

An Investigation of
THE RECOVERY OF LEAD AND ZINC

from Grum Deposit samples

submitted by

KERR ADDISON MINES LIMITED

Progress Report No. 7

014934

Project No. L.R. 1991

NOTE:

This report refers to the samples as received.

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LAKEFIELD RESEARCH OF CANADA LIMITED
Lakefield, Ontario
June 1, 1977

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June 1, 1977

Mr. R. L. Coleman
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Dear Dick:

We are pleased to enclose six copies of our Progress No. 7 on An Investigation of the Recovery of Lead and Zinc on ore samples from the Grum Deposit, submitted for testwork on behalf of Kerr Addison Mines Limited.

Further distribution of the report is as indicated below.

With best regards.

Yours very sincerely,

LAKEFIELD RESEARCH OF CANADA LIMITED



A.G. Scobie, P. Eng.

Manager

AGS:slb

Enc.

cc: Mr. M. D. Rowswell(3)

1 - DJ Carson - 10 June 77

1 - KV Konigsmann - at mine 10 June 77

1 - KVK - at Toronto 14 June 77

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

On February 28, 1977 a meeting was held in the offices of Noranda Mines Limited with Messrs. M.D. Rowswell and P.S. Cross of Kerr Addison Mines Limited and Messrs. R.L. Coleman, B.P. Wallace and K.V. Konigsmann of Noranda Mines Limited.

During the meeting it was decided that testwork would be performed on six individual character samples from the Grum deposit, followed by testwork on an overall composite. Samples A-77 and C-77 were not considered to be significant, and were therefore eliminated from the present test program. The order of priority for testing was to be as follows:

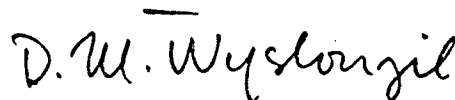
Samples H-3, C-3, D-3, F-3 (hard), G-3, F-3 (vuggy).

A standard method was to be selected for testing each sample, and modifications were then to be applied in an attempt to improve the results. All samples were to be stored in a deep freeze storage (-20°C) to retard oxidation.

LAKEFIELD RESEARCH OF CANADA LIMITED



A.G. Scobie, P. Eng.
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Investigation by: C.W. Payne

S U M M A R Y

1. Head Analyses

1.1. Individual Samples

Sample No.	Assays, %					g/t Ag
	Pb	Zn	Fe	S	C	
H-3	3.11	6.20	19.8	16.1	0.10	50.4
C-3	3.82	6.52	5.15	26.0	0.11	55.6
D-3	3.84	7.82	12.1	6.42	0.15	63.1
F-3 hard	6.87	17.1	20.8	27.8	0.06	123.1
G-3	1.37	2.83	4.98	6.11	0.05	19.2
F-3 vuggy	6.86	15.8	13.2	32.0	0.06	113.5

1.2. Classification

The samples received were classified by the resident geologist of Kerr Addison to fall into the following groups:

<u>Grouping</u>	<u>Samples</u>
Massive sulphides	A, C, E, F Hard
Quartz sulphides	D, G, H
Massive sulphides oxidized	F Vuggy, B

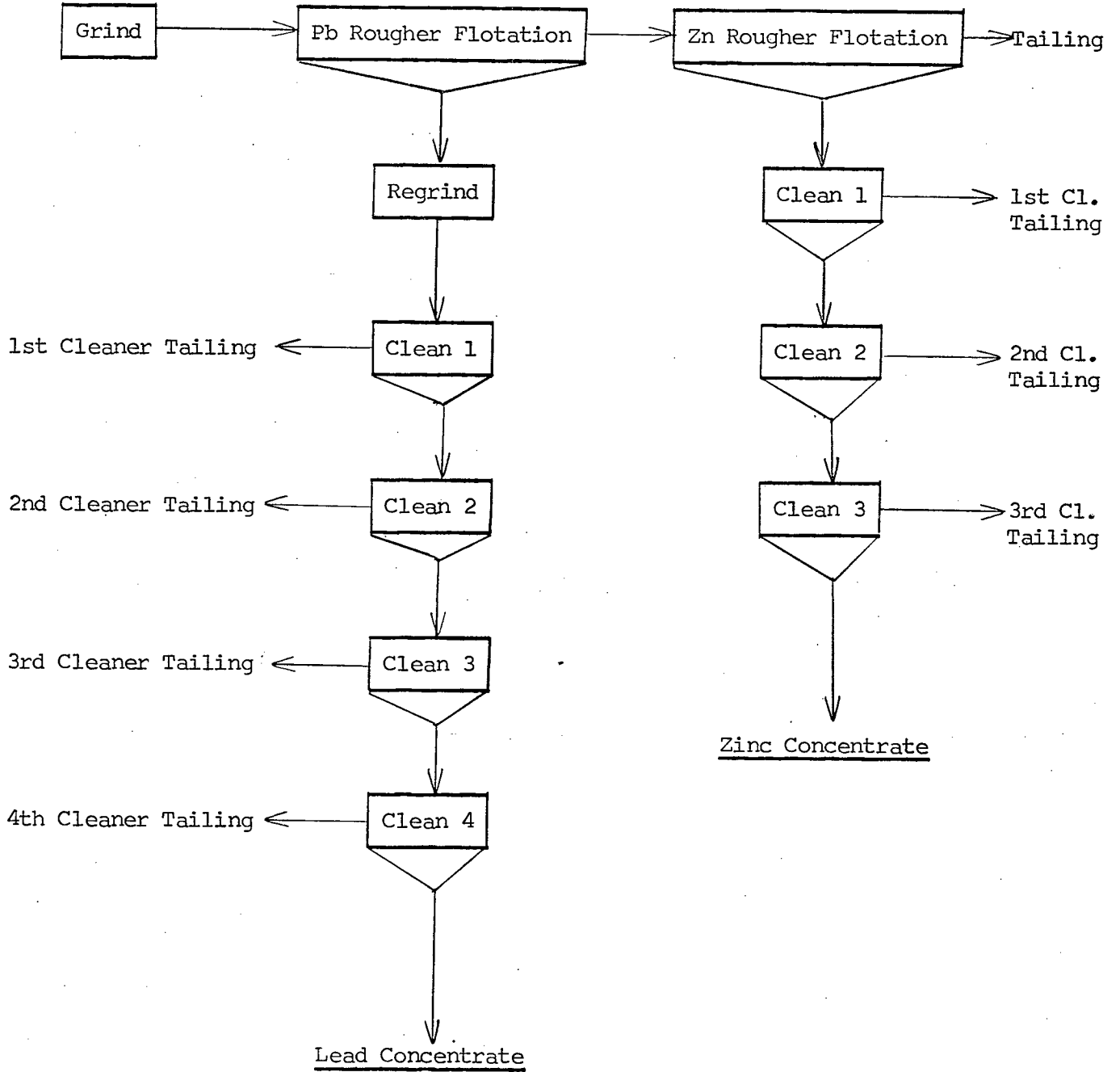
The characterization of the ore as represented by these group samples was quoted as 43 % massive, 52 % quartz and 5 % oxidized ore. Sample E was not submitted for testing.

1.3. Flowsheets

In the standard flowsheet, all products were kept separate to evaluate the distribution of the metals. On occasion the Pb first cleaner tailing was passed on to the zinc circuit, and a regrinding step for the zinc concentrate was introduced. The modified flowsheet was designed to achieve high lead and zinc recoveries.

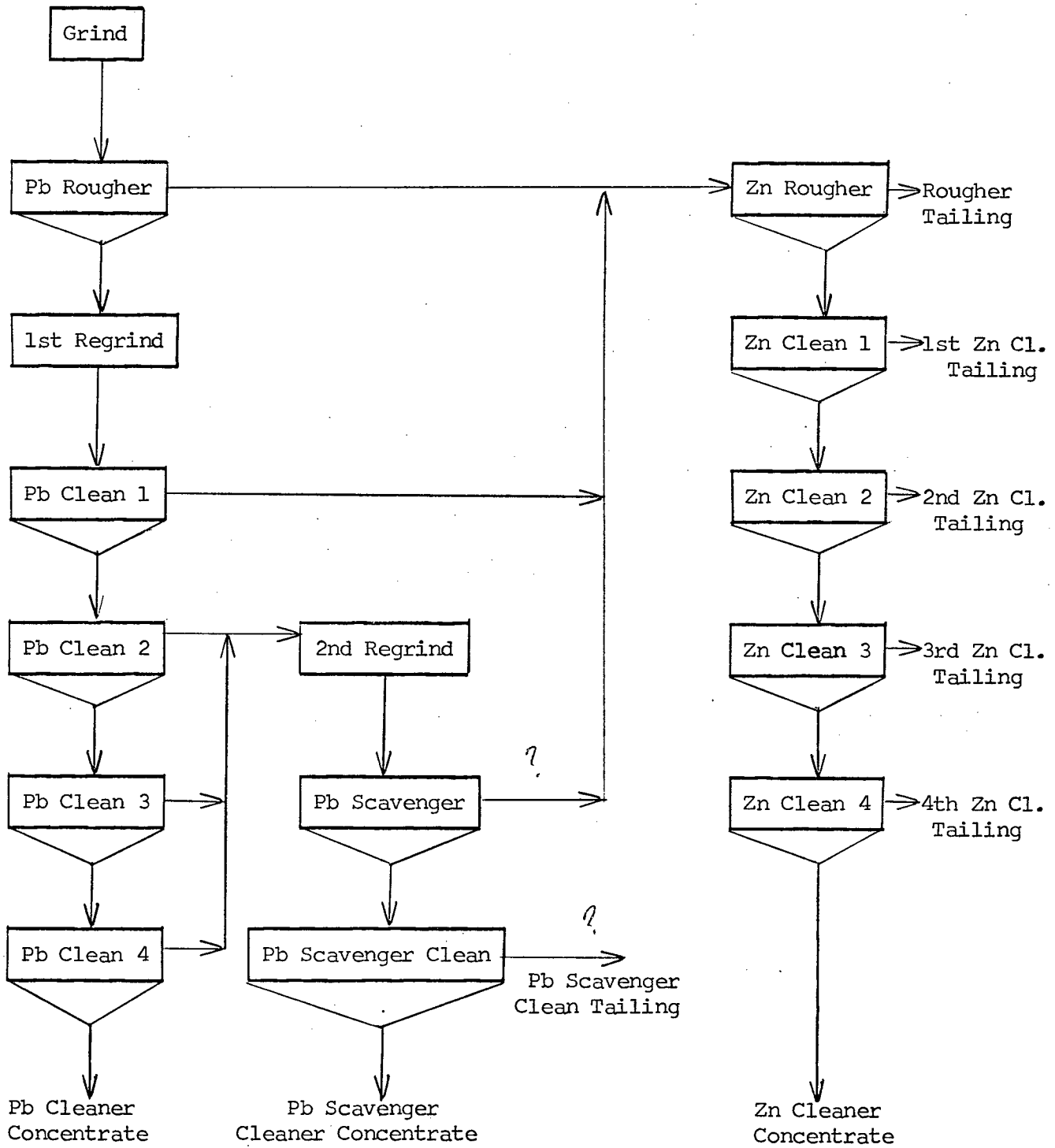
Summary - Continued

A. Standard Flowsheet



Summary - Continued

B. Modified Flowsheet



Summary - Continued

2. Test Results on Individual Samples

2.1. Sample H-3

Sixteen tests were performed on this sample, in which several variables were investigated. The standard procedure gave satisfactory results in the lead circuit but not in the zinc circuit.

2.1.1.1. Effect of Pb Scavenging on Pb and Zn Recoveries

The modified flowsheet contained a retreatment stage for the lead cleaner tailings and allowed some of the zinc to escape from the lead circuit. The effect of this scavenging and retreatment stage is shown in the table below.

Table No. 1

Effect of Pb Scavenger Circuit on Pb and Zn Flotation

Test No.	Flowsheet	Products	Weight %	Assay		% Distribution	
				Pb	Zn	Pb	Zn
153	Standard	Pb Concentrate	3.64	65.9	3.69	78.2	2.2
		Zn Concentrate	7.41	0.38	46.8	0.9	57.0
		Tailing	63.34	0.34	1.21	7.1	12.6
158	Modified	Pb Concentrate	3.67	68.3	3.73	82.4	2.3
		Zn Concentrate	8.18	0.67	50.0	1.8	66.6
		Tailing	68.87	0.35	1.35	7.9	15.1

The results indicated that some of the lead from the cleaner tailings could be recovered at grade, and that most of the zinc passed on to the zinc circuit with the lead cleaner tailing could be recovered. An examination of the zinc concentrate suggested that free gangue was the major diluent, and therefore improvements in grade could be expected. The tailing losses of Zn were more serious. Chemically it was possible to find 0.49 % oxide zinc, optically it was not possible to find this zinc. Only traces of sphalerite could be found, far less than required to account for 1.3 % Zn.

Summary - Continued

2. Test Results on Individual Samples

2.1.2. Improvement of Zn Circuit

In test 161 the zinc rougher circuit was extended to include a scavenging stage with PAX and Na₂S. The modified Pb circuit was used throughout. Sodium silicate and CMC were used in test 169 to improve the zinc concentrate grade. In test 175 Na₂SiO₃ was introduced into the zinc rougher circuit and the concentrate was cleaned without regrinding. Also, the zinc rougher tailing was thickened and reground, followed by a scavenging step for zinc. The results of these tests are summarized in the following table.

Table No. 2

Effect of Cleaning and Regrinding on Zn Recovery

Test No.	Variables	Product	Weight %	Assay, %		% Distribution	
				Pb	Zn	Pb	Zn
161	Modified Flowsheet PAX, Na ₂ S for Zn Scavenging	Pb Concentrate	4.40	57.7	4.89	83.5	3.4
		Zn Concentrate	10.89	1.8	45.5	6.4	77.4
		Tailing	45.10	0.24	1.34	3.6	9.8
169	Modified Flowsheet Na ₂ SiO ₃ and CMC in Zn Cleaning	Pb Concentrate	4.02	59.7	4.50	81.1	2.9
		Zn Concentrate	8.23	1.35	53.8	3.7	71.4
		Tailing	71.03	0.34	1.44	8.2	16.5
175	Scavenger Zn Rougher Tailing after Re grind No Concentrate Re grind	Pb Concentrate	4.77	51.2	5.26	83.4	4.0
		Zn Concentrate	7.05	0.33	53.4	0.8	60.2
		Tailing	49.20	0.19	1.28	3.2	10.1

The results indicated that the zinc concentrate grade could be well controlled with Na₂SiO₃ in the cleaning circuit. Regrinding of the zinc concentrate was essential to obtain a higher recovery at grade (tests 169-175). Scavenging of the zinc tailing, as is, or after regrinding had no effect on the overall zinc recovery. Abundant weight (pyrite-gangue) was recovered, but unselectively. By floating 30 % more weight, 6 % more zinc was recovered at less than half head-grade. This zinc fraction appeared to be unrecoverable.

Summary - Continued

2. Test Results on Individual Samples

2.1.3. Lead Circuit - Effect of Fineness of Primary Grind

Several rougher tests were performed in which the primary grinding time was varied from 30 to 25 to 20 minutes. Standard conditions were applied in the rougher flotation and in the cleaning stages.

Table No. 3

Effect of Fineness of Primary Grind

Test No.	Time Min.	% - 200 Mesh	Products	Weight %	Assay, %		% Distribution	
					Pb	Zn	Pb	Zn
153	30	87.1	Pb Cleaner Concentrate	3.64	65.9	3.69	78.2	-2.2
			Pb Rougher Concentrate	17.93	15.3	7.54	89.8	22.2
179	25	79.2	Pb Cleaner Concentrate	3.30	63.3	4.04	70.0	2.2
			Pb Rougher Concentrate	19.21	14.0	7.65	89.9	24.1
180	20	68.1	Pb Cleaner Concentrate	3.01	65.9	3.89	67.1	2.0
			Pb Rougher Concentrate	18.81	14.0	7.66	88.8	24.2

The results indicated that the fineness of grind, in the range tested, had no appreciable effect on the rougher recovery. After an equal regrind time of 30 minutes the lead recovery decreased with decreasing primary grind time.

Summary - Continued

2. Test Results on Individual Samples

2.1.4. Pb Circuit - Effect of Regrinding Time

Keeping the primary fineness of 87.1 % minus 200 mesh constant, the effect of reduced or no regrinding time on the grade and recovery of lead was investigated in tests 153, 185, and 186.

Table No. 4

Effect of Regrinding Time

Test No.	Grinding time, minutes		Products	Weight %	Assays, %		% Distribution	
	Primary	Secondary			Pb	Zn	Pb	Zn
153	30	30	Pb Cleaner Conc.	3.64	65.9	3.69	78.2	2.2
			Pb Rougher Conc.	17.93	15.3	7.54	89.8	22.2
185	30	15	Pb Cleaner Conc.	4.26	53.1	5.53	75.9	3.9
			Pb Rougher Conc.	19.80	13.9	7.53	92.4	24.9
186	30	0	Pb Cleaner Conc.	6.66	30.9	8.44	70.9	9.1
			Pb Rougher Conc.	19.28	13.8	7.74	91.7	24.3

Even though in tests 185 and 186 the weight of the Pb rougher concentrate was slightly higher, the effect of the reduced regrinding time or the omission of regrinding was clearly demonstrated. The concentrate grade dropped from 65.9 % Pb to 30.9 % Pb when no regrinding was carried out.

Summary - Continued

2. Test Results on Individual Samples

2.1.5. Effect of Point of Reagent Addition

In the standard procedure the bulk of the reagents were added to the grinding mill. In test 181 the collector was not added to the mill but to the flotation cell. To avoid over-frothing, the quantity of the collector 242 had to be reduced. The results, shown in the table below indicated that although the same rougher recovery was obtained, the lead was distributed through all the cleaner tailings.

Table No. 5

Effect of Point of Reagent Addition

Test No.	242 Addition Point lb/ton	Product	Cleaning Stages	Weight %*	Assays, %		% Recovery *	
					Pb	Zn	Pb	Zn
153	Mill 0.07 (total 0.135) **	Pb Conc.	3	3.64	65.9	3.69	78.2	2.2
		Pb Conc.	2	4.39	57.0	4.71	81.7	3.4
		Pb Conc.	1	7.23	36.6	6.48	86.4	7.7
		Pb Conc.	Rougher	17.93	15.3	7.54	89.8	22.2
181	Cell 0.03 (total 0.075) **	Pb Conc.	3	2.11	62.1	3.84	44.3	1.4
		Pb Conc.	2	3.31	52.3	4.91	58.5	2.8
		Pb Conc.	1	7.47	30.8	6.70	77.6	8.5
		Pb Conc.	Rougher	19.23	13.8	7.40	89.6	24.0

* Cumulative

** total includes stage additions during rougher and cleaning

Conditioning time and energy input during conditioning may be important factors.

Summary - Continued

2. Test Results on Individual Samples

2.1.6. Pb Circuit - Effect of Soda Ash Additions

In tests 182 and 183 the Na_2CO_3 addition was reduced to one-half and to zero respectively. Other reagents followed the schedule of the standard test. The results are summarized in the table below.

Table No. 6

Effect of Varying Na_2CO_3 Additions

Test No.	lb/ton Na_2CO_3	pH	Products	Weight %	Assays, %		% Recovery	
					Pb	Zn	Pb	Zn
153	3	9.6	Pb Cl. Conc.	3.64	65.9	3.69	78.2	2.2
			Pb Ro. Conc.	17.93	15.3	7.54	89.8	22.2
182	1.5	8.8	Pb Cl. Conc.	4.22	58.1	4.97	81.8	3.5
			Pb Ro. Conc.	21.63	12.8	7.06	92.7	25.5
183	0	7.5	Pb Cl. Conc.	0.59	25.7	4.90	5.1	0.5
			Pb Ro. Conc.	23.88	11.8	6.77	93.9	27.0

In the absence of Na_2CO_3 , selectivity was low and pyrite flotation dominated. After the regrind, 58 % of the Pb was found in the cleaner tailing. It appeared that a minimum pH of 9 should be provided to maintain a rapid and selective galena flotation.

Summary - Continued

2. Test Results on Individual Samples

2.1.7. Cycle Test

One six-stage locked-cycle test was carried out (test 179) with the standard flowsheet, but passing the Pb first cleaner tailing to the Zn rougher circuit. Only the lead rougher concentrate was reground.

The lead circuit stabilized reasonably well at a concentrate grade of about 60 % Pb and 4.9 % Zn, but the zinc circuit fluctuated strongly. The projected balance, based on the average weights and assays of the lead and zinc concentrates from the last 2 cycles and the calculated head assays, is shown below.

Table No. 7

Projected Balance Cycle Test 179

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
Pb Cleaner Concentrate E + F	4.40	59.1	4.87	86.7	3.5
Zn Cleaner Concentrate E + F	9.15	0.66	49.0	2.0	72.2
Tailing (Calculated)	86.45	0.39	1.75	11.3	24.3
Head (Calc. from test 179)	100.00	3.00	6.21	100.0	100.0

The zinc circuit almost certainly would require a regrinding step to improve the concentrate grade and possibly the zinc recovery. The CuSO_4 addition may be slightly too high and the Na_2SiO_3 addition perhaps too low. In the best open circuit test (test 169) the zinc concentrate assayed 53.8 % Zn at a zinc recovery of 71 %.

Summary - Continued

2. Test Results on Individual Samples

2.2. Sample D-3

The flotation behaviour of this sample was dominated by the presence of a strongly hydrophobic black component, resembling graphitic shale. Under standard conditions the lead flotation was strongly suppressed. (test 156) Pre-flotation of this solid with pine oil immediately improved the flotation of lead, but 8 % of the lead and 10 % of the Zn were also removed with this fraction. (test 157) Cleaning of the prefloat concentrate simply reduced the weight without changing the composition. In this test (test 160) the cleaner tailing was returned to the lead flotation feed; although a high-grade lead concentrate could be produced, almost 25 % of the lead was found in the zinc circuit. Pre-flotation at minus 10 mesh (test 170) did not yield a carbon concentrate; fine sulphides were predominant in the froth product.

After grinding the ore in the usual manner a carbon concentrate was removed with MIBC. This concentrate was then combined with the Pb rougher concentrate for regrinding and cleaning. The lead rougher recovery was 86 %, but only 50 % could be refloated at a grade of 64 % Pb.

