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A Laboratory Investigation of
THE RECOVERY OF LEAD AND ZINC
on Grum Deposit Pilot Plant samples
from ore submitted by
KERR ADDISON MINES LIMITED
Progress Report No. 10

Project No. L.R. 2027

NOTE:

This report refers to the samples as received.

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

This report contains the results of tests performed in the period September 9, 1977 to November 17, 1977 on the recovery of lead and zinc from individual and bulk pilot plant samples from ore submitted by the Kerr Addison Mines Limited.

The main research effort was placed on determining the flotation characteristics of individual samples received for pilot plant testwork, and on improving the lead and zinc flotation responses on pilot plant bulk flotation samples.

A standard flowsheet and reagent balance developed from work reported in Progress Reports No. 7 and 8 was selected for testing each ore sample, and modifications were then applied in an attempt to improve the results.

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S U M M A R Y

1. Head Analyses

The samples for laboratory testwork were prepared from bulk ore samples received for pilot plant testing. The head analyses as calculated from testwork were as follows:

Sample No.	Assays, %	
	Pb	Zn
K-76	6.93	10.34
K-80	5.08	9.40
K-68	5.32	11.42
J-76	6.30	8.80
B-5	8.96	15.50
C-4	4.25	8.16
FV-4	6.88	16.80
D-4	4.40	8.44
H-4	3.85	8.20
G-4	1.49	3.40
FQ-4	7.81	14.30
A-2	9.23	6.51
P.P. Bulk Comp.	6.02	10.10

2. General Evaluation

The test program was designed to determine flotation characteristics of individual ore samples received for the pilot plant testwork, and to improve the Pb-Zn flotation results on pilot plant bulk composites. The reagent balance and flow-sheet that were used for the testing of pilot plant samples were essentially unchanged from those reported in Progress Report No. 7 and 8, from testing of laboratory samples. However, the quantity of reagents and regrinding finenesses were varied extensively.

Summary - Continued

2. General Evaluation

The overall metallurgical results obtained with half of the pilot plant samples were poor, and were different from those obtained with the laboratory samples. In samples in which the massive pyrite minerals were abundant (i.e. K-samples, B-5, and J-76), the selectivity between lead, zinc and pyrite was poor. At the same time, the pyrite in these samples was very active and interfered with the lead and zinc flotation. Upgrading the lead concentrate in these samples was only possible by ultra-fine regrinding.

It should be noted that the tailing losses of zinc in samples H-4 and K-68 were high (1.6 % Zn to 3.4 % Zn).

In accordance with their flotation characteristics the pilot plant samples could be classified as follows:

- 1) Samples with high oxide pyrite content i.e. samples B-5, K-76, and FQ-4.
The metallurgical results obtained with these samples were extremely poor.
- 2) Samples with very fine dissemination of pyrite, lead and zinc minerals i.e. samples K-80 and J-76. The overall metallurgical results were poor, and improvement was achieved with fine regrinding of the lead concentrate.
- 3) Mixed Quartz, sulphides and massive sulphides i.e. samples A-4, C-4, G-4, D-4. The results with these samples were satisfactory, and were similar to those of the laboratory samples.

The description and discussion of the flotation characteristics of 12 pilot plant samples, as well as of the pilot plant composites is contained in the separate sections.

Summary - Continued

3. Flotation Results

3.1. Sample K-76

3.1.1. Flotation Characteristics

Sample K-76 was oxidized massive sulphide ore, in which signs of oxidation were visible. Lead flotation from this sample deteriorated due to the presence of strongly activated zinc and pyrite. The results of the standard test are summarized in table No.2. (Test No. 2)

Table No. 1

Flotation Results From Selected Tests - Sample K76-1

Test No.	Product	Weight %	Assays, %		% Distribution	
			Pb	Zn	Pb	Zn
3	Pb Cleaner Conc.	9.13	56.3	11.3	76.0	9.7
	Pb 1st Cl. Conc.	16.31	36.8	14.7	88.6	22.6
	Zn Cleaner Conc.	9.18	1.35	48.9	1.8	42.3
	Zn Ro. Conc.	25.71	1.41	30.2	5.4	73.1
	Zn Flot. Tail.	57.98	0.71	0.77	6.0	4.3

Only 60 % - 62 % Pb was recovered in the final lead concentrate, at grades of 50 % to 52 % Pb when using the standard procedure. The zinc flotation with this sample was poor.

Summary - Continued

3. Flotation Results

3.1. Sample K-76

3.1.2. Effect of Regrinding Time on Lead Flotation

A series of tests were conducted to investigate the effect of fineness of lead concentrate regrind on the grade and recovery of lead. In these tests the regrinding time was varied from 30 to 70 minutes. The results of these tests are summarized in table No. 2.

Table No. 2

Effect of Pb Concentrate Regrind on Pb Flotation - Sample K-76-1

Test No.	Primary Grind Minutes	Pb Regrind Minutes	Product	Weight %	Assays, %		% Distribution	
					Pb	Zn	Pb	Zn
2	30	30	Pb Cleaner Conc.	7.90	53.0	12.5	62.2	9.7
			Pb 1st Cl. Conc.	18.32	31.7	15.5	86.3	27.8
			Pb Comb. Tail.	81.68	1.13	9.02	13.7	72.2
3	40	50	Pb Cleaner Conc.	9.13	56.3	11.3	76.0	9.7
			Pb 1st Cl. Conc.	16.32	36.8	14.71	88.6	22.6
			Pb Comb. Tail.	83.68	0.93	9.81	11.4	77.4
34	40	70	Pb Cleaner Conc.	8.63	61.9	9.24	78.7	7.7
			Pb 1st Cl. Conc.	17.53	34.4	14.40	88.8	24.6
			Pb Comb. Tail.	82.47	0.92	9.34	11.2	75.4

The above results indicated that satisfactory lead grade and recovery could be obtained at extremely fine regrinding (test 34) of the lead concentrate.

Summary - Continued

3. Flotation Results

3.2. Sample K-68

3.2.1. Flotation Characteristics

Sample K-68 was a high pyrite, massive sulphides ore in which the pyrite was not as oxidized as in sample K-76. The selectivity between lead and zinc minerals was reasonably good. However, pyrite floated strongly in the lead rougher and cleaning. Therefore the upgrading of lead concentrate was difficult. The standard flotation test results are presented in table No. 4, (Test No. 5).

Table No. 3

Flotation Results from Selected Tests - Sample K-68

Test No.	Product	Weight %	Assays, %		% Distribution	
			Pb	Zn	Pb	Zn
20	Pb Cleaner Conc.	6.25	58.2	8.30	67.9	4.5
	Pb 1st Cl. Conc.	16.50	28.5	13.20	87.9	19.0
	Zn Cleaner Conc.	10.20	1.14	57.3	2.2	51.2
	Zn Rougher Conc.	28.77	1.16	25.1	6.3	63.3
	Zn Flot. Tail.	54.73	0.57	3.70	5.8	17.7

The results indicated that good rejection of zinc in the lead cleaning was possible. However, the tailing losses of zinc were more serious in this sample. A higher level of CuSO_4 (test 13) or lower pH in the zinc rougher had no effect on the zinc recovery. This zinc fraction appeared to be unrecoverable.

Summary - Continued

3. Flotation Results

3.2. Sample K-68

3.2.2. Effect of Pb Concentrate Regrind

Several tests were conducted in which the regrind time was varied from 30 to 50 minutes, and the primary grind from 30 to 50 minutes. These results are shown in table No. 4 below.

Table No. 4

Effect of Pb Concentrate Regrind on Pb Flotation

Test No.	Primary Grind Minutes	Pb Regrind Minutes	Product	Weight %	Assays, %		% Distribution	
					Pb	Zn	Pb	Zn
5	30	30	Pb Cleaner Conc.	8.79	46.0	11.3	77.6	8.6
			Pb 1st Cl. Conc.	14.92	30.4	13.2	87.2	17.0
			Pb Comb. Tail.	85.08	0.79	11.28	12.8	83.0
13	30	50	Pb Cleaner Conc.	6.83	53.6	9.50	69.0	5.7
			Pb 1st Cl. Conc.	17.27	26.5	12.60	86.3	19.0
			Pb Comb. Tail.	82.73	0.88	11.19	13.7	81.0
20	50	50	Pb Cleaner Conc.	6.25	58.2	8.30	67.9	4.5
			Pb 1st Cl. Conc.	16.50	28.5	13.20	87.9	19.0
			Pb Comb. Tail.	83.50	0.77	11.08	12.1	81.0

Increasing the fineness of primary grind and of lead concentrate regrind (test 20) increased the lead concentrate grade from 53.6 % Pb to 58.5 % Pb with no decrease in recovery.

Summary - Continued

3. Flotation Results

3.3. Sample K-80

3.3.1. Flotation Characteristics

Fine dissemination of the pyrite and lead minerals in the sample required regrinding of the lead concentrate to a considerable fineness in order to obtain a higher-grade lead concentrate. The selectivity between lead and zinc minerals was satisfactory. The standard test results are summarized in table No. 5 below.

Table No. 5

Flotation Results - Sample K80-1

Test No.	Primary Grind Minute	Pb Conc. Regrind Minute	Procedure	Product	Weight %	Assays, %		% Distr.	
						Pb	Zn	Pb	Zn
4	30	30	Standard	Pb Cleaner Conc.	6.09	55.2	7.60	67.7	4.9
				Pb 1st Cl. Conc.	13.01	32.9	10.7	86.2	14.7
				Zn Cleaner Conc.	12.86	0.90	52.3	2.3	70.9
				Zn Rougher Conc.	24.40	1.32	31.9	6.4	82.1
				Zn Flot. Tail.	62.59	0.58	0.50	7.4	3.2
9	30	40	Standard	Pb Cleaner Conc.	6.81	55.6	7.65	76.5	5.7
				Pb 1st Cl. Conc.	14.79	30.2	10.6	90.3	17.2
				Pb Comb. Tail.	85.21	0.56	8.91	9.7	82.8

Summary - Continued

3. Flotation Results

3.4. Sample J-76

The flotation behaviour of this sample was similar to that of sample K-80. Under the standard conditions lead cleaning was poor (Test No. 7). Finer regrinding of the lead concentrate (test 16) improved lead grade and recovery.

Table No. 6

Flotation Results - Sample J76-1

Test No.	Primary Grind Minute	Pb Regr. Grind Minute	Procedure	Product	Weight %	Assays, %		% Distr.	
						Pb	Zn	Pb	Zn
7	30	30	Standard	Pb Cleaner Conc.	9.01	46.6	11.8	68.3	11.5
				Pb 1st Cl. Conc.	18.07	29.6	13.2	87.2	25.7
				Zn Cleaner Conc.	11.69	1.34	51.2	2.8	64.5
				Zn Rougher Conc.	20.87	1.70	31.0	5.8	69.5
				Zn Flot. Tail.	61.06	0.71	0.72	7.0	4.8
16	30	50	Standard Finer Pb Regrinding	Pb Cleaner Conc.	8.69	53.9	10.10	75.6	9.7
				Pb 1st Cl. Conc.	18.07	31.1	12.40	90.6	25.0
				Zn Cleaner Conc.	10.38	0.94	53.90	1.6	62.3
				Zn Rougher Conc.	20.81	1.15	30.00	3.9	69.4
				Zn Flot. Tail.	61.12	0.56	0.82	5.5	5.6

Summary - Continued

3. Flotation Results

3.5. Sample B-5

3.5.1. Flotation Characteristics

Sample B-5 was high pyrite ore, in which the signs of oxidation were visible. The selectivity between lead and zinc was extremely poor. Fine regrinding of the lead concentrate, or higher depressant additions had no effect on zinc depression during lead cleaning. About 50 % - 60 % of the total zinc was floated in the lead rougher concentrate, and rejection of zinc during the lead cleaning was not possible with out high losses of lead. Typical results obtained with B-5 are shown in table No. 7 below.

Table No. 7

Flotation Results B-5 Sample

Test No.	Primary Grind Minute	Pb Conc. Re grind Minute	Procedure	Product	Weight %	Assays, %		% Distr.	
						Pb	Zn	Pb	Zn
15	30	30	Standard	Pb Cleaner Conc.	12.08	46.5	20.5	61.8	16.4
				Pb 1st Cl. Conc.	29.11	26.80	23.3	85.9	45.0
				Pb Comb. Tail.	70.89	1.81	11.70	14.1	55.0
17	30	40	Standard	Pb Cleaner Conc.	19.0	35.1	23.2	75.5	28.6
				Pb 1st Cl. Conc.	35.15	22.6	23.2	90.0	52.8
				Zn Cleaner Conc.	4.89	1.49	53.6	0.8	17.0
				Zn Rougher Conc.	20.36	2.00	31.3	4.5	41.3
				Zn Flot. Tail.	44.49	1.08	2.06	5.5	5.9
36	40	50	Standard	Pb Cleaner Conc.	10.49	54.3	16.1	64.2	10.9
				Pb 1st Cl. Conc.	28.72	27.1	23.1	87.9	42.8
				Pb Comb. Tail.	71.28	1.51	12.46	12.1	57.2

Summary - Continued

3. Flotation Results

3.6. Sample FQ-4

Sample FQ-4 was a very high grade, high sulphide ore and contained 7.4 % Pb and 14.5 % zinc. Only one test was carried out (test No. 8) in which the standard procedure was applied.

Table No. 8

Flotation Results from Selected Tests - Sample FQ-4

Test No.	Product	Weight %	Assays, %		% Distribution	
			Pb	Zn	Pb	Zn
27	Pb Cleaner Conc.	14.59	44.0	14.4	87.2	14.8
	Pb 1st Cl. Conc.	25.50	26.9	17.0	93.1	30.6
	Zn Cleaner Conc.	16.70	0.96	50.9	2.2	59.8
	Zn Rougher Conc.	28.87	0.97	33.4	3.7	67.9
	Zn Flot. Tail.	45.63	0.51	0.53	3.2	1.5

In general the ore responded poorly to the conditions used, but improvement could be achieved by increasing the fineness of Pb concentrate regrind.

3.7. Samples D-4, A-2, H-4, C-4, G-4, FV-4

One test was conducted on each sample, following the standard procedure. The results of these tests are summarized in table No. 9.

The lead flotation was satisfactory and high-grade concentrates could be produced from these samples. About 80 % - 90 % of the total zinc could be passed to the zinc circuit, when cleaning the lead concentrate in open-circuit. The cleaning of the zinc concentrate was also effective.

Summary - Continued

3. Flotation Results

3.7. Samples D-4, A-2, H-4, C-4, G-4, FV-4

Table No. 9

Test No.	Sample No.	Product	Weight %	Assays, %		% Distribution	
				Pb	Zn	Pb	Zn
23	D-4	Pb Cleaner Conc.	4.71	57.6	5.83	66.7	3.2
		Pb 1st Cl. Conc.	8.54	39.4	8.75	82.9	8.6
		Zn Cleaner Conc.	13.22	0.69	53.80	2.3	82.0
		Zn Rougher Conc.	19.42	1.05	38.20	5.1	84.9
		Zn Flot. Tail.	72.04	0.68	0.81	12.0	6.5
30	A-2	Pb Cleaner Conc.	12.45	60.7	6.18	83.0	12.3
		Pb 1st Cl. Conc.	16.70	48.0	7.66	88.1	20.4
		Zn Cleaner Conc.	7.60	1.85	50.2	1.5	60.7
		Zn Rougher Conc.	16.79	2.26	28.6	4.1	76.6
		Zn Flot. Tail.	66.51	1.06	0.29	7.8	3.0
24	H-4	Pb Cleaner Conc.	5.23	59.6	6.63	83.9	4.1
		Pb 1st Cl. Conc.	9.15	35.8	9.34	88.2	10.2
		Zn Cleaner Conc.	12.69	0.48	48.30	1.6	73.0
		Zn Rougher Conc.	27.48	0.54	23.40	4.0	76.6
		Zn Flot. Tail.	63.37	0.46	1.74	7.8	13.2
19	C-4	Pb Cleaner Conc.	4.76	57.4	4.87	69.7	2.8
		Pb 1st Cl. Conc.	9.38	35.7	7.31	85.3	8.3
		Zn Cleaner Conc.	12.19	0.46	53.3	1.4	78.1
		Zn Rougher Conc.	23.28	1.01	30.1	5.9	84.2
		Zn Flot. Tail.	67.34	0.51	0.94	8.8	7.5
18	FV-4	Pb Cleaner Conc.	9.40	59.5	11.0	83.5	6.2
		Pb 1st Cl. Conc.	16.70	36.6	17.5	91.2	17.5
		Zn Cleaner Conc.	23.81	0.88	54.6	3.1	77.9
		Zn Rougher Conc.	29.17	0.96	46.1	4.2	80.6
		Zn Flot. Tail.	54.13	0.57	0.58	4.6	1.9
26	G-4	Pb Cleaner Conc.	1.44	60.6	3.35	64.5	1.4
		Pb 1st Cl. Conc.	3.59	27.9	5.18	74.0	5.4
		Zn Cleaner Conc.	5.68	0.72	50.40	3.0	83.0
		Zn Rougher Conc.	17.34	0.52	17.4	6.6	87.4
		Zn Flot. Tail.	79.07	0.33	0.32	19.4	7.2

Summary - Continued

4. Composite K-samples

4.1. Flotation Characteristics

In this composite the ratio of K samples was 1:1:1. The sample responded poorly to flotation, and selectivity between lead-zinc and pyrite was not achieved when using the standard procedure.

Table No. 10

Effect of Fineness of Grind on Pb Flotation Composite K Samples (1:1:1)

Flotation Results - Mixture (1:1:1) K-Samples

Test No.	Primary Grind Minute	Pb Conc. Re grind Minute	Procedure	Product	Weight %	Assays, %		% Distr.	
						Pb	Zn	Pb	Zn
14	30	50	Standard	Pb Cleaner Conc.	10.05	47.2	10.9	76.6	10.8
				Pb 1st Cl. Conc.	26.40	18.6	12.8	91.7	33.3
				Zn Cleaner Conc.	10.13	0.90	51.1	1.7	51.6
				Zn Rougher Conc.	24.49	0.98	25.0	4.4	60.6
				Zn Flot. Tail.	49.11	0.44	1.25	3.9	6.1
12	30	30	Standard	Pb Cleaner Conc.	10.01	43.3	11.70	76.9	11.5
				Pb 1st Cl. Conc.	21.03	24.5	13.50	91.2	27.8
				Pb Comb. Tail.	78.97	0.63	9.30	8.8	72.20

4.2. Effect of Regrinding of Pb Cleaner Tailings

Two tests were conducted using the modified flowsheet described in Progress Report No. 7 (page 4), in an attempt to achieve high lead recoveries. These results are summarized in table No. 11 below.

Summary - Continued

4. Composite K-Samples

4.2. Effect of Regrinding of Pb Cleaner Tailings

Table No. 11

Effect of Regrinding of Pb Cleaner Tailings on Pb Grade and Recovery

Test No.	Primary Grind Minute	Pb Ro. Regrind Minute	Pb Cl. Regrind Minute	Product	Weight %	Assays, %		% Distr.	
						Pb	Zn	Pb	Zn
35	40	50	30	Pb Cleaner Conc.	7.66	60.70	8.33	81.9	6.3
				Pb 1st Cl. Conc.	14.54	34.60	12.40	88.6	17.8
				Pb Comb. Tail.	85.46	0.75	9.69	11.4	82.2
38	30	30	30	Pb Cleaner Conc.	8.22	56.30	9.93	81.7	8.2
				Pb 1st Cl. Conc.	16.13	31.20	12.7	89.0	20.6
				Pb Comb. Tail.	83.87	0.74	9.43	11.0	79.4

Significant improvement in the lead to concentrate grade and recovery was obtained when the modified flowsheet was used. Comparing these results with those obtained in tests 12 and 14, in which the standard flowsheet was used, it seems obvious that the lead-pyrite-zinc middlings complicated the circuit and resulted in a low-grade lead concentrate and poor selectivity.

5. Pilot Plant Bulk Composite

A total of 20 tests were conducted on this composite in which the following variables were investigated:

- 1) Effect of primary grind
- 2) Effect of lead concentrate regrind
- 3) Multiple-stage Pb concentrate regrind
- 4) Effect of pH on zinc flotation

The initial tests yielded inferior metallurgical results in the lead and zinc circuit. The selectivity between lead-zinc and pyrite was poor, and successful upgrading of the lead concentrate was achieved only at a very fine lead concentrate regrind.

Summary - Continued

5. Pilot Plant Bulk Composite

5.1. Effect of Primary Grind

A series of tests was conducted in which the primary grinding time was varied from 30 to 50 minutes. The results of these tests are summarized in table No. 12.

Table No. 12

Effect of Primary Grind on Pb Rougher Flotation - P.P. Composite

Test No.	Primary Grind		Product	Weight %	Assays, %		% Distribution	
	Time	% -200 M			Pb	Zn	Pb	Zn
39	30	90.8	Pb Rougher Conc.	25.67	20.8	13.5	88.9	34.9
			Pb Ro. + Scav. Conc.	30.91	17.8	13.2	91.4	41.3
			Pb Flot. Tailing	69.09	0.75	8.43	8.6	58.7
40	40	95.0	Pb Rougher Conc.	23.94	22.3	13.5	89.7	32.7
			Pb Ro. + Scav. Conc.	29.44	18.7	13.1	92.5	39.2
			Pb Flot. Tailing	70.56	0.66	8.50	7.8	60.8
41	50	98	Pb Rougher Conc.	23.05	23.0	13.5	89.8	31.2
			Pb Ro. + Scav. Conc.	27.73	19.6	13.30	92.2	36.9
			Pb Flot. Tail.	72.27	0.64	8.71	7.8	63.1

The above results indicated that lead-zinc-selectivity improved with increased fineness of grind. The lead recovery however, was the same in all tests.

5.2. Effect of Pb Concentrate Re grind

Using the primary grind fineness of 90.5 % minus 200 mesh, the effect of varying regrinding times on the grade and recovery of lead was investigated in series of tests 43 to 47. The results are shown in table No. 13.

Summary - Continued

5. Pilot Plant Bulk Composite

5.2. Effect of Pb Concentrate Regrind

Table No. 13

Effect of Pb Concentrate Regrind on Pb Cleaning P.P. Composite

Test No.	Primary Grind Minutes	Pb Regrind		Product	Weight %	Assays, %		% Distr.	
		Minutes	% Pass -10µm			Pb	Zn	Pb	Zn
42	30	10	31.5	Pb Cleaner Conc.	12.12	38.6	12.9	81.0	15.6
				Pb 1st Cl. Conc.	18.63	27.3	13.7	88.0	25.5
				Pb Comb. Tail.	81.37	0.85	9.19	12.0	74.5
43	30	20	37.2	Pb Cleaner Conc.	10.54	45.1	12.9	80.4	13.7
				Pb 1st Cl. Conc.	18.24	28.8	14.1	89.0	26.0
				Pb Comb. Tail.	81.76	0.80	8.97	11.0	74.0
45	30	30	47.4	Pb Cleaner Conc.	8.75	51.6	11.3	76.1	9.9
				Pb 1st Cl. Conc.	16.08	32.4	14.0	87.7	22.6
				Pb Comb. Yail.	83.92	0.87	9.14	12.3	77.4
46	30	40	58.0	Pb Cleaner Conc.	7.97	54.6	10.7	73.4	8.1
				Pb 1st Cl. Conc.	16.54	31.3	14.1	87.3	23.0
				Pb Comb. Tail.	83.46	0.89	9.2	12.7	76.0
47	30	50	62.0	Pb Cleaner Conc.	7.96	59.7	9.53	80.0	7.6
				Pb 1st Cl. Conc.	14.56	35.8	13.6	87.7	19.9
				Pb Comb. Tail.	85.44	0.86	9.32	12.3	80.1

The above results illustrate that adequate liberation of the sulphide minerals required an extremely fine regrind of the lead concentrate. High lead recovery and satisfactory selectivity between lead and zinc minerals could be achieved at a very fine lead concentrate regrind.

Summary - Continued

5. Pilot Plant Bulk Composite

5.3. Multiple Stage Pb Concentrate Regrind

A series of tests was conducted to investigate the effect of multiple-stage regrinding on the grade and recovery of lead. These results are summarized in table No. 14 below.

Table No. 14

Multiple-Stage Lead Concentrate Regrinding

Test No.	Primary Grind Minute	Pb Regrind		Pb Regr. % -10 μ m	Product	Weight %	Assays, %		% Distr.	
		1st Min.	2nd Min.				Pb	Zn	Pb	Zn
48	30	20	20	68	Pb Cleaner Conc.	7.39	58.2	9.24	72.8	6.6
					Pb 1st Cl. Conc.	17.49	29.2	14.1	86.6	23.9
					Pb Comb. Tail.	82.51	0.95	9.45	13.4	76.1
49	30	20	30	72.0	Pb Cleaner Conc.	8.23	58.4	9.51	81.1	7.6
					Pb 1st Cl. Conc.	18.29	28.2	13.9	87.0	24.8
					Pb Comb. Tail.	81.71	0.94	9.40	13.0	75.2
50	30	20	40	80.0	Pb Cleaner Conc.	7.54	62.7	8.28	81.2	6.1
					Pb 1st Cl. Conc.	17.35	29.3	13.6	87.4	23.2
					Pb Comb. Tail.	82.65	0.89	9.41	12.6	76.8
44	30	40	20	75.0	Pb Cleaner Conc.	7.75	57.8	9.78	80.1	7.76
					Pb 1st Cl. Conc.	18.20	27.4	13.80	89.3	25.8
					Pb Comb. Tail.	81.80	0.73	18.86	10.7	74.2

The use of multiple-stage lead concentrate regrind in tests 49 and 50 improved the lead concentrate grade and recovery slightly.

Summary - Continued

5. Pilot Plant Bulk Composite

5.4. Effect of pH on Zinc Rougher Flotation and Cleaning

A series of tests was performed to investigate the effect of pH on zinc rougher flotation and cleaning. The conditions and results for these tests are shown in table No. 15 below.

Table No. 15

Effect of pH on Zinc Flotation

Test No.	pH					Product	Weight %	Assays, %		% Distribution	
	Zn Ro.	1st Cl.	2nd Cl.	3rd Cl.	4th Cl.			Pb	Zn	Pb	Zn
52	10.5	11.0	11.0	11.0	11.0	Zn Cl. Conc.	11.43	0.83	55.2	1.7	62.6
						Zn Ro. Conc.	24.65	1.10	30.6	4.7	74.8
						Zn Flot. Tail.	61.04	0.71	0.92	7.6	5.6
53	10.0	10.5	10.5	10.5	10.5	Zn Cl. Conc.	12.69	0.88	54.8	1.9	68.7
						Zn Ro. Conc.	25.51	1.30	30.4	5.7	76.5
						Zn Flot. Tail.	61.16	0.70	0.96	7.3	5.7
54	10.0	10.5	9.5	9.5	9.5	Zn Cl. Conc.	12.24	0.96	55.3	2.0	66.9
						Zn Ro. Conc.	24.97	1.32	30.6	5.7	75.5
						Zn Flot. Tail.	61.38	0.71	1.09	7.5	6.2

Variation of pH in the cleaning circuit did not seem to have any effect on either grade or recovery of the final zinc concentrate.

6. Settling and Filtration Tests

6.1. Settling Tests

Settling tests were carried out on the final lead and zinc concentrates from the pilot plant test PP44. The results obtained are summarized in table No. 16 and 17.

Summary - Continued

6. Settling and Filtration Tests

6.1. Settling Tests

Table No. 16

Lead Concentrate Thickening Tests

Test No.	pH	Final Density		Settling Rate**		Thickener Area ft. ² /T/D*	
		gpl	% Solids	Feed Zone	Compr. Zone	Feed Zone	Compr. Zone
L-1	8.0	2830	77	3.26	0.24	0.76	1.61
L-2	9.0	2698	76	2.72	0.71	0.94	1.13
L-3	10.0	2741	76	2.89	0.71	0.88	1.07

* No safety factor applied

** Feet per hour

Table No. 17

Zinc Concentrate Thickening Tests

Test No.	pH	Final Density		Settling Rate**		Thickener Area ft. ² /T/D*	
		gpl	% Solids	Feed Zone	Compr. Zone	Feed Zone	Compr. Zone
Z-1	8.1	1821	60.2	0.66	0.48	3.51	3.75
Z-2	10.0	1782	57.4	0.72	0.36	3.20	3.70
Z-3	11.0	1794	58.6	0.84	0.35	2.68	3.73
Z-4	12.0	1791	58.3	0.86	0.46	2.64	3.10

* No safety factor applied

** Feet per hour

6.2. Filtration Tests

Two series of filtration tests were conducted on lead and zinc concentrates. The results are summarized in tables No. 18 and 19.

Summary - Continued

6. Settling and Filtration Tests

6.2. Filtration Tests

Table No. 18

Lead Concentrate Filtration Tests

Test No.	Slurry		Filter Cloth	Flocc. Added lb/t	Filter Time Sec.			Filter Cake			Filter Rate *
	% Solids	pH			Form	Dry	Cycle Total	Thick. In.	% Moist.	Rate **	
L-4-1	55	8.3	POPR-853F	No	60	300	540	0.2	14.4	30.8	3.87
L-4-2	55	8.3	POPR-853F	No	30	300	495	0.15	12.5	19.1	2.50
L-4-3	55	8.3	POPR-853F	No	60	300	540	0.35	13.6	37.1	4.22
L-5-3	55	8.2	POPR-851	No	60	600	990	0.30	11.6	18.3	2.02
L-5-4	65	8.2	POPR-851	No	30	300	495	0.40	13.5	43.0	2.88
L-5-5	65	8.2	POPR-851	No	30	600	945	0.40	12.4	22.6	1.31

* Dry pounds per hour per square foot

** U.S. gallons per hour per square foot

Table No. 19

Zinc Concentrate Filtration Tests

Test No.	% Solids	pH	Filter Cloth	Flocc. Added lb/t	Filter Time Sec.			Filter Cake			Filter Rate *
					Form	Dry	Cycle Total	Thick. In.	% Moist.	Rate **	
Z-5-1	55	11.1	POPR-851	-	60	180	360	0.33	18.6	31.2	2.37
Z-5-2	55	11.1	POPR-851	-	60	300	540	0.30	18.6	18.4	1.58
Z-5-3	55	11.1	POPR-851	-	60	480	810	0.30	17.6	12.6	1.06
Z-5-4	55	11.1	POPR-851	-	30	300	495	0.25	18.4	15.6	1.15
Z-5-5	55	11.1	POPR-851	-	30	480	365	0.26	18.7	18.3	1.56

** Dry pounds per Hour per Square foot

* U.S. Gallons per Hour per Square foot

7. Work Indices and Power Consumption

The work index and power consumption was determined for each individual sample, and the results are summarized in table No. 20.

Summary - Continued

7. Work Indices and Power Consumption

Table No. 20

Work Index and Power Calculation Results for Individual Samples

Sample No.	Grind Time Minutes	% Passing		K ₈₀ Micrometers	Power Consumption kWh/ton	Work Index
		200 Mesh	400 Mesh			
K-68	20	86.7	54.2	62.0	6.22	6.6
K-76	20	90.3	61.8	52.0	6.22	6.2
K-80	30	91.4	62.8	50.3	9.33	8.5
J-76	30	92.6	64.1	50.3	9.33	8.6
G-4	40	89.5	64.2	52.0	12.44	11.6
FQ-4	30	89.5	59.8	55.8	9.33	9.3
D-4	30	87.7	57.8	59.9	9.33	9.6
H-4	30	90.2	61.5	52.0	9.33	8.9
A-2	20	89.3	61.9	53.9	9.33	8.2
B-5	30	90.8	64.4	52.0	9.33	8.8
C-4	30	90.5	60.1	53.9	9.33	9.6
FV-4	30	90.1	58.1	55.8	9.33	9.5
Comp. P.P.	20	90.8	60.2	55.8	6.22	7.9

DETAILS OF TESTS

Test No. 1

Purpose: To investigate the flotation of lead from sample No. K-76-1.

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

Feed: 2000 grams minus 10 mesh sample K-76-1.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	2.0	1.0	0.30	0.05	-	-	30	-	-	7.8
Pb Rougher	1.6	-	-	0.02	0.06	-	-	1	3	9.1
	-	-	-	0.02	0.03	-	-	1	3	-
	-	-	-	0.02	0.03	-	-	1	5	-
Pb Conc. Regr.	1.0	0.5	0.20	-	-	0.03	30	-	-	-
Pb 1st Cl.	0.3	-	-	0.005	-	-	-	1	3	9.2
	-	-	-	0.005	-	0.01	-	1	3	-
Pb 2nd Cl.	0.3	0.2	0.10	-	-	-	-	1	3	9.2
	-	-	-	0.005	-	0.005	-	1	1	-
Pb 3rd Cl.	0.1	0.1	0.05	-	-	0.005	-	1	3	9.3
Pb 4th Cl.	0.1	-	0.05	-	-	-	-	1	2	9.4

Observations: Mill discharge: pH 7.8 - pyrite activated

1st Ro. Stage: pyrite floating at start, galena after 1½ minutes

2nd Ro. Stage: heavy galena float

3rd Ro. Stage: extended to recover fine galena

1st Cleaner: Pyrite mostly depressed, flotation not very selective

2nd to 4th Cleaners: strong flotation, but not very selective

Stage	Rougher	Pb Regrind	Pb 1st and 2nd Cleaner	Pb 3rd and 4th Cl.
Equipment	1000 g D - 1 Rod Mill		500 g D - 1	250 g D - 1
Speed: r.p.m.	1800	-	1300	1000
% Solids	33	-	-	-

Test No. 1 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	7.92	50.0	12.0	59.4	9.2
2. Pb 4th Cl. Tail.	2.80	26.7	18.2	11.2	4.9
3. Pb 3rd Cl. Tail.	2.24	17.7	21.8	6.0	4.7
4. Pb 2nd Cl. Tail.	5.19	8.66	18.7	6.8	9.4
5. Pb 1st Cl. Tail.	12.72	2.97	13.9	5.7	17.1
6. Pb Rougher Tail.	69.13	1.05	8.16	10.9	54.7
Head (Calculated)	100.00	6.66	10.3	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	10.72	43.9	13.6	70.6	14.1
Products 1 to 3	12.96	39.4	15.0	76.6	18.8
Products 1 to 4	18.15	30.6	16.1	83.4	28.2
Products 1 to 5	30.87	19.2	15.2	89.1	45.3

Test No. 2

Purpose: To repeat test No. 1, but increase Na_2CO_3 additions to grinding stages.

Procedure: As for test No. 1.

Feed: 2000 grams minus 10 mesh sample No. K-76-1.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na_2CO_3	ZnSO_4	NaCN	Z-11	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.05	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.06	-	-	1	3	9.3
	-	-	-	0.02	0.015	-	-	1	3	-
	-	-	-	0.01	0.015	-	-	1	3	-
Pb Regrind	1.5	0.5	0.20	-	-	0.03	30	-	-	-
Pb 1st Cl.	-	-	-	0.005	-	-	-	1	3	9.5
	-	-	-	0.005	-	0.01	-	1	3	-
Pb 2nd Cl.	0.2	0.2	0.10	-	-	-	-	1	3	9.5
	-	-	-	0.005	-	0.005	-	1	1	-
Pb 3rd Cl.	0.1	0.1	0.05	-	-	0.005	-	1	3	9.4
Pb 4th Cl.	0.1	-	0.05	-	-	-	-	1	2	9.5

Observations: Lead rougher much improved over previous test. Lead floating strongly to end point.
 1st Cleaner: Strong froth, fairly selective
 2nd to 4th Cl.: Strong froth, but final concentrate contained considerable pyrite.

