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An Investigation of
THE RECOVERY OF LEAD AND ZINC

from Vangorda Ore samples

submitted by

CURRAGH RESOURCES

Progress Report No. 1

(per R. Coleman, Consultant Mineral Processing)

Project No. L.R. 3458B

NOTE:

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LAKEFIELD RESEARCH
A DIVISION OF FALCONBRIDGE LIMITED
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ABSTRACT

The results of the laboratory testwork on the Vangorda lead-zinc ore are presented in this report. The development work was carried out on seven ore samples prepared according to the mineralogical and geological characteristics of the orebody. The laboratory procedure developed was then incorporated into locked cycle tests yielding the following results.

TABLE NO. 1 : Locked Cycle Test Results on Composites 2, 3, 4, 1B and 1A

Test No.	Product	Comp	Weight %	Assays %, g/t					% Distribution				
				Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
69	Pb Cl Conc	2	6.7	65.4	8.93	4.72	11.2	705	89.3	10.8	1.3	74.4	74.1
	Zn Cl Conc		7.7	1.07	54.7	7.09	0.84	56.9	1.7	76.9	2.2	6.5	7.0
Zn Scav Tail	85.6		0.52	0.79	27.6	0.22	14.0	9.0	12.3	96.5	19.0	18.9	
	Head (Calc)		100.0	4.88	5.51	24.5	1.00	63.4	100.0	100.0	100.0	100.0	100.0
41	Pb Cl Conc	3	5.5	66.2	7.17	4.17	8.56	814	88.4	7.6	1.0	65.0	75.3
	Zn Cl Conc		8.0	1.03	55.3	6.72	0.28	48.5	2.0	85.8	2.4	3.2	6.5
Zn Scav Tail	86.4		0.46	0.40	25.7	0.27	12.6	9.6	6.6	96.6	31.9	18.2	
	Head (Calc)		100.0	4.14	5.19	23.0	0.73	59.7	100.0	100.0	100.0	100.0	100.0
84	Pb Cl Conc	4	2.8	59.2	5.27	5.80	5.22	670	80.9	3.9	2.1	34.1	64.5
	Zn Cl Conc		6.2	0.61	53.6	8.58	0.44	39.1	1.8	88.1	6.8	6.3	8.3
Zn Scav Tail	90.9		0.39	0.33	7.90	0.28	8.8	17.3	8.0	91.1	59.6	27.2	
	Head (Calc)		100.0	2.07	3.80	7.90	0.43	29.4	100.0	100.0	100.0	100.0	100.0
71	Pb Cl Conc	1B	7.6	63.9	7.17	5.56	6.17	701	83.5	8.3	1.5	59.9	70.8
	Zn Cl Conc		9.5	1.03	57.2	6.40	0.31	38.4	1.7	82.2	2.1	3.8	4.8
Zn Scav Tail	82.9		1.05	0.76	33.6	0.34	22.3	14.8	9.5	96.4	36.3	24.4	
	Head (Calc)		100.0	5.85	6.61	28.9	0.79	75.6	100.0	100.0	100.0	100.0	100.0
85	Pb Cl Conc	1A	5.3	43.1	12.6	12.6	10.1	448	61.3	17.0	2.5	70.8	50.7
	Zn Cl Conc		4.5	2.92	52.4	8.70	0.49	73.8	3.5	59.6	1.5	2.9	7.0
Zn Scav Tail	90.2		1.46	1.02	28.0	0.22	22.1	35.2	23.4	96.0	26.3	42.3	
	Head (Calc)		100.0	3.74	3.95	26.3	0.76	47.1	100.0	100.0	100.0	100.0	100.0

Abstract - Continued

With the exception of Composite 1A, the results obtained on the locked cycle tests were considered satisfactory and were comparable to the results obtained on the Faro 3 ore.

From the laboratory testwork results the following conclusions can be made:

a) Respectable concentrate grades and metal recoveries can not be obtained on the Vangorda ore using the current flowsheet and reagent scheme. Modifications in both reagent scheme and flowsheet would be required to obtain high lead and zinc concentrate grades with satisfactory recoveries.

b) Modifier and depressant additions on Vangorda ore would be higher than those currently used in the mill. This is largely attributed to i) the presence of pyrrhotite in the ore and ii) the presence in part of the ore body of carbonaceous pyrite and secondary copper minerals, resulting in high cyanide consumption.

c) The Vangorda ore is slightly softer than Faro No. 3 ore and, for the same power consumption, a slightly finer primary grind may be expected (i.e. $K_{80} = 50 \mu\text{m}$). Slightly finer regrinds of the corresponding lead and zinc concentrates would be beneficial for the concentrate grade.

In this report, the details of the testwork, the results and the problems associated with processing of the ore are described in detail.

INTRODUCTION

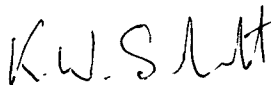
This report describes the metallurgical results obtained on the Vangorda ore during the period May 1988 to December 1988. The scope of the work was described in Mr. B. Scheduling's letter dated April 15, 1988 and discussed with Mr. R. Coleman.

The testwork was to include the following:

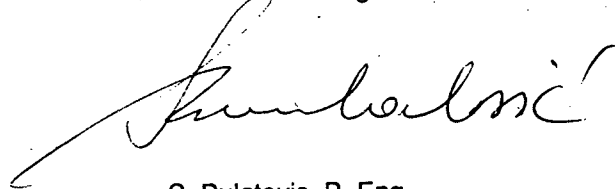
- a) Conduct detailed laboratory testwork on Composite No. 3 ore to evaluate the primary grinding requirements and to test the levels of the reagents currently used in the plant.
- b) Evaluate lead and zinc concentrate regrinding requirements.
- c) Determine the processing characteristics of 6 different ore types.
- d) Conduct final locked cycle tests on the individual composite samples to determine the final metallurgical results.
- e) Conduct impurity smelter analyses on the lead and zinc concentrates from the locked cycle tests.
- f) Identify the potential processing problems of the various ore types.
- g) Conduct grindability tests on the major ore types.

The results of the testwork were discussed with Mr. R. Coleman, Consultant and Mr. B. Scheduling of Curragh Resources. Periodic monthly progress reports were issued.

LAKEFIELD RESEARCH



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SUMMARY AND CONCLUSIONS

1. Description of Samples Used in the Laboratory Testwork

A total of 6 different composites were examined during the laboratory testwork. The ore composites were prepared according to mineralogical characteristics and geological setting. Most of the development testwork was carried out on Composite No. 3 and only preliminary tests were performed on Composite No. 5 and the Master Composite. The head analyses of the composites examined in the laboratory testwork are shown in Table No. 2.

TABLE NO. 2 : Head Analyses of Different Laboratory Composites.

Composite	Assays %, g/t											
	Cu	Pb	Zn	Fe	S	Mn	Hg	Au	Ag	C(T)	C(g)	Po
Comp 1A	0.26	3.95	4.20	26.8	28.5	0.45	0.0018	0.57	49.1	1.47	0.057	11.2
Comp 1B	0.22	5.75	6.69	28.1	28.9	1.16	0.0049	0.79	77.8	1.71	0.049	17.0
Comp 2	0.20	4.75	5.70	24.5	26.8	0.79	0.0036	0.93	64.5	1.67	0.049	12.5
Comp 3	0.15	3.96	5.35	21.7	28.2	0.61	0.0043	1.57	64.8	0.20	0.015	10.3
Comp 4	0.037	2.20	3.87	7.54	8.83	0.054	0.0023	0.44	31.2	2.20	0.64	12.5
Comp 5	0.36	0.72	0.89	29.1	26.6	0.58	0.00023	1.60	12.7	1.01	0.060	9.40
Master	0.22	3.76	4.47	24.2	27.1	0.71	0.0025	0.96	57.9	1.37	0.081	17.2

The Master composite was prepared from individual composites 1 to 5 and represents 100,000 tons of ore to be tested in the plant towards the end of 1989. The individual composite samples were prepared from 16 drill hole samples from the 1987 Vangorda drilling program.

2. Processing Characteristics of Vangorda Ore

The Vangorda Ore is a complex, massive sulphide ore in which the individual minerals are finely disseminated and the flotation characteristics of both galena and sphalerite vary within the orebody. In addition, the ore contains appreciable amounts of pyrrhotite and secondary copper minerals which interfere with the rate of flotation of galena and sphalerite. Following are the major processing characteristics of the individual ore composites.

(a) **Composite 1A** is the most refractory of the ore types and contains carbonaceous pyrite and secondary copper minerals. The secondary copper minerals were responsible for the extremely poor selectivity between lead and zinc minerals. During the lead rougher flotation, up to 70 % of the total zinc reported in the lead rougher concentrate. In addition, the lead rougher concentrate was heavily contaminated with pyrrhotite resulting in a low lead grade in the cleaner concentrate.

\Summary - Continued

b) **Composite 1B** is a high grade lead-zinc ore with high pyrrhotite content. This ore contains less carbonaceous pyrite than Composite 1A. Production of high grade lead and zinc concentrates with respectable recoveries did not represent a significant problem.

c) **Composite No. 2** is the coarsest grained of the composites examined, and gave the highest lead recovery. However, because of the presence of secondary copper minerals, the selectivity between lead and zinc was somewhat reduced, and up to 30 % of the total zinc reported in the lead rougher concentrate.

d) **Composite No. 3** represents the largest portion of the orebody and most of the laboratory development testwork was conducted on this composite. Although good metallurgical results were obtained, it was positively established that Vangorda ore cannot be processed using the plant flowsheet and reagent scheme. The most prominent feature of this ore, using the plant reagent scheme, was slow lead flotation during the lead cleaning and reduced selectivity. With a high dosage of cyanide in the rougher and cleaning and the use of a modified collector, the lead cleaning efficiency improved dramatically.

e) **Composite No. 4** represents graphitic quartzite ore with high amounts of carbon and carbonaceous pyrite. Using the conventional reagent scheme, a low grade lead concentrate was obtained. With the use of an organic base depressant DS20, the lead concentrate grade improved dramatically.

f) **Composite No. 5** is a low-grade ore (i.e. 0.66 % Pb and 0.91 % Zn). In spite of the low head grade, good lead metallurgical results were obtained. This ore made up about 20 % of the Master composite.

g) **Master Composite**. The processing characteristics of the Master Composite were similar to that of Composite No. 2.

3. Development Testwork

3.1. Grindability of the Ore and Primary Grinding Requirements

The grindability of the ore differed within the orebody and the Ball Mill Bond Work indices (Table No. 3) varied between 7.9 and 11.6 metric. The Vangorda ore, however, is somewhat softer than the Faro 3 ore and a slightly finer grind can be expected in the plant than that obtained on Faro 3 ore. The fineness of grind examined in the laboratory on the various composites is shown in Table No. 4. It appeared that a primary grind of about $k_{80} = 50$ to $K_{80} = 40$ is the optimum.

Summary - Continued

TABLE NO. 3 : Ball Mill Grindability Test Results

Description	Composite No. 3		Composite No. 2		Composite No. 4		Composite No. 1A		Composite No. 1B	
Work Index (metric)	7.9	7.6	8.9	9.8	11.57	-	9.96	10.9	9.70	-
Screen Size, μm	104	74	104	74.0	104	-	104	74	104	-
Product per revolution	3.07	2.22	2.36	1.85	1.80	-	2.29	1.72	2.33	-
Product K_8O , μm	81	53	78	59.0	81	-	83.0	60	82.0	-
Feed K_8O , μm	890	1800	1230	1230	1150	-	980	980	1000	-

TABLE NO. 4 : Summary of Finenesses of Grind Used in the Laboratory Testwork

Grinding Time minutes	Composite 1A			Composite 1B			Composite 2			Composite 3			Composite 4		
	% Pass Cum		K80 μm	% Pass Cum		K80 μm	% Pass Cum		K80 μm	% Pass Cum		K80 μm	% Pass Cum		K80 μm
	270M	400M		270M	400M		270M	400M		270M	400M		270M	400M	
20	-	-	-	-	-	-	-	-	88.5	-	42.0	-	-	-	
30	81.0	-	50.0	83.6	66.5	51.0	84.8	-	46.5	-	-	78.1	62.8	58.0	
40	89.5	-	40.0	89.1	76.4	41.0	91.8	-	37.0	93.3	-	36.0	84.9	67.2	48.0
50	92.0	-	38.0	92.7	81.4	36.0	95.0	-	33.0	95.7	86.9	31.5	91.2	74.9	41.0
60	96.4	87.0	31.0	-	-	-	-	-	-	97.6	91.3	27.5	-	-	-
70	97.1	-	29.0	-	-	-	-	-	-	99.3	91.3	30.0*	-	-	-

3.2. Lead and Zinc Concentrate Re grind

The grade of both the lead and zinc concentrates was determined by the fineness of regrinding of the corresponding lead and zinc rougher concentrates. A regrind of the total lead rougher and scavenger concentrates would be mandatory in order to maintain a high lead concentrate grade. The present lead regrind flowsheet configuration used in the plant would not be suitable for processing the Vangorda ore.

It should be noted that an improved sharpness of classification in the plant would greatly improve both lead and zinc metallurgy. An estimate of the regrinding requirements for the lead and zinc concentrates is shown below:

- (a) Lead Concentrate 90 % <25 μm
- (b) Zinc Concentrate 80 % <25 μm .

Summary - Continued

3.3. Summary of Laboratory Development Testwork

3.3.1. Composite 1A

Problems with Composite 1A were experienced in obtaining satisfactory selectivity between lead and zinc minerals. In most of the tests, over 60 % of the zinc reported in the lead rougher concentrate. The major variables examined on Composite 1A included:

- a) fineness of primary grind
- b) type of zinc depressant
- c) regrinding requirements.

The effect of the variables examined on the lead and zinc metallurgical results can be described as follows:

1. The fineness of regrind in the range tested (i.e. $K_{80} = 29-50 \mu\text{m}$) had no significant effect on lead and zinc rougher concentrate grades and recoveries.
2. The use of an organic based zinc depressant (i.e. LS8) improved lead concentrate grade slightly but at the expense of recovery.

3.3.2. Composite 1B

On this composite, standard roughing tests at different finenesses of grind and cleaning tests using different finenesses of regrind were performed. The results obtained indicated a) an improvement in the lead and precious metal recoveries at a finer primary grind and b) the lead concentrate grade improved significantly with a finer regrind of the lead rougher concentrate.

3.3.3. Composite No. 2

On this composite the fineness of primary grind and regrind and the levels of cyanide addition were examined.

Note that with this composite problems were experienced in obtaining a high grade zinc concentrate. The effects of the variables examined on this composite can be described as follows:

- a) a finer primary grind and a finer regrind of the lead concentrate had no effect on lead metallurgical results. A finer regrind of the zinc concentrate, however, improved both zinc concentrate grade and recovery.
- b) Higher cyanide additions to the lead rougher and cleaners did not effect lead metallurgical results.

It appeared that the zinc in this ore type is more finely disseminated than in the other ore types.

Summary - Continued

3.3.4. Composite No. 3

Most of the laboratory development testwork was performed on this composite and the data generated in this testwork served as the basis for metallurgical evaluation of the other composites.

The major variables examined on this ore included:

- a) fineness of primary grind
- b) fineness of lead and zinc concentrate regrind
- c) grinding media
- d) level of depressant and collector additions
- e) type of collector and pyrrhotite depressant.

The results obtained in this testwork showed the following:

a) The fineness of grind had little or no effect on lead and zinc recoveries, however precious metal recoveries increased with a finer primary grind. Replacing ball mill grinding with rod mill grinding media significantly improved lead rougher recovery.

b) Using the plant reagent scheme, the lead and zinc metallurgical results were satisfactory. However, the upgrading of the corresponding lead and zinc concentrates represented a significant problem, because both lead and zinc dropped during the cleaning operation. Typical results obtained in the lead cleaning are shown in Table No. 5.

TABLE NO. 5 : Lead Cleaning Metallurgical Results Obtained with Plant Collector Metallurgical Results

Test No.	Product	Weight %	Assays %, g/t				% Distribution			
			Pb	Zn	Au	Ag	Pb	Zn	Au	Ag
24	Pb Cleaner Conc	3.5	63.6	6.03	12.6	855	57.6	4.1	60.7	52.8
	Pb Rougher Conc	10.7	32.0	9.98	4.78	423	89.9	21.2	71.4	80.8
	Pb Rougher Tail	89.3	0.43	4.45	0.23	12.0	10.1	78.8	28.6	19.2
	Head (Calc)	100.00	3.81	5.04	0.72	559	100.0	100.0	100.0	100.0

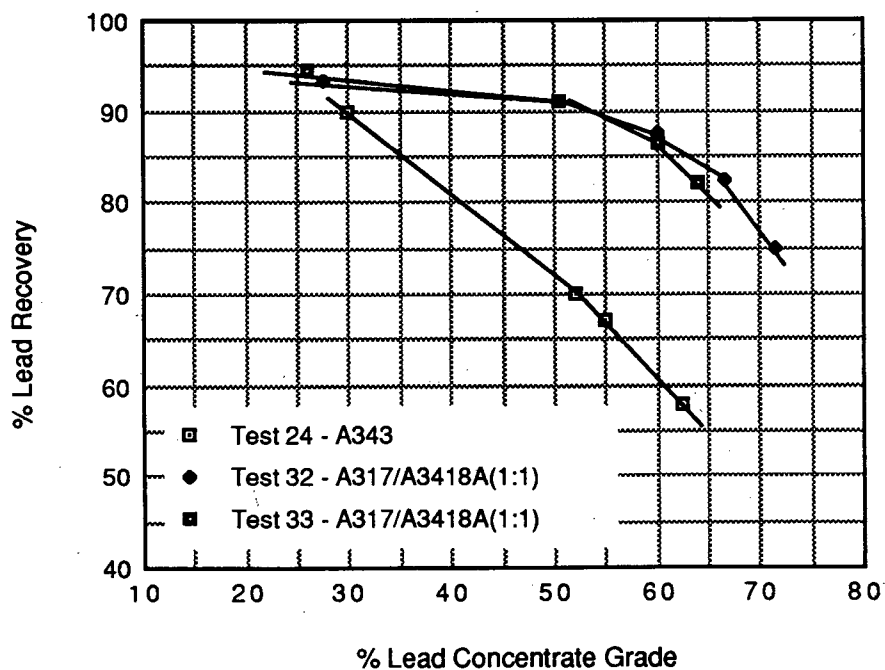
Summary - Continued

Note that the lead concentrate recovery was dramatically reduced during the cleaning operation. An improvement in the lead cleaning efficiency was realized with the introduction of collector A317:3418A mixture (1:1 ratio). Table No. 6 shows the results obtained with the above collector mixture.

TABLE NO. 6 : Lead Metallurgical Results Obtained with Modified Collector

Test No.	Product	Weight %	Assays, %		% Distribution	
			Pb	Zn	Pb	Zn
32	Pb Cleaner Concentrate	4.81	69.0	4.93	83.1	4.8
	Pb Rougher Concentrate	13.40	27.9	9.74	93.5	26.1
	Pb Rougher Tailing	86.60	0.30	4.27	6.5	73.9
	Head (Calc)	100.00	4.00	5.00	100.0	100.0

Figure No. 1 compares the lead metallurgical results obtained with the standard and with the new collector mixture.

FIGURE NO. 1 : Effect of Collector Type on Lead Cleaning

Summary - Continued

This is the only reagent change which should be transferred to the plant operation before processing Vangorda Ore.

c) The testwork results obtained with different pH's and cyanide levels indicated that higher cyanide additions are required for Vangorda ore than those normally used in the current plant.

d) In the zinc flotation, the most pronounced improvement was achieved in the rate of zinc flotation by introducing high-speed high-power conditioning after the regrind.

In general, satisfactory lead and zinc metallurgical results were obtained with higher depressant additions and changes in the type of collector. High cyanide and soda ash consumptions were mainly attributed to the presence of appreciable amounts of pyrrhotite.

3.3.5. Composite No. 4

The major problem in processing this ore type was in achieving a high lead concentrate grade. The presence of carbon and carbonaceous pyrite was the major reason for the low lead concentrate grade.

The use of an organic based depressant in place of cyanide resulted in a significant improvement in the lead concentrate grade. Table No. 7 compares the lead metallurgical results obtained with cyanide and with organic depressant DS20.

TABLE NO. 7 : Metallurgical Results Obtained with NaCN and DS20 - Composite 4 Ore

Test No.	Depressant Used	Product	Wt %	Assays %		% Distribution	
				Pb	Zn	Pb	Zn
66	NaCN	Pb Cleaner Concentrate	2.37	40.9	4.76	46.2	3.0
		Pb 1st Cleaner Conc	4.94	34.0	5.30	80.1	6.9
		Pb Combined Tailing	95.06	0.43	3.69	19.9	93.1
		Head (Calc)	100.00	2.10	3.79	100.0	100.0
77	DS20	Pb Cleaner Concentrate	1.71	57.4	4.74	47.3	2.1
		Pb Rougher Concentrate	15.23	11.6	5.85	84.9	23.2
		Pb Rougher Tailing	84.77	0.37	3.49	15.1	76.8
		Head (Calc)	100.00	2.08	3.85	100.0	100.0

Summary - Continued

3.3.6. Composite No. 5 and Master Composite

Only preliminary tests were conducted on these two composites. Composite 5 was a low grade ore and was included in the Master Composite (i.e. 20 %). The metallurgical results obtained on these two composites were similar to that obtained on Composite 3.

4. Impurity Analyses of the Lead and Zinc Concentrates

The lead and zinc concentrates from the final locked cycle tests were submitted for impurity analyses. The impurity analyses of the lead concentrate are given in Table No. 8 and the impurity analyses for the zinc concentrate are shown in Table No. 9.

TABLE NO. 8 : Pb Concentrate Impurity Analyses

Element	Assays %, g/t				
	Comp. 2	Comp. 3	Comp. 4	Comp. 1A	Comp. 1B
Iron (Fe)	4.90	4.12	5.86	11.6	5.15
Copper (Cu)	0.40	-	0.27	2.75	0.95
Nickel (Ni)	<0.002	<0.002	0.004	<0.002	<0.002
Lead (Pb)	63.5	66.2	59.0	42.6	64.6
Zinc (Zn)	8.97	7.20	5.19	12.5	7.02
Bismuth (Bi)	<0.002	0.002	<0.002	<0.002	<0.002
Cadmium (Cd)	0.014	0.011	0.008	0.019	0.012
Chromium (Cr)	0.003	0.022	0.003	0.003	0.002
Cobalt (Co)	<0.002	<0.002	0.004	0.005	<0.002
Manganese (Mn)	0.082	0.10	0.037	0.079	0.076
Uranium (U)	<0.001	-	0.005	<0.001	-
Arsenic (As)	0.032	<0.001	0.50	0.031	0.051
Antimony (Sb)	0.14	0.23	0.16	0.12	0.39
Tin (Sn)	<0.001	0.002	<0.001	<0.001	<0.001
Fluorine (F)	0.053	0.093	0.033	0.021	0.038
Chlorine (Cl)	<0.005	-	0.008	0.011	-
Sulphur (S)	18.4	17.8	17.2	25.4	18.0
Carbon Total	0.20	-	1.78	0.23	-
Silica (SiO ₂)	0.76	2.36	6.42	0.56	0.52
Alumina (Al ₂ O ₃)	0.06	0.085	0.61	0.11	0.13
Magnesia (MgO)	-	0.92	0.19	0.14	-
Lime (CaO)	-	0.12	0.17	0.10	-
Sodium (Na ₂ O)	0.002	-	0.010	0.003	-
Potassium (K ₂ O)	0.003	-	0.13	0.007	-
Insol	2.79	5.79	7.53	1.26	0.96
Mercury (Hg)	0.0067 ₃	0.0050 ₃	0.0030 ₃	0.0063 ₃	0.0068 ₃
Gold (Au)	14.0	8.60	5.67	10.3	7.32
Silver (Ag)	684.	813.	651.	490.	739.

Summary - Continued

TABLE NO. 9 : Zn Concentrate Impurity Analyses

Element	Assays %, g/t				
	Comp. 2	Comp. 3	Comp. 4	Comp. 1A	Comp. 1B
Iron (Fe)	7.44	6.72	8.86	8.54	6.56
Copper (Cu)	0.89	-	0.26	0.53	0.23
Nickel (Ni)	<0.002	<0.002	<0.002	<0.002	<0.002
Lead (Pb)	1.15	1.03	0.55	2.64	1.02
Zinc (Zn)	54.2	54.9	53.0	51.2	57.2
Bismuth (Bi)	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium (Cd)	0.071	0.069	0.062	0.071	0.075
Chromium (Cr)	0.002	0.036	0.003	0.003	0.002
Cobalt (Co)	<0.002	<0.002	0.003	0.002	<0.002
Manganese (Mn)	0.22	0.33	0.11	0.21	0.18
Uranium (U)	<0.001	-	<0.002	<0.001	-
Arsenic (As)	0.004	0.007	0.12	0.021	-
Antimony (Sb)	0.003	0.006	0.005	0.006	-
Tin (Sn)	<0.001	<0.001	<0.001	<0.001	-
Fluorine (F)	0.030	0.11	0.021	0.015	-
Chlorine (Cl)	0.045	-	<0.005	0.009	-
Sulphur (S)	31.3	33.3	32.9	31.1	-
Carbon Total	0.31	-	0.91	0.39	-
Silica (SiO ₂)	0.30	0.25	3.15	0.43	0.25
Alumina (Al ₂ O ₃)	0.07	0.034	0.43	0.13	0.07
Magnesia (MgO)	0.13	0.14	0.085	0.14	-
Lime (CaO)	0.34	0.40	0.22	0.39	-
Sodium (Na ₂ O)	<0.002	-	0.007	0.003	<0.002
Potassium (K ₂ O)	0.004	-	0.097	0.008	0.003
Insol	1.89	2.00	3.82	1.09	0.87
Mercury (Hg)	0.046 [%]	0.028 [%]	0.029 [%]	0.016 [%]	0.033 [%]
Gold (Au)	0.59	0.28	0.33	0.57	0.37
Silver (Ag)	40.1	48.5	31.5	65.7	38.2

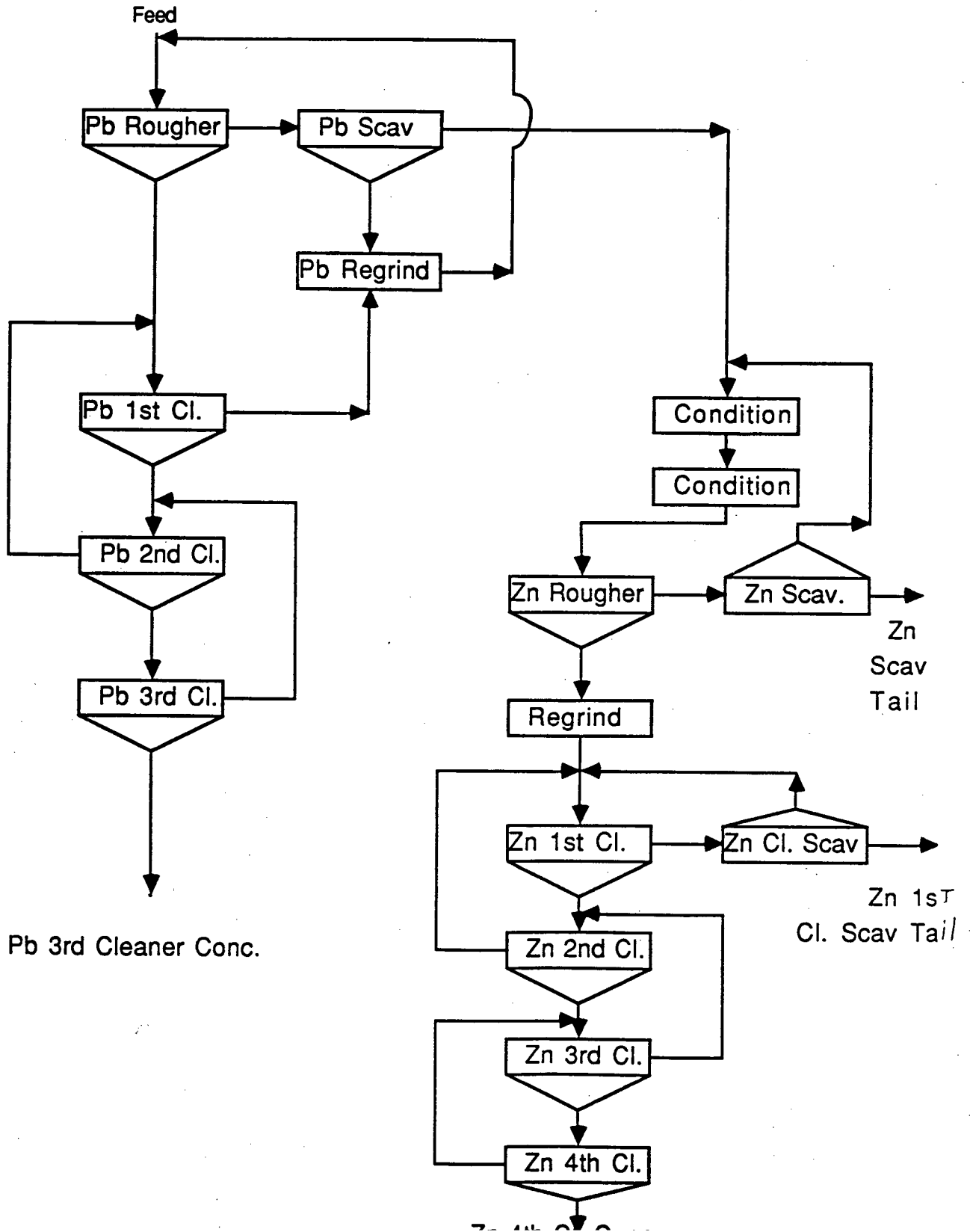
5. Overall Treatment Process**5.1. Flowsheet**

In order to obtain marketable lead and zinc concentrate grades on Vangorda Ore, the current plant flowsheet (Figure 2) should be modified as follows (Figure 3).

- (A) Both lead rougher and scavenger concentrates should be regrind before cleaning.
- (B) The lead first cleaner should be performed in open circuit cleaning with the addition of an extra cleaner scavenger stage.
- (C) The zinc first cleaner feed should include a high speed conditioner.

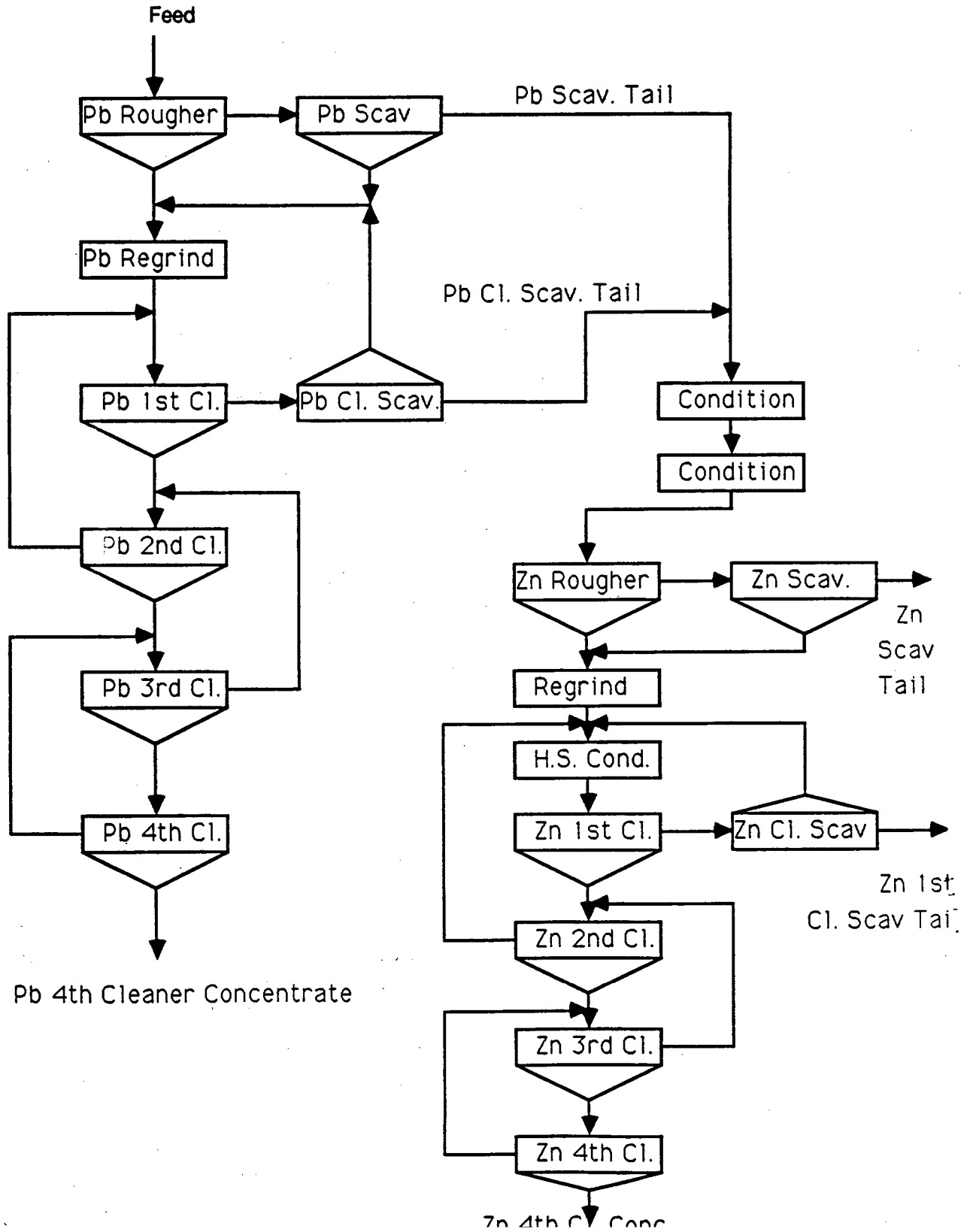
Summary - Continued

FIGURE NO. 2 : Plant Flowsheet



Summary - Continued

FIGURE NO. 3 : Modified Flowsheet



Summary - Continued

The modified flowsheet is shown in Figure 3. Comparative locked cycle tests were performed using both plant and modified flowsheets. These results are shown in Table No. 10.

TABLE NO. 10 : Comparison of Plant and Modified Flowsheets Using Composite 3 Ore

Test No.	Flowsheet	Product	Wt %	Assays %, g/t					% Distribution				
				Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
41	Modified	Pb Cleaner Conc	5.5	66.2	7.17	4.17	8.56	814	88.4	7.6	1.0	65.0	73.5
		Zn Cleaner Conc	8.0	1.03	55.3	6.72	0.28	48.5	2.0	85.8	2.4	3.2	6.5
		Zn Scav Tailing	86.4	0.46	0.40	25.7	0.27	12.6	9.6	6.6	96.6	31.9	18.2
		Head (Calc)	100.0	4.14	5.19	23.0	0.73	59.7	100.0	100.0	100.0	100.0	100.0
83	Plant	Pb Cleaner Conc	7.8	49.1	11.7	8.37	8.80	603	92.3	17.3	2.7	80.0	86.4
		Zn Cleaner Conc	7.3	0.65	55.2	7.03	0.23	41.0	1.1	76.7	2.1	1.9	5.5
		Zn Scav Tailing	84.9	0.32	0.37	27.2	0.18	5.2	6.5	6.0	95.2	18.1	8.1
		Head (Calc)	100.0	4.14	5.26	24.2	0.86	54.3	100.0	100.0	100.0	100.0	100.0

Using the plant flowsheet (Test 83), the production of a high grade lead concentrate was not possible. The zinc recovery was about 10 % lower than that obtained using the modified flowsheet.

5.2. Reagent Balance

Table No. 11 shows the reagent balance developed for treatment of the Vangorda Ore. The basic plant reagent scheme was retained with the addition of modified lead collector and additions of sodium silicate to the lead cleaners.

TABLE NO. 11 : Reagent Scheme Developed for Vangorda Ore

Reagent	Reagent Additions, g/t			
	Pb Ro + Scav	Pb Cleaners	Zn Ro + Scav	Zn Cleaners
Modifiers & Depressants				
Na ₂ CO ₃	2000	-	-	-
NaCN	200	195	-	-
Na ₂ SiO ₃ (Silicate O)	-	250	-	-
Ca(OH) ₂	-	-	2500	2500
CuSO ₄ x 5H ₂ O	-	-	800	100
Collectors & Frothers				
A317:3418A (1:1 ratio)	12.5	38	-	-
A350	-	-	40	40
MIBC	35	28	-	-
DF1012	-	-	15	10

Summary - Continued

The addition of Na_2SiO_3 to the lead cleaner improved the rate of lead flotation in the cleaners. The use of collector A317:3418A mixture resulted in a significant improvement in the lead cleaner recovery and also improved precious metal recoveries.

High levels of depressant additions in the laboratory testwork does not necessarily mean that the same reagent levels would be required in the commercial scale. It may be possible to reduce reagent levels in the plant especially with the use of plant recycle water. It is, however, clear that higher levels of cyanide addition may be required.

5.3. Overall Metallurgical Results

In general, most of the composite samples gave satisfactory metallurgical results.

Composites 2, 1B and 3 gave similar metallurgical results and may be considered as ores of similar processing characteristics. This can also be said for Composite 5 and the Master composite. Composite 1A, however, can be considered a refractory ore type which may represent significant problems during processing of the ore. One of the major problems with Composite 1A is the poor selectivity between lead and zinc minerals and the active pyrrhotite and carbonaceous pyrite flotation in the lead concentrate.

Table No. 12 shows the results of batch tests on the various ore composites. Table No. 13 shows the results obtained in the continuous locked cycle tests on the various composites.

Note that an improvement in the metallurgical results from Composite 4 was achieved with the use of an organic based depressant (i.e. DS20). Depressant DS20 was found very effective for rejection of carbonaceous pyrite and carbon.

Summary - Continued

TABLE NO. 12 : Precycle Test Results

Test No.	Composite	Product	Wt %	Assays %		% Distribution	
				Pb	Zn	Pb	Zn
67	2	Pb 4th Cleaner Conc	5.26	65.4	9.40	73.3	9.1
		Pb 1st Cleaner Conc	8.07	52.1	9.80	89.6	14.7
		Zn 4th Cleaner Conc	3.95	0.91	55.5	0.8	40.6
		Zn Rougher Conc	19.33	1.03	21.7	4.2	77.5
		Zn Rougher Tail	72.21	0.38	0.49	5.8	6.5
		Head (Calc)	100.00	4.69	5.40	100.0	100.0
40	3	Pb 4th Cleaner Conc	4.38	65.9	7.34	71.3	6.1
		Pb 1st Cleaner Conc	7.00	51.2	8.24	88.6	10.9
		Zn 4th Cleaner Conc	7.10	1.27	56.0	2.2	75.4
		Zn Rougher Conc	17.09	1.30	26.2	5.5	84.8
		Zn Rougher Tail	75.63	0.30	0.24	5.6	3.4
		Head (Calc)	100.00	4.04	5.27	100.0	100.0
78	4	Pb 4th Cleaner Conc	2.83	53.8	5.49	71.4	4.1
		Pb 1st Cleaner Conc	5.63	30.7	6.39	81.0	9.4
		Pb Rougher Conc	13.07	13.9	6.10	85.3	20.8
		Pb Rougher Tail	86.93	0.36	3.49	14.7	79.2
		Head (Calc)	100.00	2.14	3.83	100.0	100.0
		68	1B	Pb 4th Cleaner Conc	6.60	63.3	8.55
Pb 1st Cleaner Conc	9.99			50.1	9.70	86.3	14.8
Zn 4th Cleaner Conc	4.19			0.95	57.0	0.6	36.5
Zn Rougher Conc	20.96			1.46	24.3	5.3	77.7
Zn Rougher Tail	68.28			0.64	0.41	7.5	4.3
Head (Calc)	100.00			5.80	6.54	100.0	100.0
72	1A	Pb 4th Cleaner Conc	3.61	44.0	14.2	44.0	13.2
		Pb 1st Cleaner Conc	8.47	32.0	15.2	75.1	33.2
		Zn 4th Cleaner Conc	2.40	1.22	53.0	0.8	32.8
		Zn Rougher Conc	10.83	2.43	16.1	7.3	44.9
		Zn Rougher Tail	79.96	0.72	0.83	15.9	17.1
		Head (Calc)	100.00	3.61	3.88	100.0	100.0

Summary - Continued

TABLE NO. 13 : Locked Cycle Test Results on Composites 2.3.4.1B and 1A

Test No.	Composite	Product	Wt %	Assays %, g/t					% Distribution				
				Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
69	2	Pb Cl Conc	6.7	65.4	8.93	4.72	11.2	705	89.3	10.8	1.3	74.4	74.1
		Zn Cl Conc	7.7	1.07	54.7	7.09	0.84	56.9	1.7	76.9	2.2	6.5	7.0
		Zn Scav Tail	85.6	0.52	0.79	27.6	0.22	14.0	9.0	12.3	96.5	19.0	18.9
		Head (Calc)	100.0	4.88	5.51	24.5	1.00	63.4	100.0	100.0	100.0	100.0	100.0
41	3	Pb Cl Conc	5.5	66.2	7.17	4.17	8.56	814	88.4	7.6	1.0	65.0	75.3
		Zn Cl Conc	8.0	1.03	55.3	6.72	0.28	48.5	2.0	85.8	2.4	3.2	6.5
		Zn Scav Tail	86.4	0.46	0.40	25.7	0.27	12.6	9.6	6.6	96.6	31.9	18.2
		Head (Calc)	100.0	4.14	5.19	23.0	0.73	59.7	100.0	100.0	100.0	100.0	100.0
84	4	Pb Cl Conc	2.8	59.2	5.27	5.80	5.22	670	80.9	3.9	2.1	34.1	64.5
		Zn Cl Conc	6.2	0.61	53.6	8.58	0.44	39.1	1.8	88.1	6.8	6.3	8.3
		Zn Scav Tail	90.9	0.39	0.33	7.90	0.28	8.8	17.3	8.0	91.1	59.6	27.2
		Head (Calc)	100.0	2.07	3.80	7.90	0.43	29.4	100.0	100.0	100.0	100.0	100.0
71	1B	Pb Cl Conc	7.6	63.9	7.17	5.56	6.17	701	83.5	8.3	1.5	59.9	70.8
		Zn Cl Conc	9.5	1.03	57.2	6.40	0.31	38.4	1.7	82.2	2.1	3.8	4.8
		Zn Scav Tail	82.9	1.05	0.76	33.6	0.34	22.3	14.8	9.5	96.4	36.3	24.4
		Head (Calc)	100.0	5.85	6.61	28.9	0.79	75.6	100.0	100.0	100.0	100.0	100.0
85	1A	Pb Cl Conc	5.3	43.1	12.6	12.6	10.1	448	61.3	17.0	2.5	70.8	50.7
		Zn Cl Conc	4.5	2.92	52.4	8.70	0.49	73.8	3.5	59.6	1.5	2.9	7.0
		Zn Scav Tail	90.2	1.46	1.02	28.0	0.22	22.1	35.2	23.4	96.0	26.3	42.3
		Head (Calc)	100.0	3.74	3.95	26.3	0.76	47.1	100.0	100.0	100.0	100.0	100.0

Summary - Continued

6. Conclusions

1. The Vangorda orebody is a Massive sulphide ore in which the sulphide minerals are finely disseminated. In most of the ore types, about 90 % of the valuable minerals are liberated at about 40 μm and less. In addition, the ore contains high amounts of pyrrhotite and marcasite which are major contributors to slow lead and zinc flotation and also increase depressant consumption.

2. The processing characteristics of the Vangorda Ore are different than those of Faro 3 ore and in order to produce satisfactory metallurgical results, modifications in both the reagent scheme and the flowsheet are required. This would necessitate a careful examination of the plant flowsheet and reagent scheme, especially the grinding and regrinding capacities and efficiencies, in order to adapt the present plant to processing the Vangorda ore.

3. Changes in the treatment procedure would include regrinding of total lead and zinc concentrates and cleaning the lead concentrate in open circuit. Addition of the new collector mixture would also be part of the modified procedure. Introduction of high-speed high-power conditioning of the zinc 1st cleaner feed would be beneficial, not only for the Vangorda zinc circuit, but also for Faro 3 and Grum ore.

4. In general, ore Composites 3, 2 and 1B gave similar metallurgical results and high grade lead and zinc concentrates with satisfactory recoveries were readily produced. Composite 1A was the most refractory and a high-grade lead concentrate cannot be produced using the standard reagent scheme. Using the standard reagent scheme, a low lead concentrate grade was also obtained on Composite No. 4. Organic based depressant (DS20) improved lead concentrate grade on Composite 4 significantly.

RECOMMENDATIONS

Recommendations proposed in this section are based on the results obtained in the laboratory testwork.

1. If the Vangorda ore is to be processed with Faro 3 ore, further laboratory testwork should be carried out on blends of Faro 3 ore and Vangorda ore.

2. In preparation for processing the Vangorda ore, adoption of both the modified flowsheet and reagent scheme should be carried out immediately. With regard to this, the following is suggested:

(A) Conduct plant tests with the modified lead collector on Faro 3 ore (i.e. A317:3418A mixture). This may be beneficial for the lead metallurgy on Faro ore as well.

(B) Conduct a complete plant grinding survey to examine possible improvements in the grinding efficiency, because Vangorda ore will require finer primary grinding and regrinding, than does Faro 3 ore.

(C) Conduct laboratory tests on plant pulp to examine the effect of high-speed high-power conditioning on zinc concentrate upgrading and to provide data for plant design of a high-speed conditioning unit.

(D) Conduct a plant survey of the lead cleaning circuit to provide data for requirements of the 1st cleaner capacity for open circuit lead 1st cleaning.

3. Conduct a pilot plant test on a representative bulk sample of Vangorda ore in order to provide operating conditions for plant processing.

DISCUSSION

1. Description of Samples and Composites Used In the Laboratory Testwork

A total of five composites and a Master composite were used in the laboratory testwork. Following is a description of each composite:

- a) **Composite 1B** is an "E" and "G" ore from both the Eastern and Western sections of the deposit. This is weathered ore and shows signs of oxidation. This composite consisted of ~~45~~¹² intervals of non-porous core.
- b) **Composite 1A** is from the same location as Composite 1B, but consists only of porous and oxidized cores. *48 INTERVALS*
- c) **Composite 2** is an "E" and "G" ore type from the Eastern section of the deposit which is non-porous and is slightly oxidized. This composite consists of about 50 intervals.
- d) **Composite 3** represents "E" and "G" ore type from the Western section of the deposit which is non-porous and has an oxidation scale of less than 5. The composite consisted of 240 intervals.
- e) **Composite 4** is an "A" type ore from both the Eastern and Western sections of the deposit, which is non-porous. Oxidation is not a consideration with this ore with an oxidation indicator of less than 3.
- f) **Composite 5** represents "E" and "C" ore from both the Eastern and Western sections of the orebody. It is low grade ore and has a low oxidation level (<3). Most of this ore type is within the final pit envelope and can be considered as an over burden.
- g) **Master Composite** consisted of 15 % of Composites 1A and 1B divided equally, 20 % of Composite 5 and the remainder was made up of Composite 2. This material would represent the 100,000 tonnes of Vangorda ore to be treated in the plant in late 1989.

Discussion - Continued

2. Primary Grinding Size Distribution

The size distributions of the different grinds used in the laboratory testwork on the various composites is shown in Table No. 14 for Composite 1A, Table No. 15 for Composite 1B, Table No. 16 for Composite No. 2, Table No. 17 for Composite No. 3 and Table No. 18 for Composite No. 4.

In general, most of the ore types had a ball mill Bond Work Index of below 10 (metric) at 74 μm size and the ore is considered a soft ore.

From the size distribution data and the grindability test data, it can be concluded that with the present grinding capacity of the plant, the Vangorda ore may give a grind of K_{80} 52 μm . This is the minimum requirement for achieving high lead and zinc rougher recoveries.

TABLE NO. 14 : Grinding Size Distribution on Composite 1A

30 minute Grind				40 minute Grind				50 minute Grind				60 minute Grind				70 minute Grind			
Particle Size	% Retained Ind	% Retained Cum	% Pass Cum	Particle Size	% Retained Ind	% Retained Cum	% Pass Cum	Particle Size	% Retained Ind	% Retained Cum	% Pass Cum	Particle Size	% Retained Ind	% Retained Cum	% Pass Cum	Particle Size	% Retained Ind	% Retained Cum	% Pass Cum
+150M	1.5	1.5	98.5	-	-	-	-	-	-	-	-	+200M	0.9	0.9	99.1	-	-	-	-
200M	4.9	6.4	93.6	+200M	3.3	3.3	96.7	+200M	1.9	1.9	98.1	270	2.7	3.6	96.4	+200M	0.3	0.3	99.7
270M	12.0	18.4	81.6	270	7.2	10.5	89.5	270	6.1	8.0	92.0	400	9.4	13.0	87.0	270	2.5	2.8	97.2
27.8 μm	28.0	46.4	53.6	27.8 μm	25.9	36.4	63.6	27.8 μm	26.8	34.8	65.2	28.1 μm	11.4	24.4	75.6	28.1 μm	18.7	21.5	78.5
21.6	11.2	57.6	42.4	21.6	12.5	48.9	51.1	21.6	12.8	47.6	52.4	21.8	11.4	35.8	64.2	21.8	12.7	34.2	65.8
15.1	11.3	68.9	31.1	15.1	13.5	62.4	37.6	15.1	13.7	61.3	38.7	15.2	15.9	51.7	48.3	15.2	16.2	50.4	49.6
10.4	8.3	77.2	22.8	10.4	9.8	72.2	27.8	10.4	10.3	71.6	28.4	10.4	12.8	64.5	35.5	10.4	13.1	63.5	36.5
8.0	4.8	82.0	18.0	8.0	4.7	76.9	23.1	8.0	5.8	77.4	22.6	8.1	7.4	71.9	28.1	8.1	7.4	70.9	29.1
-8.0	18.0	100.0	-	-8.0	23.1	100.0	-	-8.0	22.6	100.0	-	-8.1	28.1	100.0	-	-8.1	29.1	100.0	-
Total	100.0	-	-	Total	100.0	-	-	Total	100.0	-	-	Total	100.0	-	-	Total	100.0	-	-

TABLE NO. 15 : Grinding Size Distribution on Composite 1B

30 minute Grind				40 minute Grind				50 minute Grind			
Particle Size	% Retained Ind	% Retained Cum	% Pass Cum	Particle Size	% Retained Ind	% Retained Cum	% Pass Cum	Particle Size	% Retained Ind	% Retained Cum	% Pass Cum
+200M	6.3	6.3	93.7	+200M	3.4	3.4	96.6	+200M	1.5	1.5	98.5
270	10.1	16.4	83.6	270	7.5	10.9	89.1	270	5.8	7.3	92.7
400	17.1	33.5	66.5	400	12.7	23.6	76.4	400	11.3	18.6	81.4
+27.0 μm	12.9	46.4	53.6	+27.0 μm	15.1	38.7	61.3	+26.9 μm	14.3	32.9	67.1
20.9	10.7	57.1	42.9	20.9	12.0	50.7	49.3	20.9	12.1	45.0	55.0
14.6	12.1	69.2	30.8	14.6	13.7	64.4	35.6	14.6	14.7	59.7	40.3
10.0	8.8	78.0	22.0	10.0	10.1	74.5	25.5	10.0	11.0	70.7	29.3
7.8	4.5	82.5	17.5	7.8	5.3	79.8	20.2	7.7	6.1	76.8	23.2
-7.8	17.5	100.0	-	-7.8	20.2	100.0	-	-7.7	23.2	100.0	-
Total	100.0	-	-	Total	100.0	-	-	Total	100.0	-	-

Discussion - Continued

TABLE NO. 16 : Grinding Size Distribution on Composite No. 2

30 minute Grind				40 minute Grind				50 minute Grind			
Particle Size	% Retained Ind	% Pass Cum	% Pass Cum	Particle Size	% Retained Ind	% Pass Cum	% Pass Cum	Particle Size	% Retained Ind	% Pass Cum	% Pass Cum
+150M	1.0	1.0	99.0	+150M	0.5	0.5	99.5	-	-	-	-
200	4.0	5.0	95.0	200	1.8	2.3	97.7	+200M	1.5	1.5	98.5
270	10.2	15.2	84.8	270	5.9	8.2	91.8	270	3.5	5.0	95.0
27.2µm	27.3	42.5	57.2	27.1µm	26.1	34.3	65.7	27.1µm	24.3	29.3	70.7
21.1	12.0	54.5	45.5	21.1	13.0	47.3	52.7	21.1	13.2	42.5	57.5
14.7	12.6	67.1	32.9	14.7	14.3	61.6	38.4	14.7	15.3	57.8	42.2
10.1	9.2	76.3	23.7	10.1	10.7	72.3	27.7	10.1	11.7	69.5	30.5
7.8	4.8	81.1	18.9	7.8	5.5	77.8	22.2	7.8	6.1	75.6	24.4
-7.8	18.9	100.0	-	-7.8	22.2	100.0	-	-7.8	24.4	100.0	-
Total	100.0	-	-	Total	100.0	-	-	Total	100.0	-	-

TABLE NO. 17 : Grinding Size Distribution on Composite 3

20 minute Grind			40 minute Grind			50 minute Grind			60 minute Grind			70 minute Grind		
Particle Size	% Retained Ind	% Pass Cum	Particle Size	% Retained Ind	% Pass Cum	Particle Size	% Retained Ind	% Pass Cum	Particle Size	% Retained Ind	% Pass Cum	Particle Size	% Retained Ind	% Pass Cum
+200M	3.7	3.7	96.3	-	-	-	+270M	4.3	4.3	95.7	+270M	2.4	2.4	97.6
270	7.8	11.5	88.5	+270M	6.7	6.7	93.3	400	8.8	13.1	86.9	400	6.3	8.7
27.7µm	28.9	40.4	59.6	27.8µm	24.7	31.4	68.6	27.8µm	11.6	24.7	75.3	27.8µm	10.9	19.6
21.5	12.3	52.7	47.3	21.6	13.3	44.7	55.3	21.6	12.3	37.0	63.0	21.6	12.3	
15.0	13.8	66.5	33.5	15.1	15.7	60.4	39.6	15.1	16.9	53.9	46.1	15.1	17.7	
10.3	9.6	76.1	23.9	10.4	11.3	71.7	28.3	10.4	12.8	66.7	33.3	10.4	14.0	
8.0	4.9	81.0	19.0	8.0	6.1	77.8	22.2	8.0	7.0	73.7	26.3	8.0	7.9	
-8.0	19.0	100.0	-	-8.0	22.2	100.0	-	-8.0	26.3	100.0	-	-8.0	28.5	
Total	100.0	-	-	Total	100.0	-	-	Total	100.0	-	-	Total	100.0	-

TABLE NO. 18 : Grinding Size Distribution on Composite No. 4

30 minute Grind				40 minute Grind				50 minute Grind			
Particle Size	% Retained Ind	% Pass Cum	% Pass Cum	Particle Size	% Retained Ind	% Pass Cum	% Pass Cum	Particle Size	% Retained Ind	% Pass Cum	% Pass Cum
+150M	1.5	1.5	98.5	-	-	-	-	-	-	-	-
200	7.6	9.1	90.9	+200M	4.4	4.4	95.6	+200M	2.4	2.4	97.6
270	12.8	21.9	78.1	270	10.7	15.1	84.9	270	6.4	8.8	91.2
400	15.3	37.2	62.8	400	17.7	32.8	67.2	400	16.3	25.1	74.9
34.8µm	4.0	41.2	58.8	34.6µm	3.9	36.7	63.3	34.8µm	4.4	29.5	70.5
27.0	8.4	49.6	50.4	26.8	8.3	45.0	55.0	27.0	9.3	38.8	61.2
18.8	13.8	63.4	36.6	18.7	15.3	60.3	39.7	18.8	16.9	55.7	44.3
12.9	11.1	74.5	25.5	12.9	11.9	72.2	27.8	12.9	13.4	69.1	30.9
10.0	5.9	80.4	19.6	9.9	6.0	78.2	21.8	10.0	6.8	75.9	24.1
-10.0	19.6	100.0	-	-9.9	21.8	100.0	-	-10.0	24.1	100.0	-
Total	100.0	-	-	Total	100.0	-	-	Total	100.0	-	-

Discussion - Continued

3. Lead Regrind Size Distribution

A detailed evaluation of the lead regrinding requirements was conducted on Composite 3 ore. On the other composites, the optimum regrind developed on Composite 3 ore was used. The lead regrinding size distribution is shown in Tables 19 (Composite 1A), Table 20 (Composite 1B), Table 21 (Composite 2), Table 22 (Composite 3) and Table 23 (Composite 4).