Summary - Continued

2. Test Results on Individual Samples

2.2. Sample D-3 - Continued

Table No. 8

Standard Test and Pre-flotation Tests - Pb Circuit

Test No.	Conditions	Product	Weight %	Assay, %		% Recovery	
				Pb	Zn	Pb	Zn
156	Standard open circuit	Cl. Pb Conc.	2.58	9.95	9.93	6.7	3.2
		Ro. Pb Conc.	14.01	20.7	9.40	75.7	16.5
157	Prefloat with pine oil followed by stand cond.	Cl. Pb Conc.	3.24	73.7	3.68	64.8	1.5
		Ro. Pb Conc.	10.47	27.2	9.98	77.2	13.4
160	Prefloat conc. cleaned and Cl. Tailing returned	Cl. Pb Conc.	3.55	63.3	4.81	60.7	2.2
		Ro. Pb Conc.	-	-	-	-	-
170	Prefloat conc. was comb. with Pb ro. conc. for cl.	Cl. Pb Conc.	2.81	64.4	4.52	49.7	1.6
		Ro. Pb Conc.	17.66	17.7	9.80	85.8	21.5

The results demonstrated clearly that the galena floated well after removing the carbonaceous fraction. After recombining all or a portion of the carbon concentrate with the lead concentrate, lead was strongly depressed.

Summary - Continued

2. Test Results on Individual Samples

2.2.1. The Effect of Carbon Depressants

In a series of rougher tests the following reagents were tested: Na_2SiO_3 , JCD-73, Cyanamid 610, and CMC 6CTL. Aero 610 and JCD-73 had the most positive effect, but all four reagents allowed the lead to be floated without first removing the carbon-fraction. Results and conditions of these tests are shown in the table below.

Table No. 9

Rougher Flotation Tests With Carbon Depressants

Test No.	Depressant	lb/ton	Product	Weight %	Assay, %		% Recovery	
					Pb	Zn	Pb	Zn
171	Na_2SiO_3 "D"	3.0	Conc. 1	9.49	30.4	10.4	74.0	12.4
			Conc. 1 + 2	20.57	16.1	9.58	85.1	24.8
172	JCD-73	0.5	Conc. 1	11.25	28.0	9.08	81.0	12.9
			Conc. 1 + 2	19.50	17.5	8.92	87.9	22.0
173	Aero 610	0.5	Conc. 1	7.72	38.6	9.20	77.2	9.1
			Conc. 1 + 2	16.42	20.2	8.46	85.8	17.8
174	CMC 6CTL	1.0	Conc. 1	12.23	25.2	8.71	77.4	13.3
			Conc. 1 + 2	21.09	16.2	8.49	85.7	22.4

At 85 % lead recovery the Aero 610 addition yielded the most selective concentrate. Two tests were performed (176, 177), with Aero 610 as the carbon depressant, in which the lead rougher concentrate was cleaned. The results are shown in table No. 10 below.

Summary - Continued

2. Test Results on Individual Samples

2.2.1. The Effect of Carbon Depressants - Continued

Table No. 10

Flotation Results Tests 176,177 - Pb Circuit

Test No.	Circuit	Product Pb Conc.	Weight %	Assays		% Recovery	
				Pb	Zn	Pb	Zn
176	Standard open circuit with 0.5 lb/ton Aero 610	3 cleanings	1.81	63.4	4.23	31.3	1.0
		2 cleanings	2.85	52.6	5.81	40.9	2.1
177	Modified circuit with test 173 rougher conditions	Cleaner Conc.	3.35	60.2	7.25	54.7	3.1
		Cl. + Scav.	4.30	58.0	7.36	67.7	4.0

The biggest Pb losses in test 176 were in the 1st and 2nd cleaner tailings (25 % and 18 % respectively). Comparing these results with those obtained in test 158, after removing the carbon fraction from the circuit, it seems obvious that depression of the carbon complicated the circuit and resulted in lower-grade lead concentrates. Substituting JCD 73 for Aero 610, as per test 187, had no effect on the results.

Summary - Continued

2. Test Results on Individual Samples

2.3. Sample C-3

The metal content of sample C-3 was close to that of the average mine grade, i.e. 3.6 % Pb and 6.6 % Zn. Two tests were performed, one following the standard procedure (159) and one with the modified flowsheet (166). The ore responded well to the conditions, and high-grade concentrates could be expected from this ore type at reasonable recoveries. Selected products of the two tests are shown in the table below.

Table No. 11

Selected Products From Tests 159 and 166

Test No.	Flowsheet	Product	Weight %	Assay, %		% Distribution	
				Pb	Zn	Pb	Zn
159	Standard circuit	Pb 4th Cl. Conc.	3.44	65.4	2.82	62.4	1.5
		Pb 3rd Cl. Conc.	4.72	57.2	3.75	74.9	2.7
		Pb Rougher Conc.	22.03	14.7	6.46	90.1	22.1
	Pb 1st Cleaner tailing retained	Zn Cl. Conc.	6.78	0.28	54.4	0.5	57.3
		Zn Rougher Conc.	17.93	0.60	25.3	2.9	70.7
		Tailing	60.04	0.42	0.79	7.0	7.2
166	Modified	Pb 4th Cl. Conc.	4.38	62.0	3.60	75.1	2.4
		Pb Cl. + Scav. Conc.	5.17	57.7	4.04	82.5	3.2
	Pb circuit to include scavenging	Zn Cl. Conc.	8.27	0.74	54.9	1.7	68.9
		Zn Rougher Conc.	30.38	0.89	29.6	5.4	84.4
		Tailing	62.91	0.38	0.86	6.6	8.1

The results indicated that most of the zinc that could be passed on from the lead to the zinc circuit would be recovered. The lead contained in the cleaner tailings could also be recovered. A simpler method might be equally efficient, and regrinding could probably be omitted.

Summary - Continued

2. Test Results on Individual Samples

2.4 Sample G-3

This sample contained about 4 % combined Pb and Zn. Only one standard test was carried out to evaluate the response. Although the tailing assay of lead was low, 0.26 % Pb, this represented 15.1 % of the total lead, and therefore the overall lead recovery in the final concentrate was low as shown in the table below.

Table No. 12

Selected Products From Test 165

Products	Weight %	Assay, %		% Distribution	
		Pb	Zn	Pb	Zn
Pb concentrate 4 cleaner stages	0.75	66.0	2.68	38.8	0.7
Pb concentrate 3 cleaner stages	1.31	54.1	3.66	55.5	1.7
Pb concentrate rougher	13.21	18.5	4.75	77.3	20.0
Zn concentrate 3 cleaner stages	4.31	0.67	45.2	2.3	68.2
Zn concentrate rougher	11.94	0.81	18.1	7.6	75.7
Tailing	74.85	0.26	0.17	15.1	4.3

The zinc recovery was encouraging, but the concentrate grade was too low. Sodium silicate additions usually have improved the cleaning performance in other Grum samples, and a fourth cleaning stage may be required. The lead circuit contained 20 % of the zinc; over half of that dropped out in the lead 1st cleaner tailing and could be passed on to the zinc rougher circuit.

Summary - Continued

2. Test Results on Individual Samples

2.5. Sample F-3 Hard

This sample was classified as massive ore and contained 6.5 % Pb and 18.0 % Zn. In test 162 the standard flowsheet was applied, in test 167 the modified flowsheet with some reagent adjustments was used. In general, the ore responded well to the conditions used, and improvements could almost certainly be achieved by slight adjustments of the reagent balance.

Table No. 13

Metallurgical Results on F-3 Hard Ore

Test No.	Flowsheet	Products	Weight %	Assays, %		% Distribution	
				Pb	Zn	Pb	Zn
162	Standard	Pb Concentrate	8.97	65.5	9.27	89.8	4.6
		Zn Concentrate	21.20	0.39	57.1	1.2	67.1
		Tailing	44.85	0.23	0.47	1.7	1.2
167	Modified More ZnSO ₄ , CuSO ₄	Pb Concentrate	8.94	67.0	8.46	91.0	4.1
		Zn Concentrate	28.68	0.93	56.5	4.1	87.5
		Tailing	49.71	0.36	1.07	2.7	2.8

In test 167, about 96 % of the total zinc entered the zinc circuit, and 90 % could be recovered at a grade of 54 % Zn.

Summary - Continued

2. Test Results on Individual Samples

2.6. Sample F-3 Vuggy

This sample was classified as oxidized massive sulphide ore. The head grade was high, 6.7 % Pb, 16.2 % Zn, and two tests were performed as for sample F-3 hard.

Table No. 14

Metallurgical Results F-3 Vuggy

Test No.	Flowsheet	Products	Weight %	Assays, %		% Distribution	
				Pb	Zn	Pb	Zn
163	Standard	Pb Concentrate	8.96	64.4	9.60	85.2	5.3
		Zn Concentrate	16.69	0.79	58.1	2.0	59.9
		Tailing	51.56	0.47	0.86	3.5	2.8
168	Modified	Pb Concentrate	8.61	65.5	8.76	83.7	4.6
	More ZnSO ₄	Zn Concentrate	22.45	1.28	56.3	4.3	78.3
	More CuSO ₄	Tailing	57.03	0.64	1.09	5.4	3.8

The response of the sample was quite satisfactory. Conditions were not optimum, but the results indicated that this sample was readily treatable. There was virtually no change in the pH after grinding between samples F-3 hard and F-3 vuggy.

Summary - Continued

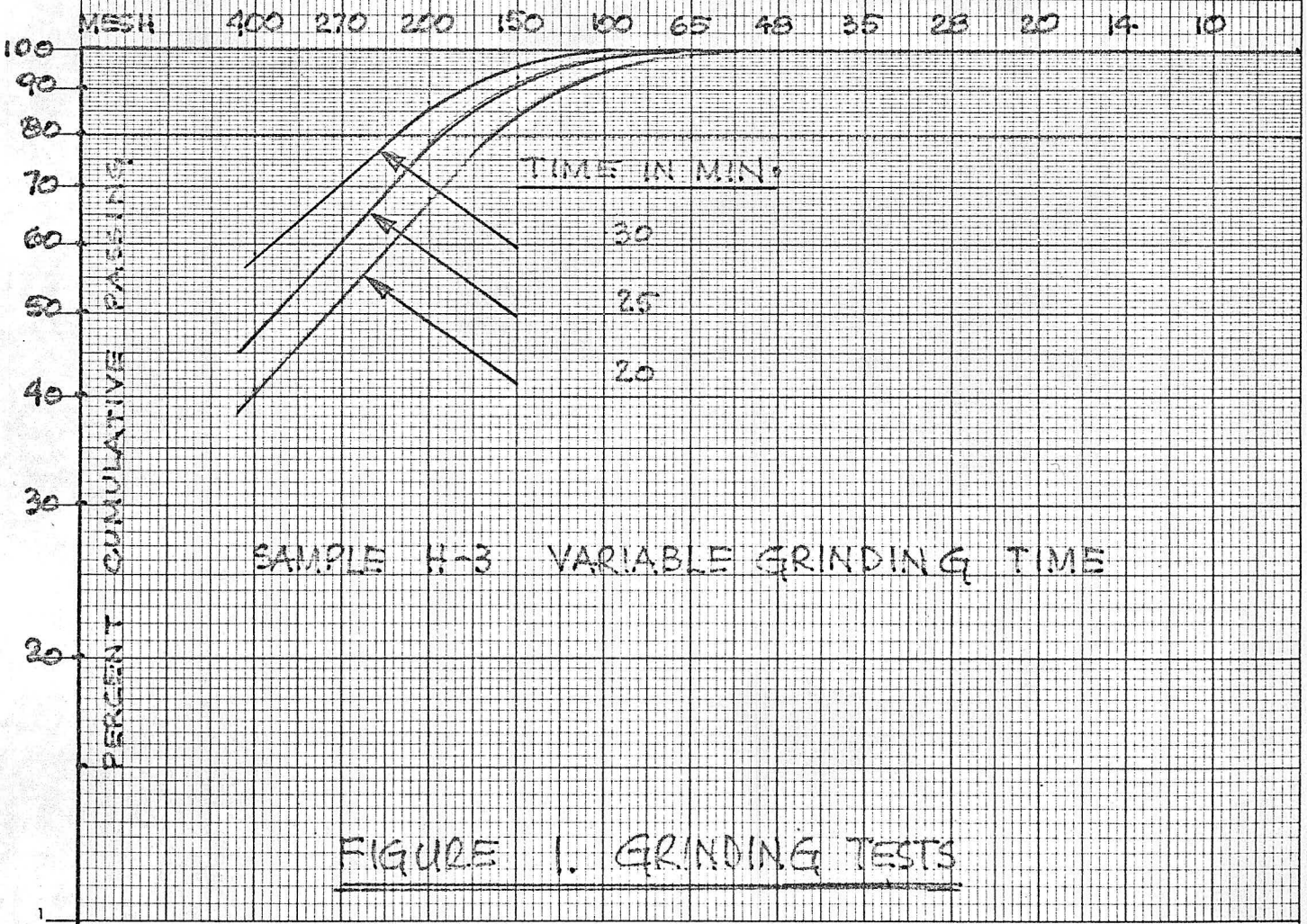
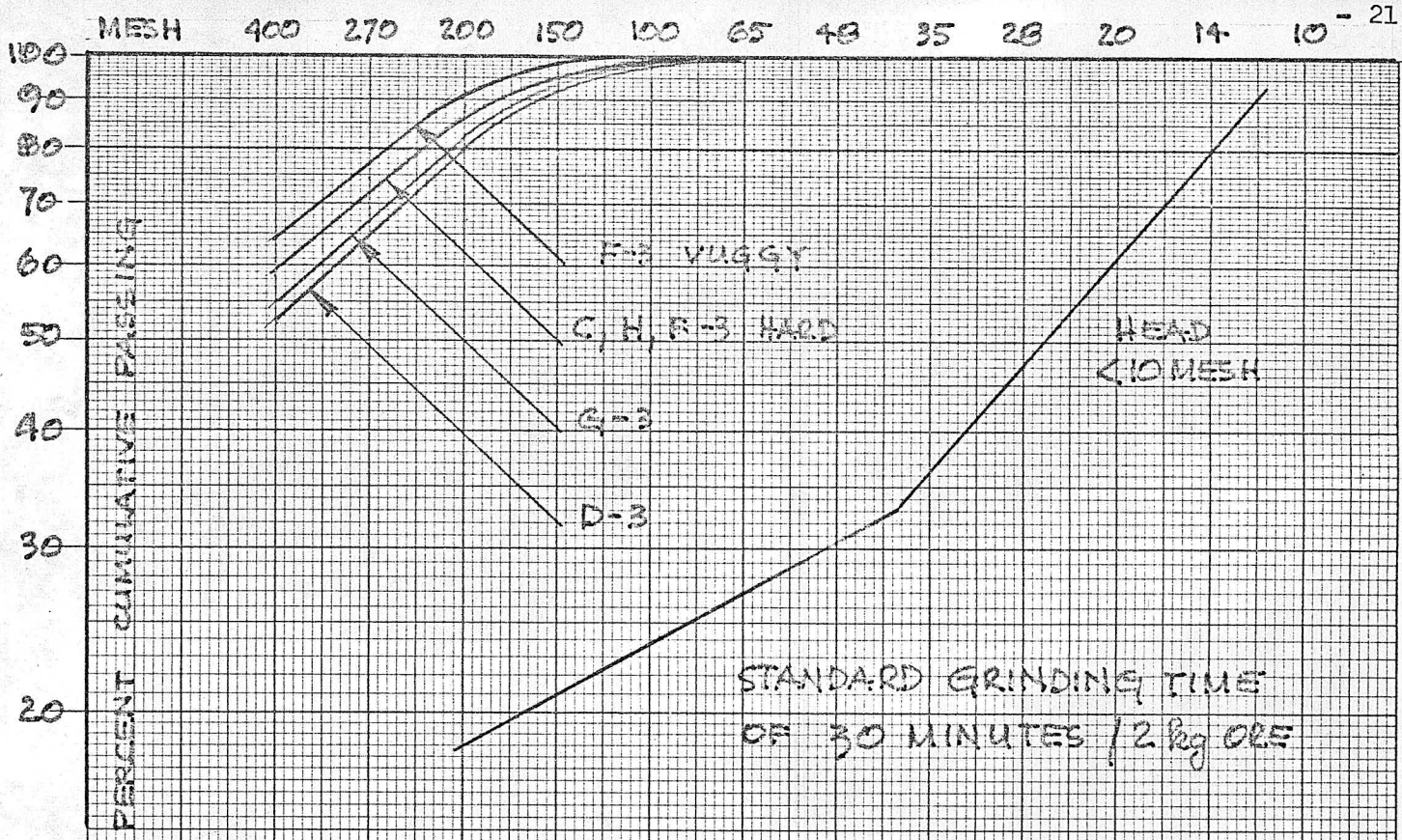
3.Grinding Tests

All samples were ground for 30 minutes and the size distribution of the mill discharge was determined. From the size distribution versus the size modulus, K_{80} μm , was obtained.

3.1.Summary of Grinding Data

Sample No.	% - 200 Mesh	K_{80} μm	Estimated Work Index
H-3	87.1	64.3	10.2
D-3	80.5	74.0	10.9
C-3	89.8	64.3	10.2
G-3	82.6	71.4	11.0
F-3 Hard	88.2	64.3	10.2
F-3 Vuggy	91.4	55.8	9.0

The difference in hardness was not pronounced, the softest ore was F-3 vuggy, the hardest ore was G-3. Grinding tests on sample H-3 indicated that the work index dropped to 9.5 for the 25 minute grind and to 8.3 for the 20 minute grind. The size distributions are plotted in Figure 1.



Summary - Continued

4. Further Testwork

In preparation for the pilot plant test run, a composite sample was prepared from the individual samples, limiting the metal content of the ore to 4 % Pb and 6.5 % Zn, and keeping within the distribution of the 3 ore types.

Detailed tests are being performed now to evaluate the most important flowsheet parameters, and to investigate the grinding requirements in the rougher and cleaning circuits.

Cycle tests are planned to evaluate the effect of middling recirculation.

SAMPLE PREPARATION

On February 23, 1977, we received 6 drums of Grum deposit ore from Kerr Addison Mines Limited. Each drum weighed about 500 pounds and contained mainly coarse pieces of ore.

Each ore sample was jaw-crushed to 3/4 inch and riffled. One-eighth was further crushed to 10 mesh and divided into 2 kg test charges. Rejects as well as test charges were stored in a deep freeze room. One charge was removed at random and pulverized for head analysis:

<u>Sample</u>	<u>% Pb</u>	<u>% Zn</u>	<u>% Fe</u>	<u>% S</u>	<u>% C</u>	<u>Ag g/t</u>
H-3	3.11	6.20	13.2	16.1	0.10	50.4
C-3	3.82	6.52	19.8	26.0	0.11	55.6
D-3	3.84	7.82	5.15	6.42	0.15	63.1
F-3 Hard	6.87	18.1	12.1	22.8	0.06	123.1
F-3 Vuggy	6.86	15.8	20.8	32.0	0.06	113.5
G-3	1.37	2.83	4.98	6.11	0.05	19.2

DETAILS OF TESTS

Test No. 153

Purpose: To investigate the flotation of lead and zinc from sample H-3, under the standard test conditions.

Procedure: As for test No. 147.

Feed: 2000 grams minus 10 mesh sample H-3.

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	R-242	R-404	MIBC	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	0.01	-	1	3	9.6
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb Conc. Reagr.	1.0	0.5	0.20	0.03	-	-	30	-	-	-
Pb 1st Cl.	-	-	-	-	0.01	-	-	1	3	9.7
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 2nd Cl.	0.3	0.2	0.10	-	-	0.005	-	1	3	9.8
	-	-	-	0.005	-	-	-	1	1	-
Pb 3rd Cl.	0.2	0.1	0.05	-	-	-	-	1	3	9.9
Pb 4th Cl.	0.2	-	0.05	-	-	-	-	1	2	10.0

Stage	Rougher	Pb Reagrind	Pb 1st & 2nd Cleaner	Pb 3rd & 4th Cleaner
Equipment	1000 g D - 1	lab rod mill	500 g D - 1	250 g D - 1
Speed: r.p.m.	1800	-	1300	1000
% Solids	33	-	-	-

Test No. 153 - Continued

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	Z-200	MIBC	DF-250	Grind	Cond.	Froth	
Zn Circuit									
Condition	2.0	1.0	-	-	-	-	2	-	10.8
Zn Rougher	-	-	0.06	0.02	-	-	1	3	-
	-	-	0.04	-	0.04	-	1	3	-
Zn 1st Cleaner	0.3	-	-	0.01	-	-	1	2	11.1
	-	-	0.01	-	0.01	-	1	2	-
Zn 2nd Cleaner	0.2	-	-	-	-	-	1	2	11.2
	-	-	0.005	0.005	-	-	-	1	-
Zn 3rd Cleaner	0.2	-	-	-	-	-	1	2	11.3

Stage	Zn 1st Cleaner	Zn 2nd & 3rd Cleaner
Flotation Cell	500 g D - 1	250 g D - 1
Speed: r.p.m.	1300	1000

Test No. 153 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	3.04	72.3	2.81	71.7	1.4
2. Pb 4th Cleaner Tail.	0.60	33.3	8.16	6.5	0.8
3. Pb 3rd Cleaner Tail.	0.75	14.2	9.63	3.5	1.2
4. Pb 2nd Cleaner Tail.	2.84	5.04	9.22	4.7	4.3
5. Pb 1st Cleaner Tail.	10.70	0.97	8.25	3.4	14.5
6. Zn Cleaner Conc.	7.41	0.38	46.8	0.9	57.0
7. Zn 3rd Cleaner Tail.	1.87	0.71	10.3	0.4	3.2
8. Zn 2nd Cleaner Tail.	2.60	0.74	5.16	0.6	2.2
9. Zn 1st Cleaner Tail.	6.85	0.54	2.45	1.2	2.8
10. Zn Rougher Tailing	63.34	0.34	1.21	7.1	12.6
Head (Calculated)	100.0	3.06	6.08	100.0	100.0

Calculated Grades and Recoveries

Products 1 + 2	3.64	65.9	3.69	78.2	2.2
Products 1 to 3	4.39	57.0	4.71	81.7	3.4
Products 1 to 4	7.23	36.6	6.48	86.4	7.7
Products 1 to 5	17.93	15.3	7.54	89.8	22.2
Products 6 + 7	9.28	0.45	39.5	1.3	60.2
Products 6 to 8	11.88	0.51	31.9	1.9	62.4
Products 6 to 9	18.73	0.52	21.2	3.1	65.2

Screen Analysis - 30 Minute Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	0.1	0.1	99.9
100	0.7	0.8	99.2
150	2.8	3.6	96.4
200	9.3	12.9	87.1
270	12.3	25.2	74.8
400	15.9	41.1	58.9
- 400	58.9	100.0	-
Total	100.0	-	-

Test No. 154

Purpose: To repeat the lead circuit of test No. 152, but on sample H-3.