Test No. 2 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	7.90	53.0	12.5	62.2	9.7
2. Pb 4th Cl. Tail.	2.70	28.5	18.1	11.4	4.8
3. Pb 3rd Cl. Tail.	2.29	16.7	19.5	5.7	4.4
4. Pb 2nd Cl. Tail.	5.43	8.69	16.8	7.0	8.9
5. Pb 1st Cl. Tail.	12.80	2.04	12.2	3.9	15.3
6. Pb Rougher Tail.	68.88	0.96	8.44	9.8	56.9
Head (Calculated)	100.00	6.73	10.2	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	10.60	46.8	13.9	73.6	14.5
Products 1 to 3	12.89	41.4	14.9	79.3	18.9
Products 1 to 4	18.32	31.7	15.5	86.3	27.8
Products 1 to 5	31.12	19.5	14.1	90.2	43.1

Test No. 3 - Continued

Conditions:

Stage	Pb Rougher	Pb Regrind	Pb 1st, 2nd to 3rd Cl.	Pb 4th Cleaner
Equipment	1000 g D - 1	Rod Mill	500 g D - 1	250 g D - 1
Speed: r.p.m.	1800	-	1300	1000
% Solids	33	-	-	-

Stage	Zn Rougher	Zn Regrind	Zn Cleaners
Equipment	1000 g D - 1	Pebble Mill	500 g D - 1
Speed: r.p.m.	1800	-	1300

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	7.61	61.2	10.0	68.8	7.2
2. Pb 4th Cl. Tail.	1.52	32.0	17.8	7.2	2.5
3. Pb 3rd Cl. Tail.	2.68	20.7	19.7	8.2	5.0
4. Pb 2nd Cl. Tail.	4.50	6.65	18.7	4.4	7.9
5. Zn Cleaner Conc.	9.18	1.35	48.9	1.8	42.3
6. Zn 3rd Cl. Tail.	4.32	1.57	35.7	1.0	14.5
7. Zn 2nd Cl. Tail.	5.09	1.56	24.4	1.2	11.7
8. Zn 1st Cl. Tail.	7.12	1.30	6.91	1.4	4.6
9. Zn Rougher Tail.	57.98	0.71	0.77	6.0	4.3
Head (Calculated)	100.00	6.77	10.6	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	9.13	56.3	11.3	76.0	9.7
Products 1 to 3	11.81	48.2	13.2	84.2	14.7
Products 1 to 4	16.31	36.8	14.7	88.6	22.6
Products 5 and 6	13.50	1.42	44.7	2.8	56.8
Products 5 to 7	18.59	1.46	39.1	4.0	68.5
Products 5 to 8	25.71	1.41	30.2	5.4	73.1

Test No. 4

Purpose: To investigate the flotation of lead and zinc from sample No. K-80-1.

Procedure: Grind and float a lead concentrate. Regrind the Pb concentrate and clean four times. Combine the lead rougher and 1st cleaner tailings and float a zinc concentrate. Regrind the zinc concentrate and clean three times.

Feed: 2000 grams minus 10 mesh sample No. K-80-1.

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

Conditions:

[illegible]

Test No. 4 - Continued

Conditions:

Stage	Pb Rougher	Pb Regrind	Pb 1st Cleaner	Pb 2nd to 4th Cleaner
Equipment	1000 g D - 1	Rod Mill	500 g D - 1	250 g D - 1
Speed: r.p.m.	1800	-	1300	1000
% Solids	33	-	-	-

Stage	Zn Rougher	Zn Regrind	Zn Cleaners
Equipment	1000 g D - 1	Pebble Mill	500 g D - 1
Speed: r.p.m.	1800	-	1300

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	6.09	55.2	7.60	67.7	4.9
2. Pb 4th Cl. Tail.	1.47	27.1	12.6	8.0	2.0
3. Pb 3rd Cl. Tail.	2.03	15.3	13.7	6.3	2.9
4. Pb 2nd Cl. Tail.	3.42	6.13	13.5	4.2	4.9
5. Zn Cleaner Conc.	12.86	0.90	52.3	2.3	70.9
6. Zn 3rd Cl. Tail.	2.15	1.94	25.1	0.8	5.7
7. Zn 2nd Cl. Tail.	2.94	2.17	11.3	1.3	3.5
8. Zn 1st Cl. Tail.	6.45	1.57	2.97	2.0	2.0
9. Zn Rougher Tail.	62.59	0.58	0.50	7.4	3.2
Head (Calculated)	100.00	4.97	9.49	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	7.56	49.7	8.57	75.7	6.9
Products 1 to 3	9.59	42.5	9.66	82.0	9.8
Products 1 to 4	13.01	32.9	10.7	86.2	14.7
Products 5 and 6	15.01	1.05	48.4	4.1	76.6
Products 5 to 7	17.95	1.23	42.3	4.4	80.1
Products 5 to 8	24.40	1.32	31.9	6.4	82.1

Test No. 5 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	8.79	46.0	11.3	77.6	8.6
2. Pb 4th Cl. Tail.	1.33	16.9	15.8	4.3	1.8
3. Pb 3rd Cl. Tail.	2.00	8.81	17.0	3.4	2.9
4. Pb 2nd Cl. Tail.	2.80	3.47	15.4	1.9	3.7
5. Zn Cleaner Conc.	11.90	1.16	54.8	2.6	56.4
6. Zn 3rd Cl. Tail.	1.45	1.92	23.4	0.5	2.9
7. Zn 2nd Cl. Tail.	2.34	1.65	11.0	0.7	2.2
8. Zn 1st Cl. Tail.	7.29	1.19	6.66	1.7	4.2
9. Zn Rougher Tail.	62.10	0.61	3.21	7.3	17.3
Head (Calculated)	100.00	5.21	11.6	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	10.12	42.2	11.9	81.9	10.4
Products 1 to 3	12.12	36.7	12.7	85.3	13.3
Products 1 to 4	14.92	30.4	13.2	87.2	17.0
Products 5 and 6	13.35	1.24	51.4	3.1	59.3
Products 5 to 7	15.69	1.30	45.4	3.8	61.5
Products 5 to 8	22.98	1.27	33.1	5.5	65.7

Test No. 6

Purpose: To conduct a flotation test using $\text{Ca}(\text{OH})_2$, SO_2 and Na_2SO_3 as Zn depressants in the Pb circuit.

Procedure: As indicated below.

Feed: 2000 grams minus 10 mesh composite No. K-76-1.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Ca-(OH) ₂	Na ₂ -SO ₃	NaCN	Z-6	MIBC	SO ₂	Grind	Cond.	Froth	
Grind	3.0	1.5	0.2	0.05	-	-	30	-	-	11.3
Rougher	-	-	-	0.02	0.06	1.25*	-	1	3	8.9
	-	-	-	0.01	0.015	-	-	1	5	-
	-	-	-	0.01	0.015	-	-	1	2	8.9
Pb Ro. Conc. Regr.	1.0	-	0.2	0.03	-	-	20	-	-	11.2
Pb 1st Cl. Cond.	-	-	-	-	-	0.75*	-	1	-	7.5
Pb 1st Cl. Float	-	-	-	0.01	0.005	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 1st Cl. Conc. Regr.	1.0	-	0.2	0.03	-	-	40	-	-	-
Pb 2nd Cl. Cond.	-	-	-	-	-	*	-	-	-	7.5
	-	-	-	0.03	0.01	-	-	1	3	-
	-	-	-	0.05	0.015	-	-	1	5	-
Pb 3rd Cl. Cond. 1	0.6	-	-	-	-	-	-	-	-	11.0
Pb 3rd Cl. Cond. 2	-	-	-	-	-	*	-	-	-	6.5
Pb 3rd Cl. Float	-	-	-	0.10	0.03	-	-	1	10	-
Pb 4th Cl. Cond. 1	*	-	-	-	-	-	-	-	-	11.0
Pb 4th Cl. Aeration	-	-	-	-	-	-	-	10*	-	6.5
Pb 4th Cl. Float	-	-	-	0.05	0.015	-	-	1	5	-

* Added as H_2SO_3 solution to obtain pH indicated.

Test No. 6 - Continued

Metallurgical Results

Product	Weight %	Assays, %			% Distribution	
		Pb	Zn	Cu	Pb	Zn
1. Pb Cleaner Conc.	1.28	40.9	10.4	2.47	7.8	1.3
2. Pb 4th Cl. Tail.	2.17	29.6	15.2	-	9.6	3.3
3. Pb 3rd Cl. Tail.	3.44	24.6	14.8	-	12.7	5.0
4. Pb 2nd Cl. Tail.	10.11	21.3	15.3	-	32.3	15.3
5. Pb 1st Cl. Tail.	17.89	10.5	13.3	-	28.2	23.6
6. Pb Rougher Tail.	65.11	0.96	7.99	-	9.4	51.5
Head (Calculated)	100.00	6.67	10.1	-	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	3.45	33.8	13.4	-	17.4	4.6
Products 1 to 3	6.89	29.2	14.1	-	30.1	9.6
Products 1 to 4	17.00	24.5	14.8	-	62.4	24.9
Products 1 to 5	34.89	17.3	14.0	0-	90.6	48.5

Test No. 7 - Continued

Metallurgical Results

Product	Weight %	Assays, %			% Distribution	
		Pb	Zn	Cu	Pb	Zn
1. Pb Cleaner Conc.	9.01	46.6	11.8	0.22	68.3	11.5
2. Pb 4th Cl. Tail.	2.12	23.8	14.4	0.31	8.2	3.3
3. Pb 3rd Cl. Tail.	2.38	14.9	15.6	0.37	5.8	4.0
4. Pb 2nd Cl. Tail.	4.56	6.54	14.1	0.32	4.9	6.9
5. Zn Cleaner Conc.	11.69	1.34	51.2	-	2.5	64.5
6. Zn 3rd Cl. Tail.	0.94	2.96	14.3	-	0.5	1.4
7. Zn 2nd Cl. Tail.	2.29	2.75	7.37	-	1.0	1.8
8. Zn 1st Cl. Tail.	5.95	1.81	2.87	-	1.8	1.8
9. Zn Rougher Tail.	61.06	0.71	0.72	-	7.0	4.8
Head (Calculated)	100.00	6.14	9.28	0.20	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	11.13	42.3	12.3	0.24	76.5	14.8
Products 1 to 3	13.51	37.4	12.9	0.26	82.3	18.8
Products 1 to 4	18.07	29.6	13.2	0.28	87.2	25.7
Products 5 and 6	12.63	1.46	48.5	-	3.0	65.9
Products 5 to 7	14.92	1.66	42.1	-	4.0	67.7
Products 5 to 8	20.87	1.70	31.0	-	5.8	69.5

Test No. 8

Purpose: To conduct a flotation test using Na₂S in the Pb circuit as Zn depressant.

Procedure: As indicated below.

Feed: 2000 grams minus 10 mesh composite K-76-1.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Ca-(OH) ₂	Na ₂ -SO ₃	Na ₂ S	NaCN	Z-6	MIBC	Grind	Cond.	Froth	
Grind	3.0	1.5	2.0	-	0.05	-	30	-	-	11.4
Pb Rougher	-	-	-	-	0.02	0.06	-	1	3	9.0
	-	-	-	-	0.02	0.015	-	1	3	7.5
	-	-	-	-	0.02	0.015	-	1	3	-
	-	-	-	-	0.02	0.015	-	1	3	-
	-	-	-	-	0.02	0.015	-	1	3	-
Pb Ro. Conc. Regr.	0.5	-	-	0.2	0.03	-	20	-	-	9.3
Pb 1st Cl. Aeration	-	-	-	-	-	-	-	15	-	7.5
Pb 1st Cl. Float	-	-	-	-	0.05	0.03	-	1	5	-
Pb 1st Cl. Float	-	-	-	-	0.05	-	-	1	5	-
Pb 1st Cl. Conc. Regr.	0.5	-	-	0.2	0.03	-	40	-	-	8.7
Pb 2nd Cl. Conditioner	1.0	-	-	-	-	-	-	-	-	11.0
Pb 2nd Cl. Aeration	-	-	-	-	-	-	-	10	-	6.5
Pb 2nd Cl. Float	-	-	-	-	0.05	-	-	1	5	-
Pb 3rd Cl. Conditioner	1.0	-	-	-	-	-	-	1	-	11.0
Pb 3rd Cl. Conditioner	-	-	-	-	-	-	-	1	-	-
Pb 3rd Cl. Float	-	-	-	-	0.03	-	-	1	4	-

Comments: Poor selectivity - evidence of Cu present in 3rd cleaner concentrate.

Test No. 8 - Continued

Metallurgical Results

Product	Weight %	Assays, %			% Distribution	
		Pb	Zn	Cu	Pb	Zn
1. Pb Cleaner Conc.	2.92	38.5	12.5	2.68	16.9	3.6
2. Pb 3rd Cl. Tail.	4.28	26.2	16.9	-	16.8	7.1
3. Pb 2nd Cl. Tail.	10.86	18.8	17.3	-	30.6	18.4
4. Pb 1st Cl. Tail.	10.62	10.6	10.4	-	16.9	10.8
5. Pb Rougher Tail.	71.32	1.76	8.58	-	18.8	60.1
Head (Calculated)	100.00	6.67	10.2	-	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	7.20	31.2	15.1	-	33.7	10.7
Products 1 to 3	18.06	23.7	16.4	-	64.3	29.1
Products 1 to 4	28.68	18.9	14.2	-	81.2	39.9

Test No. 9

Purpose: To repeat test No. 4 (Sample K-80-1) but with slightly finer lead regrind, and extended lead cleaner flotation times.

Procedure: Lead circuit only.

Feed: 2000 grams minus 10 mesh sample No. K-80-1.

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

Conditions:

Stage	Reagents Added, plunds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	4.0	1.0	0.30	0.05	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	1	3	9.6
	-	-	-	0.02	0.02	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	1	3	-
Pb Conc. Regr.	1.0	0.5	0.20	-	-	0.04	40	-	-	-
Pb 1st Cl.	-	-	-	0.005	-	-	-	1	3	9.5
	-	-	-	0.01	-	0.01	-	1	4	-
Pb 2nd Cl.	0.2	0.2	0.10	-	0.005	-	-	1	3	9.6
	-	-	-	0.005	-	0.01	-	1	2	-
Pb 3rd Cl.	0.1	0.1	0.05	-	-	-	-	1	2	9.5
	-	-	-	-	-	0.005	-	1	2	-
Pb 4th Cl.	0.1	-	0.05	-	-	-	-	1	3	9.6

Observations: Lead flotation good, selectivity improved in cleaners.

Stage	Rougher	Pb Regrind	1st and 2nd Cleaner	3rd and 4th Cleaner
Equipment	1000 g D - 1 Rod Mill		500 g D - 1	250 g D - 1
Speed: r.p.m.	1800	-	1300	1000
% Solids	33	-	-	-

Test No. 9 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	6.81	55.6	7.65	76.5	5.7
2. Pb 4th Cl. Tail.	1.33	21.0	13.1	5.6	1.9
3. Pb 3rd Cl. Tail.	1.85	9.62	13.7	3.6	2.8
4. Pb 2nd Cl. Tail.	4.80	4.78	13.0	4.6	6.8
5. Pb 1st Cl. Tail.	12.47	1.05	11.2	2.6	15.2
6. Pb Rougher Tail.	72.74	0.48	8.52	7.1	67.6
Head (Calculated)	100.00	4.95	9.17	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	8.14	49.9	8.54	82.1	7.6
Products 1 to 3	9.99	42.5	9.50	85.7	10.4
Products 1 to 4	14.79	30.2	10.6	90.3	17.2
Products 1 to 5	27.26	16.9	10.9	92.9	32.4

Test No. 10

Purpose: To improve lead flotation from sample K-68-1 by adding Na_2SO_3 to the grind, using Z-6 as collector in both rougher and cleaner circuits, and increasing lead regrind time.

Procedure: Lead circuit only.

Feed: 2000 grams minus 10 mesh sample No. K-68-1.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na_2CO_3	ZnSO_4	Na_2SO_3	NaCN	Z - 6	MIBC	Grind	Cond.	Froth	
Primary Grind	3.0	0.5	0.5	0.30	0.05	-	30	-	-	-
Pb Rougher	-	-	-	-	0.02	0.04	-	1	3	9.0
	-	-	-	-	0.02	0.02	-	1	3	-
	-	-	-	-	0.01	0.02	-	1	3	-
Pb Conc. Regr.	1.0	0.25	0.25	0.20	0.04	-	40	-	-	-
Pb 1st Cl.	-	-	-	-	-	-	-	1	3	9.3
	-	-	-	-	0.01	0.005	-	1	4	-
Pb 2nd Cl.	0.2	0.10	0.10	0.10	-	0.01	-	1	3	9.3
	-	-	-	-	0.01	0.01	-	1	2	-
Pb 3rd Cl.	0.1	0.05	0.05	0.05	-	-	-	1	2	9.4
	-	-	-	-	0.005	0.005	-	1	2	-
Pb 4th Cl.	0.1	-	-	0.05	-	0.005	-	1	3	9.5

Test No. 10 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	8.21	46.8	10.8	74.2	8.2
2. Pb 4th Cl. Tail.	1.88	19.3	16.8	7.0	2.9
3. Pb 3rd Cl. Tail.	1.63	9.07	17.8	2.9	2.7
4. Pb 2nd Cl. Tail.	4.97	4.52	15.5	4.3	7.1
5. Pb 1st Cl. Tail.	14.77	1.24	11.3	3.5	15.4
6. Pb Rougher Tail.	68.54	0.61	10.1	8.1	63.7
Head (Calculated)	100.00	5.18	10.9	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	10.09	41.7	11.9	81.2	11.1
Products 1 to 3	11.72	37.1	12.7	84.1	13.8
Products 1 to 4	16.69	27.4	13.6	88.4	20.9
Products 1 to 5	31.46	15.1	12.5	91.9	36.3

Test No. 11

Purpose: To selectively float the Pb using Z-6, Minerec 2044 as Pb collectors, and ZnSO₄ - NaCN mixture as Zn depressant.

Procedure: As outlined below.

Feed: 2000 grams minus 10 mesh sample No. K-76-1.

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

Conditions:

Stage	Reagents Added, pounds per ton							Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄ NaCN	NaCN	Z - 6	Minerec 2044	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.20	0.03	0.03	-	-	40	-	-	-
Pb Rougher	-	-	-	0.015	0.015	0.03	-	-	1	5	9.2
	-	-	-	0.015	0.015	-	-	-	1	4	-
	-	-	-	0.015	0.015	0.01	-	-	1	4	-
Pb Conc. Regr.	1.5	0.5	0.10	-	0.015	-	0.05	50	-	-	-
Pb 1st Cl.	-	-	-	-	-	-	-	-	1	6	10.1
Pb 2nd Cl.	0.2	0.2	0.1	-	-	-	-	-	1	2	10.5
Pb 3rd Cl.	-	0.1	0.05	-	-	-	-	-	1	2	9.6
Pb 4th Cl.	0.2	0.1	0.05	-	-	-	-	-	1	2	9.7
	-	-	-	0.01	-	-	-	-	1	1	-

Comments: Minerec 2044 created a very foamy froth. Pb concentrate appeared good grade but light in weight.

Stage	Pb Rougher	Pb Cleaners
Flotation Cell	1000 g D - 1	500 g D - 1
Speed: r.p.m.	1700	1160

Test No. 11 - Continued

Metallurgical Results

Product	Weight %	Assays, %			% Distribution	
		Pb	Zn	Cu	Pb	Zn
1. Pb Cleaner Conc.	2.70	56.5	9.98	1.34	22.9	2.6
2. Pb 4th Cl. Tail.	1.78	38.0	14.9	-	10.2	2.6
3. Pb 3rd Cl. Tail.	6.34	28.9	15.8	-	27.6	9.8
4. Pb 2nd Cl. Tail.	10.28	15.2	15.9	-	23.5	16.0
5. Pb 1st Cl. Tail.	19.34	3.33	12.0	-	9.7	22.8
6. Pb Rougher Tail.	59.06	0.68	7.88	-	6.1	46.2
Head (Calculated)	100.00	6.64	10.2	-	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	4.48	49.0	11.9	-	33.1	5.2
Products 1 to 3	10.82	37.2	14.2	-	60.7	15.0
Products 1 to 4	21.10	26.5	15.0	-	84.2	31.0
Products 1 to 5	40.44	15.4	13.6	-	93.9	53.8

Test No. 12

Purpose: To investigate the floation of lead and zinc from a composite of K samples.

Procedure: Standard procedure.

Feed: 2000 grams minus 10 mesh composite of K samples 1:1:1.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.3	0.05	-	-	30	-	-	-
Pb Rougher	1.0	-	-	0.02	0.06	-	-	1	3	9.3
	-	-	-	0.02	0.03	-	-	1	3	-
	-	-	-	0.02	0.03	-	-	1	5	-
Pb Conc. Regr.	1.0	0.5	0.2	-	-	0.03	30	-	-	-
Pb 1st Cl.	-	-	-	0.005	-	-	-	1	3	9.3
	-	-	-	0.005	-	0.01	-	1	4	-
Pb 2nd Cl.	0.3	0.2	0.1	-	-	-	-	1	3	9.4
	-	-	-	0.005	-	0.01	-	1	2	-
Pb 3rd Cl.	0.1	0.1	0.1	-	0.005	0.005	-	1	4	9.4
Pb 4th Cl.	0.1	0.1	0.1	-	-	-	-	1	2	9.3
	-	-	-	0.005	-	-	-	1	2	-

Comments: Large quantity of zinc and pyrite in concentrate.

Stage	Rougher	Cleaner	Regrind
Equipment	1000 g D - 1	500 g D - 1	Rod Mill
Speed: r.p.m.	1700	1160	-

Test No. 12 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	10.01	43.3	11.7	76.9	11.5
2. Pb 4th Cl. Tail.	3.09	15.6	15.9	8.5	4.8
3. Pb 3rd Cl. Tail.	3.04	6.81	15.7	3.7	4.7
4. Pb 2nd Cl. Tail.	4.89	2.43	14.1	2.1	6.8
5. Pb 1st Cl. Tail.	15.08	0.88	11.0	2.4	16.3
6. Pb Rougher Tail.	63.89	0.57	8.90	6.4	55.9
Head (Calculated)	100.00	5.64	10.2	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	13.10	36.8	12.7	85.4	16.3
Products 1 to 3	16.14	31.1	13.3	89.1	21.0
Products 1 to 4	21.03	24.5	13.5	91.2	27.8
Products 1 to 5	36.11	14.6	12.4	93.6	44.1

Screen Analyses

Pb Cleaner Feed

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	0.2	0.2	99.8
100	0.5	0.7	99.3
150	1.3	2.0	98.0
200	1.5	3.5	96.5
270	1.0	4.5	95.5
400	1.6	6.1	93.9
- 400	93.9	100.0	-
Total	100.0	-	-

Test No. 13

Purpose: To repeat test No. 5 (K-68-1) but increase lead regrind time and increase CuSO₄ addition in the zinc circuit.

Procedure: As for test No. 4, but add 4th zinc cleaner.

Feed: 2000 grams minus 10 mesh sample K-68-1.

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

Conditions:

Stage	Reagents Added, pounds per ton								Time, minutes			pH
	Na ₂ -CO ₃	Zn-SO ₄	NaCN	Z-11	MIBC	R-242	Ca-(OH) ₂	CuSO ₄	Grind	Cond.	Froth	
Primary Grind	4.0	1.0	0.30	0.07	-	-	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	-	-	1	3	9.2
	-	-	-	0.02	0.02	-	-	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	-	-	1	3	-
Pb Conc. Regr.	1.0	0.5	0.20	0.01	-	0.05	-	-	50	-	-	-
Pb 1st Cl.	-	-	-	0.01	-	-	-	-	-	1	4	9.1
	-	-	-	0.01	-	0.01	-	-	-	1	4	-
Pb 2nd Cl.	0.2	0.2	0.10	-	-	-	-	-	-	1	3	9.2
	-	-	-	0.005	-	0.005	-	-	-	1	3	-
Pb 3rd Cl.	0.2	0.1	0.05	-	-	-	-	-	-	1	2	9.2
	-	-	-	-	-	0.005	-	-	-	1	2	-
Pb 4th Cl.	0.1	-	0.05	-	-	-	-	-	-	1	3	9.3
Combine lead rougher and 1st cleaner tailings for zinc flotation.												
	DF-250	M-748										
Condition	-	-	-	-	-	-	3.0	2.0	-	3	-	10.9
Zn Rougher	0.01	0.06	-	0.05	-	-	-	-	-	2	3	-
	0.02	0.04	-	0.05	-	-	-	-	-	2	5	-
Zn Conc. Regr.	-	0.04	-	0.02	-	-	1.0	0.5	15	-	-	-
Zn 1st Cl.	0.005	-	-	0.01	-	-	0.2	-	-	1	3	11.1
	0.005	-	-	0.02	-	-	-	-	-	1	4	-
Zn 2nd Cl.	-	-	-	0.01	-	-	0.5	-	-	1	3	11.3
	0.005	-	-	0.01	-	-	-	-	-	1	2	-
Zn 3rd Cl.	-	-	-	-	-	-	0.3	-	-	1	2	11.4
	0.005	-	-	0.01	-	-	-	-	-	1	2	-
Zn 4th Cl.	0.005	-	-	-	-	-	0.3	-	-	1	3	11.5

Test No. 13 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	6.83	53.6	9.50	69.0	5.7
2. Pb 4th Cl. Tail.	1.83	21.3	15.8	7.3	2.5
3. Pb 3rd Cl. Tail.	2.21	10.3	16.3	4.3	3.2
4. Pb 2nd Cl. Tail.	6.40	4.73	13.6	5.7	7.6
5. Zn Cleaner Conc.	10.09	1.08	59.5	2.1	52.5
6. Zn 4th Cl. Tail.	0.83	2.82	38.3	0.4	2.8
7. Zn 3rd Cl. Tail.	0.95	3.38	22.3	0.6	1.9
8. Zn 2nd Cl. Tail.	2.04	2.79	10.3	1.1	1.8
9. Zn 1st Cl. Tail.	6.98	1.68	5.90	2.2	3.6
10. Zn Rougher Tail.	61.84	0.63	3.40	7.3	18.4
Head (Calculated)	100.00	5.31	11.4	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	8.66	46.8	10.8	76.3	8.2
Products 1 to 3	10.87	39.4	11.9	80.6	11.4
Products 1 to 4	17.27	26.5	12.6	86.3	19.0
Products 5 and 6	10.92	1.21	57.9	2.5	55.3
Products 5 to 7	11.87	1.39	55.0	3.1	57.2
Products 5 to 8	13.91	1.59	48.5	4.2	59.0
Products 5 to 9	20.89	1.62	34.3	6.4	62.6

Test No. 14

Purpose: To investigate the flotation of Pb from the composite K sample using finer regrind of Pb concentrate.

Procedure: Standard procedure.

Feed: 2000 grams minus 10 mesh composite K samples 1:1:1.

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

Conditions:

Stage	Reagents Added, pounds per ton								Time, minutes			pH
	Na ₂ - CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Ca- (OH) ₂	CuSO ₄	Grind	Cond.	Froth	
Primary Grind	4.0	1.0	0.3	0.05	-	-	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.06	-	-	-	-	1	3	9.3
	-	-	-	0.02	0.03	-	-	-	-	1	3	-
	-	-	-	0.02	0.03	-	-	-	-	1	5	-
Pb Conc. Regr.	1.0	0.5	0.2	0.01	-	0.05	-	-	50	-	-	-
Pb 1st Cl.	-	-	-	0.01	-	-	-	-	-	1	5	9.6
	-	-	-	0.01	-	0.01	-	-	-	1	5	-
Pb 2nd Cl.	0.3	0.2	0.1	0.005	-	-	-	-	-	1	4	9.3
	-	-	-	0.005	-	0.01	-	-	-	1	4	-
Pb 3rd Cl.	0.1	0.1	0.1	-	-	-	-	-	-	1	3	9.4
	-	-	-	0.005	-	0.01	-	-	-	1	3	-
Pb 4th Cl.	0.1	0.1	0.1	-	-	-	-	-	-	1	2	9.2
	-	-	-	0.005	-	-	-	-	-	1	2	-
	M- 748	DF- 250										
Condition	-	-	-	-	-	-	2.5	1.5	-	3	-	-
Zn Rougher	0.06	0.02	-	0.02	-	-	-	-	-	2	3	11.0
	0.04	0.02	-	0.03	-	-	-	-	-	1	5	-
Zn Conc. Regr.	0.04	-	-	-	-	-	1.0	0.5	10	-	-	-
Zn 1st Cl.	-	-	-	0.01	-	-	-	-	-	1	3	11.1
	-	-	-	0.02	-	-	-	-	-	1	3	-
Zn 2nd Cl.	-	-	-	-	-	-	0.6	-	-	1	2	11.6
	-	-	-	0.01	-	-	-	-	-	1	2	-
Zn 3rd Cl.	-	-	-	0.005	-	-	0.5	-	-	1	2	11.6
	-	0.005	-	0.005	-	-	-	-	-	1	1	-

Test No. 14 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	10.05	41.2	10.9	76.6	10.8
2. Pb 4th Cl. Tail.	4.29	9.39	15.3	7.5	6.5
3. Pb 3rd Cl. Tail.	4.41	4.61	14.7	3.8	6.4
4. Pb 2nd Cl. Tail.	7.65	2.66	12.7	3.8	9.6
5. Zn Cleaner Conc.	10.13	0.90	51.5	1.7	51.6
6. Zn 3rd Cl. Tail.	2.20	1.53	20.2	0.6	4.4
7. Zn 2nd Cl. Tail.	3.57	1.39	7.92	0.9	2.8
8. Zn 1st Cl. Tail.	8.59	0.76	2.08	1.2	1.8
9. Zn Rougher Tail.	49.11	0.44	1.25	3.9	6.1
Head (Calculated)	100.00	5.41	10.1	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	14.34	31.7	12.2	84.1	17.3
Products 1 to 3	18.75	25.3	12.8	87.9	23.7
Products 1 to 4	26.40	18.6	12.8	91.7	33.3
Products 5 and 6	12.33	1.01	45.9	2.3	56.0
Products 5 to 7	15.90	1.10	37.4	3.2	58.8
Products 5 to 8	24.49	0.98	25.0	4.4	60.6

Test No. 15

Purpose: To investigate the flotation of lead from sample B-5.

Procedure: As for test 4, standard procedure.

Feed: 2000 grams minus 10 mesh sample B-5.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.3	0.05	-	-	30	-	-	(7.8)
Pb Rougher	3.0	-	0.1	0.02	0.06	-	-	1	3	9.5
	-	-	-	0.02	0.03	-	-	1	3	-
	-	-	-	0.02	0.03	-	-	1	5	-
Pb Conc. Regr.	1.3	0.5	0.2	-	-	0.03	30	-	-	-
Pb 1st Cl.	-	-	-	0.01	-	-	-	1	4	9.5
	-	-	-	0.01	-	0.01	-	1	4	-
Pb 2nd Cl.	0.3	0.2	0.1	0.005	-	-	-	1	3	9.5
	-	-	-	0.005	-	0.005	-	1	3	-
Pb 3rd Cl.	0.2	0.1	0.05	-	0.005	0.005	-	1	4	9.4
Pb 4th Cl.	0.2	-	0.05	0.005	0.005	-	-	1	3	9.3

Comments: Pb concentrate appeared good. Pb present in Pb 4th cleaner tailing.

Test No. 15 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	12.08	46.5	20.5	61.8	16.4
2. Pb 4th Cl. Tail.	4.90	22.8	26.2	12.3	8.5
3. Pb 3rd Cl. Tail.	5.66	12.8	26.8	8.0	10.1
4. Pb 2nd Cl. Tail.	6.47	5.37	23.4	3.8	10.0
5. Pb 1st Cl. Tail.	10.87	1.97	17.8	2.4	12.8
6. Pb Rougher Tail.	60.06	1.78	10.6	11.7	42.2
Head (Calculated)	100.00	9.09	16.6	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	16.98	39.7	22.1	74.1	24.9
Products 1 to 3	22.64	33.0	23.3	82.1	35.0
Products 1 to 4	29.11	26.8	23.3	85.9	45.0
Products 1 to 5	39.98	20.1	21.8	88.3	57.8

Test No. 16

Purpose: To repeat test No. 7 (J-76-1) but increase lead regrind time and lead cleaner flotation times.

Procedure: As for test No. 13.

Feed: 2000 grams minus 10 mesh sample J-76-1.

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

Conditions:

Stage	Reagents Added, pounds per ton								Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Ca-(OH) ₂	CuSO ₄	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	0.05	-	-	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.03	-	-	-	-	1	3	9.2
	-	-	-	0.02	0.01	-	-	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	-	-	1	3	-
Pb Conc. Regr.	1.0	0.5	0.20	0.01	-	0.05	-	-	50	-	-	-
Pb 1st Cl.	-	-	-	0.01	-	-	-	-	-	1	4	9.1
	-	-	-	0.01	-	0.01	-	-	-	1	4	-
Pb 2nd Cl.	0.2	0.2	0.10	-	-	-	-	-	-	1	3	9.1
	-	-	-	0.005	-	0.005	-	-	-	1	3	-
Pb 3rd Cl.	0.2	0.1	0.05	-	-	-	-	-	-	1	2	9.3
	-	-	-	-	-	0.005	-	-	-	1	2	-
Pb 4th Cl.	0.1	-	0.05	-	-	-	-	-	-	1	3	9.3
Combine lead rougher and 1st cleaner tailings for zinc flotation.												
	M-748	DF-250										
Condition	-	-	-	-	-	-	3.0	1.5	-	3	-	11.0
Zn Rougher	0.06	0.01	-	0.03	-	-	-	-	-	2	3	-
	0.04	0.02	-	0.04	-	-	-	-	-	2	5	-
Zn Conc. Regr.	0.04	-	-	0.02	-	-	1.5	0.5	15	-	-	-
Zn 1st Cl.	-	0.005	-	0.01	-	-	-	-	-	1	3	11.1
	-	0.01	-	0.02	-	-	-	-	-	1	4	-
Zn 2nd Cl.	-	-	-	0.01	-	-	0.5	-	-	1	3	11.3
	-	0.005	-	0.01	-	-	-	-	-	1	2	-
Zn 3rd Cl.	-	-	-	-	-	-	0.3	-	-	1	2	11.3
	-	0.005	-	0.005	-	-	-	-	-	1	2	-
Zn 4th Cl.	-	-	-	-	-	-	0.5	-	-	1	3	11.5

Test No. 16 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	8.69	53.9	10.1	75.6	9.8
2. Pb 4th Cl. Tail.	2.40	22.1	15.0	8.6	4.0
3. Pb 3rd Cl. Tail.	2.09	9.84	16.5	3.3	3.8
4. Pb 2nd Cl. Tail.	4.89	3.92	13.6	3.1	7.4
5. Zn Cleaner Conc.	10.38	0.94	53.9	1.6	62.3
6. Zn 4th Cl. Tail.	0.90	1.69	28.2	0.2	2.8
7. Zn 3rd Cl. Tail.	0.94	2.13	14.6	0.3	1.5
8. Zn 2nd Cl. Tail.	1.78	1.64	5.26	0.5	1.0
9. Zn 1st Cl. Tail.	6.81	1.15	2.36	1.3	1.8
10. Zn Rougher Tail.	61.12	0.56	0.82	5.5	5.6
Head (Calculated)	100.00	6.19	8.99	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	11.09	47.0	11.2	84.2	13.8
Products 1 to 3	13.18	41.1	12.0	87.5	17.6
Products 1 to 4	18.07	31.1	12.4	90.6	25.0
Products 5 and 6	11.28	1.00	51.8	1.8	65.1
Products 5 to 7	12.22	1.09	49.0	2.1	66.6
Products 5 to 8	14.00	1.16	43.4	2.6	67.6
Products 5 to 9	20.81	1.15	30.0	3.9	69.4

Test No. 17

Purpose: To investigate the flotation of Pb with a finer regrind, followed by a standard zinc circuit.