TABLE NO. 19 : Pb Regrind Size Distribution on Composite 1A

Particle Size	No Regrind % Retained		% Pass Cum	Particle Size	20 minute Regrind % Retained		% Pass Cum
	Ind.	Cum			Ind	Cum	
+270 mesh	2.3	2.3	97.7	-	-	-	-
27.8 μm	15.1	17.4	82.6	+29.0 μm	0.1	0.1	99.9
21.6	10.6	28.0	72.0	22.5	0.9	1.0	99.0
15.1	15.7	43.7	56.3	15.7	9.2	10.2	89.8
10.3	12.8	56.5	43.5	10.8	8.0	28.2	71.8
8.0	6.9	63.4	36.6	8.3	13.1	41.3	58.7
-8.0	36.6	100.0	-	-8.3	58.7	100.0	-
Total	100.0	-	-	Total	100.0	-	-

TABLE NO. 20 : Pb Regrind Size Distribution on Composite 1B

Particle Size	No Regrind % Retained		% Pass Cum
	Ind.	Cum	
+270 mesh	1.2	1.2	98.8
26.8 μm	22.6	23.8	76.2
20.8	13.6	37.4	62.6
14.5	17.0	54.4	45.6
9.0	11.2	65.6	34.4
7.7	4.8	70.4	29.6
-7.7	29.6	100.0	-
Total	100.0	-	-

Discussion - Continued

TABLE NO. 21 : Pb Regrind Size Distribution on Composite 2

Particle Size	No Regrind			Particle Size	30 minute Regrind		
	% Retained Ind.	% Retained Cum	% Pass Cum		% Retained Ind	% Retained Cum	% Pass Cum
+270 mesh	3.1	3.1	96.9	-	-	-	-
26.8 μm	16.6	19.7	80.3	33.9 μm	0.5	0.5	99.5
20.8	9.1	28.8	71.2	26.3	1.4	1.9	98.1
14.5	15.4	44.2	55.8	18.4	10.2	12.1	87.9
9.0	11.4	55.6	44.4	12.6	19.1	31.2	68.8
7.7	5.4	61.0	39.0	9.8	12.6	43.8	56.2
-7.7	39.0	100.0	-	-9.8	56.2	100.0	-
Total	100.0	-	-	Total	100.0	-	-

TABLE NO. 22 : Pb Regrind Size Distribution on Composite 3

Particle Size	No Regrind			Particle Size	5 minute Grind			Particle Size	10 minute Grind		
	% Retained Ind	% Retained Cum	% Pass Cum		% Retained Ind	% Retained Cum	% Pass Cum		% Retained Ind	% Retained Cum	% Pass Cum
+24.6 μm	28.2	28.2	71.8	24.6 μm	15.4	15.4	84.6	24.6 μm	6.7	6.7	93.3
19.0	14.5	42.7	57.3	19.0	13.9	29.3	70.7	19.0	10.3	17.0	83.0
13.3	16.2	58.9	41.1	13.3	18.7	48.0	52.0	13.3	9.7	26.7	73.3
9.1	11.6	70.5	29.5	9.1	14.9	62.9	37.1	9.1	2.1	28.8	71.2
7.1	5.9	76.4	23.6	7.1	8.0	70.9	29.1	7.1	6.1	34.9	65.1
-7.1	23.6	100.0	-	-7.1	29.1	100.0	-	-7.1	65.1	100.0	-
Total	100.0	-	-	Total	100.0	-	-	Total	100.0	-	-

Particle Size	20 minute Regrind		% Pass Cum
	% Retained Ind.	% Retained Cum	
+24.6 μm	5.5	5.5	94.5
19.0	8.3	13.8	86.2
13.3	17.6	31.4	68.6
9.1	18.0	49.4	50.6
7.1	10.2	59.6	40.4
-7.1	40.4	100.0	-
Total	100.0	-	-

Discussion - Continued

TABLE NO. 23 : Pb Regrind Size Distribution on Composite 4

Particle Size	No Re grind		% Pass Cum	Particle Size	20 minute Re grind		% Pass Cum
	% Retained Ind.	Cum			% Retained Ind	Cum	
+270 mesh	3.9	3.9	96.1	-	-	-	-
34.6 μm	11.2	15.1	84.9	35.1 μm	-	-	100.0
26.8	8.1	23.2	76.8	27.2	0.6	0.6	99.4
18.7	14.3	37.5	62.5	19.0	7.1	7.7	92.3
12.9	13.1	50.6	49.4	13.1	16.4	24.1	75.9
9.9	7.7	58.3	41.7	10.1	12.8	36.9	63.1
-9.9	41.7	100.0	-	-10.1	63.1	100.0	-
Total	100.0	-	-	Total	100.0	-	-

The best metallurgical results were obtained using a regrind of 20 minutes. In order to obtain a similar size distribution in the plant, 4 inch cyclones are required. These cyclones would operate at a lower pulp density (i.e. 25 % solids). Under these conditions, a similar regrind fineness to that obtained in the laboratory may be achieved with the present regrinding capacities.

4. Flotation Testwork

4.1. Flotation Testwork on Composite 1A

Composite 1A consisted of oxidized ore and contained secondary copper minerals. A total of eight tests were performed on this composite, five of which were roughing tests and three cleaning tests. In general, problems were experienced with this composite in obtaining selectivity between lead and zinc minerals and with production of a high grade lead concentrate.

4.1.1. Lead and Zinc Rougher Tests

A series of five tests were conducted in which the primary grinding time varied from 30 minutes to 70 minutes per 2000 grams. The results of several tests are shown in Table No. 24.

The results obtained in these tests indicated the following:

1. Finer primary grinding improved lead and zinc rougher recovery slightly.
2. An average of 65 % of the total zinc reported in the lead rougher concentrate. Even with high cyanide additions, zinc rejection was not possible.

Discussion - Continued

TABLE NO. 24 :**Effect of Fineness of Grind on Pb-Zn Flotation Using Modified Reagent Scheme Composite1A**

Test No.	Grind		Product	Weight %	Assays, %, g/t								% Distribution			
	Time min.	% Pass 28µm			Cu	Pb	Zn	Fe	Au	Ag	Cu	Pb	Zn	Fe	Au	Ag
52	60	75.6	Pb ro. conc.	14.29	1.40	21.9	14.3	19.7	3.23	256	72.5	78.4	48.6	10.3	62.7	72.8
			Pb Scav conc.	3.73	0.36	4.52	17.9	26.3	2.44	88.9	4.9	4.2	15.9	3.6	12.4	6.6
			Pb ro + Scav conc	18.02	1.18	18.3	15.1	21.1	3.07	221	77.4	82.7	64.5	13.9	75.1	79.4
			Zn ro. conc.	4.61	0.22	2.10	16.2	27.3	0.40	44.6	3.7	2.4	17.8	4.6	2.5	4.1
			Zn Scav' conc	2.45	0.24	2.27	2.60	34.8	0.61	44.6	2.1	1.4	1.5	3.1	2.0	2.2
			Zn ro + Scav conc	7.06	0.23	2.16	11.5	29.9	0.47	44.6	5.8	3.8	19.3	7.7	4.5	6.3
			Zn Flot. tail	74.92	0.062	0.72	0.91	28.5	0.20	9.6	16.8	13.5	16.2	78.3	20.4	14.3
			Head (calc.)	100.00	0.28	3.99	4.20	27.3	0.74	50.2	100.0	100.0	100.0	100.0	100.0	100.0
53	70	78.5	Pb ro. conc.	12.85	1.53	23.6	15.7	17.2	3.25	286	73.6	77.4	49.2	8.2	62.3	70.6
			Pb Scav conc	4.22	0.37	5.09	16.1	27.6	1.17	86.8	5.8	5.5	16.6	4.3	7.4	7.0
			Pb ro + Scav conc	17.07	1.24	19.0	15.8	19.8	2.74	237	79.4	82.9	65.8	12.6	69.7	77.6
			Zn ro conc.	4.41	0.20	2.03	15.9	26.2	0.91	47.2	3.3	2.3	17.1	4.3	6.0	4.0
			Zn Scav conc.	2.24	0.22	2.42	2.48	33.7	0.47	45.5	1.8	1.4	1.4	2.8	1.6	2.0
			Zn ro + Scav conc	6.64	0.21	2.16	11.4	28.7	0.76	46.6	5.1	3.7	18.4	7.1	7.6	6.0
			Zn Flot. tail	76.29	0.054	0.69	0.85	28.3	0.20	11.2	15.4	13.4	15.8	80.3	22.8	16.4
			Head (calc.)	100.00	0.27	3.92	4.10	26.9	0.67	52.1	100.0	100.0	100.0	100.0	100.0	100.0

4.1.2. Lead Cleaning Tests

Three lead cleaning tests were performed in which different zinc depressants were examined. The conditions and results for these tests are summarized in Table 25.

From the results obtained, the following conclusions can be made:

1. No efficient zinc rejection during the lead cleaning was obtained.

Moreover, high lead losses occurred in the cleaner tailings.

2. With the use of LS8 depressant (Test 74), lead concentrate grade and zinc rejection during lead cleaning improved significantly.

Depressant DS20 had no significant effect on either lead concentrate grade or recovery.

3. No problems were experienced with zinc flotation and upgrading (Test 72).

Discussion - Continued

TABLE NO. 25 : Preliminary Cleaning Tests on Composite 1A Ore**a) Conditions**

Test No.	Regrind				Reagent Additions, g/t				pH	
	Pb Circuit		Zn Circuit		Pb Circuit		Zn Circuit		Pb	Zn
	Time	Media	Time	Media	Depressant	Collector	Depressant	Collector		
72	20	RM	30	PM	Na ₂ CO ₃ =5000 NaCN=345 Na ₂ SiO ₃ =250	A317/ 3418A= 44.0	Ca(OH) ₂ =5000 CuSO ₄ =900	A350=70	9.6	11.7- 12.3
74	20	RM	-	-	Na ₂ CO ₃ =5000 LS8 = 350 Na ₂ SiO ₃ =150 Oxalic Acid=900 NaCN=500	A317/ 3481A= 80.0	-	-	9.3- 8.9	-
76	20	RM	-	-	Na ₂ CO ₃ =5000 DS20-370 Na ₂ SiO ₃ =250	A317/ 3418A= 77.5	-	-	9.4	-

b) Results

Test No.	Product	Weight %	Assays, %g/t		% Distribution	
			Pb	Zn	Pb	Zn
72	Pb 4th Cleaner Concentrate	3.61	44.0	14.2	44.0	13.2
	Pb 1st Cleaner Concentrate	8.47	32.0	15.2	75.1	33.2
	Zn 4th Cleaner Concentrate	2.40	1.22	53.0	0.8	32.8
	Zn Rougher Concentrate	10.83	2.43	16.1	7.3	44.9
	Zn Rougher Tailing	79.96	0.72	0.83	15.9	17.1
	Head (Calc)	100.00	3.61	3.88	100.0	100.0
74	Pb 4th Cleaner Concentrate	2.11	51.5	12.6	30.4	6.5
	Pb 2nd Cleaner Concentrate	3.70	44.8	13.6	46.4	12.3
	Pb Rougher Concentrate	15.04	18.9	14.4	79.5	52.9
	Pb Rougher Tailing	84.96	0.86	2.27	20.5	47.1
	Head (Calc)	100.00	3.57	4.10	100.0	100.0
76	Pb 4th Cleaner Concentrate	3.06	41.6	15.6	34.3	11.8
	Pb 2nd Cleaner Concentrate	6.58	32.9	16.3	58.2	26.6
	Pb Rougher Concentrate	17.95	16.9	12.4	81.7	55.3
	Pb Rougher Tailing	82.05	0.83	2.20	18.3	44.7
	Head (Calc)	100.00	3.72	4.04	100.0	100.0

Discussion - Continued

4.2.2. Lead and Zinc Cleaning Tests

Only standard lead cleaning tests at different finenesses of regrind were performed on this composite. The results obtained indicated that both lead and zinc rougher concentrates can be upgraded successfully and with the finer regrind, the grade of the lead concentrate improved significantly (Table 27). The zinc cleaner recovery at finer regrind also improved.

TABLE NO. 27 : Preliminary Cleaning Tests on Composite 1B Orea) Conditions

Test No.	Regrind				Reagent Additions, g/t				pH	
	Pb Circuit		Zn Circuit		Pb Circuit		Zn Circuit		Pb	Zn
	Time	Media	Time	Media	Depressant	Collector	Depressant	Collector		
63	20	RM	20	PM	Na ₂ CO ₃ =2000 NaCN=395 Na ₂ SiO ₃ =250	A 317/ 3418A= 46.5	Ca(OH) ₂ =5000 CuSO ₄ =800	A350=50	9.8	12.3
64	30	RM	30	PM	Na ₂ CO ₃ =2000 NaCN=395 Na ₂ SiO ₃ =250	A 317/ 3418A= 46.5	Ca(OH) ₂ =5000 CuSO ₄ =900	A350=65	9.8	12.3

b) Results

Test No.	Product	Weight %	Assays, %		% Distribution	
			Pb	Zn	Pb	Zn
63	Pb 4th Cleaner Concentrate	6.46	61.0	8.31	70.7	8.2
	Pb 1st Cleaner Concentrate	9.82	49.0	9.20	86.4	13.8
	Zn 4th Cleaner Concentrate	4.98	0.86	56.6	0.8	43.3
	Zn Rougher Concentrate	20.94	1.48	24.9	5.6	80.2
	Zn Rougher Tailing	68.47	0.59	0.34	7.3	3.6
	Head (Calc)	100.00	5.57	6.51	100.0	100.0
64	Pb 4th Cleaner Concentrate	5.24	68.9	6.11	63.3	5.0
	Pb 1st Cleaner Concentrate	9.13	53.4	8.30	85.5	11.8
	Zn 4th Cleaner Concentrate	6.19	0.89	56.8	1.0	54.4
	Zn Rougher Concentrate	21.40	1.61	24.8	6.0	82.0
	Zn Rougher Tailing	68.61	0.61	0.36	7.3	3.8
	Head (Calc)	100.00	5.71	6.46	100.0	100.0

Discussion - Continued

4.3. Flotation Testwork on Composite 24.3.1. Lead and Zinc Rougher Tests

Initially, a series of lead and zinc rougher tests were performed using the conditions developed with Composite No. 3. In these tests, the grinding time was varied from 30 minutes to 50 minutes per 2000 grams. The conditions and results for these tests are shown in Table 28.

TABLE NO. 28 : Preliminary Roughing Tests on Composite 2

Test No.	Grind Time*	Product	Weight %	Assays %g/t				% Distribution			
				Pb	Zn	Au	Ag	Pb	Zn	Au	Ag
45	30	Pb Ro + Scav Conc	13.61	30.91	12.36	4.36	365.28	88.0	30.2	69.6	76.1
		Zn Ro + Scav Conc	16.22	2.00	22.21	0.45	54.57	6.7	63.6	8.5	13.3
		Zn Scavenger Tail	69.97	0.37	0.50	0.27	10.0	5.3	6.2	21.9	10.6
		Head (Calc)	100.00	4.85	5.66	0.86	66.30	100.0	100.0	100.0	100.0
46	40	Pb Ro + Scav Conc	13.56	31.02	12.12	5.16	374.9	89.4	29.9	79.8	76.9
		Zn Ro + Scav Conc	14.77	1.93	23.88	0.28	54.14	6.1	64.1	4.6	12.1
		Zn Scavenger Tail	71.67	0.30	0.46	0.19	10.1	4.6	6.0	15.5	11.0
		Head (Calc)	100.00	4.71	5.50	0.88	66.06	100.0	100.0	100.0	100.0
47	50	Pb Ro + Scav Conc	13.90	30.78	12.22	4.72	373.34	89.6	30.0	75.7	76.6
		Zn Ro + Scav Conc	14.29	1.78	24.30	0.42	75.74	5.3	63.1	7.0	16.0
		Zn Scavenger Tail	71.60	0.34	0.47	0.21	7.0	5.1	6.1	17.4	7.4
		Head (Calc)	100.00	4.78	5.51	0.87	67.76	100.0	100.0	100.0	100.0

The results from these tests indicated the following:

1. With an increase in fineness of grind, the lead rougher recovery improved only slightly. The zinc grade and recovery, however, remained unchanged.
2. The precious metal recoveries improved significantly with the increase in grinding time from 30 minutes to 40 minutes. A further increase in grinding time had no effect on precious metal recoveries.

Discussion - Continued

4.3.2. Lead and Zinc Cleaning Tests

A series of four tests was performed to examine a) fineness of regrind and b) level of cyanide in the cleaners. The conditions and results for these tests are summarized in Tables 29 (a) and (b).

TABLE NO. 29 : Preliminary Cleaning Tests on Composite 2 Ore**a) Conditions**

Test No.	Regrind				Reagent Additions, g/t				pH	
	Pb circuit		Zn circuit		Pb Circuit		Zn Circuit		Pb circuit	Zn circuit
	Time	Media	Time	Media	Depressants	Collectors	Depressants	Collectors		
51	20	R.M.	10	P.M.	Na ₂ CO ₃ = 2000 NaCN = 320 Na ₂ SiO ₃ = 250	A317/3418A = 46.5	Ca(OH) ₂ = 2250 CuSO ₄ = 800	A350 = 45	9.6-9.5	11.5-11.9
60	20	R.M.	10	P.M.	Na ₂ CO ₃ = 2000 NaCN = 395 Na ₂ SiO ₃ = 250	A317/3418A = 46.5	Ca(OH) ₂ = 5000 CuSO ₄ = 800	A350 = 45	9.7	12.2
61	20	R.M.	20	P.M.	Na ₂ CO ₃ = 2000 NaCN = 395 Na ₂ SiO ₃ = 250	A317/3418A = 46.5	Ca(OH) ₂ = 5000 CuSO ₄ = 800	A350 = 45	9.7	12.2
62	30	R.M.	30	P.M.	Na ₂ CO ₃ = 2000 NaCN = 395 Na ₂ SiO ₃ = 250	A317/3418A = 46.5	Ca(OH) ₂ = 5000 CuSO ₄ = 800	A350 = 55	9.7	12.2

Discussion - Continued

Table No. 29 - Continued**b) Results**

Test No.	Product	Weight %	Assays, %		% Distribution	
			Pb	Zn	Pb	Zn
51	Pb 4th Cleaner conc.	5.14	60.4	11.0	68.1	10.3
	Pb 1st Cleaner conc.	7.97	50.3	10.5	88.0	15.2
	Zn 4th Cleaner conc.	8.02	1.61	49.4	2.8	71.9
	Zn rougher conc.	17.43	1.49	24.3	5.7	76.9
	Zn rougher tail	74.08	0.35	0.46	5.7	6.2
	Head (Calc.)	100.00	4.56	5.51	100.0	100.0
60	Pb 4th Cleaner conc.	6.15	57.2	11.7	75.8	13.2
	Pb 1st Cleaner conc.	9.11	45.9	10.9	90.1	18.2
	Zn 4th Cleaner conc.	6.41	1.17	51.6	1.6	60.8
	Zn rougher conc.	17.53	1.17	23.1	4.4	74.3
	Zn rougher tail	72.77	0.32	0.44	5.0	5.9
	Head (Calc.)	100.00	4.64	5.44	100.0	100.0
61	Pb 4th Cleaner conc.	5.10	60.1	10.6	67.8	10.1
	Pb 1st Cleaner conc.	8.35	47.9	10.2	88.5	15.9
	Zn 4th Cleaner conc.	5.20	1.20	54.5	1.4	52.8
	Zn rougher conc.	17.24	1.26	23.6	4.8	75.8
	Zn rougher tail	73.91	0.38	0.49	6.2	6.7
	Head (calc.)	100.00	4.52	5.37	100.0	100.0
62	Pb 4th Cleaner conc.	4.88	60.6	9.88	65.6	8.9
	Pb 1st Cleaner conc.	8.08	49.3	9.70	88.4	14.5
	Zn 4th Cleaner conc.	6.00	1.22	55.0	1.6	60.8
	Zn rougher conc.	18.43	1.27	22.9	5.2	77.7
	Zn rougher tail	72.89	0.36	0.45	5.8	6.1
	Head (calc.)	100.00	4.51	5.42	100.0	100.0

From the results obtained the following conclusions can be made:

1. Finer regrinding of the lead concentrate (Tests 61 and 62) had no effect on lead metallurgical results. A finer regrind of the zinc concentrate improved both zinc concentrate grade and recovery.

2. Higher cyanide additions to the lead rougher and cleaner did not effect lead metallurgical results.

Although the behaviour of the lead and zinc flotation in the corresponding rougher and scavenger stages was similar to that of Composite 3, the upgrading of the lead and zinc concentrates was not as efficient as that obtained on Composite 3. It appeared that this ore type contains more weathered ore than the ore type of Composite 3.

Discussion - Continued

4.4. Flotation Testwork on Composite 3

This composite was used for a detailed evaluation of the Vangorda ore, since the ore types included in this composite represented the largest portion of the orebody. A large portion of the testwork was devoted to a detailed evaluation of the current plant reagent scheme and flowsheet in order to accommodate the standard plant procedure used for Faro 3 ore on processing of the Vangorda ore. During the testwork, it became obvious that the Vangorda ore cannot be processed using the Faro 3 procedure exactly as is. In this testwork, minimum changes in the reagent scheme and flowsheet have been indicated to obtain satisfactory metallurgical results on Vangorda ore. The effect of the parameters examined on the Vangorda ore Composite 3 are described in the following sections.

4.4.1. Roughing Tests**4.4.1.1. Effect of Fineness of Primary Grind**

Two series of tests with different finenesses of grind were performed. In the first series of tests (Table 30), the plant reagent scheme was used and in the second series of tests Table 31, the modified collector mixture was tested. The results from these tests showed the following:

1. The fineness of grind in the range tested had little, or no effect on lead and zinc recoveries, however, precious metal recoveries increased with the finer grind (Table 30).

**TABLE NO. 30 : Effect of Primary Grind Fineness on Rougher Flotation -
Comp. 3**

Test No.	Primary Grind			Product	Wght %	Assays, %g/t					% Distribution				
	Mill Type	Time min	% passing 28µm			Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1	Ball	30	59.6	Pb Conc	9.7	36.3	10.4	13.0	2.35	181	86.7	19.0	5.5	27.2	24.0
				Zn Conc	15.7	1.92	26.1	19.0	2.99	312	7.4	77.2	13.0	55.9	67.2
				Zn Tail	74.6	0.32	0.27	25.2	0.19	8.60	5.9	3.8	81.5	16.9	8.8
				Head(calc)	100.0	4.07	5.30	23.1	0.84	72.9	100.0	100.0	100.0	100.0	100.0
2	Ball	40	68.6	Pb Conc	9.2	38.3	9.73	12.1	4.12	200	86.1	16.3	4.9	60.8	33.1
				Zn Conc	13.4	2.15	32.7	16.6	0.73	224	7.1	79.9	9.8	15.6	54.0
				Zn Tail	77.4	0.36	0.27	25.1	0.19	9.30	6.8	3.8	85.3	23.6	12.9
				Head(calc)	100.0	4.09	5.49	22.8	0.62	55.6	100.0	100.0	100.0	100.0	100.0
3	Ball	50	75.3	Pb Conc	9.3	37.8	9.06	12.2	5.56	499	85.0	15.3	4.9	67.1	75.0
				Zn Conc	13.0	2.55	34.1	15.5	0.33	57.5	8.0	80.6	8.8	5.6	12.1
				Zn Tail	77.7	0.37	0.29	25.5	0.27	10.2	7.0	4.1	86.3	27.3	12.9
				Head(calc)	100.0	4.12	5.49	23.0	0.77	61.7	100.0	100.0	100.0	100.0	100.0
4	Ball	60	80.4	Pb Conc	9.3	38.3	8.57	12.3	4.59	508	88.1	14.4	5.0	71.4	79.9
				Zn Conc	13.3	1.96	34.3	15.9	0.31	47.5	6.4	81.9	9.2	6.7	10.6
				Zn Tail	77.4	0.29	0.26	25.3	0.17	7.30	5.5	3.6	85.7	21.9	9.5
				Head(calc)	100.0	4.06	5.55	22.8	0.60	59.4	100.0	100.0	100.0	100.0	100.0
5	Rod	70	71.2	Pb Conc	10.9	35.0	10.3	15.3	5.68	486	91.5	20.3	7.1	76.4	77.9
				Zn Conc	13.2	1.01	31.9	18.6	0.41	70.3	3.2	76.3	10.4	6.7	13.7
				Zn Tail	75.9	0.29	0.25	25.6	0.18	7.50	5.3	3.4	82.5	16.9	8.4
				Head(calc)	100.0	4.16	5.51	23.6	0.81	67.8	100.0	100.0	100.0	100.0	100.0

Discussion - Continued

2. Rod mill grinding gave much better lead and precious metal recoveries than did the ball mill for the same fineness of grind. It appeared that the grinding media plays a significant role in the flotation behaviour of lead. In the commercial plant, however, classification efficiency may be as critical as the grinding media in the laboratory testwork.

3. Using the modified collector and a coarser grind, lead recovery improved significantly (Table 31). At the finer grind no significant changes in the lead recovery occurred.

TABLE NO. 31 : Effect of Fineness of Grind on Cu-Zn Flotation Using Modified Reagent Scheme - Composite 3

Test No.	Grind		Product	Wt %	Assays %		% Distribution	
	Time min	%Pass 28 μ m			Pb	Zn	Pb	Zn
42	30	59.6	Pb Rougher Concentrate	9.52	36.0	10.2	83.1	18.7
			Pb Scavenger Conc	5.50	7.26	10.2	9.7	10.8
			Pb Ro + Scav Conc	15.02	25.5	10.2	92.7	29.4
			Zn Rougher Concentrate	9.94	0.87	34.0	2.1	65.0
			Zn Scavenger Conc	3.61	1.36	3.14	1.2	2.2
			Zn Ro + Scav Conc	13.55	1.00	25.8	3.3	67.1
			Zn Flotation Tailing	71.43	0.23	02.5	4.0	3.4
			Head (Calc)	100.00	4.13	5.20	100.0	100.0
43	40	68.6	Pb Rougher Concentrate	8.73	37.9	9.57	81.5	16.2
			Pb Scavenger Conc	2.29	9.38	12.8	5.3	5.7
			Pb Ro + Scav Conc	11.02	32.0	10.2	86.8	21.9
			Zn Rougher Concentrate	10.66	1.83	35.2	4.8	72.8
			Zn Scavenger Conc	3.93	3.58	2.36	3.5	1.8
			Zn Ro + Scav Conc	14.58	2.30	26.4	8.3	74.6
			Zn Flotation Tailing	74.40	0.27	0.24	4.9	3.5
			Head (Calc)	100.00	4.06	5.15	100.0	100.0
44	50	75.3	Pb Rougher Concentrate	7.24	44.1	8.55	77.7	11.5
			Pb Scavenger Conc	2.79	13.0	13.5	8.8	7.0
			Pb Ro + Scav Conc	10.03	35.5	9.93	86.6	18.5
			Zn Rougher Concentrate	8.85	1.64	44.1	3.5	72.6
			Zn Scavenger Conc	5.35	4.07	5.43	5.3	5.4
			Zn Ro + Scav Conc	14.20	2.55	29.5	8.8	78.0
			Zn Flotation Tailing	75.78	0.25	0.25	4.6	3.5
			Head (Calc)	100.00	4.11	5.38	100.0	100.0

4.4.1.2. Effect of Level of Cyanide

Using a 40 minute ball mill grind, a series of four tests was performed in which the levels of cyanide addition to the grind were varied from 50 g/t to 200 g/t. The conditions and results for these tests are shown in Table No. 32.

TABLE NO. 32 : Effect of NaCN Level on Rougher Flotation - Composite 3

Test No.	NaCN g/t	Product	Wght %	Assays, %g/t					% Distribution				
				Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
2	150	Pb Conc	9.2	38.3	9.73	12.1	4.12	200	86.1	16.3	4.9	60.8	33.1
		Zn Conc	13.4	2.15	32.7	16.6	0.73	224	7.1	79.9	9.8	15.6	54.0
		Zn Tail	77.4	0.36	0.27	25.1	0.19	9.30	6.8	3.8	85.3	23.6	12.9
		Head(calc)	100.0	4.09	5.49	22.8	0.62	55.6	100.0	100.0	100.0	100.0	100.0
6	50	Pb Conc	8.1	34.7	7.62	13.1	7.59	477	70.3	12.3	4.4	69.3	70.3
		Zn Conc	16.1	5.88	26.2	18.6	0.41	67.3	23.8	84.7	12.7	7.5	19.9
		Zn Tail	75.8	0.31	0.20	26.0	0.27	7.1	5.9	3.0	82.9	23.2	9.8
		Head(calc)	100.0	3.98	5.00	23.8	0.88	54.7	100.0	100.0	100.0	100.0	100.0
7	100	Pb Conc	9.6	34.8	8.90	11.9	5.13	475	85.0	16.8	5.0	73.0	77.0
		Zn Conc	14.4	2.14	28.1	17.2	0.37	51.0	7.9	80.0	10.8	7.8	12.4
		Zn Tail	76.0	0.37	0.21	25.3	0.17	8.20	7.1	3.2	84.2	19.2	10.6
		Head(calc)	100.0	3.92	5.04	22.9	0.67	59.0	100.0	100.0	100.0	100.0	100.0
8	200	Pb Conc	11.5	29.7	8.72	12.9	4.12	390	86.1	20.2	6.2	72.6	79.4
		Zn Conc	13.9	2.45	27.2	18.9	0.37	49.8	8.6	76.3	11.0	7.9	12.3
		Zn Tail	74.6	0.28	0.23	26.4	0.17	6.30	5.3	3.5	82.8	19.5	8.3
		Head(calc)	100.0	3.95	4.95	23.8	0.65	56.4	100.0	100.0	100.0	100.0	100.0

The results from these tests showed that during the processing of Vangorda ore, the cyanide consumption would be much greater than the cyanide consumption for processing Faro 3 ore. Under laboratory conditions, the optimum level of cyanide addition would be between 100 g/t and 150 g/t. It is interesting to note that silver recovery increased significantly with the increase in cyanide addition.

4.4.1.3. Effect of Level of Collector

Three tests were performed in which the level of collector was varied between 12 g/t and 25 g/t. The conditions and results for these tests are shown in Table No. 33.

TABLE NO. 33 : Effect of Collector A343 Level on Pb Rougher Flotation - Composite 3

Test No.	A343 g/t	Product	Wght %	Assays, %g/t					% Distribution				
				Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
2	12.5	Pb Conc	9.2	38.3	9.73	12.1	4.12	200	86.1	16.3	4.9	60.8	33.1
		Zn Conc	13.4	2.15	32.7	16.6	0.73	224	7.1	79.9	9.8	15.6	54.0
		Zn Tail	77.4	0.36	0.27	25.1	0.19	9.30	6.8	3.8	85.3	23.6	12.9
		Head(calc)	100.0	4.09	5.49	22.8	0.62	55.6	100.0	100.0	100.0	100.0	100.0
9	18.75	Pb Conc	11.0	31.8	9.76	14.3	4.46	428	88.1	21.0	6.5	68.6	80.1
		Zn Conc	13.4	1.97	28.7	18.7	0.55	43.4	6.7	75.5	10.4	10.3	9.9
		Zn Tail	75.6	0.27	0.23	26.5	0.2	7.7	5.2	3.4	83.1	21.1	9.9
		Head(calc)	100.0	3.96	5.10	24.1	0.72	58.7	100.0	100.0	100.0	100.0	100.0
10	25	Pb Conc	11.0	33.2	10.2	15.3	4.23	434	90.0	22.1	6.9	65.1	82.7
		Zn Conc	13.6	1.54	27.6	18.8	0.45	36.5	5.2	74.4	10.5	8.6	8.6
		Zn Tail	75.4	0.26	0.23	26.6	0.25	6.70	4.8	3.5	82.6	26.3	8.7
		Head(calc)	100.0	4.05	5.05	24.3	0.72	57.8	100.0	100.0	100.0	100.0	100.0
8	20	Pb Conc	11.5	29.7	8.72	12.9	4.12	390	86.1	20.2	6.2	72.6	79.4
		Zn Conc	13.9	2.45	27.2	18.9	0.37	49.8	8.6	76.3	11.0	7.8	12.3
		Zn Tail	74.6	0.28	0.23	26.4	0.17	6.30	5.3	3.5	82.8	19.5	8.3
		Head(calc)	100.0	3.95	4.95	23.8	0.65	56.4	100.0	100.0	100.0	100.0	100.0

Discussion - Continued

The higher level of collector gave slightly better lead recovery but the selectivity between lead and zinc minerals deteriorated. The precious metal recoveries improved with the higher additions of collector.

4.4.1.4. Effect of High Speed Conditioning

The effect of different high speed conditioning times was investigated in Tests 11, 12 and 13. These results are compared with the results of the standard test in Table No. 34. The results obtained indicated that high speed conditioning reduces lead recovery significantly.

TABLE NO. 34 : Effect of High Speed Conditioning on Pb Flotation - Composite 3

Test No.	HS Cond min	Product	Wght %	Assays, %g/t					% Distribution				
				Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
2	0	Pb Conc	9.2	38.3	9.73	12.1	4.12	200	86.1	16.3	4.9	60.8	33.1
		Zn Conc	13.4	2.15	32.7	16.6	0.73	224	7.1	79.9	9.8	15.6	54.0
		Zn Tail	77.4	0.36	0.27	25.1	0.19	9.30	6.8	3.8	85.3	23.6	12.9
		Head(calc)	100.0	4.09	5.49	22.8	0.62	55.6	100.0	100.0	100.0	100.0	100.0
11	10	Pb Conc	9.8	34.9	9.63	13.5	5.56	424	81.7	17.9	5.4	75.0	75.3
		Zn Conc	15.5	3.34	26.7	19.8	0.40	61.8	12.4	78.8	12.5	8.5	17.5
		Zn Tail	74.7	0.33	0.23	26.9	0.16	5.3	5.9	3.3	82.1	16.5	7.2
		Head(calc)	100.0	4.17	5.26	24.5	0.72	55.0	100.0	100.0	100.0	100.0	100.0
12	20	Pb Conc	8.3	37.0	8.56	12.4	5.54	500	74.7	13.7	4.2	66.3	69.7
		Zn Conc	16.0	4.94	26.9	17.6	0.56	80.9	19.2	83.1	11.6	12.9	21.7
		Zn Tail	75.7	0.33	0.22	27.1	0.19	6.70	6.1	3.2	84.2	20.8	8.6
		Head(calc)	100.0	4.11	5.18	24.4	0.69	59.5	100.0	100.0	100.0	100.0	100.0
13	30	Pb Conc	7.7	40.6	8.79	11.2	5.88	552	74.7	12.7	3.5	76.0	70.9
		Zn Conc	15.6	4.83	28.3	18.5	0.27	70.0	18.1	83.4	11.9	7.1	18.4
		Zn Tail	76.7	0.39	0.27	26.8	0.13	8.30	7.2	3.9	84.6	16.9	10.7
		Head(calc)	100.0	4.16	5.30	24.3	0.59	59.6	100.0	100.0	100.0	100.0	100.0

4.4.2. Lead and Zinc Cleaning Tests4.4.2.1. Preliminary Lead Cleaning Tests

Initially, a series of eight tests were performed in which the regrinding time, type of regrinding mill and cleaning conditions were examined. The conditions and results from these tests are shown in Table No. 35.

Discussion - Continued

TABLE NO. 35 : Preliminary Lead Cleaning Tests - Composite 3

a) Conditions

Test No.	Mill Type	Primary Time min	Grind % Passing 28 µm	Concentrate Mill Type	Regrind Time min	Regrind % Passing 28 µm	HS Cond after regr min.
14	Ball	40	68.6	-	-	29.5	-
15	Ball	40	68.6	Pebble	5	37.1	-
16	Ball	40	68.6	Pebble	10	-	-
17	Ball	40	68.6	Pebble	20	50.6	-
18	Ball	40	68.6	Pebble	20	50.6	20
22	Ball	50	75.3	Rod	10	-	-
23	Rod	70	71.2	Rod	10	-	-
24*	Rod	60	61.1	Rod	10	-	-

*SO₂ to pH 7.5 in cleaning

b) Results

Test No.	Product	Wght %	Assays, %g/t					% Distribution				
			Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
14	Pb Cl Conc	4.9	48.2	14.2	7.26	6.07	607	58.0	12.9	1.5	38.7	53.0
	Pb Ro Conc	10.7	33.3	10.1	14.8	4.25	412	87.3	19.9	6.7	59.2	78.5
	Pb Ro Tail	89.3	0.58	4.83	24.8	0.35	13.5	12.7	80.1	93.3	40.8	21.5
	Head(calc)	100.0	4.06	5.39	23.7	0.77	56.0	100.0	100.0	100.0	100.0	100.0
15	Pb Cl Conc	3.8	53.9	10.8	5.94	6.57	689	52.5	8.0	0.9	41.3	46.7
	Pb Ro Conc	10.6	31.5	9.88	15.3	4.19	400	86.8	20.7	6.7	74.6	76.8
	Pb Ro Tail	89.4	0.57	4.50	25.5	0.17	14.4	13.2	79.3	93.3	25.4	23.2
	Head(calc)	100.0	3.86	5.07	24.4	0.60	55.5	100.0	100.0	100.0	100.0	100.0
16	Pb Cl Conc	3.0	57.8	8.66	5.47	10.2	787	44.2	4.9	0.6	38.9	42.1
	Pb Ro Conc	8.7	35.4	9.23	14.1	4.92	461	78.7	15.1	4.9	54.5	71.6
	Pb Ro Tail	91.3	0.91	4.95	26.2	0.39	17.4	21.3	84.9	95.1	45.5	28.4
	Head(calc)	100.0	3.90	5.32	25.1	0.78	55.9	100.0	100.0	100.0	100.0	100.0
17	Pb Cl Conc	3.3	59.4	8.16	5.71	11.3	781	50.3	5.1	0.8	52.0	47.5
	Pb Ro Conc	9.8	33.6	10.2	15.1	5.22	423	85.3	19.3	6.0	72.2	77.3
	Pb Ro Tail	90.2	0.63	4.66	25.7	0.22	13.6	14.7	80.7	94.0	27.8	22.7
	Head(calc)	100.0	3.87	5.20	24.7	0.71	53.9	100.0	100.0	100.0	100.0	100.0
18	Pb Cl Conc	2.7	62.4	7.91	4.42	13.7	820	43.0	4.1	0.5	59.4	41.1
	Pb Ro Conc	9.7	34.0	9.82	14.7	4.53	421	83.3	18.0	5.7	69.8	75.1
	Pb Ro Tail	90.3	0.73	4.81	26.1	0.21	15.0	16.7	82.0	94.3	30.2	24.9
	Head(calc)	100.0	3.95	5.29	25.0	0.63	54.3	100.0	100.0	100.0	100.0	100.0
22	Pb Cl Conc	2.6	67.7	3.95	3.60	12.1	952	49.1	1.9	0.4	51.2	67.6
	Pb Ro Conc	6.8	38.5	7.69	13.4	5.91	521	71.6	9.7	3.7	64.2	95.0
	Pb Ro Tail	93.2	1.11	5.22	25.1	0.24	2.0	28.4	90.3	96.3	35.8	5.0
	Head(calc)	100.0	3.65	5.39	24.3	0.62	37.2	100.0	100.0	100.0	100.0	100.0
23	Pb Cl Conc	5.2	58.5	7.29	6.39	9.25	737	78.5	7.5	1.3	70.0	67.4
	Pb Ro Conc	11.1	32.1	9.49	17.1	4.69	408	91.6	20.8	7.7	75.5	79.4
	Pb Ro Tail	88.9	0.37	4.51	25.8	0.19	13.2	8.4	79.2	92.3	24.5	20.6
	Head(calc)	100.0	3.89	5.06	24.8	0.69	57.1	100.0	100.0	100.0	100.0	100.0
24	Pb Cl Conc	3.5	63.6	6.03	4.44	12.6	855	57.6	4.1	0.6	60.7	52.8
	Pb Ro Conc	10.7	32.0	9.98	16.9	4.78	423	89.9	21.2	7.3	71.4	80.8
	Pb Ro Tail	89.3	0.43	4.45	25.7	0.23	12.0	10.1	78.8	92.7	28.6	19.2

Discussion - Continued

From the results obtained the following observations can be made:

1. Regardless of the fineness of regrind, the lead during cleaning floated slowly resulting in low lead recovery in the cleaner concentrate. It was observed that the flotability of the lead changed significantly from roughing to cleaning.
2. With increasing fineness of regrind, the lead concentrate grade improved but without significant changes in recovery.
3. The type of regrinding mill (Tests 18 and 22) had no significant effect on lead flotation performance in the cleaning.
4. High collector additions to the cleaner (Test 23) significantly improved lead cleaner recovery.
5. The addition of SO₂ to the lead cleaners (Test 24) was not effective.

4.4.2.2. Effect of Levels of Cyanide to the Regrind and Cleaning

Comparative tests were carried out with different levels of cyanide added to the regrind and cleaning stages. The results of these tests are shown in Table No. 36.

The results obtained showed that the use of high cyanide additions to the regrind and the cleaners resulted in a dramatic improvement in the lead cleaner recovery. It appeared that the level of cyanide additions to the cleaners was more critical than the level of cyanide additions to the primary grind.

TABLE NO. 36 : Effect of Levels of Cyanide in the Regrind - Composite 3

Test No.	NaCN Cleaners*	Product	Wt %	Assays %		% Distribution	
				Pb	Zn	Pb	Zn
30	60	Pb Cleaner Concentrate	2.73	61.4	8.01	43.7	4.4
		Pb Rougher Concentrate	14.10	25.4	11.9	93.3	33.6
		Pb Flotation Tailing	85.90	0.30	3.89	6.7	66.4
		Head (Calc)	100.00	3.84	5.03	100.0	100.0
31	150	Pb Cleaner Concentrate	4.02	66.3	4.44	69.4	3.5
		Pb Rougher Concentrate	13.95	25.4	9.36	92.2	25.6
		Pb Flotation Tailing	86.05	0.35	4.40	7.8	74.4
		Head (Calc)	100.00	3.84	5.09	100.0	100.0

*NaCN Cleaners g/t

Discussion - Continued

4.4.2.3. Effect of Type of Collector

A series of three tests was performed in which different types of collectors were used. The purpose of these tests was to find an effective lead collector that would maintain a high rate of lead flotation in the cleaners. Collector A317/3418A mixture and collector CD3 were included in these tests. The conditions and results for these tests are summarized in Table No. 37.

TABLE NO. 37 : Effect of Type of Collector - Composite 3

Test No.	Collector Type	Product	Wt %	Assays %		% Distribution	
				Pb	Zn	Pb	Zn
31	A343	Pb Cleaner Concentrate	4.02	66.3	4.44	69.4	3.5
		Pb Rougher Concentrate	13.95	25.4	9.36	92.2	25.6
		Pb Rougher Tailing	86.05	0.35	4.40	7.8	74.4
		Head (Calc)	100.00	3.84	5.09	100.0	100.0
32	A317/3418A 1:1 ratio	Pb Cleaner Concentrate	4.81	69.0	4.93	83.1	4.8
		Pb Rougher Concentrate	13.40	27.9	9.74	93.5	26.1
		Pb Rougher Tailing	86.60	0.30	4.27	6.5	73.9
		Head (Calc)	100.00	4.00	5.00	100.0	100.0
33	CD3*	Pb Cleaner Concentrate	5.20	64.0	5.99	82.4	6.1
		Pb Rougher Concentrate	15.57	24.5	9.37	94.8	28.4
		Pb Rougher Tailing	84.43	0.25	4.35	5.2	71.6
		Head (Calc)	100.00	4.03	5.13	100.0	100.0

*cleaners

From the results obtained, the following observations can be made:

1. Collector A317/3418A mixture gave an excellent rate of lead flotation in the cleaners. As compared to the results obtained with collector A343, the lead cleaner recovery was about 14 % higher when using the collector mixture. The lead concentrate grade was also higher.
2. Collector CD3 also gave higher lead cleaner recovery, but because of the complex preparation procedure, no further work was performed with this collector.

Collector A317/3418A mixture is considered as a standard lead collector for treatment of Vangorda Ore.

Discussion - Continued

4.4.2.4. Effect of Primary Grinding Media on Lead Cleaning

Tests were performed using both rod mill and ball mill primary grind to determine the effect of grinding media on the lead cleaning. These results are compared in Table No. 38.

TABLE NO. 38 : Effect of Primary Grinding Media on Lead Cleaning - Composite 3

Test No.	Grinding Media	Product	Wt %	Assays %		% Distribution	
				Pb	Zn	Pb	Zn
32	Rod Mill	Pb Cleaner Concentrate	4.81	69.0	4.93	83.1	4.8
		Pb Rougher Concentrate	13.40	27.9	9.74	93.5	26.1
		Pb Rougher Tailing	86.60	0.30	4.27	6.5	73.9
		Head (Calc)	100.00	4.10	5.15	100.0	100.0
37	Ball Mill	Pb Cleaner Concentrate	5.35	60.8	6.92	79.3	7.2
		Pb Rougher Concentrate	9.12	40.48	8.45	90.0	15.0
		Pb Rougher Tailing	90.88	0.45	4.82	10.0	85.0
		Head (Calc)	100.00	4.10	5.15	100.0	100.0

As shown with the lead roughing tests (Table 39) the rod mill grinding media gave superior results compared to that obtained using the ball mill grinding media (Table 37).

In subsequent testwork, ball mill primary grinding was retained in order to maintain a grinding product size distribution similar to that of the plant. Note that the rod mill grind gave a product containing less slimes than the ball mill grind.

4.4.2.5. Effect of Coarse Primary Grind

At the request of Mr. Bill Schedding of Curragh Resources, comparative lead and zinc flotation tests were carried out at grinding times of 40 min/2000 g and 20 min/2000 g, respectively. These results are shown in Table No. 39.

Discussion - Continued

TABLE NO. 39 : Effect of Coarse Primary Grind Fineness on Pb-Zn Cleaning EfficiencyComposite 3a) Conditions

Test No.	Primary Grind			Reagent Additions, g/t				
	Time min.	% Passing 270M	28 μ m	K80 μ m	Pb Circuit		Zn Circuit	
					Depressants	Collector	Depressants	Collector
40	40	93.3	68.6	36.0	Na ₂ CO ₃ =2000 NaCN=320 Na ₂ SiO ₃ =250	A 317/ 3418A=44	Ca(OH) ₂ =2250 CuSO ₄ =800	A350=45
73	20	88.5	59.6	42.0	Na ₂ CO ₃ =2000 NaCN=320 Na ₂ SiO ₃ =250	A 317/ 3418A=44	Ca(OH) ₂ =2250 CuSO ₄ =800	A350=45

b) Results

Test No.	Product	Weight %	Assays, %		% Distribution	
			Pb	Zn	Pb	Zn
40	Pb 4th Cleaner Concentrate	4.38	65.9	7.34	71.3	6.1
	Pb 1st Cleaner Concentrate	7.00	51.2	8.24	88.6	10.9
	Zn 4th Cleaner Concentrate	7.10	1.27	56.0	2.2	75.4
	Zn Rougher Concentrate	17.09	1.30	26.2	5.5	84.8
	Zn Rougher Tailing	75.63	0.30	0.24	5.6	3.4
	Head (Calc)	100.00	4.04	5.27	100.0	100.0
73	Pb 4th Cleaner Concentrate	5.64	57.0	10.0	81.3	10.9
	Pb 1st Cleaner Concentrate	7.83	44.7	10.1	88.6	15.3
	Zn 4th Cleaner Concentrate	7.57	1.62	50.1	3.1	73.3
	Zn Rougher Concentrate	18.65	1.28	22.1	6.0	79.6
	Zn Rougher Tailing	73.02	0.27	0.26	5.0	3.7
	Head (Calc)	100.00	3.95	5.17	100.0	100.0

Discussion - Continued

Reducing the primary grind from 40 minutes to 20 minutes did not change the size distribution of the ground product significantly, but the lead and zinc metallurgical results were affected in the following ways.

- a) Lead cleaner concentrate grade was reduced by 9 %.
- b) Significantly more zinc reported to the lead cleaner concentrate.
- c) Zinc concentrate grade was significantly reduced.

Note that the overall lead and zinc recoveries with the coarser grind were not effected.

4.4.2.6. Zinc Cleaning Tests

A series of four zinc cleaning tests was performed to determine the zinc cleaning performance. In all tests, the lead 1st cleaner tail was combined with the lead scavenger tail for zinc flotation and cleaning. The results of these tests are summarized in Table No. 40.

In most of the tests good zinc cleaner concentrate grade at satisfactory recovery was obtained.

Discussion - Continued

TABLE NO. 40 : Zinc Cleaning Tests - Composite 3

Test No.	Product	Weight %	Assays, %		% Distribution	
			Pb	Zn	Pb	Zn
35	Pb 1st Cleaner Concentrate	8.41	43.25	7.92	89.6	12.4
	Zn Cleaner Concentrate	7.42	0.87	57.8	1.6	79.6
	Zn Rougher Concentrate	13.87	1.09	32.47	3.7	83.6
	Zn Rougher Tailing	77.72	0.35	0.28	6.7	4.0
	Head (Calc)	100.00	4.06	5.39	100.0	100.0
36	Pb 1st Cleaner Concentrate	9.94	35.81	8.21	89.1	16.0
	Zn Cleaner Concentrate	7.01	0.92	56.2	1.6	77.4
	Zn Rougher Concentrate	13.12	1.14	31.27	3.7	80.5
	Zn Rougher Tailing	76.94	0.37	0.23	7.1	3.5
	Head (Calc)	100.00	3.99	5.09	100.0	100.0
37	Pb 1st Cleaner Concentrate	9.12	40.48	8.45	90.0	15.0
	Zn Cleaner Concentrate	7.23	1.78	55.6	3.1	78.1
	Zn Rougher Concentrate	14.03	1.40	29.89	4.8	81.5
	Zn Rougher Tailing	76.84	0.28	0.24	5.2	3.6
	Head (Calc)	100.00	4.10	5.15	100.0	100.0
40	Pb 1st Cleaner Concentrate	7.27	49.41	8.53	88.9	11.8
	Zn Cleaner Concentrate	7.10	1.25	57.0	2.2	75.4
	Zn Rougher Concentrate	17.09	1.30	26.16	5.5	84.8
	Zn Rougher Tailing	75.63	0.30	0.24	5.6	3.4
	Head (Calc)	100.00	4.04	5.27	100.0	100.0

4.5. Flotation Testwork on Composite 4

This composite is a low-grade ore with relatively low pyrite content but high in carbon and carbonaceous gangue. A total of 10 laboratory batch tests and a locked cycle test were performed on this composite.

Discussion - Continued

4.5.1. Lead and Zinc Rougher Tests

Initially, three tests were performed on Composite 4 to examine the effect of primary grind on lead and zinc rougher and scavenger flotation. The conditions and results for these tests are summarized in Table No. 41.

The results obtained showed that with an increase in the fineness of primary grind from 78 % <270 mesh to 85 % <270 mesh, the lead recovery improved from 78 % to 85 %, respectively. The zinc recovery, however, was not effected by changes in the fineness of primary grind.

TABLE NO. 41 : Lead and Zinc Roughing Test Results - Composite 4

Test No.	Grinding		Product	Weight %	Assays % g/t				% Distribution			
	Time min	%Pass 270M			Pb	Zn	Au	Ag	Pb	Zn	Au	Ag
57	30	78.0	Pb Ro+Scav Conc	11.65	14.69	5.86	1.26	198.23	77.9	17.4	42.0	68.6
			Zn Ro+Scav Conc	18.43	1.19	16.70	0.57	33.04	100	78.6	30.0	18.1
			Zn Scav Tailing	69.92	0.38	0.22	0.14	6.4	12.1	3.9	28.0	13.3
			Head (Calc)	100.00	2.20	3.92	0.35	33.7	100.0	100.0	100.0	100.0
58	40	84.9	Pb Ro+Scav Conc	14.94	12.61	5.78	1.34	168.7	84.6	22.0	52.5	76.7
			Zn Ro+Scav Conc	16.58	0.62	17.52	0.51	27.13	4.6	74.0	22.3	13.7
			Zn Scav Tailing	68.47	0.35	0.23	0.14	4.6	10.8	4.0	25.2	9.6
			Head (Calc)	100.00	2.23	3.93	0.38	32.9	100.0	100.0	100.0	100.0
59	50	91.2	Pb Ro+Scav Conc	13.74	14.0	5.79	1.32	162.3	85.0	19.8	-	77.2
			Zn Ro+Scav Conc	17.54	0.81	12.77	0.54	25.8	6.2	77.1	-	15.7
			Zn Scav Tailing	68.71	0.29	0.18	-	3.0	8.8	3.1	-	7.1
			Head (Calc)	100.00	2.27	4.02	-	28.9	100.0	10.0	-	100.0

Note that both lead and zinc rougher concentrate grades were much lower than those obtained on Composite 3.

