pb 3rd Cleaner Feed	9.2
Pb 4th Cleaner Feed	9.2
Zn Rougher Feed	10.1
Zn Scavenger Tailing	9.6
Zn Regrinding Mill Feed	10.4
Zn 1st Cleaner Feed	10.8
Zn 2nd Cleaner Feed	10.8
Zn 3rd Cleaner Feed	11.0
Zn 4th Cleaner Feed	11.0

2.4.2. Pulp Densities

Product	Pulp Density gpl
Pb Rougher Feed	1188
Pb Scavenger Tailing	1178
Pb 1st Cleaner Feed	1142
Zn Rougher Feed	1162
Zn Scavenger Tailing	1122
Zn 1st Cleaner Feed	1068

2.4.3. Pulp Temperature

Product	°C
Pb Rougher Feed	26
Pb Regrinding Mill Discharge	31
Zn Rougher Feed	25
Zn Regrinding Mill Discharge	28

Test No. PP18 - Continued

2.4.4. Chemical Analyses

Product	Assays, %	
	Pb	Zn
Cyclone Overflow	5.99	10.4
Pb Rougher Feed	5.84	11.6
Pb Rougher Concentrate	18.4	15.4
Pb Rougher Tailing	2.41	10.6
Pb Scavenger Concentrate	4.69	14.0
Pb Scavenger Tailing	1.74	10.2
Pb 1st Cleaner Concentrate	23.4	18.7
Pb 1st Cleaner Tailing	5.92	16.6
Pb Regrind Discharge	20.1	13.1
Pb Regrind Cyclone Overflow	19.0	16.0
Pb Regrind Cyclone Underflow	19.9	13.0
Pb Cleaner Concentrate	57.5	11.7
Zn Rougher Feed	1.91	9.41
Zn Rougher Concentrate	2.79	27.3
Zn Rougher Tailing	1.57	2.49
Zn Scavenger Concentrate	3.29	8.41
Zn Scavenger Tailing	1.36	1.58
Zn 1st Cleaner Tailing	3.00	4.02
Zn 1st Cleaner Concentrate	3.49	41.6
Zn Regrinding Cyclone Overflow	3.24	27.3
Zn Regrinding Cyclone Underflow	1.45	16.8
Zn Regrinding Discharge	1.46	16.6
Zn 1st Cleaner Scav. Concentrate	3.88	6.37
Zn 1st Cleaner Scav. Tailing	2.18	1.82
Zn 2nd Cleaner Tailing	5.79	12.8
Zn Combined Tailing	1.42	1.62
Zn Cleaner Concentrate	2.82	50.0

Test No. PP18 - Continued

2.4.5. Metallurgical Results

Two-Product Formula

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
Pb Ro. Concentrate	22.39	18.4	15.4	68.8	29.5
Pb Ro. Tailing	77.61	2.41	10.6	31.2	70.5
Cyclone Overflow (meas)	100.00	5.99	10.4	100.0	100.0
(Calc.)	-	5.99	11.7	-	-
Pb Scav. Concentrate	17.63	4.69	14.0	13.8	21.1
Pb Scav. Tailing	59.98	1.74	10.2	17.4	52.4
Pb Ro. Tailing (meas)	77.61	2.41	10.6	31.2	79.1
(Calc.)	-	2.41	11.1	31.2	73.5
Pb 1st Cl. Concentrate	15.99	23.4	18.7	62.5	25.6
Pb 1st Cl. Tailing	6.40	5.92	16.6	6.33	12.9
Pb Ro. Concentrate (meas)	22.39	18.4	15.4	68.8	33.2
(Calc.)	-	18.4	18.1	68.8	38.5
Zn Ro. Concentrate	18.64	2.79	27.3	8.68	43.6
Zn Ro. Tailing	41.34	1.57	2.49	10.8	8.82
Pb Scav. Tailing (meas)	59.98	1.74	10.2	17.4	58.8
(Calc.)	-	1.95	10.2	19.5	52.4
Zn Scav. Concentrate	7.85	3.88	6.37	5.08	4.28
Zn Scav. Tailing	33.49	1.36	1.58	7.60	4.51
Zn Ro. Tailing (meas)	41.34	1.57	2.49	10.8	9.90
(Calc.)	-	1.84	2.48	12.7	8.80
Zn 1st Cl. Concentrate	11.44	3.49	41.6	6.67	40.8
Zn 1st Cl. Tailing	7.20	3.00	4.02	3.61	2.48
Zn Ro. Concentrate (meas)	18.64	2.79	27.03	8.68	48.4
(Calc.)	-	3.30	27.08	10.3	43.3

Three-Product Formula

Pb 4th Cl. Concentrate	7.74	57.5	11.7	74.8	8.7
Zn 4th Cl. Concentrate	16.54	2.82	50.0	7.8	79.9
Zn Combined Tailing	72.72	1.42	1.62	17.4	11.4
Cyclone Overflow	100.00	5.99	10.4	100.0	100.0

Test No. PP19

1. Grinding

1.1. Purpose: To repeat the conditions of test PP18.

1.2. Method: As for test PP18. The grinding circuit was operated for a period of 7.75 hours at a feed rate of 700 pounds per hour. Samples were taken every 30 minutes during the last two hours of operation.

1.2.1. Classification Equipment

Hendy Mill; P-50 Dorr Cyclone:

1 1/2 inch diameter
5/8 inch vortex
1/2 inch apex

Pb Regrind

Sala Mill; Krebs Cyclone:

1 inch diameter
1/4 inch vortex
1/8 inch apex

Zn Regrind

Conical Mill; Goodwin Cyclone:

1 1/2 inch diameter
1/2 inch vortex
3/16 inch apex

1.3. Flowsheet: As for test PP1

1.4. Results: The grinding circuit was very stable throughout the test run. Net power consumption in the Hendy mill was 14.89 kilowatt-hours per ton of ½ inch feed. The cyclone overflow was 88.0 % minus 200 mesh.

Test No. PP19 - Continued

1.4. Results:

1.4.1. Ball Mill Report

Feed:	Minus ½ inch ore at 0.5 percent moisture content		
Feed Rate:	700 dry pounds per hour		
Mill Speed:	32 r.p.m., 80.5 percent of critical speed		
Mill Load:	3 inch balls	1000 pounds	
	1½ inch balls	600 pounds	
	1 inch balls	400 pounds	
	Total	2000 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Mill Feed:	Total 5425 pounds, test period 1400 pounds		
Circulating Load:	Cyclone underflow 672 percent		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2082	69
	Cyclone Overflow	1372	36
	Cyclone Underflow	2446	78
Average Power:	Gross	7.13 kilowatts	
	No Load	1.92 kilowatts	
	Net	5.21 kilowatts	
Net Power Consumption:	14.89 kilowatt-hours per ton of ½ inch feed.		
Work Index:	11.53		

Test No. PP19 - Continued

1.4. Results:

1.4.2. Lead Regrinding Mill Report

Regrinding Mill:	Sala Mill		
Feed:	Lead Rougher Concentrate and Lead 2nd Cleaner Tailing		
Feed Rate:	112.63 pounds per hour, 16.09 percent of the mill feed		
Mill Speed:	31 r.p.m., 73 percent of critical speed		
Mill Load:	2 inch balls	380 pounds	
	1 inch balls	820 pounds	
	Total	1200 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2382	73
	Cyclone Feed	1351	33
	Cyclone Overflow	1137	15.5
	Cyclone Underflow	2382	73
Average Power:	Gross	7.13 kilowatts	
	No Load	0.92 kilowatts	
	Net	6.21 kilowatts	
Net Power Consumption:	17.74 kilowatt-hours per ton of feed.		

Test No. PP19 - Continued

1.4. Results:

1.4.3. Zinc Regrinding Mill Report

Regrinding Mill:	Conical Mill		
Feed:	Zinc Rougher Concentrate and Zinc 2nd Cleaner Tailing		
Feed Rate:	117.6 pounds per hour, 16.80 percent of the mill feed		
Mill Speed:	32 r.p.m., 75 percent of critical speed		
Mill Load:	1 inch balls	320 pounds	
	½ inch balls	220 pounds	
	Total	540 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2182	71.8
	Cyclone Overflow	1070	8.6
	Cyclone Underflow	2182	71.8
Average Power:	Gross	1.66 kilowatts	
	No Load	0.92 kilowatts	
	Net	0.74 kilowatts	
Net Power Consumption:	2.11 kilowatt-hours per ton of feed.		

Test No. PP19 - Continued

1.4.4. Screen Analyses

Hendy Mill Feed

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 3/8	3.8	3.8	96.2
3	12.5	16.3	83.7
4	13.5	29.8	70.2
6	9.2	39.0	61.0
8	9.0	48.0	52.0
10	8.4	56.4	43.6
14	6.3	62.7	37.3
20	4.7	67.4	32.6
28	3.9	71.3	28.7
35	3.2	74.5	25.5
48	3.3	77.8	22.2
65	3.2	81.0	19.0
100	2.7	83.7	16.3
150	2.6	86.3	13.7
200	2.8	89.1	10.9
- 200	10.9	100.0	-
Total	100.0	-	-

Hendy Mill Discharge

+ 14	0.2	0.2	99.8
20	0.2	0.4	99.6
28	0.4	0.8	99.2
35	0.6	1.4	98.6
48	1.6	3.0	97.0
65	3.0	6.0	94.0
100	5.5	11.5	88.5
150	10.0	21.5	78.5
200	18.1	39.6	60.4
270	14.4	54.0	46.0
400	18.9	72.9	27.1
- 400	27.1	100.0	-
Total	100.0	-	-

Test No. PP19 - Continued

1.4.4. Screen Analyses

Cyclone Underflow

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 10	0.1	0.1	99.9
14	0.1	0.2	99.8
20	0.3	0.5	99.5
28	0.5	1.0	99.0
35	0.7	1.7	98.3
48	1.9	3.6	96.4
65	3.7	7.3	92.7
100	6.1	13.4	86.6
150	11.3	24.7	75.3
200	20.0	44.7	55.3
270	15.4	60.1	39.9
400	18.8	78.9	21.1
- 400	21.1	100.0	-
Total	100.0	-	-

Cyclone Overflow

+ 65	0.5	0.5	99.5
100	1.1	1.6	98.4
150	2.9	4.5	95.5
200	7.5	12.0	88.0
270	8.1	20.1	79.9
400	15.3	35.4	64.6
- 400	64.6	100.0	-
Total	100.0	-	-

Test No. PP19 - Continuted

1.4.4. Screen Analyses

Pb Rougher Concentrate

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	5.3	5.3	94.7
270	6.8	12.1	87.9
27.4 µm	17.7	29.8	70.2
21.2	8.2	38.0	62.0
14.8	12.4	50.4	49.6
10.2	12.4	62.8	37.2
7.9	8.4	71.2	28.8
- 7.9	28.8	100.0	-
Total	100.0	-	-

Specific Gravity 4.79

Pb Regrind Discharge

+ 26.5 µm	14.4	14.4	85.6
20.6	11.4	25.8	74.2
14.3	25.0	50.8	49.2
9.9	18.4	69.2	30.8
7.6	7.0	76.2	23.8
- 7.6	23.8	100.0	-
Total	100.0	-	-

Specific Gravtiy 5.03

Pb Regrind Cyclone Underflow

+ 200 mesh	3.8	3.8	96.2
270	5.4	9.2	90.8
26.5 µm	20.2	29.4	70.6
20.6	13.8	43.2	56.8
14.3	24.0	67.2	32.8
9.9	16.2	83.4	16.6
7.6	6.1	89.5	10.5
- 7.6	10.5	100.0	-
Total	100.0	-	-

Specific Gravity 4.98

Test No. PP19 - Continued

1.4.4. Screen Analyses

Pb Regrind Cyclone Overflow

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 27.8 µm	0.7	0.7	99.3
21.5	0.4	1.1	98.9
15.0	0.8	1.9	98.1
10.3	4.4	6.3	93.7
7.9	11.5	17.8	82.2
- 7.9	82.2	100.0	-
Total	100.0	-	-

Specific Gravity 4.75

Pb 4th Cleaner Concentrate

+ 24.1 µm	0.6	0.6	99.4
18.7	0.8	1.4	98.6
13.0	6.9	8.3	91.7
8.9	21.2	29.5	70.5
6.9	17.4	46.9	53.1
- 6.9	53.1	100.0	-
Total	100.0	-	-

Specific Gravity 5.85

Zn Regrind Discharge

+ 200 mesh	7.4	7.4	92.6
270	12.0	19.4	80.6
29.0 µm	14.6	34.0	66.0
22.5	45.2	79.2	20.8
15.7	12.1	91.3	8.7
10.8	1.8	93.1	6.9
8.3	1.0	94.1	5.9
- 8.3	5.9	100.0	-
Total	100.0	-	-