Procedure: flotation: As for test 15, but increase reagent additions to primary grind, increase Pb regrind time, and include zinc circuit.

Feed: 2000 grams minus 10 mesh sample B-5.

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

Conditions:

Stage	Reagents Added, pounds per ton								Time, minutes			pH
	Na ₂ -CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Ca-(OH) ₂	CuSO ₄	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.4	0.05	-	-	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.06	-	-	-	-	1	3	9.1
	-	-	-	0.02	0.03	-	-	-	-	1	3	-
	-	-	-	0.02	0.03	-	-	-	-	1	5	-
Pb Conc. Regr.	1.0	0.5	0.2	-	-	0.03	-	-	40	-	-	-
Pb 1st Cl.	0.2	-	-	0.01	-	-	-	-	-	1	4	9.2
	-	-	-	0.01	-	0.01	-	-	-	1	5	-
Pb 2nd Cl.	0.3	0.2	0.1	0.005	-	-	-	-	-	1	3	9.2
	-	-	-	0.005	-	0.005	-	-	-	1	3	-
Pb 3rd Cl.	0.3	0.1	0.05	-	0.005	0.005	-	-	-	1	4	9.3
Pb 4th Cl.	0.3	-	0.05	0.005	0.005	0.005	-	-	-	1	3	9.4
	M-748	DF-250										
Condition	-	-	-	-	-	-	2.5	1.2	-	3	-	-
Zn Rougher	0.06	0.02	-	0.02	-	-	-	-	-	2	3	10.8
	0.04	0.04	-	0.03	-	-	-	-	-	2	5	-
Zn Conc. Regr.	0.04	-	-	-	-	-	1.0	0.5	10	-	-	-
Zn 1st Cl.	-	-	-	0.01	-	-	0.2	-	-	1	3	11.2
	-	0.01	-	0.01	-	-	-	-	-	1	3	-
Zn 2nd Cl.	-	-	-	-	-	-	0.6	-	-	1	2	11.5
	-	0.005	-	0.01	-	-	-	-	-	1	2	-
Zn 3rd Cl.	-	0.005	-	0.005	-	-	0.2	-	-	1	3	-

Test No. 17 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	19.00	35.1	23.2	75.5	28.6
2. Pb 4th Cl. Tail.	3.98	14.3	26.6	6.4	6.9
3. Pb 3rd Cl. Tail.	4.69	7.88	24.5	4.2	7.4
4. Pb 2nd Cl. Tail.	7.48	4.55	20.5	3.9	9.9
5. Zn Cleaner Conc.	4.89	1.49	53.6	0.8	17.0
6. Zn 3rd Cl. Tail.	3.47	2.15	43.5	0.8	9.8
7. Zn 2nd Cl. Tail.	4.65	2.34	29.5	1.2	8.9
8. Zn 1st Cl. Tail.	7.35	2.05	11.7	1.7	5.6
9. Zn Rougher Tail.	44.49	1.08	2.06	5.5	5.9
Head (Calculated)	100.00	8.83	15.4	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	22.98	31.5	23.8	81.9	35.5
Products 1 to 3	27.67	27.5	23.9	86.1	42.9
Products 1 to 4	35.15	22.6	23.2	90.0	52.8
Products 5 and 6	8.36	1.76	49.4	1.6	26.8
Products 5 to 7	13.01	1.97	42.3	2.8	35.7
Products 5 to 8	20.36	2.00	31.3	4.5	41.3

Test No. 18

Purpose: To investigate the flotation of lead and zinc from sample F-V-4.

Procedure: Standard procedure.

Feed: 2000 grams minus 10 mesh sample F-V-4.

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

Conditions:

Stage	Reagents Added, pounds per ton								Time, minutes			pH
	Na ₂ -CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Ca-(OH) ₂	Cu-SO ₄	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.3	0.05	-	-	-	-	30	-	-	(8.3)
Pb Rougher	1.0	-	0.05	0.02	0.06	-	-	-	-	1	3	9.2
	-	-	-	0.02	0.03	-	-	-	-	1	3	-
	-	-	-	0.02	0.03	-	-	-	-	1	5	-
Pb Conc. Regr.	1.2	0.5	0.2	-	-	0.03	-	-	30	-	-	-
Pb 1st Cl.	-	-	-	0.005	-	-	-	-	-	1	3	9.2
	-	-	-	0.005	-	0.01	-	-	-	1	3	-
Pb 2nd Cl.	0.5	0.2	0.1	-	-	-	-	-	-	1	2	9.4
	-	-	-	0.005	-	0.005	-	-	-	1	2	-
Pb 3rd Cl.	0.5	0.1	0.05	-	0.005	0.005	-	-	-	1	3	9.5
Pb 4th Cl.	0.1	-	0.05	-	0.005	-	-	-	-	1	2	-
	M-748	DF-250										
Condition	-	-	-	-	-	-	2.5	1.2	-	3	-	10.8
Zn Rougher	0.06	-	-	0.02	-	-	-	-	-	2	3	-
	0.04	-	-	0.03	-	-	-	-	-	2	5	-
Zn Ro. Regr.	0.04	-	-	-	-	-	1.0	0.5	15	-	-	-
Zn 1st Cl.	-	-	-	0.01	-	-	0.5	-	-	1	3	11.3
	-	0.01	-	0.01	-	-	-	-	-	1	3	-
	-	0.01	-	0.01	-	-	-	-	-	1	3	-
Zn 2nd Cl.	-	-	-	0.01	-	-	0.7	-	-	1	2	11.4
	-	0.005	-	0.01	-	-	-	-	-	1	2	-
	-	0.010	-	0.02	-	-	-	-	-	1	2	-
Zn 3rd Cl.	-	0.005	-	0.01	-	-	-	-	-	1	3	11.4
	-	-	-	0.02	-	-	-	-	-	1	3	-

Comments: Zn appeared over-ground, resulting in slow flotation rate during cleaning.

Test No. 18 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	8.67	62.6	9.90	81.1	5.1
2. Pb 4th Cl. Tail.	0.73	22.2	24.0	2.4	1.1
3. Pb 3rd Cl. Tail.	2.12	14.6	26.0	4.6	3.3
4. Pb 2nd Cl. Tail.	5.18	4.00	25.8	3.1	8.0
5. Zn Cleaner Conc.	22.18	0.82	56.6	2.7	75.2
6. Zn 3rd Cl. Tail.	1.63	1.74	27.6	0.4	2.7
7. Zn 2nd Cl. Tail.	1.41	1.77	16.0	0.4	1.4
8. Zn 1st Cl. Tail.	3.95	1.13	5.62	0.7	1.3
9. Zn Rougher Tail.	54.13	0.57	0.58	4.6	1.9
Head (Calculated)	100.00	6.69	16.7	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	9.40	59.5	11.0	83.5	6.2
Products 1 to 3	11.52	51.2	13.8	88.1	9.5
Products 1 to 4	16.70	36.6	17.5	91.2	17.5
Products 5 to 6	23.81	0.88	54.6	3.1	77.9
Products 5 to 7	25.22	0.93	52.5	3.5	79.3
Products 5 to 8	29.17	0.96	46.1	4.2	80.6

Test No. 19

Purpose: To investigate the flotation of lead and zinc from sample No. C-4.

Procedure: Standard test.

Feed: 2000 grams minus 10 mesh sample No. C-4.

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

Conditions:

Stage	Reagents Added, pounds per ton								Time, minutes			pH
	Na ₂ -CO ₃	ZnSO ₄	NaCN	Z-11	MI BC	R-242	Ca-(OH) ₂	Cu-SO ₄	Grind	Cond.	Froth	
Primary Grind	4.0	1.0	0.30	0.05	-	-	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	-	-	1	3	9.6
	-	-	-	0.02	0.02	-	-	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	-	-	1	3	-
Pb Conc. Regr.	1.0	0.5	0.20	-	-	0.03	-	-	30	-	-	-
Pb 1st Cl.	-	-	-	0.01	-	-	-	-	-	1	3	9.5
	-	-	-	0.01	-	0.01	-	-	-	1	3	-
Pb 2nd Cl.	0.2	0.2	0.10	-	-	-	-	-	-	1	3	9.5
	-	-	-	0.005	-	0.005	-	-	-	1	1	-
Pb 3rd Cl.	0.1	0.1	0.05	-	0.005	0.005	-	-	-	1	3	9.5
Pb 4th Cl.	0.1	-	0.05	-	0.005	-	-	-	-	1	2	9.6
Combine Pb rougher and 1st cleaner tailings for zinc flotation.												
	M-748	DF-250										
Condition	-	-	-	-	-	-	2.5	1.5	-	3	-	11.1
Zn Rougher	0.06	0.02	-	0.02	-	-	-	-	-	2	3	-
	0.04	0.02	-	0.04	-	-	-	-	-	2	5	-
Zn Conc. Regr.	0.04	-	-	-	-	-	1.0	0.3	15	-	-	-
Zn 1st Cl.	-	0.005	-	0.01	-	-	-	-	-	1	3	11.1
	-	0.01	-	0.02	-	-	-	-	-	1	3	-
Zn 2nd Cl.	-	-	-	-	-	-	0.5	-	-	1	2	11.3
	-	0.005	-	0.01	-	-	-	-	-	1	2	-
Zn 3rd Cl.	-	0.005	-	0.005	-	-	0.3	-	-	1	3	11.4

Test No. 19 - Continued

Conditions:

Stage	Pb Rougher	Pb Regrind	Pb 1st Cleaner	Pb 2nd to 4th Cl.
Equipment	1000 g D - 1	Rod Mill	500 g D - 1	250 g D - 1
Speed: r.p.m.	1800	-	1300	1000
% Solids	33	-	-	-

Stage	Zn Rougher	Zn Regrind	Zn Cleaners
Equipment	1000 g D - 1	Pebble Mill	500 g D - 1
Speed: r.p.m.	1800	-	-

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	3.26	66.2	3.73	55.1	1.5
2. Pb 4th Cl. Tail.	1.50	38.2	7.36	14.6	1.3
3. Pb 3rd Cl. Tail.	1.63	21.5	9.15	8.9	1.8
4. Pb 2nd Cl. Tail.	2.99	8.80	10.2	6.7	3.7
5. Zn Cleaner Conc.	12.19	0.46	53.3	1.4	78.1
6. Zn 3rd Cl. Tail.	0.94	2.29	16.0	0.5	1.8
7. Zn 2nd Cl. Tail.	2.28	2.13	7.69	1.2	2.1
8. Zn 1st Cl. Tail.	7.87	1.38	2.32	2.8	2.2
9. Zn Rougher Tail.	67.34	0.51	0.94	8.8	7.5
Head (Calculated)	100.00	3.92	8.32	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	4.76	57.4	4.87	69.7	2.8
Products 1 to 3	6.39	48.2	5.96	78.6	4.6
Products 1 to 4	9.38	35.7	7.31	85.3	8.3
Products 5 and 6	13.13	0.59	50.6	1.9	79.9
Products 5 to 7	15.41	0.82	44.3	3.1	82.0
Products 5 to 8	23.28	1.01	30.1	5.9	84.2

Test No. 20

Purpose: To repeat test No. 13 (K-68-1) but with a finer primary grind and lower pH in zinc rougher.

Procedure: Standard.

Feed: 2000 grams minus 10 mesh sample No. K-68-1.

Grind: 50 minutes at 63 percent solids in the laboratory ball mill.

Conditions:

Stage	Reagents Added, pounds per ton								Time, minutes			pH
	Na ₂ -CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Ca-(OH) ₂	Cu-SO ₄	Grind	Cond.	Froth	
Primary Grind	4.0	1.0	0.30	0.07	-	-	-	-	50	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	-	-	1	4	9.0
	-	-	-	0.02	0.02	-	-	-	-	1	4	-
	-	-	-	0.01	0.02	-	-	-	-	1	4	-
Pb Regrind	1.0	0.5	0.20	0.01	-	0.05	-	-	50	-	-	-
Pb 1st Cl.	-	-	-	0.01	-	-	-	-	-	2*	4	8.8
	-	-	-	0.01	-	0.01	-	-	-	1	4	-
Pb 2nd Cl.	0.3	0.2	0.10	-	-	-	-	-	-	1	3	9.0
	-	-	-	0.01	-	0.005	-	-	-	1	3	-
Pb 3rd Cl.	0.3	0.1	0.10	-	-	-	-	-	-	1	2	9.2
	-	-	-	0.005	-	-	-	-	-	1	2	-
Pb 4th Cl.	0.1	-	0.05	-	0.005	0.005	-	-	-	1	3	9.3
Combine lead rougher and 1st cleaner tailings for zinc flotation.												
	M-748	DF-250										
Condition	-	-	-	-	-	-	1.5	2.0	-	3	-	8.7
Zn Rougher	0.06	0.01	-	0.02	-	-	-	-	-	2	3	-
	0.04	0.01	-	0.03	-	-	-	-	-	2	5	-
Zn Conc. Regr.	0.04	-	-	0.02	-	-	1.5	0.5	15	-	-	-
Zn 1st Cl.	-	0.005	-	0.01	-	-	-	-	-	1	3	9.9
	-	0.01	-	0.02	-	-	-	-	-	1	4	-
Zn 2nd Cl.	-	-	-	0.01	-	-	1.0	-	-	1	3	10.9
	-	-	-	0.01	-	-	-	-	-	1	2	-
Zn 3rd Cl.	-	-	-	-	-	-	0.3	-	-	1	2	11.2
	-	-	-	0.005	-	-	-	-	-	1	2	-

* aeration

Test No. 20 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	6.25	58.2	8.30	67.9	4.5
2. Pb 4th Cl. Tail.	1.48	23.5	14.5	6.5	1.9
3. Pb 3rd Cl. Tail.	3.45	12.7	16.0	8.2	4.8
4. Pb 2nd Cl. Tail.	5.32	5.35	16.7	5.3	7.8
5. Zn Cleaner Conc.	10.20	1.14	57.3	2.2	51.2
6. Zn 3rd Cl. Tail.	1.68	2.12	20.5	0.7	3.0
7. Zn 2nd Cl. Tail.	4.00	1.48	9.22	1.1	3.2
8. Zn 1st Cl. Tail.	12.89	0.96	5.21	2.3	5.9
9. Zn Rougher Tail.	54.73	0.57	3.70	5.8	7.7
Head (Calculated)	100.00	5.35	11.4	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	7.73	51.6	9.49	74.4	6.4
Products 1 to 3	11.18	39.6	11.5	82.6	11.2
Products 1 to 4	16.50	28.5	13.2	87.9	19.0
Products 5 and 6	11.88	1.28	52.1	2.9	54.2
Products 5 to 7	15.88	1.33	41.3	4.0	57.4
Products 5 to 8	28.77	1.16	25.1	6.3	63.3

Test No. 21

Purpose: To investigate the effect of increasing the cyanide to the primary grind.

Procedure: Standard lead circuit, with increased NaCN.

Feed: 2000 grams minus 10 mesh composite of K samples 1:1:1.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z - 6	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	3.5	1.0	0.6	0.05	-	-	40	-	-	9.0
Pb Rougher 1	-	-	-	0.02	0.06	-	-	1	3	-
Pb Rougher 2	-	-	-	0.02	0.03	-	-	1	3	-
Pb Rougher 3	-	-	-	0.02	0.03	-	-	1	5	-
Pb Conc. Regr.	1.0	0.5	0.4	0.01	-	0.05	40	-	-	-
Pb 1st Cl.	-	-	-	-	-	-	-	1	3	9.0
	-	-	-	0.005	0.005	0.01	-	1	3	-
Pb 2nd Cl.	0.2	0.2	0.2	-	-	-	-	1	2	9.3
	-	-	-	0.005	-	0.005	-	1	2	-
	-	-	-	0.005	-	0.005	-	1	2	-
Pb 3rd Cl.	0.5	0.1	0.1	-	-	-	-	1	2	9.4
	-	-	-	-	-	0.005	-	1	2	-
	-	-	-	0.005	-	-	-	1	1	-
Pb 4th Cl.	0.5	0.1	0.1	-	-	0.005	-	1	4	9.6

Comments: Better suppression of zinc and pyrite in rougher. Pb minerals floated well after regrind. Pyrite and zinc floated at start of cleaning stages.

Test No. 21 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	11.94	40.6	11.9	84.5	13.9
2. Pb 4th Cl. Tail.	2.24	10.7	19.3	4.2	4.2
3. Pb 3rd Cl. Tail.	2.52	3.88	16.5	1.7	4.1
4. Pb 2nd Cl. Tail.	4.24	2.06	14.2	1.5	5.9
5. Pb 1st Cl. Tail.	15.19	0.85	11.6	2.2	17.3
6. Pb Rougher Tail.	63.87	0.53	8.71	5.9	54.6
Head (Calculated)	100.00	5.74	10.2	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	14.18	35.9	13.1	88.7	18.1
Products 1 to 3	16.70	31.1	13.6	90.4	22.2
Products 1 to 4	20.94	25.5	13.7	91.9	28.1
Products 1 to 5	36.13	15.0	12.8	94.1	45.4

Test No. 22

Purpose: To investigate the effect of further increasing the NaCN additions.

Procedure: As for test 21, but Z-6 was used to replace the 242 as collector in the Pb cleaning.

Feed: 2000 grams minus 10 mesh composite of K samples 1:1:1.

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

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z - 6	MIBC	Grind	Cond.	Froth	
Primary Grind	3.2	1.0	0.8	0.05	-	40	-	-	-
Pb Rougher 1	-	-	-	0.02	0.06	-	1	3	8.9
Pb Rougher 2	-	-	-	0.02	0.03	-	1	3	-
Pb Rougher 3	-	-	-	0.02	0.03	-	1	5	-
Pb Conc. Regr.	1.2	0.5	0.4	0.05	-	50	-	-	-
Pb 1st Cl.	-	-	-	-	-	-	1	10	9.1
	-	-	-	0.02	0.010	-	1	2	-
Pb 2nd Cl.	0.2	0.2	0.2	-	-	-	1	8	9.2
	-	-	-	0.01	0.005	-	1	2	-
Pb 3rd Cl.	0.5	0.1	0.1	-	-	-	1	4	9.5
	-	-	-	0.01	0.01	-	1	2	-
Pb 4th Cl.	0.5	0.1	0.1	-	-	-	1	4	9.5
	-	-	-	0.01	-	-	1	2	-

Test No. 22 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	10.32	44.8	11.1	82.0	11.5
2. Pb 4th Cl. Tail.	1.83	11.9	16.6	3.9	3.1
3. Pb 3rd Cl. Tail.	3.17	5.76	16.8	3.2	5.4
4. Pb 2nd Cl. Tail.	5.64	2.41	15.4	2.4	8.7
5. Pb 1st Cl. Tail.	13.86	0.84	11.7	2.1	16.3
6. Pb Rougher Tail.	65.18	0.56	8.41	6.4	55.0
Head (Calculated)	100.00	5.64	9.95	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	12.15	39.8	11.9	85.9	14.6
Products 1 to 3	15.32	32.8	12.9	89.1	20.0
Products 1 to 4	20.96	24.6	13.6	91.5	28.7
Products 1 to 5	34.82	15.2	12.8	93.6	45.0

Test No. 23

Purpose: To investigate the flotation of lead and zinc from sample No. D-4.

Procedure: Standard.

Feed: 2000 grams minus 10 mesh sample D-4.

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

Conditions:

Stage	Reagents Added, pounds per ton								Time, minutes			pH
	Na ₂ -CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Ca-(OH) ₂	Cu-SO ₄	Grind	Cond.	Froth	
Primary Grind	4.0	1.0	0.30	0.05	-	-	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	-	-	1	3	9.7
	-	-	-	0.02	0.02	-	-	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	-	-	1	3	-
Pb Conc. Rkgr.	1.0	0.5	0.20	-	-	0.03	-	-	30	-	-	-
Pb 1st Cl.	-	-	-	0.01	0.005	0.01	-	-	-	1	3	9.7
	-	-	-	0.015	-	0.015	-	-	-	1	4	-
Pb 2nd Cl.	0.2	0.2	0.10	-	-	0.005	-	-	-	1	3	9.6
	-	-	-	0.005	0.005	0.005	-	-	-	1	2	-
Pb 3rd Cl.	0.1	0.1	0.05	-	0.005	0.005	-	-	-	1	2	9.6
	-	-	-	-	-	0.005	-	-	-	1	2	-
Pb 4th Cl.	0.1	-	0.05	-	0.005	-	-	-	-	1	3	9.7
Combine lead rougher and 1st cleaner tailings for zinc flotation.												
Observations:	Lead rougher appeared good, not much evidence of carbon, but carbon visible after regrind. Galena slow-floating, required more collector and longer flotation times than normal.											
	M-748	DF-250										
Condition	-	-	-	-	-	-	2.5	1.5	-	3	-	11.1
Zn Rougher	0.06	0.01	-	0.02	-	-	-	-	-	2	3	-
	0.04	0.03	-	0.04	-	-	-	-	-	2	5	-
Zn Conc. Regr.	0.04	-	-	-	-	-	1.0	0.3	10	-	-	-
Zn 1st Cl.	-	0.01	-	0.01	-	-	-	-	-	1	3	11.0
	-	0.02	-	0.02	-	-	-	-	-	1	3	-
Zn 2nd Cl.	-	-	-	-	-	-	0.5	-	-	1	2	11.2
	-	0.01	-	0.01	-	-	-	-	-	1	3	-
Zn 3rd Cl.	-	-	-	-	-	-	0.3	-	-	1	2	11.3
	-	0.005	-	0.005	-	-	-	-	-	1	2	-
Observations:	Zinc rougher excellent, Zn very fast-floating. Zinc cleaners very selective, but poor froth.											

Test No. 23 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	3.47	62.2	4.92	53.1	2.0
2. Pb 4th Cl. Tail.	1.24	44.7	8.38	13.6	1.2
3. Pb 3rd Cl. Tail.	1.61	28.4	11.0	11.3	2.0
4. Pb 2nd Cl. Tail.	2.22	8.96	13.3	4.9	3.4
5. Zn Cleaner Conc.	12.71	0.61	55.4	1.9	80.6
6. Zn 3rd Cl. Tail.	0.61	2.39	19.7	0.4	1.4
7. Zn 2nd Cl. Tail.	1.34	2.43	7.67	0.8	1.2
8. Zn 1st Cl. Tail.	4.76	1.67	3.06	2.0	1.7
9. Zn Rougher Tail.	72.04	0.68	0.81	12.0	6.5
Head (Calculated)	100.00	4.06	8.74	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	4.71	57.6	5.83	66.7	3.2
Products 1 to 3	6.32	50.2	7.15	78.0	5.2
Products 1 to 4	8.54	39.4	8.75	82.9	8.6
Products 5 and 6	13.32	0.69	53.8	2.3	82.0
Products 5 to 7	14.66	0.85	49.5	3.1	83.2
Products 5 to 8	19.42	1.05	38.2	5.1	84.9

Test No. 24

Purpose: To investigate the flotation of lead and zinc from sample H-4.

Procedure: Standard.

Feed: 2000 grams minus 10 mesh sample H-4.

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

Conditions:

Stage	Reagents Added, pounds per ton								Time, minutes			pH
	Na ₂ -CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Ca-(OH) ₂	Cu-SO ₄	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.3	0.05	-	-	-	-	30	-	-	-
	-	-	-	0.02	0.06	-	-	-	-	1	3	8.9
	-	-	-	0.02	0.03	-	-	-	-	1	3	-
	-	-	-	0.01	0.03	-	-	-	-	1	3	-
Pb Conc. Regr.	1.0	0.5	0.2	-	-	0.03	-	-	30	-	-	-
Pb 1st Cl.	-	-	-	0.005	-	-	-	-	-	1	3	9.2
	-	-	-	0.005	-	0.01	-	-	-	1	3	-
Pb 2nd Cl.	0.2	0.2	0.1	-	-	-	-	-	-	1	2	9.4
	-	-	-	0.005	-	0.005	-	-	-	1	2	-
Pb 3rd Cl.	0.1	0.1	0.05	-	-	-	-	-	-	1	3	9.3
Pb 4th Cl.	0.1	-	0.05	-	-	-	-	-	-	1	2	9.4
Combine lead rougher and 1st cleaner tailings for zinc flotation.												
	M-748	DF-250										
Condition	-	-	-	-	-	-	2.5	2.0	-	3	-	-
Zn Rougher	0.06	0.02	-	0.02	-	-	-	-	-	2	3	11.0
	0.04	-	-	0.04	-	-	-	-	-	2	5	-
Zn Conc. Regr.	0.04	-	-	-	-	-	1.0	0.5	10	-	-	-
Zn 1st Cl.	-	-	-	0.01	-	-	-	-	-	1	3	11.0
	-	-	-	0.02	-	-	-	-	-	1	3	-
Zn 2nd Cl.	-	-	-	-	-	-	0.5	-	-	1	2	11.1
	-	-	-	0.01	-	-	-	-	-	1	2	-
Zn 3rd Cl.	-	-	-	0.005	-	-	0.5	-	-	1	3	11.4

Stage	Rougher	Pb 1st Cleaner	Pb 2nd to 4th Cleaner
Flotation Cell	1000 g D - 1	500 g D - 1	250 g D - 1

Test No. 24 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	5.23	59.6	6.63	83.9	4.1
2. Pb 4th Cl. Tail.	0.69	10.7	14.3	2.0	1.2
3. Pb 3rd Cl. Tail.	1.26	4.03	13.7	1.4	2.1
4. Pb 2nd Cl. Tail.	1.97	1.66	12.0	0.9	2.8
5. Zn Cleaner Conc.	12.69	0.48	48.3	1.6	73.0
6. Zn 3rd Cl. Tail.	1.22	1.07	6.92	0.4	1.0
7. Zn 2nd Cl. Tail.	2.86	0.76	3.03	0.6	1.0
8. Zn 1st Cl. Tail.	10.71	0.48	1.26	1.4	1.6
9. Zn Rougher Tail.	63.37	0.46	1.74	7.8	13.2
Head (Calculated)	100.00	3.71	8.39	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	5.92	53.9	7.52	85.9	5.3
Products 1 to 3	7.18	45.2	8.61	87.3	7.4
Products 1 to 4	9.15	35.8	9.34	88.2	10.2
Products 5 and 6	13.91	0.53	44.7	2.0	74.0
Products 5 to 7	16.77	0.57	37.6	2.6	75.0
Products 5 to 8	27.48	0.54	23.4	4.0	76.6

Test No. 25

Purpose: Attempt to improve selectivity between Pb and zinc minerals using Composite K (1:1:1).

Procedure: Similar to test No. 22, but at lower pH and increased number of cleaning stages.

Feed: 2000 grams minus 10 mesh K Composite samples (1:1:1).

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

Conditions:

Stage	Reagents Added, pounds per ton								Time, minutes			pH
	Na ₂ -CO ₃	ZnSO ₄	NaCN	Z - 6	Na ₂ -SiO ₃	MIBC	R-242	Ca-(OH) ₂	Grind	Cond.	Froth	
Grind	1.5	0.5	0.8	0.06	0.3	-	-	-	40	-	-	8.2
Pb Rougher 1	-	-	-	0.02	-	0.04	-	-	-	1	3	-
2	-	-	-	0.02	-	0.008	-	-	-	1	3	-
3	-	-	-	0.02	-	0.008	-	-	-	1	4	-
Pb Conc. Regr.	0.5	0.4	-	-	0.2	-	0.05	-	50	-	-	-
Pb 1st Cl. 1	-	-	-	-	-	0.01	-	-	-	1	10	8.2
2	-	-	-	0.01	-	0.01	-	-	-	1	2	-
Pb 2nd Cl. 1	0.2	0.2	-	-	-	-	-	-	-	4	-	8.3
2	-	-	-	0.01	-	0.01	0.02	-	-	1	8	-
Pb 3rd Cl. 1	0.1	0.2	-	-	-	-	-	-	-	3	-	8.2
2	-	-	-	0.005	-	0.008	0.02	-	-	1	7	8.2
Pb 4th Cl. 1	0.1	0.2	-	-	-	-	-	-	-	2	-	-
2	-	-	-	0.005	-	0.008	0.01	-	-	1	6	-
Pb 5th Cl. 1	0.06	0.2	-	-	-	-	-	-	-	2	-	8.3
2	-	-	-	0.005	-	0.005	0.01	-	-	1	5	-
Pb 6th Cl. 1	0.1	0.2	-	-	-	-	-	-	-	2	-	8.3
2	-	-	-	0.005	-	-	0.005	-	-	1	4	-
Combine Pb rougher, 1st and 2nd cleaner tailings for zinc flotation.												
Zinc Circuit	Cu-SO ₄	M-748					Z-200					
Conditioning	-	-	-	-	-	-	-	2.8	-	5	-	10.8
	2.0	-	-	-	-	-	-	-	-	5	-	10.5
Zn Ro. 1	-	0.04	-	0.03	-	0.04	-	-	-	1	4	-
2	-	0.02	-	0.02	-	0.01	-	-	-	1	3	-
3	-	0.02	-	0.02	-	0.01	-	-	-	1	3	-
Zn 1st Cl. 1	-	-	-	0.01	-	-	0.02	1.5	-	2	4	11.6
2	-	-	-	0.005	-	0.005	0.01	-	-	2	4	-
Zn 2nd Cl. 1	-	-	-	0.005	-	-	0.01	1.0	-	2	6	11.6
2	-	-	-	0.005	-	0.005	0.01	-	-	2	1	-
Zn 3rd Cl. 1	-	-	-	0.005	-	0.005	0.005	0.8	-	1	4	11.4
2	-	-	-	-	-	0.005	0.005	-	-	1	2	11.3
Zn 4th Cl. 1	-	-	-	-	-	0.005	-	0.6	-	1	3	11.4
	-	-	-	-	-	0.002	0.005	-	-	1	3	-

Test No. 25 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	8.67	47.0	12.7	73.6	10.7
2. Pb 6th Cl. Tail.	2.21	20.9	17.5	8.3	3.8
3. Pb 5th Cl. Tail.	1.00	6.75	16.8	1.2	1.6
4. Pb 4th Cl. Tail.	1.99	5.74	11.3	2.1	2.2
5. Pb 3rd Cl. Tail.	2.26	3.58	11.9	1.5	2.6
6. Zn Cleaner Conc.	10.23	1.11	53.6	2.1	53.3
7. Zn 4th Cl. Tail.	1.36	1.99	31.0	0.5	4.1
8. Zn 3rd Cl. Tail.	2.76	1.83	17.6	0.9	4.7
9. Zn 2nd Cl. Tail.	3.88	1.80	8.29	1.3	3.1
10. Zn 1st Cl. Tail.	6.94	1.38	4.86	1.7	3.3
11. Zn Flot. Tail.	58.70	0.65	1.85	6.8	10.6
Head (Calculated)	100.00	5.54	10.3	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	10.88	41.7	13.7	81.9	14.5
Products 1 to 3	11.88	38.8	13.9	83.1	16.1
Products 1 to 4	13.87	34.0	13.6	85.2	18.3
Products 1 to 5	16.13	29.7	13.3	86.7	20.9
Products 6 and 7	11.59	1.21	50.9	2.6	57.4
Products 6 to 8	14.35	1.33	44.5	3.5	62.1
Products 6 to 9	18.23	1.43	36.8	4.8	65.2
Products 6 to 10	25.17	1.42	28.0	6.5	68.5

Test No. 26 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	1.10	68.5	2.59	55.7	0.8
2. Pb 4th Cl. Tail.	0.34	35.1	5.79	8.8	0.6
3. Pb 3rd Cl. Tail.	0.65	13.3	6.76	6.4	1.3
4. Pb 2nd Cl. Tail.	1.50	2.81	6.25	3.1	2.7
5. Zn Cleaner Conc.	5.68	0.72	50.4	3.0	83.0
6. Zn 3rd Cl. Tail.	0.48	0.98	6.94	0.3	1.0
7. Zn 2nd Cl. Tail.	2.61	0.61	2.46	1.2	1.9
8. Zn 1st Cl. Tail.	8.57	0.33	0.59	2.1	1.5
9. Zn Rougher Tail.	79.07	0.33	0.32	19.4	7.2
Head (Calculated)	100.00	1.35	3.45	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	1.44	60.6	3.35	64.5	1.4
Products 1 to 3	2.09	45.9	4.41	70.9	2.7
Products 1 to 4	3.59	27.9	5.18	74.0	5.4
Products 5 and 6	6.16	0.74	47.0	3.3	84.0
Products 5 to 7	8.77	0.70	33.7	4.5	85.9
Products 5 to 8	17.34	0.52	17.4	6.6	87.4

Conditions:

[illegible]

Test No. 27 - Continued

Conditions:

Stage	Pb Rougher	Pb Cleaner	Regrind
Equipment	1000 g D - 1	500 g D - 1	Rod Mill

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	14.59	44.0	14.4	87.2	14.8
2. Pb 4th Cl. Tail.	0.94	9.86	16.3	1.3	1.1
3. Pb 3rd Cl. Tail.	4.65	4.99	22.3	3.2	7.3
4. Pb 2nd Cl. Tail.	5.32	2.00	19.7	1.4	7.4
5. Zn Cleaner Conc.	16.70	0.96	50.9	2.2	59.8
6. Zn 3rd Cl. Tail.	2.19	1.49	26.0	0.4	4.0
7. Zn 2nd Cl. Tail.	3.49	1.15	12.5	0.5	3.1
8. Zn 1st Cl. Tail.	6.49	0.71	2.11	0.6	1.0
9. Zn Rougher Tail.	45.63	0.51	0.53	3.2	1.5
Head (Calculated)	100.00	7.36	14.2	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	15.53	41.9	14.5	88.5	15.9
Products 1 to 3	20.18	33.4	16.3	91.7	23.2
Products 1 to 4	25.50	26.9	17.0	93.1	30.6
Products 5 and 6	18.89	1.02	48.0	2.6	63.8
Products 5 to 7	22.38	1.04	42.5	3.1	66.9
Products 5 to 8	28.87	0.97	33.4	3.7	67.9

Test No. 28

Purpose: To perform the standard test procedure on Pilot Plant Composite No. 1.

Procedure: Grind and float a lead concentrate. Regrind the lead concentrate and clean four times. Combine the lead rougher and 1st cleaner tailings and float a zinc concentrate. Regrind the zinc concentrate and clean three times.

Feed: 2000 grams minus 10 mesh PP Composite No. 1.