4.5.2. Lead and Zinc Cleaning Tests**4.5.2.1. Preliminary Cleaning Tests**

Two preliminary tests were performed on this composite to examine the effect of fineness of regrind on lead and zinc cleaning. These results are summarized in Table No. 42.

The results obtained showed that increasing the fineness of the lead regrind had no effect on lead concentrate grade.

TABLE NO. 42 : Effect of Fineness of Regrinding on Pb and Zn Cleaning - Comp. 4**a) Conditions**

Test No.	Regrind		Reagent Additions, g/t				pH	
	Pb circuit	Zn circuit	Pb Circuit		Zn Circuit		Pb	Zn
	Time Min.	Time Min.	Depressants	Collectors	Depressants	Collectors	circuit	circuit
65	20	20	Na ₂ CO ₃ = 2000 NaCN = 395 Na ₂ SiO ₃ = 250	A317/3418A =50.5	Ca(OH) ₂ = 5000 CuSO ₄ = 800	A350 = 50	10.0	12.5
66	30	30	Na ₂ CO ₃ = 2000 NaCN = 395 Na ₂ SiO ₃ = 250	A317/3418A = 50.5	Ca(OH) ₂ = 5000 CuSO ₄ = 800	A350 = 55	10.1	12.5

b) Results

Test No.	Product	Weight %	Assays, mg/L, g/t		% Distribution	
			Pb	Zn	Pb	Zn
65	Pb 4th Cleaner conc	2.52	42.7	5.52	51.0	3.6
	Pb 1st Cleaner conc.	5.11	32.7	5.60	79.2	7.5
	Zn 4th Cleaner conc.	5.26	0.54	54.1	1.3	74.6
	Zn rougher conc	12.20	1.13	27.3	6.5	87.3
	Zn rougher tail	82.26	0.35	0.20	13.6	4.3
	Head (Calc.)	100.00	2.11	3.81	100.0	100.0
66	Pb 4th Cleaner conc.	2.37	40.9	4.76	46.2	3.0
	Pb 1st Cleaner conc.	4.94	34.0	5.3	80.1	6.9
	Zn 4th Cleaner conc.	5.18	0.58	54.4	1.4	74.4
	Zn rougher conc.	14.17	1.08	23.7	7.3	88.7
	Zn rougher tail	80.57	0.32	0.18	12.3	3.8
	Head (Calc.)	100.00	2.10	3.79	100.0	100.0

Discussion - Continued

In general, the problem in these tests was to obtain a satisfactory grade of lead concentrate. In both tests the lead concentrate was contaminated with carbonaceous gangue. The zinc metallurgical results on this ore were satisfactory.

4.5.2.2. Evaluation of Organic Based Depressants on Composite 4

In a search for improvements in the lead concentrate grade, a number of tests were conducted with organic depressants LS8 and DS20. The results of these tests are compared to the results obtained with cyanide addition in Table No. 43.

1. Depressant LS8 at reduced additions (Test 78) gave significantly improved lead concentrate grade over that obtained with cyanide. Higher LS8 additions produced a high lead concentrate but at reduced recovery.

2. Depressant DS20 gave similar results to depressant LS8.

Note that the two depressants are specifically developed for depression of marcasite and carbonaceous gangue.

Discussion - Continued

TABLE NO. 43 : Effect of Various Pb Depressants and Levels on Pb-Zn Cleaning
- Comp 4

Test No.	Depressants				Product	Wt %	Assays %		% Distribution	
	Pb Ro Type	Pb Ro g/t	Pb Cl Type	Pb Cl g/t			Pb	Zn	Pb	Zn
66	NaCN	200	NaCN	195	Pb 4th Cl Conc	2.37	40.9	4.76	46.2	3.0
					Pb 1st Cl Conc	4.94	34.0	5.30	80.1	6.9
					Zn 4th Cl Conc	5.18	0.58	54.4	0.5	74.4
					Zn Ro Conc	14.17	1.08	23.7	7.3	87.7
					Zn Ro Tail	80.57	0.32	0.18	12.3	3.8
					Head (Calc)	100.00	2.10	3.79	100.0	100.0
75	LS8	300	LS8	195	Pb 4th Cl Conc	0.58	73.3	2.68	21.4	0.4
					Pb 1st Cl Conc	4.63	32.9	6.27	77.1	7.4
					Pb Ro Conc	12.07	13.7	6.12	83.5	18.9
					Pb Ro Tail	87.93	0.37	3.60	16.5	81.1
					Head (Calc)	100.00	1.98	3.90	100.0	100.0
					77	DS20	200	DS20	195	Pb 4th Cl Conc
Pb 1st Cl Conc	6.22	26.9	6.36	80.5						10.3
Pb Ro Conc	15.23	11.6	5.85	84.9						23.2
Pb Ro Tail	84.77	0.37	3.49	15.1						76.8
Head (Calc)	100.00	2.08	3.85	100.0						100.0
78	LS8	150	LS8	97.5						Pb 4th Cl Conc
					Pb 1st Cl Conc	5.63	30.7	6.39	81.0	9.4
					Pb Ro Conc	13.07	13.9	6.10	85.3	20.8
					Pb Ro Tail	86.93	0.36	3.49	14.7	79.2
					Head (Calc)	100.00	2.14	3.83	100.0	100.0

Discussion - Continued

4.6. Flotation Testwork on Composite 5 and Master Composite

Only standard batch tests were performed on Composite 5 and the Master composite. Composite 5 is a low grade ore (i.e. below cut-off grade) and may only be considered as dilution material. The Master composite represents ore that would be treated in the plant towards the end of the year 1989. The results obtained on Composite 5 are shown in Table No. 44 and on the Master Composite in Table No. 45.

TABLE NO. 44 : Preliminary Cleaning Tests on Composite 5 Using Standard FlotationConditions

Test No.	Product	Weight %	Assays, %g/t		% Distribution	
			Pb	Zn	Pb	Zn
82	Pb 4th Cleaner Concentrate	0.96	54.0	1.50	78.2	1.6
	Pb 1st Cleaner Concentrate	2.06	28.3	1.88	88.3	4.2
	Zn Rougher Concentrate	9.86	0.24	7.21	3.6	77.7
	Zn Rougher Tailing	87.60	0.054	0.18	7.2	17.2
	Head (Calc)	100.00	0.66	0.91	100.0	100.0

TABLE NO. 45 : Preliminary Cleaning Tests on Master Composite Using Standard FlotationConditions

Test No.	Product	Weight %	Assays, %g/t		% Distribution	
			Pb	Zn	Pb	Zn
81	Pb 4th Cleaner Concentrate	5.49	58.0	9.46	81.7	11.6
	Pb 1st Cleaner Concentrate	8.28	42.2	9.60	89.6	17.6
	Zn 4th Cleaner Concentrate	4.96	1.34	52.8	1.7	58.4
	Zn Rougher Concentrate	17.33	0.90	19.4	4.0	75.0
	Zn Rougher Tailing	73.83	0.32	0.36	6.1	5.9
	Head (Calc)	100.00	3.90	4.49	100.0	100.0

Composite 5 gave good lead metallurgical results in spite of the low head grade.

Only a zinc rougher concentrate was floated from this composite.

The flotation response of the Master Composite was similar to that of Composite

COMPOSITE PREPARATION

Eleven 200 liter drums of drill core samples were received at Lakefield on March 16, 1988. The ore was identified as Vangorda ore from the 1987 drilling program.

On the instruction of Mr. B. Schedding of Curragh Resources, composite samples were prepared from the drill core intervals.

Initially, Composite 3 was prepared by combining 240 intervals. The composite was crushed to 10 mesh and test charges were prepared. Other composites were prepared in the same manner. The number of intervals per composite were as follows:

Composite 1A	48 intervals
Composite 1B	12 intervals
Composite 2	50 intervals
Composite 4	25 intervals

All core samples and crushed composites were stored in the freezer.

APPENDIX NO. 1

Details of Tests on Composite C3

Test No. 1

Purpose: The first in a series of tests to determine the effect of fineness of primary grind on Pb and Zn flotation.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 30 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2500	150	-	-	-	-	-	30	-	-	10.2
Pb Rougher	-	-	5	10	-	-	-	-	1	4	-
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	2.5	5	-	-	-	-	1	3	-
				DF							
				1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.5
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	11.5
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	10	-	-	10	-	1	3	-

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 200 mesh	3.7	3.7	96.3
270 mesh	7.8	11.5	88.5
27.7 µm	28.9	40.4	59.6
21.5	12.3	52.7	47.3
15.0	13.8	66.5	33.5
10.3	9.6	76.1	23.9
8.0	4.9	81.0	19.0
- 8.0	19.0	100.0	-
Total	100.0	-	-

S.G. 4.35

Metallurgical Balance

Test No. 1

Product	Weight		Assay, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	101.5	5.08	49.0	7.18	7.85	3.57	292.	61.2	6.9	1.7	21.6	20.4
2. Pb Scav. Conc.	92.3	4.62	22.4	13.90	18.6	1.01	57.9	25.5	12.1	3.7	5.6	3.7
3. Zn Ro. Conc.	178.4	8.94	1.49	42.4	10.6	2.31	66.6	3.3	71.5	4.1	24.6	8.2
4. Zn Scav. Conc.	134.7	6.75	2.50	4.44	30.2	3.89	638.	4.1	5.7	8.8	31.3	59.0
5. Zn Scav. Tail.	1489.5	74.61	0.320	0.27	25.20	0.19	8.60	5.9	3.8	81.6	16.9	8.8
Head Calc.	1996.4	100.00	4.07	5.30	23.05	0.84	72.94	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		9.71	36.33	10.38	13.0	2.35	180.51	86.7	19.0	5.5	27.2	24.0
Products 3+4		15.68	1.92	26.07	19.0	2.99	312.42	7.4	77.2	13.0	55.9	67.2

Test No. 2

Purpose: Repeat the conditions of Test 1, but increase the Primary grinding time to 40 minutes.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	-	-	40	-	-	9.7
Pb Rougher	-	-	5	10	-	-	-	-	1	4	-
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	2.5	5	-	-	-	-	1	3	-
				DF							
				1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.7
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	11.4
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	10	-	-	10	-	1	3	-

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 270 mesh	6.7	6.7	93.3
27.8 µm	24.7	31.4	68.6
21.6	13.3	44.7	55.3
15.1	15.7	60.4	39.6
10.4	11.3	71.7	28.3
8.0	6.1	77.8	22.2
- 8.0	22.2	100.0	-
Total	100.0	-	-

S.G. 4.32

Metallurgical Balance

Test No. 2

Product	Weight		Assay, %, g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	97.4	4.88	48.2	6.21	8.30	3.29	58.	57.5	5.5	1.8	25.8	5.1
2. Pb Scav. Conc.	86.3	4.32	27.1	13.70	16.4	5.05	361.0	28.6	10.8	3.1	35.0	28.1
3. Zn Ro. Conc.	187.7	9.40	1.56	44.3	10.7	0.25	51.5	3.6	75.9	4.4	3.8	8.7
4. Zn Scav. Conc.	80.0	4.01	3.54	5.38	30.6	1.84	628.	3.5	3.9	5.4	11.8	45.2
5. Zn Scav. Tail.	1544.5	77.38	0.360	0.27	25.1	0.19	9.30	6.8	3.8	85.3	23.6	12.9
Head Calc.	1995.9	100.00	4.09	5.49	22.77	0.62	55.63	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		9.20	38.29	9.73	12.1	4.12	200.13	86.1	16.3	4.9	60.8	33.1
Products 3+4		13.41	2.15	32.67	16.6	.73	223.78	7.1	79.9	9.8	15.6	54.0

Test No. 3

Purpose: Repeat the conditions of Test 1, but increase the Primary grinding time to 50 minutes.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 50 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	-	-	50	-	-	9.7
Pb Rougher	-	-	5	10	-	-	-	-	1	4	-
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	2.5	5	-	-	-	-	1	3	-
				DF							
				1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.7
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	10	-	-	10	-	1	3	-

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 270 mesh	4.3	4.3	95.7
400	8.8	13.1	86.9
27.8 µm	11.6	24.7	75.3
21.6	12.3	37.0	63.0
15.1	16.9	53.9	46.1
10.4	12.8	66.7	33.3
8.0	7.0	73.7	26.3
- 8.0	26.3	100.0	-
Total	100.0	-	-

S.G. 4.32

Metallurgical Balance

Test No. 3

Product	Weight		Assay, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	134.9	6.77	44.8	7.46	9.90	5.08	574.	73.6	9.2	2.9	44.8	63.0
2. Pb Scav. Conc.	49.9	2.50	18.8	13.4	18.3	6.84	295.	11.4	6.1	2.0	22.3	12.0
3. Zn Ro. Conc.	177.2	8.89	1.52	46.8	9.4	0.23	46.4	3.3	75.8	3.7	2.7	6.7
4. Zn Scav. Conc.	81.6	4.10	4.78	6.37	28.8	0.55	81.7	4.7	4.8	5.1	2.9	5.4
5. Zn Scav. Tail.	1549	77.74	0.370	0.29	25.5	0.27	10.20	7.0	4.1	86.3	27.3	12.9
Head Calc.	1992.6	100.00	4.12	5.49	22.97	0.77	61.65	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		9.27	37.78	9.06	12.2	5.56	498.66	85.0	15.3	4.9	67.1	75.0
Products 3+4		12.99	2.55	34.05	15.5	.33	57.53	8.0	80.6	8.8	5.6	12.1

Test No. 4

Purpose: Repeat the conditions of Test 1, but increase the Primary grinding time to 60 minutes.

Procedure: As indicated below - increased collector to the Pb scavenger.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 60 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	-	-	60	-	-	9.7
Pb Rougher	-	-	5	15	-	-	-	-	1	4	-
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	5	10	-	-	-	-	1	3	-
				DF							
				1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.7
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	10	-	-	10	-	1	3	-

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 270 mesh	2.4	2.4	97.6
400	6.3	8.7	91.3
27.8 µm	10.9	19.6	80.4
21.6	12.3	31.9	68.1
15.1	17.7	49.6	50.4
10.4	14.0	63.6	36.4
8.0	7.9	71.5	28.5
- 8.0	28.5	100.0	-
Total	100.0	-	-

S.G. 4.32

Metallurgical Balance

Test No. 4

Product	Weight		Assay, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	117	5.85	47.9	6.23	9.14	5.09	638.	69.0	6.6	2.3	49.5	62.8
2. Pb Scav. Conc.	69.9	3.49	22.1	12.5	17.7	3.75	290.	19.0	7.9	2.7	21.8	17.1
3. Zn Ro. Conc.	180.3	9.01	1.38	47.8	9.52	0.20	43.3	3.1	77.7	3.8	3.0	6.6
4. Zn Scav. Conc.	84.9	4.24	3.18	5.53	29.3	0.53	56.5	3.3	4.2	5.4	3.7	4.0
5. Zn Scav. Tail.	1548.4	77.40	0.290	0.26	25.3	0.17	7.30	5.5	3.6	85.7	21.9	9.5
Head Calc.	2000.5	100.00	4.06	5.55	22.84	0.60	59.40	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		9.34	38.25	8.57	12.3	4.59	507.85	88.1	14.4	5.0	71.4	79.9
Products 3+4		13.26	1.96	34.27	15.9	.31	47.53	6.4	81.9	9.2	6.7	10.6

Test No. 5

Purpose: Repeat the conditions of Test 1, but increase the Primary grinding time to 70 minutes in the rod mill.

Procedure: As indicated below .

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 70 minutes at 65% solids in a lab rod mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	-	-	70	-	-	9.7
Pb Rougher	-	-	5	15	-	-	-	-	1	4	-
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	5	10	-	-	-	-	1	3	-
				DF							
				1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.7
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	10	-	-	10	-	1	3	-

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 270 mesh	0.7	0.7	99.3
400	8.0	8.7	91.3
27.8 µm	20.1	28.8	71.2
21.6	16.3	45.1	54.9
15.1	17.8	62.9	37.1
10.4	11.5	74.4	25.6
8.0	5.7	80.1	19.9
- 8.0	19.9	100.0	-
Total	100.0	-	-

S.G. 4.32

Metallurgical Balance

Test No. 5

Product	Weight		Assay, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	158	7.87	45.0	8.96	10.4	5.34	615.	85.1	12.8	3.5	52.0	71.4
2. Pb Scav. Conc.	60.3	3.00	8.9	13.7	28.2	6.56	148.	6.4	7.5	3.6	24.4	6.6
3. Zn Ro. Conc.	188.8	9.41	0.78	43.4	12.1	0.29	51.5	1.8	74.1	4.8	3.4	7.1
4. Zn Scav. Conc.	76.0	3.79	1.59	3.20	34.8	0.70	117.0	1.4	2.2	5.6	3.3	6.5
5. Zn Scav. Tail.	1524.2	75.93	0.290	0.25	25.6	0.18	7.50	5.3	3.4	82.5	16.9	8.4
Head Calc.	2007.3	100.00	4.16	5.51	23.56	0.81	67.82	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		10.88	35.04	10.27	15.3	5.68	486.00	91.5	20.3	7.1	76.4	77.9
Products 3+4		13.19	1.01	31.86	18.6	.41	70.30	3.2	76.3	10.4	6.7	13.7

Test No. 6

Purpose: First of a series of tests to investigate various levels of NaCN in the Primary grind.

Procedure: As for Test 2.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	50	-	-	-	-	-	40	-	-	9.5
Pb Rougher	-	-	5	10	-	-	-	-	1	4	-
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	2.5	5	-	-	-	-	1	3	-
				DF							
				1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.7
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	10	-	-	10	-	1	3	-

Metallurgical Balance

Test No. 6

Product	Weight		Assay, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	135.8	6.82	38.0	7.32	12.0	7.53	512.	65.1	10.0	3.4	58.1	63.8
2. Pb Scav. Conc.	24.8	1.24	16.7	9.27	19.0	7.92	284.	5.2	2.3	1.0	11.2	6.5
3. Zn Ro. Conc.	219.3	11.01	4.64	37.3	12.6	0.23	59.1	12.8	82.1	5.8	2.9	11.9
4. Zn Scav. Conc.	102.3	5.13	8.53	2.54	31.5	0.81	84.9	11.0	2.6	6.8	4.7	8.0
5. Zn Scav. Tail.	1510.2	75.80	0.310	0.20	26.0	0.27	7.10	5.9	3.0	82.9	23.2	9.8
Head Calc.	1992.4	100.00	3.98	5.00	23.77	0.88	54.68	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		8.06	34.71	7.62	13.1	7.59	476.79	70.3	12.3	4.4	69.3	70.3
Products 3+4		16.14	5.88	26.24	18.6	.41	67.31	23.8	84.7	12.6	7.6	19.9

Test No. 7

Purpose: Repeat Test 6, but increase the NaCN to 100 g/t in the primary grind.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	100	-	-	-	-	-	40	-	-	9.6
Pb Rougher	-	-	5	10	-	-	-	-	1	4	-
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	2.5	5	-	-	-	-	1	3	-
				DF							
				1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.7
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	10	-	-	10	-	1	3	-

Metallurgical Balance

Test No. 7

Product	Weight		Assay, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	129.1	6.45	43.4	7.21	9.35	5.90	577.	71.5	9.2	2.6	56.6	63.1
2. Pb Scav. Conc.	62.3	3.11	17.0	12.40	17.3	3.53	263.	13.5	7.7	2.4	16.3	13.9
3. Zn Ro. Conc.	174.8	8.74	1.20	43.3	9.93	0.19	45.1	2.7	75.0	3.8	2.5	6.7
4. Zn Scav. Conc.	112.7	5.63	3.61	4.43	28.4	0.64	60.1	5.2	4.9	7.0	5.4	5.7
5. Zn Scav. Tail.	1521.3	76.06	0.370	0.21	25.3	0.17	8.20	7.2	3.2	84.2	19.2	10.6
Head Calc.	2000.2	100.00	3.92	5.04	22.85	0.67	59.00	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		9.57	34.81	8.90	11.9	5.13	474.79	85.0	16.9	5.0	73.0	77.0
Products 3+4		14.37	2.14	28.06	17.2	.37	50.98	7.9	80.0	10.8	7.8	12.4

Test No. 8

Purpose: Repeat Test 6, but increase the NaCN to 200 g/t in the primary grind.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	200	-	-	-	-	-	40	-	-	9.7
Pb Rougher	-	-	5	10	-	-	-	-	1	4	-
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	2.5	5	-	-	-	-	1	3	-
				DF							
				1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.7
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	10	-	-	10	-	1	3	-

Metallurgical Balance

Test No. 8

Product	Weight		Assay, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	177.4	8.90	33.9	7.86	11.00	4.80	433.	76.4	14.1	4.1	65.7	68.4
2. Pb Scav. Conc.	51.1	2.56	14.9	11.70	19.3	1.75	242.	9.7	6.1	2.1	6.9	11.0
3. Zn Ro. Conc.	182.9	9.17	1.62	39.4	11.9	0.22	45.7	3.8	73.1	4.6	3.1	7.4
4. Zn Scav. Conc.	94.3	4.73	4.05	3.43	32.4	0.65	57.7	4.9	3.3	6.4	4.7	4.8
5. Zn Scav. Tail.	1488.2	74.64	0.280	0.23	26.4	0.17	6.30	5.3	3.5	82.8	19.5	8.3
Head Calc.	1993.9	100.00	3.95	4.95	23.80	0.65	56.35	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		11.46	29.65	8.72	12.9	4.12	390.29	86.1	20.2	6.2	72.6	79.4
Products 3+4		13.90	2.45	27.16	18.9	.37	49.78	8.6	76.3	11.0	7.8	12.3

Test No. 9

Purpose: Repeat the general conditions of Test 2, but increase the A343 in the Pb circuit by 50 %.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	-	-	40	-	-	9.6
Pb Rougher	-	-	7.5	10	-	-	-	-	2	4	-
Pb Scavenger	-	-	7.5	10	-	-	-	-	1	3	-
	-	-	3.75	5	-	-	-	-	1	3	-
				DF							
				1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.7
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	10	-	-	10	-	1	3	-

Metallurgical Balance

Test No. 9

Product	Weight		Assay, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	169.6	8.49	38.1	8.92	11.60	5.13	501.	81.7	14.8	4.1	60.9	72.5
2. Pb Scav. Conc.	50	2.50	10.2	12.60	23.5	2.20	179.	6.4	6.2	2.4	7.7	7.6
3. Zn Ro. Conc.	180.5	9.03	1.54	40.9	12	0.27	41.3	3.5	72.4	4.5	3.4	6.4
4. Zn Scav. Conc.	87.9	4.40	2.86	3.61	32.5	1.12	47.6	3.2	3.1	5.9	6.9	3.6
5. Zn Scav. Tail.	1510	75.58	0.270	0.23	26.5	0.20	7.70	5.2	3.4	83.1	21.1	9.9
Head Calc.	1998	100.00	3.96	5.10	24.11	0.72	58.65	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		10.99	31.75	9.76	14.3	4.46	427.68	88.2	21.0	6.5	68.6	80.1
Products 3+4		13.43	1.97	28.69	18.7	.55	43.36	6.7	75.6	10.4	10.3	9.9

Test No. 10

Purpose: Repeat the general conditions of Test 2, but increase the A343 in the Pb circuit by 100 %.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	-	-	40	-	-	-
Pb Rougher	-	-	10	10	-	-	-	-	1	4	-
Pb Scavenger	-	-	10	10	-	-	-	-	1	3	-
	-	-	5	5	-	-	-	-	1	3	-
				DF							
				1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	-
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	10	-	-	10	-	1	3	-

Metallurgical Balance

Test No. 10

Product	Weight		Assay, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	158.5	7.93	41.7	8.94	11.60	4.67	537.	81.6	14.0	3.8	51.8	73.7
2. Pb Scav. Conc.	61.5	3.08	11.1	13.30	24.7	3.08	168.	8.4	8.1	3.1	13.3	8.9
3. Zn Ro. Conc.	185.1	9.26	1.29	39.1	12.1	0.24	34.8	2.9	71.7	4.6	3.1	5.6
4. Zn Scav. Conc.	87.5	4.38	2.07	3.14	32.9	0.90	40.0	2.2	2.7	5.9	5.5	3.0
5. Zn Scav. Tail.	1506.4	75.36	0.260	0.23	26.6	0.25	6.70	4.8	3.4	82.5	26.3	8.7
Head Calc.	1999	100.00	4.05	5.05	24.29	0.72	57.77	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		11.01	33.15	10.16	15.3	4.23	433.85	90.0	22.1	6.9	65.0	82.7
Products 3+4		13.64	1.54	27.56	18.8	.45	36.47	5.2	74.4	10.5	8.6	8.6

Test No. 11

Purpose: The first of a series of tests to investigate High Speed conditioning and its effect on Pb and Zn flotation.

Procedure: As for Test 2.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	-	-	40	-	-	-
H.S. Cond.	-	-	5	10	-	-	-	-	10	-	9.7
Pb Rougher	-	-	-	-	-	-	-	-	4	-	-
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	2.5	5	-	-	-	-	1	3	-
				DF							
				1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.7
	-	-	-	-	-	800	-	-	5	-	-
Zn H.S. Cond.	-	-	-	10	-	-	20	-	10	-	-
Zn Rougher	-	-	-	-	-	-	-	-	-	4	-
Zn Scavenger	-	-	-	10	-	-	10	-	1	3	-

Metallurgical Balance

Test No. 11

Product	Weight		Assay, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	123.4	6.24	41.7	6.88	10.80	7.58	518.	62.5	8.2	2.8	65.3	58.8
2. Pb Scav. Conc.	69.6	3.52	22.7	14.50	18.3	1.98	258.	19.2	9.7	2.6	9.6	16.5
3. Zn Ro. Conc.	177.6	8.99	1.96	43.0	11.1	0.55	72.7	4.2	73.5	4.1	6.8	11.9
4. Zn Scav. Conc.	129.2	6.54	5.24	4.30	31.7	0.19	46.9	8.2	5.3	8.5	1.7	5.6
5. Zn Scav. Tail.	1476.3	74.71	0.330	0.23	26.9	0.16	5.3	5.9	3.3	82.1	16.5	7.2
Head Calc	1976.1	100.00	4.17	5.26	24.49	0.72	54.99	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		9.77	34.85	9.63	13.5	5.56	424.24	81.6	17.9	5.4	75.0	75.3
Products 3+4		15.53	3.34	26.70	19.8	.40	61.84	12.4	78.8	12.5	8.5	17.5

Test No. 12

Purpose: Repeat the conditions of Test 11, but increase the High Speed conditioning time to 20 minutes in the Pb circuit.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	-	-	40	-	-	-
H.S. Cond.	-	-	5	10	-	-	-	-	20	-	9.7
Pb Rougher	-	-	-	-	-	-	-	-	-	4	-
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	2.5	5	-	-	-	-	1	3	-
				DF							
				1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.7
	-	-	-	-	-	800	-	-	5	-	-
Zn H.S. Cond.	-	-	-	10	-	-	20	-	10	-	-
Zn Rougher	-	-	-	-	-	-	-	-	-	4	-
Zn Scavenger	-	-	-	10	-	-	10	-	1	3	-

Metallurgical Balance

Test No. 12

Product	Weight		Assay, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	95.6	4.84	45.1	5.83	9.61	8.49	634.	53.2	5.5	1.9	59.3	51.6
2. Pb Scav. Conc.	68.1	3.45	25.6	12.40	16.3	1.41	312.	21.5	8.3	2.3	7.0	18.1
3. Zn Ro. Conc.	177.7	9.00	2.98	44.9	9.92	0.85	99.4	6.5	78.0	3.7	11.0	15.0
4. Zn Scav. Conc.	137.7	6.97	7.48	3.75	27.6	0.19	57.0	12.7	5.0	7.9	1.9	6.7
5. Zn Scav. Tail.	1495.5	75.74	0.330	0.22	27.1	0.19	6.7	6.1	3.2	84.2	20.8	8.5
Head Calc.	1974.6	100.00	4.11	5.18	24.37	0.69	59.45	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		8.29	36.99	8.56	12.4	5.54	500.05	74.7	13.7	4.2	66.3	69.7
Products 3+4		15.97	4.94	26.93	17.6	.56	80.89	19.2	83.1	11.6	12.9	21.7

Test No. 13

Purpose: Repeat the conditions of Test 11, but increase the High Speed conditioning time to 30 minutes in the Pb circuit.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	-	-	40	-	-	-
H.S. Cond.	-	-	5	10	-	-	-	-	30	-	9.7
Pb Rougher	-	-	-	5	-	-	-	-	-	4	-
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	2.5	5	-	-	-	-	1	3	-
				DF							
				1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.7
	-	-	-	-	-	800	-	-	5	-	-
Zn H.S. Cond.	-	-	-	10	-	-	20	-	10	-	-
Zn Rougher	-	-	-	-	-	-	-	-	-	4	-
Zn Scavenger	-	-	-	10	-	-	10	-	1	3	-

Metallurgical Balance

Test No. 13

Product	Weight		Assay, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	115.9	5.81	46.7	6.82	9.28	7.10	630.	65.2	7.5	2.2	69.7	61.4
2. Pb Scav. Conc.	36.8	1.84	21.5	15.00	17.4	2.02	307.	9.5	5.2	1.3	6.3	9.5
3. Zn Ro. Conc.	170.7	8.55	2.49	45.2	10	0.14	50.9	5.1	73.0	3.5	2.0	7.3
4. Zn Scav. Conc.	141.1	7.07	7.65	7.78	28.8	0.43	93.2	13.0	10.4	8.4	5.1	11.1
5. Zn Scav. Tail.	1530.9	76.72	0.390	0.27	26.8	0.13	8.3	7.2	3.9	84.6	16.9	10.7
Head Calc.	1995.4	100.00	4.16	5.30	24.31	0.59	59.57	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		7.65	40.63	8.79	11.2	5.88	552.16	74.7	12.7	3.5	76.0	70.9
Products 3+4		15.63	4.83	28.27	18.5	.27	70.04	18.1	83.4	11.9	7.2	18.4

Test No. 14

Purpose: The first in a series of tests to examine Pb cleaning, using the rougher conditions of Test 2.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Grind	Cond.	Froth	
Grind	2000	150	-	-	40	-	-	-
Pb rougher	-	-	5	10	-	1	4	9.7
Pb Scavenger	-	-	5	10	-	1	3	-
	-	-	2.5	5	-	1	3	-
Pb 1st Cleaner	50	50	-	-	-	2	3	9.7
	-	-	2.5	5	-	1	3	-
Pb 2nd Cleaner	25	25	-	-	-	2	3	9.7
Pb 3rd Cleaner	25	10	-	2.5	-	2	3	9.7
Pb 4th Cleaner	25	10	-	2.5	-	2	2	9.6
	-	-	1.0	-	-	2	1	-

Size Analysis : Pb Cleaner Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 24.6 µm	28.2	28.2	71.8
19.0	14.5	42.7	57.3
13.3	16.2	58.9	41.1
9.1	11.6	70.5	29.5
7.1	5.9	76.4	23.6
- 7.1	23.6	100.0	-
Total	100.0	-	-

S.G. 5.05

Metallurgical Balance

Test No. 14

Product	Weight		Assay, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Cleaner. Conc.	97.4	4.89	48.2	14.20	7.26	6.07	607.	58.0	12.9	1.5	38.7	53.0
2. Pb 4th Cl. Tail	10.8	0.54	38.7	6.84	15.3	1.71	438.	5.2	.7	.3	1.2	4.2
3. Pb 3rd Cl. Tail	29.1	1.46	30.2	7.57	19.7	3.73	340.	10.9	2.1	1.2	7.1	8.9
4. Pb 2nd Cl. Tail	24.7	1.24	26.3	6.40	19.9	1.87	314.	8.0	1.5	1.0	3.0	7.0
5. Pb 1st Cl. Tail	50.3	2.53	8.34	6.00	24.0	2.76	120.	5.2	2.8	2.6	9.1	5.4
6. Pb Scav. Tail.	1778.8	89.34	0.58	4.83	24.8	0.35	13.5	12.7	80.1	93.3	40.8	21.5
Head Calc.	1991.1	100.00	4.06	5.39	23.73	0.77	56.03	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		5.43	47.25	13.47	8.1	5.63	590.13	63.2	13.6	1.8	40.0	57.2
Products 1-3		6.90	43.64	12.22	10.5	5.23	537.12	74.0	15.6	3.1	47.1	66.1
Products 1-4		8.14	40.99	11.33	11.96	4.72	503.10	82.1	17.1	4.1	50.1	73.1
Products 1-5		10.66	33.26	10.07	14.81	4.25	412.33	87.3	19.9	6.7	59.2	78.5

Test No. 15

Purpose: Repeat Test 14, but regrind the Pb Ro + Scav concentrate 5 minutes.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Grind	Cond.	Froth	
Grind	2000	150	-	-	40	-	-	-
Pb Rougher	-	-	5	10	-	1	4	9.7
Pb Scavenger	-	-	5	10	-	1	3	-
	-	-	2.5	10	-	1	3	-
Pb Regrind	300	50	-	-	5	-	-	9.9
Pb 1st Cleaner	-	-	-	-	-	-	4	-
Pb 1st Cl Scav	-	-	2.5	5	-	1	3	-
Pb 2nd Cleaner	25	25	-	2.5	-	2	4	9.8
Pb 3rd Cleaner	25	10	-	2.5	-	2	3	9.7
Pb 4th Cleaner	25	10	-	2.5	-	2	2	9.6

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 24.6 µm	15.4	15.4	84.6
19.0	13.9	29.3	70.7
13.3	18.7	48.0	52.0
9.1	14.9	62.9	37.1
7.1	8.0	70.9	29.1
- 7.1	29.1	100.0	-
Total	100.0	-	-

S.G. 4.99

Metallurgical Balance

Test No. 15

Product	Weight		Assay, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Cleaner Conc.	74.7	3.76	53.9	10.80	5.94	6.57	689	52.5	8.0	.9	41.3	46.7
2. Pb 4th Cl. Tail	21	1.06	46.1	7.41	11.4	2.76	523	12.6	1.5	.5	4.9	10.0
3. Pb 3rd Cl. Tail	10.2	0.51	39.3	5.20	15.1	1.55	431	5.2	.5	.3	1.3	4.0
4. Pb 2nd Cl. Tail	17.7	0.89	23.9	6.99	20.4	1.69	292	5.5	1.2	.7	2.5	4.7
5. Pb 1st Cl. Scav. Conc.	16.5	0.83	26.60	12.60	18.4	7.65	331	5.7	2.1	.6	10.6	5.0
6. Pb 1st Cl. Scav. Tail	71.3	3.59	5.71	10.4	24.4	2.31	99.60	5.3	7.4	3.6	13.9	6.4
7. Pb Scav. Tail	1775	89.36	0.57	4.5	25.5	0.17	14.4	13.2	79.3	93.3	25.4	23.2
Head Calc.	1986.4	100.00	3.86	5.07	24.42	0.60	55.45	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		4.82	52.19	10.06	7.1	5.73	652.57	65.1	9.6	1.4	46.2	56.7
Products 1-3		5.33	50.95	9.59	7.9	5.33	631.23	70.3	10.1	1.7	47.6	60.7
Products 1-4		6.22	47.07	9.32	9.09	4.81	582.65	75.8	11.3	2.5	50.1	65.4
Products 1-5		7.05	44.66	9.61	10.72	5.14	553.01	81.5	13.4	3.1	60.7	70.3
Products 1-6		10.64	31.52	9.88	15.33	4.19	400.09	86.3	20.7	6.7	74.6	76.8
Products 6+7		92.95	.77	4.73	25.46	.25	17.69	18.5	86.6	96.9	39.3	29.7

Test No. 16

Purpose: Repeat Test 15, but increase the Pb regrinding time to 10 minutes.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Grind	Cond.	Froth	
Grind	2000	150	-	-	40	-	-	-
Pb Rougher	-	-	5	10	-	1	4	9.7
Pb Scavenger	-	-	5	10	-	1	3	-
	-	-	2.5	10	-	1	3	-
Pb Re grind	300	50	-	-	10	-	-	9.8
Pb 1st Cleaner	-	-	1.0	2.5	-	-	6	-
Pb 1st Cl Scav	-	-	2.5	5	-	1	3	-
Pb 2nd Cleaner	25	25	-	2.5	-	2	5	9.8
Pb 3rd Cleaner	25	10	-	2.5	-	2	4	9.7
Pb 4th Cleaner	25	10	-	2.5	-	2	3	9.6

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 24.6 µm	6.7	6.7	93.3
19.0	10.3	17.0	83.0
13.3	9.7	26.7	73.3
9.1	2.1	28.8	71.2
7.1	6.1	34.9	65.1
- 7.1	65.1	100.0	-
Total	100.0	-	-

S.G. 5.01

Metallurgical Balance

Test No. 16

Product	Weight		Assay, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Cleaner. Conc.	59.3	2.99	57.8	8.66	5.47	10.20	787.	44.2	4.9	0.6	38.9	42.1
2. Pb 4th Cl. Tail	10.7	0.54	52.6	6.24	9.4	2.41	610.	7.3	6	0.2	1.7	5.9
3. Pb 3rd Cl. Tail	15.4	0.78	49.3	7.15	10.5	1.99	568.	9.8	1.0	0.3	2.0	7.9
4. Pb 2nd Cl. Tail	15.5	0.78	34.3	7.73	16.5	1.28	386.	6.9	1.1	0.5	1.3	5.4
5. Pb 1st Cl. Scav. Conc.	11.3	0.57	29.70	12.20	16.4	8.79	361.	4.3	1.3	0.4	6.4	3.7
6. Pb 1st Cl. Scav. Tail.	60.1	3.03	8.06	10.7	23.3	1.12	123.	6.2	6.1	2.8	4.3	6.7
7. Pb Scav. Tail.	1813.5	91.32	0.91	4.95	26.2	0.39	17.4	21.3	84.9	95.1	45.5	28.4
Head Calc.	1985.8	100.00	3.90	5.32	25.15	0.78	55.87	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		3.53	57.01	8.29	6.1	9.01	759.94	51.5	5.5	.9	40.6	47.9
Products 1-3		4.30	55.62	8.08	6.9	7.74	725.33	61.3	6.5	1.2	42.5	55.8
Products 1-4		5.08	52.34	8.03	8.35	6.75	673.20	68.1	7.7	1.7	43.8	61.2
Products 1-5		5.65	50.06	8.45	9.16	6.96	641.76	72.5	9.0	2.1	50.2	64.9
Products 1-6		8.68	35.41	9.23	14.09	4.92	460.81	78.7	15.1	4.9	54.5	71.6
Products 6+7		94.35	1.14	5.13	26.11	.41	20.79	27.5	91.0	97.9	49.8	35.1

Test No. 17

Purpose: Repeat Test 15, but increase the Pb regrinding time to 20 minutes.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Grind	Cond.	Froth	
Grind	2000	150	-	-	40	-	-	-
Pb Rougher	-	-	5	10	-	1	4	9.7
Pb Scavenger	-	-	5	10	-	1	3	-
	-	-	2.5	10	-	1	3	-
Pb Re grind	300	50	5	-	20	-	-	9.8
Pb 1st Cleaner	-	-	-	2.5	-	-	6	-
Pb 1st Cl Scav	-	-	2.5	5	-	1	4	-
Pb 2nd Cleaner	25	25	-	2.5	-	2	5	9.8
Pb 3rd Cleaner	25	10	-	2.5	-	2	4	9.7
Pb 4th Cleaner	25	10	-	2.5	-	2	3	9.6

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 24.6 µm	5.5	5.5	94.5
19.0	8.3	13.8	86.2
13.3	17.6	31.4	68.6
9.1	18.0	49.4	50.6
7.1	10.2	59.6	40.4
- 7.1	40.4	100.0	-
Total	100.0	-	-

S.G. 5.05

Metallurgical Balance

Test No. 17

Product	Weight		Assay, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Cleaner. Conc.	65	3.28	59.4	8.16	5.71	11.30	781	50.3	5.1	0.8	52.0	47.5
2. Pb 4th Cl. Tail	16.9	0.85	53.6	7.88	9.0	2.26	564	11.8	1.3	0.3	2.7	8.9
3. Pb 3rd Cl. Tail	13.9	0.70	46.2	8.25	10.7	1.63	502	8.4	1.1	0.3	1.6	6.5
4. Pb 2nd Cl. Tail	16.5	0.83	29.2	9.99	17.9	1.06	316	6.3	1.6	0.6	1.2	4.9
5. Pb 1st Cl. Scav. Conc.	11.7	0.59	25.4	12.90	18.9	7.43	321	3.9	1.5	0.5	6.2	3.5
6. Pb 1st Cl. Scav. Tail	71.1	3.59	5.06	12.6	24.7	1.68	89.6	4.7	8.7	3.6	8.5	6.0
7. Pb Scav. Tail	1788	90.16	0.63	4.66	25.7	0.22	13.6	14.7	80.7	94.0	27.8	22.7
Head Calc.	1983.1	100.00	3.87	5.20	24.66	0.71	53.92	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		4.13	58.24	8.10	6.4	9.43	736	62.1	6.4	1.1	54.7	56.4
Products 1-3		4.83	56.50	8.12	7.0	8.30	702	70.5	7.5	1.4	56.3	62.9
Products 1-4		5.66	52.49	8.40	8.61	7.24	645	76.8	9.1	2.0	57.5	67.8
Products 1-5		6.25	49.93	8.82	9.58	7.26	615	80.6	10.6	2.4	63.7	71.3
Products 1-6		9.84	33.58	10.20	15.09	5.22	423	85.3	19.3	6.0	72.2	77.3
Products 6+7		93.75	.80	4.96	25.66	.28	16.51	19.4	89.4	97.6	36.3	28.7

Test No. 18

Purpose: Repeat Test 17, but condition the reground rougher scav concentrate at high speed for 20 minutes.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Grind	Cond.	Froth	
Grind	2000	150	-	-	40	-	-	-
Pb Rougher	-	-	5	10	-	1	4	-
Pb Scavenger	-	-	5	10	-	1	3	-
	-	-	2.5	10	-	1	3	-
Pb Re grind	300	50	-	-	20	-	-	-
Hi Speed Cond	-	-	5	5	-	20	-	-
Pb 1st Cleaner	-	-	-	-	-	-	6	9.8
Pb 1st Cl Scav	-	-	2.5	5	-	1	4	-
Pb 2nd Cleaner	25	25	-	2.5	-	2	5	9.7
Pb 3rd Cleaner	25	10	-	2.5	-	2	4	9.6
Pb 4th Cleaner	25	10	-	2.5	-	2	3	9.6

Metallurgical Balance

Test No. 18

Product	Weight		Assay, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Cleaner. Conc.	54.2	2.72	62.4	7.91	4.42	13.70	820.	43.0	4.1	0.5	59.4	41.1
2. Pb 4th Cl. Tail	22.4	1.13	55.6	8.79	7.8	2.44	598.	15.8	1.9	0.4	4.4	12.4
3. Pb 3rd Cl. Tail	14.4	0.72	41.6	8.41	12.5	1.19	402.	7.6	1.1	0.4	1.4	5.4
4. Pb 2nd Cl. Tail	17.6	0.88	28.5	8.58	16.5	.96	325.	6.4	1.4	0.6	1.4	5.3
5. Pb 1st Cl. Scav. Conc.	14.6	0.73	27.6	11.50	18.3	1.01	369.	5.1	1.6	0.5	1.2	5.0
6. Pb 1st Cl. Scav. Tail.	69.4	3.49	5.99	11.9	24.3	.37	92.4	5.3	7.8	3.4	2.1	5.9
7. Pb Scav. Tail.	1797.3	90.32	0.73	4.81	26.1	0.21	15	16.7	82.0	94.3	30.2	24.9
Head Calc.	1989.9	100.00	3.95	5.29	25.00	0.63	54.33	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		3.85	60.41	8.17	5.4	10.41	755.	58.9	5.9	.8	63.8	53.5
Products 1-3		4.57	57.43	8.21	6.5	8.95	699.	66.5	7.1	1.2	65.2	58.9
Products 1-4		5.48	52.75	8.27	8.14	7.65	639.	72.9	8.5	1.8	66.5	64.1
Products 1-5		6.19	49.77	8.65	9.35	6.87	607.	78.0	10.1	2.3	67.7	69.1
Products 1-6		9.68	33.99	9.82	14.73	4.53	421.	83.3	18.0	5.7	69.8	75.1
Products 6+7		93.81	.93	5.07	26.03	.22	17.88	22.0	89.9	97.7	32.3	30.9

Test No. 19

Purpose: To investigate replacing Na_2CO_3 with lime in the Pb flotation circuit.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 50 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	$\text{Ca}(\text{OH})_2$	NaCN	A343	MIBC	Na_2CO_3	Grind	Cond.	Froth	
Grind	1000	150	10	-	-	50	-	-	10.3
Pb Rougher	-	-	15	10	1000	-	1	3	-
Pb Scav	-	-	10	10	-	-	1	3	-
	-	-	10	10	-	-	1	3	-

Metallurgical Balance

Test No. 19

Product	Weight		Assay %/gt					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	87.1	4.34	41.2	5.37	10.10	11.20	603.	44.9	4.5	1.8	62.1	46.3
2. Pb Scav. Conc.	56.5	2.82	36.3	9.70	12.6	1.97	417.	25.7	5.3	1.5	7.1	20.8
3. Pb Scav. Tail	1862	92.84	1.26	4.99	25.3	0.26	20.0	29.4	90.1	96.7	30.8	32.9
Head Calc.	2005.6	100.00	3.98	5.14	24.28	0.78	56.50	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		7.16	39.27	7.07	11.1	7.57	529.82	70.6	9.9	3.3	69.2	67.1
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Test No. 20

Purpose: Repeat Test 19, but condition 20 minutes in the Wemco High Speed conditioner prior to Pb rougher flotation.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 50 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Ca(OH) ₂	NaCN	A343	MIBC	208:242*	Grind	Cond.	Froth	
Grind	1000	150	10	-	-	50	-	-	-
H.S. Cond	-	-	20	10	-	-	20	-	9.8
Pb Rougher	-	-	5	-	25	-	-	4	8.5
Pb Scav	-	-	10	-	-	-	1	3	-
	-	-	10	-	-	-	1	3	-
	-	-	10	-	-	-	1	2	-

*208:242 = 80:20

Metallurgical Balance

Test No. 20

Product	Weight		Assay %_gt					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	101.9	5.08	42.1	5.45	9.16	10.60	616.	51.7	5.3	2.0	68.5	54.6
2. Pb Scav. Conc.	60.8	3.03	34.8	10.90	12.7	.58	363.	25.5	6.3	1.6	2.2	19.2
3. Pb Scav. Tail	1843.2	91.89	1.03	5.04	25.0	0.25	16.3	22.9	88.4	96.4	29.2	26.2
Head Calc.	2005.9	100.00	4.14	5.24	23.82	0.79	57.27	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		8.11	39.37	7.49	10.5	6.86	521.46	77.1	11.6	3.6	70.8	73.8
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Test No. 21

Purpose: To reproduce the results of Test 3.

Procedure: As for Test No. 3.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 50 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	-	-	50	-	-	-
Pb Rougher	-	-	5	10	-	-	-	-	1	4	-
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	2.5	10	-	-	-	-	1	3	-
				DF							
				1012							
Zn Conditioning	-	-	-	-	1250	-	-	-	5	-	11.7
	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	10	-	-	10	-	1	3	-

Metallurgical Balance

Test No. 21

Product	Weight		Assay, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	126.4	6.32	43.6	6.61	10.3	5.23	563.	66.0	7.9	2.8	46.9	68.2
2. Pb Scav. Conc.	75.4	3.77	24.2	14.0	18.8	3.26	283.	21.9	9.9	3.0	17.4	20.5
3. Zn Ro. Conc.	170.7	8.54	0.99	45.0	9.86	0.19	27.5	2.0	72.2	3.6	2.3	4.5
4. Zn Scav. Conc.	91.6	4.58	2.86	7.22	30.4	1.61	44.2	3.1	6.2	6.0	10.5	3.9
5. Zn Scav. Tail.	1535.3	76.79	0.380	0.26	25.8	0.21	2.00	7.0	3.8	84.6	22.9	2.9
Head Calc.	1999.4	100.00	4.18	5.32	23.41	0.70	52.2	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		10.09	36.35	9.37	13.5	4.49	458.	87.9	17.8	5.8	64.4	88.7
Products 3+4		13.12	1.64	31.8	17.0	0.69	33.	5.2	78.5	9.5	12.8	8.4

Test No. 22

Purpose: To investigate the effect of a rod mill regrind on Pb cleaning efficiency.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 50 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	50	-	-	-
Pb Rougher	-	-	5	10	-	-	1	4	-
Pb Scav	-	-	5	10	-	-	1	3	-
	-	-	5	10	-	-	1	3	-
Pb Regrind	50	10	10	-	-	10	-	-	9.3
Pb 1st Cl	-	-	10	10	-	-	1	5	-
	-	-	10	-	150	-	1	5	-
Pb 1st Cl Scav	-	-	-	7.5	-	-	1	5	-
Pb 2nd Cl	-	10	5	-	150	-	1	5	9.9
	-	-	-	7.5	-	-	1	5	-
Pb 3rd Cl	-	10	5	2.5	150	-	1	5	10.1
	-	-	-	2.5	-	-	1	5	-
Pb 4th Cl	-	10	5	2.5	150	-	1	4	10.3
	-	-	-	2.5	-	-	1	4	-

Stage	Rougher	1st Cleaner	2nd Cleaner	3rd & 4th Cleaners
Flotation Cell	1000g D-1	500 g D-1	500 g D-1	250 g D-1
Speed rpm	1900	1500	1500	1200

Metallurgical Balance

Test No. 22

Product	Weight		Assay, % g/t						% Distribution				
	g	%	Cu	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Cleaner. Conc.	52.5	2.64	1.05	67.7	3.95	3.60	12.1	952.	49.1	1.9	0.4	51.2	67.6
2. Pb 4th Cl. Tail	4.2	0.21		39.2	6.56	11.9	1.94	388.	2.3	.3	0.1	.7	2.2
3. Pb 3rd Cl. Tail	10.1	0.51		48.1	6.88	10.3	1.74	490.	6.7	.6	0.2	1.4	6.7
4. Pb 2nd Cl. Tail	16.1	0.81		30.7	10.1	15.9	2.76	364.	6.8	1.5	0.5	3.6	7.9
5. Pb 1st Cl. Scav. Conc	5.5	0.28		22.3	14.2	21.0	6.67	325.	1.7	.7	0.2	3.0	2.4
6. Pb 1st Cl. Scav. Tail.	46.3	2.33		7.83	10.6	23.6	1.18	129.	5.0	4.6	2.3	4.4	8.1
7. Pb Scav. Tail.	1851.1	93.22		1.11	5.22	25.1	0.24	2.00	28.4	90.3	96.3	35.8	5.0
Head Calc.	1985.8	100.00		3.65	5.39	24.3	0.62	37.2	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		2.86		65.6	4.14	4.21	11.3	910.	51.4	2.2	.5	51.8	69.9
Products 1-3		3.36		62.9	4.56	5.13	9.89	847.	58.1	2.8	.7	53.3	76.6
Products 1-4		4.17		56.7	5.63	7.23	8.51	753.	64.9	4.4	1.2	56.8	84.5
Products 1-5		4.45		54.5	6.17	8.08	8.39	726.	66.6	5.1	1.5	59.8	86.9
Products 1-6		6.78		38.5	7.69	13.4	5.91	521.	71.6	9.7	3.7	64.2	95.0
Products 6+7		95.55		1.27	5.35	25.1	0.26	5.10	33.4	94.9	98.5	40.2	13.1

Test No. 23

Purpose: Repeat the conditions of Test 22, but use a 70 minute rod mill primary grind.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 70 minutes at 65% solids in a lab rod mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	70	-	-	9.7
Pb Rougher	-	-	5	15	-	-	1	4	-
Pb Scav	-	-	5	15	-	-	1	3	-
	-	-	5	15	-	-	1	3	-
Pb Re grind	50	10	10	-	-	10	-	-	9.4
Pb 1st Cl.	-	-	-	10	150	-	1	10	-
	-	-	5	5	-	-	1	4	-
Pb 1st Cl Scav	-	-	2.5	-	-	-	1	2	-
Pb 2nd Cl.	-	10	5	2.5	150	-	1	5	9.9
	-	-	2	5	-	-	1	5	-
	-	-	2	5	-	-	1	3	-
Pb 3rd Cl.	-	10	5	2.5	150	-	1	5	10.1
	-	-	2.5	5	-	-	1	5	-
Pb 4th Cl.	-	10	5	2.5	150	-	1	5	10.3
	-	-	5	5	-	-	1	5	-

Stage
Flotation Cell
Speed rpm

Rougher
1000g D-1
1900

Metallurgical Balance

Test No. 23

Product	Weight		Assay, % g/t						% Distribution				
	g	%	Cu	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Cleaner. Conc.	104.6	5.22	1.17	58.5	7.29	6.39	9.25	737.	78.5	7.5	1.3	70.0	67.4
2. Pb 4th Cl. Tail	11.2	0.56	-	30.5	11.1	16.1	1.11	361.	4.4	1.2	0.4	0.9	3.5
3. Pb 3rd Cl. Tail	7.8	0.39	-	21.9	13.5	19.6	1.00	244.	2.2	1.0	0.3	0.6	1.7
4. Pb 2nd Cl. Tail	21.8	1.09	-	11.7	14.4	24.2	0.87	162.	3.3	3.1	1.1	1.4	3.1
5. Pb 1st Cl. Scav. Conc	2.6	0.13	-	8.93	32.5	17.9	0.89	116.	3	0.8	0.1	0.2	0.3
6. Pb 1st Cl. Scav. Tail	74.6	3.72	-	3.06	9.68	29.9	0.47	52.9	2.9	7.1	4.5	2.5	3.5
7. Pb Scav. Tail	1780.6	88.89	-	0.37	4.51	25.8	0.19	13.2	8.4	79.2	92.3	24.5	20.6
Head Calc.	2003.2	100.00	-	3.89	5.06	24.83	0.69	57.1	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		5.78	-	55.8	7.66	7.33	8.46	701.	82.9	8.7	1.7	70.9	71.0
Products 1-3		6.17	-	53.7	8.03	8.10	7.99	672.	85.1	9.8	2.0	71.5	72.6
Products 1-4		7.26	-	47.4	8.98	10.5	6.92	595.	88.3	12.9	3.1	72.8	75.7
Products 1-5		7.39	-	46.7	9.40	10.6	6.82	587.	88.6	13.7	3.2	73.0	76.0
Products 1-6		11.11	-	32.1	9.49	17.1	4.69	408.	91.6	20.8	7.7	75.5	79.4
Products 6+7		92.61	-	0.48	4.72	26.0	0.20	14.8	11.4	86.3	96.8	27.0	24.0

Test No. 24

Purpose: Repeat Test 23, but reduce the primary grind to 60 minutes and use SO₂ in the Pb cleaning.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 60 minutes at 65% solids in a lab rod mill

Conditions:

Stage	Reagents Added, grams per tonne						Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Na ₂ SiO ₃	SO ₂	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	-	60	-	-	9.7
Pb Rougher	-	-	10	15	-	-	-	1	4	-
Pb Scavenger	-	-	5	15	-	-	-	1	3	-
	-	-	5	15	-	-	-	1	3	-
Pb Regrind (RM)	50	10	10	-	-	-	10	-	-	9.5
Pb 1st Cleaner	-	-	-	5	150	500	-	1	5	7.0
	-	-	10	10	-	-	-	1	5	-
Pb 1st Cl Scav	-	-	5	5	-	-	-	1	5	-
Pb 2nd Cleaner	-	10	5	10	150	375	-	1	5	9.5-7.0
	-	-	5	20	-	-	-	1	5	-
	-	-	5	-	-	-	-	1	5	-
Pb 3rd Cleaner	-	10	10	10	150	250	-	1	5	9.7-7.4
	-	-	5	5	-	-	-	1	5	-
Pb 4th Cleaner	-	10	10	-	150	-	-	1	4	9.7-7.5
	-	-	5	-	-	-	-	1	4	-

Size Analysis : Pb Scavenger Tailing

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 270 mesh	2.1	2.1	97.9
27.0 μm	36.8	38.9	61.1
20.9	15.4	54.3	45.7
14.6	13.8	68.1	31.9
10.0	9.2	77.3	22.7
7.8	4.8	82.1	17.9
- 7.8	17.9	100.0	-
Total	100.0	-	-

S.G. 4.22

Metallurgical Balance

Test No. 24

Product	Weight		Assay, % g/t						% Distribution				
	g	%	Cu	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Cleaner. Conc.	69.1	3.45	1.64	63.6	6.03	4.44	12.6	855.	57.6	4.1	0.6	60.7	52.8
2. Pb 4th Cl. Tail	0.5	0.02	-	32.5	7.96	13.9	14.5	820.	0.2	0.0	0.0	.5	.4
3. Pb 3rd Cl. Tail	2.2	0.11	-	32.1	10.2	13.7	1.72	386.	0.9	0.2	0.1	.3	.8
4. Pb 2nd Cl. Tail	18.0	0.90	-	32.7	10.2	13.2	1.45	356.	7.7	1.8	0.5	1.8	5.7
5. Pb 1st Cl. Scav. Conc	10.5	0.52	-	25.0	13.7	18.9	0.96	284.	3.4	1.4	0.4	.7	2.7
6. Pb 1st Cl. Scav. Tail.	113.7	5.68	-	13.4	12.0	25.0	0.93	182.	20.0	13.5	5.7	7.4	18.5
7. Pb Scav. Tail.	1786.1	89.30	-	0.43	4.45	25.7	0.23	12.0	10.1	78.8	92.7	28.6	19.2
Head Calc.	2000.1	100.00	-	3.81	5.04	24.8	0.72	55.9	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		3.48	-	63.4	6.04	4.51	12.6	855.	57.9	4.2	.6	61.2	53.2
Products 1-3		3.59	-	62.4	6.17	4.79	12.3	840.	58.8	4.4	.7	61.5	53.9
Products 1-4		4.49	-	56.5	6.98	6.48	10.1	743.	66.5	6.2	1.2	63.3	59.7
Products 1-5		5.01	-	53.2	7.68	7.78	9.15	695.	69.9	7.6	1.6	64.0	62.3
Products 1-6		10.70	-	32.0	9.98	16.9	4.78	423.	89.9	21.2	7.3	71.4	80.8
Products 6+7		94.99	-	1.21	4.90	25.7	0.27	22.2	30.1	92.4	98.4	36.0	37.7

Test No. 25

Purpose: To repeat the conditions of Test 23, but with increased NaCN and A343 to the regrind.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 70 minutes at 65% solids in a lab rod mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	70	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.6
Pb Scav	-	-	5	10	-	-	1	3	-
	-	-	5	10	-	-	1	3	-
Pb Regrind	50	20	20	-	-	10	-	-	-
Pb 1st Cl.	-	-	-	10	150	-	1	10	10.0
Pb 1st Cl Scav	-	-	5	5	-	-	1	4	-
Pb 2nd Cl.	-	10	5	2.5	150	-	1	5	10.0
	-	-	2	5	-	-	1	5	-
Pb 3rd Cl.	-	10	2.5	2.5	100	-	1	5	9.9
	-	-	2.5	5	-	-	1	4	-
Pb 4th Cl.	-	10	5	2.5	100	-	1	4	9.8
	-	-	2	5	-	-	1	4	-

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc	7.14	50.0	9.38	88.8	13.3
2. Pb 4th Cleaner Tail	0.37	14.6	12.4	1.4	0.9
3. Pb 3rd Cleaner Tail	0.63	8.38	13.1	1.3	1.6
4. Pb 2nd Cleaner Tail	1.04	3.98	10.2	1.0	2.1
5. Pb 1st Cl Scav Conc	1.23	2.30	19.6	0.7	4.8
6. Pb 1st Cl Scav Tail	5.16	0.88	6.40	1.1	6.6
7. Pb Scavenger Tail	84.43	0.27	4.22	5.7	70.7
Head(Calc.)	100.00	4.02	5.04	100.0	100.0

Calculated Grades and Recoveries

Products 1 + 2	7.51	48.3	9.53	90.2	14.2
Products 1 to 3	8.14	45.2	9.80	91.5	15.8
Products 1 to 4	9.18	40.5	9.85	92.5	17.9
Products 1 to 5	10.41	36.0	11.0	93.2	22.7
Products 1 to 6	15.57	24.4	9.48	94.3	29.3

Test No. 26

Purpose: To repeat the conditions of Test 25, but investigate the effect of aerating the 1st cleaner feed.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 70 minutes at 65% solids in a lab rod mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	70	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.9
Pb Scavenger	-	-	5	10	-	-	1	3	-
	-	-	5	10	-	-	1	3	-
Pb Re grind	50	20	20	-	-	10	-	-	-
Aeration*	-	-	-	-	-	-	20	-	-
Pb 1st Cl.	-	-	-	10	150	-	1	5	9.8
	-	-	2.5	2.5	-	-	1	5	-
Pb 1st Cl Scav	-	-	5	2.5	-	-	1	1	-
Pb 2nd Cl.	-	10	-	2.5	150	-	1	5	9.8
	-	-	2.5	5	-	-	1	5	-
Pb 3rd Cl.	-	10	-	2.5	100	-	1	5	9.8
	-	-	2.5	5	-	-	1	4	-
Pb 4th Cl.	-	10	-	2.5	100	-	1	4	9.9
	-	-	2	5	-	-	1	4	-

*intensive aeration with air sparge.