Specific Gravity 4.42

Test No. PP19 - Continued

1.4.4. Screen Analyses

Zn Regrind Cyclone Underflow

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 150 mesh	2.9	2.9	97.1
200	7.6	10.5	89.5
270	13.4	23.9	76.1
29.0 µm	13.4	37.3	62.7
22.5	46.8	84.1	15.9
15.7	11.6	95.7	4.3
10.8	0.8	96.5	3.5
8.3	0.2	96.7	3.3
- 8.3	3.3	100.0	-
Total	100.0	-	-

Specific Gravity 4.41

Zn 4th Cleaner Concentrate

+ 30.3 µm	5.5	5.5	94.5
23.5	10.6	16.1	83.9
16.4	18.6	34.7	65.3
11.3	15.3	50.0	50.0
8.7	9.6	59.6	40.4
- 8.7	40.4	100.0	-
Total	100.0	-	-

Specific Gravity 4.10

Zn Regrind Cyclone Overflow

+ 30.3 µm	6.9	6.9	93.1
23.5	10.3	17.2	82.8
16.4	17.1	34.3	65.7
11.3	13.2	47.5	52.5
8.7	8.0	55.5	44.5
- 8.7	44.5	100.0	-
Total	100.0	-	-

Specific Gravity 4.12

Test No. PP19 - Continued

1.4.4. Screen Analyses

Zn Combined Tailing

Particle Size	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 200 mesh	10.5	10.5	89.5
270	7.6	18.1	81.9
32.4 µm	12.6	30.7	69.3
25.2	10.0	40.7	59.3
17.6	12.9	53.6	46.4
12.1	10.4	64.0	36.0
9.3	6.3	70.3	29.7
- 9.3	29.7	100.0	-
Total	100.0	-	-

Specific Gravity 3.66

Test No. PP19 - Continued

2. Flotation

2.1. Purpose: To investigate the effect of the following reagent and circuit changes:

1) Reagent Z-11 was added to the Hendy mill instead of to the cylone feed pump, and reagent R-241 was removed from the Hendy mill feed and added to the cyclone feed pump. The MIBC addition to the lead 3rd rougher cell was omitted.
2) Collector Z-200 was added to the zinc 3rd cleaner feed.
3) pH in the zinc rougher was decreased from pH 10.5 to 10.0. R-242 was added to the Pb regrind mill feed.

2.2. Method: The lead circuit was modified as indicated above. In the zinc circuit attempts were made to stabilize the pH in the zinc rougher and cleaners at the desired level.

2.2.1. Flotation Equipment

As for test PP11.

2.2.2. Flotation Reagents

See following page.

2.3. Flowsheet: As for test PP18, except that the lead 2nd cleaner tailing was added to the Pb regrind feed pump instead of to the lead 1st cleaner conditioner.

2.4. Results: The Z-11 additions to the Hendy mill at a rate of 0.05 lb/ton did not improve lead recovery. The lead cleaner concentrate assayed 57.9 % Pb at 74.2 % Pb recovery. The zinc flotation results were poor. The zinc final concentrate assayed 51.5 % Zn at 76.7 % Zn recovery.

Test No. PP19 - Continued

2.2.2. Reagent Additions:

Type	Pounds of Reagent per Ton of Feed	Point of Addition
Na_2CO_3	3.92	Ball Mill Feed
NaCN	0.22	Ball Mill Feed
$ZnSO_4$	1.00	Ball Mill Feed
Z-11	0.05	Ball Mill Feed
R-241	0.03	Cyclone Feed Pump
Z-11	0.03	Pb Rougher Conditioner
MIBC	0.054	Pb Rougher Feed Pump
Z-11	0.03	Pb Scavenger Feed
MIBC	0.025	Pb Scavenger Feed
Na_2CO_3	0.46	Pb Regrind Mill
$ZnSO_4$	0.56	Pb Regrind Mill
NaCN	0.32	Pb Regrind MIll
R-242	0.02	Pb Regrind MIll
MIBC	0.030	Pb 1st Cleaner Feed Pump
Z-11	0.02	Pb 1st Cleaner 4th Cell
NaCN	0.07	Pb 2nd Cleaner Feed
NaCN	0.04	Pb 3rd Cleaner Feed
NaCN	0.04	Pb 4th Cleaner Feed
$Ca(OH)_2$	2.30	Zn Rougher Conditioner Feed
$CuSO_4$	1.54	Zn Rougher Conditioner No. 1
M-748	0.12	Zn Rougher Conditioner No. 2
DF-250	0.075	Zn Rougher Feed Pump
Z-6	0.16	Zn Rougher Feed Pump
Z-200	0.015	Zn Rougher Feed Pump
Z-6	0.03	Zn Scavenger Feed
Z-200	0.017	Zn Scavenger Feed
DF-250	0.030	Zn Scavenger Feed
$Ca(OH)_2$	0.76	Zn Regrind Mill
Z-200	0.043	Zn Regrind Mill
$CuSO_4$	0.22	Zn Regrind Mill
DF-250	0.030	Zn 1st Cleaner Feed
$Ca(OH)_2$	0.28	Zn 2nd Cleaner Feed
Z-200	0.033	Zn 2nd Cleaner Feed
DF-250	0.005	Zn 2nd Cleaner Feed
$Ca(OH)_2$	0.016	Zn 3rd Cleaner Feed
Z-200	0.025	Zn 3rd Cleaner Feed
$Ca(OH)_2$	0.18	Zn 4th Cleaner Feed

Test No. PP19 - Continued

2.4. Results:

2.4.1. pH

Product	pH
Cylcone Overflow	9.0
Pb Rougher Feed	9.0
Pb Scavenger Tailing	8.8
Pb Regrinding Mill Discharge	9.0
Pb 1st Cleaner Feed	9.8
Pb 2nd Cleaner Feed	9.9
Pb 3rd Cleaner Feed	9.8
Pb 4th Cleaner Feed	9.8
Zn Rougher Feed	10.1
Zn Scavenger Tailing	9.7
Zn 1st Cleaner Feed	11.0
Zn 2nd Cleaner Feed	10.9
Zn 3rd Cleaner Feed	11.0
Zn 4th Cleaner Feed	11.0

2.4.2. Pulp Densities

Product	Pulp Density gpl
Pb Rougher Feed	1232
Pb Scavenger Tailing	1200
Pb 1st Cleaner Feed	1137
Zn Rougher Feed	1102
Zn Scavenger Tailing	1088
Zn 1st Cleaner Feed	1070

2.4.3. Pulp Temperature

Product	^{o}C
Pb Rougher Feed	26
Pb Regrinding Mill Discharge	33
Zn Rougher Feed	25
Zn Regrinding Mill Discharge	28

Test No. PP19 - Continued

2.4.4. Chemical Analyses

Product	Assays, %	
	Pb	Zn
Cyclone Overflow	5.93	10.0
Pb Rougher Feed	6.13	11.7
Pb Rougher Concentrate	24.5	16.3
Pb Rougher Tailing	2.38	10.4
Pb Scavenger Concentrate	5.49	14.7
Pb Scavenger Tailing	1.58	9.53
Pb 1st Cleaner Concentrate	36.6	15.2
Pb 1st Cleaner Tailing	8.5	18.3
Pb Regrind Cyclone Overflow	27.0	16.6
Pb Regrind Cyclone Underflow	23.0	14.3
Pb Cleaner Concentrate	57.9	10.4
Zn Rougher Feed	1.88	9.30
Zn Rougher Concentrate	2.75	28.5
Zn Rougher Tailing	1.64	3.15
Zn Scavenger Concentrate	2.98	11.6
Zn Scavenger Tailing	1.48	1.98
Zn 1st Cleaner Tailing	3.05	6.26
Zn 1st Cleaner Concentrate	3.02	44.8
Zn Regrind Cyclone Overflow	3.15	29.4
Zn Regrind Cyclone Underflow	1.73	17.8
Zn Cleaner Concentrate	2.55	51.5

Test No. PP19 - Continued

2.4.5. Metallurgical Results

Two-Product Formula

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
Pb Ro. Concentrate	16.09	24.5	16.3	66.4	23.1
Pb Ro. Tailing	83.91	2.38	10.4	33.6	76.9
Cyclone Overflow(meas)	100.00	5.93	10.0	100.0	100.0
(Calc.)	-	5.94	11.3	-	-
Pb Scav. Concentrate	17.17	5.49	14.7	15.9	22.2
Pb Scav. Tailing	66.74	1.58	9.53	17.8	56.0
Pb Ro. Tail.(meas)	83.91	2.38	10.4	33.7	87.3
(Calc.)	-	2.38	10.6	33.7	78.2
Pb 1st Cl. Conc.	9.16	36.6	15.2	56.5	12.3
Pb 1st Cl. Tail.	6.93	8.51	18.3	9.93	11.2
Pb Ro. Conc. (meas)	16.09	24.5	16.3	66.5	26.2
(Calc.)	-	24.5	16.5	66.4	23.5
Zn Ro. Concentrate	16.80	2.75	28.5	7.78	42.2
Zn Ro. Tailing	49.94	1.64	3.15	13.8	13.9
Pb Scav. Tailing (meas)	66.74	1.58	9.53	17.8	63.6
(Calc.)	-	1.92	9.53	21.6	56.1
Zn Scav. Concentrate	6.07	2.98	11.6	3.05	6.20
Zn Scav. Tailing	43.96	1.48	1.98	10.9	7.83
Zn Ro. Tailing (meas)	49.94	1.64	3.15	13.8	15.7
(Calc.)	-	1.66	3.15	14.0	14.0
Zn 1st Cl. Conc.	9.69	3.02	44.8	4.93	38.2
Zn 1st Cl. Tail.	7.11	3.05	6.26	3.65	3.92
Zn Ro. Conc. (meas)	16.80	2.75	28.5	7.79	47.9
(Calc.)	-	3.03	27.6	8.58	42.2

Three-Product Formula

Pb 4th Cl. Conc.	7.60	57.9	10.4	74.2	7.91
Zn 4th Cl. Conc.	14.90	2.55	51.5	6.41	76.7
Zn Scav. Tail.	77.50	1.48	1.98	19.4	15.3
Cyclone Overflow	100.0	5.93	10.0	100.0	100.0

Test No. PP20

1. Grinding

1.1. Purpose: To repeat the conditions of test PP19.

1.2. Method: As for test PP1 - 19. The grinding circuit was operated for a period of 7.75 hours at a feed rate of 704 pounds per hour. Samples were taken every 20 minutes during the last two hours of operation.

1.2.1. Classification Equipment

Hendy Mill; P-50 Dorr Cyclone:

1 1/2 inch diameter
5/8 inch vortex
1/2 inch apex

Pb Regrind

Sala Mill; Krebs Cyclone:

1 inch diameter
1/4 inch vortex
1/8 inch apex

Zn Regrind

Conical Mill; Goodwin Cyclone:

1 1/2 inch diameter
1/2 inch vortex
3/16 inch apex

1.3. Flowsheet: As for test PP1.

1.4. Results: The grinding circuit was stable during the test run. Net power consumption in the Hendy mill was 14.9 kilowatt-hours per ton of ½ inch feed. The cyclone overflow was 88 % minus 200 mesh.

Test No. PP20 - Continued

1.4. Results:

1.4.1. Ball Mill Report

Feed:	Minus ½ inch ore at 0.5 percent moisture content		
Feed Rate:	704 dry pounds per hour		
Mill Speed:	32 r.p.m., 80.5 percent of critical speed		
Mill Load:	3 inch balls	1000 pounds	
	1½ inch balls	600 pounds	
	1 inch balls	400 pounds	
	Total	2000 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Mill Feed:	Total 5456 pounds, test period 1408 pounds		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2078	69
	Cyclone Overflow	1384	37
	Cyclone Underflow	2404	78
Average Power:	Gross	7.13 kilowatts	
	No Load	1.92 kilowatts	
	Net	5.21 kilowatts	

Net Power Consumption: 14.9 kilowatt-hours per ton of ½ inch feed

Work Index: 11.53

Test No. PP20 - Continued

1.4. Results:

1.4.2. Lead Regrinding Mill Report

Regrinding Mill:	Sala Mill		
Feed:	Lead Rougher Concentrate and Lead 2nd Cleaner Tailing		
Feed Rate:	115.0 pounds per hour, 16.20 percent of the mill feed		
Mill Speed:	31 r.p.m., 73 percent of critical speed		
Mill Load:	2 inch balls	380 pounds	
	1 inch balls	820 pounds	
	Total	1200 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2332	72
	Cyclone Feed	1310	30
	Cyclone Overflow	1125	14
	Cyclone Underflow	2332	72
Average Power:	Gross	7.03 kilowatts	
	No Load	0.92 kilowatts	
	Net	6.11 kilowatts	

Net Power Consumption: 17.5 kilowatt-hours per ton of feed.

Test No. PP20 - Continued

1.4. Results:

1.4.3. Zinc Regrinding Mill Report

Regrinding Mill:	Conical Mill		
Feed:	Zinc Rougher Concentrate and Zn 2nd Cleaner Tailings		
Feed Rate:	104 pounds per hour, 14.72 percent of the mill feed		
Mill Speed:	32 r.p.m., 75 percent of critical speed		
Mill Load:	1 inch balls	320 pounds	
	½ inch balls	220 pounds	
	Total	540 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2332	76.6
	Cyclone Overflow	1065	6.9
	Cyclone Underflow	2332	76.6
Average Power:	Gross	1.90 kilowatts	
	No Load	0.92 kilowatts	
	Net	0.98 kilowatts	

Net Power Consumption: 2.8 kilowatt-hours per ton of feed.