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

Conditions:

Stage	Reagents Added, pounds per ton								Time, minutes			pH
	Na ₂ -CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Ca-(OH) ₂	Cu-SO ₄	Grind	Cond.	Froth	
Primary Grind	4.0	1.0	0.30	0.05	-	-	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.06	-	-	-	-	1	3	9.2
	-	-	-	0.02	0.03	-	-	-	-	1	3	-
	-	-	-	0.01	0.03	-	-	-	-	1	3	-
Pb Conc. Regr.	1.0	0.5	0.20	0.01	-	0.04	-	-	40	-	-	-
Pb 1st Cl.	-	-	-	0.01	-	-	-	-	-	1	3	9.2
	-	-	-	0.01	-	0.01	-	-	-	1	4	-
Pb 2nd Cl.	0.2	0.2	0.10	-	-	-	-	-	-	1	3	9.2
	-	-	-	0.005	-	0.01	-	-	-	1	2	-
Pb 3rd Cl.	0.1	0.1	0.05	-	-	-	-	-	-	1	2	9.3
	-	-	-	-	-	0.005	-	-	-	-	2	-
Pb 4th Cl.	0.1	-	0.05	-	-	-	-	-	-	1	3	9.4
Combine lead rougher and 1st cleaner tailings for zinc flotation.												
	M-748	DF-250										
Condition	-	-	-	-	-	-	2.5	1.5	-	3	-	10.8
Zn Rougher	0.06	0.02	-	0.05	-	-	-	-	-	2	3	-
	0.04	0.04	-	0.03	-	-	-	-	-	2	5	-
Zn Regrind	0.04	-	-	-	-	-	1.0	0.3	10	-	-	-
Zn 1st Cl.	-	-	-	0.01	-	-	-	-	-	1	3	11.0
	-	0.005	-	0.01	-	-	-	-	-	1	3	-
Zn 2nd Cl.	-	-	-	-	-	-	0.5	-	-	1	2	11.2
	-	-	-	0.01	-	-	-	-	-	1	2	-
Zn 3rd Cl.	-	-	-	0.005	-	-	0.3	-	-	1	3	11.3

Test No. 28 - Continued

Conditions:

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

Stage	Zn Rougher	Zn Regrind	Zn Cleaners
Equipment	1000 g D - 1	Pebble Mill	500 g D - 1
Speed: r.p.m.	1800	-	1300

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	6.50	51.0	9.37	62.9	6.2
2. Pb 4th Cl. Tail.	1.12	24.7	16.0	5.2	1.8
3. Pb 3rd Cl. Tail.	2.17	38.7	16.8	15.9	3.7
4. Pb 2nd Cl. Tail.	3.79	5.62	17.1	4.0	6.6
5. Zn Cleaner Conc.	13.33	0.96	50.6	2.4	68.5
6. Zn 3rd Cl. Tail.	1.19	1.96	18.7	0.4	2.3
7. Zn 2nd Cl. Tail.	2.47	1.66	8.84	0.8	2.2
8. Zn 1st Cl. Tail.	7.95	1.09	3.14	1.6	2.5
9. Zn Rougher Tail.	61.48	0.57	0.99	6.8	6.2
Head (Calculated)	100.00	5.27	9.85	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	7.62	47.1	10.3	68.1	8.0
Products 1 to 3	9.79	45.3	11.8	84.0	11.7
Products 1 to 4	13.58	34.2	13.3	88.0	18.3
Products 5 and 6	14.52	1.04	48.0	2.8	70.8
Products 5 to 7	16.99	1.13	42.3	3.6	73.0
Products 5 to 8	24.94	1.12	29.8	5.2	75.5

Test No. 29

Purpose: To investigate regrinding and scavenging the Pb cleaner tailings.

Procedure: See flowsheet.

Feed: 2000 grams minus 10 mesh sample B-5.

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

Conditions:

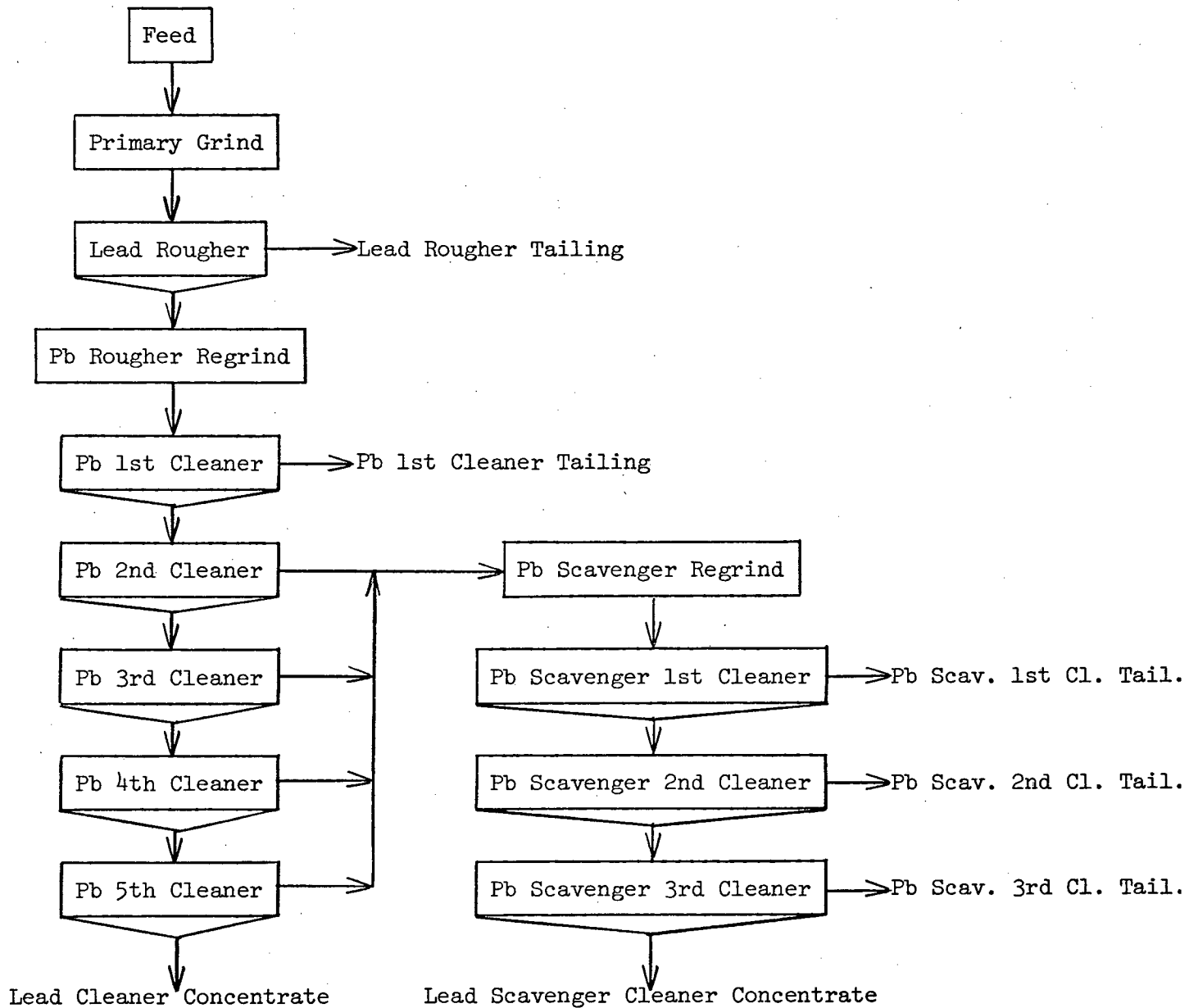
Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.4	0.05	-	-	40	-	-	-
Pb Rougher	-	-	-	0.02	0.06	-	-	1	3	9.0
	-	-	-	0.02	0.03	-	-	1	3	-
	-	-	-	0.02	0.03	-	-	1	5	-
Pb Conc. Regr.	1.3	0.5	0.2	0.01	-	0.03	50	-	-	-
	-	-	-	0.015	-	-	-	1	6	9.1
	-	-	-	0.015	-	0.01	-	1	6	-
Pb 2nd Cl.	0.5	0.2	0.1	-	-	-	-	1	7	9.4
Pb 3rd Cl.	0.5	0.1	0.1	0.005	0.005	-	-	1	6	9.4
Pb 4th Cl.	0.5	0.1	0.1	0.005	0.005	-	-	1	5	9.4
Pb 5th Cl.	0.3	-	0.05	-	-	-	-	1	5	9.7
Combine and filter the lead 2nd to 5th cleaner tailing, regrind and scavenge										
Pb Scav. Regr.	0.8	0.5	0.2	-	-	0.01	30	-	-	-
Pb Scav. 1st Cl.	-	-	-	0.01	-	-	-	1	2	9.1
	-	-	-	0.01	0.005	0.01	-	1	2	-
	-	-	-	0.01	0.005	0.01	-	1	4	-
Pb Scav. 2nd Cl.	0.5	0.1	0.1	0.01	-	-	-	1	3	9.4
	-	-	-	0.01	0.005	0.005	-	1	3	-
Pb Scav. 3rd Cl.	0.5	0.1	0.1	-	-	-	-	1	2	9.4
	-	-	-	0.01	-	0.005	-	1	3	-

Stage	Pb Rougher	Pb Ro. Regrind	Pb 1st to 3rd Cl.	Pb 4th and 5th Cl.
Equipment	1000 g D - 1	Rod Mill	500 g D - 1	250 g D - 1
Speed: r.p.m.	1800	-	1300	1000

Stage	Pb Scav. Regrind	Pb Scav. Cleaners
Equipment	Rod Mill	500 g D - 1
Speed: r.p.m.	-	1300

Test No. 29 - Continued

Flowsheet



Test No. 29 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	8.78	45.9	17.6	48.0	10.3
2. Pb Scav. Cl. Conc.	4.47	37.6	21.5	20.0	6.4
3. Pb Scav. 3rd Cl. Tail.	2.94	21.8	26.4	7.6	5.2
3. Pb Scav. 2nd Cl. Tail.	5.10	12.7	26.5	7.7	9.0
5. Pb Scav. 1st Cl. Tail.	9.23	4.71	23.5	5.2	14.5
6. Pb 1st Cleaner Tail.	12.67	1.98	17.4	3.0	14.7
7. Pb Rougher Tailing	56.81	1.24	10.5	8.5	39.9
Head (Calculated)	100.00	8.39	15.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	13.25	43.1	18.9	68.0	16.7
Products 1 to 3	16.19	39.2	20.3	75.6	21.9
Products 1 to 4	21.29	32.9	21.8	83.3	30.9
Products 1 to 5	30.52	24.4	22.3	88.5	45.4
Products 1 to 6	43.19	17.8	20.9	91.5	60.1
Products 2 and 3	7.41	31.3	23.4	27.6	11.6
Products 2 to 4	12.51	23.7	24.7	35.3	20.6
Products 2 to 5	21.74	15.7	24.2	40.5	35.1

Test No. 30

Purpose: To investigate the flotation of lead and zinc from sample No. A-2.

Procedure: Standard.

Feed: 2000 grams minus 10 mesh sample No. A-2.

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

Conditions :

[illegible]

Test No. 30 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	10.70	66.2	5.28	77.8	9.0
2. Pb 4th Cl. Tail.	1.75	27.2	11.7	5.2	3.3
3. Pb 3rd Cl. Tail.	1.16	15.4	12.7	2.0	2.3
4. Pb 2nd Cl. Tail.	3.09	9.21	11.7	3.1	5.8
5. Zn Cleaner Conc.	3.99	1.65	54.2	0.7	34.4
6. Zn 3rd Cl. Tail.	3.61	2.07	45.7	0.8	26.3
7. Zn 2nd Cl. Tail.	2.87	3.09	20.5	1.0	9.4
8. Zn 1st Cl. Tail.	6.32	2.37	6.45	1.6	6.5
9. Zn Rougher Tail.	66.51	1.06	0.29	7.8	3.0
Head (Calculated)	100.00	9.11	6.28	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	12.45	60.7	6.18	83.0	12.3
Products 1 to 3	13.61	56.9	6.74	85.0	14.6
Products 1 to 4	16.70	48.0	7.66	88.1	20.4
Products 5 and 6	7.60	1.85	50.2	1.5	60.7
Products 5 to 7	10.47	2.19	42.0	2.5	70.1
Products 5 to 8	16.79	2.26	28.6	4.1	76.6

Test No. 31

Purpose: To investigate the effect of NaClO_3 additions in the Pb and Zn circuit.

Procedure: Similar to test No. 28.

Feed: 2000 grams minus 10 mesh PP Composite No. 1.

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

Conditions:

Stage	Reagents Added, pounds per ton							Time, minutes			pH
	Na_2CO_3	ZnSO_4	NaCN	Z-11	MIBC	R-241	NaClO_3	Grind	Cond.	Froth	
Primary Grind	4.0	1.0	0.3	0.05	-	-	0.3	30	-	-	-
Cond.	-	-	-	0.02	-	-	-	-	5	-	-
Pb Ro. 1	-	-	-	-	0.06	-	-	-	1	3	-
2	-	-	-	0.02	0.03	-	-	-	1	3	-
3	-	-	-	0.01	0.02	-	-	-	1	3	-
Pb Regrind	1.0	0.5	0.2	0.01	-	0.04	0.6	40	1	3	-
Pb 1st Cl. 1	-	-	-	0.01	-	-	-	-	1	4	9.2
2	-	-	-	-	-	0.01	-	-	1	3	-
3	-	-	-	-	-	0.005	-	-	1	2	-
Pb 2nd Cl. 1	0.2	0.2	0.1	-	-	-	0.3	-	3	-	9.2
2	-	-	-	0.005	0.002	0.01	-	-	1	5	-
Pb 3rd Cl. 1	0.1	-	0.05	-	-	-	0.2	-	3	-	9.3
2	-	-	-	-	0.002	0.002	-	-	1	4	-
Pb 4th Cl.	-	-	0.05	-	-	-	0.1	-	2	-	9.2
	-	-	-	-	-	0.002	-	-	1	4	-
Combine lead rougher and 1st cleaner tailings for zinc flotation.											
		$\text{Ca}(\text{OH})_2$	CuSO_4	KMnO_4		Z-200	M-748				
Cond.	-	3.0	-	0.3	-	-	-	-	5	-	-
Cond.	-	-	2.0	-	-	-	-	-	5	-	10.8
Zn Ro. 1	-	-	-	-	0.01	0.03	0.03	-	1	4	-
2	-	-	-	-	0.02	0.03	0.03	-	1	4	-
3	-	-	-	-	0.01	0.02	-	-	1	4	-
Zn Conc. Regr.	-	1.0	0.5	-	-	0.02	-	25	-	-	12.0
Zn 1st Cl. 1	-	-	-	-	0.01	-	-	-	1	4	-
2	-	-	-	-	0.008	0.008	-	-	1	6	-
Zn 2nd Cl.	-	0.8	-	-	0.008	0.01	-	-	1	8	12.0
Zn 3rd Cl.	-	0.8	-	-	0.008	0.01	-	-	1	6	12.0
Zn 4th Cl.	-	0.8	-	-	0.008	0.005	-	-	1	6	12.0

Test No. 31 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	8.87	47.0	12.9	79.9	11.6
2. Pb 4th Cl. Tail.	1.07	15.7	13.8	3.2	1.5
3. Pb 3rd Cl. Tail.	2.02	8.96	15.8	3.5	3.2
4. Pb 2nd Cl. Tail.	4.00	3.29	14.3	2.5	5.8
5. Zn Cleaner Conc.	10.52	0.96	55.6	1.9	59.5
6. Zn 4th Cl. Tail.	2.17	1.95	24.9	0.8	5.5
7. Zn 3rd Cl. Tail.	2.77	1.79	10.2	1.0	2.9
8. Zn 2nd Cl. Tail.	4.11	1.06	4.09	0.8	1.7
9. Zn 1st Cl. Tail.	11.82	0.73	2.15	1.7	2.6
10. Zn Flot. Tail.	52.65	0.47	1.04	4.7	5.7
Head (Calculated)	100.00	5.22	9.82	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	9.94	43.6	13.0	83.1	13.1
Products 1 to 3	11.96	37.8	13.5	86.6	16.3
Products 1 to 4	15.96	29.1	13.7	89.1	22.1
Products 5 and 6	12.69	1.13	50.3	2.7	65.0
Products 5 to 7	15.46	1.25	43.2	3.7	67.9
Products 5 to 8	19.57	1.21	35.0	4.5	69.6
Products 5 to 9	31.39	1.03	22.6	6.2	72.2

Test No. 32

Purpose: To repeat test No. 28 (PP Comp. No. 1), but with finer primary grind and finer regrinds, and use 241 in place of 242 in Pb cleaners.

Procedure: As for test No. 28.

Feed: 2000 grams minus 10 mesh PP Composite No. 1.

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

Conditions:

Stage	Reagents Added, pounds per ton								Time, minutes			pH
	Na ₂ -CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-241	Ca-(OH) ₂	Cu-SO ₄	Grind	Cond.	Froth	
Primary Grind	4.0	1.0	0.30	0.06	-	-	-	-	40	-	-	-
Pb Rougher	-	-	-	0.02	0.06	-	-	-	-	1	3	9.3
	-	-	-	0.02	0.03	-	-	-	-	1	3	-
	-	-	-	0.02	0.03	-	-	-	-	1	5	-
Pb Conc. Regr.	1.0	0.5	0.20	0.01	-	0.05	-	-	50	-	-	-
Pb 1st Cl.	-	-	-	0.01	-	-	-	-	-	1	4	9.3
	-	-	-	0.01	-	0.01	-	-	-	1	4	-
Pb 2nd Cl.	0.3	0.2	0.10	-	-	-	-	-	-	1	3	9.4
	-	-	-	0.005	-	0.015	-	-	-	1	3	-
Pb 3rd Cl.	0.1	0.1	0.05	-	-	-	-	-	-	1	2	9.4
	-	-	-	-	-	0.005	-	-	-	1	2	-
Pb 4th Cl.	0.1	-	0.05	-	-	-	-	-	-	1	3	9.5
Combine lead rougher and 1st cleaner tailings for zinc flotation.												
	M-748	DF-250			Na ₂ -SiO ₃	Z-200						
Condition	-	-	-	-	-	-	2.4	2.0	-	3	-	10.6
Zn Rougher	0.06	0.04	-	0.05	-	-	-	-	-	2	3	-
	0.04	0.04	-	0.03	-	-	-	-	-	2	5	-
Zn Regrind	-	-	-	-	0.2	0.04	1.0	0.5	15	-	-	-
Zn 1st Cl.	-	-	-	0.01	-	-	-	-	-	1	3	10.9
	-	-	-	0.01	-	0.01	-	-	-	1	3	-
Zn 2nd Cl.	-	-	-	-	0.1	-	0.5	-	-	1	2	11.2
	-	-	-	-	-	0.01	-	-	-	1	2	-
Zn 3rd Cl.	-	-	-	-	0.1	0.005	0.3	-	-	1	3	11.3

Test No. 32 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	6.05	56.3	8.36	64.9	5.1
2. Pb 4th Cl. Tail.	2.34	44.6	15.2	19.9	3.6
3. Pb 3rd Cl. Tail.	1.49	9.75	20.1	2.8	3.0
4. Pb 2nd Cl. Tail.	3.05	4.36	17.8	2.5	5.5
5. Zn Cleaner Conc.	11.40	0.56	57.5	1.2	66.4
6. Zn 3rd Cl. Tail.	1.05	1.45	25.8	0.3	2.7
7. Zn 2nd Cl. Tail.	2.84	1.32	13.6	0.7	3.9
8. Zn 1st Cl. Tail.	7.15	0.94	4.28	1.3	3.1
9. Zn Rougher Tail.	64.63	0.52	1.00	6.4	6.7
Head (Calculated)	100.00	5.25	9.87	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	8.39	53.0	10.3	84.8	8.7
Products 1 to 3	9.88	46.5	11.7	87.6	11.7
Products 1 to 4	12.93	36.5	13.2	90.1	17.2
Products 5 and 6	12.45	0.63	54.8	1.5	69.1
Products 5 to 7	15.29	0.78	47.2	2.2	73.0
Products 5 to 8	22.44	0.83	33.5	3.5	76.1

Test No. 33

Purpose: To repeat conditions of test 31, but increase NaClO₃ additions to 0.6 lb/ton and grind slightly finer.

Procedure: As for test 31.

Feed: 2000 grams minus 10 mesh PP Composite No. 1 sample.

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

Conditions:

Stage	Reagents Added, pounds per ton							Time, minutes			pH
	Na ₂ -CO ₃	ZnSO ₄	NaCN	Na-ClO ₃	Z-11	R-241	MIBC	Grind	Cond.	Froth	
Primary Grind	4.0	0.5	0.3	0.6	0.05	-	-	40	-	-	9.0
Conditioning	-	-	-	-	0.02	-	-	-	5	-	-
Pb Ro. 1	-	-	-	-	-	-	0.06	-	1	3	-
2	-	-	-	-	0.02	-	0.03	-	1	3	-
3	-	-	-	-	0.01	-	0.02	-	1	3	-
Pb Regrind	1.0	-	0.2	0.6	0.01	0.05	-	50	-	-	9.0
Pb 1st Cl. 1	-	-	-	-	-	-	-	-	1	4	-
2	-	-	-	-	0.01	0.02	0.01	-	1	3	-
Pb 2nd Cl. 1	0.2	-	0.1	0.3	-	-	-	-	3	3	-
2	-	-	-	-	-	0.02	0.01	-	1	6	-
Pb 3rd Cl.	0.1	-	0.05	0.2	-	-	-	-	3	3	-
	-	-	-	-	-	0.01	0.005	-	1	3	-
Pb 4th Cl.	0.1	-	0.05	0.1	-	-	-	-	1	3	-
	-	-	-	-	-	0.005	0.005	-	1	2	-
Combine lead rougher and 1st cleaner tailings for zinc flotation.											
		Ca-(OH) ₂	Cu-SO ₄	M748	Z#200						
Cond.	-	3.0	-	-	-	-	-	-	5	-	-
	-	-	2.0	-	-	-	-	-	5	-	11.0
Zn Ro. 1	-	-	-	0.03	0.03	-	0.02	-	1	4	-
2	-	-	-	0.03	0.02	-	0.02	-	1	4	-
3	-	-	-	-	0.02	-	0.02	-	1	4	-
Zn Regrind	-	1.0	0.6	-	0.02	-	-	20	-	-	-
Zn 1st Cl. 1	-	-	-	-	-	-	-	-	1	3	12.0
2	-	-	-	-	0.02	-	0.02	-	1	6	-
Zn 2nd Cl.	-	0.8	-	-	0.01	-	0.01	-	1	8	12.0
Zn 3rd Cl.	-	0.8	-	-	0.01	-	0.008	-	1	6	11.9
Zn 4th Cl.	-	0.8	-	-	0.01	-	0.008	-	1	6	11.9

Test No. 33 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	7.88	52.9	11.3	78.4	8.9
2. Pb 4th Cl. Tail.	1.69	21.7	15.9	6.9	2.7
3. Pb 3rd Cl. Tail.	1.47	7.17	14.2	2.0	2.1
4. Pb 2nd Cl. Tail.	3.43	3.99	14.7	2.6	5.0
5. Zn Cleaner Conc.	13.16	0.85	52.5	2.1	69.0
6. Zn 4th Cl. Tail.	0.98	2.14	20.5	0.4	2.0
7. Zn 3rd Cl. Tail.	2.15	1.97	15.3	0.8	3.3
8. Zn 2nd Cl. Tail.	2.28	1.28	2.73	0.5	0.6
9. Zn 1st Cl. Tail.	4.94	0.83	1.79	0.8	0.9
10. Zn Rougher Tail.	62.02	0.47	0.89	5.5	5.5
Head (Calculated)	100.00	5.31	10.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	9.57	47.4	12.1	85.3	11.6
Products 1 to 3	11.04	42.0	12.4	87.3	13.7
Products 1 to 4	14.47	33.0	12.9	89.9	18.7
Products 5 and 6	14.14	0.94	50.3	2.5	71.0
Products 5 to 7	16.29	1.08	45.7	3.3	74.3
Products 5 to 8	18.57	1.10	40.4	3.8	74.9
Products 5 to 9	23.51	1.04	32.3	4.6	75.8

Test No. 34

Purpose: To repeat the procedure of test No. 29, but on sample K-76-1.

Procedure: As for test No. 29.

Feed: 2000 grams minus 10 mesh sample No. K-76-1.

Grind: 40 minutes at 62 percent solids in the laboratory ball mill.

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.06	-	-	40	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	1	3	9.1
	-	-	-	0.02	0.02	-	-	1	3	-
	-	-	-	0.02	0.02	-	-	1	5	-
Pb Conc. Regr.	1.5	0.5	0.20	0.01	-	-	50	-	-	-
Pb 1st Cl.	-	-	-	0.01	-	-	-	1	4	9.3
	-	-	-	0.01	-	0.01	-	1	4	-
Pb 2nd Cl.	0.3	0.2	0.10	-	-	-	-	1	3	9.4
	-	-	-	0.005	-	0.01	-	1	2	-
Pb 3rd Cl.	0.2	0.1	0.05	-	-	-	-	1	2	9.4
	-	-	-	-	-	0.005	-	1	2	-
Pb 4th Cl.	0.1	-	0.05	-	-	-	-	1	3	9.5
Pb 5th Cl.	0.1	-	0.05	-	-	-	-	1	2	9.4
Combine Pb 2nd, 3rd, 4th and 5th cleaner tailings for scavenger regrind.										
Pb Scav. Regr.	1.0	0.5	0.20	0.01	-	0.02	30	-	-	-
Pb Scav. 1st Cl.	-	-	-	0.01	-	-	-	1	3	9.2
	-	-	-	0.01	-	0.01	-	1	3	-
Pb Scav. 2nd Cl.	0.2	0.1	0.10	-	-	0.01	-	1	4	9.3
Pb Scav. 3rd Cl.	0.1	-	0.05	-	-	-	-	1	3	9.4

Stage
Equipment

Pb Regrinds
Rod Mill

Tests No. 34 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	4.68	68.3	7.53	47.1	3.4
2. Pb Scav. Cl. Conc.	2.77	63.4	8.68	25.9	2.3
3. Pb Scav. 3rd Cl. Tail.	1.18	32.7	17.3	5.7	2.0
4. Pb Scav. 2nd Cl. Tail.	2.38	14.6	20.8	5.1	4.8
5. Pb Scav. 1st Cl. Tail.	6.52	5.23	19.0	5.0	12.1
6. Pb 1st Cl. Tail.	14.96	1.24	12.9	2.7	18.9
7. Pb Rougher Tailing	67.51	0.85	8.55	8.5	56.5
Head (Calculated)	100.00	6.79	10.2	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	7.45	66.5	7.96	73.0	5.7
Products 1 to 3	8.63	61.9	9.24	78.7	7.7
Products 1 to 4	11.01	51.6	11.7	83.8	12.5
Products 1 to 5	17.53	34.4	14.4	88.8	24.6
Products 1 to 6	32.49	19.1	13.7	91.5	43.5
Products 2 and 3	3.95	54.2	11.3	31.6	4.3
Products 2 to 4	6.33	39.3	14.8	36.6	9.1
Products 2 to 5	12.85	22.0	17.0	39.3	21.2

Test No. 35

Purpose: To repeat the procedure of test No. 34, but on a composite of the three K samples (1:1:1).

Procedure: As for test No. 29.

Feed: 2000 grams minus 10 mesh composite K-76-1, K-68-1, K-80-1 (1:1:1).

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	4.0	1.0	0.30	0.06	-	-	40	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	1	3	9.0
	-	-	-	0.02	0.02	-	-	1	3	-
	-	-	-	0.02	0.02	-	-	1	5	-
Pb Conc. Regr.	1.5	0.5	0.20	0.01	-	0.05	50	-	-	-
Pb 1st Cl.	-	-	-	0.01	-	-	-	1	4	9.2
	-	-	-	0.01	-	0.01	-	1	4	-
Pb 2nd Cl.	0.3	0.2	0.10	-	-	-	-	1	3	9.3
	-	-	-	0.005	-	0.01	-	1	2	-
Pb 3rd Cl.	0.2	0.1	0.05	-	-	-	-	1	2	9.3
	-	-	-	-	-	0.005	-	1	2	-
Pb 4th Cl.	0.1	-	0.05	-	-	-	-	1	3	9.3
Pb 5th Cl.	0.1	-	0.05	-	-	-	-	1	2	9.4
Combine Pb 2nd, 3rd, 4th and 5th cleaner tailings for scavenger regrind.										
Pb Scav. Regr.	1.0	0.5	0.20	0.01	-	0.02	30	-	-	-
Pb Scav. 1st Cl.	-	-	-	0.01	-	-	-	1	3	9.2
	-	-	-	0.01	-	0.01	-	1	3	-
Pb Scav. 2nd Cl.	0.2	0.1	0.10	-	-	0.01	-	1	4	9.3
Pb Scav. 3rd Cl.	0.1	-	0.05	-	-	-	-	1	3	9.4

Stage Pb Regrinds
Equipment Rod Mill

Test No. 35 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	4.59	68.0	6.48	55.0	2.9
2. Pb Scav. Cl. Conc.	2.34	58.7	9.32	24.2	2.2
3. Pb Scav. 3rd Cl. Tail.	0.73	21.1	16.8	2.7	1.2
4. Pb Scav. 2nd Cl. Tail.	1.83	9.67	18.1	3.1	3.3
5. Pb Scav. 1st Cl. Tail.	5.04	4.08	16.4	3.6	8.2
6. Pb 1st Cleaner Tail.	14.74	1.23	12.3	3.2	18.0
7. Pb Rougher Tailing	70.73	0.65	9.15	8.2	64.2
Head (Calculated)	100.00	5.67	10.1	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	6.93	64.9	7.44	79.2	5.1
Products 1 to 3	7.66	60.7	8.33	81.9	6.3
Products 1 to 4	9.49	50.9	10.2	85.0	9.6
Products 1 to 5	14.53	34.6	12.4	88.6	17.8
Products 1 to 6	29.27	17.8	12.3	91.8	35.8
Products 2 and 3	3.07	49.8	11.1	26.9	3.4
Products 2 to 4	4.90	34.8	13.7	30.0	6.7
Products 2 to 5	9.94	19.2	15.1	33.6	14.9

Screen Analyses

Pb Cleaner Concentrate and Pb Scavenger 2nd Cleaner Concentrate

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 22.7 µm	1.2	1.2	98.8
17.6	0.9	2.1	97.9
12.3	9.4	11.5	88.5
8.4	21.6	33.1	66.9
6.5	15.8	48.9	51.1
- 6.5	51.1	100.0	-
Total	100.0	-	--

Specific Gravity 6.27

Test No. 36

Purpose: To investigate the effect of a two-stage regrind on lead grade and recovery from sample No. B-5.

Procedure: Grind and float a lead rougher concentrate. Regrind the concentrate and clean twice. Regrind the 2nd cleaner concentrate and clean four times.

Feed: 2000 grams minus 10 mesh sample No. B-5.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.08	-	-	40	-	-	-
Pb Rougher	-	-	-	0.02	0.06	-	-	1	4	8.9
	-	-	-	0.02	0.03	-	-	1	4	-
	-	-	-	0.02	0.03	-	-	1	5	-
Pb 1st Regr.	1.2	0.5	0.20	0.01	-	0.04	40	-	-	-
Pb 1st Cl.	-	-	-	0.01	-	-	-	1	5	8.9
	-	-	-	0.02	-	0.01	-	1	5	-
Pb 2nd Cl.	0.3	0.2	0.10	0.005	-	-	-	1	4	9.0
	-	-	-	0.005	-	0.01	-	1	4	-
Pb 2nd Regr.	0.8	0.5	0.20	0.01	-	0.02	20	-	-	-
Pb 3rd Cl.	-	-	-	0.01	-	-	-	1	4	9.1
	-	-	-	0.01	-	0.01	-	1	4	-
Pb 4th Cl.	0.3	0.2	0.10	-	0.005	-	-	1	3	9.2
	-	-	-	0.005	-	0.01	-	1	3	-
Pb 5th Cl.	0.2	0.1	0.10	-	0.005	-	-	1	3	9.3
	-	-	-	-	-	0.01	-	1	2	-
Pb 6th Cl.	0.1	-	0.05	-	0.005	-	-	1	4	9.4

Test No. 36 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	8.90	58.0	14.5	58.2	8.3
2. Pb 6th Cl. Tail.	1.59	33.4	24.9	6.0	2.6
3. Pb 5th Cl. Tail.	2.97	27.0	26.9	9.1	5.2
4. Pb 4th Cl. Tail.	3.52	13.6	28.9	5.4	6.6
5. Pb 3rd Cl. Tail.	5.81	5.93	26.1	3.9	9.7
6. Pb 2nd Cl. Tail.	5.93	7.89	27.4	5.3	10.6
7. Pb 1st Cl. Tail.	13.36	2.46	17.9	3.7	15.4
8. Pb Rougher Tail.	57.92	1.29	11.2	8.4	41.6
Head (Calculated)	100.00	8.86	15.5	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	10.49	54.3	16.1	64.2	10.9
Products 1 to 3	13.46	48.3	18.5	73.3	16.1
Products 1 to 4	16.98	41.1	20.6	78.7	22.7
Products 1 to 5	22.79	32.1	22.0	82.6	32.4
Products 1 to 6	28.72	27.1	23.1	87.9	43.0
Products 1 to 7	42.08	19.3	21.4	91.6	58.4

Test No. 37

Purpose: To repeat the two-stage regrind procedure on sample No. K-76-1.

Procedure: As for test No. 36.

Feed: 2000 grams minus 10 mesh sample No. K-76-1.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.05	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	1	3	9.2
	-	-	-	0.02	0.02	-	-	1	3	-
	-	-	-	0.02	0.03	-	-	1	5	-
Pb 1st Regr.	1.0	0.5	0.20	0.01	-	0.03	30	-	-	-
Pb 1st Cl.	-	-	-	0.01	-	-	-	1	4	9.1
	-	-	-	0.01	-	0.01	-	1	4	-
Pb 2nd Regr.	0.7	0.25	0.15	0.01	-	0.02	15	-	-	-
Pb 2nd Cl.	-	-	-	0.005	-	-	-	1	3	9.1
	-	-	-	0.005	-	0.01	-	1	4	-
Pb 3rd Cl.	0.3	0.2	0.10	-	-	-	-	1	3	9.2
	-	-	-	0.005	-	0.005	-	1	2	-
Pb 4th Cl.	0.2	0.1	0.05	-	-	-	-	1	2	9.2
	-	-	-	-	-	0.005	-	1	2	-
Pb 5th Cl.	0.1	-	0.05	-	-	-	-	1	3	9.3

Test No. 37 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	7.42	61.4	9.70	67.4	7.1
2. Pb 5th Cl. Tail.	1.42	33.4	18.3	7.0	2.6
3. Pb 4th Cl. Tail.	1.43	21.5	21.4	4.6	3.0
4. Pb 3rd Cl. Tail.	2.90	12.6	21.1	5.4	6.0
5. Pb 2nd Cl. Tail.	6.51	3.83	17.3	3.7	11.1
6. Pb 1st Cl. Tail.	12.62	1.49	11.4	2.8	14.2
7. Pb Rougher Tail.	67.70	0.91	8.37	9.1	56.0
Head (Calculated)	100.00	6.76	10.1	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	8.84	56.9	11.1	74.4	9.7
Products 1 to 3	10.27	52.0	12.5	79.0	12.7
Products 1 to 4	13.17	43.3	14.4	84.4	18.7
Products 1 to 5	19.68	30.2	15.4	88.1	29.8
Products 1 to 6	32.30	19.0	13.8	90.9	44.0

Test No. 38

Purpose: To repeat test No. 35 (K samples Comp.), but with coarser primary grind and Pb concentrate regrind.

Procedure: As for test No. 29.

Feed: 2000 grams minus 10 mesh composite K-76-1, K-68-1, K-80-1 (1:1:1).