Test No. 26 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc	6.32	50.7	10.8	82.1	13.4
2. Pb 4th Cleaner Tail	0.75	21.4	19.4	4.1	2.9
3. Pb 3rd Cleaner Tail	1.33	14.4	18.7	4.9	4.9
4. Pb 2nd Cleaner Tail	1.15	6.02	11.6	1.8	2.6
5. Pb 1st Cl Scav Conc	0.28	2.75	23.5	0.2	1.3
6. Pb 1st Cl Scav Tail	5.46	1.21	6.94	1.7	7.5
7. Pb Scavenger Tail	84.71	0.24	4.04	5.2	67.4
Head(Calc.)	100.00	3.90	5.08	100.0	100.0

Calculated Grades and Recoveries

Products 1 + 2	7.07	47.6	11.7	86.2	16.3
Products 1 to 3	8.40	42.3	12.8	91.1	21.2
Products 1 to 4	9.55	38.0	12.7	92.9	23.8
Products 1 to 5	9.83	37.0	13.0	93.1	25.1
Products 1 to 6	15.29	24.2	10.8	94.8	32.6

Test No. 27

Purpose: To repeat the conditions of Test 25, but investigate the effect of NaHS additions to the lead rougher and cleaners.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 70 minutes at 65% solids in a lab rod mill

Conditions:

Stage	Reagents Added, grams per tonne						Time, minutes			pH
	Na ₂ CO ₃	NaCN	NaHS	A343	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	500	-	-	-	70	-	-	-
Pb Rougher	-	-	-	5	15	-	-	1	4	10.2
Pb Scavenger	-	-	-	5	10	-	-	1	3	-
	-	-	-	5	10	-	-	1	3	-
Pb Regrind	50	20	250	20	-	-	10	-	-	-
Pb 1st Cleaner	-	-	-	2.5	10	150	-	1	10	10.4
Pb 1st Cl Scav	-	-	-	2.5	5	-	-	1	4	-
Pb 2nd Cleaner	-	20	-	-	2.5	150	-	1	5	10.4
	-	-	-	2.5	5	-	-	1	5	-
Pb 3rd Cleaner	-	15	-	-	-	100	-	1	5	10.3
	-	-	-	2	5	-	-	1	4	-
Pb 4th Cleaner	-	10	-	-	-	100	-	1	4	-
	-	-	-	-	-	-	-	1	4	-

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc	5.72	50.4	6.10	72.3	6.7
2. Pb 4th Cleaner Tail	0.66	22.4	9.21	3.7	1.2
3. Pb 3rd Cleaner Tail	2.09	14.7	10.1	7.7	4.0
4. Pb 2nd Cleaner Tail	3.53	5.05	9.86	4.5	6.7
5. Pb 1st Cl Scav Conc	0.95	3.55	9.86	0.9	1.8
6. Pb 1st Cl Scav Tail	6.94	0.84	6.29	1.6	8.3
7. Pb Scavenger Tail	80.11	0.47	4.65	9.4	71.3
Head(Calc.)	100.00	3.98	5.22	100.0	100.0

Calculated Grades and Recoveries

Products 1 + 2	6.38	47.5	6.42	76.0	7.9
Products 1 to 3	8.47	39.4	7.33	83.7	11.9
Products 1 to 4	12.00	29.3	8.07	88.2	18.6
Products 1 to 5	12.95	27.4	8.21	89.1	20.4
Products 1 to 6	19.89	18.1	7.54	90.6	28.7

Test No. 28

Purpose: To repeat the conditions of Test 26, but replace A343 with a 1 to 1 mixture of 3418A/A317.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 70 minutes at 65% solids in a lab rod mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	70	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.9
Pb Scav	-	-	5	10	-	-	1	3	-
	-	-	5	10	-	-	1	3	-
Pb Re grind	50	20	20	-	-	10	-	-	-
Aeration	-	-	-	-	-	-	20	-	-
Pb 1st Cl.	-	-	-	10	150	-	1	5	9.5
	-	-	2.5	2.5	-	-	1	5	-
Pb 1st Cl Scav	-	-	2.5	2.5	-	-	1	2	-
Pb 2nd Cl.	-	10	-	2.5	150	-	1	5	9.7
	-	-	2.5	5	-	-	1	5	-
Pb 3rd Cl.	-	10	-	2.5	100	-	1	4	9.8
	-	-	-	5	-	-	1	4	-
Pb 4th Cl.	-	10	-	2.5	100	-	1	3	9.8
	-	-	-	5	-	-	1	3	-

Test No. 28 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc	6.67	51.8	8.97	87.4	11.5
2. Pb 4th Cleaner Tail	0.60	17.8	14.1	2.7	1.6
3. Pb 3rd Cleaner Tail	1.37	8.36	13.4	2.9	3.5
4. Pb 2nd Cleaner Tail	1.46	3.02	13.5	1.1	3.8
5. Pb 1st Cl Scav Conc	1.12	1.48	15.5	0.4	3.3
6. Pb 1st Cl Scav Tail	8.14	0.70	8.77	1.4	13.8
7. Pb Scavenger Tail	80.64	0.20	4.02	4.1	62.5
Head(Calc.)	100.00	3.96	5.19	100.0	100.0

Calculated Grades and Recoveries

Products 1 + 2	7.27	49.0	9.39	90.1	13.1
Products 1 to 3	8.46	42.6	10.0	93.0	16.6
Products 1 to 4	10.10	36.8	10.5	94.1	20.4
Products 1 to 5	11.22	33.3	11.0	94.5	23.7
Products 1 to 6	19.36	19.6	10.1	95.9	37.5

Test No. 29

Purpose: To repeat the conditions of Test 28, but increase aeration time to 30 minutes.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 70 minutes at 65% solids in a lab rod mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	70	-	-	-
Pb Rougher	-	-	5	12.5	-	-	1	4	9.9
Pb Scav	-	-	5	7.5	-	-	1	3	-
	-	-	5	5	-	-	1	3	-
Pb Re grind	50	20	20	-	-	10	-	-	-
Aeration	-	-	-	-	-	-	30	-	-
Pb 1st Cl.	-	-	-	5	150	-	1	5	9.6
	-	-	2.5	5	-	-	1	5	-
Pb 1st Cl Scav	-	-	2.5	-	-	-	1	2	-
Pb 2nd Cl.	-	10	-	-	150	-	1	5	9.8
	-	-	-	-	-	-	1	5	-
Pb 3rd Cl.	-	10	-	-	100	-	1	4	9.8
	-	-	-	-	-	-	1	4	-
Pb 4th Cl.	-	10	-	-	100	-	1	3	9.7
	-	-	-	-	-	-	1	3	-

Test No. 29 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc	6.54	50.9	12.7	83.1	16.3
2. Pb 4th Cleaner Tail	0.57	17.2	28.3	2.5	3.2
3. Pb 3rd Cleaner Tail	1.33	12.2	23.2	4.0	6.0
4. Pb 2nd Cleaner Tail	1.75	4.24	14.3	1.9	4.9
5. Pb 1st Cl Scav Conc	0.81	2.53	19.3	0.5	3.1
6. Pb 1st Cl Scav Tail	6.67	1.10	3.91	1.8	5.1
7. Pb Scavenger Tail	82.33	0.30	3.81	6.2	61.4
Head(Calc.)	100.00	4.00	5.10	100.0	100.0

Calculated Grades and Recoveries

Products 1 + 2	7.11	48.2	14.0	85.6	19.5
Products 1 to 3	8.44	42.5	15.4	89.6	25.5
Products 1 to 4	10.19	36.0	15.2	91.5	30.4
Products 1 to 5	11.00	33.5	15.5	92.0	33.5
Products 1 to 6	17.67	21.3	11.1	93.8	38.6

Test No. 30

Purpose: To repeat the conditions of Test 25, but reduce collector to the Pb scavenger and increase Pb regrind time.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 70 minutes at 65% solids in a lab rod mill.

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	70	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.5
Pb Scav	-	-	5	5	-	-	1	3	-
	-	-	5	5	-	-	1	3	-
Pb Re grind	50	20	20	-	-	20	-	-	-
Pb 1st Cl.	-	-	-	10	150	-	1	10	9.9
Pb 1st Cl Scav	-	-	5	5	-	-	1	4	-
Pb 2nd Cl.	-	10	2.5	2.5	150	-	1	5	10.0
	-	-	2.5	5	-	-	1	5	-
Pb 3rd Cl.	100	20	-	2.5	150	-	1	4	10.4
	-	-	2.5	2.5	-	-	1	4	-
Pb 4th Cl.	-	10	-	2.5	150	-	1	3	10.1
	-	-	-	2.5	-	-	1	3	-

Pyrite floating from 2nd cleaner on.

Test No. 30 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc	2.73	61.4	8.01	43.7	4.4
2. Pb 4th Cleaner Tail	1.78	49.3	13.4	22.9	4.7
3. Pb 3rd Cleaner Tail	1.85	35.7	18.7	17.2	6.9
4. Pb 2nd Cleaner Tail	0.79	19.7	14.6	4.1	2.3
5. Pb 1st Cl Scav Conc	1.46	6.65	23.3	2.5	6.8
6. Pb 1st Cl Scav Tail	5.49	2.01	7.75	2.9	8.5
7. Pb Scavenger Tail	85.90	0.30	3.89	6.7	66.4
Head(Calc.)	100.00	3.84	5.03	100.0	100.0

Calculated Grades and Recoveries

Products 1 + 2	4.51	56.6	10.1	66.6	9.1
Products 1 to 3	6.36	50.5	12.6	83.8	16.0
Products 1 to 4	7.15	47.1	12.8	87.9	18.3
Products 1 to 5	8.61	40.3	14.6	90.4	25.1
Products 1 to 6	14.10	25.4	11.9	93.3	33.6

Test No. 31

Purpose: To repeat the conditions of Test 30, but omit Na_2CO_3 and increase NaCN to the regrind and cleaners.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 70 minutes at 65% solids in a lab rod mill.

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na_2CO_3	NaCN	A343	MIBC	Na_2SiO_3	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	70	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.6
Pb Scav	-	-	5	5	-	-	1	3	-
	-	-	-	5	-	-	1	3	-
Pb Regrind	-	50	20	-	-	20	-	-	-
Pb 1st Cl.	-	-	-	5	50	-	1	10	9.5
Pb 1st Cl Scav	-	-	2.5	-	-	-	1	3	-
Pb 2nd Cl.	-	50	-	-	50	-	1	5	9.6
	-	-	-	10	-	-	1	5	-
Pb 3rd Cl.	-	25	-	-	50	-	1	4	9.6
	-	-	-	5	-	-	1	4	-
Pb 4th Cl.	-	25	-	-	50	-	1	3	9.5
	-	-	-	5	-	-	1	3	-

Test No. 31 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc	3.37	68.5	4.09	60.1	2.7
2. Pb 4th Cleaner Tail	0.65	55.1	6.24	9.3	0.8
3. Pb 3rd Cleaner Tail	0.82	43.6	9.55	9.3	1.5
4. Pb 2nd Cleaner Tail	1.46	25.8	13.3	9.8	3.8
5. Pb 1st Cl Scav Conc	0.26	6.68	19.0	0.5	1.0
6. Pb 1st Cl Scav Tail	7.39	1.64	10.9	3.2	15.8
7. Pb Scavenger Tail	86.05	0.35	4.40	7.8	74.4
Head(Calc.)	100.00	3.84	5.09	100.0	100.0

Calculated Grades and Recoveries

Products 1 + 2	4.02	66.3	4.44	69.4	3.5
Products 1 to 3	4.84	62.5	5.30	78.7	5.0
Products 1 to 4	6.30	54.0	7.16	88.5	8.8
Products 1 to 5	6.56	52.1	7.63	89.0	9.8
Products 1 to 6	13.95	25.4	9.36	92.2	25.6

Test No. 32

Purpose: To repeat the conditions of Test 31, but replace collector A343 with a 1:1 mixture of A317 : 3418A.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 70 minutes at 65% solids in a lab rod mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	70	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.5
Pb Scav	-	-	5	10	-	-	1	3	-
	-	-	-	10	-	-	1	3	-
Pb Re grind	-	50	20	-	-	20	-	-	-
Pb 1st Cl	-	20	-	5	100	-	1	10	9.4
Pb 1st Cl Scav	-	-	2.5	2.5	-	-	1	3	-
Pb 2nd Cl	-	50	-	-	50	-	1	5	9.6
	-	-	4	10	-	-	1	5	-
Pb 3rd Cl	-	25	-	-	50	-	1	4	9.5
	-	-	-	10	-	-	1	4	-
Pb 4th Cl	-	25	-	-	50	-	1	3	9.5
	-	-	-	5	-	-	1	3	-

Test No. 32 - Continued

Metallurgical Results

Product	Weight %	Assays %		% Distribution	
		Pb	Zn	Pb	Zn
1. Pb Cleaner Conc	4.14	72.4	4.42	75.0	3.7
2. Pb 4th Cleaner Tail	0.67	48.1	8.08	8.1	1.1
3. Pb 3rd Cleaner Tail	0.77	30.0	10.6	5.8	1.6
4. Pb 2nd Cleaner Tail	0.86	8.98	14.0	1.9	2.4
5. Pb 1st CI Scav Conc	0.58	5.46	15.0	0.8	1.7
6. Pb 1st CI Scav Tail	6.38	1.21	12.2	1.9	15.6
7. Pb Scavenger Tail	86.60	0.30	4.27	6.5	73.9
Head(Calc.)	100.00	4.00	5.00	100.0	100.0

Calculated Grades and Recoveries

Products 1 + 2	4.81	69.0	4.93	83.1	4.8
Products 1 to 3	5.58	63.6	5.71	88.9	6.4
Products 1 to 4	6.44	56.3	6.82	90.8	8.8
Products 1 to 5	7.02	52.1	7.49	91.6	10.5
Products 1 to 6	13.40	27.9	9.74	93.5	26.1

Test No. 33

Purpose: To repeat the conditions of Test 32, but with a different collector in the Pb cleaners.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 70 minutes at 65% solids in a lab rod mill

Conditions:

Stage	Reagents Added, grams per tonne						Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	CD3*	MIBC	Na ₂ SiO ₃	Grind	Cond	Froth	
Grind	2000	150	-	-	-	-	70	-	-	-
Pb Rougher	-	-	5	-	15	-	-	1	4	-
	-	-	5	-	10	-	-	1	3	-
	-	-	-	-	10	-	-	1	3	-
Pb Regrind	-	50	-	20	-	-	20	-	-	-
Pb 1st Cleaner	-	20	-	10	-	100	-	1	10	-
Pb 1st Cl Scav	-	-	-	2.5	-	-	-	1	3	-
Pb 2nd Cleaner	-	50	-	5	-	50	-	1	5	-
	-	-	-	4	-	-	-	1	5	-
Pb 3rd Cleaner	-	25	-	-	-	50	-	1	4	-
	-	-	-	5	-	-	-	1	4	-
Pb 4th Cleaner	-	25	-	-	-	50	-	1	3	-
	-	-	-	2.5	-	-	-	1	3	-

*M2030 (1 g), CA831 (1 g), Thiourea (1 g), H₂O₂ (1 g), Pet 745 (0.3 g)

Test No. 33 - Continued

Metallurgical Results

Product	Weight %	Assays %				% Distribution			
		Pb	Zn	Au	Ag	Pb	Zn	Au	Ag
1. Pb Cleaner Conc	5.20	63.9	5.99	7.98	783.0	82.4	6.1	67.0	76.1
2. Pb 4th Cleaner Tail	0.60	32.5	10.3	3.42	396.0	4.8	1.2	3.3	4.4
3. Pb 3rd Cleaner Tail	0.63	17.0	10.9	1.85	225.0	2.7	1.3	1.9	2.6
4. Pb 2nd Cleaner Tail	1.01	5.65	10.9	0.60	86.2	1.4	2.2	1.0	1.6
5. Pb 1st Cl Scav Conc	0.56	5.62	13.1	0.91	91.7	0.8	1.4	0.8	1.0
6. Pb 1st Cl Scav Tail	7.57	1.43	11.0	0.23	26.0	2.7	16.2	2.8	3.7
7. Pb Scavenger Tail	84.43	0.25	4.35	0.17	6.7	5.2	71.6	23.2	10.6
Head (Calc)	100.00	4.03	5.13	0.62	53.5	100.0	100.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 + 2	5.80	60.7	6.44	7.51	743.0	87.2	7.3	70.3	80.5
Products 1 to 3	6.43	56.4	6.87	6.95	692.0	89.9	8.6	72.2	83.1
Products 1 to 4	7.44	49.5	7.42	6.09	610.0	91.3	10.8	73.2	84.7
Products 1 to 5	8.00	46.4	7.82	5.73	574.0	92.1	12.2	74.0	85.7
Products 1 to 6	15.57	24.5	9.37	3.06	307.0	94.8	28.4	76.8	89.4

Test No. 34

Purpose: To repeat the conditions of Test 33, but use collector CD3 in both rougher and cleaners.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 70 minutes at 65% solids in a lab rod mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	CD3	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	70	-	-	-
Pb Rougher	-	-	5	5	-	-	1	4	-
	-	-	5	-	-	-	1	3	-
	-	-	-	-	-	-	1	3	-
Pb Re grind	-	50	20	-	-	20	-	-	-
Pb 1st Cl.	-	-	10	2.5	100	-	1	10	-
Pb 1st Cl Scav	-	20	2.5	-	-	-	1	3	-
Pb 2nd Cl.	-	50	-	-	50	-	1	5	-
	-	-	7.5	-	-	-	1	5	-
Pb 3rd Cl.	-	25	-	-	50	-	1	4	-
	-	-	5	-	-	-	1	4	-
Pb 4th Cl.	-	25	-	-	50	-	1	3	-
	-	-	2.5	-	-	-	1	3	-

Test No. 34 - Continued

Metallurgical Results

Product	Weight %	Assays %				% Distribution			
		Pb	Zn	Au	Ag	Pb	Zn	Au	Ag
1. Pb Cleaner Conc	4.65	64.4	5.52	8.18	817.0	73.0	5.1	62.4	66.6
2. Pb 4th Cleaner Tail	0.65	34.3	9.67	4.08	423.0	5.4	1.2	4.3	4.8
3. Pb 3rd Cleaner Tail	0.81	23.6	11.2	2.55	287.0	4.7	1.8	3.4	4.1
4. Pb 2nd Cleaner Tail	1.31	11.9	11.4	1.05	142.0	3.8	2.9	2.3	3.3
5. Pb 1st Cl Scav Conc	1.08	9.09	12.3	1.03	116.0	2.4	2.6	1.8	2.2
6. Pb 1st Cl Scav Tail	6.41	2.64	11.1	0.33	43.0	4.1	14.1	3.5	4.8
7. Pb Scavenger Tail	85.09	0.32	4.30	0.16	9.5	6.6	72.3	22.3	14.2
Head (Calc)	100.00	4.10	5.06	0.61	57.0	100.0	100.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 + 2	5.30	60.7	6.03	7.68	769.0	78.4	6.3	66.7	71.4
Products 1 to 3	6.11	55.8	6.72	7.00	705.0	83.1	8.1	70.1	75.5
Products 1 to 4	7.42	48.0	7.54	5.95	605.0	86.9	11.0	72.4	78.8
Products 1 to 5	8.50	43.1	8.15	5.32	543.0	89.3	13.6	74.2	81.0
Products 1 to 6	14.91	25.7	9.42	3.18	328.0	93.4	27.7	77.7	85.8

Test No. 35

Purpose: To repeat Test 32, and add a zinc circuit.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 70 minutes at 65% solids in a lab rod mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	70	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	-
	-	-	5	10	-	-	1	3	-
	-	-	-	10	-	-	1	3	-
Pb Regrind	-	50	20	-	-	20	-	-	-
Pb 1st Cl.	-	20	-	5	100	-	1	10	-
Pb 1st Cl Scav	-	-	2.5	2.5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	-	50	-	1	5	-
	-	-	4	10	-	-	1	5	-
Pb 3rd Cl.	-	25	-	-	50	-	1	4	-
	-	-	2	10	-	-	1	4	-
Pb 4th Cl.	-	25	-	-	50	-	1	3	-
	-	-	-	5	-	-	1	3	-

Feed: Pb Rougher + Pb 1st Cleaner Scav Tailings.

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit:								
Condition 1	1250	-	-	-	-	5	-	12.0
Condition 2	-	800	-	-	-	5	-	11.4
Zn Rougher	-	-	20	10	-	2	4	-
Zn Scavenger	-	-	10	10	-	1	3	-
Zn Regrind (PM)	250	-	10	-	10	-	-	-
Zn 1st Cleaner	-	-	-	-	-	-	4	11.5
Zn 1st Cl Scav	-	-	5	5	-	1	4	-
Zn 2nd Cleaner	250	-	-	-	-	1	4	12.0
Zn 3rd Cleaner	250	-	-	-	-	1	3	12.2
Zn 4th Cleaner	250	-	-	-	-	1	3	12.2

Metallurgical Balance

Test No. 35

Product	Weight		Assays, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner. Conc.	91	4.55	63.3	6.38	70.9	5.4
2. Pb 4th Cl. Tail	17.3	0.86	41.7	7.52	8.9	1.2
3. Pb 3rd Cl. Tail	13.2	0.66	24.5	8.86	4.0	1.1
4. Pb 2nd Cl. Tail	30.5	1.52	12.3	10.6	4.6	3.0
5. Pb 1st Cl. Scav. Conc.	16.3	0.81	6.04	11.2	1.2	1.7
6. Zn Cleaner Conc.	148.5	7.42	0.87	57.8	1.6	79.6
7. Zn 4th Cl. Tail	4.4	0.22	2.71	19.5	0.1	0.8
8. Zn 3rd Cl. Tail	6.4	0.32	2.43	10.9	0.2	0.6
9. Zn 2nd Cl. Tail	14.3	0.71	1.89	4.32	0.3	0.6
10. Zn 1st Cl. Scav. Conc.	26.9	1.34	2.07	5.55	0.7	1.4
11. Zn 1st Cl. Scav. Tail.	77.2	3.86	0.83	0.88	0.8	0.6
12. Zn Scav. Tail	1556.2	77.72	0.35	0.28	6.7	4.0
Head Calc.	2002.2	100.00	4.06	5.39	100.0	100.0

Combined Products

Products 1+2		5.41	59.85	6.56	79.8	6.6
Products 1-3		6.07	56.01	6.81	83.7	7.7
Products 1-4		7.59	47.24	7.57	88.4	10.7
Products 1-5		8.41	43.25	7.92	89.6	12.4
Products 6+7		7.64	0.92	56.70	1.7	80.4
Products 6-8		7.96	0.98	54.86	1.9	81.0
Products 6-9		8.67	1.06	50.69	2.3	81.6
Products 6-10		10.01	1.19	44.64	2.9	83.0
Products 6-11		13.87	1.09	32.47	3.7	83.6
Products 6-12		91.59	0.46	5.15	10.4	87.6
Products 11+12		81.58	0.37	0.31	7.5	4.7

Test No. 36

Purpose: To repeat Test 33, and add a zinc circuit.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 70 minutes at 65% solids in a lab rod mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	70	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	-
	-	-	5	10	-	-	1	3	-
	-	-	CD3	10	-	-	1	3	-
Pb Regrind	-	50	20	-	-	20	-	-	-
Pb 1st Cl.	-	20	10	-	100	-	1	10	-
Pb 1st Cl Scav	-	-	2.5	-	-	-	1	3	-
Pb 2nd Cl.	-	50	5	-	50	-	1	5	-
	-	-	4	-	-	-	1	5	-
Pb 3rd Cl.	-	25	-	-	50	-	1	4	-
	-	-	5	-	-	-	1	4	-
Pb 4th Cl.	-	25	-	-	50	-	1	3	-
	-	-	2.5	-	-	-	1	3	-

Feed: Pb Rougher + Pb 1st Cleaner Scav Tailings.

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition 1	1250	-	-	-	-	5	-	12.0
Condition 2	-	800	-	-	-	5	-	11.4
Zn Rougher	-	-	20	10	-	2	4	-
Zn Scavenger	-	-	10	10	-	1	3	-
Zn Regrind (PM)	250	-	10	-	10	-	-	11.6
Zn 1st Cleaner	-	-	-	-	-	-	4	-
Zn 1st Cl Scav	-	-	5	5	-	1	4	-
Zn 2nd Cleaner	250	-	-	-	-	1	4	12.0
Zn 3rd Cleaner	250	-	-	-	-	1	3	12.2
Zn 4th Cleaner	250	-	-	-	-	1	3	12.2

Metallurgical Balance

Test No. 36

Product	Weight		Assays, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner. Conc.	83.6	4.17	59.7	7.06	62.4	5.8
2. Pb 4th Cl. Tail	23.9	1.19	33.0	8.36	9.9	2.0
3. Pb 3rd Cl. Tail	28.8	1.44	24.1	8.28	8.7	2.3
4. Pb 2nd Cl. Tail	48.9	2.44	11.5	8.8	7.0	4.2
5. Pb 1st Cl. Scav. Conc.	14	0.70	6.93	12.6	1.2	1.7
6. Zn Cleaner Conc.	140.6	7.01	0.92	56.2	1.6	77.4
7. Zn 4th Cl. Tail	4	0.20	2.59	16.6	0.1	0.7
8. Zn 3rd Cl. Tail	7.6	0.38	2.36	9.11	0.2	0.7
9. Zn 2nd Cl. Tail	17.7	0.88	1.99	3.6	0.4	0.6
10. Zn 1st Cl. Scav. Conc.	29.5	1.47	1.49	2.62	0.5	0.8
11. Zn 1st Cl. Scav. Tail.	63.5	3.17	0.99	0.65	0.8	0.4
12. Zn Scav. Tail	1542.2	76.94	0.37	0.23	7.1	3.5
Head Calc.	2004.3	100.00	3.99	5.09	100.0	100.0

Combined Products

Products 1+2		5.36	53.76	7.35	72.2	7.7
Products 1-3		6.80	47.50	7.55	80.9	10.1
Products 1-4		9.24	37.99	7.88	87.9	14.3
Products 1-5		9.94	35.81	8.21	89.1	16.0
Products 6+7		7.21	0.97	55.10	1.7	78.0
Products 6-8		7.59	1.04	52.81	2.0	78.7
Products 6-9		8.48	1.14	47.68	2.4	79.3
Products 6-10		9.95	1.19	41.01	3.0	80.1
Products 6-11		13.12	1.14	31.27	3.7	80.5
Products 6-12		90.06	0.48	4.75	10.9	84.0
Products 11+12		80.11	0.39	0.25	7.9	3.9

Test No. 37

Purpose: To repeat Test 32, but compare primary grinding in the ball mill.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	40	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.7
	-	-	5	10	-	-	1	3	-
	-	-	-	10	-	-	1	3	-
Pb Re grind	-	50	20	-	-	20	-	-	-
Pb 1st Cl.	-	20	-	5	100	-	1	10	-
Pb 1st Cl Scav	-	-	2.5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	-	50	-	1	5	-
	-	-	4	10	-	-	1	5	-
Pb 3rd Cl.	-	25	-	-	50	-	1	4	-
	-	-	-	10	-	-	1	4	-
Pb 4th Cl.	-	25	-	-	50	-	1	3	-
	-	-	-	5	-	-	1	3	-

Feed: Pb Rougher + Pb 1st Cleaner Scav Tailings.

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit:								
Condition 1	1250	-	-	-	-	5	-	-
Condition 2	-	800	-	-	-	5	-	-
Zn Rougher	-	-	20	10	-	2	4	-
Zn Scavenger	-	-	10	10	-	1	3	-
Zn Re grind (PM)	250	-	10	-	10	-	-	11.6
Zn 1st Cleaner	-	-	-	-	-	-	4	-
Zn 1st Cl Scav	-	-	5	5	-	1	4	-
Zn 2nd Cleaner	250	-	-	-	-	1	4	12.0
Zn 3rd Cleaner	250	-	-	-	-	1	3	12.2
Zn 4th Cleaner	250	-	-	-	-	1	3	12.2

Metallurgical Balance

Test No. 37

Product	Weight		Assays %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner. Conc.	106.4	5.35	60.8	6.92	79.3	7.2
2. Pb 4th Cl. Tail	13.3	0.67	32.8	9.33	5.3	1.2
3. Pb 3rd Cl. Tail	16.9	0.85	15.2	10.80	3.1	1.8
4. Pb 2nd Cl. Tail	30.5	1.53	4.25	10.4	1.6	3.1
5. Pb 1st Cl. Scav. Conc.	14.3	0.72	3.60	12.1	.6	1.7
6. Zn Cleaner Conc.	143.8	7.23	1.78	55.6	3.1	78.1
7. Zn 4th Cl. Tail	4.3	0.22	2.55	19.7	0.1	0.8
8. Zn 3rd Cl. Tail	4.9	0.25	2.18	10.1	0.1	0.5
9. Zn 2nd Cl. Tail	14.2	0.71	1.55	3.92	0.3	0.5
10. Zn 1st Cl. Scav. Conc.	31.9	1.60	1.67	3.43	0.7	1.1
11. Zn 1st Cl. Scav. Tail	80	4.02	0.48	0.60	0.5	0.5
12. Zn Scav. Tail	1528.1	76.84	0.28	0.24	5.2	3.6
Head Calc.	1988.6	100.00	4.10	5.15	100.0	100.0

Combined Products

Products 1+2		6.02	57.69	7.19	84.6	8.4
Products 1-3		6.87	52.43	7.63	87.7	10.2
Products 1-4		8.40	43.64	8.14	89.3	13.3
Products 1-5		9.12	40.48	8.45	90.0	15.0
Products 6+7		7.45	1.80	54.56	3.3	78.9
Products 6-8		7.69	1.81	53.13	3.4	79.4
Products 6-9		8.41	1.79	48.95	3.7	79.9
Products 6-10		10.01	1.77	41.66	4.3	81.0
Products 6-11		14.03	1.40	29.89	4.8	81.5
Products 6-12		90.88	0.45	4.82	10.0	85.0
Products 11+12		80.87	0.29	0.26	5.7	4.0

Test No. 38

Purpose: Repeat the conditions of Test 32.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 70 minutes at 65% solids in a lab rod mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	70	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.7
Pb Scav	-	-	5	10	-	-	1	3	-
	-	-	-	10	-	-	1	3	-
Pb Regrind	-	50	20	-	-	20	-	-	-
Pb 1st Cl.	-	20	-	5	100	-	1	4	9.6
	-	-	1.0	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	2.5	50	-	1	5	9.7
	-	-	4	10	-	-	1	5	-
Pb 3rd Cl.	-	25	-	5	50	-	1	4	9.6
	-	-	2.0	5	-	-	1	4	-
Pb 4th Cl.	-	25	-	5	50	-	1	3	9.8
	-	-	2.0	5	-	-	1	3	-

Metallurgical Balance

Test No. 38

Product	Weight		Assay, g/t, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner. Conc.	89.1	4.46	64.9	7.74	74.9	6.5
2. Pb 4th Cl. Tail	19.5	0.98	49.3	6.69	12.5	1.2
3. Pb 3rd Cl. Tail	8.9	0.45	23.4	7.47	2.7	0.6
4. Pb 2nd Cl. Tail	9.3	0.47	5.86	5.82	0.7	0.5
5. Pb 1st Cl. Scav. Conc.	4.7	0.24	3.50	15.2	0.2	0.7
6. Pb 1st Cl. Scav. Tail	99.1	4.96	1.30	12.9	1.7	12.1
7. Pb Scav. Tail	1769.4	88.47	0.32	4.67	7.3	78.3
Head Calc.	2000	100.00	3.86	5.28	100.0	100.0

Combined Products

Products 1+2		5.43	62.1	7.55	87.4	7.8
Products 1-3		5.88	59.2	7.55	90.1	8.4
Products 1-4		6.34	55.3	7.42	90.8	8.9
Products 1-5		6.58	53.4	7.70	91.0	9.6
Products 1-6		11.53	31.0	9.93	92.7	21.7
Products 6+7		93.43	0.37	5.11	9.0	90.4

Test No. 39

Purpose: Repeat the general conditions of Test 37, but condition the reground Pb rougher-scavenger concentrate at High Speed for 15 minutes.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	40	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.7
	-	-	5	10	-	-	1	3	-
	-	-	-	10	-	-	1	3	-
Pb Re grind	-	50	20	-	-	20	-	-	-
Pb H.S. Cond	-	20	-	5	100	-	15	-	-
Pb 1st Cl.	-	-	-	-	-	-	-	4	9.7
	-	-	1.0	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	2.5	50	-	1	5	9.7
	-	-	4	10	-	-	1	5	-
Pb 3rd Cl.	-	25	-	5	50	-	1	4	-
	-	-	2.0	5	-	-	1	4	-
Pb 4th Cl.	-	25	-	5	50	-	1	3	-
	-	-	2.0	5	-	-	1	3	-

Metallurgical Balance

Test No. 39

Product	Weight		Assay, g/t, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner. Conc.	104.6	5.28	63.4	7.77	81.9	8.1
2. Pb 4th Cl. Tail	13.2	0.67	27.1	11.3	4.4	1.5
3. Pb 3rd Cl. Tail	10.7	0.54	13.9	9.25	1.8	1.0
4. Pb 2nd Cl. Tail	12.8	0.65	4.77	7.26	0.8	0.9
5. Pb 1st Cl. Scav. Conc.	9.4	0.47	3.30	17.1	0.4	1.6
6. Pb 1st Cl. Scav. Tail.	110	5.55	1.35	11.6	1.8	12.7
7. Pb Scav. Tail.	1722	86.85	0.42	4.32	8.9	74.2
Head Calc.	1982.7	100.00	4.09	5.06	100.0	100.0

Combined Products

Products 1+2		5.94	59.3	8.17	86.3	9.6
Products 1-3		6.46	55.5	8.26	88.1	10.6
Products 1-4		7.13	50.9	8.17	88.9	11.5
Products 1-5		7.60	48.0	8.72	89.2	13.1
Products 1-6		13.15	28.3	9.94	91.1	25.8
Products 6+7		92.40	0.48	4.76	10.8	86.9

Test No. 40

Purpose: Precycle test using the general conditions of Test 37.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	40	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.7
Pb Scav	-	-	5	10	-	-	1	3	-
	-	-	-	10	-	-	1	3	-
Pb Regrind	-	50	20	-	-	20	-	-	-
Pb 1st Cl.	-	20	-	5	100	-	1	4	9.6
	-	-	1.0	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	2.5	50	-	1	5	9.7
	-	-	4	10	-	-	1	5	-
Pb 3rd Cl.	-	25	-	5	50	-	1	4	-
	-	-	2.0	5	-	-	1	4	-
Pb 4th Cl.	-	25	-	5	50	-	1	3	-
	-	-	2.0	5	-	-	1	3	-

Feed: Pb Rougher + Pb 1st Cleaner Scav Tailings.

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	1250	-	-	-	-	5	-	-
	-	800	-	-	-	5	-	11.5
Zn Rougher	-	-	20	10	-	2	4	-
	-	-	10	-	-	1	3	-
Zn Regrind (PM)	250	-	-	-	10	-	-	-
H.S. Cond.	-	-	10	-	-	15	-	-
Zn 1st Cleaner	-	-	-	-	-	1	4	11.2
Zn 1st Cl Scav	-	-	5	5	-	1	4	-
Zn 2nd Cleaner	250	-	-	-	-	1	4	11.8
Zn 3rd Cleaner	250	-	-	-	-	1	3	-
Zn 4th Cleaner	250	-	-	-	-	1	3	12.0

Metallurgical Balance

Test No. 40

Product	Weight		Assays, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	86.7	4.38	65.9	7.34	71.3	6.1
2. Pb 4th Cl. Tail	19.2	0.97	47.8	9.76	11.5	1.8
3. Pb 3rd Cl. Tail	15.2	0.77	24.3	10.70	4.6	1.6
4. Pb 2nd Cl. Tail	17.6	0.89	5.65	8.89	1.2	1.5
5. Pb 1st Cl. Scav. Conc.	5.4	0.27	3.70	15.9	.2	0.8
6. Zn Cleaner Conc.	140.6	7.10	1.27	56.0	2.2	75.4
7. Zn 4th Cl. Tail	9.6	0.48	2.58	31.9	0.3	2.9
8. Zn 3rd Cl. Tail	8.5	0.43	2.28	15.0	0.2	1.2
9. Zn 2nd Cl. Tail	18.7	0.94	1.47	4.14	0.3	0.7
10. Zn 1st Cl. Scav. Conc.	62.3	3.15	2.27	6.46	1.8	3.9
11. Zn 1st Cl. Scav. Tail	98.9	4.99	0.49	0.72	0.6	0.7
12. Zn Scav. Tail	1498.2	75.63	0.30	0.24	5.6	3.4
Head Calc.	1980.9	100.00	4.04	5.27	100.0	100.0

Combined Products

Products 1+2		5.35	62.62	7.78	82.8	7.9
Products 1-3		6.11	57.81	8.15	87.4	9.4
Products 1-4		7.00	51.19	8.24	88.6	10.9
Products 1-5		7.27	49.41	8.53	88.9	11.8
Products 6+7		7.58	1.35	54.46	2.5	78.3
Products 6-8		8.01	1.40	52.35	2.8	79.5
Products 6-9		8.96	1.41	47.26	3.1	80.3
Products 6-10		12.10	1.63	36.66	4.9	84.1
Products 6-11		17.09	1.30	26.16	5.5	84.8
Products 6-12		92.73	0.48	5.02	11.1	88.2
Products 11+12		80.62	0.31	0.27	6.2	4.1

Test No. 41

Purpose: A flotation locked cycle test using the conditions of Test 40.

Procedure: As shown below.

Feed: 6 x 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

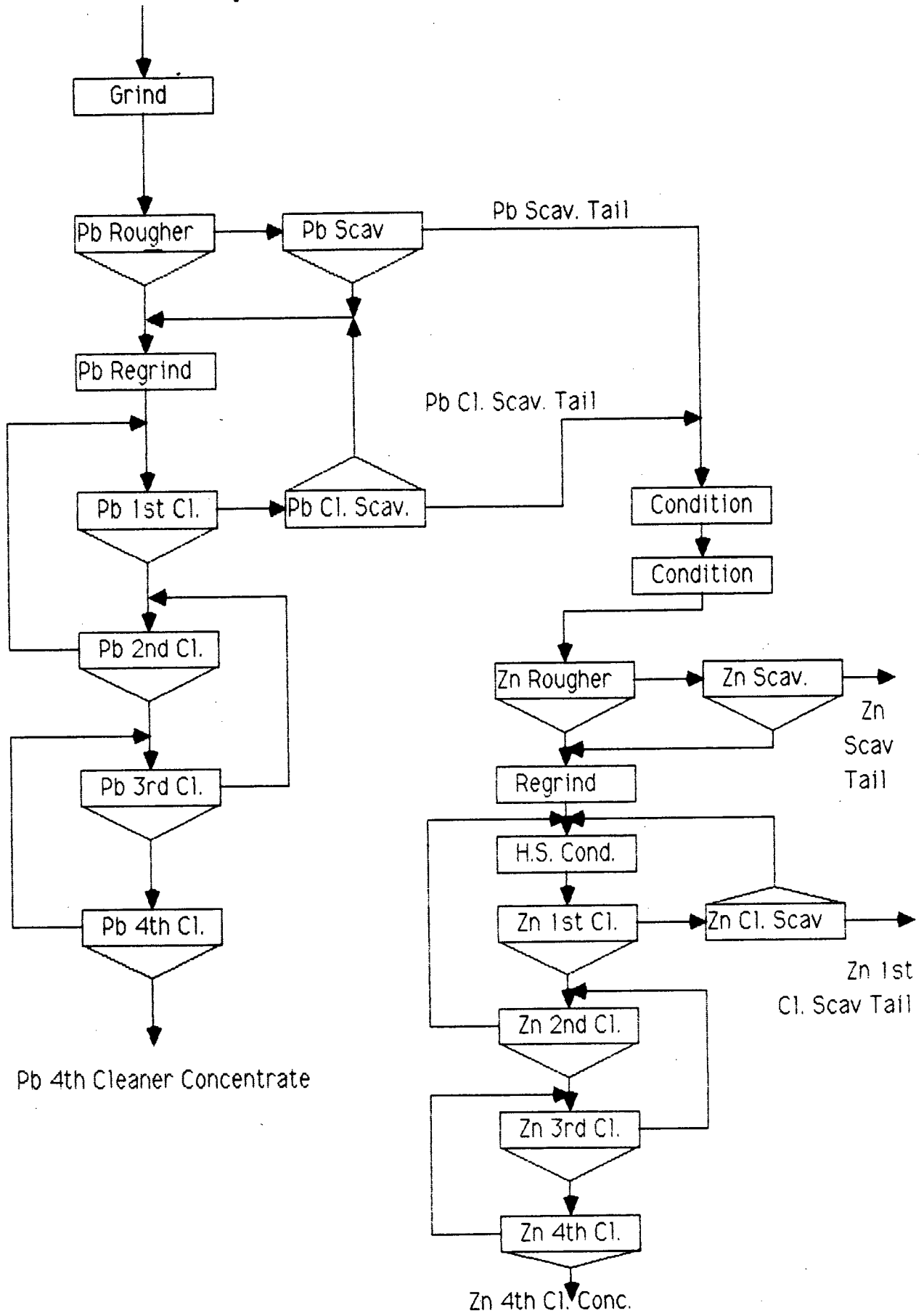
	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	40	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.7
Pb Scav	-	-	5	10	-	-	1	3	-
	-	-	-	10	-	-	1	3	-
Pb Regrind	-	50	20	-	-	20	-	-	9.6
Pb 1st Cl.	-	20	-	5	100	-	1	3	-
	-	-	1.0	5	-	-	1	3	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	-	50	-	1	3	9.7
	-	-	2	5	-	-	1	3	-
Pb 3rd Cl.	-	25	-	5	50	-	1	3	9.6
Pb 4th Cl.	-	25	-	2.5	50	-	1	3	9.5

Feed: Pb Rougher + Pb 1st Cleaner Scav Tailings.

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	1250	-	-	-	-	5	-	-
	-	800	-	-	-	5	-	11.4
Zn Rougher	-	-	20	10	-	2	4	-
	-	-	10	-	-	1	3	-
Zn Regrind (PM)	500	-	-	-	10	-	-	-
H.S. Cond.	-	-	10	-	-	10	-	-
Zn 1st Cleaner	-	-	-	-	-	1	5	11.3
Zn 1st Cl Scav	-	-	5	5	-	1	3	-
Zn 2nd Cleaner	250	-	-	-	-	1	4	11.7
Zn 3rd Cleaner	250	-	-	-	-	1	3	11.9
Zn 4th Cleaner	250	-	-	-	-	1	3	12.0

6 * 2Kg. -10 mesh Comp. No.3



3458B-41 Metallurgical Results

Product	Weight		Assays, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Cl Conc A	97.5	0.8	65.8	7.98	3.98	8.60	791	13.0	1.3	0.1	9.8	10.7
2. Pb Cl Conc B	108.7	0.9	63.0	7.69	5.41	9.33	742	13.9	1.3	0.2	11.8	11.2
3. Pb Cl Conc C	102.1	0.9	66.4	6.85	4.28	8.35	882	13.7	1.1	0.2	9.9	12.5
4. Pb Cl Conc D	95.7	0.8	65.5	7.14	4.32	8.37	829	12.7	1.1	0.1	9.3	11.0
5. Pb Cl Conc E	91.6	0.8	66.4	6.72	4.21	8.07	806	12.3	1.0	0.1	8.6	10.3
6. Pb Cl Conc F	100.2	0.8	66.0	7.58	4.14	9.00	822	13.4	1.2	0.1	10.5	11.5
7. 4th Cl Tail F	38.6	0.3	40.2	12.0	13.8	1.93	419	3.1	0.7	0.2	0.9	2.3
8. 3rd Cl Tail F	73.0	0.6	25.1	12.1	20.8	1.22	278	3.7	1.4	0.5	1.0	2.8
9. 2nd Cl Tail F	52.4	0.4	11.9	10.9	27.3	0.79	170	1.3	0.9	0.5	0.5	1.2
10. 1st Cl Scav Conc F	29.0	0.2	5.43	12.9	29.3	3.89	178	0.3	0.6	0.3	1.3	0.7
11. Zn CL Conc A	146.1	1.2	1.14	53.6	7.64	0.70	48.5	0.3	12.6	0.4	1.2	1.0
12. Zn CL Conc B	145.3	1.2	2.09	53.9	7.34	0.44	58.7	0.6	12.6	0.4	0.7	1.2
13. Zn CL Conc C	157.4	1.3	1.33	53.8	7.95	0.37	57.9	0.4	13.6	0.4	0.7	1.3
14. Zn CL Conc D	165.6	1.4	1.51	52.7	8.08	0.46	59.6	0.5	14.1	0.5	0.9	1.4
15. Zn CL Conc E	146.4	1.2	1.19	55.3	6.76	0.28	51.0	0.4	13.0	0.4	0.5	1.0
16. Zn CL Conc F	134.3	1.1	0.85	55.3	6.67	0.29	45.7	0.2	12.0	0.3	0.5	0.9
17. Zn 4th Cl Tail F	22.8	0.2	2.23	43.9	10.8	0.64	80.3	0.1	1.6	0.1	0.2	0.3
18. 3rd Cl Tail F	29.8	0.2	3.02	29.0	16.2	0.80	96.6	0.2	1.4	0.2	0.3	0.4
19. 2nd Cl Tail F	52.5	0.4	3.30	14.7	22.7	1.18	84.0	0.4	1.2	0.4	0.7	0.6
20. 1st Cl Scav Conc F	134.8	1.1	3.10	6.38	32.3	3.11	60.2	0.8	1.4	1.6	4.9	1.1
21. 1st Cl Scav Tail A	129.8	1.1	0.63	0.81	28.2	0.30	31.0	0.2	0.2	1.3	0.5	0.6
22. 1st Cl Scav Tail B	175.2	1.5	0.81	0.94	28.5	0.30	20.9	0.3	0.3	1.8	0.6	0.5
23. 1st Cl Scav Tail C	143.0	1.2	0.77	1.14	27.3	0.27	22.8	0.2	0.3	1.4	0.4	0.5
24. 1st Cl Scav Tail D	162.1	1.4	0.94	1.43	27.7	0.29	25.5	0.3	0.4	1.6	0.5	0.6
25. 1st Cl Scav Tail E	179.8	1.5	1.27	1.91	29.0	0.34	31.4	0.5	0.6	1.9	0.7	0.8
26. 1st Cl Scav Tail F	168.0	1.4	0.90	1.43	26.7	0.28	27.9	0.3	0.4	1.6	0.5	0.7
27. Zn Ro Scav Tail A	1487.8	12.4	0.32	0.25	25.7	0.20	10.6	1.0	0.6	13.6	3.5	2.2
28. Zn Ro Scav Tail B	1488.4	12.5	0.44	0.25	26.0	0.19	9.80	1.3	0.6	13.8	3.3	2.0
29. Zn Ro Scav Tail C	1524.5	12.8	0.37	0.24	26.4	0.16	9.60	1.1	0.6	14.3	2.8	2.0
30. Zn Ro Scav Tail D	1526.6	12.8	0.38	0.25	25.9	0.20	10.8	1.2	0.6	14.1	3.6	2.3
31. Zn Ro Scav Tail E	1548.3	13.0	0.44	0.27	25.7	0.18	10.5	1.4	0.7	14.2	3.2	2.3
32. Zn Ro Scav Tail F	1496.4	12.5	0.33	0.23	25.2	0.35	10.7	1.0	0.6	13.4	6.1	2.2
Head (calc)	11953.7	100.0	4.14	5.19	23.5	0.72	60.1	100.0	100.0	100.0	100.0	100.0
Combined Products												
Comb Pb Conc. 1 to 6		5.0	65.5	7.34	4.41	8.64	811	78.9	7.0	0.9	60.0	67.3
Comb Pb Cl Tails 7 to 10		1.6	21.6	11.9	22.4	1.65	262	8.4	3.7	1.5	3.7	7.0
Comb Zn Cl Conc. 11 to 16		7.5	1.36	54.1	7.43	0.43	53.9	2.5	78.0	2.4	4.4	6.7
Comb Zn Cl Tails 17 to 20		2.0	3.05	14.6	26.2	2.17	71.8	1.5	5.6	2.2	6.1	2.4
Comb Zn Cl Scav Tails 21 to 26		8.0	0.90	1.30	27.9	0.30	26.5	1.8	2.0	9.5	3.3	3.5
Comb Zn Ro Sc Tails 27 to 32		75.9	0.38	0.25	25.8	0.21	10.3	7.0	3.6	83.4	22.5	13.0
Projected Results Cycles E & F												
Pb Cleaner Conc		5.5	66.2	7.17	4.17	8.56	814	88.4	7.6	1.0	65.0	75.3
Zn Cleaner Conc		8.0	1.03	55.3	6.72	0.28	48.5	2.0	85.8	2.4	3.2	6.5
Zn Scav. Tail		86.4	0.46	0.40	25.7	0.27	12.6	9.6	6.6	96.6	31.9	18.2
Head (calc)		100.0	4.14	5.19	23.0	0.73	59.7	100.0	100.0	100.0	100.0	100.0

Test No. 42

Purpose: A-series of roughing tests using A317/3418A collector to evaluate the effect of fineness of Primary grind.