Procedure: Grind and float a lead rougher concentrate. Re grind the concentrate and clean four times. Combine the Pb 2nd to 4th cleaner tailings, re grind and float a lead scavenger concentrate. Clean the Pb scavenger concentrate once.

Feed: 2000 grams minus 10 mesh sample H-3.

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	R-242	Z - 4	MIBC	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	0.01	-	1	3	9.6
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.02	0.01	-	-	1	3	-
Pb conc. Reagr.	1.0	0.5	0.20	0.03	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	9.7
	-	-	-	0.01	0.02	-	-	1	4	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3½	9.8
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	2½	10.0
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	10.1
Combine Pb 2nd, 3rd and 4th cleaner tailings.										
Pb Scav. Reagr.	0.5	0.2	0.10	0.02	-	-	15	-	-	-
Pb Scavenger	-	-	-	-	0.01	0.01	-	1	2	9.5
	-	-	-	0.005	0.005	-	-	1	2	-
Pb Scav. Cleaner	0.2	0.1	0.05	-	-	-	-	1	2	9.7

Test No. 154 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	3.11	72.6	3.00	73.7	1.5
2. Pb Scav. Cl. Conc.	0.53	41.3	7.70	7.2	0.7
3. Pb Scav. Cl. Tail.	0.89	11.6	9.57	3.4	1.4
4. Pb Scavenger Tail.	5.21	2.90	8.60	4.9	7.3
5. Pb 1st Cleaner Tail.	12.38	0.74	7.75	3.0	15.6
6. Pb Rougher Tailing	77.88	0.31	5.80	7.8	73.5
Head (Calculated)	100.00	3.06	6.14	100.0	100.0

Calculated Grades and Recoveries

Products 1 + 2	3.64	68.0	3.68	80.9	2.2
Products 1 to 3	4.53	57.0	4.84	84.3	3.6
Products 1 to 4	9.74	28.0	6.85	89.2	10.9
Products 1 to 5	22.12	12.8	7.36	92.2	26.5

Test No. 155

Purpose: To repeat test No. 154, but with a coarser grind, and complete the zinc circuit.

Procedure: Grind and float a lead concentrate. Regrind the concentrate and clean four times. Combine the Pb 2nd, 3rd and 4th cleaner tailings and scavenge lead. Combine the lead rougher, 1st cleaner and scavenger tailings and float a zinc concentrate. Clean the Zn concentrate three times.

Feed: 2000 grams minus 10 mesh sample H-3.

Grind: 20 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	R-242	Z - 4	MIBC	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	0.05	-	-	20	-	-	-
Pb Rougher	-	-	-	0.01	0.02	0.01	-	1	3	9.8
	-	-	-	0.01	0.01	0.005	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb Conc. Reagr.	1.0	0.5	0.20	0.02	-	-	15	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	10.0
	-	-	-	0.01	0.02	-	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3	10.0
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	2½	10.1
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	10.1
Combine Pb 2nd, 3rd, and 4th cleaner tailings.										
Pb Scavenger	0.5	0.2	0.10	0.01	0.01	-	-	1	3	10.1
Combine Pb rougher, 1st cleaner and scavenger tailings for zinc flotation.										

Stage:	Rougher	Pb Regrind	Pb 1st Cl.	Pb 2nd - 4th Cl.	Pb Scavenger
Equipment	1000 g D - 1	Rod Mill	500 g D - 1	250 g D - 1	500 g D - 1
Speed: r.p.m.	1900	-	1300	1000	1300
% Solids	33	-	-	-	-

Test No. 155 - Continued

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	Z-200	MIBC	DF-250	Grind	Cond.	Froth	
Zn Circuit									
Condition		1.0	-	-	-	-	2	-	10.7
Zn Rougher	-	-	0.06	0.02	-	-	1	3	-
	-	-	0.04	-	0.02	-	1	3	-
Zn 1st Cleaner	0.3	-	-	-	-	-	1	2	11.0
	-	-	0.01	-	-	-	1	2	-
Zn 2nd Cleaner	0.2	-	-	-	-	-	1	2	11.2
	-	-	0.005	-	-	-	1	1	-
Zn 3rd Cleaner	0.2	-	-	-	-	-	1	2	11.3

Stage	Zn 1st Cleaner	Zn 2nd & 3rd Cleaner
Flotation Cell	500 g D - 1	250 g D - 1
Speed: r.p.m.	1300	1000

Test No. 155 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	2.68	68.6	3.80	61.3	1.6
2. Pb Scavenger Conc.	1.30	26.6	9.06	11.5	1.9
3. Zn Cleaner Conc.	9.39	2.85	46.1	8.9	69.0
4. Zn 3rd Cleaner Tail.	1.67	2.95	12.5	1.6	3.3
5. Zn 2nd Cleaner Tail.	2.85	1.88	7.21	1.8	3.3
6. Zn 1st Cleaner Tail.	6.95	1.51	3.23	3.5	3.6
7. Zn Rougher Tailing	75.16	0.45	1.44	11.4	17.3
Head (Calculated)	100.00	3.00	6.27	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	3.98	54.9	5.52	72.8	3.5
Products 3 plus 4	11.06	2.87	41.0	10.5	72.3
Products 3 to 5	13.91	2.66	34.1	12.3	75.6
Products 3 to 6	20.86	2.28	23.8	15.8	79.2

Screen Analysis - 20 Minute Ball Mill Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	1.4	1.4	98.6
100	6.2	7.6	92.4
150	9.3	16.9	83.1
200	16.4	33.3	66.7
270	10.6	43.9	56.1
400	14.7	58.6	41.4
- 400	41.4	100.0	-
Total	100.0	-	-

Test No. 156

Purpose: To investigate the flotation of lead and zinc from sample D-3.

Procedure: Grind and float a lead concentrate and a zinc concentrate. Clean the lead concentrate twice and the zinc concentrate three times.

Feed: 2000 grams minus 10 mesh sample D-3.

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	R-242	R-404	MIBC	Grind	Cond.	Froth	
Grind	3.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	0.03	-	1	3	9.8
	-	-	-	0.01	0.01	0.01	-	1	3	-
	-	-	-	0.01	0.01	0.01	-	1	3	-
	-	-	-	0.02	0.01	-	-	1	3	-
Pb 1st Cleaner	0.3	0.2	0.10	0.01	-	-	-	2	3	10.0
	-	-	-	0.01	0.01	0.005	-	1	3	-
Pb 2nd Cleaner	0.2	0.1	0.05	-	-	-	-	1	2	10.1
	-	-	-	0.005	-	-	-	1	2	-

Comments: Sample D-3 contains a considerable amount of graphite. In the first two stages of lead roughing only carbon was visible in the froth. Some lead floated in the third rougher stage and lead floated strongly in the fourth rougher stage.

Carbon predominated in the froth of the lead cleaners.

Test No. 156 - Continued

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	Z-200	MIBC	DF-250	Tee-Froth A	Grind	Cond.	Froth	
Zn Circuit										
Condition	1.5	1.0	-	-	-	-	-	2	-	10.9
Zn Rougher	-	-	0.06	-	0.04	-	-	1	3	-
	-	-	0.04	-	0.02	-	-	1	3	-
Zn 1st Cleaner	0.3	-	-	-	-	-	-	1	2	11.1
	-	-	0.01	0.01	-	-	-	1	2	-
Zn 2nd Cleaner	0.2	-	-	-	-	-	-	1	2	11.3
	-	-	0.005	0.01	-	-	-	1	1	-
Zn 3rd Cleaner	0.2	-	-	-	-	0.01	-	1	2	11.4

No carbon apparent in zinc flotation, but very poor froth in Zn rougher and cleaners.

Test No. 156 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	2.58	9.95	9.93	6.7	3.2
2. Pb 2nd Cleaner Tail.	3.52	38.4	7.66	35.2	3.4
3. Pb 1st Cleaner Tail.	7.91	16.4	10.0	33.8	9.9
4. Zn Cleaner Conc.	10.45	1.03	53.0	2.8	69.2
5. Zn 3rd Cleaner Tail.	0.79	4.26	19.7	0.9	1.9
6. Zn 2nd Cleaner Tail.	1.91	3.49	11.0	1.7	2.6
7. Zn 1st Cleaner Tail.	6.74	2.61	4.81	4.6	4.1
8. Zn Rougher Tailing	66.10	0.83	0.69	14.3	5.7
Head (Calculated)	100.00	3.84	8.00	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	6.10	26.4	8.62	41.9	6.6
Products 1 to 3	14.01	20.7	9.40	75.7	16.5
Products 4 plus 5	11.24	1.26	50.7	3.7	71.1
Products 4 to 6	13.15	1.58	44.9	5.4	73.7
Products 4 to 7	19.89	1.93	31.3	10.0	77.8

Screen Analysis - 30 Minute Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	0.2	0.2	99.8
100	1.9	2.1	97.9
150	4.7	6.8	93.2
200	12.7	19.5	80.5
270	10.4	29.9	70.1
400	17.2	47.1	52.9
- 400	52.9	100.0	-
Total	100.0	-	-

Test No. 157

Purpose: To investigate the effect of performing a carbon prefloat, followed by lead and zinc flotation.

Procedure: Grind and remove a carbon prefloat concentrate, a lead concentrate and a zinc concentrate. Re grind the lead concentrate and clean three times. Clean the zinc concentrate three times.

Feed: 2000 grams minus 10 mesh sample D-3.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Pine Oil	Na ₂ CO ₃	ZnSO ₄	NaCN	R-242	Z-11	Grind	Cond.	Froth	
Grind	0.06	-	-	-	-	-	30	-	-	-
Carbon Prefloat	0.04	-	-	-	-	-	-	1	3	8.0
	0.02	-	-	-	-	-	-	1	3	-
Condition	-	3.0	1.0	0.20	-	-	-	3	-	9.6
Pb Rougher	-	-	-	-	0.02	0.03	-	1	3	-
	-	-	-	-	0.01	0.01	-	1	3	-
	-	-	-	-	0.01	0.01	-	1	3	-
Pb Conc. Reagr.	-	1.0	0.5	0.10	0.02	-	15	-	-	-
Pb 1st Cleaner	-	-	-	-	-	0.01	-	1	3	9.6
	-	-	-	-	0.01	0.005	-	1	3	-
Pb 2nd Cleaner	-	0.2	0.1	0.05	-	-	-	1	3	9.8
	-	-	-	-	0.005	-	-	1	1	-
Pb 3rd Cleaner	-	0.2	-	0.05	-	-	-	1	3	10.0
Lead floated well after carbon prefloat.										

Stage	Rougher	Pb Re grind	Pb 1st Cleaner	Pb 2nd & 3rd 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. 157 - Continued

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	Z-200	Z-11	DF-250	Grind	Cond.	Froth	
Zn Circuit									
Condition	1.5	1.0	-	-	-	-	2	-	10.5
Zn Rougher	-	-	0.04	0.02	0.04	-	1	3	-
	-	-	0.02	0.01	-	-	1	3	-
Zn 1st Cleaner	0.4	-	-	-	-	-	1	2	11.0
	-	-	0.01	-	0.005	-	1	2	-
Zn 2nd Cleaner	0.2	-	-	-	-	-	1	2	11.1
	-	-	0.005	-	-	-	1	1	-
Zn 3rd Cleaner	0.2	-	-	-	-	-	1	2	11.2
Froth in the zinc circuit much improved over the previous test.									

Stage Zn Cleaners
 Flotation Cell 500 g D - 1
 Speed: r.p.m. 1300

Test No. 157 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Prefloat Conc.	8.82	3.41	8.92	8.2	10.1
2. Pb Cleaner Conc.	3.24	73.7	3.68	64.8	1.5
3. Pb 3rd Cleaner Tail.	0.75	28.6	12.6	5.8	1.2
4. Pb 2nd Cleaner Tail.	1.40	7.24	14.0	2.8	2.5
5. Pb 1st Cleaner Tail.	5.08	2.75	12.5	3.8	8.2
6. Zn Cleaner Conc.	13.63	0.62	38.3	2.3	67.1
7. Zn 3rd Cleaner Tail.	1.28	2.24	11.5	0.8	1.9
8. Zn 2nd Cleaner Tail.	1.46	2.32	7.69	0.9	1.4
9. Zn 1st Cleaner Tail.	4.30	1.38	3.10	1.6	1.7
10. Zn Rougher Tailing	60.04	0.56	0.55	9.0	4.4
Head (Calculated)	100.00	3.69	7.77	100.0	100.0

Calculated Grades and Recoveries

Products 2 plus 3	3.99	65.2	5.36	70.6	2.7
Products 2 to 4	5.39	50.2	7.60	73.4	5.2
Products 2 to 5	10.47	27.2	9.98	77.2	13.4
Products 6 plus 7	14.91	0.76	36.0	3.1	69.0
Products 6 to 8	16.37	0.90	33.5	4.0	70.4
Products 6 to 9	20.67	1.00	27.2	5.6	72.1

Test No. 158

Purpose: To repeat the lead circuit of test No. 154, but combine the lead tailings and complete the zinc circuit.

Procedure: As for test No. 154, but combine the lead rougher, 1st cleaner and scavenger tailings, and float a zinc concentrate. Clean the zinc concentrate four times.

Feed: 2000 grams minus 10 mesh sample H-3.

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	R-242	Z - 4	MIBC	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	0.01	-	1	3	9.7
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.02	0.01	-	-	1	3	-
Pb Conc. Reagr.	1.0	0.5	0.20	0.03	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	9.8
	-	-	-	0.01	0.02	-	-	1	4	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3½	9.9
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	2½	10.0
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	10.0
Combine Pb 2nd, 3rd, and 4th cleaner tailings.										
Pb Scav. Reagr.	0.5	0.2	0.10	0.02	-	-	15	-	-	-
Pb Scavenger	-	-	-	-	0.01	0.01	-	1	2	9.6
	-	-	-	0.005	0.005	-	-	1	2	-
Pb Scav. Cl.	0.2	0.1	0.05	-	-	-	-	1	2	9.9

Test No. 158 - Continued

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	Z-200	Z - 4	DF-250	Grind	Cond.	Froth	
Combine Pb rougher, 1st cleaner and scavenger tailings.									
Condition	2.0	1.0	-	-	-	-	2	-	10.9
Zn Rougher	-	-	0.02	0.04	0.04	-	1	3	-
	-	0.2	0.02	0.02	-	-	1	3	-
Zn 1st Cleaner	0.3	-	-	-	-	-	1	2	11.2
	-	-	-	0.01	-	-	1	2	-
Zn 2nd Cleaner	0.2	-	-	-	-	-	1	2	11.3
	-	-	-	0.005	-	-	1	1	-
Zn 3rd Cleaner	0.2	-	-	-	-	-	1	2½	11.3
Zn 4th Cleaner	0.2	-	-	-	-	-	1	2	11.4

Test No. 158 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	3.22	72.5	3.16	76.7	1.7
2. Pb Scav. Cl. Conc.	0.45	38.4	7.81	5.7	0.6
3. Pb Scav. Cl. Tail.	0.68	13.5	9.70	3.0	1.1
4. Zn Cleaner Conc.	8.18	0.67	50.0	1.8	66.6
5. Zn 4th Cleaner Tail.	1.41	1.05	18.9	0.5	4.3
6. Zn 3rd Cleaner Tail.	2.07	1.22	11.3	0.8	3.8
7. Zn 2nd Cleaner Tail.	3.75	1.03	5.08	1.3	3.1
8. Zn 1st Cleaner Tail.	15.37	0.62	2.01	2.3	3.7
9. Zn Rougher Tailing*	68.87	0.35	1.35	7.9	15.1
Head (Calculated)	100.00	3.04	6.14	100.0	100.0

* Oxide Zn = 0.49

Calculated Grades and Recoveries

Products 1 plus 2	3.67	68.3	3.73	82.4	2.3
Products 1 to 3	4.35	59.8	4.66	85.4	3.4
Products 4 plus 5	9.59	0.73	45.4	2.3	70.9
Products 4 to 6	11.66	0.81	39.4	3.1	74.7
Products 4 to 7	15.41	0.87	31.0	4.4	77.8
Products 4 to 8	26.78	0.76	18.7	6.7	81.5

Test No. 159

Purpose: To investigate the flotation of lead and zinc from sample C-3 under the standard test conditions.

Procedure: As for test No. 147.

Feed: 2000 grams minus 10 mesh sample C-3.

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	R-242	R-404	MIBC	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	0.01	-	1	3	9.7
	-	-	-	0.01	0.01	0.005	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb Conc. Reagr.	1.0	0.5	0.20	0.03	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	9.8
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3	9.9
	-	-	-	0.005	-	-	-	1	1	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	3	10.0
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	10.0

Stage	Rougher	Pb Reagrind	Pb 1st & 2nd Cleaner
Equipment	1000 g D - 1	Rod Mill	500 g D - 1
Speed: r.p.m.	1800	-	1300

Stage	Pb 3rd & 4th Cleaner	Zn Cleaners
Equipment	250 g D - 1	500 g D - 1
Speed: r.p.m.	1000	1300

Test No. 159 - Continued

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	Z-200	MIBC	DF-250	Grind	Cond.	Froth	
Zn Circuit									
Condition	1.5	1.0	-	-	-	-	2	-	10.9
Zn Rougher	-	-	0.06	-	0.04	-	1	3	-
	-	-	0.02	-	0.02	-	1	3	-
Zn 1st Cleaner	0.3	-	-	-	0.01	-	1	2	11.1
	-	-	0.01	-	0.01	-	1	2	-
Zn 2nd Cleaner	0.2	-	-	-	-	-	1	2	11.2
	-	-	0.005	-	-	-	1	1	-
Zn 3rd Cleaner	0.2	-	-	-	-	-	1	2	11.3

Test No. 159 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	3.44	65.4	2.82	62.4	1.5
2. Pb 4th Cleaner Tail.	1.28	35.2	6.26	12.5	1.2
3. Pb 3rd Cleaner Tail.	1.61	13.1	7.57	5.9	1.9
4. Pb 2nd Cleaner Tail.	4.41	4.75	7.58	5.8	5.2
5. Pb 1st Cleaner Tail.	11.29	1.11	6.99	3.5	12.3
6. Zn Cleaner Conc.	6.78	0.28	54.4	0.5	57.3
7. Zn 3rd Cleaner Tail.	1.60	0.73	24.4	0.3	6.1
8. Zn 2nd Cleaner Tail.	1.61	0.86	9.05	0.4	2.3
9. Zn 1st Cleaner Tail.	7.94	0.79	4.04	1.7	5.0
10. Zn Rougher Tailing	60.04	0.42	0.79	7.0	7.2
Head (Calculated)	100.00	3.61	6.44	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	4.72	57.2	3.75	74.9	2.7
Products 1 to 3	6.33	46.0	4.72	80.8	4.6
Products 1 to 4	10.74	29.1	5.90	86.6	9.8
Products 1 to 5	22.03	14.7	6.46	90.1	22.1
Products 6 plus 7	8.38	0.37	48.7	0.8	63.4
Products 6 to 8	9.99	0.45	42.3	1.2	65.7
Products 6 to 9	17.93	0.60	25.3	2.9	70.7

Screen Analysis - 30 Minute Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 100	0.5	0.5	99.5
150	1.9	2.4	97.6
200	7.8	10.2	89.8
270	9.7	19.9	80.1
400	19.6	39.5	60.5
- 400	60.5	100.0	-
Total	100.0	-	-

Test No. 160

Purpose: To investigate the effect of cleaning the prefloat concentrate and of adding Z-4 to both lead and zinc circuits.

Procedure: Grind, condition and remove a prefloat product. Clean the prefloat and combine the tailings. Condition and float a lead concentrate. Regrind the lead concentrate and clean four times. Combine Pb 2nd to 4th cleaner tailings and scavenge lead. Combine Pb rougher, 1st cleaner and scavenger tailings for Zn circuit.

Feed: 2000 grams minus 10 mesh sample D-3.