Test No. PP20 - Continued

1.4.4. Screen Analyses

Hendy Mill Feed

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 3/8	3.5	3.5	96.5
3	12.6	16.1	83.9
4	9.8	25.9	74.1
6	11.8	37.7	62.3
8	8.6	46.3	53.7
10	7.6	53.9	46.1
14	6.2	60.1	39.9
20	4.6	64.7	35.3
28	3.9	68.6	31.4
35	3.3	71.9	28.1
48	3.6	75.5	24.5
65	3.6	79.1	20.9
100	2.9	82.0	18.0
150	2.9	84.9	15.1
200	3.2	88.1	11.9
- 200	11.9	100.0	-
Total	100.0	-	-

Hendy Mill Discharge

+ 10	0.1	0.1	99.9
14	0.1	0.2	99.8
20	0.2	0.4	99.6
28	0.4	0.8	99.2
35	0.7	1.5	98.5
48	1.6	3.1	96.9
65	3.1	6.2	93.8
100	5.5	11.7	88.3
150	9.9	21.6	78.4
200	17.4	39.0	61.0
270	13.6	52.6	47.4
400	18.3	70.9	29.1
- 400	29.1	100.0	-
Total	100.0	-	-

Test No. PP20 - Continued

1.4.4. Screen Analyses

Cyclone Underflow

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 10	0.1	0.1	99.9
14	0.2	0.3	99.7
20	0.3	0.6	99.4
28	0.4	1.0	99.0
35	0.8	1.8	98.2
48	1.9	3.7	96.3
65	3.8	7.5	92.5
100	6.3	13.8	86.2
150	11.1	24.9	75.1
200	19.2	44.1	55.9
270	14.5	58.6	41.4
400	18.0	76.6	23.4
- 400	23.4	100.0	-
Total	100.0	-	-

Cyclone Overflow

+ 65	0.5	0.5	99.5
100	1.1	1.6	98.4
150	3.0	4.6	95.4
200	7.4	12.0	88.0
270	7.9	19.9	80.1
400	14.5	34.4	65.6
- 400	65.6	100.0	-
Total	100.0	-	-

Test No. PP20 - Continued

1.4.4. Screen Analyses

Pb Rougher Concentrate

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	5.6	5.6	94.4
270	7.0	12.6	87.4
27.4 µm	17.3	29.9	70.1
21.2	8.0	37.9	62.1
14.8	12.0	49.9	50.1
10.2	10.8	60.7	39.3
7.9	7.7	68.4	31.6
- 7.9	31.6	100.0	-
Total	100.0	-	-

Specific Gravity 4.82

Pb Regrind Discharge

+ 26.1 µm	12.4	12.4	87.6
20.3	9.8	22.2	77.8
14.1	24.5	46.7	53.3
9.7	21.8	68.5	31.5
7.5	9.4	77.9	22.1
- 7.5	22.1	100.0	-
Total	100.0	-	-

Specific Gravity 5.13

Pb Regrind Cyclone Underflow

+ 200 mesh	2.7	2.7	97.3
270	3.8	6.5	93.5
26.7 µm	15.4	21.9	78.1
20.7	10.8	32.7	67.3
14.4	23.2	55.9	44.1
9.9	21.8	77.7	22.3
7.7	10.0	87.7	12.3
- 7.7	12.3	100.0	-
Total	100.0	-	-

Specific Gravity 4.99

Test No. PP20 - Continued

1.4.4. Screen Analyses

Pb Regrind Cyclone Overflow

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 27.8 µm	5.5	5.5	94.5
21.5	0.4	5.9	94.1
15.0	0.6	6.5	93.5
10.3	1.2	7.7	92.3
7.9	7.0	14.7	85.3
- 7.9	85.3	100.0	-
Total	100.0	-	-

Specific Gravity 4.71

Pb 4th Cleaner Concentrate

+ 19.0 µm	1.2	1.2	98.8
13.2	2.3	3.5	96.5
9.1	11.4	14.9	85.1
7.0	14.3	29.2	70.8
- 7.0	70.8	100.0	-
Total	100.0	-	-

Specific Gravity 5.80

Zn Regrind Cyclone Underflow

+ 200 mesh	10.4	10.4	89.6
270	14.2	24.6	75.4
28.7 µm	13.8	38.4	61.6
22.3	44.8	83.2	16.8
15.5	11.4	94.6	5.4
10.7	1.2	95.8	4.2
8.3	0.4	96.2	3.8
- 8.3	3.8	100.0	-
Total	100.0	-	-

Specific Gravity 4.20

Test No. PP20 - Continued

1.4.4. Screen Analyses

Zn Regrind Discharge

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	6.6	6.6	93.4
270	12.2	18.8	81.2
28.6 µm	14.6	33.4	66.6
22.2	44.4	77.8	22.2
15.8	12.5	90.3	9.7
10.6	2.2	92.5	7.5
8.2	1.1	93.6	6.4
- 8.2	6.4	100.0	-
Total	100.0	-	-

Specific Gravity 4.50

Zn Scavenger Tailing

+ 200 mesh	10.8	10.8	89.2
270	7.8	18.6	81.4
32.3 µm	11.4	30.0	70.0
25.1	9.6	39.6	60.4
17.5	13.0	52.6	47.4
12.0	10.3	62.9	37.1
9.2	6.4	69.3	30.7
- 9.2	30.7	100.0	-
Total	100.0	-	-

Specific Gravity 3.69

Zn Regrind Cyclone Overflow

+ 29.8 µm	6.4	6.4	93.6
23.1	9.8	16.2	83.8
16.2	18.0	34.2	65.8
11.1	14.3	48.5	51.5
8.6	8.6	57.1	42.9
- 8.6	42.9	100.0	-
Total	100.0	-	-

Specific Gravity 4.20

Test No. PP20 - Continued

2. Flotation

2.1. Purpose: To optimize reagent additions in the lead and zinc circuits.

2.2. Method: The following changes were made in the lead and zinc circuits.

A. Lead Circuit

1) Z-11 addition was removed from the Pb conditioner, and added to the Hendy mill feed at a rate of 0.09 lb/ton. Collector R-241 was removed from the Hendy mill cyclone pump and added to the Pb conditioner. Collector R-242 in the Pb regrind mill feed was replaced with collector R-241.

2) Omitted cyanide additions in the Pb 3rd and 4th cleaners.

Zinc Circuit

1) Omitted lime from the zinc 3rd and 4th cleaners. Adjusted pH, in the zinc rougher to 10.2 and in the 1st and 2nd cleaner to 10.5.

2.2.1. Flotation Equipment

As for test PP11.

2.2.2. Flotation Reagents

See following page.

2.3. Flowsheet: As for test PP18.

2.4. Results: Removing the cyanide addition from the Pb 3rd and 4th cleaners resulted in a higher recirculating load in the Pb cleaners and slow Pb flotation in the cleaning. Very fine galena floated in the Pb rougher. The omission of lime from the zinc 3rd and 4th cleaners resulted in a poor zinc concentrate grade. It appeared that pH in the zinc cleaning was an important factor.

Test No. PP20 - Continued

2.2.2. Reagent Additions

Type	Pounds of Reagent per Ton of Feed	Point of Additions
Na_2CO_3	3.60	Ball Mill Feed
NaCN	0.22	Ball Mill Feed
$ZnSO_4$	0.94	Ball Mill Feed
Z-11	0.09	Ball Mill Feed
R-241	0.03	Pb Rougher Conditioner
MIBC	0.054	Pb Rougher Feed Pump
Z-11	0.03	Pb Scavenger Feed
MIBC	0.023	Pb Scavenger Feed
$ZnSO_4$	0.54	Pb Regrind Mill
NaCN	0.32	Pb Regrind Mill
R-241	0.03	Pb Regrind Mill
MIBC	0.031	Pb 1st Cleaner Feed Pump
Z-11	0.02	Pb 1st Cleaner 4th Cell
NaCN	0.07	Pb 2nd Cleaner Feed
$Ca(OH)_2$	2.14	Zn Rougher Conditioner Feed
$CuSO_4$	1.54	Zn Rougher Conditioner No. 1
M-748	0.053	Zn Rougher Conditioner No. 2
Z-6	0.17	Zn Rougher Feed Pump
DF-250	0.075	Zn Rougher Feed Pump
Z-200	0.014	Zn Rougher Feed Pump
Z-6	0.03	Zn Scavenger Feed
Z-200	0.018	Zn Scavenger Feed
DF-250	0.030	Zn Scavenger Feed
$Ca(OH)_2$	0.44	Zn Regrind Mill
Z-200	0.042	Zn Regrind Mill
$CuSO_4$	0.20	Zn Regrind Mill
Na_2SiO_3	0.21	Zn 1st Cleaner Feed
DF-250	0.032	Zn 1st Cleaner Feed
$Ca(OH)_2$	0.34	Zn 2nd Cleaner Feed
DF-250	0.005	Zn 2nd Cleaner Feed
Z-200	0.033	Zn 2nd Cleaner Feed
Z-200	0.023	Zn 3rd Cleaner Feed

Test No. PP20 - Continued

2.4. Results:

2.4.1. pH

Product	pH
Cyclone Overflow	8.9
Pb Rougher Feed	9.0
Pb Scavenger Tailing	8.8
Pb Regrinding Mill Discharge	8.1
Pb 1st Cleaner Feed	9.4
Pb 2nd Cleaner Feed	9.7
Pb 3rd Cleaner Feed	9.8
Pb 4th Cleaner Feed	9.8
Zn Rougher Feed	9.9
Zn Scavenger Tailing	9.6
Zn 1st Cleaner Feed	10.3
Zn 2nd Cleaner Feed	10.2
Zn 3rd Cleaner Feed	9.8
Zn 4th Cleaner Feed	9.5

2.4.2. Pulp Densities

Product	Pulp Density gpl
Pb Rougher Feed	1240
Pb Scavenger Tailing	1200
Pb 1st Cleaner Feed	1125
Zn Rougher Feed	1102
Zn Scavenger Tailing	1088
Zn 1st Cleaner Feed	1065

2.4.3. Pulp Temperature

Product	°C
Pb Rougher Feed	25
Pb Regrinding Mill Discharge	28
Zn Rougher Feed	23
Zn Regrinding Mill Discharge	25

Test No. PP20 - Continued

2.4.4. Chemical Analyses

Product	Assays, %	
	Pb	Zn
Cyclone Overflow	6.15	10.1
Pb Rougher Feed	6.58	11.4
Pb Rougher Concentrate	24.1	15.6
Pb Rougher Tailing	2.68	10.6
Pb Scavenger Concentrate	6.46	14.5
Pb Scavenger Tailing	1.93	9.87
Pb 1st Cleaner Concentrate	34.2	14.6
Pb 1st Cleaner Tailing	12.3	18.0
Pb Regrind Cyclone Overflow	27.4	15.7
Pb Regrind Cyclone Underflow	24.2	14.2
Pb Cleaner Concentrate	59.7	8.81
Zn Rougher Feed	2.21	9.85
Zn Rougher Concentrate	2.78	31.7
Zn Rougher Tailing	1.98	4.05
Zn Scavenger Concentrate	3.03	11.5
Zn Scavenger Tailing	1.74	2.46
Zn 1st Cleaner Tailing	3.08	6.23
Zn 1st Cleaner Concentrate	3.33	43.3
Zn Regrinding Cyclone Overflow	3.32	29.3
Zn Regrinding Cyclone Underflow	1.98	17.2
Zn Cleaner Concentrate	2.91	48.3

Test No. PP20 - Continued

2.4.5. Metallurgical Results

Two-Product Formula

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
Pb Ro. Concentrate	16.20	24.1	15.6	63.5	22.1
Pb Ro. Tailing	83.80	2.68	10.6	36.5	77.9
Cyclone Overflow (meas)	100.00	6.15	10.1	100.0	100.0
(Calc.)	-	6.15	11.4	-	-
Pb Scav. Concentrate	13.87	6.46	14.5	14.6	17.6
Pb Scav. Tailing	69.93	1.93	9.87	21.9	60.5
Pb Ro. Tailing (meas)	83.80	2.68	10.6	36.5	87.9
(Calc.)	-	2.68	10.6	36.5	78.1
Pb 1st Cl. Concentrate	8.73	34.2	14.6	48.5	11.2
Pb 1st Cl. Tailing	7.47	12.3	18.0	14.9	11.8
Pb Ro. Concentrate (meas)	16.20	24.1	15.6	63.5	25.0
(Calc.)	-	24.1	16.2	63.5	23.0
Zn Ro. Concentrate	14.72	2.78	31.7	6.66	40.9
Zn Ro. Tailing	55.21	1.98	4.05	17.8	19.6
Pb Scav. Tailing (meas)	69.93	1.93	9.87	21.9	68.3
(Calc.)	-	2.15	9.87	24.4	60.5
Zn Scav. Concentrate	7.29	6.46	14.5	7.66	9.26
Zn Scav. Tailing	47.92	1.74	2.46	13.6	10.3
Zn Ro. Tailing (meas)	55.21	1.98	4.05	17.8	22.1
(Calc.)	-	2.36	4.05	21.3	19.6
Zn 1st Cl. Concentrate	10.11	3.33	43.3	5.47	38.4
Zn 1st Cl. Tailing	4.61	3.08	6.23	2.31	2.52
Zn Ro. Concentrate (meas)	14.72	2.78	31.7	6.65	46.2
(Calc.)	-	3.25	31.7	7.78	40.9

Three-Product Formula

Pb 4th Cl. Concentrate	7.29	59.7	8.81	70.8	6.3
Zn 4th Cl. Concentrate	15.66	2.91	48.3	7.4	74.9
Zn Scav. Tailing	77.05	1.74	2.46	21.8	18.8
Cyclone Overflow	100.00	6.15	10.1	100.0	100.0

Test No. PP21

1. Grinding

1.1. Purpose: To repeat the conditions of test PP20, but at a slightly lower density in the Dorr cyclone overflow.

1.2. Method: Similar to test PP 1 - 20, except that pulp density in the cyclone overflow was lowered from 1400 gpl to 1360 gpl. The grinding circuit was operated for a period of 7.75 hours at a feed rate of 699 pounds per hour. Samples were taken every 20 minutes during the last two hours of operation.