Procedure: As indicated below .

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 30 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	-	-	30	-	-	9.7
Pb Rougher	-	-	5	15	-	-	-	-	1	4	-
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	-	10	-	-	-	-	1	3	-
				DF 1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.6
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	-	-	-	10	-	1	3	-

Metallurgical Balance

Test No. 42

Product	g	Weight	Assay, %		% Distribution	
		%	Pb	Zn	Pb	Zn
1. Pb Ro. Conc.	189.7	9.52	36.0	10.20	83.1	18.7
2. Pb Scav. Conc.	109.5	5.50	7.26	10.2	9.7	10.8
3. Zn Ro. Conc.	198.1	9.94	0.87	34.0	2.1	65.0
4. Zn Scav. Conc.	71.9	3.61	1.36	3.14	1.2	2.2
5. Zn Scav. Tail.	1423.1	71.43	0.230	0.25	4.0	3.4
Head Calc.	1992.3	100.00	4.13	5.20	100.0	100.0

Combined Products

Products 1+2		15.02	25.48	10.20	92.7	29.4
Products 3+4		13.55	1.00	25.78	3.3	67.1

Test No. 43

Purpose: Repeat Test 42, but increase the Primary grinding time to 40 minutes.

Procedure: As for Test 42.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	-	-	40	-	-	9.7
Pb Rougher	-	-	5	15	-	-	-	-	1	4	-
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	-	10	-	-	-	-	1	3	-
				DF 1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.5
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	-	-	-	10	-	1	3	-

Metallurgical Balance

Test No. 43

Product	g	Weight	Assay, %		% Distribution	
		%	Pb	Zn	Pb	Zn
1. Pb Ro. Conc.	173.9	8.73	37.9	9.57	81.5	16.2
2. Pb Scav. Conc.	45.6	2.29	9.38	12.8	5.3	5.7
3. Zn Ro. Conc.	212.3	10.66	1.83	35.2	4.8	72.8
4. Zn Scav. Conc.	78.2	3.93	3.58	2.36	3.5	1.8
5. Zn Scav. Tail.	1482.2	74.40	0.270	0.24	4.9	3.5
Head Calc.	1992.2	100.00	4.06	5.15	100.0	100.0

Combined Products

Products 1+2		11.02	31.98	10.24	86.8	21.9
Products 3+4		14.58	2.30	26.36	8.3	74.6

Test No. 44

Purpose: Repeat Test 42, but increase the Primary grinding time to 50 minutes.

Procedure: As for Test 42.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 50 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	-	-	50	-	-	9.7
Pb Rougher	-	-	5	15	-	-	-	-	1	4	-
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	-	10	-	-	-	-	1	3	-
				DF 1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.5
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	-	-	-	10	-	1	3	-

Metallurgical Balance

Test No. 44

Product	Weight		Assay, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Ro. Conc.	144.8	7.24	44.1	8.55	77.7	11.5
2. Pb Scav. Conc.	55.8	2.79	13.0	13.5	8.8	7.0
3. Zn Ro. Conc.	177	8.85	1.64	44.1	3.5	72.6
4. Zn Scav. Conc.	106.9	5.35	4.07	5.43	5.3	5.4
5. Zn Scav. Tail.	1515.5	75.78	0.250	0.25	4.6	3.5
Head Calc.	2000	100.00	4.11	5.38	100.0	100.0

Combined Products

Products 1+2		10.03	35.45	9.93	86.6	18.5
Products 3+4		14.20	2.55	29.54	8.8	78.0

Test No. 73

Purpose: To investigate the effect of a coarse Primary grind on Pb and Zn cleaning using Composite 3 ore.

Procedure: Standard flotation conditions of Tes 40.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 20 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	20	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.8
Pb Scav	-	-	5	10	-	-	1	3	-
	-	-	-	10	-	-	1	3	-
Pb Re grind	-	50	20	-	-	20	-	-	-
Pb 1st Cl.	-	20	-	5	100	-	1	4	-
	-	-	1.0	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	2.5	50	-	1	4	9.7
	-	-	4	10	-	-	1	4	-
Pb 3rd Cl.	-	25	-	5	50	-	1	4	-
	-	-	2.0	5	-	-	1	3	-
Pb 4th Cl.	-	25	-	5	50	-	1	3	-
	-	-	2.0	5	-	-	1	3	-

Feed: Pb Rougher + Pb 1st Cleaner Scav Tailings.

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	1250	-	-	-	-	5	-	-
	-	800	-	-	-	5	-	11.5
Zn Rougher	-	-	20	10	-	2	4	-
	-	-	10	-	-	1	3	-
Zn Re grind (PM)	250	-	-	-	10	-	-	-
H.S. Cond.	-	-	10	-	-	10	-	-
Zn 1st Cleaner	-	-	-	-	-	1	4	11.2
Zn 1st Cl Scav	-	-	5	5	-	1	4	-
Zn 2nd Cleaner	250	-	-	-	-	1	4	12.0
Zn 3rd Cleaner	250	-	-	-	-	1	3	-
Zn 4th Cleaner	250	-	-	-	-	1	2	-

Test No. 73

Product	g	Weight %	Assays, %		% Distribution	
			Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	111.7	5.64	57.0	10	81.3	10.9
2. Pb 4th Cl. Tail	16.9	0.85	21.8	11.1	4.7	1.6
3. Pb 3rd Cl. Tail	10.3	0.52	12.9	9.55	1.7	1.0
4. Pb 2nd Cl. Tail	16.2	0.82	4.2	10.1	.9	1.6
5. Pb 1st Cl. Scav. Conc.	9.9	0.50	2.91	15.4	0.4	1.5
6. Zn Cleaner Conc.	149.9	7.57	1.62	50.1	3.1	73.3
7. Zn 4th Cl. Tail	12.5	0.63	2.72	18.2	0.4	2.2
8. Zn 3rd Cl. Tail	9.1	0.46	2.46	12.1	0.3	1.1
9. Zn 2nd Cl. Tail	12.1	0.61	2.01	5.2	0.3	0.6
10. Zn 1st Cl. Scav. Conc.	58.6	2.96	1.50	2.75	1.1	1.6
11. Zn 1st Cl. Scav. Tail	127.2	6.42	0.48	0.62	0.8	0.8
12. Zn Scav. Tail	144.6	73.02	0.27	0.26	5.0	3.7
Head Calc.	1980.4	100.00	3.95	5.17	100.0	100.0

Combined Products

Products 1+2	6.49	52.4	10.1	86.0	12.7
Products 1-3	7.01	49.4	10.1	87.7	13.7
Products 1-4	7.83	44.7	10.1	88.6	15.3
Products 1-5	8.33	42.2	10.4	89.0	16.8
Products 6+7	8.20	1.70	47.6	3.5	75.5
Products 6-8	8.66	1.74	45.8	3.8	76.6
Products 6-9	9.27	1.76	43.1	4.1	77.2
Products 6-10	12.33	1.70	33.3	5.3	78.8
Products 6-11	19.65	1.28	22.1	6.0	79.6
Products 6-12	91.67	0.48	4.70	11.0	83.2
Products 11+12	79.44	0.29	0.29	5.8	4.4

Test No. 79

Purpose: To investigate the effect of LS8 on Composite 3 Pb flotation.

Procedure: Standard conditions of Test 40, but replace NaCN with depressant LS8 - reduce addition by 50 %.

Feed: 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	LS8	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	75	-	-	-	40	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.5
Pb Scav	-	-	5	10	-	-	1	3	-
	-	-	2.5	10	-	-	1	3	-
Pb Re grind	-	25	20	-	-	20	-	-	-
Pb 1st Cl.	-	10	-	5	100	-	1	4	-
	-	-	1.0	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	25	-	2.5	50	-	1	4	9.5
	-	-	4	5	-	-	1	4	-
Pb 3rd Cl.	-	12.5	-	5	50	-	1	3	-
	-	-	2	5	-	-	1	3	-
Pb 4th Cl.	-	12.5	-	5	50	-	1	3	9.5
	-	-	2	2.5	-	-	1	3	-

Test No. 79

Product	g	Weight %	Assay %		% Distribution	
			Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	28.3	1.42	66.2	3.97	24.3	1.1
2. Pb 4th Cl. Tail	24.2	1.21	59.3	6.26	18.6	1.4
3. Pb 3rd Cl. Tail	21.9	1.10	48.7	8.17	13.8	1.7
4. Pb 2nd Cl. Tail	25.2	1.26	19.4	12	6.3	2.8
5. Pb 1st Cl. Scav. Conc.	5.5	0.28	12.3	13.1	9	0.7
6. Pb 1st Cl. Scav. Tail	76	3.81	3.26	12	3.2	8.6
7. Pb Scav. Tail	1814.4	90.92	1.4	4.92	32.9	83.8
Head Calc.	1995.5	100.00	3.87	5.34	100.0	100.0

Combined Products

Products 1+2	9.63	63.02	5.03	42.9	2.5
Products 1-3	3.73	58.80	5.95	56.7	4.2
Products 1-4	4.99	48.63	7.48	63.0	7.0
Products 1-5	5.27	46.92	7.78	63.9	7.7
Products 1-6	9.08	28.60	9.55	67.1	16.2
Products 6+7	94.73	1.47	5.20	36.1	92.3

Test No. 83

Purpose: To run a locked cycle test on Composite 3 using the Plant flowsheet.

Procedure: Similar to Test 41.

Feed: 6 x 2000 g of minus 10 mesh Composite 3.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

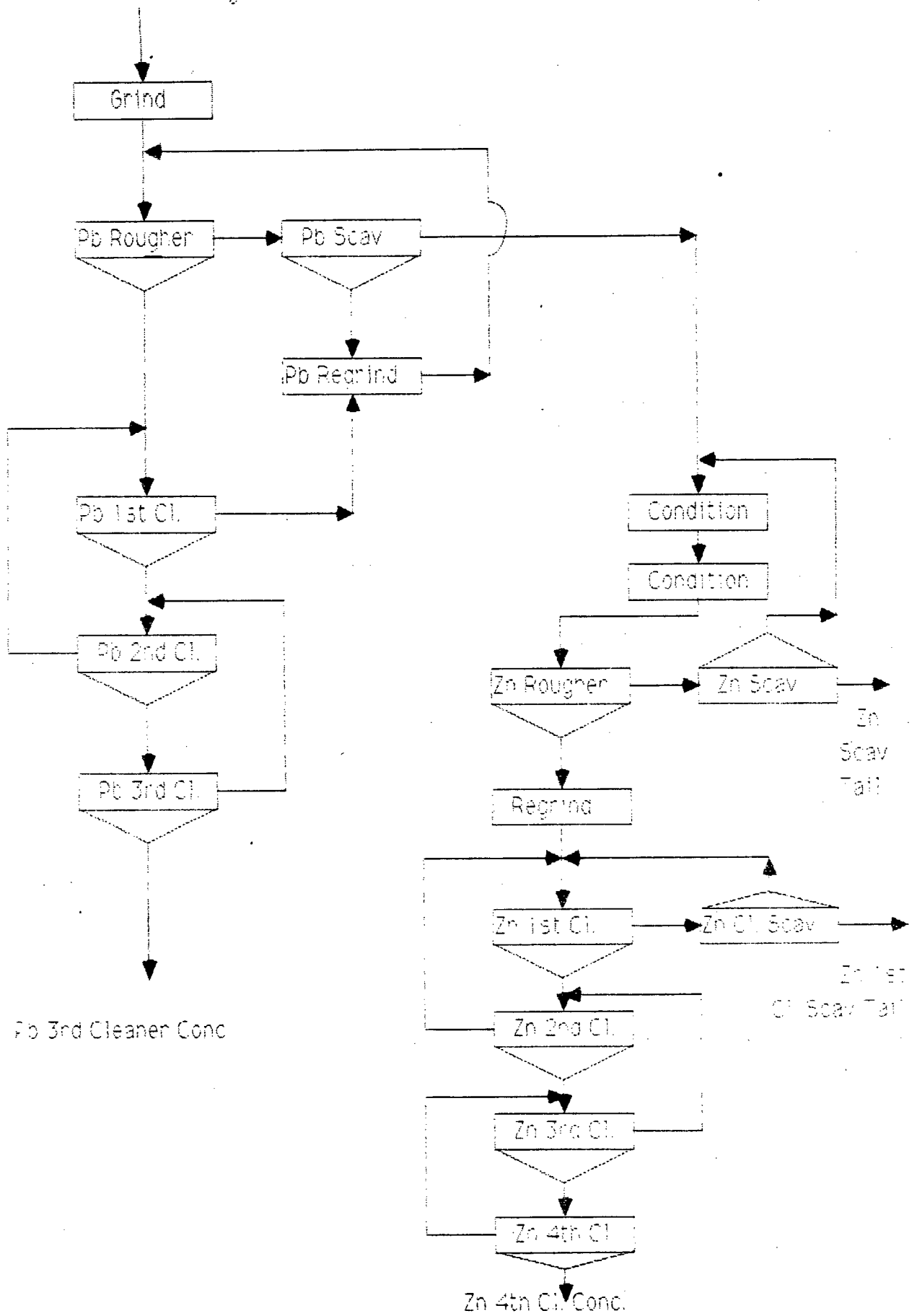
	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	40	-	-	-
Pb Rougher	-	-	5	10	-	-	1	4	9.5
Pb Scav	-	-	5	10	-	-	1	3	-
	-	-	-	5	-	-	1	3	-
Pb 1st Cl.	-	50	2	-	100	-	1	3	9.5
Pb Re grind (Pb Scav + Pb 1st Cl Tail)	-	-	-	-	-	20	-	-	-
Pb 2nd Cl.	-	50	-	-	50	-	1	1.5	9.5
Pb 3rd Cl.	-	25	-	-	50	-	1	1	-

Feed: Pb Scavenger Tailing

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	1250	-	-	-	-	5	-	-
	-	800	-	-	-	5	-	-
Zn Rougher	-	-	20	7.5	-	2	4	-
Zn Scavenger	-	-	10	2.5	-	1	3	-
Zn Re grind (PM)	500	10	-	-	10	-	-	-
H.S. Cond.	-	-	10	2.5	-	-	-	-
Zn 1st Cleaner	-	-	-	-	-	1	5	-
Zn 1st Cl Scav	-	-	5	5	-	1	3	-
Zn 2nd Cleaner	250	-	-	-	-	1	4	-
Zn 3rd Cleaner	250	-	-	-	-	1	3	-
Zn 4th Cleaner	250	-	-	-	-	1	2	-

6 * 2Kg. -10 mesh Comp. No 3



34588-83 Metallurgical Results

Product	g	Weight %	Assays % g/t					% Distribution				
			Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Cl Conc A	140.2	1.2	45.1	12	10.9	5.47	576.	12.6	2.7	0.5	7.8	11.9
2. Pb Cl Conc B	146.1	1.2	42.9	11.5	11.3	6.70	530.	12.6	2.7	0.5	9.9	11.4
3. Pb Cl Conc C	99.7	0.8	46.3	10.8	9.68	7.27	565.	9.4	1.7	0.3	7.3	8.3
4. Pb Cl Conc D	111.0	0.9	45.9	11.6	9.25	8.20	574.	10.3	2.0	0.3	9.2	9.4
5. Pb Cl Conc E	99.7	0.8	49	11.6	8.41	9.20	602.	9.3	1.8	0.3	9.3	8.9
6. Pb Cl Conc F	97.7	0.8	49.3	11.8	8.33	8.40	605.	9.7	1.9	0.3	8.3	8.7
7. 3rd Cl Tail F	83.0	0.7	44.3	10.5	11.5	2.43	485.	7.4	1.4	0.3	2.0	5.9
8. 2nd Cl Tail F	139.6	1.2	36.9	9.5	15.4	1.24	382.	10.4	2.1	0.7	1.8	7.9
9. 1st Cl Tail F	171.0	1.4	19.9	8.37	20.8	0.90	277.	6.9	2.4	1.2	1.6	7.0
10. Scav Conc F	175.3	1.5	8.45	11	28.7	1.28	136.	3.0	3.1	1.7	2.3	3.6
11. Zn CL Conc A	57.5	0.5	0.42	57.3	6.05	0.48	31.8	0.0	5.2	0.1	0.3	0.3
12. Zn CL Conc B	120.6	1.0	0.59	55.8	6.48	0.35	34.1	0.1	10.7	0.3	0.4	0.6
13. Zn CL Conc C	144.4	1.2	0.74	55.1	7.21	0.43	53.4	0.2	12.6	0.3	0.6	1.1
14. Zn CL Conc D	115.2	1.0	0.59	56.3	6.58	0.24	40.6	0.1	10.3	0.2	0.3	0.7
15. Zn CL Conc E	106.3	0.9	0.6	55.6	7.32	0.22	40.2	0.1	9.4	0.3	0.2	0.6
16. Zn CL Conc F	142.3	1.2	0.59	54.8	6.91	0.23	41.6	0.2	12.4	0.3	0.3	0.9
17. Zn 4th Cl Tail F	43.0	0.4	1.31	39.5	12.2	0.37	67.2	0.1	2.7	0.2	0.2	0.4
18. 3rd Cl Tail F	76.3	0.6	1.43	29.2	16.8	0.45	64.4	0.2	3.5	0.4	0.3	0.7
19. 2nd Cl Tail F	149.4	1.2	1.35	17.3	21.6	0.55	55.2	0.4	4.1	1.1	0.8	1.2
20. 1st Cl Scav Conc F	61.0	0.5	1.64	10.9	29.4	0.87	53.3	0.2	1.1	0.6	0.5	0.5
21. Scav. Conc. F	221.3	1.8	1.39	4.16	31.7	0.49	30.5	0.6	1.1	5.2	18.8	0.3
22. 1st Cl Scav Tail A	53.3	0.4	0.26	1.28	23.3	0.22	10.5	0.0	0.1	0.4	0.1	0.1
23. 1st Cl Scav Tail B	68.6	0.6	0.3	1.15	21.6	0.19	20.1	0.0	0.1	0.5	0.1	0.2
24. 1st Cl Scav Tail C	113.1	0.9	0.41	1.39	28.1	0.21	11.2	0.1	0.2	1.0	0.2	0.2
25. 1st Cl Scav Tail D	111.3	0.9	0.5	1.54	24.5	0.23	14.2	0.1	0.3	0.3	0.3	0.2
26. 1st Cl Scav Tail E	112.6	0.9	0.69	2.36	26.4	0.27	19	0.2	0.4	1.0	0.3	0.3
27. 1st Cl Scav Tail F	82.6	0.7	0.65	1.35	25.4	0.13	20.2	0.1	0.2	0.7	0.1	0.2
28. Zn Ro Scav Tail A	1342.7	11.2	0.16	0.26	26.5	0.17	6.2	0.4	0.6	11.7	2.3	1.2
29. Zn Ro Scav Tail B	1501.0	12.5	0.26	0.25	28.0	0.20	6.3	0.3	0.6	13.8	3.0	1.9
30. Zn Ro Scav Tail C	1496.4	12.5	0.29	0.29	27.4	0.19	9.8	0.9	0.7	13.5	2.9	1.6
31. Zn Ro Scav Tail D	1528.7	12.8	0.27	0.24	27.3	0.17	8	0.8	0.6	13.7	2.6	1.4
32. Zn Ro Scav Tail E	1557.7	13.0	0.31	0.28	27.8	0.19	4.5	1.0	0.7	14.3	3.0	1.0
33. Zn Ro Scav Tail F	1513.0	12.6	0.28	0.26	28.7	0.17	4	0.9	0.6	13.3	2.6	0.3
Head(calc)	11981.6	100.0	4.14	5.25	25.3	0.82	58.5	100.0	100.0	100.0	100.0	100.0

Combined Products

Comb Pb Conc. 1 to 6	5.8	46.1	11.57	9.32	7.37	572	94.6	12.6	2.2	51.8	58.7
Comb Pb Cl Tails 7 to 10	4.7	24.1	9.3	20.6	1.32	290	27.7	9.0	3.9	7.6	24.4
Comb Zn Cl Conc. 11 to 16	5.7	0.63	55.7	6.61	0.31	41.6	0.9	60.7	1.5	2.2	4.2
Comb Zn Cl Tails 17 to 21	4.6	1.41	14.3	41.1	3.71	38.3	1.3	12.5	7.5	20.7	3.1
Comb Zn Cl Scav Tails 22 to 27	4.5	0.43	1.57	23.3	0.21	15.9	0.5	1.4	4.5	1.2	1.3
Comb Zn Ro Scav Tails 28 to 33	74.6	0.26	0.26	37.3	0.18	6.3	4.3	3.7	30.4	16.5	8.4

Projected Results Cycles E & F

Pb Cleaner Conc	7.8	49.1	11.70	8.37	6.80	603	92.3	17.3	2.7	80.0	86.4
Zn Cleaner Conc	7.3	0.65	55.2	7.33	0.23	41.0	1.1	76.7	2.1	1.9	5.5
Zn Scav. Tail	84.9	0.32	0.37	27.2	0.13	5.2	6.5	6.0	95.2	19.1	8.1
Head(calc)	100.0	4.14	5.26	24.2	0.86	54.3	100.0	100.0	100.0	100.0	100.0

APPENDIX NO. 2

Details of Tests on Composite 1A

Test No. 48

Purpose: A series of rougher flotation tests on Composite 1A ore to evaluate the effect of grinding size on Pb and Zn rougher flotation.

Procedure: As for Test 41. Increased Na₂CO₃ to maintain pH 9.5 in the Pb rougher.

Feed: 2000 g of minus 10 mesh Composite 1A.

Grind: 30 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2500	150	-	-	-	-	-	30	-	-	-
Pb Rougher	1000	-	5	10	-	-	-	-	1	4	8.0-9.4
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	-	10	-	-	-	-	1	3	-
				DF 1012							
Zn Conditioning 1	-	-	-	-	1500	-	-	-	5	-	11.5
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	-	-	-	10	-	1	3	-

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 150 mesh	1.5	1.5	98.5
200	4.9	6.4	93.6
270	12.0	18.4	81.6
27.8 µm	28.0	46.4	53.6
21.6	11.2	57.6	42.4
15.1	11.3	68.9	31.1
10.4	8.3	77.2	22.8
8.0	4.8	82.0	18.0
- 8.0	18.0	100.0	-
Total	100.0	-	-

S.G. 4.11

Metallurgical Balance

Test No. 48

Product	Weight		Assay, % g/t						% Distribution					
	g	%	Cu	Pb	Zn	Fe	Au	Ag	Cu	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	115.5	5.81	1.91	33.8	12.90	13.8	5.08	379.	41.7	51.0	18.2	3.0	48.3	48.9
2. Pb Scav. Conc.	108.7	5.47	0.96	14.7	21.4	20.2	1.74	182.	19.7	20.9	28.5	4.1	15.6	22.1
3. Zn Ro. Conc.	190.2	9.57	0.33	4.20	15.2	28.7	0.47	69.9	11.9	10.4	35.4	10.3	7.4	14.8
4. Zn Scav. Conc.	74.8	3.76	0.33	3.90	1.93	37.1	0.67	57.5	4.7	3.8	1.8	5.2	4.1	4.8
5. Zn Scav. Tail.	1499.2	75.40	0.078	0.710	0.88	27.3	0.20	5.6	22.1	13.9	16.1	77.3	24.7	9.4
Head Calc.	1988.4	100.00	0.27	3.85	4.11	26.6	0.61	45.0	100.0	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		11.28	1.45	24.54	17.02	16.90	3.46	283.49	61.4	71.9	46.7	7.2	63.8	71.0
Products 3+4		13.33	0.33	4.12	11.45	31.07	0.53	66.40	16.5	14.2	37.1	15.5	11.5	19.6

Test No. 49

Purpose: Repeat Test 48 but increase the Primary grinding time to 40 minutes.

Procedure: As for Test 48.

Feed: 2000 g of minus 10 mesh Composite 1A.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	3500	150	-	-	-	-	-	40	-	-	-
Pb Rougher	500	-	5	15	-	-	-	-	1	4	8.9-9.4
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	-	10	-	-	-	-	1	3	-
				DF							
				1012							
Zn Conditioning 1	-	-	-	-	1500	-	-	-	5	-	11.4
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	-	-	-	10	-	1	3	-

Test No. 49 - Continued

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 200 mesh	3.3	3.3	96.7
270	7.2	10.5	89.5
27.8 μm	25.9	36.4	63.6
21.6	12.5	48.9	51.1
15.1	13.5	62.4	37.6
10.4	9.8	72.2	27.8
8.0	4.7	76.9	23.1
- 8.0	23.1	100.0	-
Total	100.0	-	-

S.G. 4.14

Size Analysis : Pb Ro + Scav Conc Combined (No Re grind)

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 270 mesh	2.3	2.3	97.7
27.8 μm	15.1	17.4	82.6
21.6	10.6	28.0	72.0
15.1	15.7	43.7	56.3
10.3	12.8	56.5	43.5
8.0	6.9	63.4	36.6
- 8.0	36.6	100.0	-
Total	100.0	-	-

S.G. 4.75

Metallurgical Balance

Test No. 49

Product	Weight		Assay, % g/t						% Distribution					
	g	%	Cu	Pb	Zn	Fe	Au	Ag	Cu	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	157	7.95	1.86	27.9	13.80	15.9	3.85	333.	55.3	57.1	26.8	4.7	41.0	52.7
2. Pb Scav. Conc.	141	7.14	0.75	12.1	19.9	23	2.81	157.	20.0	22.2	34.7	6.1	26.9	22.3
3. Zn Ro. Conc.	154.1	7.80	0.26	2.87	11.6	30.7	0.60	49.4	7.6	5.8	22.1	8.9	6.3	7.7
4. Zn Scav. Conc.	60.7	3.07	0.26	2.25	1.50	40.1	0.71	41.8	3.0	1.8	1.1	4.6	2.9	2.6
5. Zn Scav. Tail.	1462.6	74.04	0.051	0.690	0.85	27.7	0.23	10.0	14.1	13.2	15.4	75.8	22.8	14.7
Head Calc.	1975.4	100.00	0.27	3.89	4.10	27.0	0.75	50.2	100.0	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		15.09	1.33	20.42	16.69	19.26	3.36	249.72	75.3	79.3	61.4	10.7	68.0	75.0
Products 3+4		10.87	0.26	2.69	8.75	33.36	0.63	47.25	10.6	7.5	23.2	13.4	9.2	10.2

Test No. 50

Purpose: Repeat Test 48, but increase the Primary grinding time to 50 minutes.

Procedure: As for Test 48.

Feed: 2000 g of minus 10 mesh Composite 1A.

Grind: 50 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	4000	150	-	-	-	-	-	50	-	-	-
Pb Rougher	500	-	5	15	-	-	-	-	1	4	9.1-9.5
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
				5	-	-	-	-	1	3	-
				DF 1012							
Zn Conditioning 1	-	-	-	-	2000	-	-	-	5	-	11.5
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	-	-	-	10	-	1	3	-

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 200 mesh	1.9	1.9	98.1
270	6.1	8.0	92.0
27.8 µm	26.8	34.8	65.2
21.6	12.8	47.6	52.4
15.1	13.7	61.3	38.7
10.4	10.3	71.6	28.4
8.0	5.8	77.4	22.6
- 8.0	22.6	100.0	-
Total	100.0	-	-

S.G. 4.13

Metallurgical Balance

Test No. 50

Product	Weight		Assay, %, g/t						% Distribution					
	g	%	Cu	Pb	Zn	Fe	Au	Ag	Cu	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	229.1	11.52	1.6	24.9	13.40	16.3	4.46	332.	68.5	74.3	42.9	7.7	71.1	67.8
2. Pb Scav. Conc.	85.5	4.30	0.46	6.54	17.8	23.5	0.81	138.	7.3	7.3	21.2	4.1	4.8	10.5
3. Zn Ro. Conc.	107.6	5.41	0.22	2.59	12.7	26.5	0.36	85.5	4.4	3.6	19.1	5.9	2.7	8.2
4. Zn Scav. Conc.	31.8	1.60	0.29	2.83	2.17	34.2	0.50	78.6	1.7	1.2	1.0	2.2	1.1	2.2
5. Zn Scav. Tail.	1534.3	77.17	0.063	0.680	0.74	25.4	0.19	8.2	18.1	13.6	15.9	80.1	20.3	11.2
Head Calc.	1988.3	100.00	0.27	3.86	3.60	24.5	0.72	56.4	100.0	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		15.82	1.29	19.91	14.60	18.26	3.47	279.28	75.8	81.6	64.1	11.8	75.9	78.3
Products 3+4		7.01	0.24	2.64	10.30	28.26	0.39	83.93	6.1	4.8	20.0	8.1	3.8	10.4

Test No. 52

Purpose: Repeat Test 48, but increase the Primary grinding time to 60 minutes.

Procedure: As for Test 48.

Feed: 2000 g of minus 10 mesh Composite 1A.

Grind: 60 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	5000	150	-	-	-	-	-	60	-	-	-
Pb Rougher	-	-	5	15	-	-	-	-	1	4	9.6
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	-	5	-	-	-	-	1	3	-
				DF 1012							
Zn Conditioning 1	-	-	-	-	2000	-	-	-	5	-	11.5
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	-	-	-	10	-	1	3	-

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 200 mesh	0.9	0.9	99.1
270	2.7	3.6	96.4
400	9.4	13.0	87.0
28.1 µm	11.4	24.4	75.6
21.8	11.4	35.8	64.2
15.2	15.9	51.7	48.3
10.4	12.8	64.5	35.5
8.1	7.4	71.9	28.1
- 8.1	28.1	100.0	-
Total	100.0	-	-

S.G. 4.09

Metallurgical Balance

Test No. 52

Product	Weight		Assay, % g/t						% Distribution					
	g	%	Cu	Pb	Zn	Fe	Au	Ag	Cu	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	284.7	14.29	1.4	21.9	14.30	19.7	3.23	256.	72.5	78.4	48.6	10.3	62.7	72.8
2. Pb Scav. Conc.	74.4	3.73	0.36	4.52	17.9	26.3	2.44	88.9	4.9	4.2	15.9	3.6	12.4	6.6
3. Zn Ro. Conc.	91.9	4.61	0.22	2.10	16.2	27.3	0.40	44.6	3.7	2.4	17.8	4.6	2.5	4.1
4. Zn Scav. Conc.	48.8	2.45	0.24	2.27	2.60	34.8	0.61	44.6	2.1	1.4	1.5	3.1	2.0	2.2
5. Zn Scav. Tail.	1493	74.92	0.062	0.720	0.91	28.5	0.20	9.6	16.8	13.5	16.2	78.3	20.4	14.3
Head Calc.	1992.8	100.00	0.28	3.99	4.20	27.3	0.74	50.2	100.0	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		18.02	1.18	18.30	15.05	21.07	3.07	221.38	77.4	82.7	64.5	13.9	75.1	79.4
Products 3+4		7.06	0.23	2.16	11.48	29.90	0.47	44.60	5.8	3.8	19.3	7.7	4.5	6.3

Test No. 53

Purpose: Repeat Test 48, but increase the Primary grinding time to 70 minutes.

Procedure: As for Test 48.

Feed: 2000 g of minus 10 mesh Composite 1A.

Grind: 70 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	5000	150	-	-	-	-	-	60	-	-	-
Pb Rougher	-	-	5	15	-	-	-	-	1	4	9.5
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	-	5	-	-	-	-	1	3	-
				DF 1012							
Zn Conditioning 1	-	-	-	-	2000	-	-	-	5	-	11.5
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	3	-
Zn Scavenger	-	-	-	-	-	-	10	-	1	3	-

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 200 mesh	0.3	0.3	99.7
270	2.5	2.8	97.2
28.1 µm	18.7	21.5	78.5
21.8	12.7	34.2	65.8
15.2	16.2	50.4	49.6
10.4	13.1	63.5	36.5
8.1	7.4	70.9	29.1
- 8.1	29.1	100.0	-
Total	100.0	-	-

S.G. 4.11

Metallurgical Balance

Test No. 53

Product	Weight		Assay, % g/t						% Distribution					
	g	%	Cu	Pb	Zn	Fe	Au	Ag	Cu	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	255.7	12.85	1.53	23.6	15.70	17.2	3.25	286.	73.6	77.4	49.2	8.2	62.3	70.6
2. Pb Scav. Conc.	83.9	4.22	0.37	5.09	16.1	27.6	1.17	86.8	5.8	5.5	16.6	4.3	7.4	7.0
3. Zn Ro. Conc.	87.7	4.41	0.2	2.03	15.9	26.2	0.91	47.2	3.3	2.3	17.1	4.3	6.0	4.0
4. Zn Scav. Conc.	44.5	2.24	0.22	2.42	2.48	33.7	0.47	45.5	1.8	1.4	1.4	2.8	1.6	2.0
5. Zn Scav. Tail.	1517.7	76.29	0.054	0.690	0.85	28.3	0.20	11.2	15.4	13.4	15.8	80.3	22.8	16.4
Head Calc.	1989.5	100.00	0.27	3.92	4.10	26.9	0.67	52.1	100.0	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		17.07	1.24	19.03	15.80	19.77	2.74	236.79	79.4	82.9	65.8	12.6	69.7	77.6
Products 3+4		6.64	0.21	2.16	11.38	28.72	0.76	46.63	5.1	3.7	18.4	7.1	7.6	6.0

Test No. 72

Purpose: Preliminary cleaning test on Composite 1A ore using the rougher flotation conditions of Test 52.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 1A.

Grind: 60 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	5000	150	-	-	-	60	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.6
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	-	10	-	-	1	3	-
Pb Re grind	-	75	20	-	-	20	-	-	-
Pb 1st Cl.	-	20	-	5	100	-	1	4	9.7
	-	-	1.0	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	2.5	50	-	1	4	9.5
	-	-	4.0	2.5	-	-	1	4	-
Pb 3rd Cl.	-	25	-	5	50	-	1	4	9.5
	-	-	2.0	5	-	-	1	3	-
Pb 4th Cl.	-	25	-	5	50	-	1	3	-
	-	-	2.0	5	-	-	1	3	-

Feed: Pb Scavenger + Pb 1st Cleaner Scavenger Tailings

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	1250	-	-	-	-	5	-	-
	-	800	-	-	-	5	-	11.7
Zn Rougher	-	-	30	10	-	2	4	-
	-	-	10	5	-	1	3	-
Zn Re grind (PM)	1000	100	-	-	30	-	-	-
H.S. Cond.	-	-	20	-	-	10	-	-
Zn 1st Cleaner	-	-	-	5	-	1	4	12.0
Zn 1st Cl Scav	-	-	10	5	-	1	2	-
Zn 2nd Cleaner	500	-	-	-	-	1	4	12.3
Zn 3rd Cleaner	500	-	-	-	-	1	3	12.3
Zn 4th Cleaner	500	-	-	-	-	1	2	-

Metallurgical Balance

Test No. 72

Product	Weight		Assays, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	71.6	3.61	44.0	14.2	44.0	13.2
2. Pb 4th Cl. Tail	37.2	1.88	35.0	16.5	18.2	8.0
3. Pb 3rd Cl. Tail	27.2	1.37	22.8	16.7	8.7	5.9
4. Pb 2nd Cl. Tail	32.0	1.61	9.55	14.5	4.3	6.0
5. Pb 1st Cl. Scav. Conc.	14.6	0.74	8.06	25.5	1.6	4.8
6. Zn Cleaner Conc.	47.5	2.40	1.22	53.0	0.8	32.8
7. Zn 4th Cl. Tail	11.9	0.60	2.36	36.3	0.4	5.6
8. Zn 3rd Cl. Tail	8	0.40	3.88	16.8	0.4	1.7
9. Zn 2nd Cl. Tail	17.9	0.90	4.08	6.2	1.0	1.4
10. Zn 1st Cl. Scav. Conc.	26.2	1.32	4.46	4.28	1.6	1.5
11. Zn 1st Cl. Scav. Tail	103.3	5.21	2.09	1.36	3.0	1.8
12. Zn Scav. Tail	1585.7	79.96	0.72	0.83	15.9	17.1
Head Calc.	1983.1	100.00	3.61	3.88	100.0	100.0

Combined Products

Products 1+2	5.49	40.9	15.0	62.2	21.2
Products 1-3	6.86	37.3	15.3	70.8	27.1
Products 1-4	8.47	32.0	15.2	75.1	33.2
Products 1-5	9.21	30.1	16.0	76.8	38.0
Products 6+7	3.00	1.45	49.7	1.2	38.4
Products 6-8	3.40	1.74	45.8	1.6	40.1
Products 6-9	4.30	2.23	37.5	2.7	41.6
Products 6-10	5.62	2.75	29.7	4.3	43.0
Products 6-11	10.83	2.43	16.1	7.3	44.9
Products 6-12	90.79	0.92	2.65	23.2	62.0
Products 11+12	85.17	0.80	0.86	19.0	19.0

Test No. 74

Purpose: Repeat Test 72, but replace NaCN with depressant LS8.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 1A.

Grind: 60 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	LS8	A317 3418A	MIBC	Na ₂ SiO ₃	Oxalic Acid	NaCN	Grind	Cond.	Froth	
Grind	5000	300	-	-	-	-	-	60	-	-	-
Aerate	-	-	5	15	-	-	-	-	10	-	-
Pb Rougher	-	-	-	-	-	-	-	-	1	4	9.3
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	5	10	-	-	-	-	1	3	-
Pb Regrind (RM)	-	-	-	-	-	-	-	20	-	-	-
H.S. Condition	-	-	-	-	-	900	500	-	20	-	7.5
Pb 1st Cleaner	-	-	5	10	-	-	-	-	1	3	-
	-	-	5	5	-	-	-	-	1	3	-
Pb 1st Cl. Scav.	-	-	5	5	-	-	-	-	1	3	-
Pb 2nd Cleaner	-	50	10	5	50	-	-	-	1	3	9.0
	-	-	10	5	-	-	-	-	1	3	-
	-	-	10	5	-	-	-	-	1	2	-
Pb 3rd Cleaner	-	-	-	-	50	-	-	-	1	3	8.9
	-	-	10	5	-	-	-	-	1	3	-
Pb 4th Cleaner	-	-	-	5	50	-	-	-	1	3	-
	-	-	10	-	-	-	-	-	1	2	-

Size Analysis : Combined Product - Pb Cleaner Feed (20 minute regrind)

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 29.0 µm	0.1	0.1	99.9
22.5	0.9	1.0	99.0
15.7	9.2	10.2	89.8
10.8	18.0	28.2	71.8
8.3	13.1	41.3	58.7
- 8.3	58.7	100.0	-
Total	100.0	-	-

S.G. 4.66

Test No. 74

Product	g	Weight %	Assay, %		% Distribution	
			Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	42	2.11	51.5	12.6	30.4	6.5
2. Pb 4th Cl. Tail	12.5	0.63	40.5	15.1	7.1	2.3
3. Pb 3rd Cl. Tail	19.2	0.96	33.1	14.8	8.9	3.5
4. Pb 2nd Cl. Tail	33.5	1.68	28.1	13.7	13.2	5.6
5. Pb 1st Cl. Scav. Conc.	22	1.10	20.9	20.6	6.5	5.6
6. Pb 1st Cl. Scav. Tail	170.6	8.56	5.61	14.1	13.4	29.5
7. Pb Scav. Tail	1693	84.96	0.86	2.27	20.5	47.1
Head Calc.	1992.8	100.00	3.57	4.10	100.0	100.0

Combined Products

Products 1+2	2.73	48.98	13.17	37.5	6.8
Products 1-3	3.70	44.84	13.60	46.4	12.3
Products 1-4	5.36	39.61	13.63	59.6	17.9
Products 1-5	6.48	36.42	14.82	66.1	23.5
Products 1-6	15.04	18.89	14.41	79.5	52.9
Products 6+7	93.52	1.29	3.35	33.9	76.5

Test No. 76

Purpose: Repeat Test 72, but replace NaCN with depressant DS20.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 1A.

Grind: 60 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	DS20	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	5000	200	-	-	-	60	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.4
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	5	10	-	-	1	3	-
Pb Regrind	-	75	20	-	-	20	-	-	-
Pb 1st Cl.	-	20	-	5	100	-	1	4	9.5
	-	-	2.5	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	2.5	50	-	1	3	9.5
	-	-	5	5	-	-	1	3	-
Pb 3rd Cl.	-	25	-	5	50	-	1	3	9.4
	-	-	5	5	-	-	1	3	-
Pb 4th Cl.	-	-	-	5	50	-	1	2	9.4
	-	-	5	5	-	-	1	2	-

Test No. 76

Product	g	Weight %	Assay, %		% Distribution	
			Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	60.6	3.06	41.6	15.6	34.3	11.8
2. Pb 4th Cl. Tail	24.9	1.26	29.3	17.3	9.9	5.4
3. Pb 3rd Cl. Tail	44.6	2.25	23	16.8	14.0	9.4
4. Pb 2nd Cl. Tail	79.7	4.03	15.1	14.5	16.4	14.5
5. Pb 1st Cl. Scav. Conc.	21.1	1.07	7.9	17.2	2.3	4.5
6. Pb 1st Cl. Scav. Tail	124.2	6.28	2.89	6.19	4.9	9.6
7. Pb Scav. Tail	1623.4	82.05	0.83	2.2	18.3	44.7
Head Calc.	1978.5	100.00	3.72	4.04	100.0	100.0

Combined Products

Products 1+2	4.32	38.02	16.10	44.2	17.2
Products 1-3	6.58	32.67	16.34	50.2	26.6
Products 1-4	10.60	26.12	15.64	74.5	41.1
Products 1-5	11.67	24.45	15.78	76.8	45.6
Products 1-6	17.95	16.91	12.43	81.7	55.3
Products 6+7	88.33	.98	2.48	23.2	54.4

Test No. 85

Purpose: A locked cycle test on Composite 1A ore, using conditions similar to Test 72.

Procedure: As shown below.

Feed: 6 x 2000 g of minus 10 mesh Composite 1A.

Grind: 60 minutes at 65% solids in a lab ball mill

Conditions:

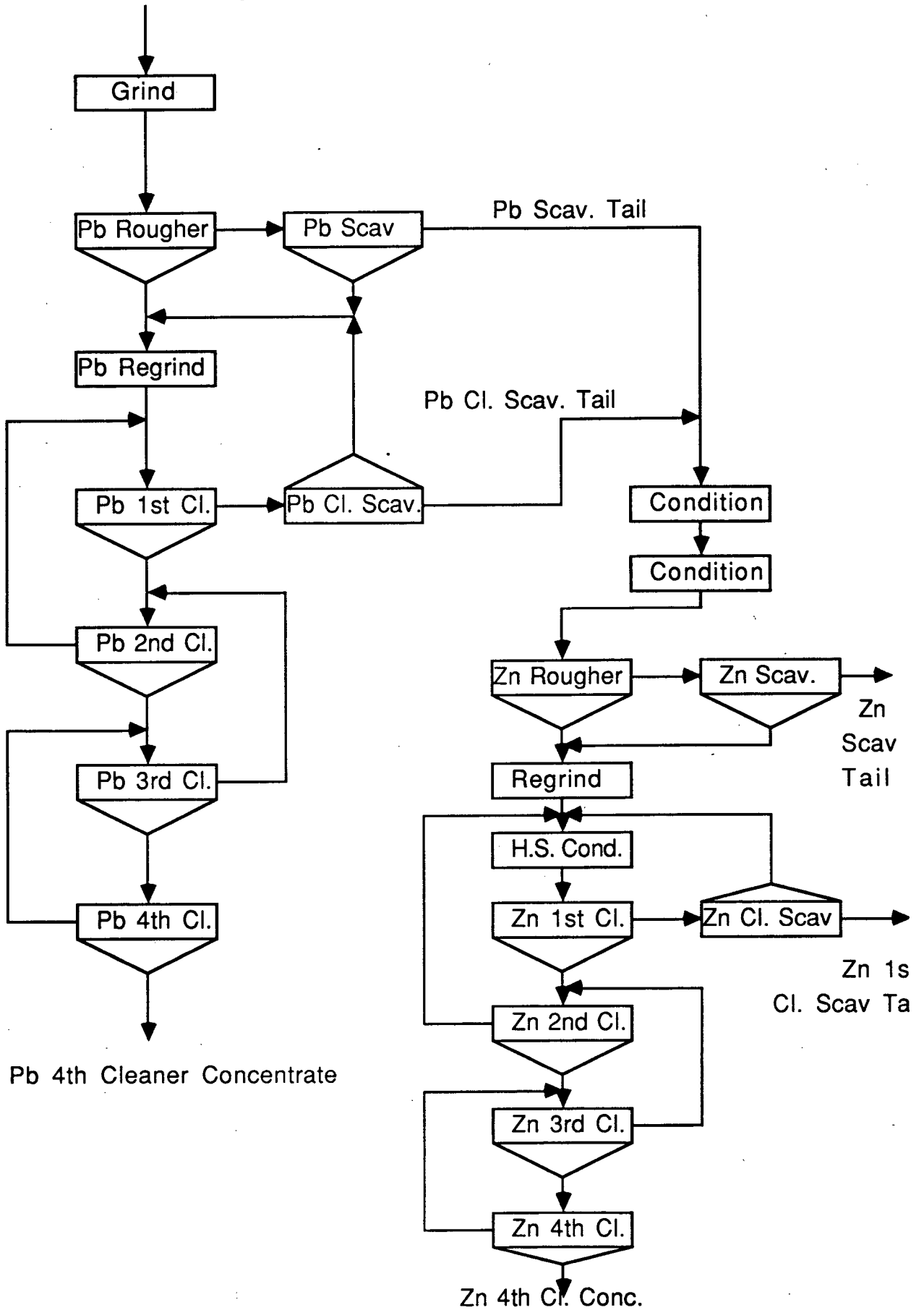
	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	5000	150	-	-	-	60	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.6
Pb Scav.	-	-	5	5	-	-	1	3	-
	-	-	5	5	-	-	1	3	-
Pb Regrind	-	75	20	-	-	20	-	-	-
Pb 1st Cl.	-	20	-	2.5	100	-	1	3	9.7
	-	-	2.5	2.5	-	-	1	3	-
Pb 1st Cl Scav	-	-	5	2.5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	-	50	-	1	3	9.5
	-	-	4.0	2.5	-	-	1	3	-
Pb 3rd Cl.	-	25	-	-	50	-	1	3	9.5
Pb 4th Cl.	-	25	-	-	50	-	1	1.5	9.5

Feed: Pb Rougher + Pb 1st Cleaner Scav Tailings.

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition 1	2500	-	-	-	-	5	-	11.6
Condition 2	-	800	-	-	-	5	-	11.7
Zn Rougher	-	-	30	10	-	2	4	-
	-	-	10	5	-	1	3	-
Zn Regrind (PM)	1000	100	-	-	30	-	-	-
H.S. Condition	-	-	20	-	-	10	-	-
Zn 1st Cleaner	-	-	-	5	-	1	4	12.0
Zn 1st Cl Scav	-	-	10	5	-	1	2	-
Zn 2nd Cleaner	500	-	-	-	-	1	4	12.3
Zn 3rd Cleaner	500	-	-	-	-	1	3	12.3
Zn 4th Cleaner	500	-	-	-	-	1	2	12.4

6 * 2Kg. -10 mesh Comp. No.1A



3458B-85 Metallurgical Results

Product	Weight		Assays,%gt							% Distribution			
	g	%	Cu	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Cl Conc A	48.7	0.4	2.93	48.7	10.3	9.67	13.5	523.	5.4	1.1	0.2	7.9	4.6
2. Pb Cl Conc B	89.6	0.8	2.37	43.9	12.1	12.2	10.3	453.	8.9	2.3	0.4	11.1	7.3
3. Pb Cl Conc C	83.6	0.7	2.42	45.2	11.5	11.2	10.1	470.	8.5	2.1	0.3	10.2	7.0
4. Pb Cl Conc D	85.5	0.7	3.06	43.7	13.7	11.1	9.88	477.	8.4	2.5	0.3	10.2	7.3
5. Pb Cl Conc E	84.0	0.7	2.54	42.5	12.7	12.0	9.90	460.	8.1	2.3	0.3	10.0	6.9
6. Pb Cl Conc F	82.9	0.7	2.55	43.7	12.5	13.2	10.4	436.	8.2	2.2	0.4	10.4	6.5
7. 4th Cl Tail F	57.9	0.5	-	34.3	14.8	15.3	2.28	350.	4.5	1.8	0.3	1.6	3.6
8. 3rd Cl Tail F	98.5	0.8	-	28.3	16.5	17.6	1.77	308.	6.3	3.5	0.6	2.1	5.4
9. 2nd Cl Tail F	96.9	0.8	-	18.0	16.6	21.3	1.17	225.	3.9	3.4	0.7	1.4	3.9
10. 1st Cl Scav Conc F	44.9	0.4	-	15.3	18.6	22.7	1.15	202.	1.5	1.8	0.3	0.6	1.6
11. Zn CL Conc A	67.2	0.6	-	1.70	52.4	9.66	0.55	54.9	0.3	7.5	0.2	0.4	0.7
12. Zn CL Conc B	60.3	0.5	-	4.12	49.4	10.8	0.75	82.7	0.6	6.4	0.2	0.5	0.9
13. Zn CL Conc C	82.2	0.7	-	2.44	52.0	8.77	0.55	73.1	0.5	9.1	0.2	0.5	1.1
14. Zn CL Conc D	77.8	0.7	-	2.79	52.0	8.81	0.91	73.0	0.5	8.7	0.2	0.9	1.0
15. Zn CL Conc E	83.2	0.7	-	2.73	52.8	8.59	0.46	71.1	0.5	9.4	0.2	0.5	1.1
16. Zn CL Conc F	91.3	0.8	-	3.09	52.1	8.80	0.52	76.3	0.6	10.2	0.3	0.6	1.2
17. Zn 4th Cl Tail F	20.6	0.2	-	11.7	24.7	17.9	1.07	181	0.5	1.1	0.1	0.3	0.7
18. 3rd Cl Tail F	47.8	0.4	-	12.5	11.9	22.6	0.99	171	1.3	1.2	0.3	0.6	1.5
19. 2nd Cl Tail F	76.5	0.6	-	10.5	6.92	26.2	0.99	142	1.8	1.1	0.6	0.9	1.9
20. 1st Cl Scav Conc F	70.3	0.6	-	8.67	4.67	29.4	1.54	117	1.4	0.7	0.7	1.3	1.5
21. 1st Cl Scav Tail A	193.5	1.6	-	1.95	1.23	26.6	0.59	29.5	0.9	0.5	1.7	1.4	1.0
22. 1st Cl Scav Tail B	105.1	0.9	-	1.72	1.22	26.5	0.35	28.9	0.4	0.3	0.9	0.4	0.5
23. 1st Cl Scav Tail C	237.7	2.0	-	3.00	1.36	27.8	0.36	46.0	1.6	0.7	2.1	1.0	2.0
24. 1st Cl Scav Tail D	182.3	1.5	-	4.04	1.71	26.2	0.43	60.6	1.7	0.7	1.5	0.9	2.0
25. 1st Cl Scav Tail E	294.5	2.5	-	3.39	1.51	27.6	0.37	49.0	2.3	1.0	2.6	1.3	2.6
26. 1st Cl Scav Tail F	291.3	2.5	-	4.30	1.65	27.4	0.41	61.0	2.8	1.0	2.6	1.4	3.2
27. Zn Ro Scav Tail A	1489.3	12.6	-	0.75	0.85	28.2	0.22	11.8	2.5	2.7	13.6	3.9	3.1
28. Zn Ro Scav Tail B	1506.7	12.7	-	0.84	0.87	26.8	0.20	13.2	2.9	2.8	13.1	3.6	3.6
29. Zn Ro Scav Tail C	1528.7	12.9	-	0.93	0.91	28.5	0.19	13.1	3.2	3.0	14.1	3.5	3.6
30. Zn Ro Scav Tail D	1591.7	13.4	-	0.98	0.92	27.3	0.20	16.5	3.5	3.1	14.0	3.8	4.7
31. Zn Ro Scav Tail E	1463.1	12.4	-	1.01	0.93	27.7	0.19	16.1	3.3	2.9	13.1	3.3	4.2
32. Zn Ro Scav Tail F	1507.3	12.7	-	0.97	0.90	28.5	0.19	15.1	3.3	2.9	13.9	3.4	4.1
Head (calc)	11840.9	100.0	-	3.74	3.95	26.1	0.70	47.3	100.0	100.0	100.0	100.0	100.0
Combined Products													
Comb Pb Conc.1 to 6	4.0	2.62	44.3	12.3	11.7	10.5	466	47.4	12.5	1.8	59.7	39.5	
Comb Pb Cl Tails 7to10	2.5	-	24.2	16.5	19.1	1.58	273	16.3	10.5	1.8	5.7	14.6	
Comb Zn Cl Conc. 11to16	3.9	-	2.79	51.9	9.14	0.61	72.0	2.9	51.3	1.4	3.4	5.9	
Comb Zn Cl Tails 17to20	1.8	-	10.5	8.99	25.7	1.18	144	5.1	4.1	1.8	3.0	5.5	
Comb Zn Cl Scav Tails 21to26	11.0	-	3.26	1.48	27.2	0.42	48.2	9.6	4.1	11.5	6.5	11.2	
Comb Zn Ro Sc Tails 27to32	76.7	-	0.91	0.90	27.8	0.20	14.3	18.7	17.4	81.8	21.7	23.2	
Projected Results Cycles E & F													
Pb Cleaner Conc	5.3		43.1	12.6	12.6	10.1	448	61.3	17.0	2.5	70.8	50.7	
Zn Cleaner Conc	4.5		2.92	52.4	8.70	0.49	73.8	3.5	59.6	1.5	2.9	7.0	
Zn Scav. Tail	90.2		1.46	1.02	28.0	0.22	22.1	35.2	23.4	96.0	26.3	42.3	
Head(calc)	100.0		3.74	3.95	26.3	0.76	47.1	100.0	100.0	100.0	100.0	100.0	100.0

APPENDIX NO. 3

Details of Tests on Composite 1B

Test No. 54

Purpose: To examine the effect of fineness of grind on Pb-Zn rougher flotation on Composite 1B ore.