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

Conditions:

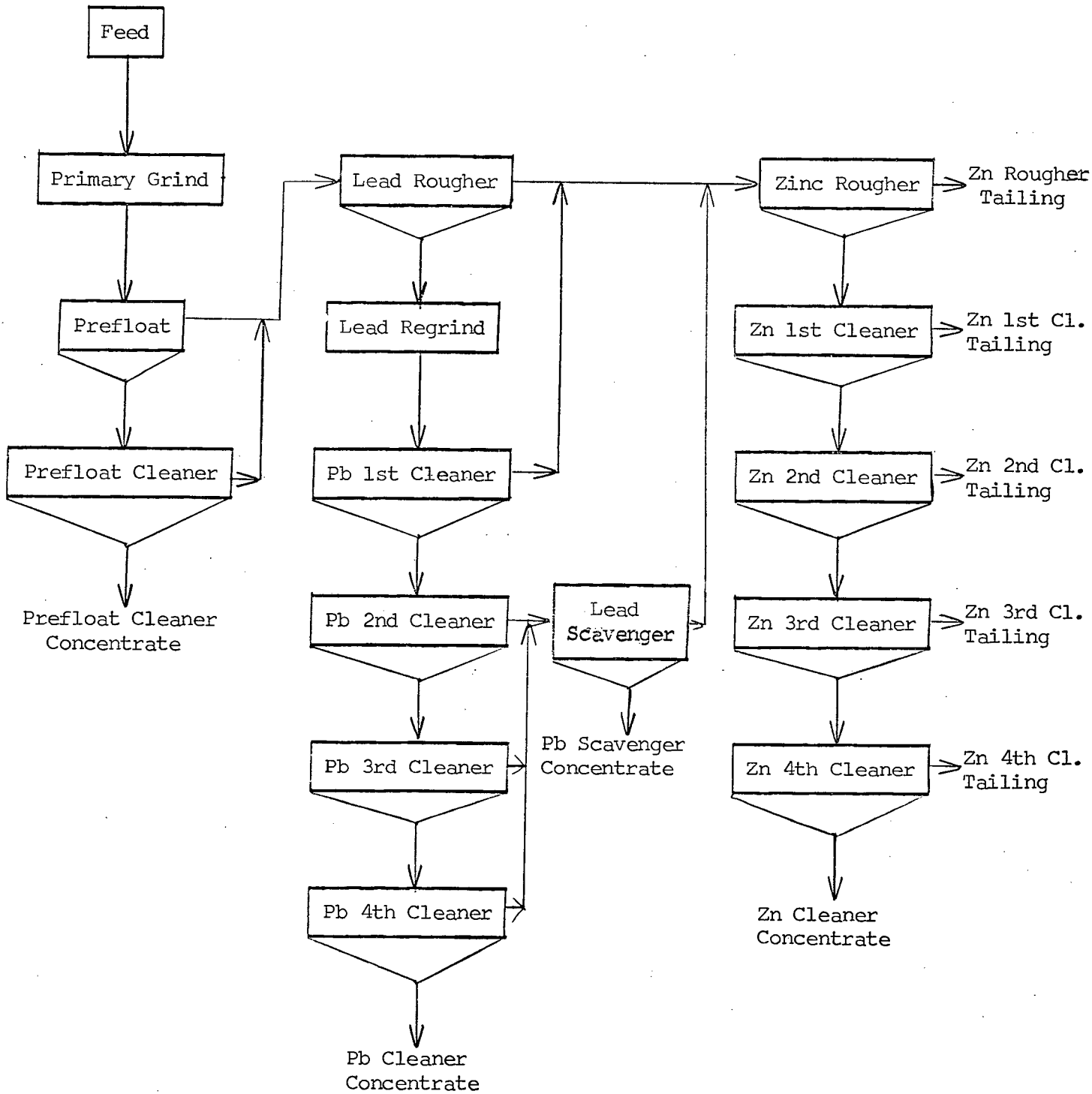
Stage	Reagents Added, pounds per ton							Time, minutes			pH
	Fuel Oil	Pine Oil	Na ₂ CO ₃	ZnSO ₄	NaCN	R-242	Z - 4	Grind	Cond.	Froth	
Primary Grind	-	-	-	-	-	-	-	30	-	-	-
Condition	0.04	0.06	-	-	-	-	-	-	5	-	8.0
Prefloat	-	0.02	-	-	-	-	-	-	1	3	-
	0.02	0.04	-	-	-	-	-	-	2	3	-
Prefloat Cl.	-	-	-	-	-	-	-	-	1	4	-
Combine prefloat tailing and cleaner tailing.											
Condition	-	-	2.5	1.0	0.20	-	-	-	3	-	9.6
Pb Rougher	-	-	-	-	-	0.02	0.05	-	1	3	-
	-	-	-	-	-	0.01	0.02	-	1	3	-
	-	-	-	-	-	0.01	0.01	-	1	3	-
Pb Conc. Reagr.	-	-	1.0	0.5	0.10	0.02	-	20	-	-	-
Pb 1st Cleaner	-	-	-	-	-	-	0.01	-	1	3	9.8
	-	-	-	-	-	0.01	0.01	-	1	3	-
Pb 2nd Cleaner	-	-	0.3	0.2	0.05	-	-	-	1	3	9.9
	-	-	-	-	-	0.005	-	-	1	1	-
Pb 3rd Cleaner	-	-	0.2	0.1	0.05	-	-	-	1	3	10.0
Pb 4th Cleaner	-	-	0.2	-	0.05	-	-	-	1	2	10.0
Combine Pb 2nd, 3rd, and 4th cleaner tailings.											
Pb Scavenger	-	-	0.3	0.2	0.05	-	-	-	2	3	9.6

Test No. 160 - Continued

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	Z-200	Z - 4	DF-1012	Grind	Cond.	Froth	
Zn Circuit (Combine Pb rougher, 1st cleaner and scavenger tailings.)									
Condition	2.0	1.0	-	-	-	-	2	-	11.0
Zn Rougher	-	-	0.02	0.04	0.02	-	1	3	-
	-	-	0.01	0.02	-	-	1	3	-
Zn 1st Cleaner	0.3	-	-	-	-	-	1	2	11.2
	-	-	-	0.01	-	-	1	2	-
Zn 2nd Cleaner	0.2	-	-	-	-	-	1	2	11.3
	-	-	-	0.005	-	-	1	1	-
Zn 3rd Cleaner	0.2	-	-	-	-	-	1	2½	11.3
Zn 4th Cleaner	0.2	-	-	-	-	-	1	2	11.4

Flowsheet



Test No. 160 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Prefloat Cl. Conc.*	3.93	3.54	10.6	3.8	5.2
2. Pb Cleaner Conc.	2.32	71.8	3.36	45.0	1.0
3. Pb Scavenger Conc.	1.23	47.1	7.53	15.7	1.2
4. Zn Cleaner Conc.	13.22	3.22	46.0	11.5	76.1
5. Zn 4th Cleaner Tail.	2.55	4.42	13.0	3.0	4.1
6. Zn 3rd Cleaner Tail.	2.75	3.70	7.80	2.7	2.7
7. Zn 2nd Cleaner Tail.	4.12	2.83	4.46	3.1	2.3
8. Zn 1st Cleaner Tail.	10.81	1.53	1.88	4.5	2.5
9. Zn Rougher Tailing	59.07	0.67	0.66	10.7	4.9
Head (Calculated)	100.00	3.70	7.99	100.0	100.0

* C = 5.0

Calculated Grades and Recoveries

Products 2 plus 3	3.55	63.3	4.81	60.7	2.2
Products 4 plus 5	15.77	3.41	40.7	14.5	80.2
Products 4 to 6	18.52	3.46	35.8	17.2	82.9
Products 4 to 7	22.64	3.34	30.1	20.3	85.2
Products 4 to 8	33.45	2.76	21.0	24.8	87.7

Test No. 161

Purpose: To investigate the improved recovery of zinc from sample H-3 by scavenging with Z-6 and Na₂S.

Procedure: See flowsheet.

Feed: 2000 grams minus 10 mesh sample H-3.

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	R-242	Z - 4	MIBC	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	0.01	-	1	3	9.5
	-	-	-	0.01	0.01	0.005	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.02	0.01	-	-	1	3	-
Pb Conc. Reagr.	1.0	0.5	0.20	0.03	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	9.7
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3	9.9
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	2½	-
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	10.0
Combine Pb 2nd to 4th cleaner tailings.										
Pb Scavenger	0.3	0.2	0.05	0.005	0.005	-	-	2	3	9.8
Combine Pb rougher, 1st cleaner and scavenger tailings.										

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

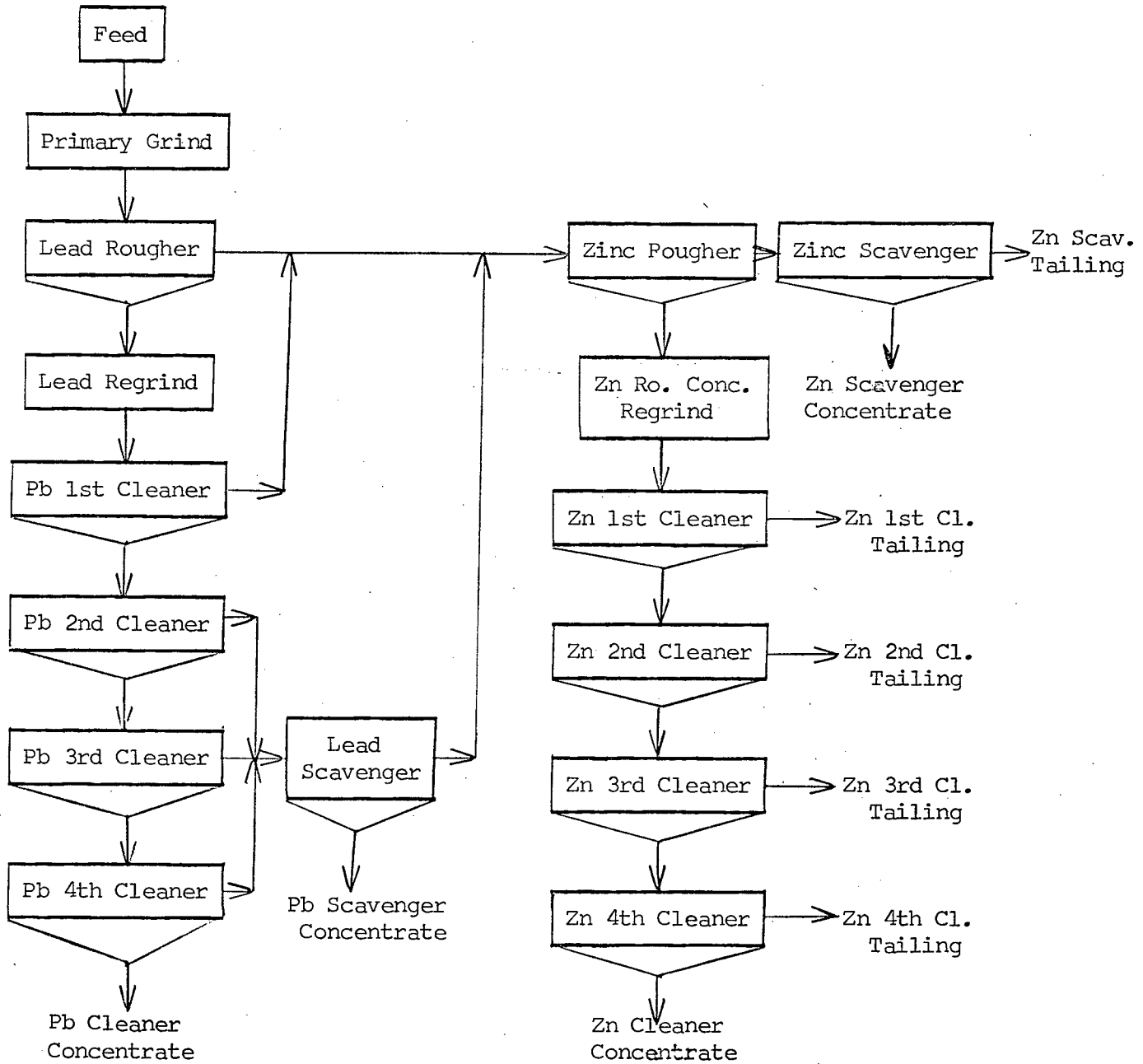
Test No. 161 - Continued

Conditions:

Stage	Reagents Added, pounds per ton							Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	Z-200	Z - 4	DF-1012	Z - 6	Na ₂ S	Grind	Cond.	Froth	
Zn Circuit											
Condition	2.0	1.0	-	-	-	-	-	-	2	-	10.
Zn Rougher	-	-	0.02	0.04	0.01	-	-	-	1	3	-
	-	0.2	0.02	0.02	0.01	-	-	-	1	3	-
	-	-	-	-	0.01	0.05	-	-	1	3	-
Condition	-	-	-	-	-	-	0.5	-	2	-	10.
Zn Scavenger	-	-	-	-	0.01	0.10	-	-	1	3	-
Zn Ro. Conc. Reagr.	1.0	-	0.02	-	-	-	-	15	-	-	-
Zn 1st Cleaner	-	-	-	-	-	-	-	-	1	3	11.
	-	-	0.005	0.005	-	-	-	-	1	3	-
Zn 2nd Cleaner	0.3	-	-	-	-	-	-	-	1	2	11.
	-	-	0.005	-	-	-	-	-	1	2	-
Zn 3rd Cleaner	0.2	-	-	-	-	-	-	-	1	3	11.
Zn 4th Cleaner	0.2	-	-	-	-	-	-	-	1	2	11.

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

Flowsheet



Test No. 161 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	3.36	70.8	3.44	78.2	1.8
2. Pb Scavenger Conc.	1.04	15.4	9.60	5.3	1.6
3. Zn Cleaner Conc.	10.89	1.79	45.5	6.4	77.4
4. Zn 4th Cleaner Tail.	1.06	2.41	9.14	0.8	1.5
5. Zn 3rd Cleaner Tail.	1.82	1.49	4.38	0.9	1.3
6. Zn 2nd Cleaner Tail.	4.55	0.64	1.83	0.9	1.3
7. Zn 1st Cleaner Tail.	23.63	0.32	1.08	2.5	4.0
8. Zn Scavenger Conc.	8.55	0.50	1.29	1.4	1.3
9. Zn Scavenger Tail.	45.10	0.24	1.34	3.6	9.8
Head (Calculated)	100.00	3.04	6.40	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	4.40	57.7	4.89	83.5	3.4
Products 3 plus 4	11.95	1.60	42.27	7.2	78.9
Products 3 to 5	13.77	1.80	37.26	8.1	80.2
Products 3 to 6	18.32	1.50	29.86	9.0	81.5
Products 3 to 7	41.95	0.84	13.03	11.5	85.5
Products 3 to 8	50.50	0.78	11.05	12.9	86.8

Test No. 162

Purpose: To investigate the recovery of lead and zinc from sample F-3 Hard under the standard test conditions.

Procedure: As for test No. 147.

Feed: 2000 grams minus 10 mesh sample F-3 Hard.

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	R-242	R-404	MIBC	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	0.01	-	1	3	9.6
	-	-	-	0.01	0.01	0.005	-	1	3	-
	-	-	-	0.01	0.01	0.005	-	1	3	-
Pb Conc. Reagr.	1.0	0.5	0.20	0.03	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	0.005	-	1	3	9.7
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3	9.8
	-	-	-	0.005	-	-	-	1	1	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	3	9.9
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	9.9

Test No. 162 - Continued

Conditions:

Stage	Reagents Added, pounds per ton				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	Z-200	DF-1012	Grind	Cond.	Froth	
Zn Circuit								
Condition	1.5	1.0	-	-	-	2	-	10.7
Zn Rougher	-	-	0.06	0.01	-	1	3	-
	-	-	0.04	0.005	-	1	3	-
Zn 1st Cleaner	0.3	-	-	-	-	1	2	11.0
	-	-	0.01	0.005	-	1	3	-
Zn 2nd Cleaner	0.2	-	-	-	-	1	2	11.2
	-	-	0.005	-	-	1	2	-
Zn 3rd Cleaner	0.2	-	-	-	-	1	3	11.3

Test No. 162 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	7.90	70.3	7.45	84.9	3.3
2. Pb 4th Cleaner Tail.	1.07	30.1	22.7	4.9	1.3
3. Pb 3rd Cleaner Tail.	1.50	12.3	28.5	2.8	2.4
4. Pb 2nd Cleaner Tail.	4.21	3.86	27.3	2.5	6.4
5. Pb 1st Cleaner Tail.	12.04	0.78	24.0	1.4	16.0
6. Zn Cleaner Conc.	19.99	0.37	59.5	1.1	65.9
7. Zn 3rd Cleaner Tail.	1.21	0.65	18.2	0.1	1.2
8. Zn 2nd Cleaner Tail.	2.09	0.70	11.6	0.2	1.3
9. Zn 1st Cleaner Tail.	5.14	0.53	3.36	0.4	1.0
10. Zn Rougher Tailing	44.85	0.23	0.47	1.7	1.2
Head (Calculated)	100.00	6.54	18.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	8.97	65.5	9.27	89.8	4.6
Products 1 to 3	10.47	57.9	12.0	92.6	7.0
Products 1 to 4	14.68	42.4	16.4	95.1	13.4
Products 1 to 5	26.72	23.6	19.8	96.5	29.4
Products 6 plus 7	21.20	0.39	57.1	1.2	67.1
Products 6 to 8	23.29	0.41	53.1	1.4	68.4
Products 6 to 9	28.43	0.44	44.1	1.8	69.4

Screen Analysis - 30 Minute Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 100	0.5	0.5	99.5
150	2.1	2.6	97.4
200	9.2	11.8	88.2
270	10.5	22.3	77.7
400	19.6	41.9	58.1
- 400	58.1	100.0	-
Total	100.0	-	-

Test No. 163

Purpose: To investigate the recovery of lead and zinc from sample F-3 Vuggy under the standard test conditions.

Procedure: As for test No. 147.

Feed: 2000 grams minus 10 mesh sample F-3 Vuggy.

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	R-242	R-404	MIBC	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	1.0	-	-	0.01	0.02	0.01	-	1	3	9.5
	-	-	-	0.01	0.01	0.005	-	1	3	-
	-	-	-	0.01	0.01	0.005	-	1	3	-
Pb Conc. Reagr.	1.0	0.5	0.20	0.03	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	0.005	-	1	3	9.7
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3	9.9
	-	-	-	0.005	-	-	-	1	1	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	3	10.0
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	10.0

Test No. 163 - Continued

Conditions:

Stage	Reagents Added, pounds per ton				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	Z-200	DF-1012	Grind	Cond.	Froth	
Zn Circuit								
Condition	2.0	1.0	-	-	-	2	-	10.8
Zn Rougher	-	-	0.06	0.01	-	1	3	-
	-	-	0.04	-	-	1	4	-
Zn 1st Cleaner	0.3	-	-	-	-	1	2	11.0
	-	-	0.01	-	-	1	2	-
Zn 2nd Cleaner	0.2	-	-	-	-	1	2	11.1
	-	-	0.005	-	-	1	1	-
Zn 3rd Cleaner	0.2	-	-	-	-	1	2	11.2

Test No. 163 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	8.96	64.4	9.60	85.2	5.3
2. Pb 4th Cleaner Tail.	1.27	14.9	27.7	2.8	2.2
3. Pb 3rd Cleaner Tail.	1.42	7.12	29.3	1.5	2.6
4. Pb 2nd Cleaner Tail.	4.65	3.12	26.1	2.1	7.5
5. Pb 1st Cleaner Tail.	12.44	1.06	22.6	2.0	17.4
6. Zn Cleaner Conc.	8.72	0.52	62.3	0.7	33.6
7. Zn 3rd Cleaner Tail.	6.17	0.72	59.2	0.7	22.6
8. Zn 2nd Cleaner Tail.	1.80	2.30	33.6	0.6	3.7
9. Zn 1st Cleaner Tail.	3.01	2.02	12.5	0.9	2.3
10. Zn Rougher Tailing	51.56	0.47	0.86	3.5	2.8
Head (Calculated)	100.00	6.77	16.2	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	10.23	58.3	11.8	88.0	7.5
Products 1 to 3	11.65	52.0	14.0	89.5	10.1
Products 1 to 4	16.30	38.1	17.4	91.6	17.6
Products 1 to 5	28.74	22.1	19.7	93.6	35.0
Products 6 plus 7	14.89	0.60	61.0	1.4	56.2
Products 6 to 8	16.69	0.79	58.1	2.0	59.9
Products 6 to 9	19.70	0.97	51.1	2.9	62.2

Screen Analysis - Vuggy 30 Minute Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 100	0.3	0.3	99.7
150	1.4	1.7	98.3
200	6.9	8.6	91.4
270	10.9	19.5	80.5
400	15.9	35.4	64.6
- 400	64.6	100.0	-
Total	100.0	-	-

Test No. 164

Purpose: Attempt to improve Zn grade and recovery.

Procedure: Float and clean Pb concentrates at lower NaCN additions using Collector Z-11. Thicken Zn flotation feed before flotation and use Modified Zn flowsheet and reagent balance as follows.

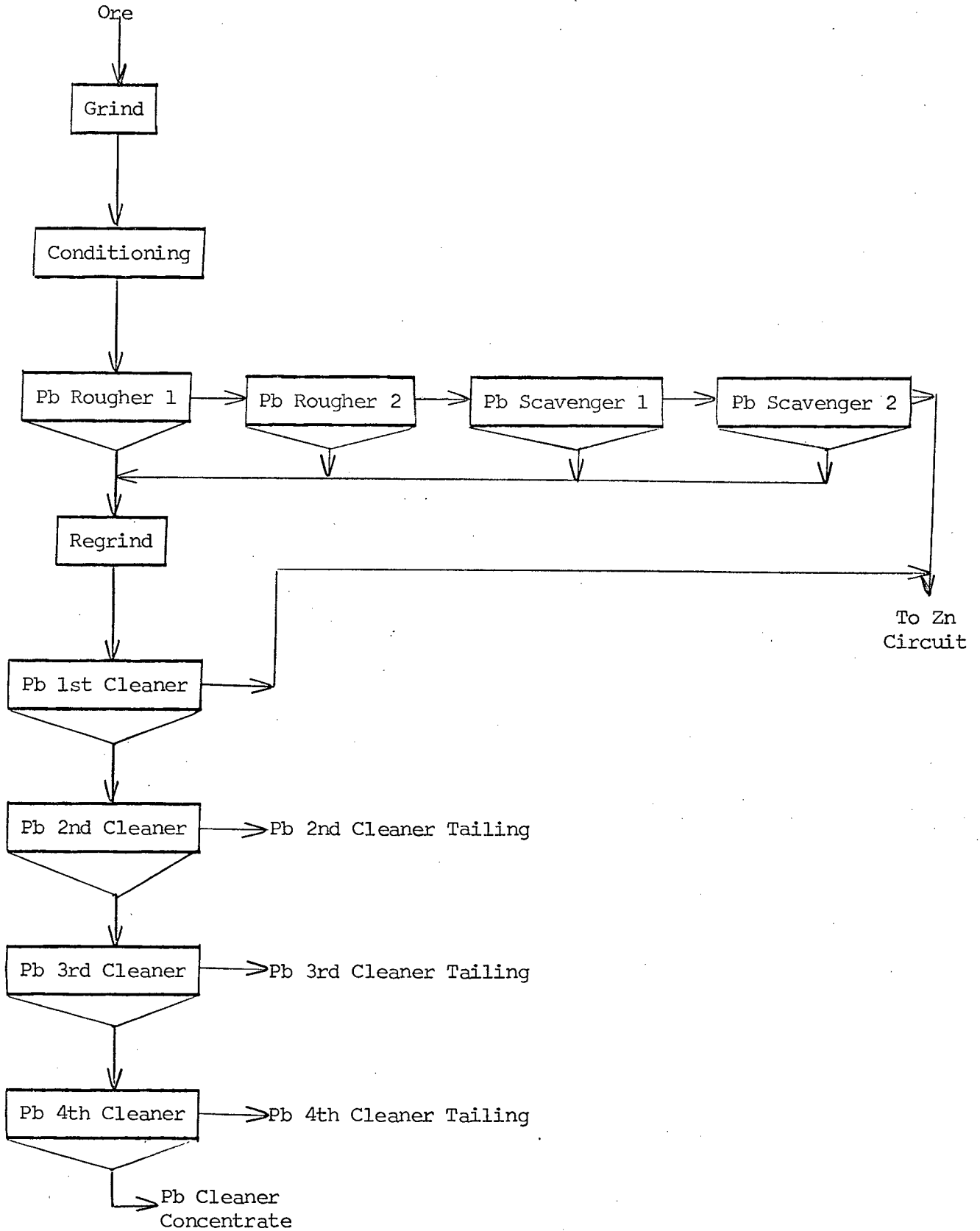
Feed: 2000 grams minus 10 mesh sample H-3.