1.2.1. Classification Equipment

Hendy Mill; P-50 Dorr Cyclone:

1 1/2 inch diameter
5/8 inch vortex
1/2 inch apex

Pb Regrind

Sala Mill; Polyclon Cyclone:

20 mm diameter
10 mm vortex
8 mm apex

Zn Regrind

Conical Mill; Krebs Cyclone:

1 1/2 inch diameter
1/2 inch vortex
1/4 inch apex

1.3. Flowsheet: As for test PP1.

1.4. Results: The grinding circuit was quite stable during the test run. Net power consumption in the Hendy mill was 14.54 kilowatt-hours per ton of ½ inch feed. The cyclone overflow was 87.7 % minus 200 mesh.

Test No. PP21 - Continued

1.4. Results:

1.4.1. Ball Mill Report

Feed:	Minus ½ inch ore at 0.4 percent moisture content		
Feed Rate:	699 dry pounds per hour		
Mill Speed:	32 r.p.m., 80.5 percent of critical speed		
Mill Load:	3 inch balls	1000 pounds	
	1½ inch balls	600 pounds	
	1 inch balls	400 pounds	
	Total	2000 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Mill Feed:	Total 5417 pounds, test period 1398 pounds		
Circulating Load:	Cyclone underflow 560 percent		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2084	69
	Cyclone Overflow	1354	35
	Cyclone Underflow	2436	78
Average Power:	Gross	7.01 kilowatts	
	No Load	1.92 kilowatts	
	Net	5.09 kilowatts	
Net Power Consumption:	14.54 kilowatt-hours per ton of ½ inch feed.		
Work Index:	11.72		

Test No. PP21 - Continued

1.4. Results:

1.4.2. Lead Regrinding Mill Report

Regrinding Mill:	Sala Mill		
Feed:	Lead Rougher Concentrate		
Feed Rate:	119.7 pounds per hour, 17.05 percent of the mill feed		
Mill Speed:	31 r.p.m., 73 percent of critical speed		
Mill Load:	2 inch balls	380 pounds	
	1 inch balls	820 pounds	
	Total	1200 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2446	75
	Cyclone Feed	1188	20
	Cyclone Overflow	1117	14
	Cyclone Underflow	2446	75
Average Power:	Gross	7.01 kilowatts	
	No Load	0.92 kilowatts	
	Net	6.09 kilowatts	
Net Power Consumption:	17.40 kilowatt-hours per ton of feed.		

Test No. PP21 - Continued

1.4. Results:

1.4.3. Zinc Regrinding Mill Report

Regrinding Mill:	Conical Mill		
Feed:	Zinc Rougher Concentrate and Zn 2nd Cleaner Tailing		
Feed Rate:	136.1 pounds per hour, 19.47 percent of the mill feed		
Mill Speed:	32 r.p.m., 75 percent of critical speed		
Mill Load:	1 inch balls	320 pounds	
	½ inch balls	220 pounds	
	Total	540 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2154	72
	Cyclone Overflow	1095	11.5
	Cyclone Underflow	2154	72
Average Power:	Gross	1.43 kilowatts	
	No Load	0.92 kilowatts	
	Net	0.51 kilowatts	
Net Power Consumption:	1.46 kilowatt-hours per ton of feed.		

Test No. PP21 - Continued

1.4.4. Screen Analyses

Hendy Mill Feed

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 3/8	4.0	4.0	96.0
3	13.4	17.4	82.6
4	11.1	28.5	71.5
6	10.8	39.3	60.7
8	8.9	48.2	51.8
10	8.5	56.7	43.3
14	6.4	63.1	36.9
20	4.7	67.8	32.2
28	3.9	71.7	28.3
35	3.1	74.8	25.2
48	3.3	78.1	21.9
65	3.1	81.2	18.8
100	2.6	83.8	16.2
150	2.6	86.4	13.6
200	2.8	89.2	10.8
- 200	10.8	100.0	-
Total	100.0	-	-

Hendy Mill Discharge

+ 10	0.1	0.1	99.9
14	0.1	0.2	99.8
20	0.2	0.4	99.6
28	0.4	0.8	99.2
35	0.7	1.5	98.5
48	1.6	3.1	96.9
65	3.2	6.3	93.7
100	5.6	11.9	88.1
150	10.3	22.2	77.8
200	18.3	40.5	59.5
270	14.1	54.6	45.4
400	17.9	72.5	27.5
- 400	27.5	100.0	-
Total	100.0	-	-

Test No. PP21 - Continued

1.4.4. Screen Analyses

Cyclone Underflow

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 10	0.2	0.2	99.8
14	0.2	0.4	99.6
20	0.2	0.6	99.4
28	0.5	1.1	98.9
35	0.8	1.9	98.1
48	1.9	3.8	96.2
65	3.7	7.5	92.5
100	6.4	13.9	86.1
150	11.4	25.3	74.7
200	20.1	45.4	54.6
270	15.0	60.4	39.6
400	18.8	79.2	20.8
- 400	20.8	100.0	-
Total	100.0	-	-

Cyclone Overflow

+ 65	0.5	0.5	99.5
100	1.1	1.6	98.4
150	3.1	4.7	95.3
200	7.6	12.3	87.7
270	8.0	20.3	79.7
400	15.3	35.6	64.4
- 400	64.4	100.0	-
Total	100.0	-	-

Test No. PP21 - Continued

1.4.4. Screen Analyses

Pb Rougher Concentrate

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	5.0	5.0	95.0
270	6.8	11.8	88.2
27.0 µm	18.0	29.8	70.2
20.9	8.8	38.6	61.4
14.6	13.0	51.6	48.4
10.0	11.4	63.0	37.0
7.7	7.4	70.4	29.6
- 7.7	29.6	100.0	-
Total	100.0	-	-

Specific Gravity 4.85

Pb Regrind Discharge

+ 26.5 µm	11.8	11.8	88.2
20.6	9.8	21.6	78.4
14.4	22.8	44.4	55.6
9.9	19.6	64.0	36.0
7.6	9.1	73.1	26.9
- 7.6	26.9	100.0	-
Total	100.0	-	-

Specific Gravity 5.05

Pb Regrind Cyclone Underflow

+ 200 mesh	1.3	1.3	98.7
270	2.9	4.2	95.8
26.1 µm	15.5	19.7	80.3
20.3	12.1	31.8	68.2
14.1	25.9	57.7	42.3
9.7	22.0	79.7	20.3
7.5	8.3	88.0	12.0
- 7.5	12.0	100.0	-
Total	100.0	-	-

Specific Gravity 5.10

Test No. PP21 - Continued

1.4.4. Screen Analyses

Pb Regrind Cyclone Overflow

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 14.8 µm	1.18	1.18	98.82
10.2	4.80	5.98	94.02
7.9	11.30	17.28	82.72
- 7.9	82.72	100.00	-
Total	100.0	-	-

Specific Gravity 4.80

Pb 4th Cleaner Concentrate

+ 24.6 µm	4.3	4.3	95.7
19.0	3.0	7.3	92.7
13.3	9.8	17.1	82.9
9.1	16.5	33.6	66.4
7.1	14.0	47.6	52.4
- 7.1	52.4	100.0	-
Total	100.0	-	-

Specific Gravity 5.79

Zn Regrind Cyclone Underflow

+ 200 mesh	10.6	10.6	89.4
270	11.4	22.0	78.0
28.6 µm	11.2	33.2	66.8
22.2	44.7	77.9	22.1
15.5	15.2	93.1	6.9
10.6	2.1	95.2	4.8
8.2	0.5	95.7	4.3
- 8.2	4.3	100.0	-
Total	100.0	-	-

Specific Gravity 4.45

Test No. PP21 - Continued

1.4.4. Screen Analyses

Zn 4th Cleaner Concentrate

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 30.3 µm	2.0	2.0	98.0
23.5	2.8	4.8	95.2
16.4	11.7	16.5	83.5
11.3	16.2	32.7	67.3
8.7	11.3	44.0	56.0
- 8.7	56.0	100.0	-
Total	100.0	-	-

Specific Gravity 4.11

Zn Regrind Cyclone Overflow

+ 29.8 µm	11.0	11.0	89.0
23.1	6.2	17.2	82.8
16.2	15.6	32.8	67.2
11.1	14.5	47.3	52.7
8.6	8.2	55.5	44.5
- 8.6	44.5	100.0	-
Total	100.0	-	-

Specific Gravity 4.18

Zn Scavenger 2 Tailing

+ 200 mesh	11.3	11.3	88.7
270	8.1	19.4	80.6
32.5 µm	11.7	31.1	68.9
25.2	10.0	41.1	58.9
17.6	13.6	54.7	45.3
12.1	10.6	65.3	34.7
9.3	6.2	71.5	28.5
- 9.3	28.5	100.0	-
Total	100.0	-	-

Specific Gravity 3.70

Test No. PP21 - Continued

1.4.4. Screen Analyses

Zn Regrind Discharge

Particle Size	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 200 mesh	6.5	6.5	93.5
270	10.6	17.1	82.9
28.6 µm	12.5	29.6	70.4
22.2	39.3	68.9	31.1
15.5	22.1	91.0	9.0
10.6	2.6	93.6	6.4
8.2	0.8	94.4	5.6
- 8.2	5.6	100.0	-
Total	100.0	-	-

Specific Gravity 4.51

Test No. PP21 - Continued

2. Flotation

2.1. Purpose:
1) To improve lead recovery.
2) To improve zinc concentrate grade.

2.2. Method: The following changes in the circuits were made;

A. Pb Circuit

1) Increased collector Z-11 to the Hendy mill feed from 0.09 lb/ton to 0.13 lb/ton.
2) Increased cyanide additions to the Hendy mill feed from 0.2 to 0.3 lb/ton, and cyanide was added to the Pb 3rd and 4th cleaners.
3) Collector R-241 was removed from the Sala mill and added to the 1st cleaner feed pump.
4) In the Pb regrind the 1 inch Krebs cyclone was replaced by 20 mm Polyclon cyclone.

B. Zinc Circuit

1) Collectors Z-6, M-748 and Z-200 were replaced with collector Z-11.
2) Increased zinc flotation time by approximately 5.5 minutes.
3) Increased pH in the zinc cleaners from pH 10.3 to 11.5

2.2.1. Flotation Equipment

As for test PP20, except that an additional bank of 6 Fagergreen cells were used in the zinc scavenger circuit.

2.2.2. Flotation Reagents

See following page.

2.4. Flotation Results: The lead circuit was not stable during the test run. The high density in the Pb regrind cyclone overflow resulted in unstable cleaning conditions. This resulted in a low Pb concentrate grade. Changes in the zinc circuit improved zinc concentrate grade.