Procedure: As for Test 42.

Feed: 2000 g of minus 10 mesh Composite 1B.

Grind: 30 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	-	-	30	-	-	-
Pb Rougher	-	-	5	15	-	-	-	-	1	4	9.6
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	-	5	-	-	-	-	1	3	-
				DF 1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.5
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	2.5	-	-	10	-	1	3	-

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 200 mesh	6.3	6.3	93.7
270	10.1	16.4	83.6
400	17.1	33.5	66.5
27.0 µm	12.9	46.4	53.6
20.9	10.7	57.1	42.9
14.6	12.1	69.2	30.8
10.0	8.8	78.0	22.0
7.8	4.5	82.5	17.5
- 7.8	17.5	100.0	-
Total	100.0	-	-

S.G. 4.32

Metallurgical Balance

Test No. 54

Product	Weight		Assay, % g/t						% Distribution					
	g	%	Cu	Pb	Zn	Fe	Au	Ag	Cu	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	188.5	9.49	1.13	42.5	10.70	11.6	4.86	487.	49.4	68.2	15.1	3.8	55.5	59.7
2. Pb Scav. Conc.	98.1	4.94	0.52	16.30	13.3	24.3	2.35	205.0	11.8	13.6	9.8	4.2	14.0	13.1
3. Zn Ro. Conc.	258.4	13.02	0.21	2.62	34.7	17.7	0.39	56.8	12.6	5.8	67.2	8.0	6.1	9.5
4. Zn Scav. Conc.	171.9	8.66	0.26	3.75	3.27	36	0.65	70.0	10.4	5.5	4.2	10.9	6.8	7.8
5. Zn Scav. Tail.	1268.4	63.89	0.054	0.640	0.39	32.8	0.23	11.9	15.9	6.9	3.7	73.1	17.7	9.8
Head Calc.	1985.3	100.00	0.22	5.92	6.72	28.7	0.83	77.4	100.0	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		14.44	0.92	33.53	11.59	15.95	4.00	390.47	61.2	81.8	24.9	8.0	69.5	72.8
Products 3+4		21.67	0.23	3.07	22.14	25.01	0.49	62.07	22.9	11.3	71.4	18.9	12.9	17.4

Test No. 55

Purpose: Repeat Test 54, but increase the grinding time to 40 minutes.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 1B.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	-	-	40	-	-	-
Pb Rougher	-	-	5	15	-	-	-	-	1	4	9.6
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	-	10	-	-	-	-	1	3	-
				DF 1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.5
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	2.5	-	-	10	-	1	3	-

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 200 mesh	3.4	3.4	96.6
270	7.5	10.9	89.1
400	12.7	23.6	76.4
27.0 µm	15.1	38.7	61.3
20.9	12.0	50.7	49.3
14.6	13.7	64.4	35.6
10.0	10.1	74.5	25.5
7.8	5.3	79.8	20.2
- 7.8	20.2	100.0	-
Total	100.0	-	-

S.G. 4.33

Test No. 55 - Continued

Size Analysis : Pb Ro + Scav Conc Combined (no regrind)

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 270 mesh	1.2	1.2	98.8
26.8 μ m	22.6	23.8	76.2
20.8	13.6	37.4	62.6
14.5	17.0	54.4	45.6
9.0	11.2	65.6	34.4
7.7	4.8	70.4	29.6
- 7.7	29.6	100.0	-
Total	100.0	-	-

Metallurgical Balance

Test No. 55

Product	Weight		Assay, % g/t						% Distribution					
	g	%	Cu	Pb	Zn	Fe	Au	Ag	Cu	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	185.2	9.28	1.19	44.2	10.20	10.6	5.03	527.	52.4	69.7	14.3	3.5	63.0	62.4
2. Pb Scav. Conc.	94.9	4.75	0.59	16.80	15.3	23.6	1.61	213.9	13.3	13.6	11.0	4.0	10.3	13.0
3. Zn Ro. Conc.	189.2	9.48	0.17	1.65	43.3	12.3	0.25	44.1	7.6	2.7	61.8	4.2	3.2	5.3
4. Zn Scav. Conc.	196.4	9.84	0.26	4.22	6.35	34.4	0.61	75.6	12.1	7.1	9.4	12.1	8.1	9.5
5. Zn Scav. Tail.	1330.1	66.64	0.046	0.620	0.35	32.0	0.17	11.5	14.5	7.0	3.5	76.2	15.3	9.8
Head Calc.	1995.8	100.00	0.21	5.89	6.64	28.0	0.74	78.4	100.0	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		14.03	0.99	34.92	11.93	15.00	3.87	420.92	65.7	83.3	25.2	7.5	73.4	75.4
Products 3+4		19.32	0.22	2.96	24.48	23.56	0.43	60.14	19.8	9.7	71.3	16.3	11.3	14.8

Test No. 56

Purpose: Repeat Test 54, but increase the grinding time to 50 minutes.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 1B.

Grind: 50 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	-	-	50	-	-	-
Pb Rougher	-	-	5	15	-	-	-	-	1	4	9.6
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	-	10	-	-	-	-	1	3	-
				DF 1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.5
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	2.5	-	-	10	-	1	3	-

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 200 mesh	1.5	1.5	98.5
270	5.8	7.3	92.7
400	11.3	18.6	81.4
26.9 μm	14.3	32.9	67.1
20.9	12.1	45.0	55.0
14.6	14.7	59.7	40.3
10.0	11.0	70.7	29.3
7.7	6.1	76.8	23.2
- 7.7	23.2	100.0	-
Total	100.0	-	-

S.G. 4.36

Metallurgical Balance

Test No. 56

Product	Weight		Assay, %, g/t						% Distribution					
	g	%	Cu	Pb	Zn	Fe	Au	Ag	Cu	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	201.9	10.11	1.2	43.3	9.87	11.5	4.80	502.	56.2	73.4	14.8	4.1	63.7	63.9
2. Pb Scav. Conc.	90.1	4.51	0.65	15.00	15.8	22.5	2.09	220.7	13.6	11.4	10.6	3.6	12.4	12.5
3. Zn Ro. Conc.	195.2	9.78	0.15	1.59	43.7	12.5	0.21	50.4	6.8	2.6	63.4	4.3	2.7	6.2
4. Zn Scav. Conc.	177.5	8.89	0.27	4.17	5.92	35	0.62	74.7	11.1	6.2	7.8	11.0	7.2	8.4
5. Zn Scav. Tail.	1332.1	66.71	0.04	0.570	0.35	32.6	0.16	10.8	12.4	6.4	3.5	77.0	14.0	9.1
Head Calc.	1996.8	100.00	0.22	5.96	6.74	28.3	0.76	79.5	100.0	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		14.62	1.03	34.57	11.70	14.89	3.96	415.20	69.7	84.8	25.4	7.7	76.1	76.4
Products 3+4		18.66	0.21	2.82	25.71	23.22	0.41	61.97	17.9	8.8	71.2	15.3	9.9	14.6

Test No. 63

Purpose: Preliminary cleaning test on Composite 1B ore using the rougher flotation conditions of Test 61.

Procedure: As for Test 61.

Feed: 2000 g of minus 10 mesh Composite 1B.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	200	-	-	-	40	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.7
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	2.5	10	-	-	1	3	-
Pb Re grind	-	75	20	-	-	20	-	-	-
Pb 1st Cl.	-	20	-	5	100	-	1	4	9.8
	-	-	1.0	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	2.5	50	-	1	4	-
	-	-	4.0	10	-	-	1	4	-
Pb 3rd Cl.	-	25	-	5	50	-	1	4	-
	-	-	2.0	5	-	-	1	3	-
Pb 4th Cl.	-	25	-	5	50	-	1	3	-
	-	-	2.0	5	-	-	1	3	-

Feed: Pb Scavenger + Pb 1st Cleaner Scavenger Tailings

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	2500	-	-	-	-	5	-	-
	-	800	-	-	-	5	-	12.2
Zn Rougher	-	-	20	5	-	2	4	-
	-	-	10	2.5	-	1	3	-
Zn Re grind (PM)	1000	-	-	-	20	-	-	-
H.S. Cond.	-	-	10	-	-	10	-	-
Zn 1st Cleaner	-	-	-	-	-	1	5	12.2
Zn 1st Cl Scav	-	-	10	5	-	1	3	-
Zn 2nd Cleaner	500	-	-	-	-	1	4	12.3
Zn 3rd Cleaner	500	-	-	-	-	1	3	12.3
Zn 4th Cleaner	500	-	-	-	-	1	2	-

Metallurgical Balance

Test No. 63

Product	Weight		Assays, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	127.5	6.46	61.0	8.31	70.7	8.2
2. Pb 4th Cl. Tail	24.5	1.24	44.2	8.64	9.9	1.6
3. Pb 3rd Cl. Tail	13.8	0.70	27.2	10.9	3.4	1.2
4. Pb 2nd Cl. Tail	28.2	1.43	9.32	12.6	2.4	2.8
5. Pb 1st Cl. Scav. Conc.	15.1	0.76	5.65	20.6	0.8	2.4
6. Zn Cleaner Conc.	98.4	4.98	0.86	56.6	0.8	43.3
7. Zn 4th Cl. Tail	13.5	0.68	1.25	45.4	0.2	4.8
8. Zn 3rd Cl. Tail	25.2	1.28	1.65	40.9	0.4	8.0
9. Zn 2nd Cl. Tail	47.3	2.40	1.93	28.7	0.8	10.6
10. Zn 1st Cl. Scav. Conc.	79.6	4.03	2.37	18.30	1.7	11.3
11. Zn 1st Cl. Scav. Tail	149.5	7.57	1.26	1.86	1.7	2.2
12. Zn Scav. Tail	1352.1	68.47	0.59	0.34	7.3	3.6
Head Calc.	1974.7	100.00	5.57	6.51	100.0	100.0

Combined Products

Products 1+2		7.70	58.3	8.4	80.6	9.9
Products 1-3		8.40	55.7	8.6	84.0	11.1
Products 1-4		9.82	49.0	9.2	86.4	13.8
Products 1-5		10.59	45.8	10.0	87.2	16.2
Products 6+7		5.67	0.91	55.2	.9	48.1
Products 6-8		6.94	1.04	52.6	1.3	56.1
Products 6-9		9.34	1.27	46.5	2.1	66.7
Products 6-10		13.37	1.60	38.0	3.8	78.0
Products 6-11		20.94	1.48	24.9	5.6	80.2
Products 6-12		89.41	0.80	6.10	12.8	83.8
Products 11+12		76.04	0.66	0.49	9.0	5.7

Test No. 64

Purpose: Preliminary Pb-Zn cleaning test on Composite 1B ore using the conditions of Test 62.

Procedure: As for Test 62, but increase the Zn rougher collector to 30 g/t and add 100 g/t CuSO₄ to the Zn regrind.

Feed: 2000 g of minus 10 mesh Composite 1B.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	200	-	-	-	40	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.7
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	2.5	10	-	-	1	3	-
Pb Regrind	-	75	20	-	-	30	-	-	-
Pb 1st Cl.	-	20	-	5	100	-	1	4	9.7
	-	-	1.0	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	2.5	50	-	1	4	9.8
	-	-	4.0	10	-	-	1	4	-
Pb 3rd Cl.	-	25	-	5	50	-	1	4	9.8
	-	-	2.0	5	-	-	1	3	-
Pb 4th Cl.	-	25	-	5	50	-	1	3	-
	-	-	2.0	5	-	-	1	3	-

Feed: Pb Scavenger + Pb 1st Cleaner Scavenger Tailings

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	2500	-	-	-	-	5	-	-
	-	800	-	-	-	5	-	12.2
Zn Rougher	-	-	30	10	-	2	4	-
	-	-	10	5	-	1	3	-
Zn Regrind (PM)	1000	100	-	-	30	-	-	-
H.S. Cond.	-	-	15	-	-	10	-	-
Zn 1st Cleaner	-	-	-	25	-	1	5	12.2
Zn 1st Cl Scav	-	-	10	5	-	1	3	-
Zn 2nd Cleaner	500	-	-	-	-	1	4	12.3
Zn 3rd Cleaner	500	-	-	-	-	1	3	12.3
Zn 4th Cleaner	500	-	-	-	-	1	2	-

Metallurgical Balance

Test No. 64

Product	Weight		Assays, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	104.1	5.24	68.9	6.11	63.3	5.0
2. Pb 4th Cl. Tail	27.7	1.39	53.0	7.24	13.0	1.6
3. Pb 3rd Cl. Tail	22.9	1.15	33.9	11.7	6.9	2.1
4. Pb 2nd Cl. Tail	26.7	1.34	10.1	15.3	2.4	3.2
5. Pb 1st Cl. Scav. Conc.	17	0.86	7.70	17.7	1.2	2.3
6. Zn Cleaner Conc.	122.9	6.19	0.89	56.8	1.0	54.4
7. Zn 4th Cl. Tail	18.6	0.94	1.32	48.7	0.2	7.1
8. Zn 3rd Cl. Tail	17.5	0.88	1.97	36.6	0.3	5.0
9. Zn 2nd Cl. Tail	20.8	1.05	2.49	16.6	0.5	2.7
10. Zn 1st Cl. Scav. Conc.	79.9	4.02	3.28	18.70	2.3	11.6
11. Zn 1st Cl. Scav. Tail	165.4	8.33	1.21	0.97	1.8	1.3
12. Zn Scav. Tail	1362.6	68.61	0.61	0.36	7.3	3.8
Head Calc.	1986.1	100.00	5.71	6.46	100.0	100.0

Combined Products

Products 1+2		6.64	65.6	6.3	76.3	6.5
Products 1-3		7.79	60.9	7.1	83.1	8.6
Products 1-4		9.13	53.4	8.3	85.5	11.8
Products 1-5		9.99	49.5	9.1	86.6	14.1
Products 6+7		7.12	0.95	55.7	1.2	61.5
Products 6-8		8.01	1.06	53.6	1.5	66.5
Products 6-9		9.05	1.22	49.3	1.9	69.1
Products 6-10		13.08	1.86	39.9	4.3	80.8
Products 6-11		21.40	1.61	24.8	6.0	82.0
Products 6-12		90.01	0.85	6.16	13.4	85.9
Products 11+12		76.93	0.67	0.43	9.1	5.1

Test No. 68

Purpose: A precycle test on Composite 1B ore using the flotation conditions of Test 64.

Procedure: As for Test 64.

Feed: 2000 g of minus 10 mesh Composite 1B.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	200	-	-	-	40	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.7
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	2.5	10	-	-	1	3	-
Pb Regrind	-	75	20	-	-	30	-	-	-
Pb 1st Cl.	-	20	-	5	100	-	1	4	-
	-	-	1.0	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	2.5	50	-	1	4	-
	-	-	4.0	10	-	-	1	4	-
Pb 3rd Cl.	-	25	-	5	50	-	1	4	-
	-	-	2.0	5	-	-	1	3	-
Pb 4th Cl.	-	25	-	5	50	-	1	3	-
	-	-	2.0	5	-	-	1	3	-

Feed: Pb Scavenger + Pb 1st Cleaner Scavenger Tailings

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	2500	-	-	-	-	5	-	-
	-	800	-	-	-	5	-	11.8
Zn Rougher	-	-	30	10	-	2	4	-
	-	-	10	5	-	1	3	-
Zn Regrind (PM)	1000	100	-	-	30	-	-	-
H.S. Cond.	-	-	20	-	-	10	-	-
Zn 1st Cleaner	-	-	-	5	-	1	6	11.7
Zn 1st Cl Scav	-	-	10	5	-	1	3	-
Zn 2nd Cleaner	500	-	-	-	-	1	4	-
Zn 3rd Cleaner	500	-	-	-	-	1	3	12.0
Zn 4th Cleaner	500	-	-	-	-	1	2	-

Metallurgical Balance

Test No. 68

Product	Weight		Assays, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner, Conc.	131	6.60	63.3	8.55	72.1	8.6
2. Pb 4th Cl. Tail	22.1	1.11	42.7	9.58	8.2	1.6
3. Pb 3rd Cl. Tail	18.7	0.94	24.9	12.3	4.0	1.8
4. Pb 2nd Cl. Tail	26.4	1.33	8.64	13.8	2.0	2.8
5. Pb 1st Cl. Scav. Conc.	15.2	0.77	6.50	27.1	0.9	3.2
6. Zn Cleaner Conc.	83.1	4.19	0.84	57.0	0.6	36.5
7. Zn 4th Cl. Tail	33	1.66	0.95	55	0.3	14.0
8. Zn 3rd Cl. Tail	27	1.36	1.41	44.4	0.3	9.2
9. Zn 2nd Cl. Tail	34.3	1.73	2.01	27.8	0.6	7.3
10. Zn 1st Cl. Scav. Conc.	59.6	3.00	2.56	18.60	1.3	8.5
11. Zn 1st Cl. Scav. Tail.	178.7	9.01	1.37	1.51	2.1	2.1
12. Zn Scav. Tail	1354.3	68.28	0.64	0.41	7.5	4.3
Head Calc.	1983.4	100.00	5.80	6.54	100.0	100.0

Combined Products

Products 1+2		7.72	60.3	8.7	80.3	10.3
Products 1-3		8.66	56.5	9.1	84.4	12.0
Products 1-4		9.99	50.1	9.7	86.3	14.8
Products 1-5		10.76	47.0	11.0	87.2	18.0
Products 6+7		5.85	0.87	56.4	.9	50.5
Products 6-8		7.21	0.97	54.2	1.2	59.7
Products 6-9		8.94	1.17	49.1	1.8	67.1
Products 6-10		11.95	1.52	41.4	3.1	75.6
Products 6-11		20.96	1.46	24.3	5.3	77.7
Products 6-12		89.24	0.83	6.01	12.8	82.0
Products 11+12		77.29	0.73	0.54	9.7	6.4

Test No. 70

Purpose: A precycle test on Composite 1B ore using the flotation conditions of Test 68.

Procedure: As for Test 68 - but increase the collector in the Zn high speed conditioner.

Feed: 2000 g of minus 10 mesh Composite 1B.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	200	-	-	-	40	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.5
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	2.5	10	-	-	1	3	-
Pb Re grind	-	75	20	-	-	30	-	-	-
Pb 1st Cl.	-	20	-	5	100	-	1	4	9.7
	-	-	1.0	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	2.5	50	-	1	4	9.8
	-	-	4.0	10	-	-	1	4	-
Pb 3rd Cl.	-	25	-	5	50	-	1	4	-
	-	-	2.0	5	-	-	1	3	-
Pb 4th Cl.	-	25	-	5	50	-	1	3	-
	-	-	2.0	5	-	-	1	3	-

Feed: Pb Scavenger + Pb 1st Cleaner Scavenger Tailings

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	2500	-	-	-	-	5	-	-
	-	800	-	-	-	5	-	12.0
Zn Rougher	-	-	30	10	-	2	4	-
	-	-	10	5	-	1	3	-
Zn Re grind (PM)	1000	100	-	-	30	-	-	-
H.S. Cond.	-	-	30	-	-	10	-	-
Zn 1st Cleaner	-	-	-	5	-	1	6	11.7
Zn 1st Cl Scav	-	-	10	5	-	1	3	-
Zn 2nd Cleaner	500	-	-	-	-	1	4	>12
Zn 3rd Cleaner	500	-	-	-	-	1	3	12.0
Zn 4th Cleaner	500	-	-	-	-	1	3	12.1

Test No. 70

Product	Weight		Assays, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner. Conc.	115.3	5.81	62.4	7.63	62.8	6.9
2. Pb 4th Cl. Tail	31.8	1.60	51.1	8.6	14.2	2.1
3. Pb 3rd Cl. Tail	27.9	1.40	32.8	10.9	8.0	2.4
4. Pb 2nd Cl. Tail	38.1	1.92	8.16	12.6	2.7	3.8
5. Pb 1st Cl. Scav. Conc.	19.6	0.99	4.26	15.9	0.7	2.4
6. Zn Cleaner Conc.	149.7	7.54	0.72	56.4	0.9	66.3
7. Zn 4th Cl. Tail	11	0.55	1.24	43.5	0.1	3.8
8. Zn 3rd Cl. Tail	11.2	0.56	2.00	34.7	0.2	3.1
9. Zn 2nd Cl. Tail	13.5	0.68	2.80	13.6	0.3	1.4
10. Zn 1st Cl. Scav. Conc.	20	1.01	3.09	10.30	0.5	1.6
11. Zn 1st Cl. Scav. Tail.	108.8	5.48	1.30	1.57	1.2	1.3
12. Zn Scav. Tail	1439.1	72.46	0.65	0.43	8.2	4.9
Head Calc.	1986	100.00	5.77	6.41	100.0	100.0

Combined Products

Products 1+2		7.41	60.0	7.8	77.0	9.1
Products 1-3		8.81	55.6	8.3	85.0	11.4
Products 1-4		10.73	47.1	9.1	87.7	15.2
Products 1-5		11.72	43.5	9.7	88.5	17.7
Products 6+7		8.09	0.76	55.5	1.1	70.0
Products 6-8		8.66	0.84	54.2	1.3	73.1
Products 6-9		9.34	0.98	51.2	1.6	74.5
Products 6-10		10.34	1.19	47.2	2.1	76.1
Products 6-11		15.82	1.22	31.4	3.4	77.5
Products 6-12		88.28	0.75	5.98	11.5	82.3
Products 11+12		77.94	0.70	0.51	9.4	6.2

Test No. 71

Purpose: A flotation locked cycle tes tusing the conditions of Test 70.

Procedure: As for Test 70.

Feed: 6 x 2000 g of minus 10 mesh Composite 1B.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

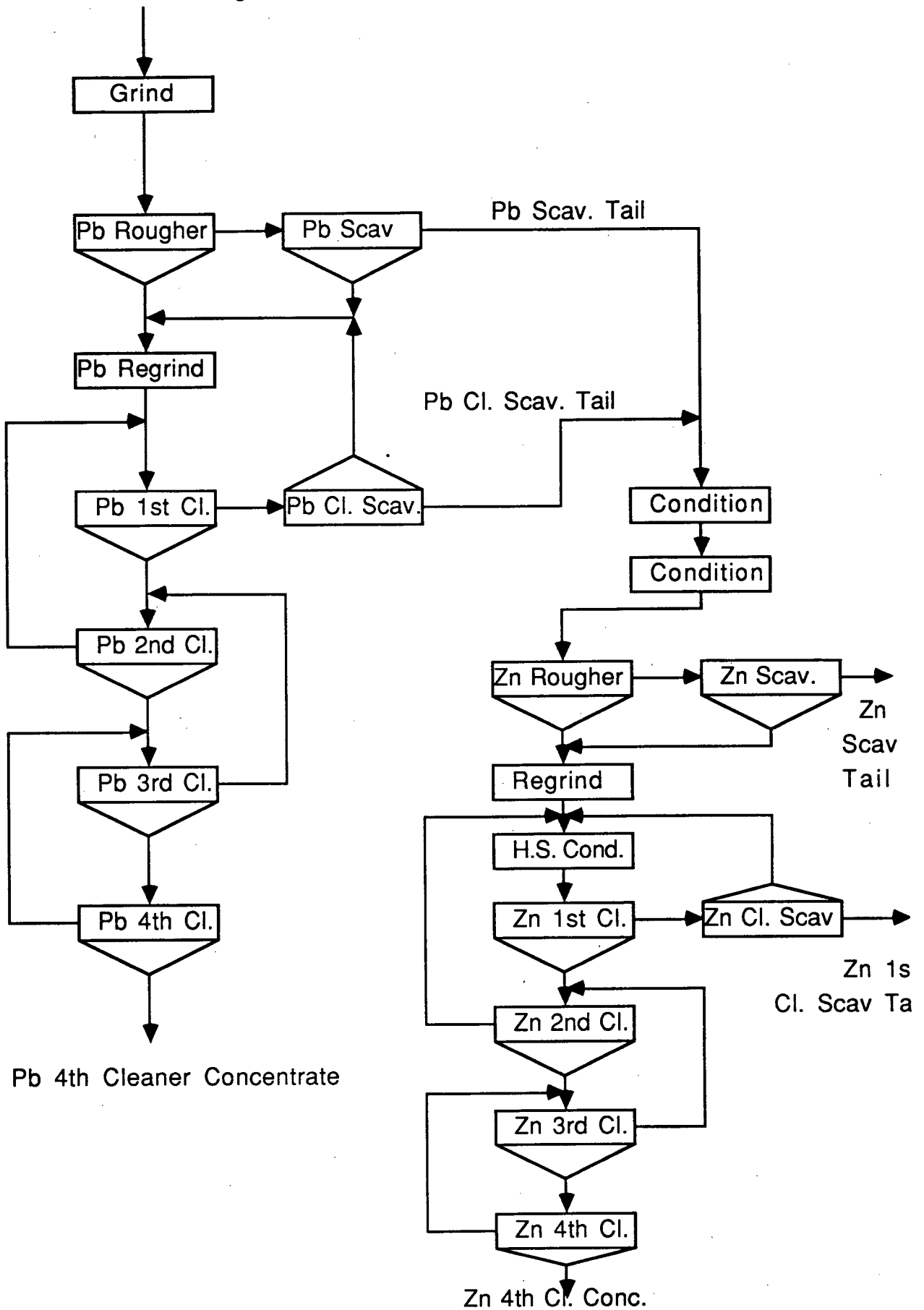
	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	200	-	-	-	40	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.7
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	2.5	10	-	-	1	3	-
Pb Re grind	-	75	20	-	-	30	-	-	-
Pb 1st Cl.	-	20	-	5	100	-	1	3	9.6
	-	-	1.0	5	-	-	1	3	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	-	50	-	1	3	-
	-	-	4.0	5	-	-	1	3	9.7
Pb 3rd Cl.	-	25	-	5	50	-	1	3	9.6
Pb 4th Cl.	-	25	-	2.5	50	-	1	3	9.6

Feed: Pb Scavenger + Pb 1st Cleaner Scavenger Tailings

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	2500	-	-	-	-	5	-	-
	-	800	-	-	-	5	-	11.8
Zn Rougher	-	-	30	10	-	2	4	-
	-	-	10	5	-	1	3	-
Zn Re grind (PM)	1000	100	-	-	30	-	-	-
H.S. Cond.	-	-	30	-	-	10	-	-
Zn 1st Cleaner	-	-	-	5	-	1	6	11.7
Zn 1st Cl Scav	-	-	10	5	-	1	3	-
Zn 2nd Cleaner	500	-	-	-	-	1	4	12.0
Zn 3rd Cleaner	500	-	-	-	-	1	3	12.0
Zn 4th Cleaner	500	-	-	-	-	1	3	-

6 * 2Kg. -10 mesh Comp. No.1B



3458B-71 Metallurgical Results

Product	Weight		Assays, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Cl Conc A	78.0	0.6	65.4	6.94	4.16	8.93	855.	7.3	0.7	0.1	7.9	7.4
2. Pb Cl Conc B	128.9	1.1	65.4	7.08	5.16	5.67	719.	12.0	1.1	0.2	8.3	10.4
3. Pb Cl Conc C	123.0	1.0	66.4	6.58	4.88	5.07	718.	11.6	1.0	0.2	8.4	9.9
4. Pb Cl Conc D	149.6	1.2	62.9	7.66	5.88	6.20	690.	13.4	1.4	0.3	10.5	11.5
5. Pb Cl Conc E	128.3	1.1	65	6.76	5.24	6.07	708.	11.9	1.1	0.2	8.8	10.1
6. Pb Cl Conc F	132.7	1.1	62.9	7.57	5.86	6.26	694.	11.9	1.3	0.2	9.4	10.3
7. 4th Cl Tail F	77.8	0.6	52	10.1	11.8	1.50	416.	5.8	1.0	0.3	1.3	3.6
8. 3rd Cl Tail F	127.8	1.1	36.4	12.4	10.1	1.40	305.	6.6	2.0	0.4	2.0	4.4
9. 2nd Cl Tail F	90.5	0.8	18.7	12.9	25.5	1.25	178.	2.4	1.5	0.7	1.3	1.8
10. 1st Cl Scav Conc F	48.2	0.4	11.1	14.7	29.8	1.06	164.	0.8	0.9	0.4	0.6	0.9
11. Zn CL Conc A	79.7	0.7	0.81	58.5	6.13	0.33	33.1	0.1	5.9	0.1	0.3	0.3
12. Zn CL Conc B	160.8	1.3	0.95	57.5	6.2	0.27	36.3	0.2	11.6	0.3	0.5	0.7
13. Zn CL Conc C	169.8	1.4	1.09	56.8	6.4	0.29	37.2	0.3	12.1	0.3	0.6	0.7
14. Zn CL Conc D	178.3	1.5	1.01	56.9	6.59	0.28	36.1	0.3	12.8	0.3	0.6	0.7
15. Zn CL Conc E	133.9	1.1	1.02	56.8	6.44	0.34	37.6	0.2	9.6	0.2	0.5	0.6
16. Zn CL Conc F	163.2	1.4	1.04	57.6	6.36	0.29	39.1	0.2	11.8	0.3	0.5	0.7
17. Zn 4th Cl Tail F	28.3	0.2	1.82	49.1	8.78	0.40	53.3	0.1	1.7	0.1	0.1	0.2
18. 3rd Cl Tail F	79.1	0.7	2.12	46.3	10.4	0.40	56.8	0.2	4.6	0.2	0.4	0.5
19. 2nd Cl Tail F	121.9	1.0	2.47	37.6	14.5	0.60	63.3	0.4	5.8	0.5	0.6	0.9
20. 1st Cl Scav Conc F	117.4	1.0	4.26	22.7	25	0.79	83.4	0.7	3.4	0.8	1.0	1.1
21. 1st Cl Scav Tail A	91.6	0.8	2.4	3.04	32.6	0.33	55.8	0.3	0.4	0.9	0.3	0.6
22. 1st Cl Scav Tail B	111.2	0.9	2.4	2.67	34.3	0.34	58.4	0.4	0.4	1.1	0.4	0.7
23. 1st Cl Scav Tail C	137.3	1.1	2.82	3.49	32	0.29	52.1	0.6	0.6	1.3	0.5	0.8
24. 1st Cl Scav Tail D	166.5	1.4	2.01	2.43	32.2	0.26	53.1	0.5	0.5	1.5	0.5	1.0
25. 1st Cl Scav Tail E	203.3	1.7	2.62	2.52	32.1	0.46	52.4	0.8	0.6	1.9	1.1	1.2
26. 1st Cl Scav Tail F	166.1	1.4	2.77	3.09	31.8	0.37	51.2	0.7	0.6	1.5	0.7	0.9
27. Zn Ro Scav Tail A	1493.4	12.4	0.84	0.51	33.8	0.47	20.5	1.8	1.0	14.5	7.9	3.4
28. Zn Ro Scav Tail B	1488.4	12.4	0.79	0.46	34.1	0.22	17.5	1.7	0.9	14.6	3.7	2.9
29. Zn Ro Scav Tail C	1479.2	12.3	0.91	0.5	33.2	0.39	19.9	1.9	0.9	14.1	6.5	3.3
30. Zn Ro Scav Tail D	1437.4	12.0	0.8	0.52	34.6	0.22	16	1.6	0.9	14.3	3.6	2.6
31. Zn Ro Scav Tail E	1449.3	12.1	0.87	0.47	33.9	0.37	19.6	1.8	0.9	14.1	6.1	3.2
32. Zn Ro Scav Tail F	1466.0	12.2	0.81	0.53	33.7	0.30	17.5	1.7	1.0	14.2	5.0	2.9
Head (calc)	12006.9	100.0	5.85	6.61	29.0	0.74	74.6	100.0	100.0	100.0	100.0	100.0
Combined Products												
Comb Pb Conc. 1 to 6		6.2	64.5	7.13	5.29	6.36	721	68.1	6.7	1.1	53.3	59.6
Comb Pb Cl Tails 7 to 10		2.9	31.7	12.3	17.3	1.34	277	15.6	5.3	1.7	5.2	10.7
Comb Zn Cl Conc. 11 to 16		7.4	1.00	57.2	6.38	0.30	38.9	1.3	63.9	1.6	3.0	3.6
Comb Zn Cl Tails 17 to 20		2.9	2.94	35.5	16.7	0.60	67.8	1.5	15.5	1.7	2.4	2.6
Comb Zn Cl Scav Tails 21 to 26		7.3	2.51	2.84	32.4	0.35	53.4	3.1	3.1	8.1	3.5	5.2
Comb Zn Ro Sc Tails 27 to 32		73.4	0.84	0.50	33.9	0.33	18.5	10.5	5.5	85.7	32.8	18.2
Projected Results Cycles E & F												
Pb Cleaner Conc		7.6	63.9	7.17	5.56	6.17	701	83.5	8.3	1.5	59.9	70.8
Zn Cleaner Conc		9.5	1.03	57.2	6.40	0.31	38.4	1.7	82.2	2.1	3.8	4.8
Zn Scav. Tail		82.9	1.05	0.76	33.6	0.34	22.3	14.8	9.5	96.4	36.3	24.4
Head (calc)		100.0	5.85	6.61	28.9	0.79	75.9	100.0	100.0	100.0	100.0	100.0

APPENDIX NO. 4

Details of Tests on Composite No. 2

Test No. 45

Purpose: A series of roughing tests on Composite No. 2 to evaluate the effect of grinding fineness.

Procedure: As for Test 42.

Feed: 2000 g of minus 10 mesh Composite 2.

Grind: 30 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2500	150	-	-	-	-	-	30	-	-	9.5
Pb Rougher	-	-	5	15	-	-	-	-	1	4	-
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	-	10	-	-	-	-	1	3	-
				DF 1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.5
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	-	-	-	10	-	1	3	-

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 150 mesh	1.0	1.0	99.0
200	4.0	5.0	95.0
270	10.2	15.2	84.8
27.2 µm	27.3	42.5	57.5
21.1	12.0	54.5	45.5
14.7	12.6	67.1	32.9
10.1	9.2	76.3	23.7
7.8	4.8	81.1	18.9
- 7.8	18.9	100.0	-
Total	100.0	-	-

S.G. 4.24

Metallurgical Balance

Test No. 45

Product	Weight		Assay, %, g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	173.1	8.69	42.4	12.10	10.9	5.89	472.	76.0	18.6	3.9	59.3	61.9
2. Pb Scav. Conc.	101.9	5.12	11.4	12.8	27.3	1.75	184.	12.0	11.6	5.7	10.4	14.2
3. Zn Ro. Conc.	206.5	10.37	1.66	32.1	16.0	0.34	54.5	3.5	58.8	6.8	4.1	8.5
4. Zn Scav. Conc.	116.4	5.85	2.59	4.66	33.0	0.65	54.7	3.1	4.8	7.9	4.4	4.8
5. Zn Scav. Tail.	1393.2	69.97	0.370	0.50	26.6	0.27	10.0	5.3	6.2	75.8	21.9	10.6
Head Calc.	1991.1	100.00	4.85	5.66	24.55	0.86	66.30	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		13.81	30.91	12.36	17.0	4.36	365.28	88.0	30.2	9.6	69.6	76.1
Products 3+4		16.22	2.00	22.21	22.1	.45	54.57	6.7	63.6	14.6	8.5	13.3

Test No. 46

Purpose: Repeat the conditions of Test 45, but increase the Primary grinding time to 40 minutes.

Procedure: As for Test 42.

Feed: 2000 g of minus 10 mesh Composite 2.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2500	150	-	-	-	-	-	40	-	-	9.5
Pb Rougher	-	-	5	15	-	-	-	-	1	4	-
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	-	10	-	-	-	-	1	3	-
				DF 1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.5
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	-	-	-	10	-	1	3	-

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 150 mesh	0.5	0.5	99.5
200	1.8	2.3	97.7
270	5.9	8.2	91.8
27.1 µm	26.1	34.3	65.7
21.1	13.0	47.3	52.7
14.7	14.3	61.6	38.4
10.1	10.7	72.3	27.7
7.8	5.5	77.8	22.2
- 7.8	22.2	100.0	-
Total	100.0	-	-

S.G. 4.26

Test No. 46 - Continued

Size Analysis : Pb Ro + Scav Conc Combined (no regrind)

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 270 mesh	3.1	3.1	96.9
26.8 μm	16.6	19.7	80.3
20.8	9.1	28.8	71.2
14.5	15.4	44.2	55.8
9.0	11.4	55.6	44.4
7.7	5.4	61.0	39.0
- 7.7	39.0	100.0	-
Total	100.0	-	-

S.G. 4.98

Metallurgical Balance

Test No. 46

Product	Weight		Assay, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	172.2	8.63	42.5	11.50	10.1	6.97	489.	78.0	18.1	3.6	68.7	63.9
2. Pb Scav. Conc.	98.2	4.92	10.9	13.2	24.9	1.98	175.	11.4	11.8	5.0	11.1	13.0
3. Zn Ro. Conc.	205.3	10.29	1.60	32.6	15.5	0.26	54.5	3.5	61.0	6.6	3.1	8.5
4. Zn Scav. Conc.	89.4	4.48	2.70	3.85	33.5	0.31	53.3	2.6	3.1	6.2	1.6	3.6
5. Zn Scav. Tail.	1429.7	71.67	0.300	0.46	26.7	0.19	10.1	4.6	6.0	78.7	15.5	11.0
Head Calc.	1994.8	100.00	4.71	5.50	24.33	0.88	66.06	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		13.56	31.02	12.12	15.5	5.16	374.97	89.4	29.9	8.6	79.8	76.9
Products 3+4		14.77	1.93	23.88	21.0	.28	54.14	6.1	64.1	12.7	4.6	12.1

Test No. 47

Purpose: Repeat the conditions of Test 45, but increase the Primary grinding time to 50 minutes.

Procedure: As for Test 42.

Feed: 2000 g of minus 10 mesh Composite 2.

Grind: 50 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2500	150	-	-	-	-	-	50	-	-	9.4
Pb Rougher	-	-	5	15	-	-	-	-	1	4	-
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	-	10	-	-	-	-	1	3	-
				DF 1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.4
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	-	-	-	10	-	1	3	-

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 200 mesh	1.5	1.5	98.5
270	3.5	5.0	95.0
27.1 µm	24.3	29.3	70.7
21.1	13.2	42.5	57.5
14.7	15.3	57.8	42.2
10.1	11.7	69.5	30.5
7.8	6.1	75.6	24.4
- 7.8	24.4	100.0	-
Total	100.0	-	-

S.G. 4.27

Metallurgical Balance

Test No. 47

Product	Weight		Assay, % g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	186.4	9.34	40.8	11.40	10.7	5.50	465.	79.7	19.3	4.1	59.2	64.1
2. Pb Scav. Conc.	91.2	4.57	10.3	13.9	24.9	3.14	186.	9.8	11.5	4.7	16.5	12.5
3. Zn Ro. Conc.	191.9	9.61	1.44	34.3	14.4	0.35	89.7	2.9	59.8	5.7	3.9	12.7
4. Zn Scav. Conc.	93.5	4.68	2.48	3.86	32.9	0.57	47.1	2.4	3.3	6.3	3.1	3.3
5. Zn Scav. Tail.	1433.6	71.80	0.340	0.47	26.8	0.21	7.0	5.1	6.1	79.2	17.4	7.4
Head Calc.	1996.6	100.00	4.78	5.51	24.30	0.87	67.76	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		13.90	30.78	12.22	15.4	4.72	373.34	89.6	30.8	8.8	75.7	76.6
Products 3+4		14.29	1.78	24.33	20.5	.42	75.74	5.3	63.1	12.0	7.0	16.0

Test No. 51

Purpose: A precycle test on Composite No. 2 ore, using the general conditions of Test 41.

Procedure: As for Test 41.

Feed: 2000 g of minus 10 mesh Composite 2.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	40	-	-	9.6
Pb Rougher	-	-	5	15	-	-	1	4	-
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	2.5	10	-	-	1	3	-
Pb Regrind	-	50	20	-	-	20	-	-	-
Pb 1st Cl.	-	20	-	5	100	-	1	4	9.5
	-	-	1.0	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	2.5	50	-	1	5	9.5
	-	-	4.0	10	-	-	1	5	-
Pb 3rd Cl.	-	25	-	5	50	-	1	4	9.5
	-	-	2.0	5	-	-	1	4	-
Pb 4th Cl.	-	25	-	5	50	-	1	3	9.5
	-	-	2.0	5	-	-	1	3	-

Feed: Pb Scavenger + Pb 1st Cleaner Scavenger Tailings

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	1250	-	-	-	-	5	-	11.5
	-	800	-	-	-	5	-	-
Zn Rougher	-	-	20	10	-	2	4	-
	-	-	10	5	-	1	3	-
Zn Regrind (PM)	250	-	10	-	10	-	-	-
Zn 1st Cleaner	-	-	-	-	-	1	4	11.0
Zn 1st Cl Scav	-	-	5	5	-	1	4	-
Zn 2nd Cleaner	250	-	-	-	-	1	4	11.5
Zn 3rd Cleaner	250	-	-	-	-	1	3	11.9
Zn 4th Cleaner	250	-	-	-	-	1	3	11.9

Metallurgical Balance

Test No. 51

Product	Weight		Assays, %					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Cleaner. Conc.	101.7	5.14	60.4	11.00	4.90	11.4	708.	68.1	10.3	1.1	70.4	59.7
2. Pb 4th Cl. Tail	24.6	1.24	49.4	8.87	11.3	1.23	452.	13.5	2.0	0.6	1.8	9.2
3. Pb 3rd Cl. Tail	12	0.61	30	9.03	19.3	0.94	269.	4.0	1.0	0.5	0.7	2.7
4. Pb 2nd Cl. Tail	19.4	0.98	11.4	11.1	28.8	0.72	133.	2.5	2.0	1.2	0.8	2.1
5. Pb 1st Cl. Scav. Conc.	10.3	0.52	5.13	17.8	30.1	1.55	149.	0.6	1.7	0.7	1.0	1.3
6. Zn Cleaner Conc.	158.7	8.02	1.61	49.4	9.0	0.40	62.3	2.8	71.9	3.0	3.9	8.2
7. Zn 4th Cl. Tail	8.8	0.44	2.57	12.5	25.3	0.60	77.7	0.3	1.0	0.5	0.3	0.6
8. Zn 3rd Cl. Tail	11.5	0.58	2.37	8.52	29.1	0.59	75.4	0.3	0.9	0.7	0.4	0.7
9. Zn 2nd Cl. Tail	20.2	1.02	1.87	4.00	29.4	0.45	93.6	0.4	0.7	1.3	0.6	1.6
10. Zn 1st Cl. Scav. Conc.	52.1	2.63	2.06	3.33	35.5	0.60	50.9	1.2	1.6	3.9	1.9	2.2
11. Zn 1st Cl. Scav. Tail.	93.6	4.73	0.67	0.85	27.5	0.22	16.5	0.7	0.7	5.4	1.3	1.3
12. Zn Scav. Tail	1465.7	74.08	0.35	0.46	26.3	0.19	8.6	5.7	6.2	81.3	16.9	10.5
Head Calc.	1978.6	100.00	4.56	5.51	24.0	0.83	60.9	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		6.38	58.26	10.59	6.15	9.4	658.	81.6	12.3	1.6	72.3	68.9
Products 1-3		6.99	55.81	10.45	7.29	8.7	624.	85.6	13.3	2.1	73.0	71.6
Products 1-4		7.97	50.34	10.53	9.93	7.7	564.	88.0	15.2	3.3	73.8	73.7
Products 1-5		8.49	47.57	10.98	11.17	7.33	538.	88.6	16.9	4.0	74.8	75.0
Products 6+7		8.47	1.66	47.46	9.9	.41	63.	3.1	72.9	3.5	4.2	8.8
Products 6-8		9.05	1.71	44.96	11.1	0.42	63.9	3.4	73.8	4.2	4.6	9.5
Products 6-9		10.07	1.72	40.81	13.0	0.42	66.9	3.8	74.6	5.4	5.1	11.1
Products 6-10		12.70	1.79	33.04	17.6	0.46	63.6	5.0	76.2	9.3	7.0	13.3
Products 6-11		17.43	1.49	24.30	20.3	0.40	50.8	5.7	76.9	14.8	8.3	14.5
Products 6-12		91.51	0.57	5.00	25.2	0.23	16.6	11.4	83.1	96.0	25.2	25.0
Products 11+12		78.81	0.37	0.48	26.4	0.19	9.1	6.4	6.9	86.7	18.2	11.7

Test No. 60

Purpose: Repeat the general conditions of Test 51, but increase the NaCN in the primary grind to 200 g/t and to 75 g/t to the Pb regrind. Use High Speed conditioning in the Zn 1st cleaner circuit and maintain pH 12.0 throughout.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 2.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	200	-	-	-	40	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.7
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	2.5	10	-	-	1	3	-
Pb Regrind	-	75	20	-	-	20	-	-	-
Pb 1st Cl.	-	20	-	5	100	-	1	4	9.5
	-	-	1.0	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	2.5	50	-	1	5	9.6
	-	-	4.0	10	-	-	1	5	-
Pb 3rd Cl.	-	25	-	5	50	-	1	4	9.7
	-	-	2.0	5	-	-	1	4	-
Pb 4th Cl.	-	25	-	5	50	-	1	3	-
	-	-	2.0	5	-	-	1	3	-

Feed: Pb Scavenger + Pb 1st Cleaner Scavenger Tailings

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	2500	-	-	-	-	5	-	11.5
	-	800	-	-	-	5	-	-
Zn Rougher	-	-	20	5	-	2	4	-
	-	-	10	2.5	-	1	3	-
Zn Regrind (PM) H.S. Condition	1000	-	10	-	10	-	-	-
	-	-	10	-	-	10	-	-
Zn 1st Cleaner	-	-	-	-	-	1	5	12.0
Zn Cl Scavenger	-	-	5	5	-	1	3	-
Zn 2nd Cleaner	500	-	-	-	-	1	3	12.1
Zn 3rd Cleaner	500	-	-	-	-	1	3	12.2
Zn 4th Cleaner	500	-	-	-	-	1	2	12.2

Metallurgical Balance

Test No. 60

Product	Weight		Assays, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner, Conc.	122.4	6.15	57.2	11.70	75.8	13.2
2. Pb 4th Cl. Tail	20.2	1.01	41.6	10.70	9.1	2.0
3. Pb 3rd Cl. Tail	15.3	0.77	21.5	7.41	3.6	1.0
4. Pb 2nd Cl. Tail	23.5	1.18	6.7	8.86	1.7	1.9
5. Pb 1st Cl. Scav. Conc.	11.6	0.58	3.40	14.8	0.4	1.6
6. Zn Cleaner Conc.	127.6	6.41	1.17	51.6	1.6	60.8
7. Zn 4th Cl. Tail	16.6	0.83	1.81	37.5	0.3	5.7
8. Zn 3rd Cl. Tail	13.3	0.67	2.25	21.4	0.3	2.6
9. Zn 2nd Cl. Tail	21	1.05	2.44	10.20	0.6	2.0
10. Zn 1st Cl. Scav. Conc.	53.7	2.70	1.44	4.01	0.8	2.0
11. Zn 1st Cl. Scav. Tail.	116.9	5.87	0.60	1.09	0.8	1.2
12. Zn Scav. Tail	1448.8	72.77	0.32	0.44	5.0	5.9
Head Calc.	1990.9	100.00	4.64	5.44	100.0	100.0

Combined Products

Products 1+2		7.16	54.99	11.56	84.9	15.2
Products 1-3		7.93	51.75	11.16	88.4	16.3
Products 1-4		9.11	45.91	10.86	90.1	18.2
Products 1-5		9.69	43.35	11.10	90.6	19.8
Products 6+7		7.24	1.24	49.98	1.9	66.6
Products 6-8		7.91	1.33	47.56	2.3	69.2
Products 6-9		8.97	1.46	43.17	2.8	71.2
Products 6-10		11.66	1.45	34.11	3.7	73.2
Products 6-11		17.53	1.17	23.05	4.4	74.3
Products 6-12		90.31	0.48	4.83	9.4	80.2
Products 11+12		78.64	0.34	0.49	5.8	7.1

Test No. 61

Purpose: Repeat the general conditions of Test 60, but increase the Zn regrinding time to 20 minutes.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 2.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	200	-	-	-	40	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.7
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	2.5	10	-	-	1	3	-
Pb Re grind	-	75	20	-	-	20	-	-	-
Pb 1st Cl.	-	20	-	5	100	-	1	4	9.5
	-	-	1.0	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	2.5	50	-	1	4	9.5
	-	-	4.0	10	-	-	1	4	-
Pb 3rd Cl.	-	25	-	5	50	-	1	4	9.7
	-	-	2.0	5	-	-	1	3	-
Pb 4th Cl.	-	25	-	5	50	-	1	3	-
	-	-	2.0	5	-	-	1	3	-

Feed: Pb Scavenger + Pb 1st Cleaner Scavenger Tailings

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	2500	-	-	-	-	5	-	12.2
	-	800	-	-	-	5	-	-
Zn Rougher	-	-	20	5	-	2	4	-
	-	-	10	2.5	-	1	3	-
Zn Re grind (PM) H.S. Condition	1000	-	-	-	20	-	-	-
	-	-	10	-	-	10	-	-
Zn 1st Cleaner	-	-	-	-	-	1	5	12.2
Zn 1st Cl Scav	-	-	5	5	-	1	3	-
Zn 2nd Cleaner	500	-	-	-	-	1	3	12.2
Zn 3rd Cleaner	500	-	-	-	-	1	3	12.2
Zn 4th Cleaner	500	-	-	-	-	1	2	12.2

Metallurgical Balance

Test No. 61

Product	Weight		Assays, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner. Conc.	101.1	5.10	60.1	10.60	67.8	10.1
2. Pb 4th Cl. Tail	22.7	1.15	49.6	8.89	12.6	1.9
3. Pb 3rd Cl. Tail	18.7	0.94	29.7	10.30	6.2	1.8
4. Pb 2nd Cl. Tail	23.0	1.16	7.58	10	1.9	2.2
5. Pb 1st Cl. Scav. Conc.	9.9	0.50	3.98	15.7	0.4	1.5
6. Zn Cleaner Conc.	103	5.20	1.20	54.5	1.4	52.8
7. Zn 4th Cl. Tail	19.9	1.00	1.38	50.3	0.3	9.4
8. Zn 3rd Cl. Tail	13.9	0.70	2.18	37.3	0.3	4.9
9. Zn 2nd Cl. Tail	15	0.76	2.67	21.60	0.4	3.0
10. Zn 1st Cl. Scav. Conc.	47.1	2.38	2.37	8.85	1.2	3.9
11. Zn 1st Cl. Scav. Tail.	142.7	7.20	0.68	1.35	1.1	1.8
12. Zn Scav. Tail	1464.4	73.91	0.38	0.49	6.2	6.7
Head Calc.	1981.4	100.00	4.52	5.37	100.0	100.0

Combined Products

Products 1+2		6.25	58.17	10.29	80.4	12.0
Products 1-3		7.19	54.44	10.29	86.6	13.8
Products 1-4		8.35	47.93	10.25	88.5	15.9
Products 1-5		8.85	45.45	10.56	89.0	17.4
Products 6+7		6.20	1.23	53.82	1.7	62.2
Products 6-8		6.90	1.33	52.14	2.0	67.1
Products 6-9		7.66	1.46	49.12	2.5	70.1
Products 6-10		10.04	1.67	39.59	3.7	74.0
Products 6-11		17.24	1.26	23.61	4.8	75.8
Products 6-12		91.15	0.55	4.86	11.0	82.6
Products 11+12		81.11	0.41	0.57	7.3	8.6

Test No. 62

Purpose: Repeat Test 61, but increase the regrinding times in the Pb and Zn circuits.

Procedure: As for Test 61, but the Pb regrinding time was increased to 30 minutes and the Zn regrinding time was also increased to 30 minutes.

Feed: 2000 g of minus 10 mesh Composite 2.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	200	-	-	-	40	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.6
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	2.5	10	-	-	1	3	-
Pb Re grind	-	75	20	-	-	30	-	-	-
Pb 1st Cl.	-	20	-	5	100	-	1	4	9.4
	-	-	1.0	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	2.5	50	-	1	4	9.6
	-	-	4.0	10	-	-	1	4	-
Pb 3rd Cl.	-	25	-	5	50	-	1	4	9.7
	-	-	2.0	5	-	-	1	3	-
Pb 4th Cl.	-	25	-	5	50	-	1	3	-
	-	-	2.0	5	-	-	1	3	-

Feed: Pb Scavenger + Pb 1st Cleaner Scavenger Tailings

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	2500	-	-	-	-	5	-	12.2
	-	800	-	-	-	5	-	-
Zn Rougher	-	-	20	10	-	2	4	-
	-	-	10	5	-	1	3	-
Zn Re grind (PM)	1000	-	-	-	30	-	-	-
H.S. Condition	-	-	15	-	-	10	-	-
Zn 1st Cleaner	-	-	-	-	-	1	5	12.2
Zn 1st Cl Scav	-	-	10	5	-	1	3	-
Zn 2nd Cleaner	500	-	-	-	-	1	3	12.2
Zn 3rd Cleaner	500	-	-	-	-	1	3	12.2
Zn 4th Cleaner	500	-	-	-	-	1	2	12.2

Metallurgical Balance

Test No. 62

Product	Weight		Assays, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner. Conc.	97.1	4.88	60.6	9.88	65.6	8.9
2. Pb 4th Cl. Tail	26.8	1.35	49.0	9.01	14.6	2.2
3. Pb 3rd Cl. Tail	17.6	0.88	31.1	9.28	6.1	1.5
4. Pb 2nd Cl. Tail	19.3	0.97	9.27	10.4	2.0	1.9
5. Pb 1st Cl. Scav. Conc.	11.7	0.59	4.56	15.7	0.6	1.7
6. Zn Cleaner Conc.	119.3	6.00	1.22	55.0	1.6	60.8
7. Zn 4th Cl. Tail	11.6	0.58	2.04	42.7	0.3	4.6
8. Zn 3rd Cl. Tail	12.1	0.61	2.58	29.2	0.3	3.3
9. Zn 2nd Cl. Tail	25.1	1.26	2.32	15.6	0.6	3.6
10. Zn 1st Cl. Scav. Conc.	47.2	2.37	2.09	7.78	1.1	3.4
11. Zn 1st Cl. Scav. Tail.	151.4	7.61	0.71	1.42	1.2	2.0
12. Zn Scav. Tail	1450	72.89	0.36	0.45	5.8	6.1
Head Calc.	1989.2	100.00	4.51	5.42	100.0	100.0

Combined Products

Products 1+2		6.23	58.1	9.7	80.3	11.1
Products 1-3		7.11	54.7	9.6	86.4	12.6
Products 1-4		8.08	49.3	9.7	88.4	14.5
Products 1-5		8.67	46.2	10.1	89.0	16.2
Products 6+7		6.58	1.29	53.9	1.9	65.4
Products 6-8		7.19	1.40	51.8	2.2	68.7
Products 6-9		8.45	1.54	46.4	2.9	72.3
Products 6-10		10.82	1.66	37.9	4.0	75.7
Products 6-11		18.43	1.27	22.9	5.2	77.7
Products 6-12		91.33	0.54	4.97	11.0	83.8
Products 11+12		80.50	0.39	0.54	7.0	8.0

Test No. 67

Purpose: A precycle test on Composite 2 ore, using the flotation conditions of Test 62.