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	4.0	1.0	0.30	0.05	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	1	3	8.8
	-	-	-	0.02	0.02	-	-	1	3	-
	-	-	-	0.02	0.02	-	-	1	5	-
Pb Conc. Regr.	1.0	0.5	0.20	0.01	-	0.03	30	-	-	-
Pb 1st Cl.	-	-	-	0.01	-	-	-	1	4	8.9
	-	-	-	0.01	-	0.01	-	1	4	-
Pb 2nd Cl.	0.3	0.2	0.10	-	0.005	-	-	1	3	9.0
	-	-	-	0.005	-	0.01	-	1	2	-
Pb 3rd Cl.	0.2	0.1	0.05	-	-	-	-	1	2	9.0
	-	-	-	-	-	0.005	-	1	2	-
Pb 4th Cl.	0.1	-	0.05	-	0.005	-	-	1	3	9.1
Pb 5th Cl.	0.1	-	0.05	-	-	-	-	1	2	9.2
Combine Pb 2nd, 3rd, 4th and 5th cleaner tailings for scavenger regrind.										
Pb Scav. Regr.	1.0	0.5	0.20	0.01	-	0.02	30	-	-	-
Pb Scav. 1st Cl.	-	-	-	0.01	-	-	-	1	3	8.8
	-	-	-	0.01	-	0.01	-	1	3	-
Pb Scav. 2nd Cl.	0.3	0.1	0.05	-	0.005	0.01	-	1	4	9.1
Pb Scav. 3rd Cl.	0.1	-	0.05	-	0.005	-	-	1	3	9.2

Test No. 38 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	5.96	59.5	9.03	62.6	5.4
2. Pb Scav. Cleaner Conc.	2.26	47.8	12.3	19.1	2.8
3. Pb Scav. 3rd Cl. Tail.	0.93	16.5	17.4	2.7	1.6
4. Pb Scav. 2nd Cl. Tail.	1.44	6.12	17.2	1.6	2.5
5. Pb Scav. 1st Cl. Tail.	5.54	3.06	14.9	3.0	8.3
6. Pb 1st Cleaner Tail.	12.83	1.15	11.3	2.6	14.6
7. Pb Rougher Tailing	71.04	0.67	9.09	8.4	64.8
Head (Calculated)	100.00	5.66	9.96	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	8.22	56.3	9.93	81.7	8.2
Products 1 to 3	9.15	52.2	10.7	84.4	9.8
Products 1 to 4	10.59	46.0	11.6	86.0	12.3
Products 1 to 5	16.13	31.2	12.7	89.0	20.6
Products 1 to 6	28.96	17.9	12.1	91.6	35.2
Products 2 and 3	3.19	38.7	13.8	21.8	4.4
Products 2 to 4	4.63	28.6	14.9	23.4	6.9
Products 2 to 5	10.17	14.7	14.9	26.4	15.2

Test No. 39

Purpose: To conduct the first in a series of tests to determine the effect of primary grind on lead flotation from PP bulk sample No. 1.

Procedure: Grind and float four lead concentrates.

Feed: 2000 grams minus 10 mesh Pilot Plant Bulk Sample No. 1.

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

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	Grind	Cond.	Froth	
Primary Grind	4.0	1.0	0.30	0.05	-	30	-	-	-
Pb Conc. No. 1	-	-	-	0.02	0.04	-	1	3	8.8
Pb Conc. No. 2	-	-	-	0.02	0.02	-	1	3	-
Pb Conc. No. 3	-	-	-	0.01	0.02	-	1	3	-
Pb Conc. No. 4	-	-	-	0.01	0.02	-	1	3	-

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Conc. No. 1	16.82	29.0	13.5	81.1	22.9
2. Pb Conc. No. 2	8.85	5.29	13.4	7.8	12.0
3. Pb Conc. No. 3	3.22	3.16	12.3	1.7	4.0
4. Pb Conc. No. 4	2.02	2.56	11.9	0.8	2.4
5. Pb Rougher Tail.	69.09	0.75	8.43	8.6	58.7
Head (Calculated)	100.00	6.02	9.92	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	25.67	20.8	13.5	88.9	34.9
Products 1 to 3	28.89	18.9	13.3	90.6	38.9
Products 1 to 4	30.91	17.8	13.2	91.4	41.3

Test No. 39 - Continued

Screen Analysis

Composite of All Products

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 200 mesh	9.2	9.2	90.8
270	12.2	21.4	78.6
30.8 μ m	20.3	41.7	58.3
23.9	10.8	52.5	47.5
16.6	13.7	66.2	33.8
11.4	9.5	75.7	24.3
8.8	5.1	80.8	19.2
- 8.8	19.2	100.0	-
Total	100.0	-	-

Specific Gravity 3.89

Composite Pb Concentrate

+ 200 mesh	6.5	6.5	93.5
270	10.9	17.4	82.6
27.1 μ m	26.5	43.9	56.1
21.0	9.7	56.6	43.4
14.7	12.6	66.2	33.8
10.1	9.2	75.4	24.6
7.8	5.2	80.6	19.4
- 7.8	19.4	100.0	-
Total	100.0	-	-

Specific Gravity 4.62

Test No. 40

Purpose: To repeat test No. 39, but with a finer primary grind.

Procedure: As for test No. 39.

Feed: 2000 grams minus 10 mesh.

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

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	Grind	Cond.	Froth	
Primary Grind	4.5	1.0	0.30	0.06	-	40	-	-	-
Pb Conc. No. 1	-	-	-	0.02	0.04	-	1	3	8.9
Pb Conc. No. 2	-	-	-	0.02	0.02	-	1	3	-
Pb Conc. No. 3	-	-	-	0.01	0.02	-	1	3	-
Pb Conc. No. 4	-	-	-	0.01	0.02	-	1	3	-

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Conc. No. 1	16.14	30.5	13.6	82.6	22.2
2. Pb Conc. No. 2	7.80	5.43	13.3	7.1	10.5
3. Pb Conc. No. 3	3.22	2.98	11.9	1.6	3.9
4. Pb Conc. No. 4	2.28	2.36	11.2	0.9	2.6
5. Pb Rougher Tail.	70.56	0.66	8.50	7.8	60.8
Head (Calculated)	100.00	5.96	9.87	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	23.94	22.3	13.5	89.7	32.7
Products 1 to 3	27.16	20.0	13.3	91.3	36.6
Products 1 to 4	29.44	18.7	13.1	92.2	39.2

Test No. 40 - Continued

Screen Analysis

Composite of All Products

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 200 mesh	4.0	4.0	96.0
270	8.5	12.5	87.5
30.4 μ m	19.6	32.1	67.9
23.6	11.8	43.9	56.1
16.4	15.8	59.7	40.3
11.3	11.4	71.1	28.9
8.7	6.1	77.2	22.8
- 8.7	22.8	100.0	-
Total	100.0	-	-

Specific Gravity 3.92

Composite Pb Concentrate

+ 200 mesh	1.4	1.4	98.6
270	3.0	4.4	95.6
27.5 μ m	12.4	16.8	83.2
21.3	21.8	38.6	61.4
14.9	15.9	54.5	45.5
10.2	11.2	65.7	34.3
7.9	7.0	72.7	27.3
- 7.9	27.3	100.0	-
Total	100.0	-	-

Specific Gravity 4.58

Test No. 41

Purpose: To repeat tests No. 39 and 40, but with a still finer grind.

Procedure: As for test No. 39.

Feed: 2000 grams minus 10 mesh.

Grind: 50 minutes at 65 percent solids in the laboratory ball mill.

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.07	-	50	-	-	-
Pb Conc. No. 1	-	-	-	0.02	0.04	-	1	3	9.0
Pb Conc. No. 2	-	-	-	0.02	0.02	-	1	3	-
Pb Conc. No. 3	-	-	-	0.01	0.02	-	1	3	-
Pb Conc. No. 4	-	-	-	0.01	0.02	-	1	3	-

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Conc. No. 1	15.20	32.2	13.5	82.8	20.6
2. Pb Conc. No. 2	7.85	5.29	13.5	7.0	10.6
3. Pb Conc. No. 3	2.91	3.16	12.3	1.6	3.6
4. Pb Conc. No. 4	1.77	2.48	11.6	0.8	2.1
5. Pb Rougher Tail.	72.27	0.64	8.71	7.8	63.1
Head (Calculated)	100.00	5.91	9.97	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	23.05	23.0	13.5	89.8	31.2
Products 1 to 3	25.96	20.8	13.4	91.4	34.8
Products 1 to 4	27.73	19.6	13.3	92.2	36.9

Test No. 41 - Continued

Screen Analysis

Composite of All Products

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 200 mesh	2.0	2.0	98.0
270	5.3	7.3	92.7
30.9 μ m	17.8	25.1	74.9
24.0	11.6	36.7	63.3
16.7	17.1	53.8	46.2
11.5	13.0	66.8	33.2
8.9	7.0	73.8	26.2
- 8.9	26.2	100.0	-
Total	100.0	-	-

Specific Gravity 3.89

Composite Pb Concentrate

+ 200 mesh	0.9	0.9	99.1
270	3.4	4.3	95.7
27.7 μ m	22.5	26.8	73.2
21.4	11.0	37.8	62.2
15.0	15.8	53.6	46.4
10.3	12.6	66.2	33.8
7.9	7.3	73.5	26.5
- 7.9	26.5	100.0	-
Total	100.0	-	-

Specific Gravity 4.56

Test No. 42

Purpose: The first in a series of tests to investigate the effect of lead concentrate regrind time on lead grade and recovery.

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

Feed: 2000 grams minus 10 mesh Pilot Plant Bulk Sample No. 1.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.05	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	1	3	9.1
	-	-	-	0.02	0.02	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	1	3	-
Pb Conc. Regr.	0.5	0.5	0.20	0.01	-	0.01	10	-	-	-
Pb 1st Cl.	-	-	-	0.005	-	-	-	1	3	9.0
	-	-	-	0.005	-	0.01	-	1	3	-
Pb 2nd Cl.	0.2	0.2	0.10	-	-	-	-	1	2	9.1
	-	-	-	-	0.005	0.01	-	1	2	-
Pb 3rd Cl..	0.1	0.1	0.05	-	-	-	-	1	2	9.1
	-	-	-	-	0.005	0.005	-	1	1	-
Pb 4th Cl.	0.1	-	0.05	-	0.005	-	-	1	2	9.2

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

Test No. 42 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	12.12	38.6	12.9	81.0	15.6
2. Pb 4th Cl. Tail.	1.98	10.3	15.2	3.5	3.0
3. Pb 3rd Cl. Tail.	1.92	5.91	15.9	2.0	3.0
4. Pb 2nd Cl. Tail.	2.61	3.23	15.0	1.5	3.9
5. Pb 1st Cl. Tail.	11.52	1.55	11.4	3.1	13.1
6. Pb Rougher Tail.	69.85	0.74	8.83	8.9	61.4
Head (Calculated)	100.00	5.78	10.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	14.10	34.6	13.2	84.5	18.6
Products 1 to 3	16.02	31.2	13.5	86.5	21.6
Products 1 to 4	18.63	27.3	13.7	88.0	25.5
Products 1 to 5	30.15	17.4	12.9	91.1	38.6

Screen Analyses

Composite Pb Cleaner Products

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 270 mesh	0.30	0.30	99.7
28.1 μ m	19.5	19.8	80.2
21.8	14.7	34.5	65.5
15.2	19.4	53.9	46.1
10.4	13.8	67.7	32.3
8.1	7.2	74.9	25.1
- 8.1	25.1	100.0	-
Total	100.0	-	-

Specific Gravity 4.54

Test No. 43

Purpose: To repeat test No. 42, but increase lead regrind time to 20 minutes.

Procedure: As for test No. 42.

Feed: 2000 grams minus 10 mesh Pilot Plant Bulk Sample No. 1.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.05	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	1	3	9.2
	-	-	-	0.02	0.02	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	1	3	-
Pb Conc. Regr.	0.75	0.5	0.20	0.01	-	0.02	20	-	-	-
Pb 1st Cl.	-	-	-	0.005	-	-	-	1	3	9.0
	-	-	-	0.005	0.005	0.01	-	1	4	-
Pb 2nd Cl.	0.2	0.2	0.10	-	0.005	-	-	1	3	9.1
	-	-	-	-	-	0.01	-	1	2	-
Pb 3rd Cl.	0.1	0.1	0.05	-	0.005	-	-	1	2	9.2
	-	-	-	-	-	0.005	-	-	1½	-
Pb 4th Cl.	0.1	-	0.05	-	0.005	-	-	1	2½	9.3

Test No. 43 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	10.54	45.1	12.9	80.4	13.7
2. Pb 4th Cl. Tail.	1.67	13.6	15.7	3.8	2.6
3. Pb 3rd Cl. Tail.	1.61	7.25	17.1	2.0	2.8
4. Pb 2nd Cl. Tail.	4.42	3.69	15.4	2.8	6.9
5. Pb 1st Cl. Tail.	12.72	1.19	10.9	2.5	14.0
6. Pb Rougher Tail.	69.04	0.73	8.62	8.5	60.0
Head (Calculated)	100.00	5.92	9.92	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	12.21	40.8	13.3	84.2	16.3
Products 1 to 3	13.82	36.9	13.7	86.2	19.1
Products 1 to 4	18.24	28.8	14.1	89.0	26.0
Products 1 to 5	30.96	17.5	12.8	91.5	40.0

Screen Analyses

Composite Pb Cleaner Products

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 27.7 μ m	8.8	8.8	91.2
21.4	13.6	22.4	77.6
15.0	23.0	45.4	54.6
10.3	16.6	62.0	38.0
7.9	8.5	70.5	29.5
- 7.9	29.5	100.0	-
Total	100.0	-	-

Specific Gravity 4.66

Test No. 44

Purpose: To investigate the effect of a two-stage regrind on lead grade and recovery from sample PP BS1.

Procedure: Grind and float a lead rougher concentrate. Regrind the concentrate and clean twice. Regrind the 2nd cleaner concentrate and clean four more times.

Feed: 2000 grams minus 10 mesh sample No. PPBS1.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.08	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.06	-	-	1	4	9.5
	-	-	-	0.02	0.03	-	-	1	4	-
	-	-	-	0.02	0.03	-	-	1	4	-
Pb 1st Regr.	1.2	0.5	0.20	0.01	-	0.04	40	-	-	-
Pb 1st Cl.	-	-	-	0.01	-	-	-	1	5	9.5
	-	-	-	0.02	-	0.01	-	1	5	-
Pb 2nd Cl.	0.3	0.2	0.10	0.005	-	-	-	1	4	9.6
	-	-	-	0.005	-	0.01	-	1	4	-
Pb 2nd Regr.	0.8	0.5	0.20	0.01	-	0.02	20	-	-	-
Pb 3rd Cl.	-	-	-	0.01	0.010	-	-	1	4	9.6
	-	-	-	0.01	-	0.01	-	1	4	-
Pb 4th Cl.	-	0.2	0.10	-	0.005	-	-	1	3	9.6
	-	-	-	0.005	-	0.01	-	1	3	-
Pb 5th Cl.	0.2	0.1	0.10	-	0.005	-	-	1	3	9.7
	-	-	-	-	-	0.01	-	1	2	-
Pb 6th Cl.	0.1	-	0.05	-	0.005	-	-	1	4	9.7

Stage	Pb Rougher	Pb 1st Cleaner
Flotation Cell	2000 g D - 2	500 g D - 2
Speed: r.p.m.	1800	1200

Test No. 44 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	6.67	63.6	8.51	75.9	5.8
2. Pb 6th Cl. Tail.	1.08	22.0	17.6	4.3	2.0
3. Pb 5th Cl. Tail.	1.19	11.7	19.1	2.3	2.4
4. Pb 4th Cl. Tail.	1.46	6.75	17.9	1.8	2.7
5. Pb 3rd Cl. Tail.	3.67	3.99	15.0	2.6	5.6
6. Pb 2nd Cl. Tail.	4.17	3.14	17.1	2.3	7.3
7. Pb 1st Cl. Tail.	14.7	0.90	11.7	2.4	17.6
8. Pb Rougher Tail.	67.1	0.69	8.24	8.4	56.6
Head (Calculated)	100.00	5.59	9.77	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	7.75	57.8	9.78	80.2	7.8
Products 1 to 3	8.94	51.7	11.12	82.5	10.2
Products 1 to 4	10.4	45.4	12.1	84.3	12.9
Products 1 to 5	14.1	34.5	12.8	86.9	18.5
Products 1 to 6	18.2	27.4	13.8	89.2	25.8
Products 1 to 7	32.9	15.58	12.9	91.6	43.4

Test No. 44 - Continued

Screen Analysis

Pb Cleaner Concentrate

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 26.6 μ m	2.9	2.9	97.1
20.6	3.4	6.3	93.7
14.4	16.8	23.1	76.9
9.9	21.6	44.7	55.3
7.6	13.8	58.5	41.5
- 7.6	41.5	100.0	-
Total	100.0	-	-

Specific Gravity 6.01

Test No. 45

Purpose: To repeat tests 42 and 43, but increase lead regrind time to 30 minutes.

Procedure: As for test No. 42.

Feed: 2000 grams minus 10 mesh Pilot Plant Bulk Sample No. 1.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.05	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	1	3	9.1
	-	-	-	0.02	0.02	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	1	3	-
Pb Conc. Regr.	1.0	0.5	0.20	0.01	-	0.03	30	-	-	-
Pb 1st Cl.	-	-	-	0.005	-	-	-	1	4	9.2
	-	-	-	0.005	0.005	0.01	-	1	4	-
Pb 2nd Cl.	0.2	0.2	0.10	-	-	0.005	-	1	3	9.2
	-	-	-	0.005	0.005	0.005	-	1	3	-
Pb 3rd Cl.	0.1	0.1	0.05	-	-	-	-	1	2	9.3
	-	-	-	-	0.005	0.005	-	1	2½	-
Pb 4th Cl.	0.1	-	0.05	-	0.005	-	-	1	3	9.4

Test No. 45 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	8.75	51.6	11.3	76.1	9.9
2. Pb 4th Cl. Tail.	1.37	20.3	17.3	4.7	2.4
3. Pb 3rd Cl. Tail.	1.88	10.9	18.1	3.5	3.4
4. Pb 2nd Cl. Tail.	4.08	5.00	16.8	3.4	6.9
5. Pb 1st Cl. Tail.	12.17	1.48	12.0	3.0	14.7
6. Pb Rougher Tail.	71.75	0.77	8.66	9.3	62.7
Head (Calculated)	100.00	5.93	9.93	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	10.12	47.4	12.1	80.8	12.3
Products 1 to 3	12.00	41.6	13.1	84.3	15.7
Products 1 to 4	16.08	32.4	14.0	87.7	22.6
Products 1 to 5	28.25	19.1	13.1	90.7	37.3

Screen Analyses

Combine Pb Cleaner Products

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 27.7 μ m	2.4	2.4	97.6
21.4	7.2	9.6	90.4
15.0	21.7	31.3	68.7
10.3	20.6	51.9	48.1
7.9	11.3	63.2	36.8
- 7.9	36.8	100.0	-
Total	100.0	-	-

Specific Gravity 4.72

Test No. 46

Purpose: To repeat tests No. 42, 43 and 45, but increase lead regrind time to 40 minutes.

Procedure: As for test No. 42.

Feed: 2000 grams minus 10 mesh Pilot Plant Bulk Sample No. 1.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.05	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	1	3	9.2
	-	-	-	0.02	0.02	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	1	3	-
Pb Conc. Regr.	1.1	0.5	0.20	0.01	-	0.04	40	-	-	-
Pb 1st Cl.	-	-	-	0.005	-	-	-	1	4	9.2
	-	-	-	0.005	-	0.01	-	1	5	-
Pb 2nd Cl.	0.2	0.2	0.10	-	-	0.005	-	1	3	9.3
	-	-	-	0.005	0.005	0.01	-	1	4	-
Pb 3rd Cl.	0.1	0.1	0.05	-	0.005	-	-	1	2	9.3
	-	-	-	-	-	0.01	-	1	3	-
Pb 4th Cl.	0.1	-	0.05	-	0.005	-	-	1	3½	9.4

Test No. 46 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	7.97	54.6	10.4	73.4	8.1
2. Pb 4th Cl. Tail.	1.95	21.4	18.6	7.1	3.6
3. Pb 3rd Cl. Tail.	1.84	10.4	19.0	3.2	3.5
4. Pb 2nd Cl. Tail.	4.78	4.51	16.4	3.6	7.8
5. Pb 1st Cl. Tail.	13.43	1.31	12.4	3.0	16.6
6. Pb Rougher Tail.	70.03	0.82	8.61	9.7	60.4
Head (Calculated)	100.00	5.93	10.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	9.92	48.1	12.0	80.5	11.7
Products 1 to 3	11.76	42.2	13.1	83.7	15.2
Products 1 to 4	16.54	31.3	14.1	87.3	23.0
Products 1 to 5	29.97	17.9	13.3	90.3	39.6

Screen Analyses

Combine Pb Cleaner Products

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 26.4 µm	1.0	1.0	99.0
20.5	4.3	5.3	94.7
14.3	19.2	24.5	75.5
9.8	21.4	45.9	54.1
7.6	12.4	58.3	41.7
- 7.6	41.7	100.0	-
Total	100.0	-	-

Specific Gravity 5.06

Test No. 47

Purpose: To repeat tests No. 42, 43, 45 and 46, but increase lead regrind time to 50 minutes.

Procedure: As for test No. 42.

Feed: 2000 grams minus 10 mesh Pilot Plant Bulk Sample No. 1.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.05	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	1	3	9.2
	-	-	-	0.02	0.02	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	1	3	-
Pb Conc. Regr.	1.2	0.5	0.20	0.01	-	0.05	50	-	-	-
Pb 1st Cl.	-	-	-	0.005	-	0.005	-	1	5	9.3
	-	-	-	0.005	-	0.01	-	1	5	-
Pb 2nd Cl.	0.2	0.2	0.10	-	-	0.01	-	1	4	9.3
	-	-	-	0.005	-	0.01	-	1	4	-
Pb 3rd Cl.	0.1	0.1	0.05	-	-	-	-	1	3	9.4
	-	-	-	-	-	0.01	-	1	3	-
Pb 4th Cl.	0.1	-	0.05	-	-	-	-	1	4	9.5

Test No. 47 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	7.96	59.7	9.53	79.9	7.6
2. Pb 4th Cl. Tail.	1.41	15.7	19.9	3.7	2.8
3. Pb 3rd Cl. Tail.	1.42	7.23	20.0	1.8	2.9
4. Pb 2nd Cl. Tail.	3.77	3.59	17.4	2.3	6.6
5. Pb 1st Cl. Tail.	13.94	1.12	12.4	2.6	17.4
6. Pb Rougher Tail.	71.50	0.81	8.72	9.7	62.7
Head (Calculated)	100.00	5.95	9.94	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	9.37	53.1	11.1	83.6	10.4
Products 1 to 3	10.79	47.0	12.3	85.4	13.3
Products 1 to 4	14.56	35.8	13.6	87.7	19.9
Products 1 to 5	28.50	18.8	13.0	90.3	37.3

Screen Analyses

Combine Pb Cleaner Products

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 27.2 μ m	1.4	1.4	98.6
21.1	3.3	4.7	95.3
14.7	15.8	20.5	79.5
10.1	21.7	42.2	57.8
7.8	13.5	55.7	44.3
- 7.8	44.3	100.0	-
Total	100.0	-	-

Specific Gravity 4.79

Test No. 48

Purpose: To perform the first in a series of tests to investigate the effect of multiple-stage regrinding of the lead rougher concentrate on lead grade and recovery.

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

Feed: 2000 grams minus 10 mesh Pilot Plant Bulk Sample No. 1.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.05	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	1	3	9.2
	-	-	-	0.02	0.02	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	1	3	-
Pb 1st Regr.	0.75	0.5	0.20	0.01	-	0.03	20	-	-	-
Pb 1st Cl.	-	-	-	0.005	-	-	-	1	4	9.1
	-	-	-	0.005	-	0.01	-	1	4	-
Pb 2nd Regr.	0.4	0.3	0.15	-	-	0.02	20	-	-	-
Pb 2nd Cl.	-	-	-	0.005	-	-	-	1	3	9.0
	-	-	-	0.005	0.005	0.01	-	1	4	-
Pb 3rd Cl.	0.2	0.2	0.10	-	-	-	-	1	2	9.2
	-	-	-	0.005	0.005	0.01	-	1	3	-
Pb 4th Cl.	0.1	0.1	0.05	-	-	-	-	1	2	9.2
	-	-	-	-	-	0.005	-	1	1½	-
Pb 5th Cl.	0.1	-	0.05	-	-	-	-	1	2½	9.3

Stage	Pb Rougher	Pb Regrinds	Pb 1st to 3rd Cl.	Pb 4th and 5th Cl.
Equipment	1000 g D - 1	Rod Mill	500 g D - 1	250 g D - 1
Speed: r.p.m.	1800	-	1300	1000
% Solids	33	-	-	-

Test No. 48 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	6.13	63.1	7.89	65.5	4.7
2. Pb 5th Cl. Tail.	1.26	34.2	15.8	7.3	1.9
3. Pb 4th Cl. Tail.	1.42	19.6	18.3	4.7	2.5
4. Pb 3rd Cl. Tail.	2.94	10.9	18.4	5.4	5.3
5. Pb 2nd Cl. Tail.	5.74	3.76	17.0	3.7	9.5
6. Pb 1st Cl. Tail.	11.45	1.42	12.4	2.8	13.8
7. Pb Rougher Tail.	71.06	0.88	8.98	10.6	62.3
Head (Calculated)	100.00	5.90	10.2	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	7.39	58.2	9.24	72.8	6.6
Products 1 to 3	8.81	52.0	10.7	77.5	9.1
Products 1 to 4	11.75	41.7	12.6	82.9	14.4
Products 1 to 5	17.49	29.2	14.1	86.6	23.9
Products 1 to 6	28.94	18.2	13.4	89.4	37.7

Screen Analyses

Pb Cleaner Products

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 14.9 μ m	8.6	8.6	91.4
10.2	20.8	29.4	70.6
7.9	16.0	45.4	54.6
- 7.9	54.6	100.0	-
Total	100.0	-	-

Specific Gravity 5.04

Test No. 49

Purpose: To repeat test No. 48, but increase Pb 2nd regrind time to 30 minutes.

Procedure: As for test No. 48.

Feed: 2000 grams minus 10 mesh Pilot Plant Bulk Sample No. 1.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.05	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	1	3	9.2
	-	-	-	0.02	0.02	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	1	3	-
Pb 1st Regr.	0.75	0.5	0.20	0.01	-	0.03	20	-	-	-
Pb 1st Cl.	-	-	-	0.005	-	-	-	1	4	9.1
	-	-	-	0.005	0.005	0.01	-	1	4	-
Pb 2nd Regr.	0.5	0.3	0.15	0.005	-	0.03	30	-	-	-
Pb 2nd Cl.	-	-	-	0.005	0.005	-	-	1	4	9.0
	-	-	-	0.005	0.005	-	-	1	3½	-
Pb 3rd Cl.	0.3	0.2	0.10	-	-	-	-	1	3	9.2
	-	-	-	0.005	0.005	0.01	-	1	3	-
Pb 4th Cl.	0.1	0.1	0.05	-	-	-	-	1	2	9.2
	-	-	-	-	-	0.005	-	1	2	-
Pb 5th Cl.	0.1	-	0.05	-	0.005	-	-	1	3	9.3

Test No. 49 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	7.41	62.8	8.30	78.5	6.0
2. Pb 5th Cl. Tail.	0.82	18.7	20.5	2.6	1.6
3. Pb 4th Cl. Tail.	0.99	10.2	22.2	1.7	2.2
4. Pb 3rd Cl. Tail.	2.16	4.96	19.8	1.8	4.2
5. Pb 2nd Cl. Tail.	6.91	2.06	16.0	2.4	10.8
6. Pb 1st Cl. Tail.	11.32	1.39	12.1	2.7	13.4
7. Pb Rougher Tail.	70.39	0.87	8.97	10.3	61.8
Head (Calculated)	100.00	5.93	10.2	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	8.23	58.4	9.51	81.1	7.6
Products 1 to 3	9.22	53.2	10.9	82.8	9.8
Products 1 to 4	11.38	44.1	12.6	84.6	14.0
Products 1 to 5	18.29	28.2	13.9	87.0	24.8
Products 1 to 6	29.61	17.9	13.2	89.7	38.2

Screen Analyses

Composite Pb Cleaner Products

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 29.4 μ m	7.9	7.9	92.1
22.8	1.2	9.1	90.9
15.9	3.6	12.7	87.3
10.9	12.8	25.5	74.5
8.4	15.4	40.9	59.1
- 8.4	59.1	100.0	-
Total	100.0	-	-

Specific Gravity 5.01

Test No. 50

Purpose: To repeat tests No. 48 and 49, but increase Pb 2nd regrind time to 40 minutes.

Procedure: Lead circuit as for test No. 48.
Combine Pb rougher and 1st cleaner tailings, condition and float a zinc concentrate. Regrind the zinc concentrate and clean three times.

Feed: 2000 grams minus 10 mesh Pilot Plant Bulk Sample No. 1.

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

Conditions:

Stage	Reagents Added, pounds per ton								Time, minutes			pH
	Na ₂ -CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Ca-(OH) ₂	Cu-SO ₄	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.05	-	-	-	-	30	-	-	-
	-	-	-	0.02	0.04	-	-	-	-	1	3	9.2
	-	-	-	0.02	0.02	-	-	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	-	-	1	3	-
Pb 1st Regr.	0.75	0.5	0.20	0.01	-	0.03	-	-	20	-	-	-
	-	-	-	0.005	-	-	-	-	-	1	4	9.2
	-	-	-	0.005	-	0.01	-	-	-	1	4	-
Pb 2nd Regr.	0.6	0.3	0.15	0.01	-	0.04	-	-	40	-	-	-
Pb 2nd Cl.	-	-	-	0.005	0.005	-	-	-	-	1	4	9.0
-	-	-	-	0.005	0.005	0.01	-	-	-	1	4	-
Pb 3rd Cl.	0.3	0.1	0.10	-	-	-	-	-	-	1	3	9.2
-	-	-	-	0.005	0.005	0.01	-	-	-	1	3	-
Pb 4th Cl.	0.1	0.1	0.05	-	-	-	-	-	-	1	2	9.2
-	-	-	-	-	-	0.005	-	-	-	1	2	-
Pb 5th Cl.	0.1	-	0.05	-	0.005	-	-	-	-	1	3	9.3
Combine lead rougher and 1st cleaner tailings for zinc flotation.												
	M-748	DF-250										
Condition	-	-	-	-	-	-	3.0	1.5	-	3	-	10.8
Zn Rougher	0.06	0.04	-	0.02	-	-	-	-	-	2	3	-
-	0.04	0.04	-	0.03	-	-	-	-	-	2	5	-
Zn Conc. Regr.	0.02	-	-	-	-	-	1.0	0.3	15	-	-	-
Zn 1st Cl.	-	-	-	-	-	-	-	-	-	1	3	10.7
-	-	-	-	0.01	-	-	-	-	-	1	3	-
Zn 2nd Cl.	-	-	-	-	-	-	0.5	-	-	1	3	11.1
-	-	-	-	0.01	-	-	-	-	-	1	2	-
Zn 3rd Cl.	-	-	-	-	-	-	0.3	-	-	1	3	11.3
-	-	-	-	0.005	-	-	-	-	-	1	1	-

Test No. 50 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	6.77	67.5	6.91	78.5	4.6
2. Pb 5th Cl. Tail.	0.77	20.3	20.3	2.7	1.5
3. Pb 4th Cl. Tail.	0.93	10.7	22.1	1.7	2.0
4. Pb 3rd Cl. Tail.	2.36	5.33	20.0	2.2	4.7
5. Pb 2nd Cl. Tail.	6.52	2.02	16.1	2.3	10.4
6. Zn Cleaner Conc.	14.09	1.39	48.4	3.4	67.3
7. Zn 3rd Cl. Tail.	1.87	1.88	10.1	0.6	1.9
8. Zn 2nd Cl. Tail.	4.00	1.48	3.16	1.0	1.3
9. Zn 1st Cl. Tail.	13.63	0.78	1.33	1.8	1.8
10. Zn Rougher Tail.	49.06	0.70	0.94	5.8	4.5
Head (Calculated)	100.00	5.82	10.1	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	7.54	62.7	8.28	81.2	6.1
Products 1 to 3	8.47	57.0	9.80	82.9	8.1
Products 1 to 4	10.83	45.7	12.0	85.1	12.8
Products 1 to 5	17.35	29.3	13.6	87.4	23.2
Products 6 and 7	15.96	1.45	43.9	4.0	69.2
Products 6 to 8	19.96	1.45	35.7	5.0	70.5
Products 6 to 9	33.59	1.18	21.8	6.8	72.3

Screen Analyses

Composite Pb Cleaner Products

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 29.2 μ m	0.2	0.2	99.8
22.6	0.8	1.0	99.0
15.8	3.5	4.5	95.5
10.9	9.7	14.2	85.8
8.4	15.4	29.6	70.4
- 8.4	70.4	100.0	-
Total	100.0	-	-

Specific Gravity 5.06

Test No. 51

Purpose: To investigate the effect of regrinding and scavenging the lead cleaner tailings from PP Bulk Sample No. 1.

Procedure: Grind and float a lead concentrate. Regrind the concentrate and clean five times. Combine 2nd, 3rd, 4th and 5th Pb cleaner tailings and do a scavenger regrind. Clean the scavenger concentrate four times.

Feed: 2000 grams minus 10 mesh Pilot Plant Sample No. 1.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.05	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	1	3	9.3
	-	-	-	0.02	0.02	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	1	3	-
Pb Conc. Regr.	1.0	0.5	0.20	0.01	-	0.03	30	-	-	-
Pb 1st Cl.	-	-	-	0.005	-	0.005	-	1	4	9.3
	-	-	-	0.005	-	0.01	-	1	4	-
Pb 2nd Cl.	0.3	0.2	0.10	-	-	-	-	1	3	9.4
	-	-	-	-	-	0.01	-	1	2	-
Pb 3rd Cl.	0.2	0.1	0.05	-	-	0.005	-	1	4	9.4
Pb 4th Cl.	0.1	-	0.05	-	0.005	-	-	1	3	-
Pb 5th Cl.	0.1	-	0.05	-	0.005	-	-	1	2	9.5
Combine Pb 2nd, 3rd, 4th and 5th cleaner tailings for scavenger regrind.										
Pb Scav. Regr.	1.0	0.5	0.20	0.01	-	0.03	30	-	-	-
Pb Scav. 1st Cl.	-	-	-	0.01	0.004	-	-	1	3	9.3
	-	-	-	0.01	-	0.01	-	1	3	-
Pb Scav. 2nd Cl.	0.2	0.1	0.10	-	-	0.005	-	1	4	9.4
Pb Scav. 3rd Cl.	0.1	-	0.05	-	-	-	-	1	3	9.4
Pb Scav. 4th Cl.	0.1	-	0.05	-	-	-	-	1	2	9.5

Stage	Pb Rougher	Pb Regrinds	Pb 1st and 2nd Cl.	Pb 3rd to 5th Cl.
Equipment	1000 g D - 1	Rod Mill	500 g D - 1	250 g D - 1
Speed: r.p.m.	1800	-	1300	1000
% Solids	33	-	-	-

Test No. 51 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	7.18	57.9	10.4	71.1	7.5
2. Pb Scav. Cl. Conc.	1.35	45.9	14.2	10.6	1.9
3. Pb Scav. 4th Cl. Tail.	0.67	17.6	18.6	2.0	1.2
4. Pb Scav. 3rd Cl. Tail.	1.02	8.25	19.0	1.4	1.9
5. Pb Scav. 2nd Cl. Tail.	1.75	3.59	17.0	1.1	3.0
6. Pb Scav. 1st Cl. Tail.	6.40	1.97	15.0	2.2	9.6
7. Pb 1st Cleaner Tail.	11.55	1.17	12.2	2.3	14.1
8. Pb Rougher Tailing	70.08	0.78	8.69	9.3	60.8
Head (Calculated)	100.00	5.85	10.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 and 2	8.53	56.0	11.0	81.7	9.4
Products 1 to 3	9.20	53.2	11.6	83.7	10.6
Products 1 to 4	10.22	48.7	12.3	85.1	12.5
Products 1 to 5	11.97	42.1	13.0	86.2	15.5
Products 1 to 6	18.37	28.1	13.7	88.4	25.1
Products 1 to 7	29.92	17.7	13.1	90.7	39.2
Products 2 to 6	11.19	9.03	15.8	17.3	17.6

Test No. 52

Purpose: To investigate the flotation of zinc from the Pilot Plant Bulk Sample No. 1.