Test No. PP21 - Continued

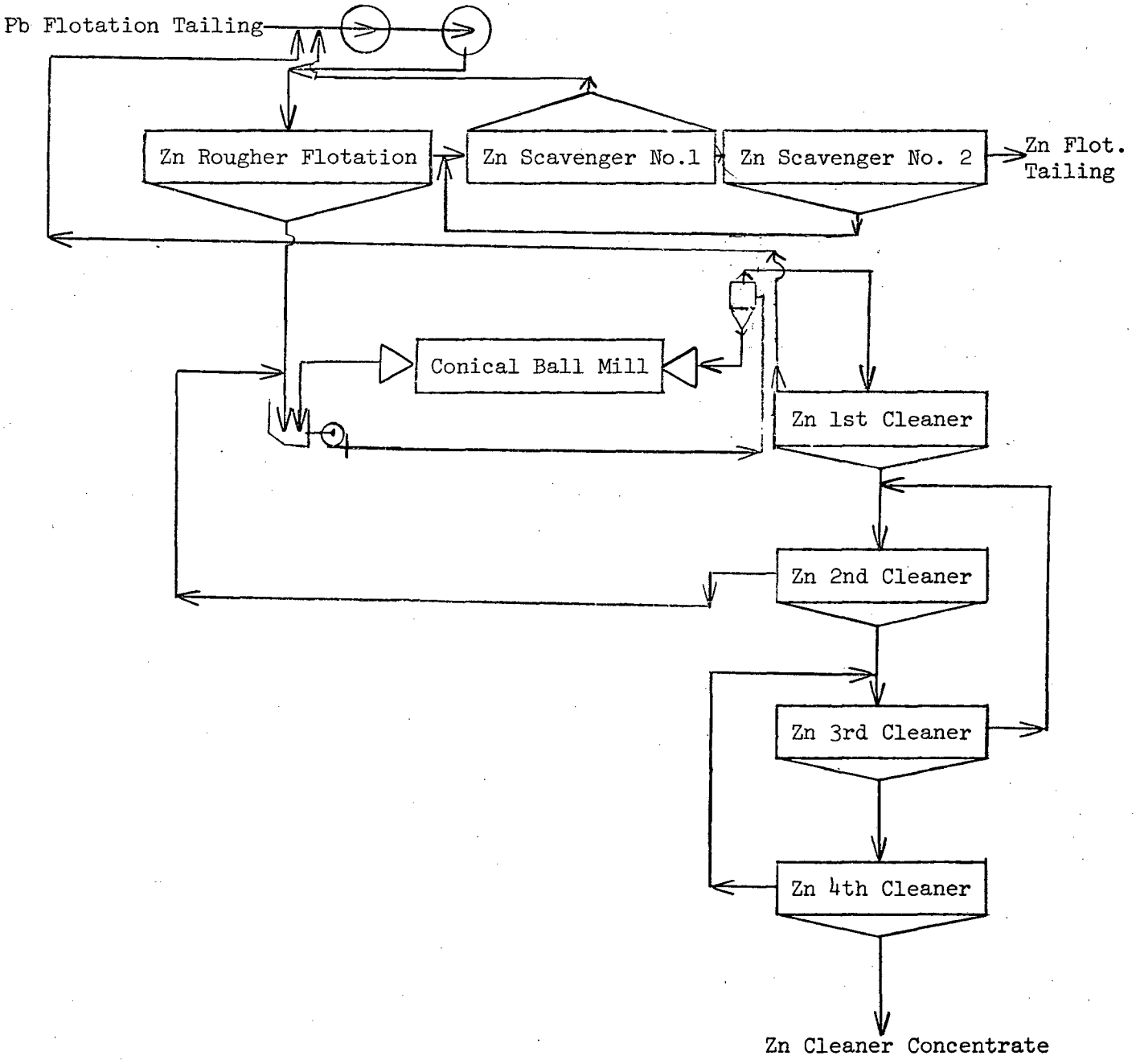
2.2.2. Reagent Additions

Type	Pounds of Reagent per Ton of Feed	Point of Addition
Na_2CO_3	4.28	Ball Mill Feed
$ZnSO_4$	0.95	Ball Mill Feed
NaCN	0.32	Ball Mill Feed
Z-11	0.12	Ball Mill Feed
R-241	0.03	Pb Rougher Conditioner
MIBC	0.075	Pb Rougher Feed Pump
Z-11	0.03	Pb Scavenger Feed
MIBC	0.023	Pb Scavenger Feed
$ZnSO_4$	0.52	Pb Regrind Mill
NaCN	0.31	Pb Regrind Mill
R-241	0.03	Pb 1st Cleaner Feed
MIBC	0.030	Pb 1st Cleaner Feed
Z-11	0.01	Pb 1st Cleaner 4th Cell
NaCN	0.07	Pb 2nd Cleaner Feed
NaCN	0.03	Pb 3rd Cleaner Feed
NaCN	0.03	Pb 4th Cleaner Feed
$Ca(OH)_2$	3.76	Zn Rougher Conditioner No. 1
$CuSO_4$	2.00	Zn Rougher Conditioner No. 2
Z-11	0.30	Zn Rougher Feed Pump
DF-250	0.045	Zn Rougher Feed Pump
Z-11	0.03	Zn 1st Scavenger Feed
DF-250	0.029	Zn 1st Scavenger Feed
Z-11	0.01	Zn 2nd Scavenger Feed
$Ca(OH)_2$	1.02	Zn Regrind Mill
$CuSO_4$	0.20	Zn Regrind Mill
Z-11	0.03	Zn Regrind Mill
Na_2SiO_3	0.22	Zn 1st Cleaner Feed
DF-250	0.032	Zn 1st Cleaner Feed
$Ca(OH)_2$	0.50	Zn 2nd Cleaner Feed
Z-11	0.01	Zn 2nd Cleaner Feed
DF-250	0.006	Zn 3rd Cleaner Feed
$Ca(OH)_2$	0.40	Zn 3rd Cleaner Feed
$Ca(OH)_2$	0.30	Zn 4th Cleaner Feed

Test No. PP21 - Continued

2.3. Flowsheet

A) Pb Circuit: As for test PP18
B) Zinc Circuit



Test No. PP21 - Continued

2.4. Results:

2.4.1. pH

Product	pH
Cyclone Overflow	9.2
Pb Rougher Feed	9.2
Pb Scavenger Tailing	9.0
Pb Regrinding Mill Discharge	8.3
Pb 1st Cleaner Feed	9.0
Pb 2nd Cleaner Feed	9.2
Pb 3rd Cleaner Feed	9.2
Pb 4th Cleaner Feed	9.3
Zn Rougher Feed	10.5
Zn Scavenger Tailing	9.9
Zn 2nd Scavenger Feed	9.8
Zn 1st Cleaner Feed	11.2
Zn 2nd Cleaner Feed	11.5
Zn 3rd Cleaner Feed	11.6
Zn 4th Cleaner Feed	11.7

2.4.2. Pulp Densities

Product	Pulp Density gpl
Pb Rougher Feed	1195
Pb Scavenger Tailing	1160
Pb 1st Cleaner Feed	1117
Zn Rougher Feed	1100
Zn Scavenger Tailing	1085
Zn 1st Cleaner Feed	1095

2.4.3. Pulp Temperature

Product	°C
Pb Rougher Feed	24
Pb Regrinding Mill Discharge	27
Zn Rougher Feed	25
Zn Regrinding Mill Discharge	27

Test No. PP21 - Continued

2.4.4. Chemical Analyses

Product	Assays, %	
	Pb	Zn
Cyclone Overflow	6.10	10.4
Pb Rougher Feed	6.22	11.2
Pb Rougher Concentrate	23.1	15.3
Pb Rougher Tailing	1.99	10.4
Pb Scavenger Concentrate	6.74	15.8
Pb Scavenger Tailing	1.58	9.90
Pb 1st Cleaner Concentrate	27.3	19.2
Pb 1st Cleaner Tailing	6.83	16.2
Pb Regrind Cyclone Overflow	22.5	15.7
Pb Regrind Cyclone Underflow	23.1	13.3
Pb Cleaner Concentrate	53.6	13.1
Zn Rougher Feed	1.76	9.67
Zn Rougher Concentrate	2.73	31.2
Zn Rougher Tailing	1.49	3.54
Zn Scavenger Concentrate No. 1	2.97	14.5
Zn Scavenger Concentrate No. 2	3.21	9.69
Zn Scavenger Tailing No. 1	1.48	2.54
Zn Scavenger Tailing No. 2	1.29	1.73
Zn 1st Cleaner Tailing	3.32	8.27
Zn 1st Cleaner Concentrate	3.10	45.9
Zn Regrind Cyclone Overflow	3.27	26.6
Zn Regrind Cyclone Underflow	1.87	17.4
Zn Cleaner Concentrate	2.39	53.9

Test No. PP21 - Continued

2.4.5. Metallurgical Results

Two-Product Formula

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
Pb Ro. Concentrate	19.47	23.1	15.3	73.7	26.2
Pb Ro. Tailing	80.53	1.99	10.4	26.3	73.8
Cyclone Overflow (meas)	100.00	6.10	10.4	100.0	100.0
(Calc.)	-	6.10	11.4	-	-
Pb Scav. Concentrate	6.40	6.74	15.8	7.07	8.91
Pb Scav. Tailing	74.13	1.58	9.90	19.2	64.6
Pb Ro. Tailing (meas)	80.53	1.99	10.4	26.3	80.5
(Calc.)	-	1.99	10.4	26.3	73.5
Pb 1st Cl. Conc.	15.48	27.3	19.2	69.3	26.2
Pb 1st Cl. Tail.	3.99	6.83	16.2	4.47	5.69
Pb Ro. Conc. (meas)	19.47	23.1	15.3	73.7	28.6
(Calc.)	-	23.1	18.6	73.8	31.9
Zn Ro. Concentrate	17.05	2.73	31.2	7.6	46.9
Zn Ro. Tailing	57.08	1.49	3.54	13.9	17.8
Pb Scav. Tailing (meas)	74.13	1.58	9.90	19.2	70.6
(Calc.)	-	1.78	9.90	21.5	64.7
Zn Scav. Conc. No. 1	4.77	2.97	14.5	2.3	6.1
Zn Scav. Tail. No. 1	52.31	1.48	2.54	12.7	11.7
Zn Ro. Tailing (meas)	57.08	1.49	3.54	13.9	19.4
(Calc.)	-	1.60	3.54	15.0	17.8
Zn Scav. Conc. No. 2	5.32	3.21	9.69	2.6	4.5
Zn Scav. Tail. No. 2	46.99	1.29	1.73	9.9	7.2
Zn Scav. Tail. No. 1 (meas)	52.31	1.48	2.54	12.7	12.8
(Calc.)	-	1.49	2.54	12.7	11.7
Zn 1st Cl. Conc.	10.39	3.10	45.9	5.3	42.0
Zn 1st Cl. Tail.	6.66	3.32	8.27	3.6	4.9
Zn Ro. Concentrate (meas)	17.05	2.73	31.2	7.6	51.2
(Calc.)	-	3.19	31.2	8.9	46.9

Three-Product Formula

Pb 4th Cl. Conc.	8.89	53.6	13.1	78.1	11.2
Zn 4th Cl. Conc.	14.68	2.39	53.9	5.75	76.1
Zn Scav. Tail.	76.43	1.29	1.7	16.2	12.7
Cyclone Overflow	100.00	6.10	10.4	100.0	100.0

Test No. PP22

1. Grinding

1.1. Purpose: To repeat the conditions of test PP21.

1.2. Method: Similar to test PP1 - 21. The grinding circuit was operated for a period of 7.75 hours at a feed rate of 697 pounds per hour. Samples were taken every 20 minutes in the last two hours of operation.

1.2.1. Classification Equipment

Hendy Mill; P-50 Dorr Cyclone:

1 1/2 inch diameter
5/8 inch vortex
1/2 inch apex

Pb Regrind

Sala Mill; Krebs Cyclone:

1 inch diameter
1/4 inch vortex
1/8 inch apex

Zn Regrind

Conical Mill; Krebs Cyclone:

1 1/2 inch diameter
1/2 inch vortex
1/4 inch apex

1.3. Flowsheet: As for test PP1.

1.4. Results: The grinding circuit was stable during the test run. Net power consumption in the Hendy mill was 14.84 kilowatt-hours per ton of ½ inch feed. The cyclone overflow was 86.5 % minus 200 mesh.

Test No. PP22 - Continued

1.4. Results:

1.4.1. Ball Mill Report

Feed:	Minus ½ inch ore at 0.4 percent moisture content		
Feed Rate:	697 dry pounds per hour		
Mill Speed:	32 r.p.m., 80.5 percent of critical speed		
Mill Load:	3 inch balls	1000 pounds	
	1½ inch balls	600 pounds	
	1 inch balls	400 pounds	
	Total	2000 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Mill Feed:	Total 5402 pounds, test period 1394 pounds		
Circulating Load:	Cyclone Underflow 572 percent		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2090	65
	Cyclone Overflow	1352	33
	Cyclone Underflow	2468	74
Average Power:	Gross	7.13 kilowatts	
	No Load	1.92 kilowatts	
	Net	5.21 kilowatts	
Net Power Consumption:	14.89 kilowatt-hours per ton of ½ inch feed.		
Work Index:	11.72		

Test No. PP22 - Continued

1.4. Results:

1.4.2. Lead Regrind Mill Report

Regrinding Mill:	Sala Mill		
Feed:	Lead Rougher Concentrate and Lead 2nd Cleaner Tailing		
Feed Rate:	148.4 pounds per hour 21.26 percent of the mill feed		
Mill Speed:	31 r.p.m., 73 percent of critical speed		
Mill Load:	2 inch balls	380 pounds	
	1 inch balls	820 pounds	
	Total	1200 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2396	73
	Cyclone Feed	1235	24
	Cyclone Overflow	1095	11.5
	Cyclone Underflow	2396	73
Average Power:	Gross	6.89 kilowatts	
	No Load	0.92 kilowatts	
	Net	5.97 kilowatts	
Net Power Consumption:	19.68 kilowatt-hours per ton of feed.		