Procedure: As for Test 62.

Feed: 2000 g of minus 10 mesh Composite 2.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	200	-	-	-	40	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.7
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	2.5	10	-	-	1	3	-
Pb Regrind	-	75	20	-	-	30	-	-	9.4
Pb 1st Cl.	-	20	-	5	100	-	1	4	9.7
	-	-	1.0	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	2.5	50	-	1	4	9.6
	-	-	4.0	10	-	-	1	4	-
Pb 3rd Cl.	-	25	-	5	50	-	1	4	9.7
	-	-	2.0	5	-	-	1	3	-
Pb 4th Cl.	-	25	-	5	50	-	1	3	-
	-	-	2.0	5	-	-	1	3	-

Feed: Pb Scavenger + Pb 1st Cleaner Scavenger Tailings

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	2500	-	-	-	-	5	-	11.8
	-	800	-	-	-	5	-	-
Zn Rougher	-	-	20	10	-	2	4	-
	-	-	10	5	-	1	3	-
Zn Regrind (PM) H.S. Condition	1000	-	-	-	30	-	-	-
	-	-	15	-	-	10	-	-
Zn 1st Cleaner	-	-	-	-	-	1	5	11.7
Zn 1st Cl Scav	-	-	10	5	-	1	3	-
Zn 2nd Cleaner	500	-	-	-	-	1	4	12.0
Zn 3rd Cleaner	500	-	-	-	-	1	3	-
Zn 4th Cleaner	500	-	-	-	-	1	2	12.1

Metallurgical Balance

Test No. 67

Product	Weight		Assays, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner. Conc.	104	5.26	65.4	9.4	73.3	9.1
2. Pb 4th Cl. Tail	22.6	1.14	45.8	9.54	11.2	2.0
3. Pb 3rd Cl. Tail	13.4	0.68	24.2	11.1	3.5	1.4
4. Pb 2nd Cl. Tail	19.7	1.00	7.81	11.7	1.7	2.2
5. Pb 1st Cl. Scav. Conc.	7.7	0.39	3.91	16.6	0.3	1.2
6. Zn Cleaner Conc.	78.1	3.95	0.91	55.5	0.8	40.6
7. Zn 4th Cl. Tail	29.1	1.47	0.88	53.8	0.3	14.6
8. Zn 3rd Cl. Tail	21.4	1.08	1.41	42.7	0.3	8.5
9. Zn 2nd Cl. Tail	27.9	1.41	1.93	24.4	0.6	6.4
10. Zn 1st Cl. Scav. Conc.	36.1	1.83	2.29	14.30	0.9	4.8
11. Zn 1st Cl. Scav. Tail	189.7	9.59	0.68	1.46	1.4	2.6
12. Zn Scav. Tail	1428.3	72.21	0.38	0.49	5.8	6.5
Head Calc.	1978	100.00	4.69	5.40	100.0	100.0

Combined Products

Products 1+2		6.40	61.9	9.4	84.4	11.2
Products 1-3		7.08	58.3	9.6	87.9	12.6
Products 1-4		8.07	52.1	9.8	89.6	14.7
Products 1-5		8.46	49.9	10.2	89.9	15.9
Products 6+7		5.42	0.90	55.0	1.0	55.2
Products 6-8		6.50	0.99	53.0	1.4	63.8
Products 6-9		7.91	1.15	47.9	1.9	70.1
Products 6-10		9.74	1.37	41.6	2.8	75.0
Products 6-11		19.33	1.03	21.7	4.2	77.5
Products 6-12		91.54	0.52	4.96	10.1	84.1
Products 11+12		81.80	0.42	0.60	7.2	9.1

Test No. 69

Purpose: A flotation locked cycle test using the conditions of Test 67.

Procedure: As for Test 67.

Feed: 6 x 2000 g of minus 10 mesh Composite 2.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	200	-	-	-	40	-	-	-
Pb Rougher	-	-	5	15	-	-	1	4	9.7
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	2.5	10	-	-	1	3	-
Pb Regrind	-	75	20	-	-	30	-	-	-
Pb 1st Cl.	-	20	-	5	100	-	1	3	9.7
	-	-	1.0	5	-	-	1	3	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	-	50	-	1	3	9.6
	-	-	2.0	5	-	-	1	3	-
Pb 3rd Cl.	-	25	-	5	50	-	1	3	9.6
Pb 4th Cl.	-	25	-	2.5	50	-	1	3	-

Feed: Pb Scavenger + Pb 1st Cleaner Scavenger Tailings

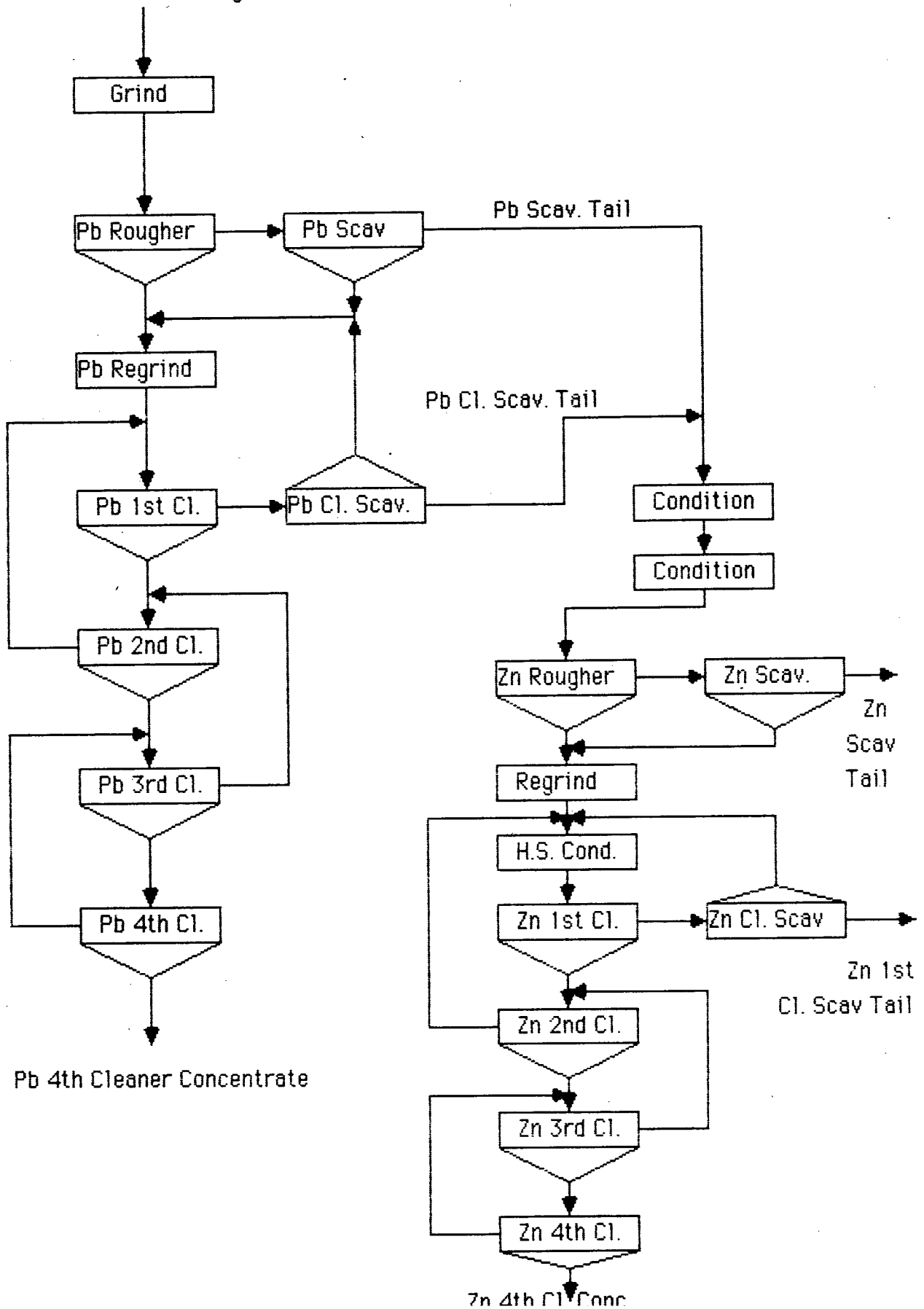
Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	2500	-	-	-	-	5	-	11.8
	-	800	-	-	-	5	-	-
Zn Rougher	-	-	20	10	-	2	4	-
	-	-	10	5	-	1	3	-
Zn Regrind (PM) H.S. Condition	1000	-	-	-	30	-	-	-
	-	-	25	-	-	10	-	-
Zn 1st Cleaner	-	-	-	-	-	1	6	11.7
Zn 1st Cl Scav	-	-	10	5	-	1	4	-
Zn 2nd Cleaner	500	-	-	-	-	1	4	11.9
Zn 3rd Cleaner	500	-	-	-	-	1	3	12.0
Zn 4th Cleaner	500	-	-	-	-	1	2	12.1

Test No. 69

Flowsheet

6 * 2Kg. -10 mesh Comp. No. 2



3458B-69 Metallurgical Results

Product	Weight		Assays, %/g/t					% Distribution				
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb Cl Conc A	85.4	0.7	65.9	9.05	4.18	14.66	772.	9.6	1.2	0.1	10.1	8.9
2. Pb Cl Conc B	130.1	1.1	62.5	9.79	5.87	9.87	657.	13.9	1.9	0.3	10.3	11.6
3. Pb Cl Conc C	111.0	0.9	65.6	8.76	4.76	23.73	698.	12.4	1.5	0.2	21.2	10.5
4. Pb Cl Conc D	117.3	1.0	63.9	8.99	5.06	11.61	703.	12.8	1.6	0.2	10.9	11.2
5. Pb Cl Conc E	107.6	0.9	66.4	8.6	4.46	11.07	716.	12.2	1.4	0.2	9.6	10.4
6. Pb Cl Conc F	124.3	1.0	64.6	9.22	4.94	11.30	696.	13.7	1.7	0.2	11.3	11.7
7. 4th Cl Tail F	72.0	0.6	45.3	12.5	12.1	1.68	386.	5.6	1.4	0.3	1.0	3.8
8. 3rd Cl Tail F	109.2	0.9	32.1	13.4	18.4	1.70	280.	6.0	2.2	0.7	1.5	4.1
9. 2nd Cl Tail F	81.7	0.7	18.5	13.3	25.1	1.29	181.	2.6	1.6	0.7	0.8	2.0
10. 1st Cl Scav Conc F	36.8	0.3	8.2	15.1	29.4	2.60	150.	0.5	0.8	0.4	0.8	0.7
11. Zn CL Conc A	79.7	0.7	1.08	55.3	7.51	0.55	48	0.1	6.7	0.2	0.4	0.5
12. Zn CL Conc B	125.4	1.0	1.09	54.8	6.96	0.47	50.7	0.2	10.4	0.3	0.5	0.9
13. Zn CL Conc C	128.3	1.1	1.07	54.7	7.33	0.56	52.9	0.2	10.6	0.3	0.6	0.9
14. Zn CL Conc D	151.1	1.3	1.16	52.9	7.87	0.59	55.8	0.3	12.1	0.4	0.7	1.1
15. Zn CL Conc E	115.7	1.0	1.01	55.1	6.95	0.59	55.4	0.2	9.7	0.3	0.5	0.9
16. Zn CL Conc F	120.3	1.0	1.13	54.4	7.22	1.09	58.4	0.2	9.9	0.3	1.1	1.0
17. Zn 4th Cl Tail F	41.5	0.3	1.56	49.8	8.35	0.59	86	0.1	3.1	0.1	0.2	0.5
18. 3rd Cl Tail F	86.3	0.7	2.11	41.8	11.5	0.69	72.8	0.3	5.5	0.3	0.5	0.9
19. 2nd Cl Tail F	106.4	0.9	2.79	24.7	18.6	0.75	75.4	0.5	4.0	0.7	0.6	1.1
20. 1st Cl Scav Conc F	107.5	0.9	2.63	13.4	27.5	0.59	66.3	0.5	2.2	1.0	0.5	1.0
21. 1st Cl Scav Tail A	211.9	1.8	0.64	1.1	27.6	0.21	16.9	0.2	0.4	2.0	0.4	0.5
22. 1st Cl Scav Tail B	226.4	1.9	0.74	1.42	27.3	0.23	21.6	0.3	0.5	2.1	0.4	0.7
23. 1st Cl Scav Tail C	222.2	1.9	0.75	1.6	27.6	0.28	21.9	0.3	0.5	2.1	0.5	0.7
24. 1st Cl Scav Tail D	194.6	1.6	0.92	2.35	26.7	0.31	27.2	0.3	0.7	1.8	0.5	0.7
25. 1st Cl Scav Tail E	213.3	1.8	0.96	2.22	27.7	0.32	26.2	0.3	0.7	2.0	0.5	0.8
26. 1st Cl Scav Tail F	236.3	2.0	1.05	2.46	27.2	0.29	29.3	0.4	0.9	2.2	0.6	0.9
27. Zn Ro Scav Tail A	1388.0	11.6	0.38	0.47	27.1	0.18	9	0.9	1.0	12.9	2.0	1.7
28. Zn Ro Scav Tail B	1398.9	11.7	0.36	0.49	26.7	0.19	10.5	0.9	1.0	12.8	2.1	2.0
29. Zn Ro Scav Tail C	1441.0	12.0	0.38	0.53	26.9	0.24	9.8	0.9	1.2	13.3	2.8	1.9
30. Zn Ro Scav Tail D	1491.0	12.4	0.44	0.55	27.4	0.19	9.2	1.1	1.2	14.0	2.3	1.9
31. Zn Ro Scav Tail E	1463.7	12.2	0.43	0.55	27.7	0.19	13.2	1.1	1.2	13.9	2.2	2.6
32. Zn Ro Scav Tail F	1461.4	12.2	0.45	0.55	27.5	0.23	10.6	1.1	1.2	13.8	2.7	2.1
Head (calc)	11986.3	100.0	4.88	5.51	24.4	1.04	61.6	100.0	100.0	100.0	100.0	100.0
Combined Products												
Comb Pb Conc. 1 to 6		5.6	64.7	9.09	4.94	13.51	703	74.7	9.3	1.1	73.4	64.3
Comb Pb Cl Tails 7 to 10		2.5	28.6	13.4	20.1	1.69	263	14.7	6.1	2.1	4.1	10.7
Comb Zn Cl Conc. 11 to 16		6.0	1.09	54.4	7.32	0.64	53.9	1.3	59.4	1.8	3.7	5.3
Comb Zn Cl Tails 17 to 20		2.9	2.42	28.5	18.4	0.67	73.2	1.4	14.7	2.1	1.8	3.4
Comb Zn Cl Scav Tails 21 to 26		10.9	0.84	1.86	27.4	0.27	23.9	1.9	3.7	12.2	2.9	4.2
Comb Zn Ro Sc Tails 27 to 32		72.1	0.41	0.52	27.2	0.20	10.4	6.0	6.9	80.6	14.1	12.2
Projected Results Cycles E & F												
Pb Cleaner Conc		6.7	65.4	8.93	4.72	11.19	705	89.3	10.8	1.3	74.4	74.1
Zn Cleaner Conc		7.7	1.07	54.7	7.09	0.84	56.9	1.7	76.9	2.2	6.5	7.0
Zn Scav. Tail		85.6	0.52	0.79	27.6	0.22	14.0	9.0	12.3	96.5	19.0	18.9
Head (calc)		100.0	4.88	5.51	24.5	1.00	63.4	100.0	100.0	100.0	100.0	100.0

Test No. 80

Purpose: To investigate the effect of LS8 on Composite 2 Pb flotation.

Procedure: Standard conditions of Test 67, but replace NaCN with depressant LS8.

Feed: 2000 g of minus 10 mesh Composite 2.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	LS8	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	200	-	-	-	40	-	-	9.3
Pb Rougher	-	-	5	15	-	-	1	4	-
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	5	10	-	-	1	3	-
	-	-	2.5	5	-	-	1	3	-
Pb Regrind	-	37.5	20	-	-	30	-	-	-
Pb 1st Cl.	-	10	-	5	100	-	1	4	9.4
	-	-	1.0	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	25	-	2.5	50	-	1	4	9.3
	-	-	4.0	5	-	-	1	4	-
Pb 3rd Cl.	-	12.5	-	2.5	50	-	1	3	9.3
	-	-	2.0	5	-	-	1	3	-
Pb 4th Cl.	-	12.5	-	2.5	50	-	1	2	-
	-	-	2.0	5	-	-	1	2	-

Size Analysis : Combined Product (30 Minute Regrind)

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 33.9 µm	0.5	0.5	99.5
26.3	1.4	1.9	98.1
18.4	10.2	12.1	87.9
12.6	19.1	31.2	68.8
9.8	12.6	43.8	56.2
- 9.8	56.2	100.0	-
Total	100.0	-	-

S.G. 4.86

Test No. 80

Product	O	Weight %	Assay %		% Distribution	
			Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	66.2	3.43	63.4	7.3	48.6	4.5
2. Pb 4th Cl Tail	41.2	2.07	44.1	11.7	20.4	4.3
3. Pb 3rd Cl Tail	48	2.41	24.7	14.7	13.3	6.3
4. Pb 2nd Cl Tail	39.9	2.00	3.93	15.1	4.0	5.4
5. Pb 1st Cl Scaw Conc.	12.9	0.65	6.7	14.2	1.0	1.6
6. Pb 1st Cl Scaw Tail	168.4	8.46	1.85	11.4	3.5	17.3
7. Pb Scaw Tail	1611.9	80.98	0.51	4.17	9.2	60.5
Head Calc.	1990.5	100.00	4.47	5.58	100.0	100.0

Combined Products

Products 1+2	5.50	56.13	8.96	69.0	8.8
Products 1-3	7.91	46.55	10.71	82.3	15.2
Products 1-4	9.91	38.94	11.60	86.3	20.6
Products 1-5	10.56	36.96	11.76	87.3	22.2
Products 1-6	19.02	21.34	11.60	90.8	39.5
Products 6+7	89.44	.64	4.65	12.7	77.8

APPENDIX NO. 5

Details of Tests on Composite No. 4

Test No. 57

Purpose: To examine the effect of fineness of grind on Pb-Zn rougher flotation from Composite No. 4 ore.

Procedure: As for Test 42.

Feed: 2000 g of minus 10 mesh Composite 4.

Grind: 30 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	-	-	30	-	-	-
Pb Rougher	-	-	5	25	-	-	-	-	1	4	10.0
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	-	10	-	-	-	-	1	3	-
				DF							
				1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.8
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	10	-	-	10	-	1	3	-
	-	-	-	5	-	-	5	-	1	2	-

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 150 mesh	1.5	1.5	98.5
200	7.6	9.1	90.9
270	12.8	21.9	78.1
400	15.3	37.2	62.8
34.8 µm	4.0	41.2	58.8
27.0	8.4	49.6	50.4
18.8	13.8	63.4	36.6
12.9	11.1	74.5	25.5
10.0	5.9	80.4	19.6
- 10.0	19.6	100.0	-
Total	100.0	-	-

S.G. 3.01

Metallurgical Balance

Test No. 57

Product	Weight		Assay, % g/t						% Distribution					
	g	%	Cu	Pb	Zn	Fe	Au	Ag	Cu	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	132.9	6.67	0.042	16.1	5.00	5.55	1.48	212.	4.9	48.9	8.5	4.9	28.3	42.0
2. Pb Scav. Conc.	99.3	4.98	0.11	12.80	7.0	9.70	0.96	179.8	9.5	29.0	8.9	6.4	13.7	26.6
3. Zn Ro. Conc.	172.5	8.66	0.15	0.83	31.6	9.60	0.25	31.4	22.5	3.3	69.9	11.0	6.2	8.1
4. Zn Scav. Conc.	194.8	9.78	0.18	1.51	3.51	15.6	0.85	34.5	30.5	6.7	8.8	20.2	23.8	10.0
5. Zn Scav. Tail.	1393.3	69.92	0.027	0.380	0.22	6.20	0.14	6.4	32.7	12.1	3.9	57.5	28.0	13.3
Head Calc.	1992.8	100.00	0.06	2.20	3.92	7.54	0.35	33.7	100.0	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		11.65	0.07	14.69	5.86	7.32	1.26	198.23	14.3	77.9	17.4	11.3	42.0	68.6
Products 3+4		18.43	0.17	1.19	16.70	12.78	0.57	33.04	53.0	10.0	78.6	31.2	30.0	18.1

Test No. 58

Purpose: Repeat Test 57, but increase the grinding time to 40 minutes.

Procedure: As for Test 42.

Feed: 2000 g of minus 10 mesh Composite 4.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	-	-	40	-	-	-
Pb Rougher	-	-	5	25	-	-	-	-	1	4	10.0
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	-	10	-	-	-	-	1	3	-
				DF							
				1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.8
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	10	-	-	10	-	1	3	-
	-	-	-	5	-	-	5	-	1	2	-

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 200 mesh	4.4	4.4	95.6
270	10.7	15.1	84.9
400	17.7	32.8	67.2
34.6 µm	3.9	36.7	63.3
26.8	8.3	45.0	55.0
18.7	15.3	60.3	39.7
12.9	11.9	72.2	27.8
9.9	6.0	78.2	21.8
- 9.9	21.8	100.0	-
Total	100.0	-	-

S.G. 3.05

Test No. 58 - Continued

Size Analysis : Pb Ro + Scav Conc Combined (no regrind)

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 270 mesh	3.9	3.9	96.1
34.6 μm	11.2	15.1	84.9
26.8	8.1	23.2	76.8
18.7	14.3	37.5	62.5
12.9	13.1	50.6	49.4
9.9	7.7	58.3	41.7
- 9.9 μm	41.7	100.0	-
Total	100.0	-	-

Metallurgical Balance

Test No. 58

Product	Weight		Assay, % g/t						% Distribution					
	g	%	Cu	Pb	Zn	Fe	Au	Ag	Cu	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	167.8	8.43	0.04	14.8	4.86	5.46	1.35	194.	5.2	56.0	10.4	6.0	29.9	49.8
2. Pb Scav. Conc.	129.8	6.52	0.13	9.78	6.96	11.70	1.32	136.0	13.2	28.6	11.6	9.9	22.6	27.0
3. Zn Ro. Conc.	183	9.20	0.13	0.44	27.9	8.41	0.17	24.9	18.6	1.8	65.4	10.0	4.1	7.0
4. Zn Scav. Conc.	146.9	7.38	0.28	0.84	4.59	15.5	0.94	29.9	32.1	2.8	8.6	14.8	18.2	6.7
5. Zn Scav. Tail.	1362.4	68.47	0.029	0.350	0.23	6.70	0.14	4.6	30.9	10.8	4.0	59.4	25.2	9.6
Head Calc.	1989.9	100.00	0.06	2.23	3.93	7.73	0.38	32.9	100.0	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		14.96	0.08	12.61	5.78	8.18	1.34	168.70	18.4	84.6	22.0	15.8	52.5	76.7
Products 3+4		16.58	0.20	0.62	17.52	11.57	0.51	27.13	50.7	4.6	74.0	24.8	22.3	13.7

Test No. 59

Purpose: Repeat Test 57, but increase the grinding time to 50 minutes.

Procedure: As for Test 42.

Feed: 2000 g of minus 10 mesh Composite 4.

Grind: 50 minutes at 65% solids in a lab ball mill

Conditions:

Stage	Reagents Added, grams per tonne							Time, minutes			pH
	Na ₂ CO ₃	NaCN	A343	MIBC	Ca(OH) ₂	CuSO ₄	A350	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	-	-	50	-	-	-
Pb Rougher	-	-	5	25	-	-	-	-	1	4	10.0
Pb Scavenger	-	-	5	10	-	-	-	-	1	3	-
	-	-	-	10	-	-	-	-	1	3	-
				DF							
				1012							
Zn Conditioning 1	-	-	-	-	1250	-	-	-	5	-	11.8
Zn Conditioning 2	-	-	-	-	-	800	-	-	5	-	-
Zn Rougher	-	-	-	10	-	-	20	-	2	4	-
Zn Scavenger	-	-	-	10	-	-	10	-	1	3	-
	-	-	-	5	-	-	5	-	1	2	-

Size Analysis : Combined Product

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 200 mesh	2.4	2.4	97.6
270	6.4	8.8	91.2
400	16.3	25.1	74.9
34.8 µm	4.4	29.5	70.5
27.0	9.3	38.8	61.2
18.8	16.9	55.7	44.3
12.9	13.4	69.1	30.9
10.0	6.8	75.9	24.1
- 10.0	24.1	100.0	-
Total	100.0	-	-

S.G. 3.05

Metallurgical Balance

Test No. 59

Product	Weight		Assay, % g/t						% Distribution					
	g	%	Cu	Pb	Zn	Fe	Au	Ag	Cu	Pb	Zn	Fe	Au	Ag
1. Pb Ro. Conc.	153.1	7.68	0.05	18.3	5.00	5.45	1.62	206.	6.2	62.0	9.6	5.3	10.6	54.7
2. Pb Scav. Conc.	120.9	6.06	0.12	8.56	6.8	10.90	0.93	107.0	11.7	22.9	10.3	8.4	4.8	22.5
3. Zn Ro. Conc.	214.3	10.75	0.24	0.67	27.8	9.78	0.24	27.5	41.4	3.2	74.3	13.4	2.2	10.2
4. Zn Scav. Conc.	135.4	6.79	0.12	1.02	1.65	17.5	1.02	23.1	13.1	3.1	2.8	15.1	5.9	5.4
5. Zn Scav. Tail.	1369.8	68.71	0.025	0.290	0.18	6.59	1.30	3.0	27.6	8.8	3.1	57.7	76.4	7.1
Head Calc.	1993.5	100.00	0.06	2.27	4.02	7.85	1.17	28.9	100.0	100.0	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		13.74	0.08	14.00	5.79	7.85	1.32	162.32	17.9	85.0	19.8	13.8	15.5	77.2
Products 3+4		17.54	0.19	0.81	17.68	12.77	0.54	25.80	54.5	6.2	77.1	28.5	8.1	15.7

Test No. 65

Purpose: Preliminary cleaning test on Composite 4 ore using the general conditions of Test 61.

Procedure: As for Test 61.

Feed: 2000 g of minus 10 mesh Composite 4.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	200	-	-	-	40	-	-	-
Pb Rougher	-	-	5	25	-	-	1	4	10.1
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	2.5	10	-	-	1	3	-
Pb Regrind	-	75	20	-	-	20	-	-	-
Pb 1st Cl.	-	20	-	10	100	-	1	4	10.1
	-	-	1.0	5	-	-	1	5	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	10	50	-	1	4	-
	-	-	4.0	10	-	-	1	4	-
Pb 3rd Cl.	-	25	-	10	50	-	1	4	10.0
	-	-	4.0	10	-	-	1	3	-
Pb 4th Cl.	-	25	-	10	50	-	1	3	10.0
	-	-	4.0	5	-	-	1	3	-

Feed: Pb Scavenger + Pb 1st Cleaner Scavenger Tailings

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	2500	-	-	-	-	5	-	12.4
	-	800	-	-	-	5	-	-
Zn Rougher	-	-	20	5	-	2	4	-
	-	-	10	2.5	-	1	3	-
Zn Regrind (PM) H.S. Condition	1000	-	-	-	20	-	-	-
	-	-	10	-	-	10	-	-
Zn 1st Cleaner	-	-	-	5	-	1	5	12.4
Zn 1st Cl Scav	-	-	10	5	-	1	3	-
Zn 2nd Cleaner	500	-	-	2.5	-	1	4	12.5
Zn 3rd Cleaner	500	-	-	-	-	1	3	12.5
Zn 4th Cleaner	500	-	-	-	-	1	2	-

Metallurgical Balance

Test No. 65

Product	Weight		Assays, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	50.3	2.52	42.7	5.52	51.0	3.6
2. Pb 4th Cl. Tail	17.5	0.88	44.8	5.55	18.6	1.3
3. Pb 3rd Cl. Tail	8.9	0.45	23	4.06	4.9	0.5
4. Pb 2nd Cl. Tail	25.4	1.27	7.91	6.29	4.8	2.1
5. Pb 1st Cl. Scav. Conc.	8.6	0.43	3.06	7.5	0.6	0.8
6. Zn Cleaner Conc.	105	5.26	0.54	54.1	1.3	74.6
7. Zn 4th Cl. Tail	14.7	0.74	1.23	39.1	0.4	7.5
8. Zn 3rd Cl. Tail	8.5	0.43	2.17	17.6	0.4	2.0
9. Zn 2nd Cl. Tail	11.6	0.58	2.41	6.2	0.7	0.9
10. Zn 1st Cl. Scav. Conc.	21.2	1.06	2.72	4.84	1.4	1.3
11. Zn 1st Cl. Scav. Tail	82.6	4.14	1.17	0.89	2.3	1.0
12. Zn Scav. Tail	1642.7	82.26	0.35	0.2	13.6	4.3
Head Calc.	1997	100.00	2.11	3.81	100.0	100.0

Combined Products

Products 1+2		3.40	43.2	5.5	69.6	4.9
Products 1-3		3.84	40.9	5.4	74.4	5.4
Products 1-4		5.11	32.7	5.6	79.2	7.5
Products 1-5		5.54	30.4	5.7	79.8	8.3
Products 6+7		5.99	0.62	52.3	1.8	82.1
Products 6-8		6.42	0.73	50.0	2.2	84.1
Products 6-9		7.00	0.87	46.3	2.9	85.0
Products 6-10		8.06	1.11	40.9	4.2	86.4
Products 6-11		12.20	1.13	27.3	6.5	87.3
Products 6-12		94.46	0.45	3.70	20.2	91.7
Products 11+12		86.39	0.39	0.23	15.9	5.3

Test No. 66

Purpose: Preliminary cleaning test on Composite 4 ore using the general conditions similar to Test 62.

Procedure: As for Test 62.

Feed: 2000 g of minus 10 mesh Composite 4.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	200	-	-	-	40	-	-	-
Pb Rougher	-	-	5	25	-	-	1	4	10.1
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	2.5	10	-	-	1	3	-
Pb Regrind	-	75	20	-	-	30	-	-	-
Pb 1st Cl.	-	20	-	10	100	-	1	4	10.1
	-	-	1.0	5	-	-	1	5	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	10	50	-	1	4	-
	-	-	4.0	10	-	-	1	4	-
Pb 3rd Cl.	-	25	-	10	50	-	1	4	10.1
	-	-	4.0	10	-	-	1	3	-
Pb 4th Cl.	-	25	-	10	50	-	1	3	-
	-	-	4.0	10	-	-	1	3	-

Feed: Pb Scavenger + Pb 1st Cleaner Scavenger Tailings

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	2500	-	-	-	-	5	-	12.4
	-	800	-	-	-	5	-	-
Zn Rougher	-	-	20	10	-	2	4	-
	-	-	10	5	-	1	3	-
Zn Regrind (PM) H.S. Condition	1000	-	-	-	30	-	-	-
	-	-	15	-	-	10	-	-
Zn 1st Cleaner	-	-	-	5	-	1	5	12.4
Zn 1st Cl Scav	-	-	10	5	-	1	3	-
Zn 2nd Cleaner	500	-	-	-	-	1	4	12.4
Zn 3rd Cleaner	500	-	-	-	-	1	3	12.4
Zn 4th Cleaner	500	-	-	-	-	1	2	-

Metallurgical Balance

Test No. 66

Product	Weight		Assays, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner. Conc.	47.2	2.37	40.9	4.76	46.2	3.0
2. Pb 4th Cl. Tail	19.9	1.00	50.9	5.01	24.2	1.3
3. Pb 3rd Cl. Tail	13.7	0.69	25.6	6.16	8.4	1.1
4. Pb 2nd Cl. Tail	17.7	0.89	3.11	6.47	1.3	1.5
5. Pb 1st Cl. Scav. Conc.	6.4	0.32	2.18	6.91	0.3	0.6
6. Zn Cleaner Conc.	103.4	5.18	0.58	54.4	1.4	74.4
7. Zn 4th Cl. Tail	14.6	0.73	1.40	39.7	0.5	7.7
8. Zn 3rd Cl. Tail	10.1	0.51	2.19	20.6	0.5	2.8
9. Zn 2nd Cl. Tail	21.2	1.06	2.22	6.4	1.1	1.8
10. Zn 1st Cl. Scav. Conc.	25.6	1.28	2.76	3.52	1.7	1.2
11. Zn 1st Cl. Scav. Tail.	107.7	5.40	0.78	0.65	2.0	0.9
12. Zn Scav. Tail	1607	80.57	0.32	0.18	12.3	3.8
Head Calc.	1994.5	100.00	2.10	3.79	100.0	100.0

Combined Products

Products 1+2		3.36	43.9	4.8	70.4	4.3
Products 1-3		4.05	40.8	5.1	78.8	5.4
Products 1-4		4.94	34.0	5.3	80.1	6.9
Products 1-5		5.26	32.1	5.4	80.4	7.5
Products 6+7		5.92	0.68	52.6	1.9	82.0
Products 6-8		6.42	0.80	50.1	2.5	84.8
Products 6-9		7.49	1.00	43.9	3.6	86.6
Products 6-10		8.77	1.26	38.0	5.3	87.7
Products 6-11		14.17	1.08	23.7	7.3	88.7
Products 6-12		94.74	0.43	3.70	19.6	92.5
Products 11+12		85.97	0.35	0.21	14.3	4.7

Test No. 75

Purpose: To investigate the effect of depressant LS8 on Pb flotation using Composite No. 4 ore.

Procedure: Using the general conditions of Test 65.

Feed: 2000 g of minus 10 mesh Composite 4.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	LS8	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	300	-	-	-	40	-	-	-
Pb Rougher	-	-	5	25	-	-	1	4	10.0
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	2.5	10	-	-	1	3	-
Pb Regrind	-	100	20	-	-	20	-	-	-
Pb 1st Cl.	-	20	-	10	100	-	1	4	10.1
	-	-	1.0	5	-	-	1	5	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	10	10	50	-	1	4	9.5
	-	-	10	5	-	-	1	4	-
Pb 3rd Cl.	-	25	5	10	50	-	1	3	9.7
	-	-	5	5	-	-	1	3	-
Pb 4th Cl.	-	-	5	10	-	-	1	3	-

Size Analysis : Combined Product (20 minute regrind)

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 27.2 µm	0.6	0.6	99.4
19.0	7.1	7.7	92.3
13.1	16.4	24.1	75.9
10.1	12.8	36.9	63.1
- 10.1	63.1	100.0	-
Total	100.0	-	-

S.G. 3.50

Test No. 75

Product	g	Weight %	Assay %		% Distribution	
			Pb	Zn	Pb	Zn
1 Pb Cleaner Conc.	11.5	0.58	73.3	2.68	21.4	0.4
2 Pb 4th Cl Tail	11.8	0.59	51.3	5.81	15.4	0.9
3 Pb 3rd Cl Tail	21.1	1.06	38.7	6.9	20.7	1.9
4 Pb 2nd Cl Tail	47.8	2.40	16.1	6.96	19.5	4.3
5 Pb 1st Cl Scav Conc.	18.3	0.92	4.05	7.24	1.9	1.7
6 Pb 1st Cl Scav Tail	129.8	6.52	1.39	5.85	4.6	9.6
7 Pb Scav Tail	1751	87.93	0.37	3.6	16.5	81.1
Head Calc.	1991.3	100.00	1.98	3.90	100.0	100.0

Combined Products

Products 1+2	1.17	62.16	4.27	36.6	1.3
Products 1-3	2.23	51.01	5.52	57.5	3.2
Products 1-4	4.63	32.91	6.27	77.1	7.4
Products 1-5	5.55	28.13	6.43	79.0	9.1
Products 1-6	12.07	13.69	6.12	83.5	18.9
Products 6+7	94.45	.44	3.76	21.0	90.9

Test No. 77

Purpose: Repeat Test 75, but replace LS8 with depressant DS20.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 4.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	DS20	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	200	-	-	-	40	-	-	-
Pb Rougher	-	-	5	25	-	-	1	4	10.1
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	2.5	10	-	-	1	3	-
Pb Regrind	-	75	20	-	-	20	-	-	-
Pb 1st Cl.	-	20	-	5	100	-	1	4	10.1
	-	-	2	5	-	-	1	5	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	5	5	50	-	1	4	-
	-	-	5	5	-	-	1	4	-
Pb 3rd Cl.	-	25	5	5	50	-	1	4	10.1
	-	-	5	-	-	-	1	3	-
Pb 4th Cl.	-	25	5	-	50	-	1	3	10.1

Test No. 77

Product	Q	Weight %	Assay %		% Distribution	
			Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	34	1.71	57.4	4.74	47.3	2.1
2. Pb 4th Cl. Tail	30.6	1.54	28.1	7.48	20.8	3.0
3. Pb 3rd Cl. Tail	25.4	1.28	12.3	7.19	7.6	2.4
4. Pb 2nd Cl. Tail	33.6	1.69	5.85	6.34	4.8	2.8
5. Pb 1st Cl. Scav. Conc.	18.3	0.92	2.71	6.44	1.2	1.5
6. Pb 1st Cl. Scav. Tail	160.5	8.08	0.83	5.4	3.2	11.3
7. Pb Scav. Tail	1663.8	84.77	0.37	3.49	15.1	76.8
Head Calc.	1986.2	100.00	2.08	3.85	100.0	100.0

Combined Products

Products 1+2	3.25	43.52	6.04	68.1	5.1
Products 1-3	4.53	34.71	6.36	75.7	7.5
Products 1-4	6.22	26.86	6.36	80.5	10.3
Products 1-5	7.14	23.75	6.37	81.7	11.8
Products 1-6	15.23	11.58	5.85	84.9	23.2
Products 6+7	92.86	41	3.66	18.3	88.2

Test No. 78

Purpose: Repeat Test 75, but replace LS8 by 50%.

Procedure: As shown below.

Feed: 2000 g of minus 10 mesh Composite 4.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	DS20	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	40	-	-	-
Pb Rougher	-	-	5	25	-	-	1	4	9.8
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	2.5	10	-	-	1	3	-
Pb Regrind	-	50	20	-	-	20	-	-	-
Pb 1st Cl.	-	10	-	5	100	-	1	4	9.5
	-	-	5	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	25	10	10	50	-	1	4	9.5
	-	-	5	5	-	-	1	4	-
Pb 3rd Cl.	-	12.5	5	10	50	-	1	3	9.5
	-	-	5	5	-	-	1	3	-
Pb 4th Cl.	-	-	5	10	-	-	1	3	-

Test No. 78

Product	θ	Weight %	Assey %		% Distribution	
			Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	56.4	2.63	53.8	5.49	71.4	4.1
2. Pb 4th Cl. Tail	12.3	0.62	15.7	6.03	4.5	1.3
3. Pb 3rd Cl. Tail	14.2	0.71	7.21	7.26	2.4	1.4
4. Pb 2nd Cl. Tail	29.1	1.46	3.69	7.02	2.7	2.7
5. Pb 1st Cl. Scav. Conc.	13.7	0.69	3.39	6.66	1.1	1.2
6. Pb 1st Cl. Scav. Tail	134.5	6.76	1.03	5.76	3.3	10.2
7. Pb Scav. Tail	1730.1	66.93	0.36	3.49	14.7	79.2
Head Calc.	1990.3	100.00	2.14	3.33	100.0	100.0

Combined Products

Products 1+2	3.45	46.93	5.91	75.9	5.4
Products 1-3	4.17	40.17	6.17	78.3	6.7
Products 1-4	5.63	30.74	6.39	61.0	9.4
Products 1-5	6.32	27.76	6.45	82.1	10.6
Products 1-6	13.07	13.94	6.10	85.3	20.8
Products 6+7	93.66	41	3.66	17.9	89.4

Test No. 84

Purpose: To perform a locked cycle test on Composite No. 4 using the Pb flotation conditions of Test 78 and the Zn flotation conditions of Test 65.

Procedure: As shown below.

Feed: 6 x 2000 g of minus 10 mesh Composite 4.

Grind: 40 minutes at 65% solids in a lab ball mill

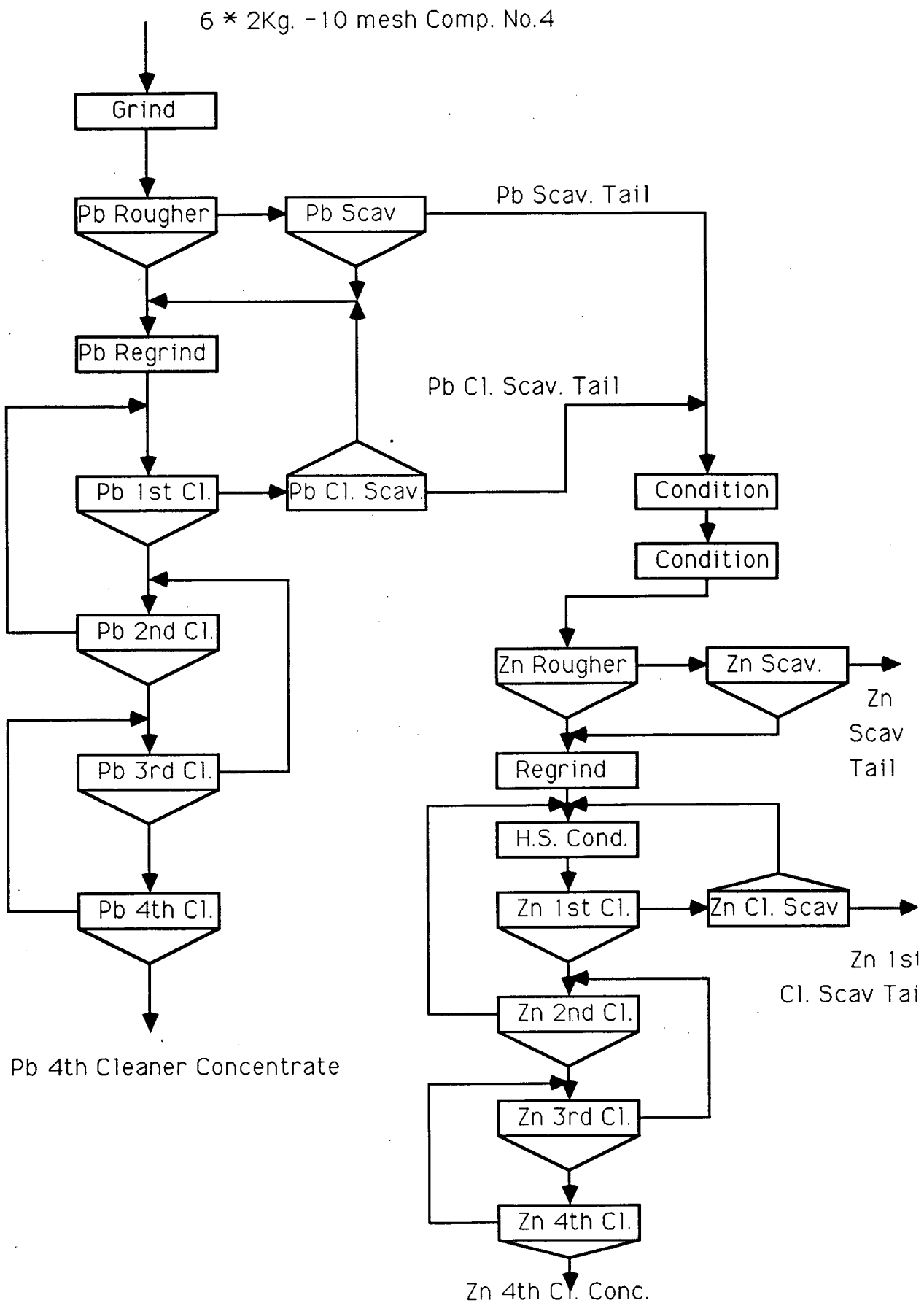
Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	150	-	-	-	40	-	-	-
Pb Rougher	-	-	5	25	-	-	1	4	9.8
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	5	10	-	-	1	3	-
Pb Re grind	-	50	20	-	-	20	-	-	-
Pb 1st Cl.	-	10	-	10	100	-	1	4	9.5
	-	-	5	5	-	-	1	4	-
Pb 1st Cl Scav	-	-	10	5	-	-	1	3	-
Pb 2nd Cl.	-	25	10	5	50	-	1	3	9.5
	-	-	5	2.5	-	-	1	3	-
Pb 3rd Cl.	-	12.5	5	5	50	-	1	3	-
Pb 4th Cl.	-	12.5	5	-	25	-	1	2	9.5

Feed: Pb Scavenger + Pb 1st Cleaner Scavenger Tailings

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	2500	-	-	-	-	5	-	12.4
	-	800	-	-	-	5	-	-
Zn Rougher	-	-	20	5	-	2	4	-
	-	-	10	2.5	-	1	3	-
Zn Re grind (PM)	1000	-	-	-	20	-	-	12.5
H.S. Condition	-	-	10	-	-	10	-	-
Zn 1st Cleaner	-	-	-	5	-	1	5	12.5
Zn 1st Cl Scav	-	-	10	5	-	1	3	-
Zn 2nd Cleaner	500	-	-	2.5	-	1	4	12.5
Zn 3rd Cleaner	500	-	-	-	-	1	3	12.5
Zn 4th Cleaner	500	-	-	-	-	1	2	12.5



3458B-84 Metallurgical Results

Product	Weight		Assays,%g/t						% Distribution			
	g	%	Pb	Zn	Fe	Au	Ag	Pb	Zn	Fe	Au	Ag
1. Pb CI Conc A	38.4	0.3	62.9	4.6	5.23	7.07	685.	9.8	0.4	0.2	5.0	7.2
2. Pb CI Conc B	48.9	0.4	56.4	5.5	6.53	6.73	694.	11.2	0.6	0.3	6.1	9.3
3. Pb CI Conc C	50.1	0.4	59.1	5.2	5.95	6.19	667.	12.0	0.6	0.3	5.7	9.2
4. Pb CI Conc D	48.4	0.4	59.6	4.8	5.33	5.83	673.	11.7	0.5	0.3	5.2	9.0
5. Pb CI Conc E	56.7	0.5	58.4	5.3	5.8	5.05	659.	13.4	0.7	0.3	5.3	10.3
6. Pb CI Conc F	49.2	0.4	60.1	5.3	5.8	5.42	683.	12.0	0.6	0.3	4.9	9.3
7. 4th CI Tail F	37.6	0.3	27.8	9	10.7	2.19	355.	4.2	0.7	0.4	1.5	3.7
8. 3rd CI Tail F	58.9	0.5	14.3	9.4	12.3	1.99	203.	3.4	1.2	0.8	2.2	3.3
9. 2nd CI Tail F	88.3	0.7	7.71	7.6	11.1	1.67	125.	2.8	1.5	1.0	2.7	3.0
10. 1st CI Scav Conc F	36.7	0.3	3.51	7.3	11.9	1.68	73.	0.5	0.6	0.5	1.1	0.7
11. Zn CL Conc A	77.2	0.6	0.43	54	8.83	0.43	27.3	0.1	9.2	0.7	0.6	0.6
12. Zn CL Conc B	119.4	1.0	0.52	52	8.86	0.27	27.4	0.3	13.7	1.1	0.6	0.9
13. Zn CL Conc C	113.3	1.0	0.54	53	8.84	0.35	35.4	0.2	13.3	1.1	0.7	1.1
14. Zn CL Conc D	115.5	1.0	0.53	54	8.33	0.33	40	0.2	13.8	1.0	0.7	1.3
15. Zn CL Conc E	132.5	1.1	0.62	53	8.69	0.36	39.8	0.3	15.6	1.2	0.9	1.5
16. Zn CL Conc F	112.7	0.9	0.59	54	8.45	0.53	38.2	0.3	13.4	1.0	1.1	1.2
17. Zn 4th CI Tail F	20.8	0.2	2.09	34	10.1	0.91	84	0.2	1.5	0.2	0.3	0.5
18. 3rd CI Tail F	57.4	0.5	2.44	19.6	11.6	1.00	80	0.6	2.5	0.7	1.1	1.3
19. 2nd CI Tail F	86.9	0.7	2.31	9.5	13.2	0.81	61.7	0.8	1.8	1.2	1.3	1.5
20. 1st CI Scav Conc F	86.7	0.7	2.11	7	17.8	0.92	53.8	0.7	1.3	1.6	1.5	1.3
21. 1st CI Scav Tail A	207.4	1.7	0.59	0.5	9.37	0.28	14	0.5	0.2	2.1	1.1	0.8
22. 1st CI Scav Tail B	275.5	2.3	0.54	0.4	9.1	0.29	12.2	0.6	0.3	2.7	1.5	0.9
23. 1st CI Scav Tail C	187.6	1.6	0.98	1	11.4	0.37	21.8	0.7	0.4	2.3	1.3	1.1
24. 1st CI Scav Tail D	218.2	1.8	1.18	1.5	13.1	0.41	26.7	1.0	0.7	3.0	1.6	1.6
25. 1st CI Scav Tail E	241.1	2.0	1.01	1.2	12.0	0.38	23.2	1.0	0.6	3.1	1.7	1.5
26. 1st CI Scav Tail F	220.9	1.9	1.19	1.6	12.2	0.52	27	1.1	0.8	2.9	2.1	1.6
27. Zn Ro Scav Tail A	1452.3	12.2	0.28	0.2	7.15	0.25	6.8	1.6	0.5	11.0	6.7	2.7
28. Zn Ro Scav Tail B	1410.6	11.8	0.25	0.2	7.1	0.23	6	1.4	0.5	10.5	6.0	2.3
29. Zn Ro Scav Tail C	1566.1	13.1	0.29	0.2	7.12	0.25	6.7	1.8	0.7	11.8	7.2	2.9
30. Zn Ro Scav Tail D	1558.8	13.1	0.28	0.2	7.3	0.25	6.6	1.8	0.6	12.0	7.2	2.8
31. Zn Ro Scav Tail E	1569.5	13.2	0.28	0.2	7.19	0.25	6.7	1.8	0.6	11.9	7.2	2.9
32. Zn Ro Scav Tail F	1581.0	13.3	0.3	0.2	7.37	0.27	6.1	1.9	0.6	12.3	7.9	2.7
Head (calc)	11924.6	100.0	2.07	3.80	7.9	0.45	30.5	100.0	100.0	100.0	100.0	100.0

Combined Products

Comb Pb Conc. 1 to 6	2.4	59.3	5.13	5.80	5.99	676	70.0	3.3	1.8	32.2	54.3
Comb Pb CI Tails 7to10	1.9	12.2	8.3	11.5	1.85	176	10.9	4.0	2.7	7.5	10.7
Comb Zn CI Conc. 11to16	5.6	0.55	53.3	8.66	0.37	35.2	1.5	78.8	6.1	4.6	6.5
Comb Zn CI Tails 17to20	2.1	2.25	12.9	14.2	0.90	65.0	2.3	7.2	3.8	4.2	4.5
Comb Zn CI Scav Tails 21to26	11.3	0.90	1.01	11.1	0.37	20.5	4.9	3.0	15.9	9.3	7.6
Comb Zn Ro Sc Tails 27to32	76.6	0.28	0.18	7.2	0.25	6.5	10.4	3.6	69.7	42.2	16.3

Projected Results Cycles E & F

Pb Cleaner Conc	2.8	59.2	5.27	5.80	5.22	670	80.9	3.9	2.1	34.1	64.5
Zn Cleaner Conc	6.2	0.61	53.6	8.58	0.44	39.1	1.8	88.1	6.8	6.3	8.3
Zn Scav. Tail	90.9	0.39	0.33	7.9	0.28	8.8	17.3	8.0	91.1	59.6	27.2
Head(calc)	100.0	2.07	3.80	7.9	0.45	30.5	100.0	100.0	100.0	100.0	100.0

APPENDIX NO. 6

Details of Tests on Composite No. 5

Test No. 82

Purpose: To investigate the flotation response of Composite No. 5 ore using the standard Pb-Zn flotation conditions.

Procedure: Similar to Test 67.

Feed: 2000 g of minus 10 mesh Composite 5.

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	200	-	-	-	40	-	-	9.8
Pb Rougher	-	-	5	15	-	-	1	3	-
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	2.5	10	-	-	1	3	-
Pb Re grind	-	75	20	-	-	30	-	-	-
Pb 1st Cl.	-	20	-	5	100	-	1	3	9.5
	-	-	1.0	5	-	-	1	3	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	2	-
Pb 2nd Cl.	-	50	-	5	50	-	1	3	9.8
	-	-	4.0	5	-	-	1	2	-
Pb 3rd Cl.	-	25	-	5	50	-	1	2	9.8
	-	-	2.0	5	-	-	1	2	-
Pb 4th Cl.	-	25	-	5	50	-	1	2	9.8

Feed: Pb Scavenger + Pb 1st Cleaner Scavenger Tailings

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	2500	-	-	-	-	5	-	11.8
	-	800	-	-	-	5	-	-
Zn Rougher	-	-	20	10	-	2	3	-

Test No. 82 - Continued

Size Analysis : Flotation Feed (40 minute Grind)

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 200 mesh	4.1	4.1	95.9
270	7.5	11.6	88.4
35.3 μm	17.5	29.1	70.9
27.3	14.3	43.4	56.6
19.1	19.1	62.5	37.5
13.1	12.3	74.8	25.2
10.1	5.4	80.2	19.8
- 10.1	19.8	100.0	-
Total	100.0	-	-

S.G. 3.66

Test No. 82

Product	#	Weight %	Assay, %		% Distribution	
			Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	18.8	0.96	54.0	1.5	78.2	1.6
2. Pb 4th Cl. Tail	7.4	0.36	13.6	2.56	7.8	1.1
3. Pb 3rd Cl. Tail	4.3	0.22	3.48	2.14	1.2	0.5
4. Pb 2nd Cl. Tail	10.0	0.51	1.6	1.99	1.2	1.1
5. Pb 1st Cl. Scaw Conc.	9.3	0.47	1.26	1.52	0.9	0.8
6. Znro. Conc.	194	9.86	0.24	7.21	3.6	7.7
7. Zn Scaw Tail	1723	87.60	0.054	0.18	7.2	17.2
Head Calc	1966.8	100.00	0.66	0.91	100.0	100.0

*41.6 g of tail feed removed for size analyses

Combined Products

Products 1+2	133	42.59	1.80	66.0	2.6
Products 1-3	1.55	37.08	1.85	87.1	3.1
Products 1-4	2.06	28.32	1.88	88.3	4.2
Products 1-5	3.53	23.26	1.81	89.2	5.0
Products 1+7	97.47	0.073	0.89	10.8	95.0

APPENDIX NO. 7

Details of Tests on the Master Composite

Test No. 81

Purpose: To investigate lead and zinc flotation on the Master Composite using the standard test conditions.