Procedure: Grind and float a lead concentrate. Regrind the lead concentrate and clean once. Combine the lead rougher and cleaner tailings, condition and float a zinc concentrate. Regrind the zinc concentrate and clean four times.

Feed: 2000 grams minus 10 mesh Pilot Plant Bulk Sample No. 1.

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

Conditions:

Stage	Reagents Added, pounds per ton							Time, minutes			pH
	Na ₂ -CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	DF-250	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.05	-	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	-	1	3	9.1
	-	-	-	0.02	0.02	-	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	-	1	3	-
Pb Conc. Regr.	1.2	0.5	0.20	0.01	-	0.05	-	50	-	-	-
Pb 1st Cl.	-	-	-	0.005	-	-	-	-	1	4	9.2
	-	-	-	0.005	-	0.01	-	-	1	4	-
Combine lead rougher and 1st cleaner tailings for zinc flotation.											
	Ca-(OH) ₂	CuSO ₄	M-748								
Condition	2.5	-	-	-	-	-	-	-	5	-	-
	1.0	2.0	-	-	-	-	-	-	5	-	10.5
Zn Rougher	-	-	0.06	0.02	-	-	0.02	-	2	3	-
	-	-	0.04	0.03	-	-	0.04	-	2	5	-
Zn Conc. Regr.	1.0	0.5	0.04	-	-	-	-	20	-	-	-
Zn 1st Cl.	0.6	-	-	0.01	-	-	-	-	1	3	11.0
	-	-	-	0.01	-	-	-	-	1	3	-
Zn 2nd Cl.	0.4	-	-	-	-	-	-	-	1	3	11.0
	-	-	-	0.01	-	-	0.005	-	1	2	-
Zn 3rd Cl.	0.3	-	-	-	-	-	-	-	1	3	11.0
	-	-	-	0.005	-	-	0.005	-	1	1	-
Zn 4th Cl.	0.3	-	-	-	0.005	-	-	-	1	3	11.0

Test No. 52 - Continued

Conditions:

Stage	Pb and Zn Ro.	Pb Regrind	Pb Cleaner	Zn Regrind	Zn Cleaners
Equipment	1000 g D - 1	Rod Mill	500 g D - 1	Pebble Mill	500 g D - 1
Speed: r.p.m.	1800	-	1300	-	1300
% Solids	33	-	-	-	-

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb 1st Cleaner Conc.	14.31	35.2	13.8	87.7	19.6
2. Zn Cleaner Conc.	11.43	0.83	55.2	1.7	62.6
3. Zn 4th Cl. Tail.	1.97	1.47	36.5	0.5	7.1
4. Zn 3rd Cl. Tail.	1.14	1.96	17.8	0.4	2.0
5. Zn 2nd Cl. Tail.	1.96	1.86	5.74	0.6	1.1
6. Zn 1st Cl. Tail.	8.15	1.09	2.42	1.5	2.0
7. Zn Rougher Tail.	61.04	0.71	0.92	7.6	5.6
Head (Calculated)	100.0	5.74	10.1	100.0	100.0

Calculated Grades and Recoveries

Products 2 and 3	13.40	0.92	52.5	2.2	69.7
Products 2 to 4	14.54	1.01	49.7	2.6	71.7
Products 2 to 5	16.50	1.11	44.5	3.2	72.8
Products 2 to 6	24.65	1.10	30.6	4.7	74.8

Test No. 53

Purpose: To repeat test No. 52, but float and clean zinc at lower pH.

Procedure: As for test No. 52.

Feed: 2000 grams minus 10 mesh Pilot Plant Bulk Sample No. 1.

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

Conditions:

Stage	Reagents Added, pounds per ton							Time, minutes			pH
	Na ₂ -CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	DF-250	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.05	-	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	-	1	3	9.1
	-	-	-	0.02	0.02	-	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	-	1	3	-
Pb Conc. Regr.	1.2	0.5	0.20	0.01	-	0.05	-	50	-	-	-
Pb 1st Cl.	-	-	-	0.005	-	-	-	-	1	4	9.1
	-	-	-	0.005	-	0.01	-	-	1	4	-
Combine lead rougher and 1st cleaner tailings for zinc flotation.											
	Ca-(OH) ₂	CuSO ₄	M-748								
Condition	2.5	-	-	-	-	-	-	-	5	-	-
	0.6	2.0	-	-	-	-	-	-	5	-	10.0
Zn Rougher	-	-	0.06	0.02	-	-	0.02	-	2	3	-
	-	-	0.04	0.03	-	-	0.03	-	2	5	-
Zn Conc. Regr.	1.0	0.5	0.04	-	-	-	-	20	-	-	-
Zn 1st Cl.	0.4	-	-	0.01	-	-	-	-	1	3	10.5
	-	-	-	0.01	-	-	0.005	-	1	3	-
Zn 2nd Cl.	0.3	-	-	-	-	-	-	-	1	3	10.5
	-	-	-	0.01	-	-	0.005	-	-	2	-
Zn 3rd Cl.	0.25	-	-	-	-	-	-	-	1	3	10.5
	-	-	-	0.005	-	-	0.005	-	1	1	-
Zn 4th Cl.	0.20	-	-	-	0.005	-	-	-	1	3	10.5

Test No. 53 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb 1st Cleaner Conc.	13.33	38.1	13.5	87.0	17.8
2. Zn Cleaner Conc.	12.69	0.88	54.8	1.9	68.7
3. Zn 4th Cl. Tail.	0.46	2.48	23.6	0.2	1.1
4. Zn 3rd Cl. Tail.	0.75	2.73	15.1	0.4	1.1
5. Zn 2nd Cl. Tail.	2.86	2.24	8.65	1.1	2.4
6. Zn 1st Cl. Tail.	8.75	1.43	3.67	2.1	3.2
7. Zn Rougher Tail.	61.16	0.70	0.96	7.3	5.7
Head (Calculated)	100.00	5.84	10.1	100.0	100.0

Calculated Grades and Recoveries

Products 2 and 3	13.15	0.94	53.7	2.1	69.8
Products 2 to 4	13.90	1.03	49.6	2.5	70.9
Products 2 to 5	16.76	1.24	44.1	3.6	73.3
Products 2 to 6	25.51	1.30	30.4	5.7	76.5

Test No. 54

Purpose: To repeat tests No. 52 and 53, but clean zinc with no lime added after 1st zinc cleaner.

Procedure: As for test No. 52.

Feed: 2000 grams minus 10 mesh Pilot Plant Bulk Sample No. 1.

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

Conditions:

Stage	Reagents Added, pounds per ton							Time, minutes			pH
	Na ₂ -CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	DF-250	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.05	-	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	-	1	3	9.2
	-	-	-	0.02	0.02	-	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	-	1	3	-
Pb Conc. Regr.	1.2	0.5	0.20	0.01	-	0.05	-	50	-	-	-
Pb 1st Cl.	-	-	-	0.005	-	-	-	-	1	4	9.2
	-	-	-	0.005	-	0.01	-	-	1	4	-
Combine lead rougher and 1st cleaner tailings for zinc flotation.											
	Ca-(OH) ₂	CuSO ₄	M-748								
Condition	2.5	-	-	-	-	-	-	-	5	-	-
	0.8	2.0	-	-	-	-	-	-	5	-	10.0
Zn Rougher	-	-	0.06	0.02	-	-	0.02	-	2	3	-
	-	-	0.04	0.03	-	-	0.04	-	2	5	-
Zn Conc. Regr.	1.0	0.5	0.04	-	-	-	-	20	-	-	-
Zn 1st Cl.	0.5	-	-	0.01	-	-	-	-	1	3	10.5
	-	-	-	0.01	-	-	0.005	-	1	3	-
Zn 2nd Cl.	-	-	-	-	-	-	0.005	-	1	3	9.5
	-	-	-	0.01	-	-	0.005	-	1	2	-
Zn 3rd Cl.	-	-	-	-	-	-	-	-	1	3	8.9
	-	-	-	0.005	-	-	0.005	-	1	1	-
Zn 4th Cl.	-	-	-	-	0.005	-	-	-	1	3	8.4

Test No. 54 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb 1st Cleaner Conc.	13.65	36.9	13.6	86.8	18.3
2. Zn Cleaner Conc.	12.24	0.96	55.3	2.0	66.9
3. Zn 4th Cl. Tail.	0.41	2.43	28.9	0.2	1.2
4. Zn 3rd Cl. Tail.	0.73	2.49	18.1	0.3	1.3
5. Zn 2nd Cl. Tail.	1.89	2.14	9.91	0.7	1.8
6. Zn 1st Cl. Tail.	9.70	1.47	4.49	2.5	4.3
7. Zn Rougher Tail.	61.38	0.71	1.02	7.5	6.2
Head (Calculated)	100.00	5.80	10.1	100.0	100.0

Calculated Grades and Recoveries

Products 2 and 3	12.65	1.01	54.4	2.2	68.1
Products 2 to 4	13.38	1.09	52.5	2.5	69.4
Products 2 to 5	15.27	1.22	47.2	3.2	71.2
Products 2 to 6	24.97	1.32	30.6	5.7	75.5

Test No. 55

Purpose: To investigate the effect of low pH conditioning on zinc flotation.

Procedure: Grind and float a lead concentrate. Regrind the lead concentrate and clean twice. Combine lead rougher, 1st and 2nd cleaner tailings, condition, and float a zinc concentrate. Regrind the Zn concentrate and clean four times.

Feed: 2000 grams minus 10 mesh Pilot Plant Bulk Sample No. 1.

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

Conditions:

Stage	Reagents Added, pounds per ton							Time, minutes			pH
	Na ₂ -CO ₃	ZnSO ₄	NaCN	Z-11	MIBC	R-242	DF-250	Grind	Cond.	Froth	
Primary Grind	5.0	1.0	0.30	0.05	-	-	-	30	-	-	-
Pb Rougher	-	-	-	0.02	0.04	-	-	-	1	3	9.0
	-	-	-	0.02	0.02	-	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	-	1	3	-
	-	-	-	0.01	0.02	-	-	-	1	3	-
Pb Conc. Regr.	1.5	0.5	0.20	0.01	-	0.05	-	50	-	-	-
Pb 1st Cl.	-	-	-	0.005	-	-	-	-	1	4	9.1
	-	-	-	0.005	-	0.01	-	-	1	4	-
Pb 2nd Cl.	0.3	0.2	0.10	-	-	-	-	-	1	3	9.2
	-	-	-	0.005	-	0.01	-	-	1	3	-
Combine Pb rougher, 1st and 2nd cleaner tailings for zinc flotation.											
	Ca-(OH) ₂	CuSO ₄	M-748			H ₂ SO ₄					
Condition	-	2.0	-	-	-	0.5	-	-	5	-	6.8
	3.5	-	-	-	-	-	-	-	5	-	10.5
Zn Rougher	-	-	0.06	0.02	-	-	0.02	-	5	3	-
	-	-	0.04	0.03	-	-	0.02	-	2	5	-
Zn Conc. Regr.	1.0	0.5	0.04	-	-	-	-	20	-	-	-
Zn 1st Cl.	0.6	-	-	0.01	-	-	-	-	1	3	11.0
	-	-	-	0.01	-	-	-	-	1	3	-
Zn 2nd Cl.	0.4	-	-	-	-	-	-	-	1	3	11.0
	-	-	-	0.01	-	-	-	-	1	2	-
Zn 3rd Cl.	0.3	-	-	-	-	-	-	-	1	3	11.0
	-	-	-	0.005	-	-	-	-	1	1	-
Zn 4th Cl.	0.3	-	-	-	0.005	-	-	-	1	3	11.0

Test No. 55 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb 2nd Cleaner Conc.	12.00	42.3	13.5	86.3	15.8
2. Zn Cleaner Conc.	13.83	1.20	51.6	2.8	69.7
3. Zn 4th Cl. Tail.	1.54	2.45	18.1	0.6	2.7
4. Zn 3rd Cl. Tail.	1.98	2.35	10.4	0.8	2.0
5. Zn 2nd Cl. Tail.	2.85	1.74	5.61	0.8	1.6
6. Zn 1st Cl. Tail.	7.39	1.15	2.41	1.4	1.7
7. Zn Rougher Tail.	60.41	0.70	1.10	7.3	6.5
Head (Calculated)	100.0	5.88	10.24	100.0	100.0

Calculated Grades and Recoveries

Products 2 and 3	15.37	1.33	48.2	3.4	72.4
Products 2 to 4	17.35	1.44	43.9	4.2	74.4
Products 2 to 5	20.20	1.48	38.5	5.0	76.0
Products 2 to 6	27.59	1.39	28.8	6.4	77.7

WORK INDEX CALCULATIONS

The Work Indices were calculated in accordance with Bond's "Third Theory of Comminution" from the following formula:

$$\text{Work Index} = \frac{C \times T}{W} \times \frac{1}{\frac{10}{P} - \frac{10}{F}}$$

where: C = mill constant

T = grinding time in minutes

W = weight of feed in grams

P = size modulus K_{80} of product

F = size modulus K_{80} of feed

The mill constant C was determined by grinding a reference ore of known work index.

Work Index Calculations - Continued

Table No. 1

Work Index and Power Consumption Results

Sample No.	Product	% Passing minus 200 mesh	K ₈₀ Micrometers	Power Consumption kWh/ton	Work Index
K-68	-10 mesh feed	21.9	886.0	-	-
	20 min. Grind	86.7	62.0	6.22	6.6
	30 min. Grind	94.4	47.0	9.33	8.2
	40 min. Grind	97.3	39.6	12.44	9.9
K-76	-10 mesh feed	28.0	677.0	-	-
	20 min. Grind	90.3	52.0	6.22	6.2
	30 min. Grind	96.4	41.0	9.33	7.9
	40 min. Grind	98.4	35.7	12.44	9.6
K-80	-10 mesh feed	16.5	983.0	-	-
	20 min. Grind	80.1	74.0	6.22	7.4
	30 min. Grind	91.4	50.3	9.33	8.5
	40 min. Grind	96.3	41.0	12.44	10.0
J-76-1	-10 mesh feed	19.9	949.0	-	-
	20 min. Grind	83.4	69.0	6.22	7.1
	30 min. Grind	92.6	50.3	9.33	8.6
	40 min. Grind	96.6	41.0	12.44	10.1
G-4	-10 mesh feed	20.0	949.0	-	-
	20 min. Grind	64.7	100.5	6.22	9.2
	30 min. Grind	83.0	69.0	9.33	10.6
	40 min. Grind	89.5	52.0	12.44	11.6
FQ-4	-10 mesh feed	20.8	886.0	-	-
	20 min. Grind	76.7	79.2	6.22	7.9
	30 min. Grind	89.5	55.8	9.33	9.3
	40 min. Grind	92.4	47.0	12.44	11.0
D-4	-10 mesh feed	17.9	983.0	-	-
	20 min. Grind	69.4	93.9	6.22	8.7
	30 min. Grind	87.7	59.9	9.33	9.6
	40 min. Grind	92.8	48.6	12.44	11.1
H-4	-10 mesh feed	24.5	856.0	-	-
	20 min. Grind	78.4	76.6	6.22	7.7
	30 min. Grind	90.2	52.0	9.33	8.9
	40 min. Grind	95.4	42.4	12.44	10.4

Work Index Calculations - Continued

Table No. 1

Work Index and Power Consumption Results

Sample No.	Product	% Passing minus 200 mesh	K ₈₀ Micrometers	Power Consumption kWh/ton	Work Index
A-2	-10 mesh feed	32.0	654.0	-	-
	20 min. Grind	89.3	53.9	6.22	6.5
	30 min. Grind	95.4	42.4	9.33	8.2
	40 min. Grind	97.8	37.0	12.44	10.0
B-5	-10 mesh feed	21.0	917.0	-	-
	20 min. Grind	79.4	74.0	6.22	7.5
	30 min. Grind	90.8	52.0	9.33	8.8
	40 min. Grind	93.7	42.4	12.44	10.3
C-4	-10 mesh feed	20.5	917.0	-	-
	20 min. Grind	78.5	76.0	6.22	7.4
	30 min. Grind	90.5	53.9	9.33	9.0
	40 min. Grind	95.1	43.8	12.44	10.5
FV-4	-10 mesh feed	21.6	777.0	-	-
	20 min. Grind	78.9	76.6	6.22	7.9
	30 min. Grind	90.1	55.8	9.33	9.5
	40 min. Grind	95.3	43.8	12.44	10.8
Bulk Composite	-10 mesh feed	20.3	949.0	-	-
	20 min. Grind	90.8	55.8	6.22	7.9
	30 min. Grind	96.0	42.4	9.33	9.5
	40 min. Grind	98.0	35.7	12.44	10.8

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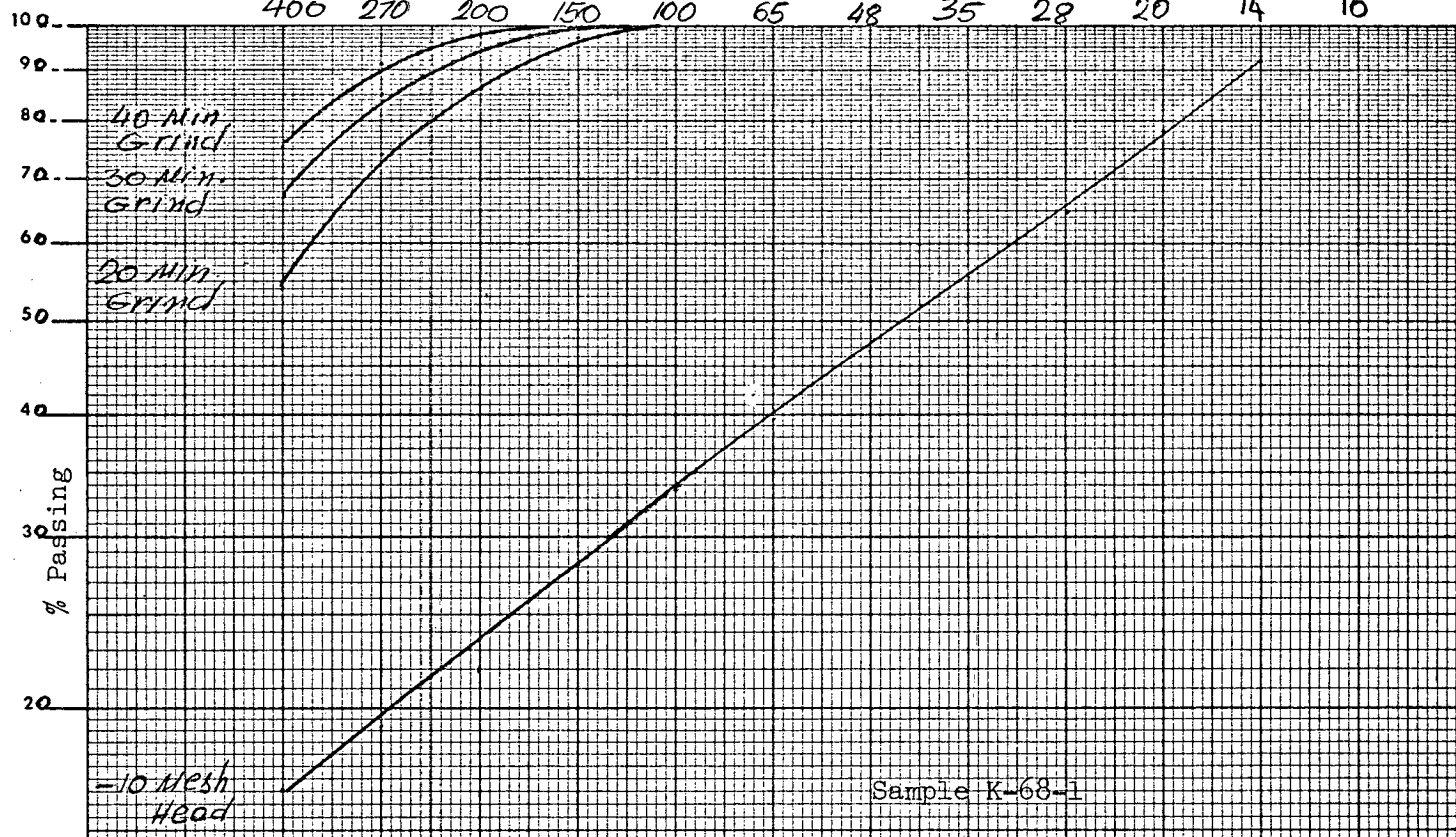
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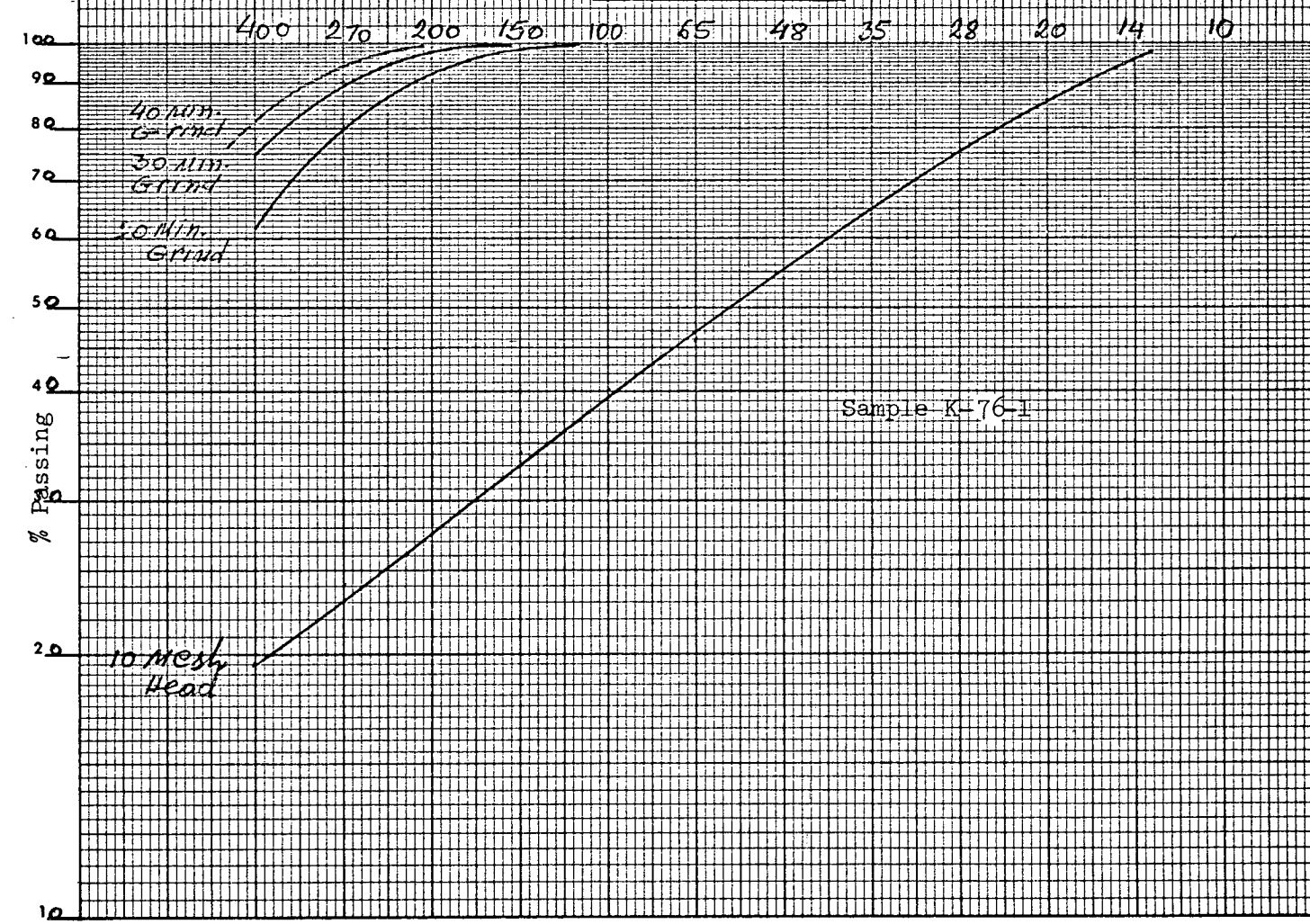
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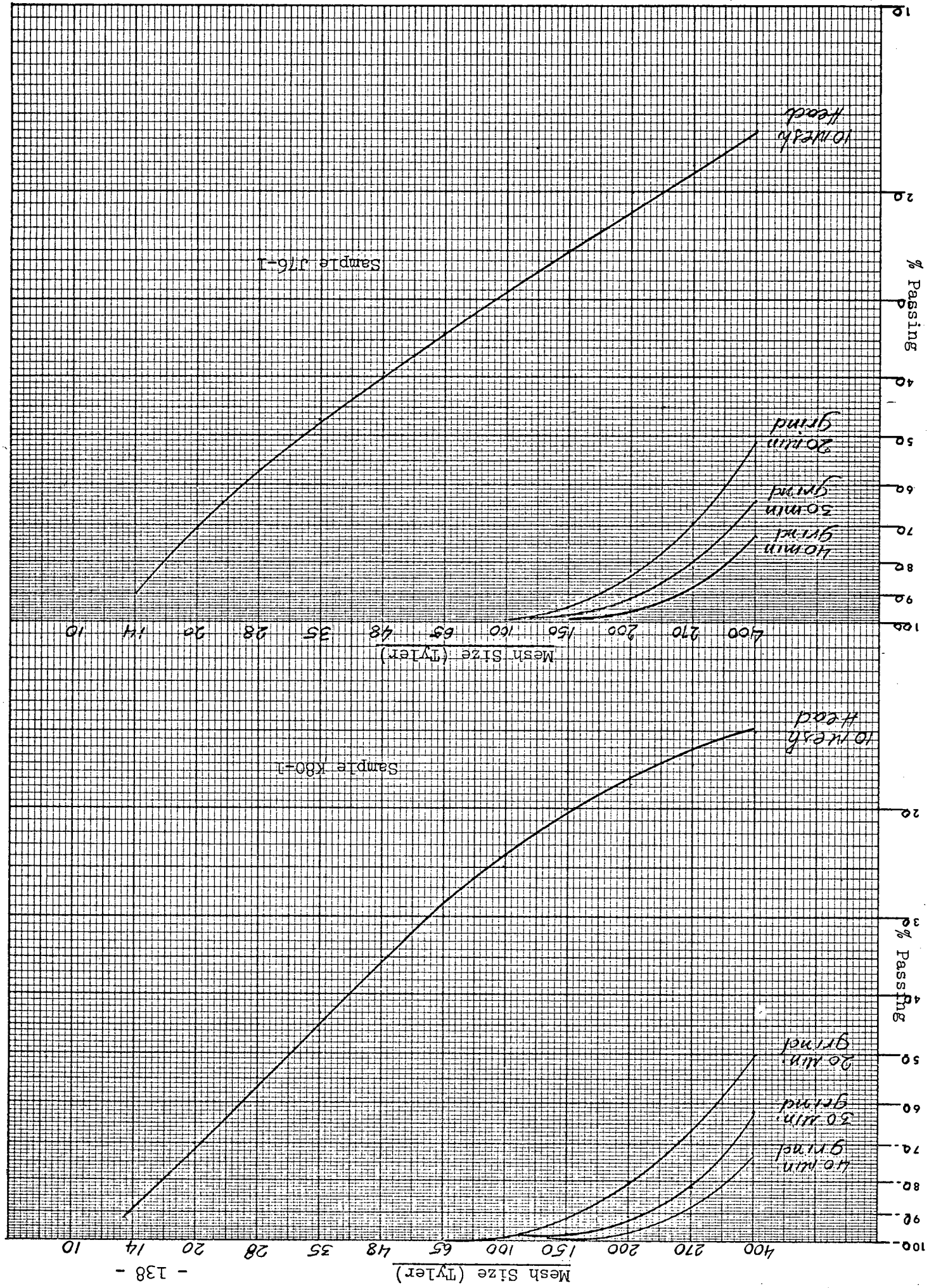
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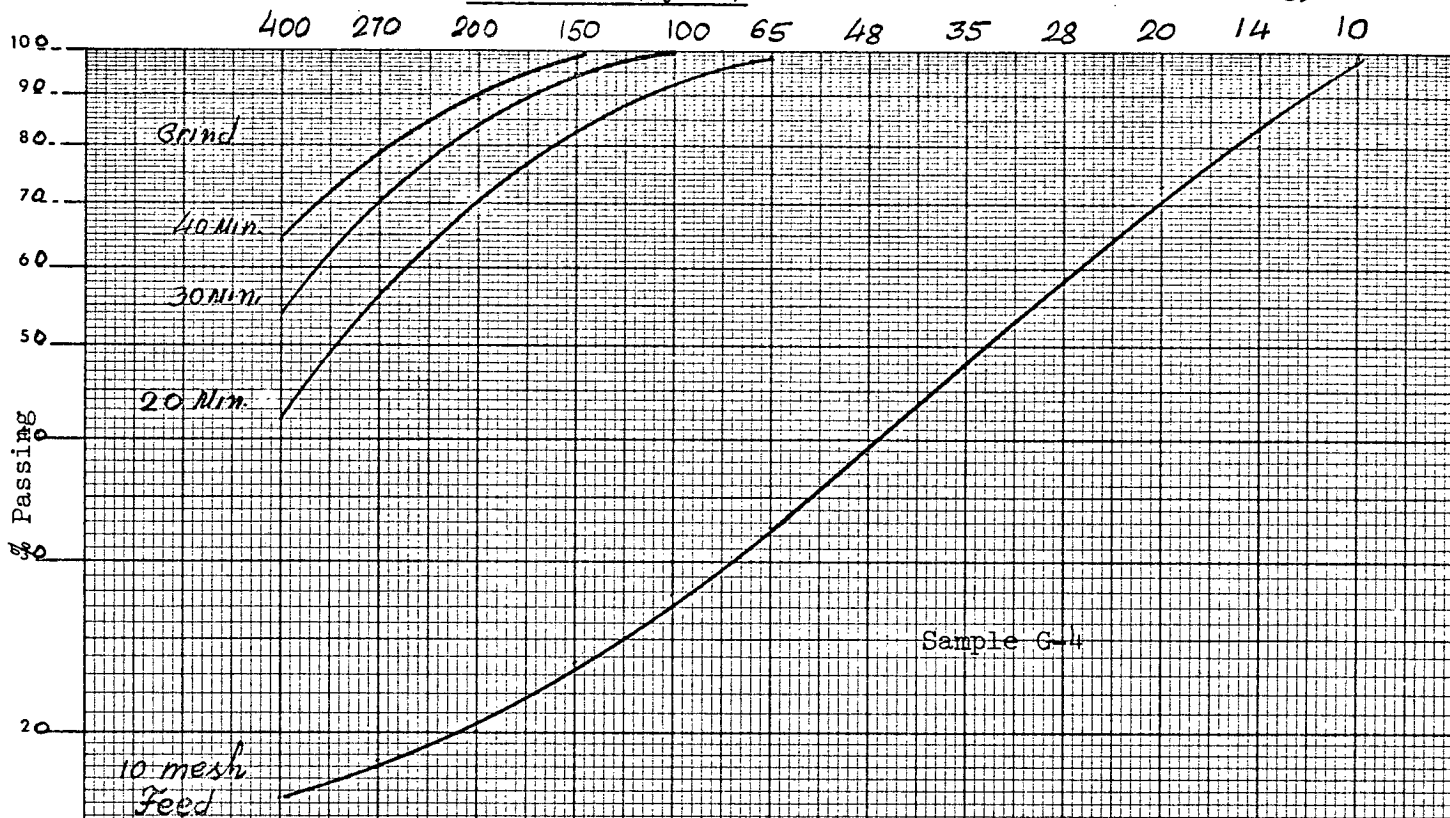