Test No. PP22 - Continued

1.4. Results:

1.4.3. Zinc Regrind Mill Report

Regrinding Mill:	Conical Mill		
Feed:	Zn Ro. Conc., Zn 2nd Cl. Tail. and Zn 1st Cl. Scav. Conc.		
Feed Rate:	101.1 pounds per hour, 14.48 percent of the mill feed		
Mill Speed:	32 r.p.m., 75 percent of critical speed		
Mill Load:	1 inch balls	320 pounds	
	½ inch balls	220 pounds	
	Total	540 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2252	74
	Cyclone Overflow	1058	7.0
	Cyclone Underflow	2252	74
Average Power:	Gross	1.90 kilowatts	
	No Load	0.92 kilowatts	
	Net	0.98 kilowatts	
Net Power Consumption:	2.80 kilowatt-hours per ton of feed.		

Test No. PP22 - Continued

1.4.4. Screen Analyses

Hendy Mill Feed

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 3/8	4.1	4.1	95.9
3	13.7	17.8	82.2
4	11.3	29.1	70.9
6	10.7	39.8	60.2
8	9.8	49.6	50.4
10	7.5	57.1	42.9
14	6.2	63.3	36.7
20	4.6	67.9	32.1
28	3.8	71.7	28.3
35	3.1	74.8	25.2
48	3.4	78.2	21.8
65	3.1	81.3	18.7
100	2.6	83.9	16.1
150	2.6	86.5	13.5
200	2.8	89.3	10.7
- 200	10.7	100.0	-
Total	100.0	-	-

Mill Discharge

+ 10	0.1	0.1	99.9
14	0.2	0.3	99.7
20	0.3	0.6	99.4
28	0.4	1.0	99.0
35	0.7	1.7	98.3
48	1.7	3.4	96.6
65	3.2	6.6	93.4
99	5.7	12.3	87.7
150	10.6	22.9	77.1
200	18.8	58.3	58.3
270	14.7	56.4	43.6
400	17.4	73.8	26.2
- 400	26.2	100.0	-
Total	100.0	-	-

Test No. PP22 - Continued

1.4.4. Screen Analyses

Cyclone Underflow

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 10	0.2	0.2	99.8
14	0.2	0.4	99.6
20	0.3	0.7	99.3
28	0.6	1.3	98.7
35	0.8	2.1	97.9
48	2.1	4.2	95.8
65	3.8	8.0	92.0
100	6.5	14.5	85.5
150	11.8	26.3	73.7
200	20.4	46.7	53.3
270	15.5	62.2	37.8
400	18.6	80.8	19.2
- 400	19.2	100.0	-
Total	100.0	-	-

Cyclone Overflow

+ 65	0.6	0.6	99.4
100	1.2	1.8	98.2
150	3.3	5.1	94.9
200	8.4	13.5	86.5
270	8.7	22.2	77.8
400	15.4	37.6	62.4
- 400	62.4	100.0	-
Total	100.0	-	-

Test No. PP22 - Continued

1.4.4. Screen Analyses

Pb Rougher Concentrate

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	8.8	8.8	91.2
270	8.5	17.3	82.7
27.8 µm	18.6	35.9	64.1
21.5	8.2	44.1	55.9
15.0	11.6	55.7	44.3
10.3	10.0	65.7	34.3
7.9	6.6	72.3	27.7
- 7.9	27.7	100.0	-
Total	100.0	-	-

Specific Gravity 4.74

Pb Regrind Discharge

+ 27.4 µm	14.9	14.9	85.1
21.2	8.8	23.7	76.3
14.8	19.0	42.7	57.3
10.2	20.4	63.1	36.9
7.9	11.2	74.3	25.7
- 7.9	25.7	100.0	-
Total	100.0	-	-

Specific Gravity 4.81

Pb Regrind Cyclone Underflow

+ 200 mesh	5.8	5.8	94.2
270	6.3	12.1	87.9
27.4 µm	17.7	29.8	70.2
21.2	10.5	40.3	59.7
14.8	19.0	59.3	40.7
10.2	19.8	79.1	20.9
7.9	9.2	88.3	11.7
- 7.9	11.7	100.0	-
Total	100.0	-	-

Specific Gravity 4.76

Test No. PP22 - Continued

1.4.4. Screen Analyses

Pb Regrind Cyclone Overflow

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 27.8 µm	0.2	0.2	99.8
21.5	0.6	0.8	99.2
15.0	5.7	6.5	93.5
10.3	11.8	18.3	81.7
7.9	12.3	30.6	69.4
- 7.9	69.4	100.0	-
Total	100.0	-	-

Specific Gravity 4.72

Pb 4th Cleaner Concentrate

+ 23.2 µm	2.4	2.4	97.6
18.0	1.6	4.0	96.0
12.6	6.2	10.2	89.8
8.6	12.5	22.7	77.3
6.7	12.0	34.7	65.3
- 6.7	65.3	100.0	-
Total	100.0	-	-

Specific Gravity 6.28

Zn Regrind Discharge

+ 200 mesh	6.0	6.0	94.0
270	10.8	16.8	83.2
29.4 µm	12.4	29.2	70.8
22.8	40.8	70.0	30.0
15.9	23.0	93.0	7.0
10.9	1.8	94.8	5.2
8.5	0.6	95.4	4.6
- 8.5	4.6	100.0	-
Total	100.0	-	--

Specific Gravity 4.33

Test No. PP22 - Continued

1.4.4. Screen Analyses

Zn Regrind Cyclone Underflow

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	8.2	8.2	91.8
270	11.8	20.0	80.0
29.4 µm	11.6	31.6	68.4
22.8	40.6	72.2	27.8
15.9	22.5	94.7	5.3
10.9	1.1	95.8	4.2
8.5	0.3	96.1	3.9
- 8.5	3.9	100.0	-
Total	100.0	-	-

Specific Gravity 4.33

Zn Regrind Cyclone Overflow

+ 29.4 µm	6.3	6.3	93.7
22.8	5.8	12.1	87.9
15.9	14.2	26.3	73.7
10.9	14.4	40.7	59.3
8.5	9.2	49.9	50.1
- 8.5	50.1	100.0	-
Total	100.0	-	-

Specific Gravity 4.23

Zn 4th Cleaner Concentrate

+ 29.8 µm	4.5	4.5	95.5
23.1	7.0	11.5	88.5
16.2	18.4	29.9	70.1
11.1	16.0	45.9	54.1
8.6	10.6	56.5	43.5
- 8.6	43.5	100.0	-
Total	100.0	-	-

Specific Gravity 4.19

Test No. PP22 - Continued

1.4.4. Screen Analyses

Zn Combined Tailing

Particle Size	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 200 mesh	12.2	12.2	87.8
270	8.5	20.7	79.3
31.9 µm	11.7	32.4	67.6
24.7	9.4	41.8	58.2
17.3	12.6	54.4	45.6
11.9	10.3	64.7	35.3
9.2	6.3	71.0	29.0
- 9.2	29.0	100.0	-
Total	100.0	-	-

Specific Gravity 3.77

Test No. PP22 - Continued

2. Flotation

2.1. Purpose:

1) To improve lead concentrate grade.
2) To improve zinc recovery.

2.2. Method:

The flowsheet for the lead circuit was similar to test PP21. The polyclon 20 mm cyclone in the Pb regrind was replaced with a 1 inch Krebs cyclone. The cyanide additions to the Pb 3rd and 4th cleaners were omitted. Froth discharge in the lead scavenger circuit was maintained at a low level.

In the zinc circuit the flowsheet and reagent balance were modified as follows:

1) The second scavenger stage was omitted from the circuit, and the 1st cleaner tailing was scavenged in open circuit. The 1st cleaner scavenger concentrate was returned to the zinc regrind feed pump and tailing was discarded.

2) The $CuSO^4$ was moved from the Zn 2nd conditioner to the Zn 1st conditioner, and lime was added to the zinc 2nd conditioner.

3) Increased collector additions to the Zn scavenger cleaner feed.

4) pH in the Zn cleaning was maintained at pH 11.0

2.2.1. Flotation Equipment

As for test PP21.

2.2.2. Flotation Reagents

See following page.

2.4. Flotation Results:

The lead grade improved significantly after the above changes, but the recovery was poor. The lead cleaner concentrate assayed 62.5 % Pb at 71 % recovery. The zinc recovery improved slightly from 76 % Zn in the previous test to 78 % Zn, but the tailing assay remained very high. It appeared that longer flotation time would further improve zinc recovery.

Test No. PP22 - Continued

2.2.2. Reagent Additions

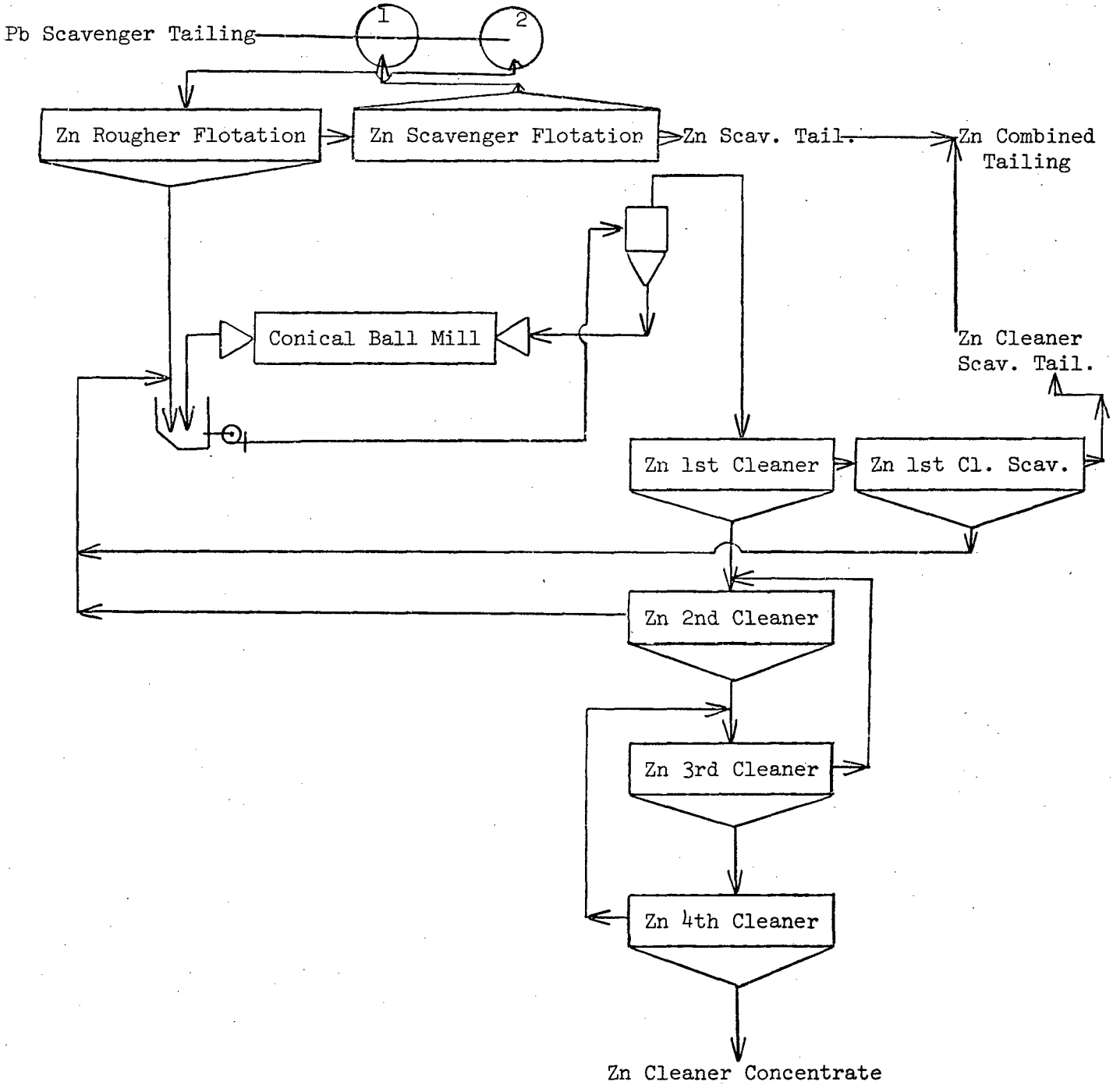
Type	Pounds of Reagent per ton of Feed	Point of Addition
Na_2CO_3	4.12	Ball Mill Feed
$ZnSO_4$	0.25	Ball Mill Feed
NaCN	0.33	Ball Mill Feed
Z-11	0.13	Ball Mill Feed
R-241	0.03	Pb Rougher Conditioner
MIBC	0.075	Pb Rougher Feed Pump
Z-11	0.03	Pb Scavenger Feed
MIBC	0.023	Pb Scavenger Feed
NaCN	0.31	Pb Regrind Mill
$ZnSO_4$	0.56	Pb Regrind Mill
R-241	0.03	Pb Regrind Mill
MIBC	0.030	Pb 1st Cleaner Feed
Z-11	0.02	Pb 1st Cleaner Feed
NaCN	0.07	Pb 2nd Cleaner Feed
$CuSO_4$	2.08	Zn Ro. Conditioner No. 1
$Ca(OH)_2$	2.20	Zn Ro. Conditioner No. 2
Z-11	0.30	Zn Rougher Feed Pump
DF-250	0.075	Zn Rougher Feed Pump
Z-11	0.03	Zn Scavenger Feed
DF-250	0.03	Zn Scavenger Feed
$Ca(OH)_2$	1.24	Zn Regrind Mill
$CuSO_4$	0.30	Zn Regrind Mill
Z-11	0.03	Zn Regrind Mill
DF-250	0.030	Zn 1st Cleaner Feed
Z-11	0.06	Zn 1st Cl. Scav. Feed
Z-200	0.007	Zn 1st Cl. Scav. Feed
$Ca(OH)_2$	0.20	Zn 2nd Cleaner Feed
Z-11	0.01	Zn 2nd Cleaner Feed
DF-250	0.008	Zn 3rd Cleaner Feed
$Ca(OH)_2$	0.20	Zn 3rd Cleaner Feed
$Ca(OH)_2$	0.12	Zn 4th Cleaner Feed