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

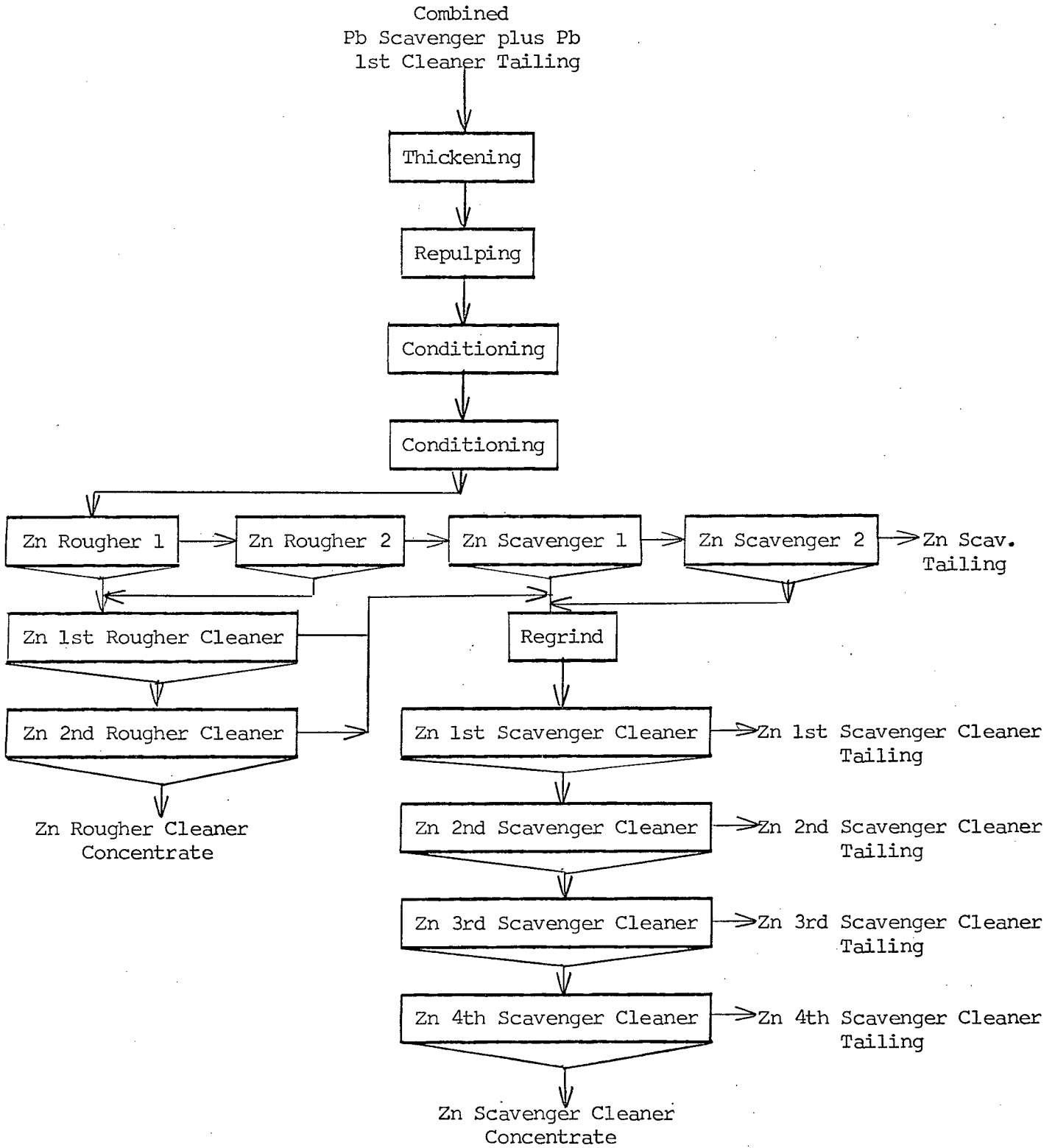
Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z - 11	MIBC	Grind	Cond.	Froth	
Grind	4.0	-	0.2	0.04	-	30	-	-	9.8
Conditioning	-	-	-	0.01	-	-	10	-	-
Pb Rougher 1	-	-	-	-	0.01	-	1	3	9.7
Pb Rougher 2	-	-	-	0.01	0.01	-	1	3	-
Pb Rougher 3	-	-	-	0.01	0.005	-	1	3	-
Pb Rougher 4	-	-	-	0.01	0.005	-	1	3	-
Combined Pb rougher concentrates for regrinding and cleaning.									
Pb Regrind	1.0	0.2	0.1	0.02	-	30	-	-	9.7
Pb 1st Cleaner	-	0.2	-	0.01	0.005	-	1	3	-
	-	-	-	0.01	0.005	-	1	3	9.6
Pb 2nd Cleaner	-	-	0.05	-	0.005	-	1	5	9.8
Pb 3rd Cleaner	-	-	0.05	-	0.005	-	1	4	9.8
Pb 4th Cleaner	-	-	0.05	-	0.005	-	1	3	9.8
Zn Circuit									
Combined Pb rougher and 1st cleaner tailings.									
Thickening (~60 % solids)									
Repulping									

Flowsheet - A. Pb Circuit



Flowsheet - B. Zinc Circuit



Test No. 164 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	3.90	55.2	5.62	76.1	3.6
2. Pb 4th Cleaner Tail.	0.98	16.8	8.50	5.8	1.4
3. Pb 3rd Cleaner Tail.	1.32	6.89	8.29	3.2	1.8
4. Pb 2nd Cleaner Tail.	3.32	2.56	8.21	3.0	4.4
5. Zn Ro. Cleaner Conc.	6.40	0.35	54.4	0.8	56.8
6. Zn Scav. Cl. Conc.	2.76	2.11	34.6	2.1	15.6
7. Zn 4th Scav. Cl. Tail.	0.56	1.65	8.17	0.3	0.7
8. Zn 3rd Scav. Cl. Tail.	0.97	1.19	3.87	0.4	0.6
9. Zn 2nd Scav. Cl. Tail.	3.92	0.66	1.72	0.9	1.1
10. Zn 1st Scav. Cl. Tail.	23.68	0.35	0.93	2.9	3.6
11. Zn Scavenger Tailing	52.19	0.24	1.22	4.5	10.4
Head (Calculated)	100.00	2.83	6.13	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	4.88	47.5	6.20	81.9	5.0
Products 1 to 3	6.20	38.8	6.64	85.1	6.8
Products 1 to 4	9.52	26.2	7.19	88.1	11.2
Products 5 plus 6	9.16	0.88	48.4	2.9	72.4
Products 5 to 7	9.72	0.92	46.1	3.2	73.1
Products 5 to 8	10.69	0.95	42.3	3.6	73.7
Products 5 to 8	14.61	0.87	31.4	4.5	74.8
Products 5 to 10	38.29	0.55	12.6	7.4	78.4

Test No. 165

Purpose: To investigate the flotation of lead and zinc from sample G-3 under the standard test conditions.

Procedure: As for test No. 147.

Feed: 2000 grams minus 10 mesh sample G-3.

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	R-242	R-404	MIBC	Grind	Cond.	Froth	
Grind	3.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	0.02	-	1	3	9.7
	-	-	-	0.01	0.01	0.01	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb Re grind	1.0	0.5	0.20	0.03	-	-	15*	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	9.9
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3	9.9
	-	-	-	0.005	-	-	-	1	1	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	3	10.0
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	10.0

* Because of low head-grade, lead regrinding time reduced to 15 minutes.

Test No. 165 - Continued

Conditions:

Stage	Reagents Added, pounds per ton				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	Z-200	DF-1012	Grind	Cond.	Froth	
Zn Circuit								
Condition	1.5	1.0	-	-	-	2	-	10.9
Zn Rougher	-	-	0.06	0.02	-	1	3	-
	-	-	0.04	0.01	-	1	3	-
Zn 1st Cleaner	0.3	-	-	0.005	-	1	2	11.0
	-	-	0.01	0.005	-	1	2	-
Zn 2nd Cleaner	0.2	-	-	-	-	1	2	11.1
	-	-	0.005	-	-	1	1	-
Zn 3rd Cleaner	0.2	-	-	-	-	1	2	11.2

Test No. 165 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	0.75	66.0	2.68	38.8	0.7
2. Pb 4th Cleaner Tail.	0.56	38.1	4.96	16.7	1.0
3. Pb 3rd Cleaner Tail.	0.78	12.6	5.81	7.7	1.6
4. Pb 2nd Cleaner Tail.	2.92	4.14	4.96	9.5	5.1
5. Pb 1st Cleaner Tail.	8.20	0.71	4.03	4.6	11.6
6. Zn Cleaner Conc.	4.31	0.67	45.2	2.3	68.2
7. Zn 3rd Cleaner Tail.	1.25	1.30	9.22	1.3	4.0
8. Zn 2nd Cleaner Tail.	2.12	1.23	3.45	2.0	2.6
9. Zn 1st Cleaner Tail.	4.26	0.59	0.59	2.0	0.9
10. Zn Rougher Tailing	74.85	0.26	0.17	15.1	4.3
Head (Calculated)	100.00	1.28	2.86	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	1.31	54.1	3.66	55.5	1.7
Products 1 to 3	2.09	38.6	4.46	63.2	3.3
Products 1 to 4	5.01	18.5	4.75	72.7	8.4
Products 1 to 5	13.21	7.46	4.30	77.3	20.0
Products 6 plus 7	5.56	0.81	37.1	3.6	72.2
Products 6 to 8	7.68	0.93	27.8	5.6	74.8
Products 6 to 9	11.94	0.81	18.1	7.6	75.7

Screen Analysis - 30 Minute Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 100	1.1	1.1	98.9
150	3.8	4.9	95.1
200	12.5	17.4	82.6
270	12.7	30.1	69.9
400	14.9	45.0	55.0
- 400	55.0	100.0	-
Total	100.0	-	-

Test No. 166

Purpose: To investigate the effect of regrinding the lead cleaner tails and scavenging lead, and of then passing the lead tailings to the Zn Circuit.

Procedure: As for test No. 152, but five stages of zinc cleaning.

Feed: 2000 grams minus 10 mesh sample C-3.

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	R-242	Z - 4	MIBC	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	0.01	-	1	3	9.7
	-	-	-	0.01	0.01	0.005	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.02	0.01	-	-	1	3	-
Pb Conc. Reagr.	1.0	0.5	0.20	0.03	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	9.8
	-	-	-	0.01	0.02	-	-	1	4	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3½	9.9
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	2½	9.9
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	10.0
Combine Pb 2nd, 3rd, and 4th cleaner tailings.										
Pb Scav. Reagr.	0.5	0.2	0.10	0.02	-	-	15	-	-	-
Pb Scavenger	-	-	-	-	0.01	0.005	-	1	2	9.7
	-	-	-	0.005	0.01	-	-	1	2	-
Pb Scav. Cl.	0.2	0.1	0.05	-	-	-	-	1	2	9.9

Test No. 166 - Continued

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	Z-200	Z - 4	DF-1012	Grind	Cond.	Froth	
Combine Pb rougher, 1st cleaner and scavenger tailings.									
Condition	2.0	1.0	-	-	-	-	2	-	11.0
Zn Rougher	-	-	0.02	0.04	0.01	-	1	3	-
Zn 1st Cleaner	-	0.2	0.02	0.02	-	-	1	5	-
Zn 1st Cleaner	0.3	-	-	-	-	-	1	3	11.2
Zn 2nd Cleaner	-	-	-	0.01	-	-	1	2	-
Zn 2nd Cleaner	0.2	-	-	-	-	-	1	2	11.3
Zn 3rd Cleaner	-	-	-	0.005	-	-	1	2	-
Zn 3rd Cleaner	0.2	-	-	-	-	-	1	3	11.3
Zn 4th Cleaner	0.2	-	-	-	-	-	1	2	11.3
Zn 5th Cleaner	0.3	-	0.005	-	-	-	1	2	11.5

Test No. 166 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	4.38	62.0	3.60	75.1	2.4
2. Pb Scav. Cl. Conc.	0.79	33.8	6.48	7.4	0.8
3. Pb Scav. Cl. Tail.	1.54	7.94	7.42	3.4	1.7
4. Zn Cleaner Conc.	8.27	0.74	54.9	1.7	68.8
5. Zn 5th Cleaner Tail.	2.37	1.10	23.1	0.7	8.3
6. Zn 4th Cleaner Tail.	1.64	1.62	13.6	0.7	3.4
7. Zn 3rd Cleaner Tail.	2.08	1.53	6.33	0.9	2.0
8. Zn 2nd Cleaner Tail.	4.47	1.11	2.76	1.4	1.9
9. Zn 1st Cleaner Tail.	11.55	0.65	1.46	2.1	2.6
10. Zn Rougher Tailing	62.91	0.38	0.86	6.6	8.1
Head (Calculated)	100.00	3.61	6.60	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	5.17	57.7	4.04	82.5	3.2
Products 1 to 3	6.71	46.3	4.82	85.9	4.9
Products 4 plus 5	10.64	0.82	47.8	2.4	77.1
Products 4 to 6	12.28	0.93	43.2	3.1	80.5
Products 4 to 7	14.36	1.01	37.9	4.0	82.5
Products 4 to 8	18.83	1.04	29.6	5.4	84.4
Products 4 to 9	30.38	0.89	18.9	7.5	87.0

Test No. 167

Purpose: To investigate the effect of regrinding the lead cleaner tailings, scavenging lead and of passing the lead scavenger tailing to the zinc circuit.

Procedure: As for test No. 152.

Feed: 2000 grams minus 10 mesh sample F-3 Hard.

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	R-242	Z-4	MIBC	Grind	Cond.	Froth	
Primary Grind	3.0	2.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	0.01	-	1	3	9.6
	-	-	-	0.01	0.01	0.005	-	1	3	-
	-	-	-	0.01	0.01	0.005	-	1	3	-
Pb Conc. Re grind	1.0	1.0	0.20	0.03	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	9.6
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3½	9.8
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	2½	9.9
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	9.9
Combine lead 2nd, 3rd and 4th cleaner tailings.										
Pb Scav. Re grind	0.5	0.2	0.10	0.02	-	-	15	-	-	-
Pb Scavenger	-	-	-	-	0.01	-	-	1	2	9.6
	-	-	-	0.005	0.01	-	-	1	2	-
Pb Scav. Cl.	0.2	0.1	0.05	-	-	-	-	1	2	9.8

Test No. 167 - Continued

Conditions - Continued

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	Z-200	Z-4	DF-1012	Grind	Cond.	Froth	
Combine lead rougher, 1st cleaner and scavenger tailings.									
Condition	2.0	1.0	-	-	-	-	2	-	11.0
Zn Rougher	-	0.5	0.02	0.04	-	-	1	4	-
	-	0.5	0.02	0.02	0.01	-	1	4	-
Zn 1st Cleaner	0.3	-	-	-	-	-	1	3	11.1
	-	-	0.005	0.01	0.005	-	1	3	-
Zn 2nd Cleaner	0.2	-	-	-	-	-	1	3	11.1
	-	-	0.005	0.005	-	-	1	2	-
Zn 3rd Cleaner	0.2	-	-	-	-	-	1	2	11.2
	-	-	0.005	-	-	-	-	2	-
Zn 4th Cleaner	0.2	-	-	-	-	-	1	3	11.2

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	7.18	74.3	5.64	81.1	2.2
2. Pb Scav. Cl. Conc.	0.87	54.6	14.1	7.2	0.7
3. Pb Scav. Cl. Tailing	0.89	20.0	25.7	2.7	1.2
4. Zn Cleaner Concentrate	26.76	0.83	58.3	3.4	84.2
5. Zn 4th Cleaner Tailing	1.92	2.39	31.8	0.7	3.3
6. Zn 3rd Cleaner Tailing	2.08	2.13	18.1	0.7	2.0
7. Zn 2nd Cleaner Tailing	3.17	1.41	10.6	0.7	1.8
8. Zn 1st Cleaner Tailing	7.42	0.72	4.45	0.8	1.8
9. Zn Rougher Tailing	49.71	0.36	1.07	2.7	2.8
Head (calculated)	100.00	6.58	18.5	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	8.05	72.2	6.55	88.3	2.9
Products 1 to 3	8.94	67.0	8.46	91.0	4.1
Products 4 plus 5	28.68	0.93	56.5	4.1	87.5
Products 4 to 6	30.76	1.02	53.9	4.8	89.5
Products 4 to 7	33.93	1.05	49.9	5.5	91.3
Products 4 to 8	41.35	0.99	41.7	6.3	93.1

Test No. 168

Purpose: To investigate the effect of regrinding and scavenging the lead cleaner tailings and of passing the scavenger tailing to the zinc circuit.

Procedure: As for test No. 167.

Feed: 2000 grams minus 10 mesh sample 'F-3 Vuggy'.

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	R-242	Z-4	MIBC	Grind	Cond.	Froth	
Primary Grind	3.0	2.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	1.0	-	-	0.01	0.02	0.01	-	1	3	9.5
	-	-	-	0.01	0.01	0.005	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb Conc. Re grind	1.0	1.0	0.20	0.03	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	9.5
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3½	9.7
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	2½	9.9
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	10.0
Combine lead 2nd, 3rd and 4th cleaner tailings.										
Pb Scav. Re grind	0.5	0.2	0.10	0.02	-	-	15	-	-	-
Pb Scavenger	-	-	-	-	0.01	0.005	-	1	2	9.6
	-	-	-	0.005	0.005	-	-	1	2	-
Pb Scav. Cleaner	0.2	0.1	0.05	-	-	-	-	1	2	9.9

Test No. 168 - Continued

Conditions - Continued

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	Z-200	Z-4	MIBC	Grind	Cond.	Froth	
Combine lead rougher, 1st cleaner and scavenger tailings.									
Condition	2.0	1.5	-	-	-	-	-	-	10.6
Zn Rougher	-	-	0.02	0.04	-	-	1	4	-
Zn 1st Cleaner	-	0.5	0.02	0.02	0.01	-	1	4	-
Zn 2nd Cleaner	0.3	-	-	-	-	-	1	3	10.9
Zn 3rd Cleaner	-	-	0.005	0.01	-	-	1	3	-
Zn 4th Cleaner	0.2	-	-	-	-	-	1	3	11.1
Zn 1st Cleaner	-	-	0.005	0.005	-	-	1	2	-
Zn 2nd Cleaner	0.2	-	-	-	-	-	1	2	11.2
Zn 3rd Cleaner	-	-	0.005	-	-	-	1	2	-
Zn 4th Cleaner	0.2	-	-	-	-	-	1	3	11.2

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	7.08	69.7	7.14	73.2	3.1
2. Pb Scavenger Cl. Conc.	1.53	46.4	16.3	10.5	1.5
3. Pb Scavenger Cl. Tailing	1.34	15.3	24.8	3.1	2.1
4. Zn Cleaner Concentrate	15.54	0.95	59.5	2.2	57.2
5. Zn 4th Cleaner Tailing	2.10	1.58	49.8	0.5	6.5
6. Zn 3rd Cleaner Tailing	4.81	2.20	49.0	1.6	14.6
7. Zn 2nd Cleaner Tailing	5.00	2.50	28.3	1.8	8.7
8. Zn 1st Cleaner Tailing	5.57	2.09	7.24	1.7	2.5
9. Zn Rougher Tailing	57.03	0.64	1.09	5.4	3.8
Head (calculated)	100.00	6.74	16.2	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	8.61	65.5	8.76	83.7	4.6
Products 1 to 3	9.95	58.8	10.9	86.8	6.7
Products 4 plus 5	17.64	1.02	58.3	2.7	63.7
Products 4 to 6	22.45	1.28	56.3	4.3	78.3
Products 4 to 7	27.45	1.50	51.2	6.1	87.0
Products 4 to 8	33.02	1.60	43.8	7.8	89.5

Test No. 169

Purpose: To repeat test No. 161, but add gangue depressants to the zinc circuit.

Procedure: As for test No. 161, but with 5 stages of zinc cleaning.

Feed: 2000 grams minus 10 mesh sample H-3.