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Sample K-76-1

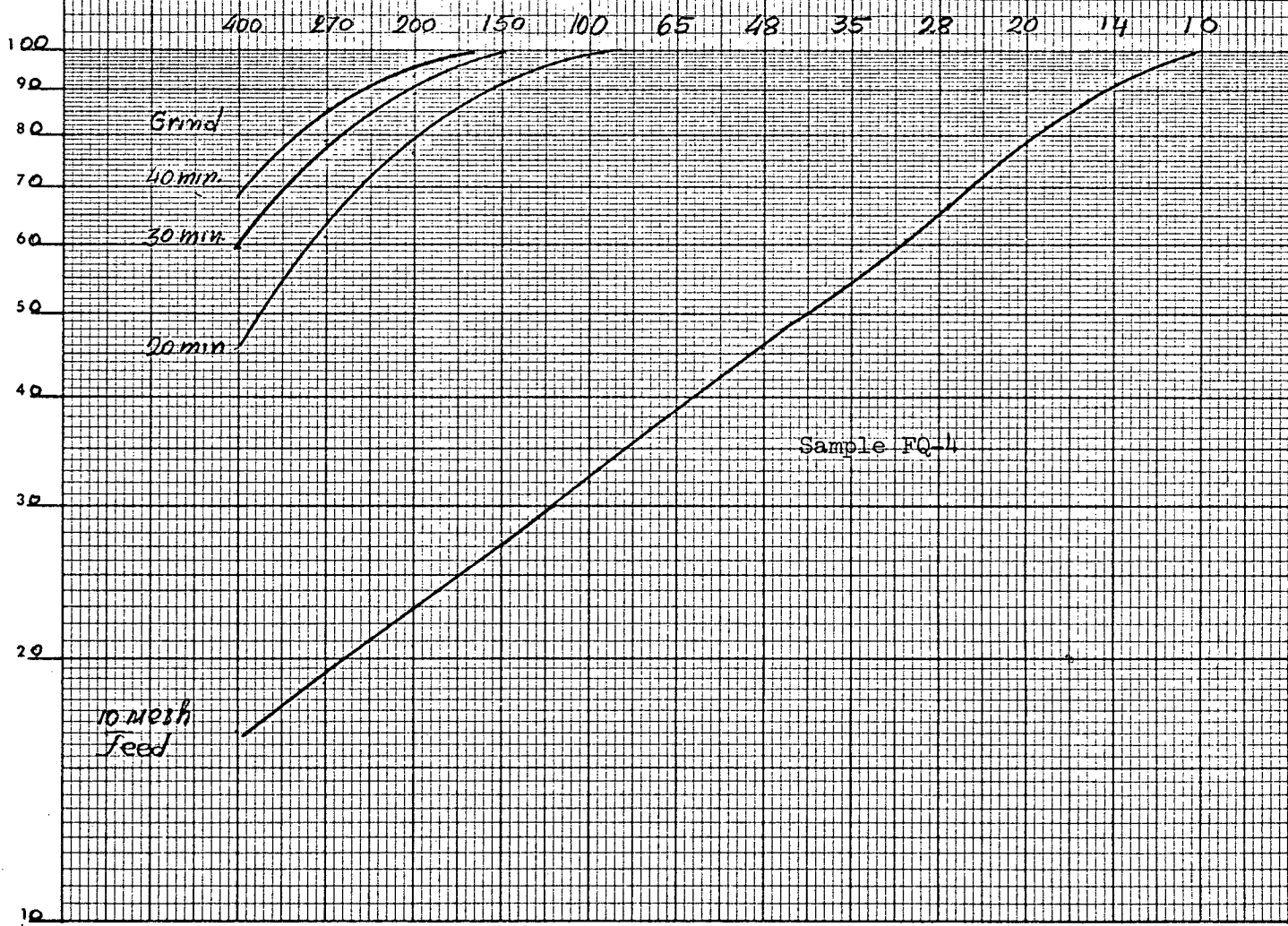




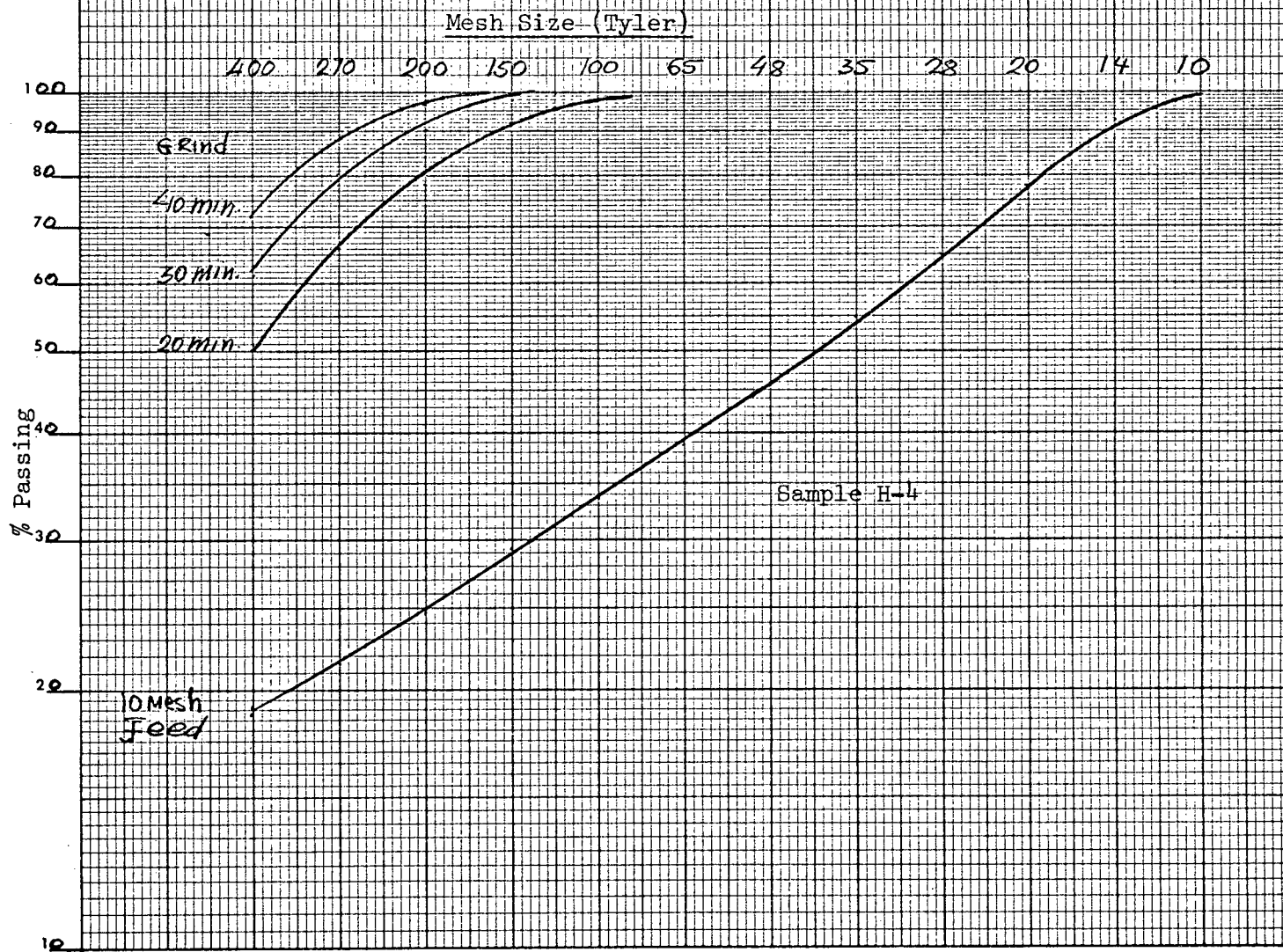
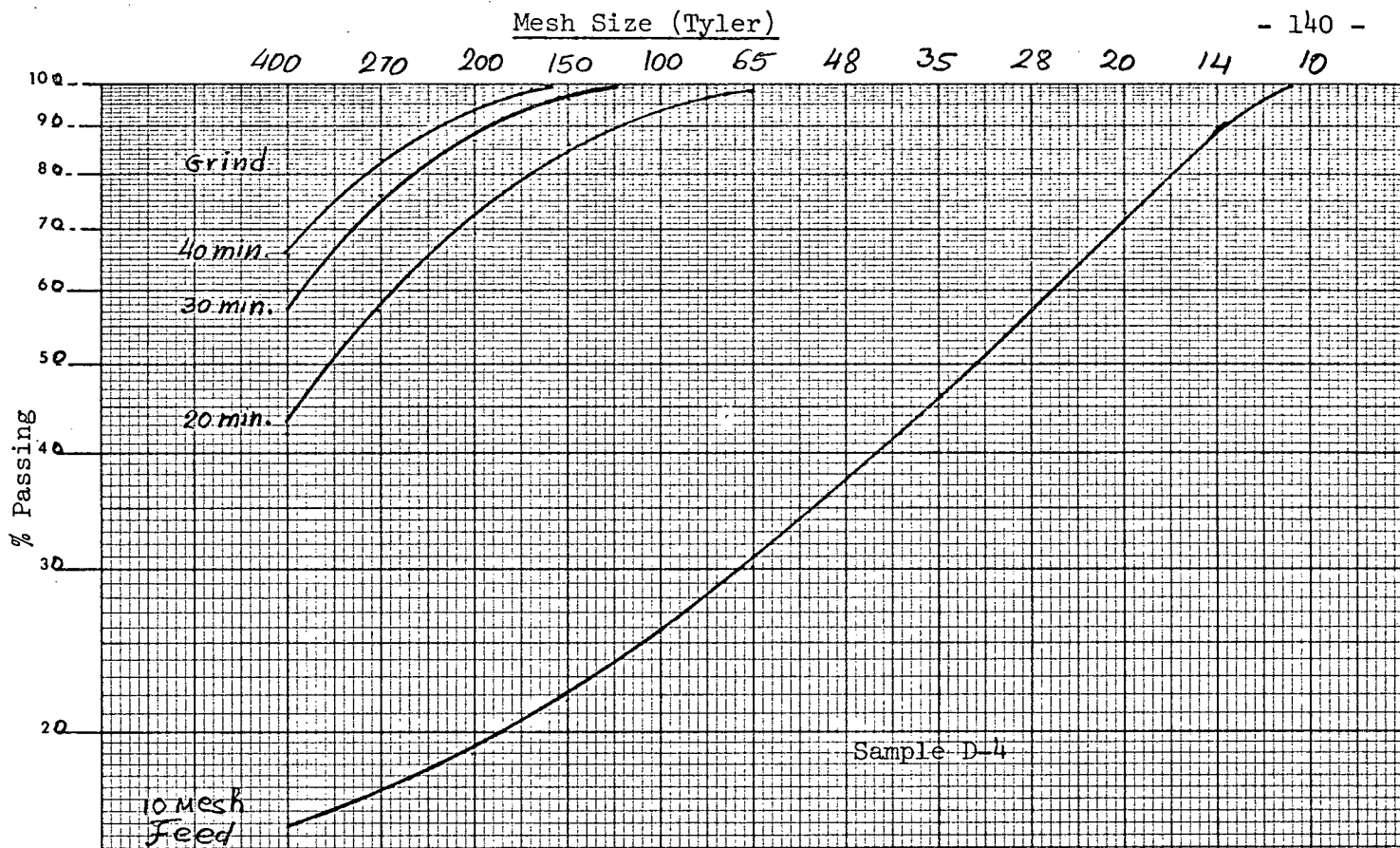


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Mesh Size

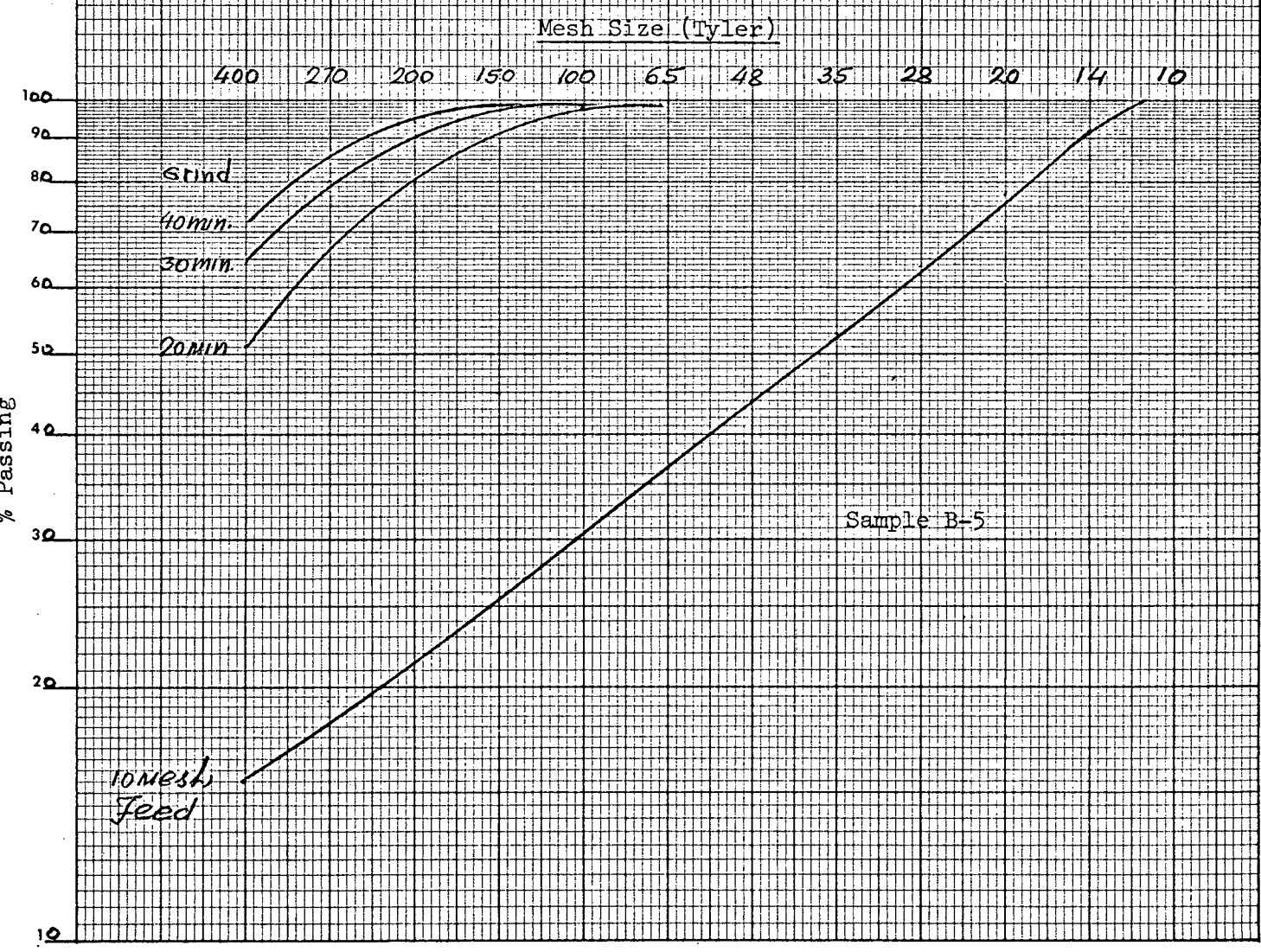
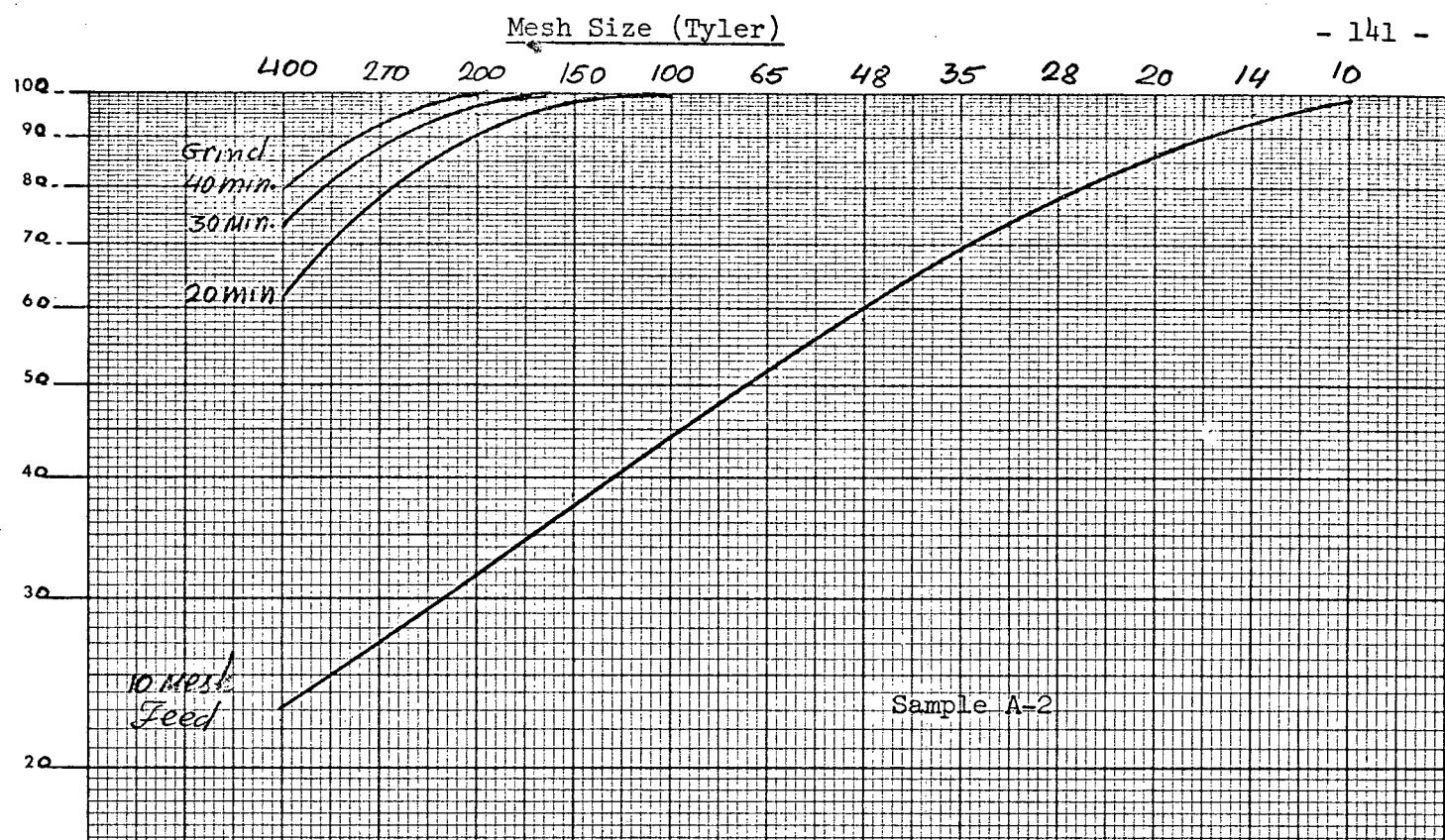


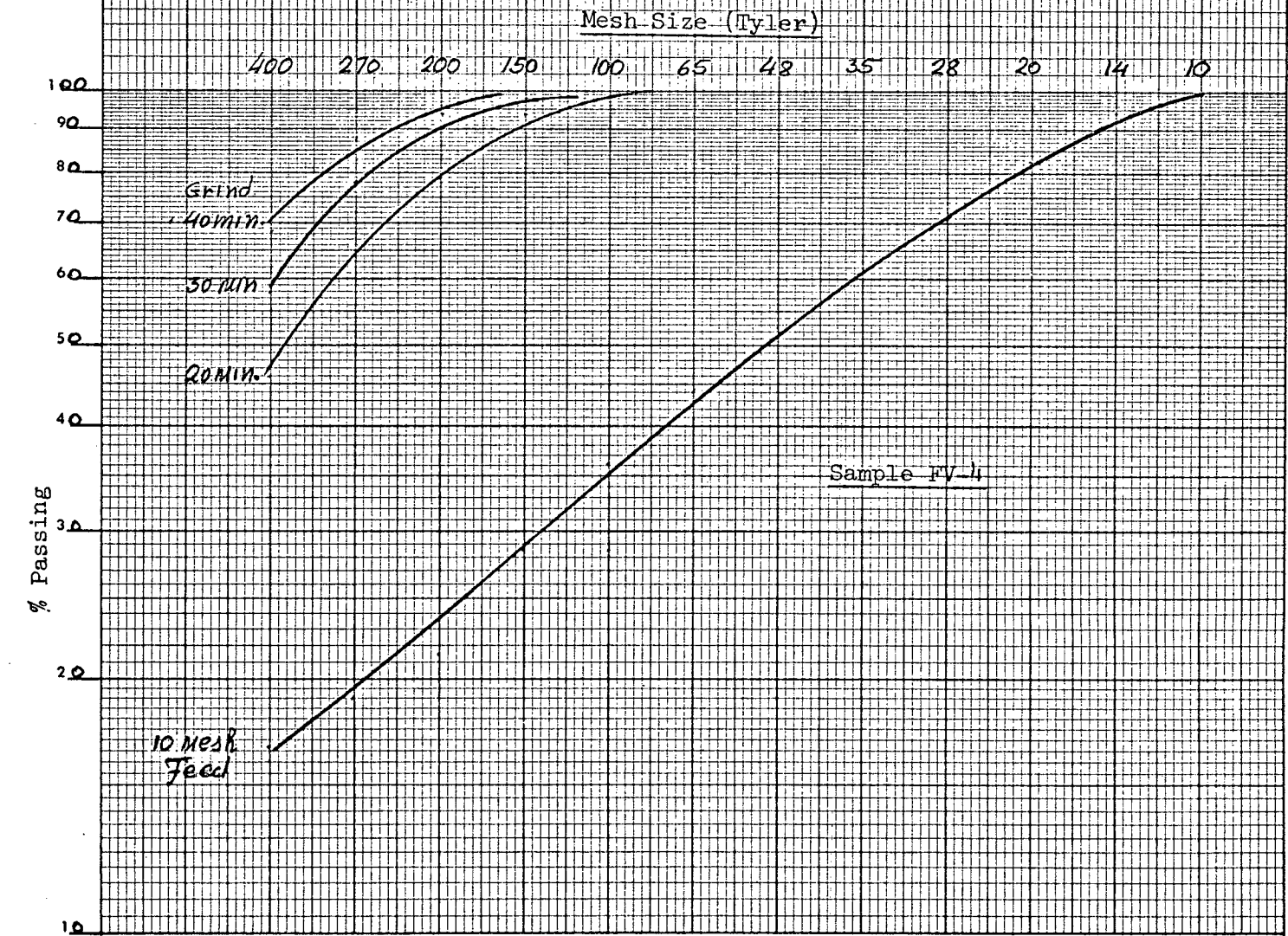
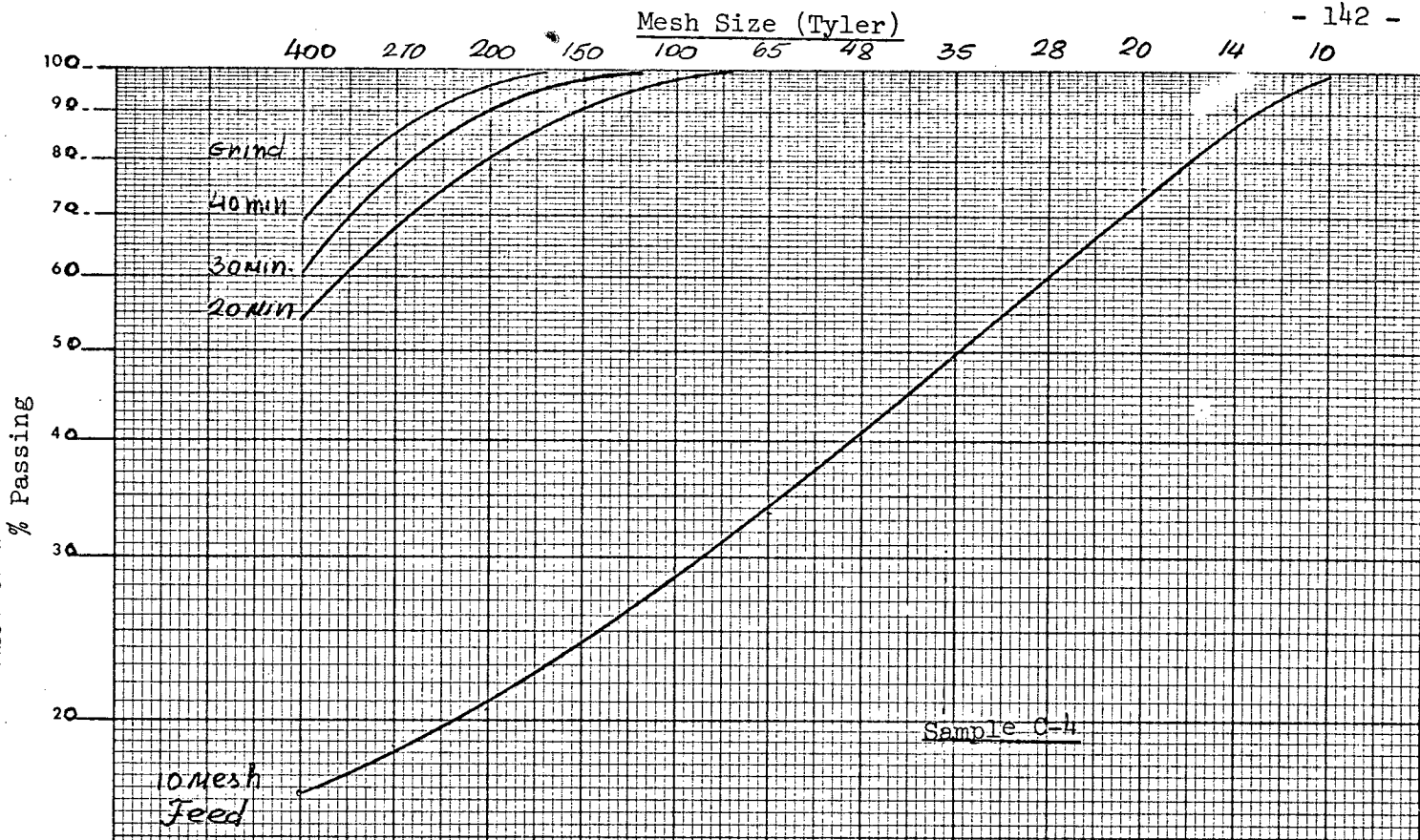
Sample FQ-4



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Work Index Calculations - Continued

2. Sample K76-1 - Screen Analyses

2.1. 10 Mesh Head

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 14	4.3	4.3	95.7
20	9.6	13.9	86.1
28	11.4	25.3	74.7
35	10.3	35.6	64.4
48	10.3	45.9	54.1
65	7.8	53.7	46.3
100	6.2	59.9	40.1
150	5.8	65.7	34.3
200	6.3	72.0	28.0
270	4.0	76.0	24.0
400	5.1	81.1	18.9
- 400	18.9	100.0	=
Total	100.0	-	-

2.2. 20 Minutes Grind

+ 100	0.2	0.2	99.8
150	1.6	1.8	98.2
200	7.9	9.7	90.3
270	10.0	19.7	80.3
400	18.5	38.2	61.8
- 400	61.8	100.0	-
Total	100.0	-	-

2.3. 30 Minutes Grind

+ 150	0.4	0.4	99.6
200	3.2	3.6	96.4
270	6.5	10.1	89.9
400	15.2	25.3	74.7
- 400	74.7	100.0	=
Total	100.0	-	-

Work Index Calculations - Continued

2. Sample K76-1 - Screen Analyses

2.4. 40 Minutes Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 150	0.2	0.2	99.8
200	1.4	1.6	98.4
270	3.6	5.2	94.8
400	13.1	18.3	81.7
- 400	81.7	100.0	-
Total	100.0	-	-

3. Sample K68-1

3.1. 10 Mesh Head

+ 14	7.6	7.6	92.4
20	14.0	21.6	78.4
28	13.4	35.0	65.0
35	9.7	44.7	55.3
48	8.8	53.5	46.5
65	6.9	60.4	39.6
100	5.6	66.0	34.0
150	5.7	71.7	28.3
200	6.4	78.1	21.9
270	3.9	82.0	18.0
400	4.8	86.8	13.2
- 400	13.2	100.0	-
Total	100.0	-	-

3.2. 20 Minutes Grind

+ 100	0.3	0.3	99.7
150	2.4	2.7	97.3
200	10.6	13.3	86.7
270	12.4	25.7	74.3
400	20.1	45.8	54.2
- 400	54.2	100.0	-
Total	100.0	-	-

Work Index Calculations - Continued

3. Sample K68-1 - Screen Analyses

3.3. 30 Minutes Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 150	0.7	0.7	99.3
200	4.9	5.6	94.4
270	9.1	14.7	85.3
400	17.9	32.6	67.4
- 400	67.4	100.0	-
Total	100.0	-	-

3.4. 40 Minutes Grind

+ 150	0.2	0.2	99.8
200	2.5	2.7	97.3
270	5.8	8.5	91.5
400	15.7	24.2	75.8
- 400	75.8	100.0	-
Total	100.0	-	-

4. Sample J76-1

4.1. 10 Mesh Head

+ 14	10.1	10.1	89.9
20	18.3	28.4	71.6
28	14.9	43.3	56.7
35	9.7	53.0	47.0
48	7.7	60.7	39.3
65	5.4	66.1	33.9
100	4.4	70.5	29.5
150	4.4	74.9	25.1
200	5.2	80.1	19.9
270	3.6	83.7	16.3
400	4.4	88.1	11.9
- 400	11.9	100.0	-
Total	100.0	-	-

Work Index Calculations - Continued

4. Sample J76-1 - Screen Analyses

4.2. 20 Minutes Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	0.2	0.2	99.8
100	0.8	1.0	99.0
150	3.5	4.5	95.5
200	12.1	16.6	83.4
270	13.7	30.3	69.7
400	18.1	48.4	51.6
- 400	51.6	100.0	-
Total	100.0	-	-

4.3. 30 Minutes Grind

+ 100	0.2	0.2	99.8
150	1.0	1.2	98.8
200	6.2	7.4	92.6
270	10.9	18.3	81.7
400	17.6	35.9	64.1
- 400	64.1	100.0	-
Total	100.0	-	-

4.4. 40 Minutes Grind

+ 150	0.5	0.5	99.5
200	2.9	3.4	96.6
270	6.2	9.6	90.4
400	16.9	26.5	73.5
- 400	73.5	100.0	-
Total	100.0	-	-

Work Index Calculations - Continued

5. Sample K80-1 - Screen Analyses

5.1. 10 Mesh Head

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 14	10.3	10.3	89.7
20	19.1	29.4	70.6
28	16.2	45.6	54.4
35	10.7	56.3	43.7
48	8.5	64.8	35.2
65	5.8	70.6	29.4
100	4.5	75.1	24.9
150	4.1	79.2	20.8
200	4.3	83.5	16.5
270	2.6	86.1	13.9
400	3.6	89.7	10.3
- 400	10.3	100.0	-
Total	100.0	-	-

5.2. 20 Minutes Grind

+ 65	0.4	0.4	99.6
100	1.5	1.9	98.1
150	5.0	6.9	93.1
200	13.5	20.4	79.6
270	12.8	33.2	66.8
400	17.2	50.4	49.6
- 400	49.6	100.0	-
Total	100.0	-	-

5.3. 30 Minutes Grind

+ 100	0.2	0.2	99.8
150	1.6	1.8	98.2
200	6.5	8.3	91.7
270	9.2	17.5	82.5
400	19.7	37.2	62.8
- 400	62.8	100.0	-
Total	100.0	-	-

Work Index Calculations - Continued

5. Sample K80-1 - Screen Analyses

5.4. 40 Minutes Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 150	0.5	0.5	99.5
200	3.3	3.8	96.2
270	6.1	9.9	90.1
400	16.9	26.8	73.2
- 400	73.2	100.0	-
Total	100.0	-	-

6. Sample G-4 - Screen Analyses

6.1. 10 Mesh Feed

+ 10	0.1	0.1	99.9
14	10.1	10.2	89.8
20	16.7	26.9	73.1
28	14.7	41.6	58.4
35	10.7	52.3	47.7
48	8.9	61.2	38.8
65	6.1	67.3	32.7
100	4.8	72.1	27.9
150	4.1	76.2	23.8
200	3.8	80.0	20.0
270	2.2	82.2	17.8
400	3.1	85.3	14.7
- 400	14.7	100.0	-
Total	100.0	-	-

6.2. 20 Minutes Grind

+ 65	1.2	1.2	98.8
100	4.4	5.6	94.4
150	11.0	16.6	83.4
200	18.7	35.3	64.7
270	11.6	46.9	53.1
400	10.8	57.7	42.3
- 400	42.3	100.0	-
Total	100.0	-	-

Work Index Calculations - Continued

6. Sample G-4 - Screen Analyses

6.3. 30 Minutes Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 100	0.6	0.6	99.4
150	3.8	4.4	95.6
200	12.6	17.0	83.0
270	11.9	28.9	71.1
400	16.6	45.5	54.5
- 400	54.5	100.0	-
Total	100.0	-	-

6.4. 40 Minutes Grind

+ 100	0.2	0.2	98.8
150	2.2	2.4	97.6
200	8.1	10.5	89.5
270	10.1	20.6	79.4
400	15.2	35.8	64.2
- 400	64.2	100.0	-
Total	100.0	-	-

7. Sample FQ-4 - Screen Analyses

7.1. 10 Mesh Feed

+ 14	7.4	7.4	92.6
20	14.2	21.6	78.4
28	13.3	34.9	65.1
35	10.1	45.0	55.0
48	9.3	54.3	45.7
65	7.4	61.7	38.3
100	6.3	68.0	32.0
150	5.7	73.7	26.3
200	5.5	79.2	20.8
270	3.2	82.4	17.6
400	4.0	86.4	13.6
- 400	13.6	100.0	-
Total	100.0	-	-

Work Index Calculations - Continued

7. Sample FQ-4 - Screen Analyses

7.2. 20 Minutes Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	0.3	0.3	99.7
100	1.4	1.7	98.3
150	5.7	7.4	92.6
200	15.9	23.3	76.7
270	15.2	38.5	61.5
400	16.0	54.5	45.5
- 400	45.5	100.0	-
Total	100.0	-	-

7.3. 30 Minutes Grind

+ 100	0.3	0.3	99.7
150	1.7	2.0	98.0
200	8.5	10.5	89.5
270	11.7	22.2	77.8
400	18.0	40.2	59.8
- 400	59.8	100.0	-
Total	100.0	-	-

7.4. 40 Minutes Grind

+ 100	0.2	0.2	99.8
150	1.5	1.7	98.3
200	5.9	7.6	92.4
270	7.9	15.5	84.5
400	16.9	32.4	67.6
- 400	67.6	100.0	-
Total	100.0	-	-

Work Index Calculations - Continued

8. Sample H-4 - Screen Analyses

8.1. 10 Mesh Feed

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 10	0.3	0.3	99.7
14	7.2	7.5	92.5
20	13.8	21.3	78.7
28	13.5	34.8	65.2
35	10.3	45.1	54.9
48	9.4	54.5	45.5
65	6.6	61.1	38.9
100	5.2	66.3	33.7
150	4.6	70.9	29.1
200	4.6	75.5	24.5
270	2.8	78.3	21.7
400	4.1	82.4	17.6
- 400	17.6	100.0	-
Total	100.0	-	-

8.2. 20 Minutes Grind

+ 65	0.3	0.3	99.7
100	1.8	2.1	97.9
150	5.8	7.9	92.1
200	13.7	21.6	78.4
270	11.5	33.1	66.9
400	16.1	49.2	50.8
- 400	50.8	100.0	-
Total	100.0	-	-

8.3. 30 Minutes Grind

+ 65	0.1	0.1	99.9
100	0.2	0.3	99.7
150	1.7	2.0	98.0
200	7.8	9.8	90.2
270	10.1	19.9	80.1
400	18.6	38.5	61.5
- 400	61.5	100.0	-
Total	100.0	-	-

Work Index Calculations - Continued

8. Sample H-4 - Screen Analyses

8.4. 40 Minutes Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 100	0.1	0.1	99.9
150	0.5	0.6	99.4
200	3.6	4.2	95.4
270	7.2	11.4	88.6
400	15.7	27.1	72.9
- 400	72.9	100.0	-
Total	100.0	-	-

9. Sample A-2 - Screen Analyses

9.1. 10 Mesh Feed

+ 14	4.3	4.3	95.7
20	9.4	13.7	86.3
28	10.1	23.8	76.2
35	8.8	32.6	67.4
48	8.9	41.5	58.5
65	7.5	49.0	51.0
100	6.3	55.3	44.7
150	6.1	61.4	38.6
200	6.6	68.0	32.0
270	4.3	72.3	27.7
400	5.3	77.6	22.4
- 400	22.4	100.0	-
Total	100.0	-	-

9.2. 20 Minutes Grind

+ 100	0.4	0.4	99.6
150	2.7	2.5	97.5
200	8.2	10.7	89.3
270	10.0	20.7	79.3
400	17.4	38.1	61.9
- 400	61.9	100.0	-
Total	100.0	-	-

Work Index Calculations - Continued

9. Sample A-2 - Screen Analyses

9.3. 30 Minutes Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 100	0.1	0.1	99.9
150	0.6	0.7	99.3
200	3.9	4.6	95.4
270	7.0	11.6	88.4
400	15.1	26.7	73.3
- 400	73.3	100.0	-
Total	100.0	-	-

9.4. 40 Minutes Grind

+ 150	0.2	0.2	99.8
200	2.0	2.2	97.8
270	4.4	6.6	93.4
400	14.3	20.9	79.1
- 400	79.1	100.0	-
Total	100.0	-	-

10. Sample D-4 - Screen Analyses

10.1. 10 Mesh Feed -

+ 14	9.6	9.6	90.4
20	17.1	26.7	73.3
28	16.0	42.7	57.3
35	11.4	54.1	45.9
48	9.2	63.3	36.7
65	6.2	69.5	30.5
100	4.6	74.1	25.9
150	4.0	78.1	21.9
200	4.0	82.1	17.9
270	2.5	84.6	15.4
400	3.5	88.1	11.9
- 400	11.9	100.0	-
Total	100.0	-	-

Work Index Calculations - Continued

10. Sample D-4 - Screen Analyses

10.2. 20 Minutes Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	1.2	1.2	98.8
100	3.7	4.9	95.1
150	8.9	13.8	86.2
200	16.8	30.6	69.4
270	12.2	42.8	57.2
400	14.3	57.1	42.9
- 400	42.9	100.0	-
Total	100.0	-	-

10.3. 30 Minutes Grind

+ 65	0.1	0.1	99.9
100	0.5	0.6	99.4
150	2.6	3.2	96.8
200	9.1	12.3	87.7
270	10.9	23.2	76.8
400	19.0	42.2	57.8
- 400	57.8	100.0	-
Total	100.0	-	-

10.4. 40 Minutes Grind

+ 65	0.1	0.1	99.9
100	0.1	0.2	99.8
150	1.1	1.3	98.7
200	5.9	7.2	92.8
270	9.8	17.0	83.0
400	17.4	34.4	65.6
- 400	65.6	100.0	-
Total	100.0	-	-

Work Index Calculations - Continued

11. Sample B-5 - Screen Analyses

11.1. 10 Mesh Feed

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 14	8.0	8.0	92.0
20	15.0	23.0	77.0
28	13.5	36.5	63.5
35	10.1	46.6	53.4
48	9.5	56.1	43.9
65	7.4	63.5	36.5
100	5.9	69.4	30.6
150	5.0	74.4	25.6
200	4.6	79.0	21.0
270	2.6	81.6	18.4
400	3.3	84.9	15.1
- 400	15.1	100.0	-
Total	100.0	-	-

11.2. 20 Minutes Grind

+ 65	0.3	0.3	99.7
100	1.4	1.7	98.3
150	5.4	7.1	92.9
200	13.5	20.6	79.4
270	11.4	32.0	68.0
400	16.5	48.5	51.5
- 400	51.5	100.0	-
Total	100.0	-	-

11.3. 30 Minutes Grind

+ 65	0.1	0.1	99.9
100	0.2	0.3	99.7
150	1.5	1.8	98.2
200	7.4	9.2	90.8
270	10.2	19.4	80.6
400	16.2	35.6	64.4
- 400	64.4	100.0	-
Total	100.0	-	-

Work Index Calculations - Continued

11. Sample B-5 - Screen Analyses

11.4. 40 Minutes Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	0.1	0.1	99.9
100	0.2	0.3	99.7
150	1.1	1.4	98.6
200	4.9	6.3	93.7
270	6.8	13.1	86.9
400	15.8	28.9	71.1
- 400	71.1	100.0	-
Total	100.0	-	-

12. Sample C-4 - Screen Analyses

12.1. 10 Mesh Feed

+ 14	8.2	8.2	91.8
20	16.5	24.7	75.3
28	15.2	39.9	60.1
35	10.9	50.8	49.2
48	9.0	59.8	40.2
65	6.3	66.1	33.9
100	4.7	70.8	29.2
150	4.3	75.1	24.9
200	4.4	79.5	20.5
270	2.8	82.3	17.7
400	4.3	86.6	13.4
- 400	13.4	100.0	-
Total	100.0	-	-

12.2. 20 Minutes Grind

+ 65	0.3	0.3	99.7
100	1.5	1.8	98.2
150	5.3	7.1	92.9
200	14.4	21.5	78.5
270	13.3	34.8	65.2
400	11.1	45.9	54.1
- 400	54.1	100.0	--
Total	100.0	-	-

Work Index Calculations - Continued

12. Sample C-4 - Screen Analyses

12.3. 30 Minutes Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 100	0.3	0.3	99.7
150	1.6	1.9	98.1
200	7.6	9.5	90.5
270	11.1	20.6	79.4
400	19.3	39.9	60.1
- 400	60.1	100.0	-
Total	100.0	-	-

12.4. 40 Minutes Grind

+ 100	0.1	0.1	99.9
150	0.6	0.7	99.3
200	4.2	4.9	95.1
270	7.5	12.4	87.6
400	19.1	31.5	68.5
- 400	68.5	100.0	-
Total	100.0	-	-

13. Sample FV-4

13.1. 10 Mesh Feed

+ 14	5.7	5.7	94.3
20	11.7	17.4	82.6
28	11.0	28.4	71.6
35	9.4	37.8	62.2
48	9.4	47.2	52.8
65	8.7	55.9	44.1
100	8.0	63.9	36.1
150	7.5	71.4	28.6
200	7.0	78.4	21.6
270	3.7	82.1	17.9
400	4.5	86.6	13.4
- 400	13.4	100.0	-
Total	100.0	-	-

Work Index Calculations - Continued

13. Sample FV-4 - Screen Analyses

13.2. 20 Minutes Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 100	1.2	1.2	98.8
150	5.1	6.3	93.7
200	14.8	21.1	78.9
270	13.1	34.2	65.8
400	19.7	53.9	46.1
- 400	46.1	100.0	-
Total	100.0	-	-

13.3. 30 Minutes Grind

+ 100	0.2	0.2	99.8
150	1.6	1.8	98.2
200	8.1	9.9	90.1
270	12.1	22.0	78.0
400	19.9	41.9	58.1
- 400	58.1	100.0	-
Total	100.0	-	-

13.4. 40 Minutes Grind

+ 150	0.5	0.5	99.5
200	4.2	4.7	95.3
270	7.6	12.3	87.7
400	19.3	31.6	68.4
- 400	68.4	100.0	-
Total	100.0	-	-

LEAD AND ZINC CONCENTRATES

Settling and Filtration Tests

Test No. L-1 to L-5

Purpose: To conduct a series of settling and filtration tests on a pilot plant bulk Pb concentrate sample.