Test No. PP22 - Continued

2.3. Flowsheet

a) Pb Circuit: As for test PP21

b) Zn Circuit



Test No. PP22 - Continued

2.4. Results:

2.4.1. pH

Product	pH
Cyclone Overflow	9.1
Pb Rougher Feed	9.0
Pb Scavenger Tailing	8.8
Pb Regrinding Mill Discharge	8.1
Pb 1st Cleaner Feed	9.1
Pb 2nd Cleaner Feed	9.4
Pb 3rd Cleaner Feed	9.4
Pb 4th Cleaner Feed	9.6
Zn Rougher Feed	10.0
Zn Scavenger Tailing	9.4
Zn 1st Cl. Scav. Feed	11.1
Zn 1st Cleaner Feed	11.2
Zn 2nd Cleaner Feed	11.1
Zn 3rd Cleaner Feed	11.2
Zn 4th Cleaner Feed	11.0

2.4.2. Pulp Densities

Product	Pulp Density gpl
Pb Rougher Feed	1235
Pb Scavenger Tailing	1180
Pb 1st Cleaner Feed	1095
Zn Rougher Feed	1160
Zn Scavenger Tailing	1135
Zn 1st Cleaner Feed	1058

2.4.3. Pulp Temperature

Product	°C
Pb Rougher Feed	24
Pb Regrind Mill Discharge	29
Zn Rougher Feed	26
Zn Regrind Mill Discharge	25

Test No. PP22 - Continued

2.4.4. Chemical Analyses

Product	Assays, %	
	Pb	Zn
Cyclone Overflow	6.05	10.3
Pb Rougher Feed	6.17	11.0
Pb Rougher Concentrate	20.2	14.7
Pb Rougher Tailing	2.23	9.79
Pb Scavenger Concentrate	6.90	14.6
Pb Scavenger Tailing	1.88	9.48
Pb 1st Cleaner Concentrate	33.7	16.0
Pb 1st Cleaner Tailing	10.5	17.7
Pb Regrind Cyclone Overflow	22.0	16.7
Pb Regrind Cyclone Underflow	19.4	15.7
Pb Cleaner Concentrate	62.3	8.99
Zn Rougher Feed	1.99	9.99
Zn Rougher Concentrate	2.88	36.3
Zn Rougher Tailing	1.74	2.87
Zn Scavenger Concentrate	4.61	14.9
Zn Scavenger Tailing	1.63	1.92
Zn 1st Cleaner Tailing	4.31	8.57
Zn 1st Cleaner Concentrate	3.36	48.7
Zn Regrind Cyclone Overflow	4.27	30.8
Zn Regrind Cyclone Underflow	1.85	21.9
Zn 1st Cl. Scav. Conc.	4.93	12.7
Zn 1st Cl. Scav. Tail.	3.47	3.20
Zn Combined Tailing	1.72	2.08
Zn Cleaner Concentrate	2.47	54.2

Test No. PP22 - Continued

2.4.5. Metallurgical Results

Two-Product Formula

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
Pb Ro. Concentrate	21.26	20.2	14.7	71.0	28.9
Pb Ro. Tailing	78.74	2.23	9.79	29.0	71.1
Cyclone Overflow (meas)	100.00	6.05	10.3	100.0	100.0
(Calc.)	-	6.05	10.8	-	-
Pb Scav. Concentrate	5.49	6.90	14.6	6.26	7.40
Pb Scav. Tailing	73.25	1.88	9.48	22.8	64.1
Pb Ro. Tailing (meas)	78.74	2.23	9.79	29.0	74.8
(Calc.)	-	2.23	9.84	29.1	71.5
Pb 1st Cl. Concentrate	8.89	33.7	16.0	49.5	13.1
Pb 1st Cl. Tailing	12.37	10.5	17.7	21.5	20.2
Pb Ro. Concentrate (meas)	21.26	20.2	14.7	71.0	30.3
(Calc.)	-	20.2	17.0	71.0	33.4
Zn Ro. Concentrate	14.48	2.88	36.3	6.89	48.5
Zn Ro. Tailing	58.77	1.74	2.87	16.9	15.6
Pb Scav. Tailing (meas)	73.25	1.88	9.48	22.8	67.4
(Calc.)	-	1.97	9.48	23.8	64.1
Zn Scav. Concentrate	4.30	4.61	14.9	3.28	5.92
Zn Scav. Tailing	54.47	1.63	1.92	14.7	9.66
Zn Ro. Tailing (meas)	58.77	1.74	2.87	16.9	16.4
(Calc.)	-	1.85	2.87	18.0	15.6
Zn 1st Cl. Conc.	10.01	3.36	48.7	5.56	45.0
Zn 1st Cl. Tail.	4.47	4.31	8.57	3.19	3.54
Zn Ro. Concentrate (meas)	14.48	2.88	36.3	6.89	51.0
(Calc.)	-	3.65	36.3	8.74	48.5
Zn 1st Cl. Scav. Conc.	2.53	4.93	12.7	2.06	2.97
Zn 1st Cl. Scav. Tail.	1.94	3.47	3.20	1.11	0.57
Zn 1st Cl. Tail. (meas)	4.47	4.31	8.57	3.18	3.72
(Calc.)	-	4.30	8.58	3.17	3.54

Three-Product Formula

Pb 4th Cl. Concentrate	6.96	62.3	8.99	71.7	6.1
Zn 4th Cl. Concentrate	14.85	2.47	54.2	6.06	78.1
Zn Combined Tailing	78.19	1.72	2.08	22.2	15.8
Cyclone Overflow (meas)	100.00	6.05	10.3	100.0	100.0
(Calc.)	-	6.05	10.3	-	-

Test No. PP22 - Continued

2.4.6. Water Assays

Product	pH	S_2O_3 ppm
Hendy Cyclone Overflow	8.55	134.5
Pb Scavenger Tailing	8.45	97.9
Zn Scavenger Tailing	8.89	117.1
Tailing Pond H_2O	8.40	86.7

Product	Na_2CO_2 g/l	$NaHCO_3$ g/l	CN mg/l
Tailing H_2O	-	-	0.270
Hendy Cyclone Overflow	0.067	0.537	-
Pb Scavenger Tailing	0.022	0.260	-

Test No. PP23

1. Grinding

1.1. Purpose: To repeat the conditions of test PP22.

1.2. Method: Similar to test PP 1 - 22. The grinding circuit was operated for a period of 7.75 hours at a feed rate of 696 pounds per hour. Samples were taken every 20 minutes during the last two hours of operation.

1.2.1. Classification Equipment

Hendy Mill; P-50 Dorr Cyclone:

1 1/2 inch diameter
5/8 inch vortex
1/2 inch apex

Pb Regrind

Sala Mill; Krebs Cyclone:

1 inch diameter
1/4 inch vortex
1/8 inch apex

Zn Regrind

Conical Mill; Krebs Cyclone:

1 1/2 inch diameter
1/2 inch vortex
1/4 inch apex

2.3. Flowsheet: As for test PP1.

2.4. Results: The grinding circuit was very stable throughout the test run. Net power consumption in the Hendy mill was 13.86 kilowatt-hours per ton of ½ inch feed. The cyclone overflow was 88.2 % minus 200 mesh.

Test No. PP23 - Continued

1.4. Results:

1.4.1. Ball Mill Report

Feed:	Minus ½ inch ore at 0.5 percent moisture content		
Feed Rate:	696 dry pounds per hour		
Mill Speed:	32 r.p.m., 80.5 percent of critical speed		
Mill Load:	3 inch balls	1000 pounds	
	1½ inch balls	600 pounds	
	1 inch balls	400 pounds	
	Total	2000 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Mill Feed:	Total 5394 pounds, test period 1392 pounds		
Circulating Load:	Cyclone Underflow 555 percent		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2082	69
	Cyclone Overflow	1356	35
	Cyclone Underflow	2440	78
Average Power:	Gross	6.77 kilowatts	
	No Load	1.92 kilowatts	
	Net	4.85 kilowatts	
Net Power Consumption:	13.86 kilowatt-hours per ton of ½ inch feed.		
Work Index:	11.31		

Test No. PP23 - Continued

1.4. Results:

1.4.2. Lead Regrind Mill Report

Regrinding Mill:	Sala Mill		
Feed:	Lead Rougher Concentrate and 2nd Cleaner Tailing		
Feed Rate:	101.6 pounds per hour, 14.60 percent of the mill feed		
Mill Speed:	31 r.p.m., 73 percent of critical speed		
Mill Load:	2 inch balls	380 pounds	
	1 inch balls	820 pounds	
	Total	1200 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2418	74
	Cyclone Feed	1263	26
	Cyclone Overflow	1083	9.5
	Cyclone Underflow	2418	74
Average Power:	Gross	6.65 kilowatts	
	No Load	0.92 kilowatts	
	Net	5.73 kilowatts	

Net Power Consumpiton: 16.37 kilowatt-hours per ton of feed.

Test No. PP23 - Continue

1.4. Results:

1.4.3. Zinc Regrind Mill Report

Regrinding Mill:	Conical Mill		
Feed:	Zn Ro. Conc., Zn 2nd Cl. Tail. and Zn 1st Cl. Scav. Conc.		
Feed Rate:	156.4 pounds per hour, 22.47 percent of the mill feed		
Mill Speed:	31 r.p.m., 73 percent of critical speed		
Mill Load:	1 inch balls	320 pounds	
	½ inch balls	220 pounds	
	Total	540 pounds	
Operating Time:	Total 7.75 hours, test period 2.0 hours		
Pulp Densities:		gpl	% Solids
	Mill Discharge	2460	79
	Cyclone Overflow	1113	13.5
	Cyclone Underflow	2460	79
Average Power:	Gross	1.90 kilowatts	
	No Load	0.92 kilowatts	
	Net	0.98 kilowatts	

Net Power Consumption: 2.80 kilowatt-hours per ton of feed.