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	R-242	Z-4	MIBC	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	0.01	-	1	3	9.6
	-	-	-	0.01	0.01	0.005	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	0.02	0.01	-	-	1	3	-
Pb Conc. Re grind	1.0	0.5	0.20	0.03	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	9.6
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3	9.8
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	2½	9.9
Pb 4th Cleaner	0.2	-	0.05	-	-	-	-	1	2	10.0
Combine lead 2nd, 3rd and 4th cleaner tailings.										
Pb Scavenger	0.3	0.2	0.05	0.01	0.005	0.005	-	2	2	9.9

Test No. 169 - Continued

Conditions - Continued

Stage	Reagents Added, pounds per ton							Time, minutes			pH
	Ca-(OH) ₂	CuSO ₄	Na ₂ -SiO ₃	Z-200	Z-4	CMC-6TE	DF-1012	Grind	Cond.	Froth	
Combine lead rougher, 1st cleaner sand scavenger tailings.											
Condition	2.0	1.0	0.5	-	-	-	-	-	2	-	-
Zn Rougher	-	-	-	0.02	0.04	-	-	-	1	3	11.0
	-	0.2	-	0.02	0.02	-	0.005	-	1	3	-
	-	0.1	-	-	0.05	-	0.005	-	1	3	-
Zn Conc. Re grind	1.0	0.2	0.25	0.02	-	-	-	15	-	-	-
Zn 1st Cleaner	-	-	-	-	-	-	-	-	1	3	11.2
	-	-	-	0.01	-	-	-	-	1	3	-
Zn 2nd Cleaner	0.3	-	0.10	-	-	-	-	-	2	2	11.3
	-	-	-	0.01	-	-	-	-	1	3	-
Zn 3rd Cleaner	0.2	-	-	-	-	0.05	-	-	1	2	11.3
	-	-	-	0.005	-	-	-	-	-	2	-
							MIBC				
Zn 4th Cleaner	0.2	-	-	-	-	0.03	-	-	1	2	11.3
	-	-	-	-	-	-	0.005	-	-	1	-
Zn 5th Cleaner	0.2	-	-	-	-	0.02	-	-	1	2	11.4

Test No. 169 - Continued

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	3.31	68.8	3.46	77.0	1.8
2. Pb Scavenger Conc.	0.71	17.1	9.33	4.1	1.1
3. Zn Cleaner Concentrate	6.11	0.87	57.8	1.8	56.9
4. Zn 5th Cleaner Tailing	0.95	1.93	49.1	0.6	7.5
5. Zn 4th Cleaner Tailing	1.17	3.37	36.9	1.3	7.0
6. Zn 3rd Cleaner Tailing	1.30	3.90	17.7	1.7	3.7
7. Zn 2nd Cleaner Tailing	2.47	2.65	5.07	2.2	2.0
8. Zn 1st Cleaner Tailing	12.95	0.71	1.67	3.1	3.5
9. Zn Rougher Tailing	71.03	0.34	1.44	8.2	16.5
Head (calculated)	100.00	2.96	6.20	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	4.02	59.7	4.50	81.1	2.9
Products 3 plus 4	7.06	1.01	56.6	2.4	64.4
Products 3 to 5	8.23	1.35	53.8	3.7	71.4
Products 3 to 6	9.53	1.70	48.9	5.4	75.1
Products 3 to 7	12.00	1.89	39.9	7.6	77.1
Products 3 to 8	24.95	1.28	20.0	10.7	80.6

Test No. 170

Purpose: To attempt a carbon prefloat at minus 10 mesh, and to investigate the possibility of depressing the carbon in lead cleaning.

Procedure: Grind and float carbon with frother only, float lead with 242 and Z-4, float zinc from lead rougher tailing. Combine carbon and lead concentrates, regrind and clean four times. Clean the zinc concentrate four times.

Feed: 2000 grams minus 10 mesh sample D-3.

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

Conditions:

Stage	Reagents Added, pounds per ton							Time, minutes			pH
	Pine Oil	Na ₂ CO ₃	ZnSO ₄	NaCN	R-242	Z - 4	CMC 6TE	Grind	Cond.	Froth	
- 10 mesh pre-float	0.06	-	-	-	-	-	-	-	1	-	-
The attempt to float carbon at minus 10 mesh was unsuccessful, only some fine carbon and galena were removed. Products recombined and filtered for grinding.											
	MIBC										
Grind	-	3.0	1.0	0.30	-	-	-	30	-	-	-
Carbon Float	0.03	-	-	-	-	-	-	-	1	5	9.0
Pb Rougher	-	-	-	-	0.01	0.05	-	-	1	3	-
	-	-	-	-	0.01	0.01	-	-	1	3	-
	-	-	-	-	0.01	0.01	-	-	1	3	-
Combine carbon and lead concentrates.											
Pb Regrind	-	1.0	0.5	0.20	0.02	0.03	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.02	0.03	0.10	-	2	4	9.0
	-	-	-	-	0.01	0.03	-	-	1	4	-
Pb 2nd Cleaner	-	0.3	0.2	0.10	-	-	0.02	-	1	2	9.0
	-	-	-	-	0.005	0.01	-	-	1	3	-
Pb 3rd Cleaner	-	0.2	0.1	0.05	-	-	0.01	-	1	2	9.0
	-	-	-	-	0.005	0.005	-	-	1	1½	-
Pb 4th Cleaner	-	0.2	-	0.05	-	0.005	-	-	1	2	10.0

Test No. 170 - Continued

Conditions:

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

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	Z-200	Z - 4	DF-1012	CMC 6TE	Grind	Cond.	Froth	
Zn Circuit (lead rougher tailing)										
Condition	1.5	1.0	-	-	-	-	-	2	-	10.6
Zn Rougher	-	-	0.02	0.04	0.02	-	-	1	3	-
Zn 1st Cleaner	-	-	0.02	0.02	0.01	-	-	1	3	-
Zn 2nd Cleaner	0.3	-	-	-	-	-	-	1	2	10.9
	-	-	0.01	-	0.005	-	-	1	2	-
Zn 3rd Cleaner	0.3	-	-	-	-	-	-	1	2	11.1
Zn 4th Cleaner	-	-	0.005	-	-	-	-	1	1	-
	0.2	-	-	-	-	-	-	1	2	11.2
	0.2	-	-	-	-	0.05	-	1	2	11.2

Stage	Zn 1st & 2nd Cleaners	Zn 3rd & 4th Cleaners
Flotation Cell	500 g D - 1	250 g D - 1
Speed: r.p.m.	1300	1000

Test No. 170 - Continued

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	1.93	73.2	3.16	38.8	0.8
2. Pb 4th Cleaner Tail.	0.88	45.2	7.50	10.9	0.8
3. Pb 3rd Cleaner Tail.	1.08	23.8	9.95	7.1	1.3
4. Pb 2nd Cleaner Tail.	4.19	11.7	10.8	13.5	5.6
5. Pb 1st Cleaner Tail.	9.58	5.87	10.9	15.5	13.0
6. Zn Cleaner Conc.	9.47	0.38	53.1	1.0	62.6
7. Zn 4th Cleaner Tail.	2.28	0.94	24.0	0.6	6.8
8. Zn 3rd Cleaner Tail.	0.93	1.37	10.0	0.3	1.2
9. Zn 2nd Cleaner Tail.	1.01	1.21	4.76	0.3	0.6
10. Zn 1st Cleaner Tail.	6.25	0.84	2.05	1.4	1.6
11. Zn Rougher Tailing	62.40	0.62	0.74	10.6	5.7
Head (Calculated)	100.00	3.64	8.04	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	2.81	64.4	4.52	49.7	1.6
Products 1 to 3	3.89	53.2	6.03	56.8	2.9
Products 1 to 4	8.08	31.7	8.50	70.3	8.5
Products 1 to 5	17.66	17.7	9.80	85.8	21.5
Products 6 plus 7	11.75	0.49	47.5	1.6	69.4
Products 6 to 8	12.68	0.55	44.7	1.9	70.6
Products 6 to 9	13.69	0.60	41.8	2.2	71.2
Products 6 to 10	19.94	0.68	29.3	3.6	72.8

Test No. 171

Purpose: To investigate the effect of Na₂SiO₃ on lead flotation from sample D-3.

Procedure: Grind and float a series of lead concentrates.

Feed: 2000 grams minus 10 mesh sample D-3.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ SiO ₃ 'D'	Na ₂ CO ₃	ZnSO ₄	R-242	Z-11	MIBC	Grind	Cond.	Froth	
Grind	3.0	-	-	-	-	-	30	-	-	-
Condition	-	-	1.0	-	-	-	-	2	-	7.2
Pb Conc. No.1	-	-	-	0.05	0.05	0.04	-	1	3	-
Pb Conc. No.2	-	-	-	0.03	0.03	0.02	-	1	3	-
Pb Conc. No.3	-	-	-	0.02	0.02	0.01	-	1	3	-

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Concentrate No. 1	9.49	30.4	10.4	74.0	12.4
2. Pb Concentrate No. 2	11.08	3.91	8.87	11.1	12.4
3. Pb Concentrate No. 3	7.31	1.91	8.78	3.6	8.1
4. Pb Rougher Tailing	72.12	0.61	7.40	11.3	67.1
Head (calculated)	100.00	3.90	7.95	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	20.57	16.1	9.58	85.1	24.8
Products 1 to 3	27.88	12.4	9.37	88.7	32.9

Test No. 172

Purpose: To investigate the effect of JCD-73 on lead flotation from sample D-3.

Procedure: As for test No. 171.

Feed: 2000 grams minus 10 mesh sample D-3.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	JCD-73	Na ₂ CO ₃	ZnSO ₄	R-242	Z-11	MIBC	Grind	Cond.	Froth	
Grind	0.50	-	-	-	-	-	30	-	-	-
Condition	-	0.5	1.0	-	-	-	-	2	-	7.6
Pb Conc. No.1	-	-	-	0.05	0.05	0.03	-	1	3	-
Pb Conc. No.2	-	-	-	0.02	0.02	0.01	-	1	3	-
Pb Conc. No.3	-	-	-	0.01	0.01	0.01	-	1	3	-

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Concentrate No. 1	11.25	28.0	9.08	81.0	12.9
2. Pb Concentrate No. 2	8.25	3.23	8.71	6.9	9.1
3. Pb Concentrate No. 3	4.75	1.78	8.96	2.2	5.4
4. Pb Rougher Tailing	75.75	0.51	7.62	9.9	72.6
Head (calculated)	100.00	3.89	7.94	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	19.50	17.5	8.92	87.9	22.0
Products 1 to 3	24.25	14.4	8.93	90.1	27.4

Test No. 173

Purpose: To investigate the effect of Aero Depressant 610 on lead flotation from sample D-3.

Procedure: As for test No. 171.

Feed: 2000 grams minus 10 mesh sample D-3.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Aero 610	Na ₂ CO ₃	ZnSO ₄	R-242	Z-11	MIBC	Grind	Cond.	Froth	
Grind	0.5	-	-	-	-	-	30	-	-	-
Condition	-	0.5	1.0	-	-	-	-	2	-	-
Pb Conc. No.1	-	-	-	0.05	0.05	0.03	-	1	3	7.8
Pb Conc. No.2	-	-	-	0.02	0.02	0.01	-	1	3	-
Pb Conc. No.3	-	-	-	0.01	0.01	0.01	-	1	3	-

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Concentrate No.1	7.72	38.6	9.20	77.2	9.1
2. Pb Concentrate No.2	8.70	3.82	7.80	8.6	8.7
3. Pb Concentrate No.3	6.28	1.74	7.99	2.8	6.4
4. Pb Rougher Tailing	77.30	0.57	7.64	11.4	75.8
Head (calculated)	100.00	3.86	7.80	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	16.42	20.2	8.46	85.8	17.8
Products 1 to 3	22.70	15.1	8.33	88.6	24.2

Test No. 174

Purpose: To investigate the effect of CMC-6CTL on lead flotation from sample D-3.

Procedure: As for test No. 171.

Feed: 2000 grams minus 10 mesh sample D-3.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	CMC-6CTL	Na ₂ CO ₃	ZnSO ₄	R-242	Z-11	MIBC	Grind	Cond.	Froth	
Grind	1.0	-	-	-	-	-	30	-	-	-
Condition	-	0.5	1.0	-	-	-	-	2	-	7.7
Pb Conc. No.1	-	-	-	0.05	0.05	0.03	-	1	3	-
Pb Conc. No.2	-	-	-	0.02	0.02	0.01	-	1	3	-
Pb Conc. No.3	-	-	-	0.01	0.01	0.01	-	1	3	-

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Concentrate No. 1	12.23	25.2	8.71	77.4	13.3
2. Pb Concentrate No. 2	8.86	3.72	8.19	8.3	9.1
3. Pb Concentrate No. 3	4.00	2.85	9.94	2.9	5.0
4. Pb Rougher Tailing	74.91	0.61	7.77	11.4	72.6
Head (calculated)	100.00	3.98	8.01	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	21.09	16.2	8.49	85.7	22.4
Products 1 to 3	25.09	14.1	8.72	88.6	27.4

Test No. 175

Purpose: To investigate the effect of Na_2SiO_3 in the zinc circuit while omitting the zinc regrind. Also regrind zinc tailing and scavenge.

Procedure: Grind and float a lead concentrate. Regrind the lead concentrate and clean twice. Combine the lead rougher and 1st cleaner tailings and float a zinc rougher concentrate. Regrind the zinc rougher tailings and scavenge zinc. Clean the zinc rougher concentrate.

Feed: 2000 grams minus 10 mesh sample H-3.

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

Conditions:

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Na_2CO_3	ZnSO_4	NaCN	R-242	Z-4	MIBC	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	0.01	-	1	3	9.7
	-	-	-	0.01	0.01	0.005	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb Conc. Regrind	1.0	0.5	0.20	0.03	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	9.7
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3	9.9
Combine lead rougher and 1st cleaner tailings for zinc flotation.										

Test No. 175 - Continued

Conditions - Continued

Stage	Reagents Added, pounds per ton							Time, minutes			pH
	Ca-(OH) ₂	CuSO ₄	Na ₂ -SiO ₃	Z-200	Z-4	DF-1012	Na ₂ S	Grind	Cond.	Froth	
Condition	2.0	1.0	0.5	-	-	-	-	-	2	-	-
Zn Rougher	-	-	-	0.02	0.04	0.01	-	-	1	3	11.0
	-	0.2	-	0.02	0.02	0.005	-	-	1	3	-
De-water zinc rougher tailing and Re grind.											
Secondary Re grind	-	-	-	-	-	-	-	30	-	-	-
Condition	1.0	0.5	0.2	-	-	-	-	-	2	-	-
Zn Scav. Conc. 1	-	-	-	0.02	0.04	0.01	-	-	1	3	11.0
Zn Scav. Conc. 2	-	-	-	-	0.10	-	0.5	-	2	3	-
Zn 1st Cleaner	0.3	-	0.2	-	-	-	-	-	1	2	11.2
	-	-	-	0.01	-	-	-	-	1	2	-
Zn 2nd Cleaner	0.2	-	0.2	-	-	-	-	-	1	2	11.3
	-	-	-	0.005	-	-	-	-	1	1	-
Zn 3rd Cleaner	0.2	-	0.1	-	-	-	-	-	1	2½	-
Zn 4th Cleaner	0.2	-	-	-	-	-	-	-	1	2	11.5

Test No. 175 - Continued

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	4.77	51.2	5.26	83.4	4.0
2. Pb 2nd Cleaner Tailing	3.77	4.32	9.09	5.6	5.5
3. Zn Cleaner Concentrate	7.05	0.33	53.4	0.8	60.2
4. Zn 4th Cleaner Tailing	1.35	0.65	27.1	0.3	5.9
5. Zn 3rd Cleaner Tailing	1.10	0.98	18.3	0.4	3.2
6. Zn 2nd Cleaner Tailing	1.62	0.97	8.38	0.5	2.2
7. Zn 1st Cleaner Tailing	5.35	0.61	2.83	1.1	2.4
8. Zn Scav. Conc. No. 1	9.26	0.92	2.78	2.9	4.1
9. Zn Scav. Conc. No. 2	16.53	0.32	0.92	1.8	2.4
10. Zn Scavenger Tailing	49.20	0.19	1.28	3.2	10.1
Head (calculated)	100.00	2.93	6.25	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	8.54	30.5	6.95	89.0	9.5
Products 3 plus 4	8.40	0.38	49.2	1.1	66.1
Products 3 to 5	9.50	0.45	45.6	1.5	69.3
Products 3 to 6	11.12	0.53	40.2	2.0	71.5
Products 3 to 7	16.47	0.55	28.0	3.1	73.9
Products 8 plus 9	25.79	0.54	1.59	4.7	6.5
Products 3 to 9	42.26	0.54	11.9	7.8	80.4
Products 8 to 10	74.99	0.31	1.39	7.9	16.6

Screen Analysis - Zn Scavenger Product

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	0.1	0.1	99.9
100	0.2	0.3	99.7
150	0.6	0.9	99.1
200	2.8	3.7	96.3
270	4.6	8.3	91.7
400	14.0	22.3	77.7
- 400	77.7	100.0	-
Total	100.0	-	-

Test No. 176

Purpose: To investigate the use of Cyanamid Depressant 610 in the flotation and cleaning of lead from sample D-3.

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

Feed: 2000 grams minus 10 mesh sample D-3.

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	610	R-242	Z-4	MIBC	Grind	Cond.	Froth	
Grind	3.0	1.0	0.30	0.5	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	-	0.03	0.05	0.03	-	1	3	9.7
	-	-	-	-	0.01	0.025	-	-	1	3	-
	-	-	-	-	0.01	0.025	-	-	1	3	-
Pb Conc. Regrind	1.0	0.5	0.20	0.25	0.03	0.02	-	20	-	-	-
Pb 1st Cleaner	-	-	-	-	-	0.04	-	-	1	3	9.8
	-	-	-	-	0.01	0.02	-	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	-	1	2	9.9
	-	-	-	-	0.005	0.02	-	-	1	2	-
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	-	1	2	10.0
	-	-	-	-	0.005	0.005	-	-	-	1	-
Pb 4th Cleaner	0.2	-	0.05	-	-	0.005	-	-	1	2	10.0

Test No. 176 - Continued

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	1.04	71.0	3.04	20.1	0.4
2. Pb 4th Cleaner Tailing	0.77	53.2	5.84	11.2	0.6
3. Pb 3rd Cleaner Tailing	1.04	33.8	8.57	9.6	1.1
4. Pb 2nd Cleaner Tailing	3.93	17.0	10.1	18.2	5.0
5. Pb 1st Cleaner Tailing	9.75	9.46	10.3	25.1	12.8
6. Pb Rougher Tailing	83.47	0.70	7.55	15.8	80.1
Head (calculated)	100.00	3.67	7.87	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	1.81	63.4	4.23	31.3	1.0
Products 1 to 3	2.85	52.6	5.81	40.9	2.1
Products 1 to 4	6.78	32.0	8.30	59.1	7.1
Products 1 to 5	16.53	18.7	9.48	84.2	19.9

Test No. 177

Purpose: To repeat the lead rougher conditions of test No. 173, and investigate the effect of cleaning the lead and zinc concentrates.

Procedure: See flowsheet.

Feed: 2000 grams minus 10 mesh sample D-3.

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

Conditions:

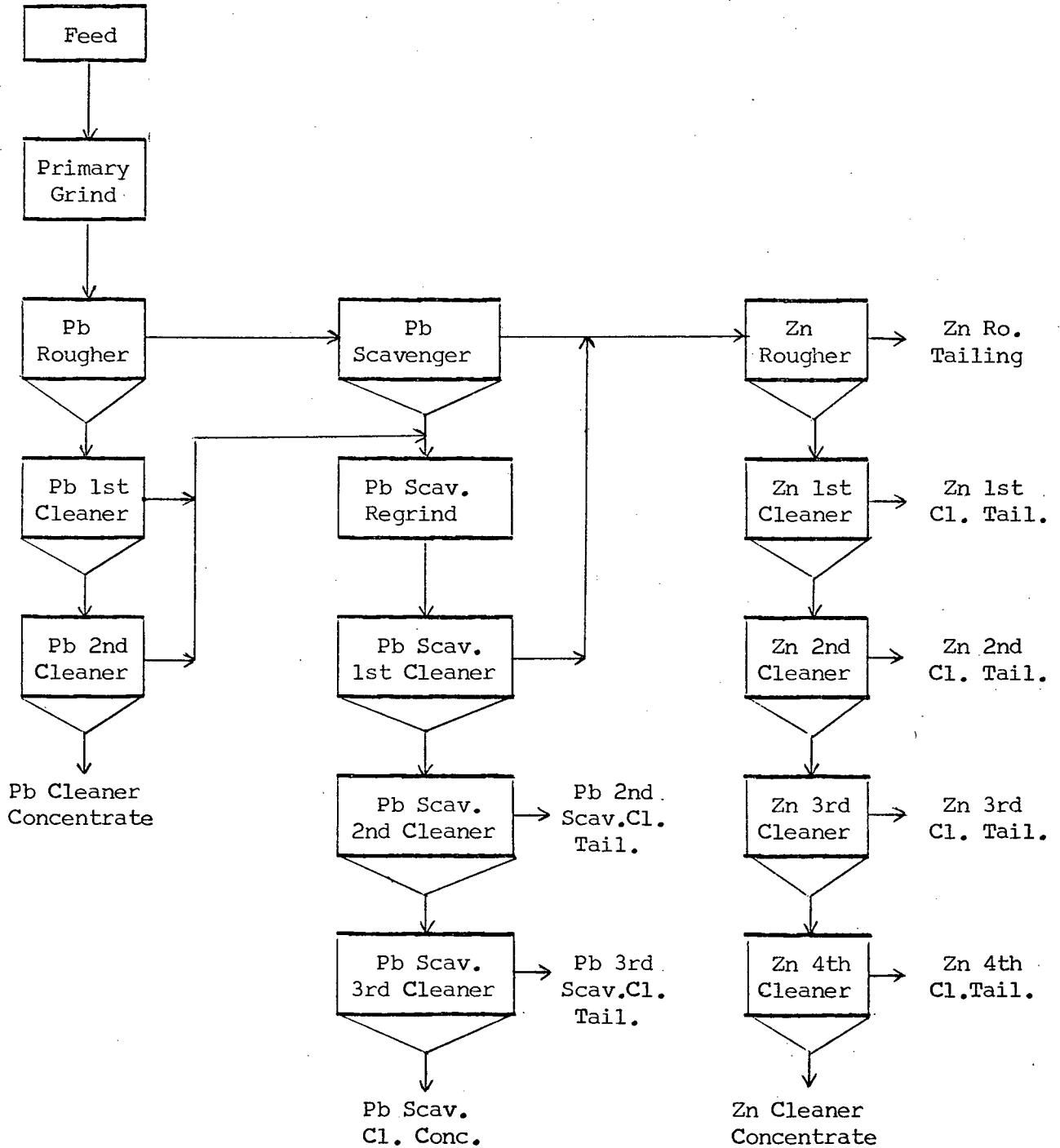
Stage	Reagents Added, pounds per ton							Time, minutes			pH
	Aero 610	Na ₂ CO ₃	ZnSO ₄	R-242	Z-4	MIBC	ZnSO ₄ /KCN*	Grind	Cond.	Froth	
Primary Grind Condition	0.5	-	-	-	-	-	-	30	-	-	-
Pb Rougher	-	0.5	1.0	-	-	-	-	-	2	-	7.5
Pb Scavenger	-	-	-	0.07	0.05	0.03	-	-	1	3	-
Pb Ro. 1st Cl.	-	-	-	0.01	0.02	-	-	-	1	3	-
Pb Ro. 2nd Cl.	-	-	-	0.02	0.03	-	-	-	1	5	-
Pb Ro. 1st Cl.	-	-	-	0.01	0.01	-	0.30	-	1	2	9.3
Pb Ro. 2nd Cl.	-	-	-	0.01	-	-	0.15	-	1	1½	9.5
Combine lead scavenger concentrate and lead rougher 1st and 2nd cleaner tailings.											
Pb Scav. Re grind	-	-	-	0.02	-	-	0.30	15	-	-	-
Pb Scav. 1st Cl.	-	-	-	0.01	0.01	-	-	-	1	3	8.8
Pb Scav. 2nd Cl.	-	-	-	0.005	0.005	-	-	-	1	2	-
Pb Scav. 2nd Cl.	-	-	-	-	-	-	0.10	-	1	2	9.1
Pb Scav. 3rd Cl.	-	-	-	0.005	0.005	-	-	-	1	1	-
Pb Scav. 3rd Cl.	-	-	-	0.005	-	-	0.05	-	1	2	9.0