Feed: Pilot plant test No. 44, bulk Pb 4th cleaner concentrate collected during the pilot plant sampling period.

Procedure: The pulp density of the Pb concentrate was adjusted to 30 percent solids. A 4 litre sample of the pulp was removed and transferred to a 1000 ml Denver D - 1 cell and violently agitated. A 1000 ml sample was removed as is, and then the pH was adjusted to pH 9.0 and to 10.0 with Na_2CO_3 . Samples of 1000 ml were removed at each pH.

The settling tests were carried out in 1000 ml graduated cylinders, with the results calculated following the Robert's interpretation of the Talmage-Fitch method.

For the filtration test feed, the pulp density of the Pb concentrate was adjusted to 55 percent solids. A series of standard pick-up tests were performed using a 0.1 square foot filter test leaf.

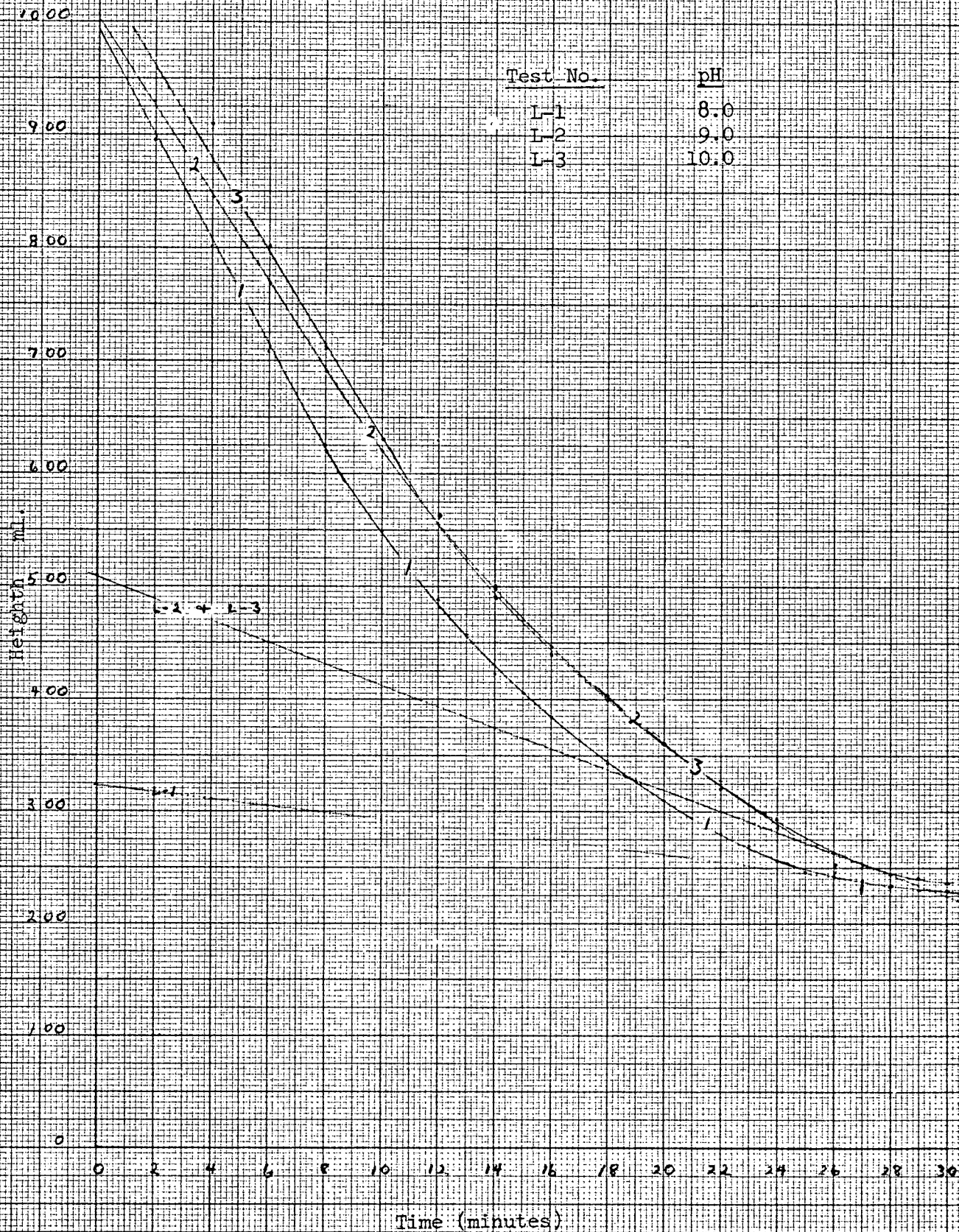
Screen Analyses

Pb Cleaner Concentrate

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 26.6 μm	2.9	2.9	97.1
20.6	3.4	6.3	93.7
14.4	16.8	23.1	76.9
9.9	21.6	44.7	55.3
7.6	13.8	58.5	41.5
- 7.6	41.5	100.0	-
Total	100.0	-	-

Settling Curves

Lead 4th Cleaner Concentrate



U-14
S
TRI
ORE
G PZ

U-14
S
TRI
ORE
G PZ

U-14
S
TRI
ORE
G PZ

Settling and Filtration Tests

Test No. L-1 to L-5 - Continued

Summary of Pb Concentrate Thickening Results

Test No.	pH	% Solids		Settling Rate ft. per hour		Thickener Area Required	
		Feed	Final	Initial	Comp.	Initial	Final
L - 1	8.0	31.6	77	3.26	0.24	0.76	1.61
L - 2	9.3	31.0	76	2.72	0.71	0.94	1.13
L - 3	10.0	31.1	76	2.89	0.71	0.88	1.07

* Thickener Area Required - sq. ft. per ton of dry solids per 24 hours, no safety factor.

Comments: increasing the amount of Na_2CO_3 added greatly decreased the clarity of the supernatant.

Summary of Pb Concentrate Filtration Results

Test No.	Slurry		Filter Cloth	Vaccum in.	Filter Time(Sec)			Filter Cake			Filter Rate *
	% Solids	pH			Form	Dry	Cycle Total	Thick. in.	% Moisture	Rate **	
L-4-1	55	8.3	POPR [®]	18	60	300	540	0.2	14.4	30.8	3.87
L-4-2	55	8.3	POPR [®]	18	30	300	495	0.15	12.5	19.1	2.50
L-4-3	55	8.3	POPR [®]	24	60	300	540	0.35	13.6	37.1	4.22
L-4-4	55	8.3	POPR [®]	24	45	300	518	0.30	12.7	32.1	3.68
L-4-5	55	8.3	POPR [®]	24	45	600	968	0.30	12.8	17.4	1.97
L-5-1	55	8.2	POPR ^{®®}	24	45	300	518	0.25	13.4	31.7	3.31
L-5-2	55	8.2	POPR ^{®®}	24	45	600	968	0.25	13.9	17.2	1.77
L-5-3	55	8.2	POPR ^{®®}	24	60	600	990	0.30	11.6	18.3	2.02
L-5-4	65	8.2	POPR ^{®®}	24	30	300	495	0.40	13.5	43.0	2.88
L-5-5	65	8.2	POPR ^{®®}	24	30	600	945	0.40	12.4	22.6	1.31

** U.S. Gallons per hour per sq. ft.

* Dry pounds per hour per sq. ft.

[®] POPR 853F

^{®®} POPR 851

Settling and Filtration Tests - Continued

Test No. L-1

Purpose: To conduct a settling test on the Pb 4th cleaner concentrate at natural pH.

Feed: 1000 ml pulp bulk Pb 4th cleaner concentrate Pilot Plant test No. 44.

pH: 8.0 (as is)

Pulp Volume: 986 ml.

Pulp Weight: 1340 g

Specific Gravity of Dry Solids: 6.01

Settling Time Minutes	Mudline ml.	Settling Time Minutes	Mudline ml.
0	990	15	406
1	940	16	385
2	895	17	364
3	848	18	343
4	801	19	327
5	757	20	310
6	708	21	294
7	669	22	280
8	625	23	269
9	583	24	255
10	549	25	246
11	514	26	241
12	487	27	239
13	457	28	233
14	432	29	230
		30	229
		60	200
		24 hrs.	193

Observations: Supernatant clear.

Settling and Filtration Tests - Continued

Test No. L-1 - Continued

Thickener Area Requirements

Calculations

Feed Concentration Zone

Initial pulp density: 1359 g/l

Initial percent solids: 31.6

$$F = 68.4 / 31.6 = 2.16$$

Final pulp density: 2830 g/l

Final percent solids: 77

$$D = 23 / 77 = 0.30$$

R = 3.26 feet per hour

$$A = \frac{1.333 (2.16 - 0.30)}{3.26}$$

= 0.76 square feet per ton of dry solids per 24 hours thickener
area required (no safety factor applied)

Compression Zone

Initial pulp density: 2093 g/l

Initial percent solids: 63

$$F = 37 / 63 = 0.59$$

Final pulp density: 2830 g/l

Final percent solids: 77

$$D = 23 / 77 = 0.30$$

R = 0.24 feet per hour

$$A = \frac{1.333 (0.59 - 0.30)}{0.24}$$

= 1.61 square feet per ton of dry solids per 24 hours thickener
area required (no safety factor applied)

Settling and Filtration Tests - Continued

Test No. L-2

Purpose: To conduct a settling test on the Pb 4th cleaner concentrate at pH 9.3.

Feed: 1000 ml pulp bulk Pb 4th cleaner concentrate pilot plant test 44.

pH: 9.3 (adjusted with Na_2CO_3)

Pulp Volume: 1000 ml.

Pulp Weight: 1349 g

Specific Gravity of Dry Solids: 6.01

Settling Time Minutes	Mudline ml.	Settling Time Minutes	Mudline ml.
0	1000	15	476
1	935	16	447
2	930	17	426
3	885	18	403
4	845	19	382
5	805	20	361
6	767	21	344
7	728	22	327
8	690	23	310
9	655	24	293
10	620	25	276
11	588	26	264
12	555	27	249
13	527	28	243
14	497	29	240
		30	235
		60	215
		24 hours	205

Observations: Supernatant slightly cloudy. Na_2CO_3 appeared to have a dispersing effect.

Settling and Filtration Tests - Continued

Test No. L-2 - Continued

Thickener Area Requirements

Calculations

Feed Concentration Zone

Initial pulp density: 1349 g/l

Initial percent solids: 31.0

$$F = 69.0 / 31.0 = 2.23$$

Final pulp density: 2698 g/l

Final percent solids: 76

$$D = 24 / 76 = 0.32$$

R = 2.72 feet per hour

$$A = \frac{1.333 (2.23 - 0.32)}{2.72}$$

= 0.94 square feet per ton of dry solids per 24 hours thickener
area required (no safety factor applied)

Compression Zone

Initial pulp density: 1679 g/l

Initial percent solids: 52

$$F = 48 / 52 = 0.92$$

Final pulp density: 2698 g/l

Final percent solids: 76

$$D = 24 / 76 = 0.32$$

R = 0.71 feet per hour

$$A = \frac{1.333 (0.92 - 0.32)}{0.71}$$

= 1.13 square feet per ton of dry solids per 24 hours thickener
area required (no safety factor applied)

Settling and Filtration Tests - Continued

Test No. L-3

Purpose: To conduct a settling test on the Pb 4th cleaner concentrate at pH 10.0

pH: 10.0

Pulp Volume: 1000 ml.

Pulp Weight: 1350 g

Specific Gravity of Dry Solids: 6.01

Settling Time Minutes	Mudline ml.	Settling Time Minutes	Mudline ml.
4	910	19	380
6	800	21	340
7	740	22	320
8	710	23	300
9	680	24	285
10	630	25	265
11	600	26	250
12	560	27	240
13	520	28	232
14	500	29	230
15	471	30	229
16	440	60	220
17	420	24 hrs.	201
18	400		

Observations: Supernatant liquid very cloudy.
Pulp appeared highly dispersed.

Settling and Filtration Tests - Continued

Test No. L-3 - Continued

Thickener Area Requirements

Calculations

Feed Concentration Zone

Initial pulp density: 1350 g/l

Initial percent solids: 31.1

$$F = 68.9 / 31.1 = 2.22$$

Final pulp density: 2741 g/l

Final percent solids: 76

$$D = 24 / 76 = 0.32$$

R = 2.89 feet per hour

$$A = \frac{1.333 (2.22 - 0.32)}{2.89}$$

= 0.88 square feet per ton of dry solids per 24 hours thickener
area required (no safety factor applied)

Compression Zone

Initial pulp density: 1689 g/l

Initial percent solids: 53

$$F = 47 / 53 = 0.89$$

Final pulp density: 2741 g/l

Final percent solids: 76

$$D = 24 / 76 = 0.32$$

R = 0.71 feet per hour

$$A = \frac{1.333 (0.89 - 0.32)}{0.71}$$

= 1.07 square feet per ton of dry solids per 24 hours thickener
area required (no safety factor applied)

Settling and Filtration Tests - Continued

Test No. L-4

Purpose: To conduct a series of filtration tests on the pilot plant bulk Pb 4th cleaner concentrate.

Procedure: Standard pick up test using a 0.1 square foot Eimco test leaf filter.

Feed: Pilpt Plant test No. 44 bulk Pb concentrate as is.

Cloth Specifications

Media Number	POPR - 853 F
Material	Polypropylene
Air-flow (cfm/sq. ft.)	22.00
Yarn	Multi-filament
Weave	2/2 twill
Weight (oz./sq. yd.)	9.00
Thread Count	59 x 38
Finish	Heat-set

Settling and Filtration Tests - Continued

Test No. L-4 - Continued

Test Conditions

Test No.	Filter Cloth	Slurry			Filter Vac. (In. Hg)		Filter Time - Sec.		
		% Solids	pH	Temp. °C	Form	Dry	Form	Dry	Cycle
1	POPR 853F	55	8.3	23	18	18	60	300	540
2	POPR 853F	55	8.3	23	18	18	30	300	495
3	POPR 853F	55	8.3	23	24	24	60	300	540
4	POPR 853F	55	8.3	23	24	24	45	300	517.5
5	POPR 853F	55	8.3	23	24	24	45	600	967.5

Test Results

Test No.	Filter Cake Data						Filtrate Data		
	Cracks No.	Thick. In.	Weight Wet	Grams Dry	% Moist	Rate *	Volume ml.	Clarity	Rate **
1	No	0.2	245.3	209.9	14.4	30.8	220	Very Dirty	3.87
2	No	0.15	135.3	119.4	12.5	19.1	130	Very Dirty	2.50
3	Multiple After 15 sec.	0.35	292.5	252.8	13.6	37.1	240	Very Dirty	4.22
4	No	0.30	240.0	209.5	12.7	32.1	200	Very Dirty	3.68
5	No	0.30	243.1	212.1	12.8	17.4	200	Very Dirty	1.97

* Dry Pounds per Hour per Square Foot

** U.S. Gallons per Hour per Square Foot

Settling and Filtration Tests - Continued

Test No. L-5

Purpose: To conduct a series of filtration tests on the Pb bulk concentrate, but use a lower air-flow filter cloth.

Procedure: Pilot Plant test No. 44 bulk Pb concentrate (as is).

Cloth Specifications

Media Number	POPR - 851
Material	Polypropylene
Air-Flow (Cfm/sq. ft.)	8.3
Yarn	Multi - filament
Weave	1/1 Plain
Weight (oz./sq. yd.)	8.00
Thread Count	58 x 32
Finish	Greige

Settling and Filtration Tests - Continued

Test No. L-5 - Continued

Test Conditions

Test No.	Filter Cloth	Slurry			Filter Vac. (In. Hg)		Filter Time - Sec.		
		% Solids	pH	Temp. °C	Form	Dry	Form	Dry	Cycle
1	POPR 851	55	8.2	24	24	24	45	300	517.5
2	POPR 851	55	8.2	24	24	24	45	600	967.5
3	POPR 851	55	8.2	24	24	24	60	600	990.0
4	POPR 851	65	8.2	24	24	24	30	300	495.0
5	POPR 851	65	8.2	24	24	24	30	600	945.0

Test Results

Test No.	Filter Cake Data						Filtrate Data		
	Cracks No.	Thick. In.	Weight Wet	Grams Dry	% Moist	Rate *	Volume ml.	Clarity	Rate **
1	No	0.25	238.8	206.8	13.4	31.7	180	Cloudy	3.31
2	4	0.25	243.9	209.9	13.9	17.2	180	Cloudy	1.77
3	3	0.30	257.9	228.1	11.6	18.3	210	Cloudy	2.02
4	7	0.40	310.5	268.5	13.5	43.0	150	Cloudy	2.88
5	7	0.40	307.3	269.1	12.4	22.6	130	Cloudy	1.31

* Dry Pounds per Hour per Square Foot

** U.S. Gallons per Hour per Square Foot

Settling and Filtration Tests - Continued

Tests No. Z-1 to Z-5

Purpose: To conduct a series of settling and filtration tests on a pilot plant bulk Zn concentrate sample.

Feed: Pilot plant test No. 44, bulk Zn 4th cleaner concentrate collected during the pilot plant sampling period.

Procedure: As for tests L-1 to L-5, but the pH was adjusted with lime rather than with Na_2CO_3 .

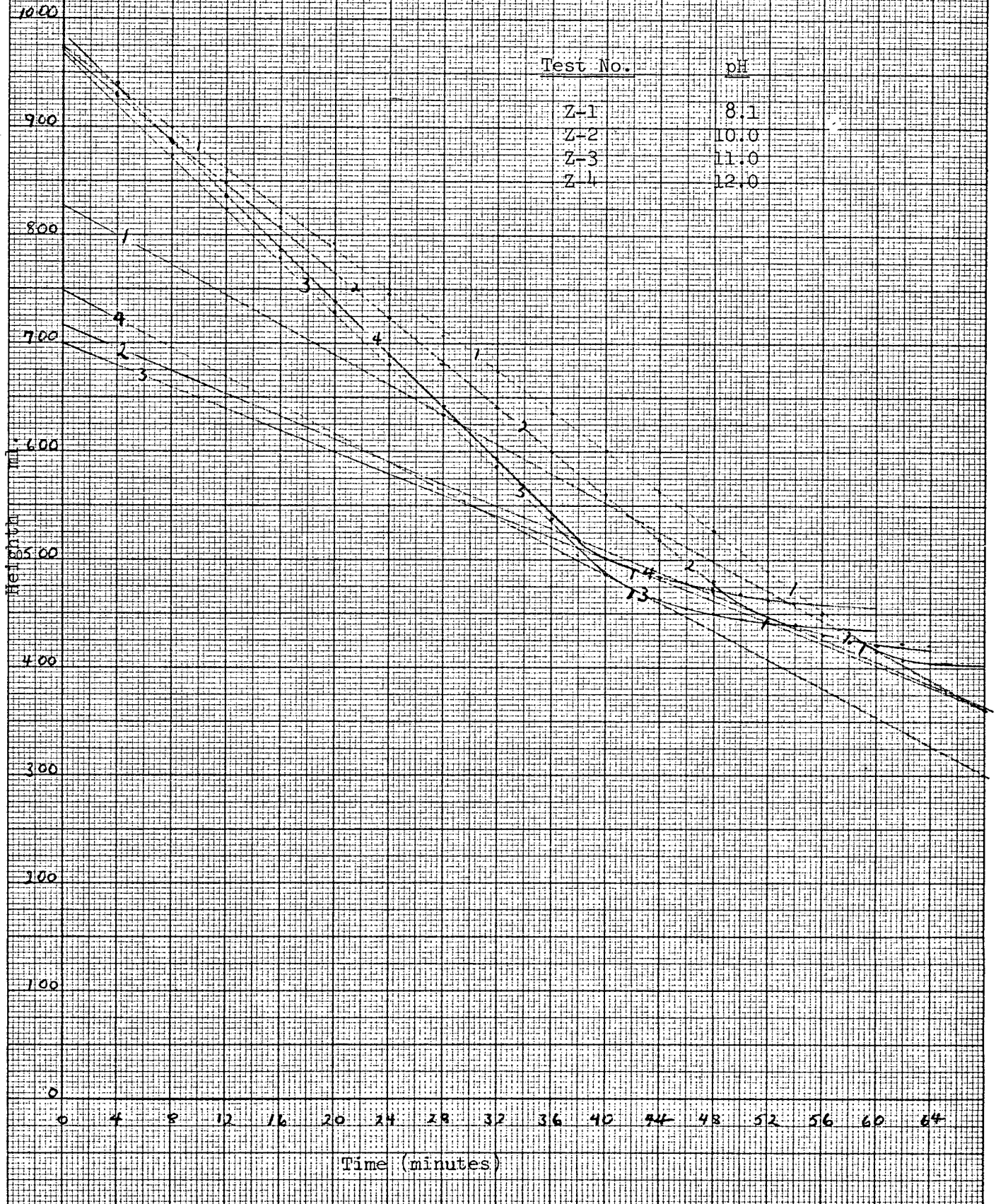
Screen Analyses

Zn Cleaner Concentrate Test PP 44

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 33.8 μm	0.2	0.2	99.8
26.2	1.2	1.4	98.6
18.3	7.8	9.2	90.6
12.6	15.1	24.3	75.7
9.7	13.2	37.5	62.5
- 9.7	62.5	100.0	-
Total	100.0	-	-

Settling Curves

Zinc 4th Cleaner Concentrate



Settling and Filtration Tests - Continued

Test No. Z-1

Purpose: To conduct a settling test on the pilot plant zinc concentrate at the standard pH.

Feed: 1000 ml pulp zinc concentrate pilot plant test 44.

pH: 8.1

Pulp Volume: 970 ml.

Pulp Weight: 1245 g

Specific Gravity of Dry Solids: 4.05

Settling Time Minutes	Mudline ml.	Settling Time Minutes	Mudline ml.
0	970	30	690
2	960	32	672
4	940	34	653
6	917	36	635
8	900	38	617
10	878	40	600
12	857	42	580
14	836	44	562
16	820	46	543
18	800	48	526
20	782	50	509
22	763	52	490
24	745	54	470
26	727	56	450
28	707	58	432
		60	415
		62	406
		64	403
		24 hrs.	336

Observations: Supernatant clear.

Settling and Filtration Tests - Continued

Test No. Z-1 - Continued

Thickener Area Requirements

Calculations

Feed Concentration Zone

Initial pulp density: 1284 g/l

Initial percent solids: 29.4

$$F = 70.6 / 29.4 = 2.40$$

Final Pulp density: 1821 g/l

Final percent solids: 60.2

$$D = 39.8 / 60.2 = 0.66$$

R = 0.66 feet per hour

$$A = \frac{1.333 (2.40 - 0.66)}{0.66}$$

= 3.51 square feet per ton of dry solids per 24 hours thickener
area required (no safety factor applied)

Compression Zone

Initial pulp density: 1334 g/l

Initial percent solids: 33.2

$$F = 66.8 / 33.2 = 2.01$$

Final pulp density: 1821 g/l

Final percent solids: 60.2

$$D = 39.8 / 60.2 = 0.66$$

R = 0.48 feet per hour

$$A = \frac{1.333 (2.01 - 0.66)}{0.48}$$

= 3.75 square feet per ton of dry solids per 24 hours thickener
area required (no safety factor applied)

Settling and Filtration Tests - Continued

Test No. Z-2

Purpose: To conduct a settling test on the pilot plant zinc concentrate at pH 10.0

Feed: 1000 ml pulp zinc concentrate pilot plant test 44

pH: 10.0 adjusted with lime

Pulp Volume: 980 ml.

Pulp Weight: 1251 g

Specific Gravity of Dry Solids: 4.05

Settling Time Minutes	Mudline ml.	Settling Time Minutes	Mudline ml.
0	980	30	660
2	960	32	640
4	940	34	620
6	917	36	600
8	898	38	578
10	870	40	560
12	849	42	536
14	826	44	517
16	807	46	493
18	785	48	477
20	764	50	459
22	743	52	443
24	723	54	435
26	704	56	430
28	680	58	423
		60	420
		24 hr.	348

Observations: Supernatant clear.

Settling and Filtration Tests - Continued

Test No. Z-2 - Continued

Thickener Area Requirements

Calculations

Feed Concentration Zone

Initial pulp density: 1277 g/l

Initial percent solids: 28.8

$$F = 71.2 / 28.8 = 2.47$$

Final pulp density: 1782 g/l

Final percent solids: 57.4

$$D = 42.6 / 57.4 = 0.74$$

R = 0.72 feet per hour

$$A = \frac{1.33 (2.47 - 0.74)}{0.72}$$

= 320 square feet per ton of dry solids per 24 hours thickener
area required (no safety factor applied)

Compression Zone

Initial pulp density: 1380 g/l

Initial percent solids: 36.5

$$F = 63.5 / 36.5 = 1.74$$

Final pulp density: 1782 g/l

Final percent solids: 57.4

$$D = 42.6 / 57.4 = 0.74$$

R = 0.36 feet per hour

$$A = \frac{1.333 (1.74 - 0.74)}{0.36}$$

= 3.70 square feet per ton of dry solids per 24 hours thickener
area required (no safety factor applied)

Settling and Filtration Tests - Continued

Test No. Z-3

Purpose: To conduct a settling test on the pilot plant zinc concentrate at pH 11.0.

Feed: 1000 ml pulp zinc concentrate pilot plant test 44.

pH: 11.0 adjusted with lime.

Pulp Volume: 960 ml.

Pulp Weight: 1232 g

Specific Gravity of Dry Solids: 4.05

Settling Time Minutes	Mudline ml.	Settling Time Minutes	Mudline ml.
0	960	30	609
2	954	32	586
4	927	34	564
6	903	36	538
8	873	38	504
10	850	40	486
12	825	42	471
14	800	44	463
16	778	46	455
18	754	48	450
20	728	50	445
22	705	52	443
24	680	54	440
26	656	60	435
28	633	24 hr.	344

Observations: Supernatant clear.

Settling and Filtration Tests - Continued

Test No. Z-3 - Continued

Thickener Area Requirements

Calculations

Feed Concentration Zone

Initial pulp density: 1283 g/l

Initial percent solids: 29.4

$$F = 70.6 / 29.4 = 2.40$$

Final pulp density: 1794 g/l

Final percent solids: 58.6

$$D = 41.4 / 58.6 = 0.71$$

R = 0.84 feet per hour

$$A = \frac{1.333 (2.40 - 0.71)}{0.84}$$

= 2.68 square feet per ton of dry solids per 24 hours thickener
area required (no safety factor applied)

Compression Zone

Initial pulp density: 1390 g/l

Initial percent solids: 37.2

$$F = 62.8 / 37.2 = 1.69$$

Final pulp density: 1794 g/l

Final percent solids: 58.6

$$D = 41.4 / 58.6 = 0.71$$

R = 0.35 feet per hour

$$A = \frac{1.333 (1.69 - 0.71)}{0.35}$$

= 3.73 square feet per ton of dry solids per 24 hours thickener
area required (no safety factor applied)

Settling and Filtration Tests - Continued

Test No. Z-4

Purpose: To conduct a settling test on the pilot plant zinc concentrate at pH 12.0

Feed: 1000 ml pulp zinc concentrate pilot plant test 44.

pH: 12.0 adjusted with lime.

Pulp Volume: 985 ml.

Pulp Weight: 1260 g

Specific Gravity of Dry Solids: 4.05

Settling Time Minutes	Mudline ml.	Settling Time Minutes	Mudline ml.
0	985	30	617
2	970	32	594
4	941	34	565
6	915	36	542
8	886	38	517
10	860	40	500
12	835	42	490
14	810	44	483
16	785	46	477
18	765	48	470
20	737	50	468
22	713	52	462
24	688	54	460
26	665	60	455
28	640	24 hr.	350

Observations: Supernatant clear.

Settling and Filtration Tests - Continued

Test No. Z-4 - Continued

Thickener Area Requirements

Calculations

Feed Concentration Zone

Initial pulp density: 1279 g/l

Initial percent solids: 29.2

$$F = 70.8 / 29.2 = 2.42$$

Final pulp density: 1791 g/l

Final percent solids: 58.3

$$D = 41.7 / 58.3 = 0.72$$

R = 0.86 feet per hour

$$A = \frac{1.333 (2.42 - 0.72)}{0.86}$$

= 2.64 square feet per ton of dry solids per 24 hours thickener
area required (no safety factor applied)

Compression Zone

Initial pulp density: 1370 g/l

Initial percent solids: 35.8

$$F = 64.2 / 35.8 = 1.79$$

Final pulp density: 1791 g/l

Final percent solids: 58.3

$$D = 41.7 / 58.3 = 0.72$$

R = 0.46 feet per hour

$$A = \frac{1.333 (1.79 - 0.72)}{0.46}$$

= 3.10 square feet per ton of dry solids per 24 hours thickener
area required (no safety factor applied)

Settling and Filtration Tests - Continued

Test No. Z-5

Purpose: To conduct a series of filtration tests on the pilot plant bulk zinc concentrate.

Procedure: Standard pick up procedure using a 0.1 sq. ft. Eimco test leaf.

Feed: Pilot Plant No. 44 bulk Zn concentrate.

pH: 11.0 adjusted with lime.

Cloth Specifications

Media Number	POPR-851
Material	Polypropylene
Air-flow (cfm/sq. ft.)	8.30
Yarn	Multi filament
Weave	1/1 Plain
Weight (1z./sq. yd.)	8.00
Thread Count	58 x 32
Finish	Greige

Settling and Filtration Tests - Continued

Test No. Z-5 - Continued

Test Conditions

Test No.	Filter Cloth	Slurry			Filter Vac. (In. Hg)		Filter Time - Sec.		
		% Solids	pH	Temp. °C	Form	Dry	Form	Dry	Cycle
1	POPR 851	55	11.1	22	18	18	60	180	360
2	POPR 851	55	11.1	22	18	18	60	300	540
3	POPR 851	55	11.1	22	18	18	60	480	810
4	POPR 851	55	11.1	22	18	18	30	300	495
5	POPR 851	55	11.1	22	18	18	30	480	365

Test Results

Test No.	Filter Cake Data						Filtrate Data		
	Cracks No.	Thick. In.	Weight - Grams Wet	Grams Dry	% Moist.	Rate *	Volume ml.	Clarity	Rate **
1	8	0.33	173.9	141.5	18.6	31.2	190	Cloudy	2.37
2	8	0.30	154.0	125.4	18.6	18.4	90	Cloudy	1.58
3	10	0.30	156.0	128.6	17.6	12.6	90	Cloudy	1.06
4	9	0.25	119.5	97.5	18.4	15.6	60	Cloudy	1.15
5	8	0.26	103.5	84.1	18.7	18.3	60	Cloudy	1.56

* Dry Pounds per Hour per Square Foot

** U.S. Gallons per Hour per Square Foot