Test No. PP23 - Continued

1.4.4. Screen Analyses

Hendy Mill Feed

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 3/8	2.2	2.2	97.8
3	11.7	13.9	86.1
4	15.2	29.1	70.9
6	10.8	39.9	60.1
8	10.0	49.9	50.1
10	8.4	58.3	41.7
14	6.6	64.9	35.1
20	4.9	69.8	30.2
28	3.9	73.7	26.3
35	3.1	76.8	23.2
48	3.2	80.0	20.0
65	3.0	83.0	17.0
100	2.3	85.3	14.7
150	2.3	87.6	12.4
200	2.6	90.2	9.8
- 200	9.8	100.0	-
Total	100.0	-	-

Mill Discharge

+ 10	0.1	0.1	99.9
14	0.1	0.2	99.8
20	0.2	0.4	99.6
28	0.4	0.8	99.2
35	0.7	1.5	98.5
48	1.6	3.1	96.9
65	3.1	6.2	93.8
100	5.5	11.7	88.3
150	10.4	22.1	77.9
200	18.4	40.5	59.5
270	14.1	54.6	45.4
400	17.8	72.4	27.6
- 400	27.6	100.0	-
Total	100.0	-	-

Test No. PP23 - Continued

1.4.4. Screen Analyses

Cyclone Underflow

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 10	0.1	0.1	99.9
14	0.2	0.3	99.7
20	0.3	0.6	99.4
28	0.5	1.1	98.9
35	0.8	1.9	98.1
48	2.0	3.9	96.1
65	3.7	7.6	92.4
100	6.3	13.9	86.1
150	11.4	25.3	74.7
200	19.7	45.0	55.0
270	14.9	59.9	40.1
400	18.3	78.2	21.8
- 400	21.8	100.0	-
Total	100.0	-	-

Cyclone Overflow

+ 65	0.5	0.5	99.5
100	1.0	1.5	98.5
150	2.9	4.4	95.6
200	7.4	11.8	88.2
270	7.9	19.7	80.3
400	15.0	34.7	65.3
- 400	65.3	100.0	-
Total	100.0	-	-

Test No. PP23 - Continued

1.4.4. Screen Analyses

Pb Rougher Concentrate

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	7.4	7.4	92.6
270	7.7	15.1	84.9
27.0 µm	18.3	33.4	66.6
20.9	8.4	41.8	58.2
14.6	12.2	54.0	46.0
10.0	10.3	64.3	35.7
7.7	7.0	71.3	28.7
- 7.7	28.7	100.0	-
Total	100.0	-	-

Specific Gravity 4.92

Pb Regrind Cyclone Underflow

+ 200 mesh	3.7	3.7	96.3
270	4.4	8.1	91.9
27.0 µm	16.6	24.7	75.3
20.9	11.0	35.7	64.3
14.6	24.0	59.7	40.3
10.0	20.4	80.1	19.9
7.7	8.0	88.1	11.9
- 7.7	11.9	100.0	-
Total	100.0	-	-

Specific Gravity 4.94

Pb Regrind Discharge

+ 26.1 µm	13.0	13.0	87.0
20.3	10.0	23.0	77.0
14.1	24.5	47.5	52.5
9.7	23.0	70.5	29.5
7.5	9.0	79.5	20.5
- 7.5	20.5	100.0	-
Total	100.0	-	-

Specific Gravity 5.12

Test No. PP23 - Continued

1.4.4. Screen Analyses

Pb Regrind Cyclone Overflow

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 21.5 µm	0.4	0.4	99.6
15.0	1.0	1.4	98.6
10.3	8.6	10.0	90.0
8.0	10.8	20.8	79.2
- 8.0	79.2	100.0	-
Total	100.0	-	-

Specific Gravity 4.68

Pb 4th Cleaner Concentrate

+ 13.7 µm	3.2	3.2	96.8
9.4	13.3	16.5	83.5
7.3	17.5	34.0	66.0
- 7.3	66.0	100.0	-
Total	100.0	-	-

Specific Gravity 5.44

Zn Regrind Cyclone Overflow

+ 29.4 µm	17.7	17.7	82.3
22.8	16.1	33.8	66.2
15.9	18.9	52.7	47.3
10.9	11.2	63.9	36.1
8.5	6.0	69.9	30.1
- 8.5	30.1	100.0	-
Total	100.0	-	-

Specific Gravity 4.27

Test No. PP23 - Continued

1.4.4. Screen Analyses

Zn Regrind Cyclone Underflow

Particle Size	% Retained Individual	% Retained Cumulative	% Passing Cumulative
+ 200 mesh	9.7	9.7	90.3
270	14.6	24.3	75.7
29.0 µm	13.3	37.6	62.4
22.5	43.0	80.6	19.4
15.7	14.2	94.8	5.2
10.8	1.6	96.4	3.6
8.3	0.4	96.8	3.2
- 8.3	3.2	100.0	-
Total	100.0	-	-

Specific Gravity 4.38

Zn 4th Cleaner Concentrate

+ 30.3 µm	2.1	2.1	97.9
23.5	4.4	6.5	93.5
16.4	13.2	19.7	80.3
11.3	14.4	34.1	65.9
8.6	10.7	44.8	55.2
- 8.6	55.2	100.0	-
Total	100.0	-	-

Specific Gravity 4.14

Zn Combined Tailing

+ 200 mesh	10.9	10.9	89.1
270	7.8	18.7	81.3
32.7 µm	13.3	32.0	68.0
25.4	11.4	43.4	56.6
17.7	13.6	57.0	43.0
12.2	9.8	66.8	33.2
9.4	5.8	72.6	27.4
- 9.4	27.4	100.0	-
Total	100.0	-	-

Specific Gravity 3.65

Test No. PP23 - Continued

1.4.4. Screen Analyses

Zn Regrind Discharge

Particle Size	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 200 mesh	7.7	7.7	92.3
270	15.4	23.1	76.9
28.6 µm	15.6	38.7	61.3
22.2	48.6	87.3	12.7
15.5	5.8	93.1	6.9
10.6	1.7	94.8	5.2
8.2	0.8	95.6	4.4
- 8.2	4.4	100.0	-
Total	100.0	-	-

Specific Gravity 4.45

Test No. PP23 - Continued

2. Flotation

2.1. Purpose:

1) To investigate the effect of omitting the $ZnSO_4$ from the lead circuit.
2) To investigate the effect of Z-200 additions to the zinc circuit when using flowsheet from test PP22.

2.2. Method:

The following reagents changes were made:

A. Pb Circuit

1) The $ZnSO_4$ was omitted from the Hendy mill feed and Sala mill feed.

B. Zn Circuit

1) The Z-11 additions to the Zn rougher were decreased, and Z-200 was added at a rate of 0.15 lb/ton.
2) The Z-11 additions in the cleaning were replaced with Z-200.
3) The pH in the Zn rougher was lowered from pH 10.3 to 9.8, and the pH in the zinc cleaning was maintained slightly above pH 11.0

2.2.1. Flotation Equipment

As for test PP22.

2.2.2. Flotation Reagents

See following page.

2.3. Flowsheet:

As for test PP22.

2.4. Results:

The unstable conditions in the lead cleaning resulted in a poor lead concentrate grade and recovery. The high pH in the zinc cleaning improved zinc concentrate grade, but recovery was poor. It would appear that pH in the zinc cleaning should be maintained slightly above pH 11.0.

Test No. PP23 - Continued

2.2.2. Reagent Additions

Type	Pounds of Reagent per Ton of Feed	Point of Addition
Na_2CO_3	4.12	Ball Mill Feed
NaCN	0.30	Ball Mill Feed
Z-11	0.13	Ball Mill Feed
R-242	0.04	Pb Rougher Conditioner
MIBC	0.076	Pb Rougher Feed Pump
MIBC	0.023	Pb Scavenger Feed
Z-11	0.03	Pb Scavenger Feed
NaCN	0.31	Pb Regrind Mill
R-242	0.03	Pb Regrind Mill
Z-11	0.01	Pb 1st Cleaner Feed
MIBC	0.030	Pb 1st Cleaner Feed
NaCN	0.08	Pb 2nd Cleaner Feed
$CuSO_4$	2.04	Zn Ro. Conditioner No. 1
$Ca(OH)_2$	1.92	Zn Ro. Conditioner No. 2
Z-11	0.20	Zn Rougher Feed Pump
DF-250	0.09	Zn Rougher Feed Pump
Z-200	0.156	Zn Rougher Feed Pump
Z-11	0.03	Zn Scavenger Feed
DF-250	0.031	Zn Scavenger Feed
$CuSO_4$	0.32	Zn Regrind Mill
Z-200	0.082	Zn Regrind Mill
Z-11	0.02	Zn 1st Cleaner Feed
DF-250	0.03	Zn 1st Cleaner Feed
$Ca(OH)_2$	1.62	Zn 1st Cleaner Feed
Z-200	0.022	Zn 1st Cl. Scavenger
Z-11	0.05	Zn 1st Cl. Scavenger
Z-200	0.043	Zn 2nd Cleaner Feed
$Ca(OH)_2$	0.44	Zn 2nd Cleaner Feed
Z-200	0.022	Zn 3rd Cleaner Feed
DF-250	0.006	Zn 3rd Cleaner Feed
$Ca(OH)_2$	0.24	Zn 3rd Cleaner Feed
$Ca(OH)_2$	0.22	Zn 4th Cleaner Feed

Test No. PP23 - Continued

2.4. Results:

2.4.1. pH

Product	pH
Cyclone Overflow	9.0
Pb Rougher Feed	9.1
Pb Scavenger Tailing	8.8
Pb Regrinding Mill Discharge	8.3
Pb 1st Cleaenr Feed	9.6
Pb 2nd Cleaner Feed	9.7
Pb 3rd Cleaner Feed	9.6
Pb 4th Cleaner Feed	9.6
Zn Rougher Feed	9.8
Zn Scavenger Tailing	9.4
Zn 1st Cl. Scav. Feed	11.2
Zn 1st Cleaner Feed	11.3
Zn 2nd Cleaner Feed	11.5
Zn 3rd Cleaner Feed	11.6
Zn 4th Cleaner Feed	11.6

2.4.2. Pulp Densities

Product	Pulp Density gpl
Pb Rougher Feed	1225
Pb Scavenger Tailing	1185
Pb 1st Cleaner Feed	1083
Zn Rougher Feed	1185
Zn Scavenger Tailing	1122
Zn 1st Cleaner Feed	1113

2.4.3. Pulp Temperature

Product	^{o}C
Pb Rougher Feed	26
Pb Regrind Mill Discharge	32
Zn Rougher Feed	28
Zn Regrind Mill Discharge	27

Test No. PP23 - Continued

2.4.4. Chemical Analyses

Product	Assays, %	
	Pb	Zn
Cyclone Overflow	5.95	10.3
Pb Rougher Feed	6.55	11.4
Pb Rougher Concentrate	25.6	15.4
Pb Rougher Tailing	2.59	10.5
Pb Scavenger Concentrate	6.56	14.0
Pb Scavenger Tailing	1.89	9.76
Pb 1st Cleaner Concentrate	32.3	17.4
Pb 1st Cleaner Tailing	11.8	17.4
Pb Regrind Cyclone Overflow	24.3	17.0
Pb Regrind Cyclone Underflow	23.4	14.2
Pb Cleaner Concentrate	52.3	12.6
Zn Rougher Feed	1.99	8.08
Zn Rougher Concentrate	2.46	26.0
Zn Rougher Tailing	1.71	2.48
Zn Scavenger Concentrate	2.20	4.50
Zn Scavenger Tailing	1.56	1.53
Zn 1st Cleaner Tailing	2.37	14.8
Zn 1st Cleaner Concentrate	3.50	46.0
Zn Regrind Cyclone Overflow	2.68	25.5
Zn Regrind Cyclone Underflow	1.54	17.8
Zn 1st Cl. Scav. Conc.	2.76	23.0
Zn 1st Cl. Scav. Tailing	2.08	6.64
Zn Combined Tailing	1.69	2.72
Zn Cleaner Concentrate	2.99	56.3

Test No. PP23 - Continued

2.4.5. Metallurgical Results

Two-Product Formula

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
Pb Ro. Concentrate	14.60	25.6	15.4	62.8	20.0
Pb Ro. Tailing	85.40	2.59	10.5	37.2	80.0
Cyclone Overflow (meas)	100.0	5.95	10.3	100.0	100.0
(Calc.)	-	5.95	11.2	-	-
Pb Scav. Concentrate	12.80	6.56	14.0	14.1	16.0
Pb Scav. Tailing	72.60	1.89	9.76	23.1	63.2
Pb Ro. Tailing (meas)	85.40	2.59	10.5	37.2	87.1
(Calc.)	-	2.59	10.4	37.2	79.2
Pb 1st Cl. Conc.	9.83	32.3	17.4	53.4	15.3
Pb 1st Cl. Tail.	4.77	11.8	17.4	9.46	7.4
Pb Ro. Conc. (meas)	14.60	25.6	15.4	62.8	21.8
(Calc.)	-	25.6	17.4	62.9	22.7
Zn Ro. Concentrate	22.47	2.46	26.0	9.29	52.1
Zn Ro. Tailing	50.13	1.71	2.48	14.4	11.1
Pb Scav. Tailing (meas)	72.60	1.89	9.76	23.1	68.8
(Calc.)	-	1.94	9.76	23.7	63.2
Zn Scav. Concentrate	16.03	2.20	4.50	5.93	6.43
Zn Scav. Tailing	34.10	1.56	1.53	8.94	4.65
Zn Ro. Tailing (meas)	50.13	1.71	2.48	14.4	12.1
(Calc.)	-	1.76	2.48	14.9	11.1
Zn 1st Cl. Conc.	8.87	3.50	46.0	5.22	36.4
Zn 1st Cl. Tail.	13.60	2.37	14.8	5.42	17.9
Zn Ro. Concentrate (meas)	22.47	2.46	26.0	9.29	56.7
(Calc.)	-	2.56	27.1	10.6	54.3
Zn 1st Cl. Scav. Conc.	6.78	2.76	23.0	3.14	13.9
Zn 1st Cl. Scav. Tail.	6.82	2.08	6.64	2.39	4.04
Zn 1st Cl. Tailing (meas)	13.60	2.37	14.8	5.42	19.5
(Calc.)	-	2.41	14.8	5.53	17.9

Three-Product Formula

Pb 4th Cl. Conc.	8.05	52.3	12.6	71.0	9.9
Zn 4th Cl. Conc.	12.59	2.99	56.3	6.4	69.1
Zn Combined Tail.	79.36	1.69	2.72	22.6	21.0
Cyclone Overflow	100.0	5.95	10.3	100.0	100.0