* ZnSO₄/KCN = 3/1

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	Z-200	Z-4	MIBC	Grind	Cond.	Froth	
Combine lead scavenger and scavenger 1st cleaner tailings.									
Condition	2.0	1.0	-	-	-	-	2	-	-
Zn Rougher	-	-	0.02	0.04	0.01	-	1	3	10.9
Zn 1st Cleaner	-	0.5	0.02	0.02	0.02	-	1	3	-
Zn 1st Cleaner	0.3	-	-	-	-	-	1	2	11.1
Zn 2nd Cleaner	-	-	0.01	-	-	-	1	2	-
Zn 2nd Cleaner	0.2	-	-	-	0.005	-	1	2	11.2
Zn 3rd Cleaner	-	-	0.005	-	-	-	1	1	-
Zn 3rd Cleaner	0.2	-	-	-	0.005	-	1	2½	11.2
Zn 4th Cleaner	0.2	-	-	-	0.005	-	1	2	11.3

Test No. 177 - Continued

Flowsheet



Test No. 177 - Continued

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	3.35	60.2	7.25	54.7	3.1
2. Pb Scav. Cleaner Conc.	0.95	50.1	7.73	12.9	0.9
3. Pb Scav. 3rd Cl. Tail.	1.24	21.0	10.7	7.1	1.7
4. Pb Scav. 2nd Cl. Tail.	2.28	9.04	10.1	5.6	2.9
5. Zn Cleaner Concentrate	12.03	0.75	49.3	2.4	75.8
6. Zn 4th Cleaner Tailing	2.30	2.27	14.3	1.4	4.2
7. Zn 3rd Cleaner Tailing	2.37	2.51	9.42	1.6	2.9
8. Zn 2nd Cleaner Tailing	5.48	2.15	5.26	3.2	3.6
9. Zn 1st Cleaner Tailing	10.67	0.94	1.44	2.7	2.0
10. Zn Rougher Tailing	59.33	0.52	0.38	8.4	2.9
Head (calculated)	100.00	3.69	7.83	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	4.30	58.0	7.36	67.6	4.0
Products 1 to 3	5.54	49.7	8.10	74.7	5.7
Products 1 to 4	7.82	37.8	8.69	80.3	8.6
Products 5 plus 6	14.33	0.99	43.7	3.8	80.0
Products 5 to 7	16.70	1.21	38.8	5.4	82.9
Products 5 to 8	22.18	1.44	30.5	8.6	86.5
Products 5 to 9	32.85	1.28	21.1	11.3	88.5

Test No. 178

Purpose: To perform a six-stage locked cycle test on sample H-3 following the rougher and cleaner procedure of test No. 175.

Procedure: See flowsheet.

Feed: Six 2000 gram charges minus 10 mesh sample H-3.

Grind: 30 minutes per charge 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	R-242	Z-4	MIBC	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	0.07	-	-	30	-	-	-
	-	-	-	0.01	0.02	0.005	-	1	3	9.7
	-	-	-	0.01	0.01	0.005	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb Conc. Re grind	1.0	0.5	0.20	0.03	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	9.9
	-	-	-	0.005	0.01	-	-	1	3	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3	10.0
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	2	10.0

Stage	Rougher	Pb Re grind	Pb 1st & 2nd Cl.	Pb 3rd Cleaner
Equipment	1000 g D-1	Lab. Rod Mill	500 g D-1	250 g D-1
Speed: r.p.m.	1800		1300	1000
% Solids	33			

Zn Circuit

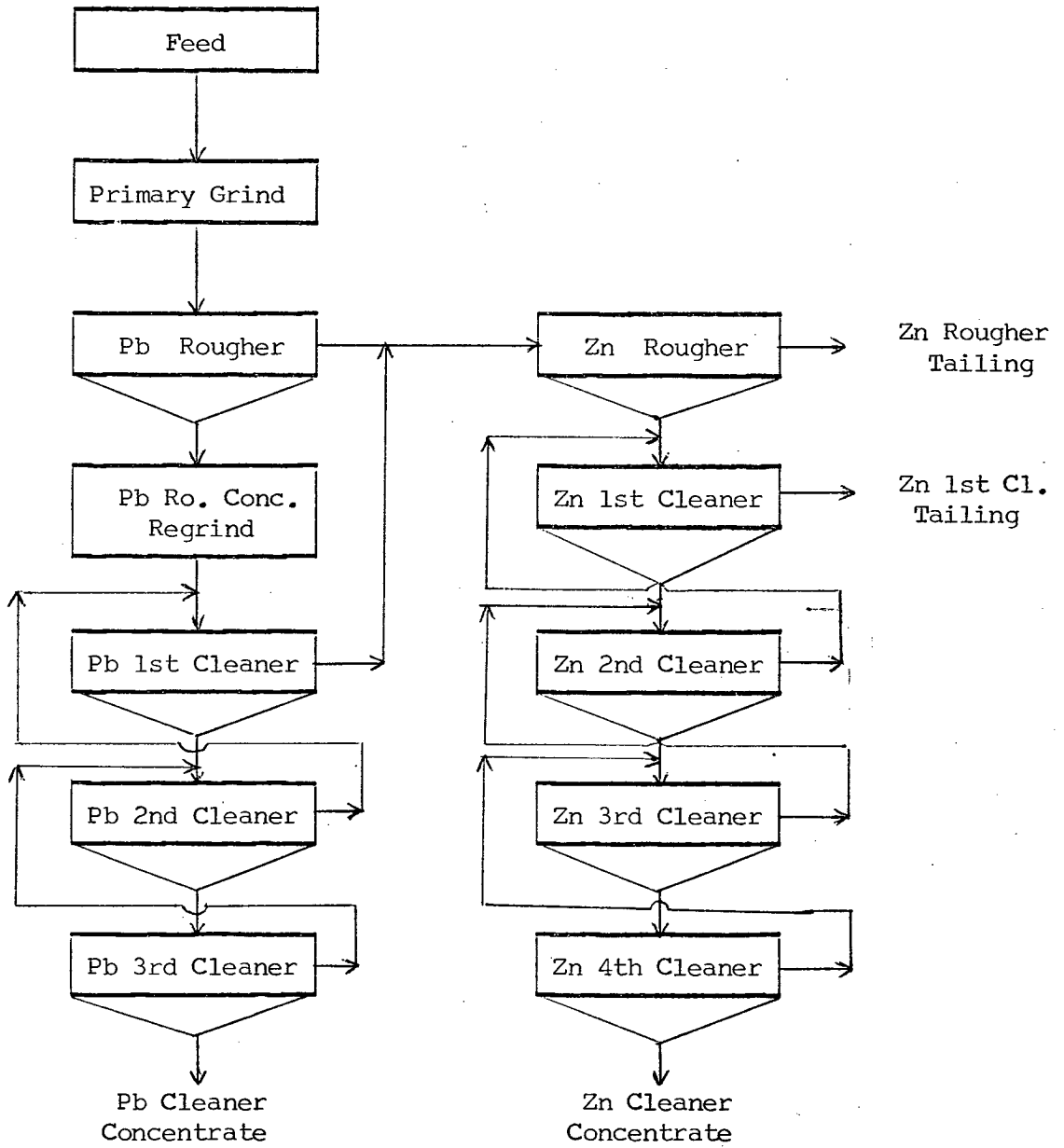
Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	Na ₂ SiO ₃	Z-200	Z-4	Tee.A*	Grind	Cond.	Froth	
Condition	1.5	1.0	0.5	-	-	-	-	2	-	10.8
Zn Rougher	-	-	-	0.02	0.04	0.015	-	1	3	-
	-	-	-	0.02	0.02	0.005	-	1	3	-
Zn 1st Cleaner	0.23	-	0.2	-	-	-	-	1	2	11.4
	-	-	-	0.01	-	-	-	1	2	-
Zn 2nd Cleaner	0.15	-	0.2	0.005	-	-	-	1	3	11.4
Zn 3rd Cleaner	0.12	-	0.1	-	-	-	-	1	2½	11.5
Zn 4th Cleaner	0.09	-	0.1	-	-	-	-	1	2	11.5

* Teefroth 'A'

Stage	Zn Rougher	Zn 1st & 2nd Cl.	Zn 3rd & 4th Cl.
Flotation Cell	1000 g D-1	500 g D-1	250 g D-1
Speed: r.p.m.	1800	1300	1000

Test No. 178 - Continued

Flowsheet



Test No. 178 - Continued

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc. A	0.53	70.8	3.02	12.5	0.3
2. Pb Cleaner Conc. B	0.59	67.3	3.52	13.2	0.3
3. Pb Cleaner Conc. C	0.75	60.0	4.85	15.0	0.6
4. Pb Cleaner Conc. D	0.72	60.3	4.70	14.5	0.5
5. Pb Cleaner Conc. E	0.72	60.3	4.77	14.5	0.6
6. Pb Cleaner Conc. F	0.75	58.0	4.98	14.5	0.6
7. Pb 3rd Cleaner Tail. F	0.26	9.84	10.0	0.9	0.4
8. Pb 2nd Cleaner Tail. F	0.87	4.92	9.64	1.4	1.4
9. Pb 1st Cleaner Tail. F	2.37	1.32	8.57	1.0	3.2
10. Zn Cleaner Conc. A	1.45	0.34	41.4	0.2	9.7
11. Zn Cleaner Conc. B	1.14	0.54	53.5	0.2	9.9
12. Zn Cleaner Conc. C	1.68	0.67	45.9	0.4	12.4
13. Zn Cleaner Conc. D	1.51	0.70	48.6	0.4	11.8
14. Zn Cleaner Conc. E	1.62	0.71	46.7	0.4	11.8
15. Zn Cleaner Conc. F	1.43	0.60	51.7	0.3	11.9
16. Zn 4th Cleaner Tail. F	0.09	1.76	24.9	0.1	0.4
17. Zn 3rd Cleaner Tail. F	0.49	1.35	17.2	0.2	1.3
18. Zn 2nd Cleaner Tail. F	0.46	1.56	11.9	0.2	0.9
19. Zn 1st Cleaner Tail. A	1.32	0.46	1.92	0.2	0.4
20. Zn 1st Cleaner Tail. B	1.91	0.68	2.93	0.4	0.9
21. Zn 1st Cleaner Tail. C	1.26	0.76	3.02	0.3	0.6
22. Zn 1st Cleaner Tail. D	1.13	0.85	3.56	0.3	0.6
23. Zn 1st Cleaner Tail. E	0.88	1.13	4.96	0.3	0.7
24. Zn 1st Cleaner Tail. F	1.13	0.99	4.13	0.4	0.8
25. Zn Rougher Tailing A	9.40	0.27	1.36	0.8	2.1
26. Zn Rougher Tailing B	13.26	0.36	1.48	1.6	3.1
27. Zn Rougher Tailing C	12.56	0.34	1.43	1.4	2.9
28. Zn Rougher Tailing D	13.21	0.31	1.47	1.4	3.1
29. Zn Rougher Tailing E	13.36	0.34	1.52	1.5	3.3
30. Zn Rougher Tailing F	13.15	0.34	1.46	1.5	3.1
Head (calculated)	100.00	3.00	6.21	100.0	100.0

Test No. 178 - Continued

Metallurgical Results - Continued

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
Combined Pb Cl. Conc.	4.06	62.2	4.40	84.2	2.9
Combined Pb Cl. Tailings	3.50	2.85	8.94	3.3	5.0
Combined Zn Cl. Conc.	8.83	0.60	47.7	1.9	67.9
Combined Zn Cl. Tailings	1.04	1.48	15.5	0.5	2.6
Combined Zn 1st Cl. Tails.	7.63	0.78	3.28	1.9	4.0
Combined Zn Rougher Tails.	74.94	0.33	1.46	8.2	17.6
Head (calculated)	100.00	3.00	6.21	100.0	100.0

Projected Results of Cycles E and F (based on concentrate weights and assays, tailing weights and assays, calculated by difference)

Pb Cleaner Concentrate	4.40	59.1	4.87	86.7	3.5
Zn Cleaner Concentrate	9.15	0.66	49.0	2.0	72.2
Zn 1st Cleaner Tailing	6.39	1.05	4.49	2.2	4.6
Zn Rougher Tailing	80.06	0.34	1.53	9.1	19.7
Head	100.00	3.00	6.21	100.0	100.0

Test No. 179

Purpose: To investigate the effect of a coarser primary grind on sample H-3.

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

Feed: 2000 grams minus 10 mesh sample H-3.

Grind: 25 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	R-242	Z-4	MIBC	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	0.07	-	-	25	-	-	-
Pb Rougher	-	-	-	0.01	0.02	0.005	-	1	3	9.9
	-	-	-	0.01	0.01	0.005	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb Conc. Regrind	1.0	0.5	0.20	0.02	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	9.8
	-	-	-	0.01	0.01	-	-	1	2	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3	9.9
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	2	10.0

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

Test No. 179 - Continued

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	3.30	63.3	4.04	70.0	2.2
2. Pb 3rd Cleaner Tailing	1.05	24.1	8.62	8.5	1.5
3. Pb 2nd Cleaner Tailing	3.40	6.33	8.99	7.2	5.0
4. Pb 1st Cleaner Tailing	11.46	1.10	8.20	4.2	15.4
5. Pb Rougher Tailing	80.79	0.37	5.74	10.1	75.9
Head (calculated)	100.00	2.98	6.11	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	4.35	53.8	6.16	78.5	3.7
Products 1 to 3	7.75	33.0	6.83	85.7	8.7
Products 1 to 4	19.21	14.0	7.65	89.9	24.1

Screen Analysis - 25 Minute Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	0.2	0.2	99.8
100	1.3	1.5	98.5
150	5.5	7.0	93.0
200	14.8	21.8	79.2
270	12.3	34.1	65.9
400	18.1	47.8	52.2
- 400	52.2	100.0	-
Total	100.0	-	-

Test No. 180

Purpose: To repeat test No. 179, but with a still coarser primary grind.

Procedure: As for test No. 179.

Feed: 2000 grams minus 10 mesh sample H-3.

Grind: 20 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	R-242	Z-4	MIBC	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	0.07	-	-	20	-	-	-
Pb Rougher	-	-	-	0.01	0.02	0.005	-	1	3	10.0
	-	-	-	0.01	0.01	0.005	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb Conc. Re grind	1.0	0.5	0.20	0.02	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	9.9
	-	-	-	0.01	0.01	-	-	1	2	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3	10.0
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	2	10.1

Test No. 180 - Continued

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	3.01	65.9	3.89	67.1	2.0
2. Pb 3rd Cleaner Tailing	1.15	25.9	8.92	10.1	1.7
3. Pb 2nd Cleaner Tailing	3.42	6.06	9.08	7.0	5.2
4. Pb 1st Cleaner Tailing	11.23	1.21	8.11	4.6	15.3
5. Pb Rougher Tailing	81.19	0.41	5.57	11.2	75.8
Head (calculated)	100.00	2.96	5.96	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	4.16	54.8	5.28	77.2	3.7
Products 1 to 3	7.58	32.8	6.99	84.2	8.9
Products 1 to 4	18.81	14.0	7.66	88.8	24.2

Screen Analysis - 20 Minute Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	1.2	1.2	98.8
100	3.7	4.9	95.1
150	9.6	14.5	85.5
200	17.4	31.9	68.1
270	11.4	43.3	56.7
400	15.6	58.9	41.1
- 400	41.1	100.0	-
Total	100.0	-	-

Test No. 181

Purpose: To investigate the effect of adding 242 to the cell rather than to the mill.

Procedure: As for test No. 179, except for the point of addition of 242.

Feed: 2000 grams minus 10 mesh sample H-3.

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	R-242	Z-4	MIBC	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	-	-	-	30	-	-	-
Pb Rougher	-	-	-	0.03	0.03	0.015	-	1	3	9.8
	-	-	-	0.01	0.01	0.005	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb Conc. Re grind	1.0	0.5	0.20	-	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	0.01	0.01	-	-	1	3	9.8
	-	-	-	0.01	0.01	-	-	1	2	-
Pb 2nd Cleaner	0.3	0.2	0.10	0.005	-	-	-	1	3	9.8
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	0.005	-	1	2	9.9

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	2.11	62.1	3.84	44.3	1.4
2. Pb 3rd Cleaner Tailing	1.20	35.1	6.80	14.2	1.4
3. Pb 2nd Cleaner Tailing	4.16	13.6	8.12	19.1	5.7
4. Pb 1st Cleaner Tailing	11.76	3.01	7.85	12.0	15.5
5. Pb Rougher Tailing	80.77	0.38	5.63	10.4	76.0
Head (calculated)	100.00	2.96	5.97	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	3.31	52.3	4.91	58.5	2.8
Products 1 to 3	7.47	30.8	6.70	77.6	8.5
Products 1 to 4	19.23	13.8	7.40	89.6	24.0

Test No. 182

Purpose: To investigate the effect of decreasing the Na₂CO₃ additions to the lead circuit.

Procedure: As for test No. 179.

Feed: 2000 grams minus 10 mesh sample H-3.

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	R-242	Z-4	MIBC	Grind	Cond.	Froth	
Primary Grind	1.5	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	0.01	-	1	3	8.8
	-	-	-	0.01	0.01	0.005	-	1	3	-
	-	-	-	0.01	0.01	0.005	-	1	3	-
Pb Conc. Re grind	0.5	0.5	0.20	0.02	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	9.0
	-	-	-	0.01	0.01	-	-	1	2	-
Pb 2nd Cleaner	0.15	0.2	0.10	-	-	0.005	-	1	3	9.2
Pb 3rd Cleaner	0.10	0.1	0.05	-	-	-	-	1	2	9.3

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	4.22	58.1	4.97	81.8	3.5
2. Pb 3rd Cleaner Tailing	1.05	10.3	9.28	3.6	1.6
3. Pb 2nd Cleaner Tailing	3.45	3.36	8.26	3.9	4.8
4. Pb 1st Cleaner Tailing	12.91	0.80	7.24	3.4	15.6
5. Pb Rougher Tailing	78.37	0.28	5.70	7.3	74.5
Head (calculated)	100.00	3.00	5.99	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	5.27	48.6	5.83	85.4	5.1
Products 1 to 3	8.72	30.7	6.79	89.3	9.9
Products 1 to 4	21.63	12.8	7.06	92.7	25.5

Test No. 183

Purpose: To investigate the effect of omitting entirely the Na_2CO_3 from the lead circuit.

Procedure: As for test No. 179.

Feed: 2000 grams minus 10 mesh sample H-3.

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

Conditions:

Stage	Reagents Added, pounds per ton					Time, minutes			pH
	ZnSO ₄	NaCN	R-242	Z-4	MIBC	Grind	Cond.	Froth	
Primary Grind	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	0.01	0.02	0.02	-	1	3	7.5
	-	-	0.01	0.01	-	-	1	3	-
	-	-	0.01	0.01	-	-	1	3	-
Pb Conc. Re grind	0.5	0.20	0.02	-	-	30	-	-	-
Pb 1st Cleaner	-	-	-	0.01	-	-	1	3	8.2
	-	-	0.01	0.01	-	-	1	2	-
Pb 2nd Cleaner	0.2	0.10	0.005	0.005	-	-	1	3	8.5
Pb 3rd Cleaner	0.1	0.05	-	-	-	-	1	2	8.6

Flotation very unselective, particularly in the cleaner stages.

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	0.59	25.7	4.90	5.1	0.5
2. Pb 3rd Cleaner Tailing	1.26	15.8	5.79	6.6	1.2
3. Pb 2nd Cleaner Tailing	6.35	11.2	6.33	23.7	6.7
4. Pb 1st Cleaner Tailing	15.68	11.2	7.10	58.5	18.6
5. Pb Rougher Tailing	76.12	0.24	5.72	6.1	73.0
Head (calculated)	100.00	3.00	5.97	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	1.85	19.0	5.51	11.7	1.7
Products 1 to 3	8.20	12.9	6.15	35.4	8.4
Products 1 to 4	23.88	11.8	6.77	93.9	27.0

Test No. 184

Purpose: To investigate the effect of omitting cyanide from the lead circuit and of reducing Na₂CO₃ addition to the primary grind.

Procedure: As for test No. 181.

Feed: 2000 grams minus 10 mesh sample H-3.

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	R-242	Z-4	MIBC	Grind	Cond.	Froth	
Primary Grind	2.0	1.0	-	-	-	30	-	-	-
Pb Rougher	-	-	0.03	0.03	0.02	-	1	3	9.1
	-	-	0.01	0.01	0.005	-	1	3	-
	-	-	0.01	0.01	0.005	-	1	3	-
Pb Conc. Re grind	1.0	0.5	-	-	-	30	-	-	-
Pb 1st Cleaner	-	-	0.01	0.01	0.005	-	1	3	9.5
	-	-	0.01	0.01	-	-	1	2	-
Pb 2nd Cleaner	0.3	0.2	0.005	-	-	-	1	3	9.5
Pb 3rd Cleaner	0.2	0.1	-	-	-	-	1	2	9.6

Metallurgical Results

Product	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	4.41	42.0	5.08	63.7	3.7
2. Pb 3rd Cleaner Tailing	2.28	12.7	6.32	10.0	2.4
3. Pb 2nd Cleaner Tailing	6.57	4.13	6.20	9.3	6.8
4. Pb 1st Cleaner Tailing	16.26	1.46	6.87	8.2	18.6
5. Pb Rougher Tailing	70.48	0.35	5.85	8.8	68.5
Head (calculated)	100.00	2.91	6.02	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	6.69	32.2	5.51	73.7	6.1
Products 1 to 3	13.26	18.3	5.85	83.0	12.9
Products 1 to 4	29.52	9.01	6.41	91.2	31.5

Test No. 185

Purpose: To investigate the effect of a coarser regrind on lead grade and recovery.

Procedure: As for test No. 179.

Feed: 2000 grams minus 10 mesh sample H-3.

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	R-242	Z-4	MIBC	Grind	Cond.	Froth	
Primary Grind	3.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	0.005	-	1	3	9.8
	-	-	-	0.01	0.01	0.005	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb Conc. Regrind	1.0	0.5	0.20	0.02	-	-	15	-	-	-
Pb 1st Cleaner	-	-	-	-	0.01	-	-	1	3	9.9
	-	-	-	0.01	0.01	-	-	1	2	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3	9.9
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	2	10.0

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	4.26	53.1	5.53	75.9	3.9
2. Pb 3rd Cleaner Tailing	1.30	15.2	8.60	6.6	1.9
3. Pb 2nd Cleaner Tailing	4.26	4.70	8.66	6.7	6.2
4. Pb 1st Cleaner Tailing	9.98	0.96	7.77	3.2	12.9
5. Pb Rougher Tailing	80.20	0.28	5.61	7.6	75.1
Head (calculated)	100.00	2.98	5.99	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	5.56	44.2	6.25	82.5	5.8
Products 1 to 3	9.82	27.1	7.29	89.2	12.0
Products 1 to 4	19.80	13.9	7.53	92.4	24.9

Test No. 186

Purpose: To investigate the effect of cleaning the lead concentrate without regrinding.

Procedure: Grind and float a lead rougher concentrate. Clean the concentrate three times.

Feed: 2000 grams minus 10 mesh sample H-3.

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	R-242	Z-4	MIBC	Grind	Cond.	Froth	
Grind	3.0	1.0	0.30	0.07	-	-	30	-	-	-
Pb Rougher	-	-	-	0.01	0.02	0.005	-	1	3	9.8
	-	-	-	0.01	0.01	0.005	-	1	3	-
	-	-	-	0.01	0.01	-	-	1	3	-
Pb 1st Cleaner	0.5	0.3	0.10	-	-	-	-	2	3	9.9
	-	-	-	0.01	0.01	-	-	1	2	-
Pb 2nd Cleaner	0.3	0.2	0.10	-	-	-	-	1	3	9.9
Pb 3rd Cleaner	0.2	0.1	0.05	-	-	-	-	1	2	10.0

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	6.66	30.9	8.44	70.9	9.1
2. Pb 3rd Cleaner Tailing	2.35	10.3	7.92	8.3	3.0
3. Pb 2nd Cleaner Tailing	3.93	6.27	7.42	8.5	4.7
4. Pb 1st Cleaner Tailing	6.34	1.83	7.15	4.0	7.5
5. Pb Rougher Tailing	80.72	0.30	5.77	8.3	75.7
Head (calculated)	100.00	2.91	6.15	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	9.01	25.5	8.31	79.2	12.1
Products 1 to 3	12.94	19.7	8.04	87.7	16.8
Products 1 to 4	19.28	13.8	7.74	91.7	24.3

Test No. 187

Purpose: To repeat test No. 177, but substitute JCD-73 for 610, increase Na₂CO₃ to the grind, and add Na₂SiO₃ to the zinc circuit.

Procedure: As for test No. 177, but clean lead rougher concentrate three times, including lead 3rd rougher cleaner tailing with 1st and 2nd to lead scavenger regrind.

Feed: 2000 grams minus 10 mesh sample D-3.

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

Conditions:

Stage	Reagents Added, pounds per ton							Time, minutes			pH
	JCD-73	Na ₂ CO ₃	ZnSO ₄	R-242	Z-4	MIBC	ZnSO ₄ KCN	Grind	Cond.	Froth	
Primary Grind	0.5	-	-	-	-	-	-	30	-	-	-
Condition	-	1.0	1.0	-	-	-	-	-	2	-	8.8
Pb Rougher	-	-	-	0.07	0.05	0.03	-	-	1	3	-
Pb Scavenger	-	-	-	0.01	0.02	-	-	-	1	3	-
	-	-	-	0.02	0.03	-	-	-	1	5	-
Pb Ro. 1st Cl.	-	-	-	0.01	0.01	-	0.30	-	1	2	9.3
Pb Ro. 2nd Cl.	-	-	-	0.01	-	-	0.15	-	1	1½	9.4
Pb Ro. 3rd Cl.	-	-	-	0.005	-	-	0.10	-	1	1	9.4
Combine lead scavenger concentrate and lead rougher 1st, 2nd and 3rd cleaner tailings.											
Pb Scav. Regrind	-	-	-	0.02	-	-	0.30	15	-	-	-
Pb Scav. 1st Cl.	-	-	-	0.01	0.01	-	-	-	1	3	8.9
	-	-	-	0.005	0.01	-	-	-	1	2	-
Pb Scav. 2nd Cl.	-	-	-	-	-	-	0.10	-	1	2	9.2
	-	-	-	0.005	0.005	-	-	-	1	1	-
Pb Scav. 3rd Cl.	-	-	-	0.005	-	-	0.05	-	1	2	9.3

Test No. 187 - Continued

Conditions - Continued

Stage	Reagents Added, pounds per ton						Time, minutes			pH
	Ca-(OH) ₂	CuSO ₄	Na ₂ -SiO ₃	Z-200	Z-4	MIBC	Grind	Cond.	Froth	
Combine lead scavenger and scavenger 1st cleaner tailings.										
Condition	2.0	1.0	0.5	-	-	-	-	-	-	-
Zn Rougher	-	-	-	0.02	0.04	0.01	-	1	3	11.0
Zn 1st Cleaner	-	0.3	-	0.02	0.02	0.02	-	1	3	-
Zn 2nd Cleaner	0.3	-	0.2	-	-	0.005	-	1	2	11.2
Zn 3rd Cleaner	-	-	-	0.01	-	-	-	1	2	-
Zn 4th Cleaner	0.2	-	0.1	-	-	0.005	-	1	2	11.2
Zn 5th Cleaner	-	-	-	0.005	-	-	-	1	1	-
Zn 6th Cleaner	0.2	-	0.1	-	-	0.005	-	1	2½	11.3
Zn 7th Cleaner	0.2	-	0.1	-	-	0.005	-	1	2	11.3

Test No. 187 - Continued

Metallurgical Results

Products	Weight %	Assays, %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Concentrate	2.64	64.3	6.27	45.7	2.1
2. Pb Scav. Cleaner Conc.	2.31	41.2	9.03	25.6	2.6
3. Pb Scav. 3rd Cl. Tailing	1.57	10.3	11.2	4.4	2.2
4. Pb Scav. 2nd Cl. Tailing	2.54	6.04	11.0	4.1	3.5
5. Zn Cleaner Concentrate	10.02	0.47	54.4	1.3	69.1
6. Zn 4th Cleaner Tailing	1.81	1.86	27.0	0.9	6.2
7. Zn 3rd Cleaner Tailing	2.20	2.53	15.9	1.5	4.4
8. Zn 2nd Cleaner Tailing	3.60	3.53	8.96	3.4	4.1
9. Zn 1st Cleaner Tailing	9.05	1.45	1.85	3.5	2.1
10. Zn Rougher Tailing	64.26	0.55	0.44	9.6	3.7
Head (calculated)	100.00	3.71	7.89	100.0	100.0

Calculated Grades and Recoveries

Products 1 plus 2	4.95	53.5	7.56	71.3	4.7
Products 1 to 3	6.52	43.1	8.44	75.7	6.9
Products 1 to 4	9.06	43.1	9.16	79.8	10.4
Products 5 plus 6	11.83	0.68	50.2	2.2	75.3
Products 5 to 7	14.03	0.97	44.8	3.7	79.7
Products 5 to 8	17.63	1.49	37.5	7.1	83.8
Products 5 to 9	26.68	1.48	25.4	10.6	85.9

LAKEFIELD RESEARCH OF CANADA LIMITED
 Lakefield, Ontario
 June 1, 1977 / tmg, slb

LAKEFIELD RESEARCH OF CANADA LIMITED

JUN 17 1977

Test No: 207 Project No: 1991 Date: June 10th 77 Operator: C.P. and B.T.

Purpose: To perform a locked-cycle test on the overall composite using Z-11 as collector in the lead circuit and Minerex 748 in the zinc circuit.

Procedure: See flowsheet

Feed: Six 2000 gram charges minus 10 mesh Overall Composite No. 1

Grind: 30 minutes per charge at 65% solids in the laboratory ball mill.

Conditions:

	Reagents Added, pounds per ton						Time, minutes			pH
	Na ₂ CO ₃	ZnSO ₄	NaCN	Z-11	MIBC CA	R-242	Grind	Cond.	Froth	
Grind	1.5	0.5	0.30	0.05			30			
Conditioning	0.5	0.5						5		9.3
Pb rougher (1)				0.02	0.05			1	3	
(2)				0.01	0.02			1	3	
(3)				0.01	0.02			1	3	
Pb Conc. Re-grind.	0.5	0.5	0.2			0.03	30			
Pb 1st Cleaner (1)								1	2	9.4
								1	2	
Pb 1st Cl. Sear.	0.3	0.3		0.01		0.01		3	3	9.6
Pb 2nd Cleaner	0.2	0.2	0.1					3	3	9.7
Pb 3rd Cleaner (1)	0.1	0.1	0.05		0.005			3	2½	9.8
(2)										
Pb 4th Cleaner (1)	0.1		0.05					3	2	9.9
(2)										

Stage	Pb Rougher	Pb Re-grind	Pb 1st Cleaner	Pb 2nd to 4th Cleaner
Flotation Cell	1000g D-1	Rad Mill	500g D-1	250g D-1
Speed: r. p. m.	1800		1300	1000
% Solids				
% - mesh				

LAKEFIELD RESEARCH OF CANADA LIMITED

Test No: 207 Project No: 1991 Date: _____ Operator: _____

Purpose: _____

Procedure: _____

Feed: _____

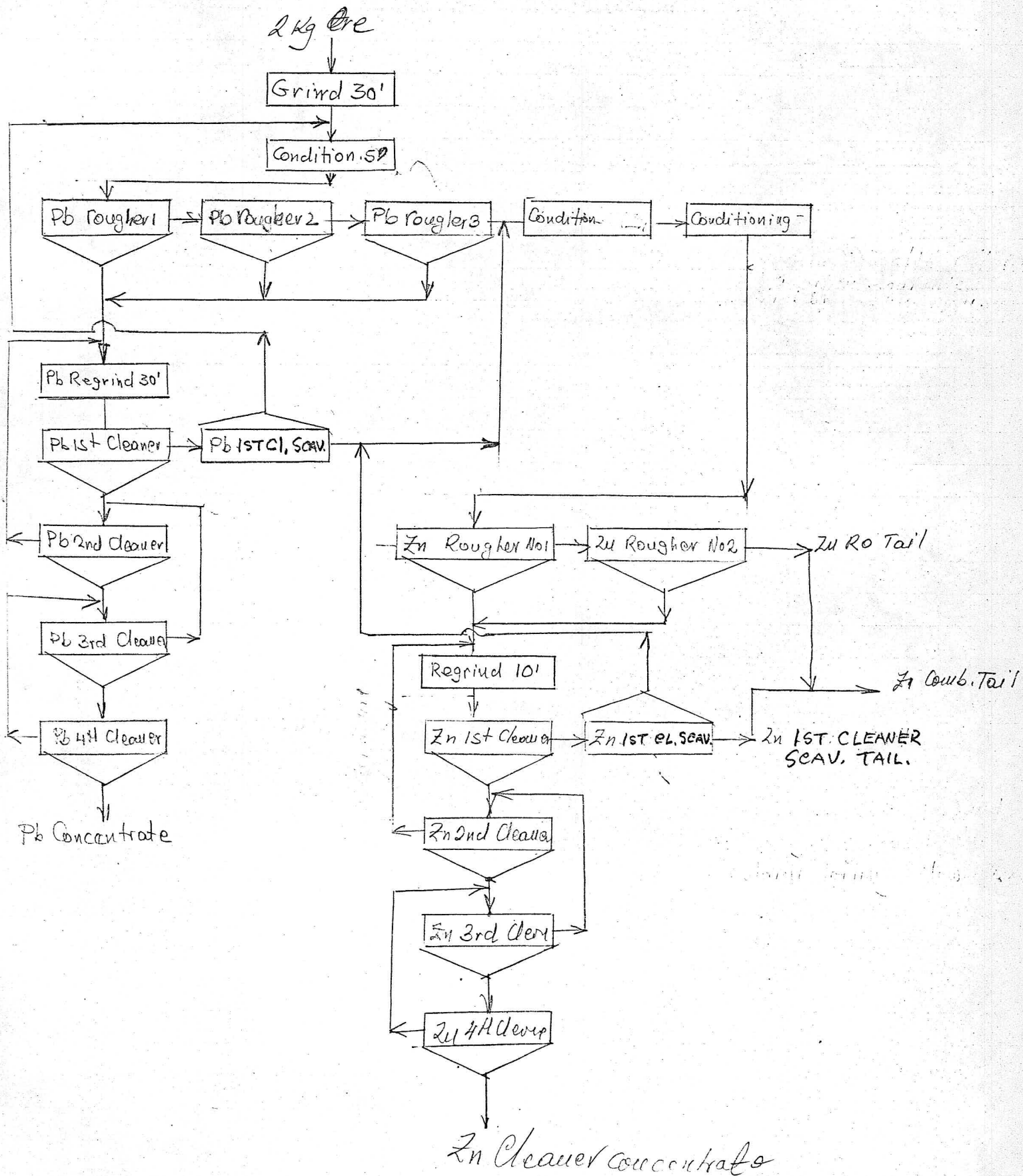
Grind: _____

Conditions: _____

	Reagents Added, pounds per ton							Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	M748	Z-11	MIBC	U ₂ S ₂ O ₈	TEE FROTH A	Grind	Cond.	Froth	
Condition	2.0	1.0							5		11.0
Zn Rougher			0.06		0.02				3	3	
			0.02	0.02	0.01				1	3	
Zn Conc Reor	0.5	0.2	0.02			0.2		10			
Zn 1 st Cleaner							0.005		1	3	11.0
				0.01					1	3	
Zn 1 st Cl Scav				0.03			0.005		1	4	10.6
Zn 2 nd Cleaner	0.15					0.1			1	2	11.1
				0.005	0.005				1	2	
Zn 3 rd Cleaner	0.17				0.005	0.1			1	3 1/2	11.1
Zn 4 th Cleaner	0.18				0.005	0.1			1	3	11.2

Stage	Zn Rougher	Zn Re-grind	Zn Cleaners
Flotation Cell	1000g D-1	Pebble Mill	500g D-1
Speed: r. p. m.	1800		1200
% Solids			

ycle test. - 207



Product	Weight		Assays, %		% Distribution		Metal Units	
	g	%	Pb	Zn	Pb	Zn	Pb	Zn
1. Pb Cleaner Conc. A	54.3	0.45	69.2	3.72	7.7	0.2	31.14	1.67
2. Pb Cleaner Conc. B	91.1	0.75	68.0	4.38	12.6	0.5	51.00	3.28
3. Pb Cleaner Conc. C	99.4	0.82	67.5	4.54	13.6	0.6	55.35	3.72
4. Pb Cleaner Conc. D	104.5	0.86	63.5	5.06	13.5	0.6	54.61	4.35
5. Pb Cleaner Conc. E	99.5	0.82	64.5	4.71	13.0	0.6	52.89	3.86
6. Pb Cleaner Conc. F	92.1	0.77	69.1	4.40	13.1	0.5	53.21	3.39
7. Pb 4th Cleaner Tail F	55.2	0.46	50.0	8.31	5.7	0.6	23.00	3.82
8. Pb 3rd Cleaner Tail F	91.7	0.76	31.5	11.4	5.8	1.3	23.94	8.66
9. Pb 2nd Cleaner Tail F	129.1	1.07	12.3	12.4	3.2	2.0	13.16	13.27
10. Pb 1st Cl. Scav. Conc. F	82.1	0.68	4.49	10.9	0.8	1.1	3.05	7.41
11. Pb 1st Cl. Scav. Tail F	270.7	2.24	1.04	9.57	0.6	3.1	2.33	21.44
12. Zn Cleaner Conc. A	125.4	1.04	0.35	57.4	0.1	8.9	0.36	59.70
13. Zn Cleaner Conc. B	193.5	1.60	0.51	53.3	0.2	12.7	0.92	85.28
14. Zn Cleaner Conc. C	195.8	1.62	0.53	55.2	0.2	13.3	0.86	89.42
15. Zn Cleaner Conc. D	179.0	1.48	0.48	58.2	0.2	12.8	0.71	86.14
1. Zn Cleaner Conc. E	189.3	1.57	0.54	57.2	0.2	13.4	0.85	89.80
2. Zn Cleaner Conc. F	179.9	1.49	0.62	57.7	0.2	12.8	0.92	85.97
3. Zn 4th Cleaner Tail F	46.1	0.38	2.05	41.0	0.2	2.3	0.78	15.58
4. Zn 3rd Cleaner Tail F	83.8	0.69	2.26	25.3	0.4	2.6	1.56	17.47
5. Zn 2nd Cleaner Tail F	104.4	0.86	2.16	12.5	0.5	1.6	1.86	10.75
6. Zn 1st Cl. Scav. Conc. F	61.8	0.51	1.87	5.75	0.2	0.5	0.95	2.93
7. Zn 1st Cl. Scav. Tail A	80.8	0.67	0.40	1.24	0.1	0.1	0.27	0.83
8. Zn 1st Cl. Scav. Tail B	100.0	0.83	0.57	1.52	0.1	0.2	0.47	1.26
9. Zn 1st Cl. Scav. Tail C	89.1	0.74	0.61	1.40	0.1	0.2	0.45	1.04
10. Zn 1st Cl. Scav. Tail D	102.2	0.85	0.66	1.16	0.1	0.1	0.56	0.99
11. Zn 1st Cl. Scav. Tail E	98.5	0.82	0.73	1.29	0.2	0.2	0.60	1.06
12. Zn 1st Cl. Scav. Tail F	104.3	0.86	0.85	1.40	0.2	0.2	0.73	1.20
13. Zn Rougher Tail A	1258.6	10.42	0.34	0.50	0.9	0.8	3.54	5.21
14. Zn Rougher Tail B	1475.9	12.22	0.38	0.62	1.1	1.1	4.64	7.58
15. Zn Rougher Tail C	1521.5	12.59	0.42	0.68	1.3	1.3	5.29	8.56
13. Zn Rougher Tail D	1560.0	12.91	0.41	0.65	1.3	1.2	5.29	8.39
14. Zn Rougher Tail E	1587.7	13.14	0.39	0.66	1.3	1.3	5.12	8.67
15. Zn Rougher Tail F	1573.8	13.03	0.41	0.67	1.3	1.3	5.34	8.73
Head (Calculated)	12,081.1	100.00	4.06	6.71	100.0	100.0	405.65	671.43

Calculated Grades and Recoveries

24652 148936

Combined Pb Cl. Conc.	4.47	66.7	4.53	73.5	3.0	298.20	20.27
Combined Pb Cl. Tail.	5.21	12.6	10.5	16.1	8.1	65.48	54.60
Combined Zn Cl. Conc.	8.80	0.51	56.4	1.1	73.9	4.52	496.31
Combined Zn Cl. Tail.	2.44	2.11	19.1	1.3	7.0	5.15	46.73
Combined Zn Cl. Scav. Tail.	4.77	0.65	1.34	0.8	1.0	3.08	6.38
Combined Zn Rougher Tail	74.31	0.39	0.63	7.2	7.0	29.22	47.14
Combined Zn Final Tail	79.08	0.41	0.68	8.0	8.0	32.30	53.52
Zn Final Tailing A	11.09	0.34	0.54	1.0	0.9	3.21	6.04
Zn Final Tailing B	13.05	0.39	0.68	1.2	1.3	5.11	8.84
Zn Final Tailing C	13.33	0.43	0.72	1.4	1.5	5.74	9.60
Zn Final Tailing D	13.76	0.43	0.68	1.4	1.3	5.85	9.38
Zn Final Tailing E	13.96	0.41	0.70	1.5	1.5	5.72	9.73
Zn Final Tailing F	13.89	0.44	0.71	1.5	1.5	6.07	9.93

LAKEFIELD RESEARCH OF CANADA LIMITED

Test No: 207

Project No: _____

Date: _____

Metallurgical Results

Addition Assays.

Product	Weight		Assays, %					% Distribution				Metal Units			
	g	%	Pb	Zn	As	Hg	Ag*	Pb	Zn			Pb	Zn		
1 Zn Cleaner Conc. A															
2 Zn Cleaner Conc. B															
3 Zn Cleaner Conc. C															
4 Zn Cleaner Conc. D															
5 Zn Cleaner Conc. E															
6 Zn Cleaner Conc. F															
7															
8															
9															
10															
11															
12															
Head calc.)															

*g/ton

Projected Results - Cycles E and F (Noranda procedure)
~~Calculated Grades and Recoveries~~

Pb Cleaner Concentrate	4.77	66.7	4.56				78.4	3.2			318.16	21.75		
Zn Cleaner Concentrate	9.18	0.58	57.4				1.3	78.5			5.32	526.93		
Zn Final Tailing	86.05	0.95	1.43				20.3	18.3			82.17	122.75		
Head	100.00	4.06	6.71				100.0	100.0			405.65	671.43		