Procedure: Similar to Test 67.

Feed: 2000 g of minus 10 mesh Master Composite..

Grind: 40 minutes at 65% solids in a lab ball mill

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ CO ₃	NaCN	A317 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Grind	2000	200	-	-	-	40	-	-	9.4
Pb Rougher	-	-	5	15	-	-	1	4	-
Pb Scav.	-	-	5	10	-	-	1	3	-
	-	-	2.5	10	-	-	1	3	-
Pb Regrind	-	75	20	-	-	30	-	-	-
Pb 1st Cl.	-	20	-	5	100	-	1	4	9.4
	-	-	1.0	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cl.	-	50	-	2.5	50	-	1	4	9.4
	-	-	4.0	5	-	-	1	4	-
Pb 3rd Cl.	-	25	-	5	50	-	1	4	9.4
	-	-	2.0	5	-	-	1	3	-
Pb 4th Cl.	-	25	-	5	50	-	1	3	9.4
	-	-	2.0	5	-	-	1	3	-

Feed: Pb Scavenger + Pb 1st Cleaner Scavenger Tailings

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) ₂	CuSO ₄	A350	DF 1012	Grind	Cond.	Froth	
Zn Circuit: Condition	2500	-	-	-	-	5	-	11.8
	-	800	-	-	-	5	-	-
Zn Rougher	-	-	20	10	-	2	4	-
	-	-	10	5	-	1	3	-
Zn Regrind (PM) H.S. Condition	1000	-	-	-	30	-	-	-
	-	-	15	-	-	15	-	-
Zn 1st Cleaner	-	-	-	-	-	1	5	11.8
Zn 1st Cl Scav	-	-	10	5	-	1	3	-
Zn 2nd Cleaner	500	-	-	-	-	1	4	11.9
Zn 3rd Cleaner	500	-	-	-	-	1	3	12.0
Zn 4th Cleaner	500	-	-	-	-	1	2	12.0

Test No. 81 - Continued

Size Analysis : Flotation Feed

Particle Size	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 200 mesh	2.8	2.8	97.2
270	7.4	10.2	89.8
33.4 μm	15.2	25.4	74.6
25.9	12.3	37.7	62.3
18.1	18.7	56.4	43.6
12.4	13.0	69.4	30.6
9.6	6.6	76.0	24.0
- 9.6	24.0	100.0	-
Total	100.0	-	-

S.G. 3.94

Metallurgical Balance

Test No 41

Product	g	Weight %	Assays %		% Distribution	
			Pb	Zn	Pb	Zn
1. Pb Cleaner Conc.	106.4	5.49	56.0	9.46	81.7	11.6
2. Pb 4th Cl Tail	13.2	0.66	24.7	9.29	4.3	1.4
3. Pb 3rd Cl Tail	15.8	0.82	11.7	10.7	2.4	1.9
4. Pb 2nd Cl Tail	24.9	1.29	3.49	9.49	1.2	2.7
5. Pb 1st Cl Scav Conc.	11	0.57	2.33	11.6	0.3	1.5
6. Zn Cleaner Conc.	96.1	4.96	1.34	52.6	1.7	58.4
7. Zn 4th Cl Tail	19.3	1.00	1.60	36.6	0.4	8.6
8. Zn 3rd Cl Tail	12.3	0.64	1.57	19.5	0.3	2.8
9. Zn 2nd Cl Tail	22.6	1.17	1.00	7.2	0.3	1.9
10. Zn 1st Cl Scav Conc.	45.3	2.34	0.96	3.95	0.6	2.1
11. Zn 1st Cl Scav Tail	139.9	7.22	0.41	0.81	0.8	1.3
12. Zn Scav Tail	1429.6	73.83	0.32	0.36	6.1	5.9
Head Tail	1936.4	100.00	3.90	4.49	100.0	100.0

*47.5g removed for size analyses

Combined Products

Products 1+2	6.18	54.3	9.4	86.0	13.0
Products 1-3	6.99	49.4	9.6	88.4	14.9
Products 1-4	8.28	42.2	9.6	89.6	17.6
Products 1-5	8.65	39.7	9.7	89.9	19.1
Products 6+7	5.96	1.38	50.5	2.1	67.0
Products 6-8	6.59	1.40	47.5	2.4	69.7
Products 6-9	7.76	1.34	41.1	2.7	71.6
Products 6-10	10.10	1.26	32.7	3.3	73.7
Products 6-11	17.33	0.90	19.4	4.0	75.0
Product 6-12	31.15	0.43	3.68	10.1	80.9
Products 11+12	81.05	0.33	0.40	6.8	7.2

APPENDIX NO. 8

Work Index Data

BOND BALL MILL CLOSED CIRCUIT GRINDABILITY TEST

Sample: Composite 1A

Mesh of Grind: 150 Mesh

Feed: 30.9 % Passing 150 Mesh

Cycle	New Feed g	Number of Revolutions	grams of minus 150 mesh			
			In Mill Product	In Mill Feed	Net Product	Net Per Revolution
1	1907	150	858	589	269	1.79
2	858	156	588	265	323	2.07
3	588	175	568	182	386	2.21
4	568	167	536	176	360	2.16
5	536	175	547	166	381	2.18
6	547	172	529	169	360	2.09
7	529	183	563	163	400	2.18
8	563	170	564	174	390	2.29
9	564	162	543	174	369	2.28
10	543	165	549	168	381	2.31

Unit Volume (700 ml) = 1907 g in mill : Equivalent to 2724 kg/m³ at minus 10 mesh

Ideal potential product = 545 g

Average of last 2 periods: 546 g : 250 % circulating load

2.29 Net g minus 150 mesh per revolution

Bonds Formula

$$W_i = \frac{44.5}{S^{0.23} \times N^{0.82} \times \left\{ \frac{10}{\sqrt{P}} - \frac{10}{\sqrt{F}} \right\}}$$

where:

W	=	Work Index (Bond)	=	9.96
S	=	Screen size, in μm	=	104
N	=	Net grams of undersize produced per revolution of test mill	=	2.29
P	=	Size in μm , 80% passing in product	=	83
F	=	Size in μm , 80% passing in feed	=	980

Project No. 3458B

Date Nov 17, 8

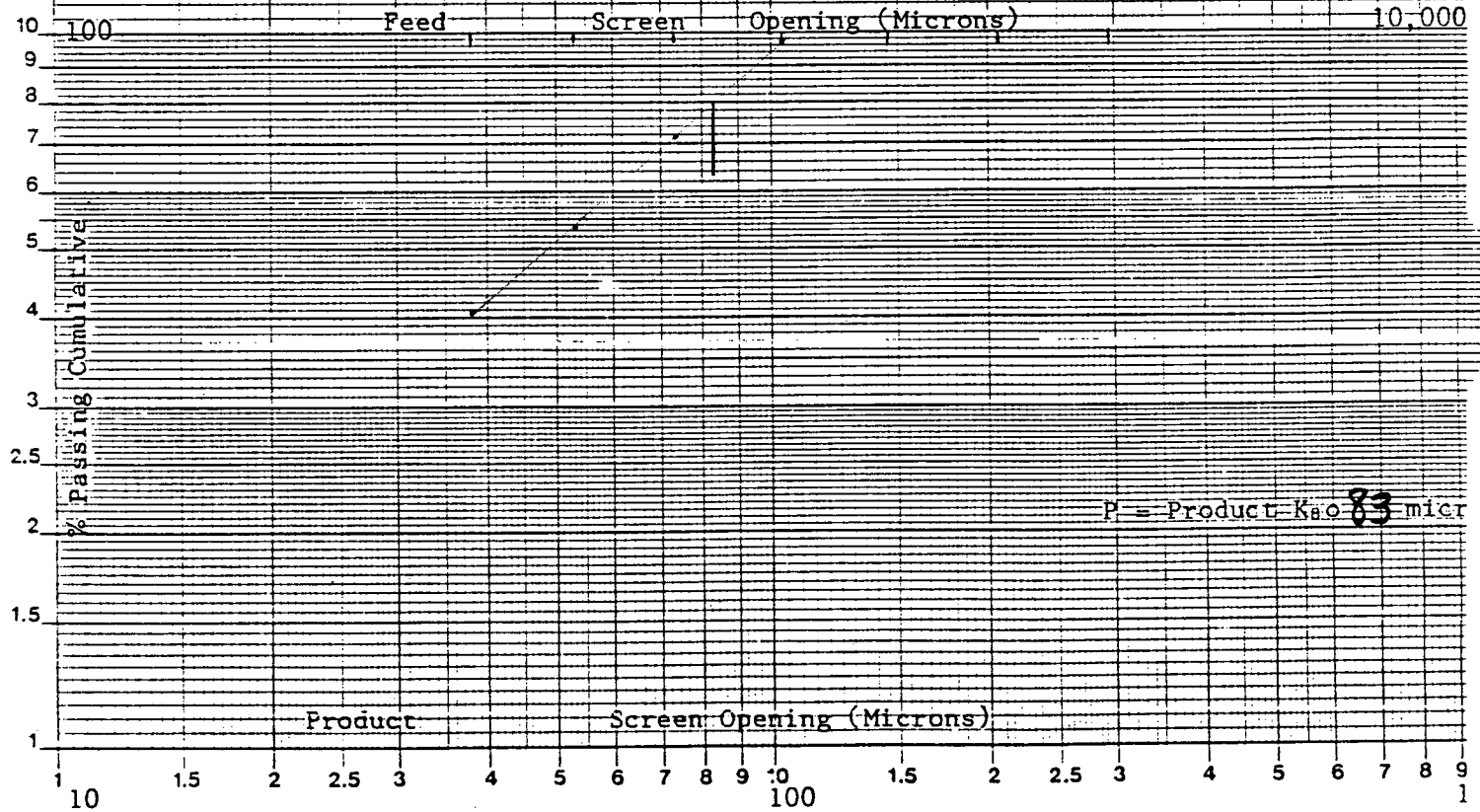
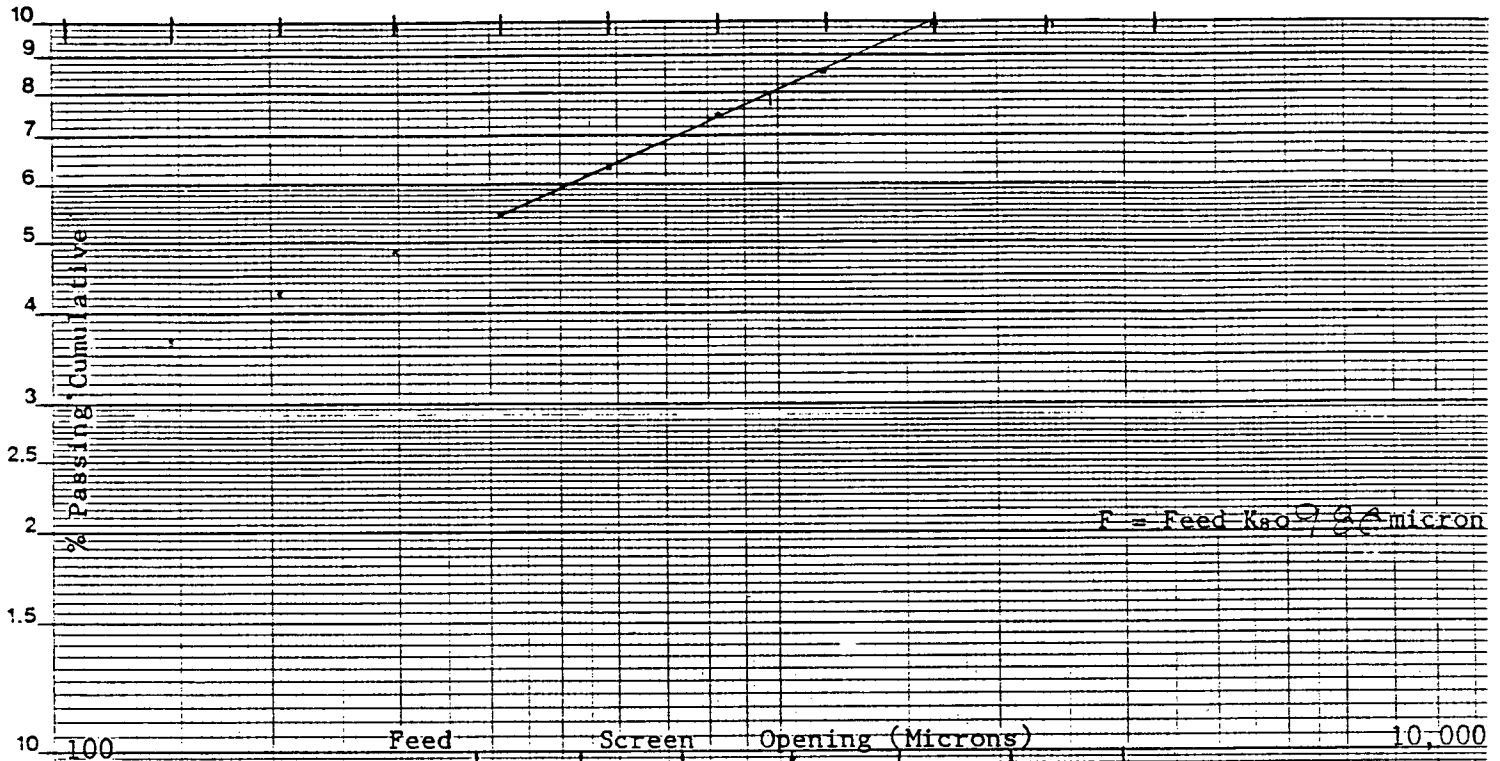
Screen Size Analysis for Bond Work Index

240

Feed of Sample: COMP 1A -10M

GRAPHIC CONTROLS CANADA LTD.
GARRARD, ONTARIO M7A 1E1 CANADA

GRF 6110 LOG-PROTHMIC 2X2 CYCLES
SPECIFY TRACING OR DRAWING PAPER



Composite 1A - Bond Work Index - Continued

SCREEN ANALYSES**-10 Mesh Feed**

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 10	0.8	0.8	99.2
14	13.4	14.2	85.8
20	11.3	25.5	74.5
28	11.1	36.6	63.4
35	8.6	45.2	54.8
48	6.5	51.7	48.3
65	5.7	57.4	42.6
100	5.7	63.1	36.9
150	6.0	69.1	30.9
200	6.6	75.7	24.3
270	5.0	80.7	19.3
400	4.3	85.0	15.0
- 400	15.0	100.0	-
Total	100.0	-	-

-150 mesh Product

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 150	2.5	2.5	97.5
200	25.9	28.4	71.6
270	18.1	46.5	53.5
400	12.7	59.2	40.8
- 400	40.8	100.0	-
Total	100.0	-	-

BOND BALL MILL CLOSED CIRCUIT GRINDABILITY TEST

Sample: Composite 1A

Mesh of Grind: minus 200 Mesh

Feed: 24.3 % Passing 200 Mesh

Cycle	New Feed g	Number of Revolutions	grams of minus 200 mesh			
			In Mill Product	In Mill Feed	Net Product	Net Per Revolution
1	1921	202	808	467	341	1.69
2	808	200	551	196	355	1.77
3	551	234	538	134	404	1.73
4	538	242	548	131	417	1.72
5	548	242	554	133	421	1.74
6	554	238	543	135	408	1.71

Unit Volume (700 ml) = 1921 g in mill : Equivalent to 2744 kg/m³ at minus 10 mesh

Ideal potential product = 549 g

Average of last 3 periods: 548 g : 250 % circulating load

1.72 Net g minus 200 mesh per revolution

Bonds Formula

$$W_i = \frac{44.5}{S^{0.23} \times N^{0.82} \times \left\{ \frac{10}{\sqrt{P}} - \frac{10}{\sqrt{F}} \right\}}$$

where:

W	=	Work Index (Bond)	=	10.9
S	=	Screen size, in μm	=	74
N	=	Net grams of undersize produced per revolution of test mill	=	1.72
P	=	Size in μm , 80% passing in product	=	860
F	=	Size in μm , 80% passing in feed	=	980

Project No. 3458B

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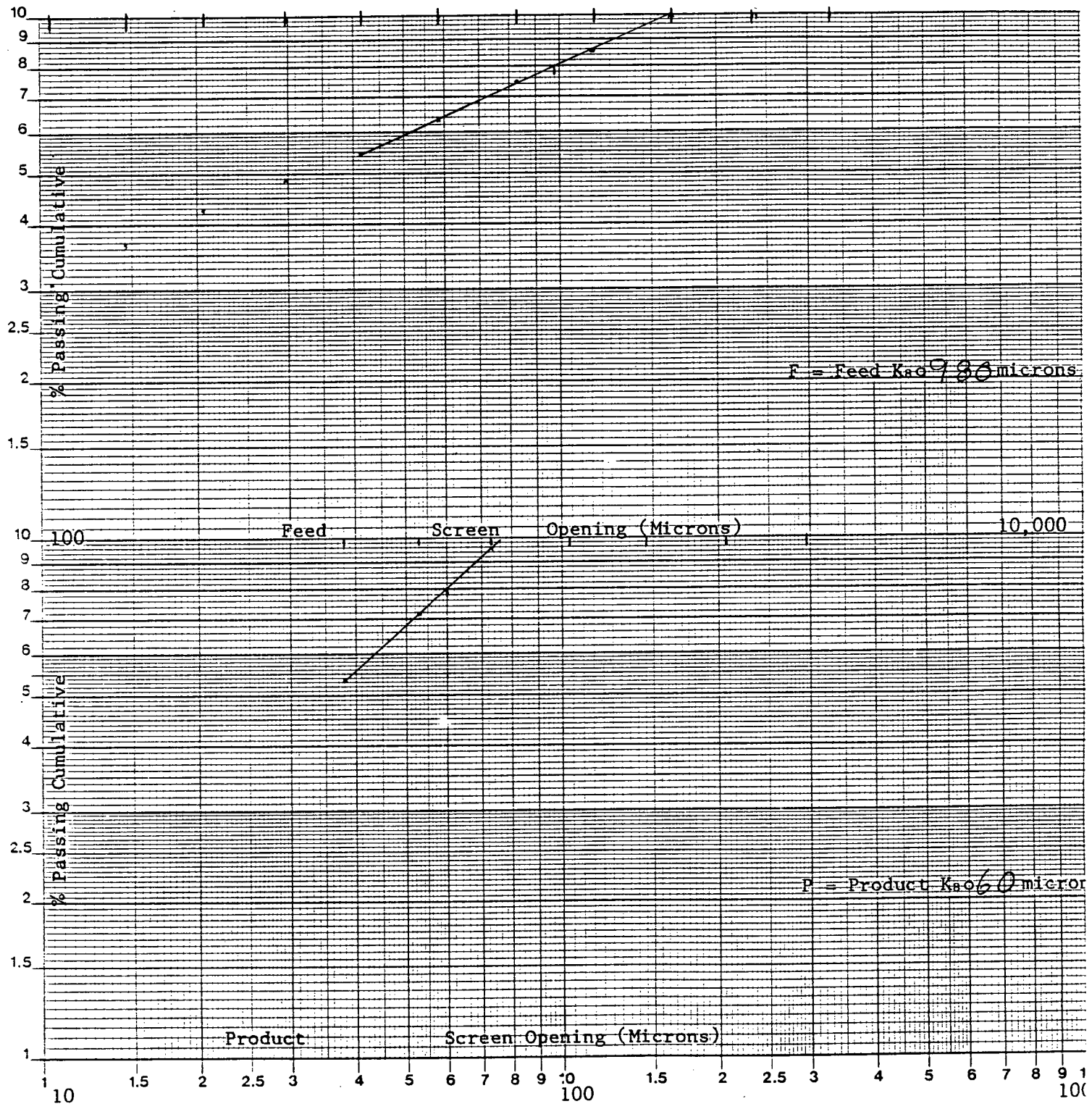
Date Nov 17, 89

Screen Size Analysis for Bond Work Index DN 200M

Feed of Sample: COMP 1A -10M

GRAPHIC CONTROLS CANADA LTD.
CANADIAN DIVISION OF THE GRAPHIC

GRF GT10 LOGARITHMIC 2X2 CYCLES
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Composite 1A - Bond Work Index - Continued

SCREEN ANALYSES**-10 Mesh Feed**

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 10	0.8	0.8	99.2
14	13.4	14.2	85.8
20	11.3	25.5	74.5
28	11.1	36.6	63.4
35	8.6	45.2	54.8
48	6.5	51.7	48.3
65	5.7	57.4	42.6
100	5.7	63.1	36.9
150	6.0	69.1	30.9
200	6.6	75.7	24.3
270	5.0	80.7	19.3
400	4.3	85.0	15.0
- 400	15.0	100.0	-
Total	100.0	-	-

-200 mesh Product

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 200	4.1	4.1	95.9
270	24.5	28.6	71.4
400	17.9	46.5	53.5
- 400	53.5	100.0	-
Total	100.0	-	-

BOND BALL MILL CLOSED CIRCUIT GRINDABILITY TEST

Sample: Composite 1B

Mesh of Grind: 150 Mesh

Feed: 27.1 % Passing 150 Mesh

Cycle	New Feed g	Number of Revolutions	grams of minus 150 mesh			
			In Mill Product	In Mill Feed	Net Product	Net Per Revolution
1	2073	150	846	562	284	1.89
2	846	192	661	229	432	2.25
3	661	184	587	179	408	2.22
4	587	195	617	159	458	2.35
5	617	181	594	167	427	2.36
6	594	183	585	161	424	2.32
7	585	187	593	159	434	2.32

Unit Volume (700 ml) = 2073 g in mill : Equivalent to 2961 kg/m³ at minus 10 mesh

Ideal potential product = 592 g

Average of last 3 periods: 591 g : 251 % circulating load

2.33 Net g minus 150 mesh per revolution

Bonds Formula

$$W_i = \frac{44.5}{S^{0.23} \times N^{0.82} \times \left\{ \frac{10}{\sqrt{P}} - \frac{10}{\sqrt{F}} \right\}}$$

where:

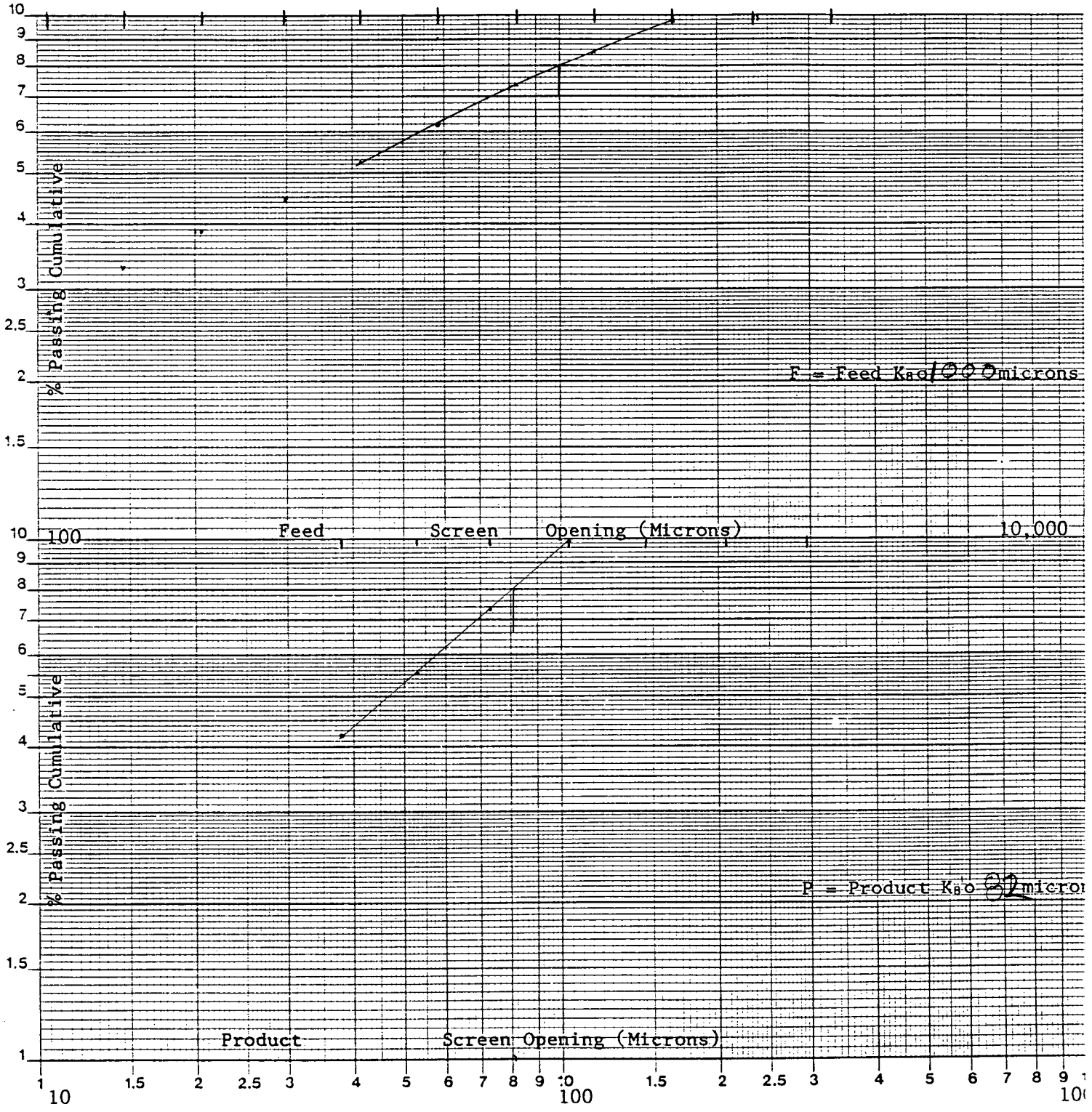
W	=	Work Index (Bond)	=	9.70
S	=	Screen size, in μm	=	104
N	=	Net grams of undersize produced per revolution of test mill	=	2.33
P	=	Size in μm , 80% passing in product	=	82
F	=	Size in μm , 80% passing in feed	=	1000

Screen Size Analysis for Bond Work Index

Feed of Sample: COMP 1B

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CANADIAN MADE IN CANADA

GRF G110 LOGARITHMIC 2 X 2 CYCLES
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Composite 1B - Bond Work Index - Continued

SCREEN ANALYSES**-10 Mesh Feed**

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 10	1.2	1.2	98.8
14	13.7	14.9	85.1
20	11.3	26.2	73.8
28	11.9	38.1	61.9
35	9.7	47.8	52.2
48	7.4	55.2	44.8
65	6.1	61.3	38.7
100	5.7	67.0	33.0
150	5.9	72.9	27.1
200	5.4	78.3	21.7
270	4.9	83.2	16.8
400	3.9	87.1	12.9
- 400	12.9	100.0	-
Total	100.0	-	-

-150 mesh Product

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 150	1.1	1.1	98.9
200	25.4	26.5	73.5
270	18.3	44.8	55.2
400	13.1	57.9	42.1
- 400	42.1	100.0	-
Total	100.0	-	-

BOND BALL MILL CLOSED CIRCUIT GRINDABILITY TEST

Sample: Composite 2

Mesh of Grind: 150 Mesh

Feed: 22.5 % Passing 150 Mesh

Cycle	New Feed g	Number of Revolutions	grams of minus 150 mesh			
			In Mill Product	In Mill Feed	Net Product	Net Per Revolution
1	1964	150	788	442	346	2.31
2	788	166	544	177	367	2.21
3	544	199	627	122	505	2.54
4	627	165	539	141	398	2.41
5	539	183	576	121	455	2.49
6	576	173	557	130	427	2.47
7	557	177	541	125	416	2.35
8	541	187	560	122	438	2.34
9	560	186	569	126	443	2.38

Unit Volume (700 ml) = 1964 g in mill : Equivalent to 2806 kg/m³ at minus 10 mesh

Ideal potential product = 561 g

Average of last 3 periods: 557 g : 253 % circulating load

2.36 Net g minus 150 mesh per revolution

Bonds Formula

$$W_i = \frac{44.5}{S^{0.23} \times N^{0.82} \times \left\{ \frac{10}{\sqrt{P}} - \frac{10}{\sqrt{F}} \right\}}$$

where:

W	=	Work Index (Bond)	=	8.9
S	=	Screen size, in μm	=	104
N	=	Net grams of undersize produced per revolution of test mill	=	2.36
P	=	Size in μm , 80% passing in product	=	78
F	=	Size in μm , 80% passing in feed	=	1230

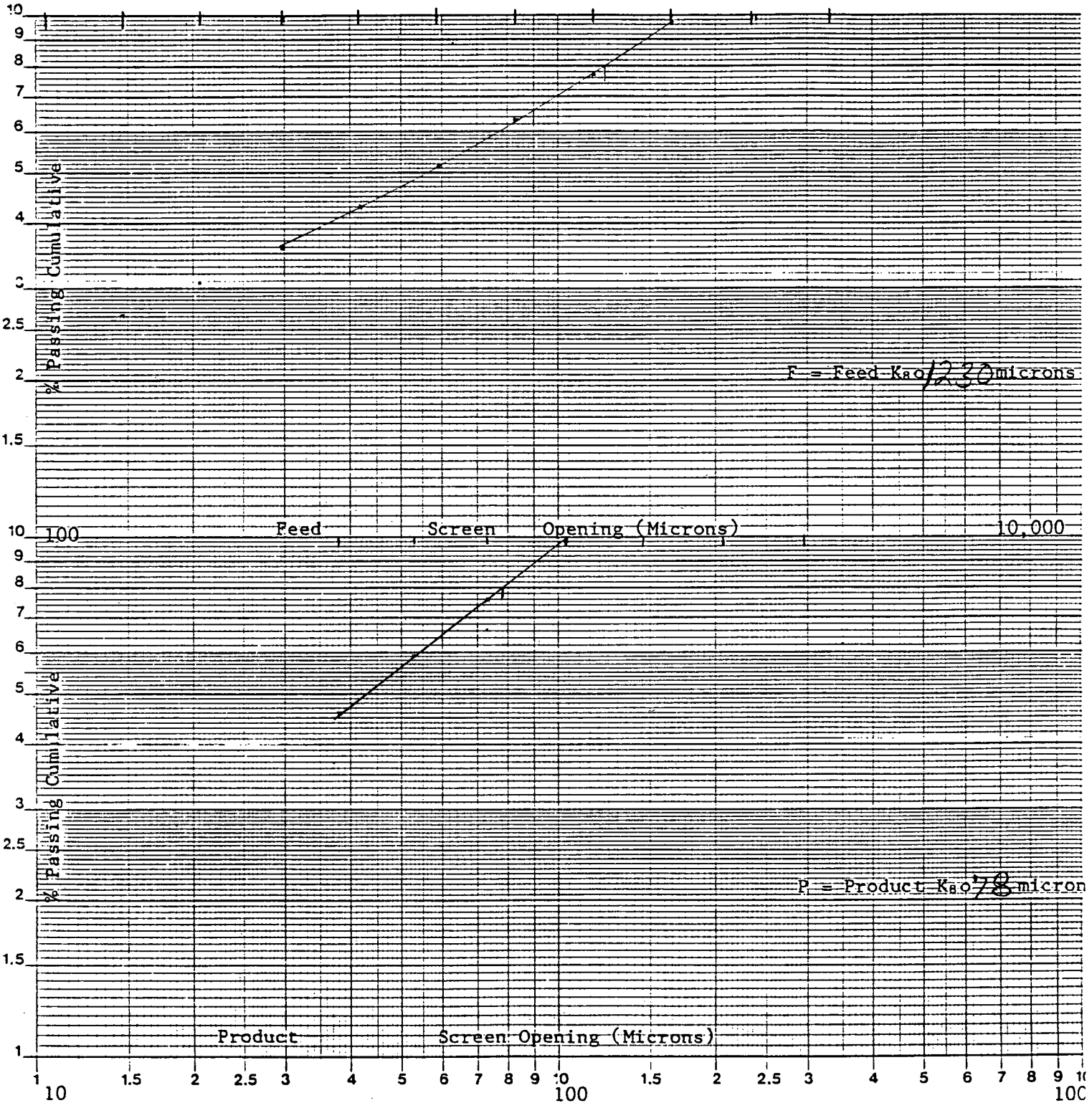
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Screen Size Analysis for Bond Work Index

Feed of Sample: COMP 2



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Composite 2 - Bond Work Index - Continued

SCREEN ANALYSES-10 Mesh Feed

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 10	3.6	3.6	96.4
14	19.6	23.2	76.8
20	13.4	36.6	63.4
28	12.0	48.6	51.4
35	8.4	57.0	43.0
48	7.1	64.1	35.9
65	5.0	69.1	30.9
100	4.3	73.4	26.6
150	4.1	77.5	22.5
200	3.5	81.0	19.0
270	3.3	84.3	15.7
400	3.1	87.4	12.6
- 400	12.6	100.0	-
Total	100.0	-	-

-150 mesh Product

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 150	0.7	0.7	99.3
200	23.3	24.0	76.0
270	16.8	40.8	59.2
400	13.2	54.0	46.0
- 400	46.0	100.0	-
Total	100.0	-	-

BOND BALL MILL CLOSED CIRCUIT GRINDABILITY TEST

Sample: Composite 2

Mesh of Grind: 200 Mesh

Feed: 19.0 % Passing 200 Mesh

Cycle	New Feed g	Number of Revolutions	grams of minus 150 mesh			
			In Mill Product	In Mill Feed	Net Product	Net Per Revolution
1	1972	200	744	375	369	1.85
2	744	220	576	141	435	1.98
3	576	230	561	109	452	1.97
4	561	232	565	107	458	1.97
5	565	232	545	107	438	1.89
6	545	243	550	104	446	1.84
7	550	249	564	105	459	1.84
8	564	248	572	107	465	1.87

Unit Volume (700 ml) = 1972 g in mill : Equivalent to 2817 kg/m³ at minus 10 mesh

Ideal potential product = 564 g

Average of last 3 periods: 562 g : 251 % circulating load

1.85 Net g minus 200 mesh per revolution

Bonds Formula

$$W_i = \frac{44.5}{S^{0.23} \times N^{0.82} \times \left\{ \frac{10}{\sqrt{P}} - \frac{10}{\sqrt{F}} \right\}}$$

where:

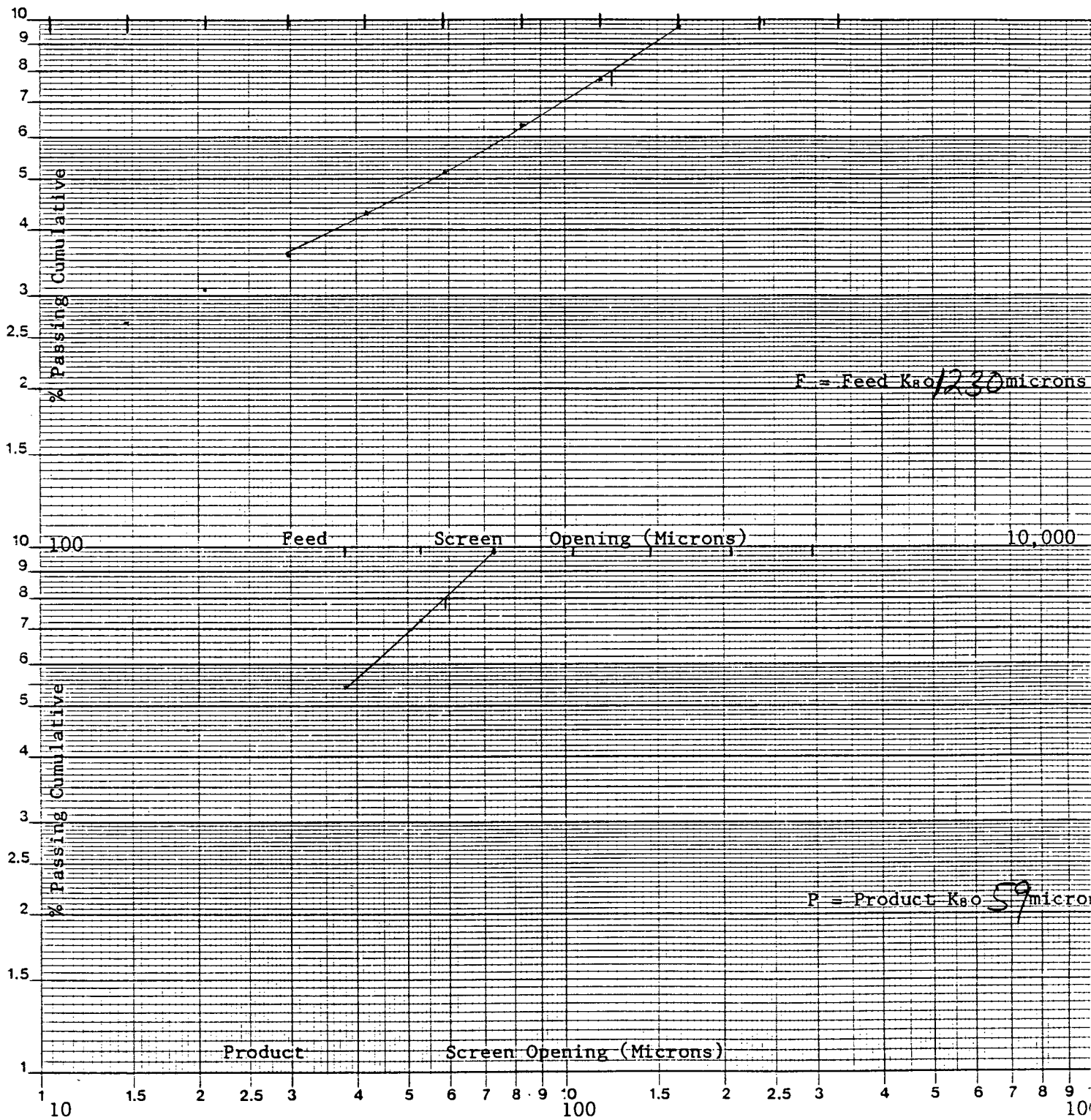
W	=	Work Index (Bond)	=	9.8
S	=	Screen size, in μm	=	74
N	=	Net grams of undersize produced per revolution of test mill	=	1.85
P	=	Size in μm , 80% passing in product	=	59
F	=	Size in μm , 80% passing in feed	=	1230

Screen Size Analysis for Bond Work Index

Feed of Sample: COMP 2

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Composite 2 - Bond Work Index - Continued

SCREEN ANALYSES**-10 Mesh Feed**

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 10	3.6	3.6	96.4
14	19.6	23.2	76.8
20	13.4	36.6	63.4
28	12.0	48.6	51.4
35	8.4	57.0	43.0
48	7.1	64.1	35.9
65	5.0	69.1	30.9
100	4.3	73.4	26.6
150	4.1	77.5	22.5
200	3.5	81.0	19.0
270	3.3	84.3	15.7
400	3.1	87.4	12.6
- 400	12.6	100.0	-
Total	100.0	-	-

-200 mesh Product

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 200	1.9	1.9	98.1
270	25.4	27.3	72.7
400	18.4	45.7	54.3
- 400	54.3	100.0	-
Total	100.0	-	-

BOND BALL MILL CLOSED CIRCUIT GRINDABILITY TEST

Sample: Composite 3

Mesh of Grind: 150 Mesh

Feed: 32.2 % Passing 150 Mesh

Cycle	New Feed g	Number of Revolutions	grams of minus 150 mesh			
			In Mill Product	In Mill Feed	Net Product	Net Per Revolution
1	2423	100	1202	780	422	4.22
2	1202	72	613	387	226	3.14
3	613	158	692	197	495	3.13
4	692	150	683	222	461	3.07
5	683	154	691	220	471	3.06
6	691	153	692	223	469	3.07

Unit Volume (700 ml) = 2423 g in mill : Equivalent to 3461 kg/m³ at minus 150 mesh

Ideal potential product = 692 g

Average of last 2 periods: 692 g : 250 % circulating load

3.07 Net g minus 150 mesh per revolution

Bonds Formula

$$W_i = \frac{44.5}{S^{0.23} \times N^{0.82} \times \left\{ \frac{10}{\sqrt{P}} - \frac{10}{\sqrt{F}} \right\}}$$

where:

W	=	Work Index (Bond)	=	7.9
S	=	Screen size, in μm	=	104
N	=	Net grams of undersize produced per revolution of test mill	=	3.07
P	=	Size in μm , 80% passing in product	=	81
F	=	Size in μm , 80% passing in feed	=	890

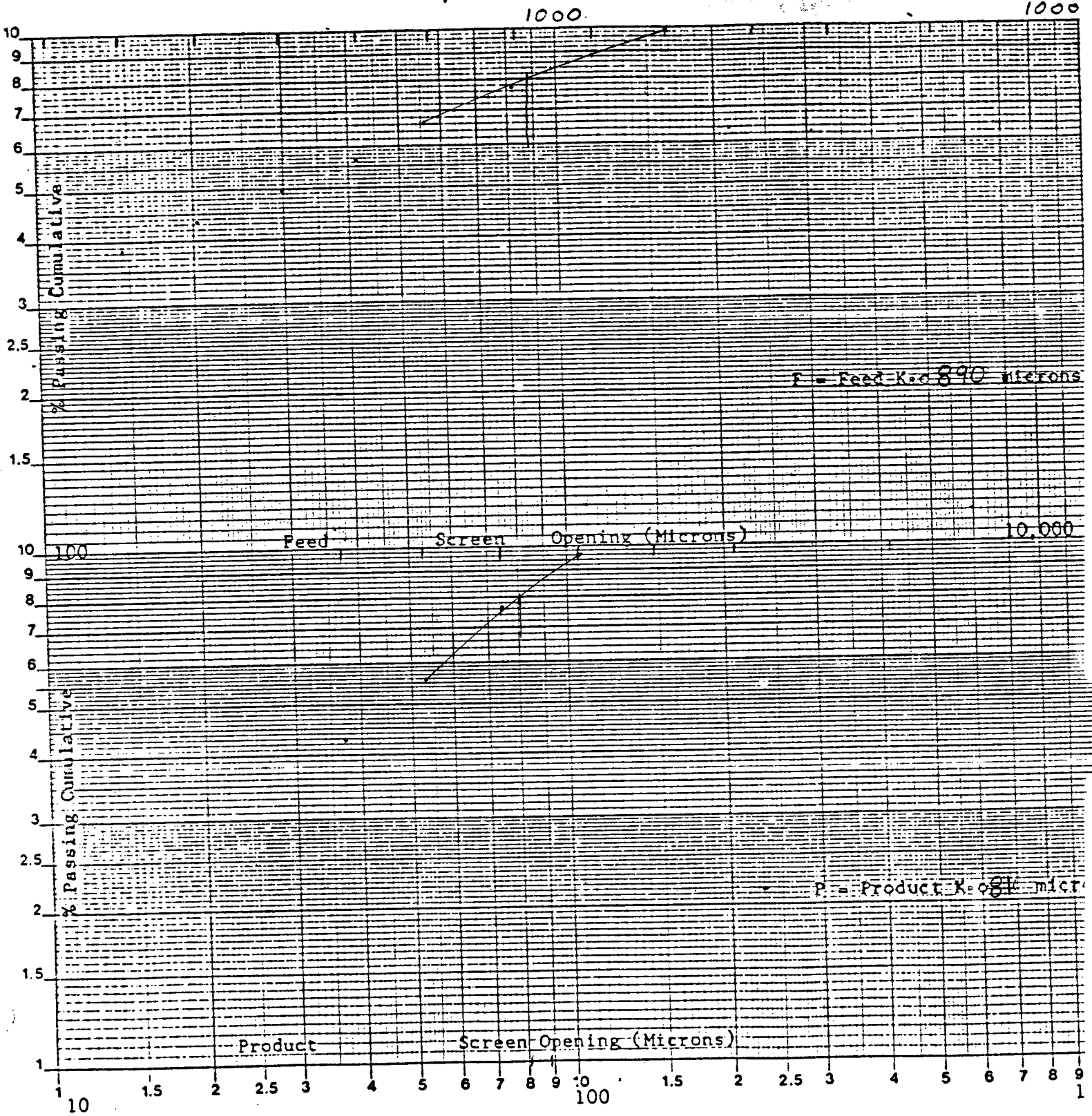
Project No. 3458 B

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Date June 8/88

Screen Size Analysis for Bond Work Index

Feed of Sample: Comp #3



Composite 3 - Bond Work Index - Continued

SCREEN ANALYSES**-10 Mesh Feed**

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 10	0.5	0.5	99.5
14	11.3	11.8	88.2
20	11.1	22.9	77.1
28	11.0	33.9	66.1
35	9.6	43.5	56.5
48	6.9	50.4	49.6
65	6.2	56.6	43.4
100	5.3	61.9	38.1
150	5.9	67.8	32.2
200	5.4	73.2	26.8
270	5.5	78.7	21.3
400	4.2	82.9	17.1
- 400	17.1	100.0	-
Total	100.0	-	-

-150 mesh Product

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 150	3.8	3.8	96.2
200	23.2	27.0	73.0
270	17.4	44.4	55.6
400	12.9	57.3	42.7
- 400	42.7	100.0	-
Total	100.0	-	-

BOND BALL MILL CLOSED CIRCUIT GRINDABILITY TEST

Sample: Composite 3

Mesh of Grind: 200 Mesh

Feed: 17.4 % Passing 200 Mesh

Cycle	New Feed g	Number of Revolutions	grams of minus 200 mesh			
			In Mill Product	In Mill Feed	Net Product	Net Per Revolution
1	2052	200	743	357	386	1.93
2	743	425	961	129	832	1.96
3	961	214	637	167	470	2.20
4	637	216	598	111	487	2.25
5	598	214	577	104	473	2.21
6	577	220	582	100	482	2.19

Unit Volume (700 ml) = 2052 g in mill : Equivalent to 2931 kg/m³ at minus 6 mesh

Ideal potential product = 586 g

Average of last 3 periods: 586 g : 250 % circulating load

2.22 Net g minus 200 mesh per revolution

Bonds Formula

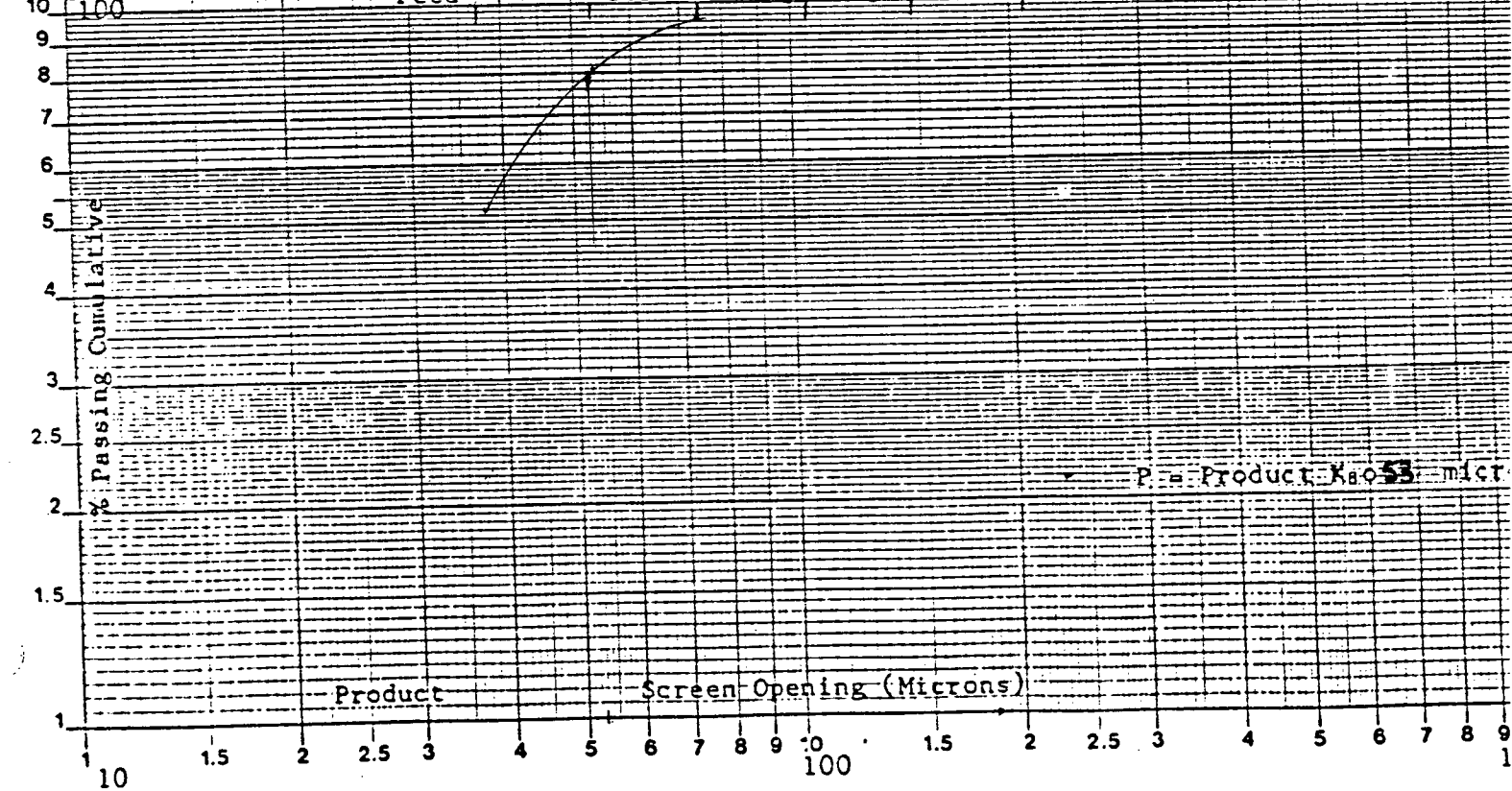
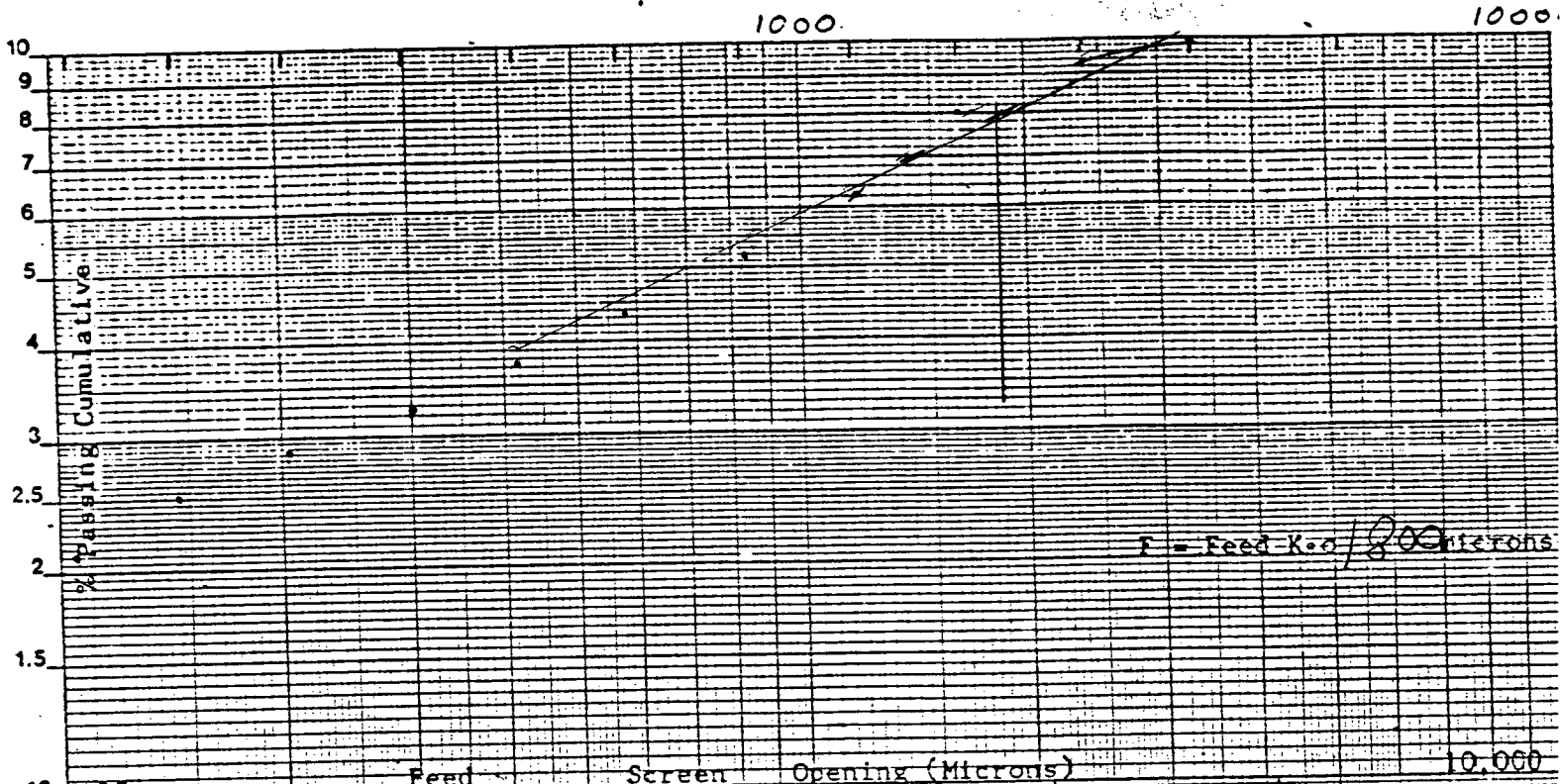
$$W_i = \frac{44.5}{S^{0.23} \times N^{0.82} \times \left\{ \frac{10}{\sqrt{P}} - \frac{10}{\sqrt{F}} \right\}}$$

where:

W	=	Work Index (Bond)	=	7.6
S	=	Screen size, in μm	=	74
N	=	Net grams of undersize produced per revolution of test mill	=	2.22
P	=	Size in μm , 80% passing in product	=	53
F	=	Size in μm , 80% passing in feed	=	1800

Screen Size Analysis for Bond Work Index

Feed of Sample: Comp #3



Composite 3 - Bond Work Index - Continued

SCREEN ANALYSES**-10 Mesh Feed**

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 6	0.1	0.1	99.9
8	7.1	7.2	92.8
10	12.6	19.8	80.2
14	17.9	37.7	62.3
20	10.4	48.1	51.9
28	8.3	56.4	43.6
35	6.4	62.8	37.2
48	4.5	67.3	32.7
65	4.1	71.4	28.6
100	3.5	74.9	25.1
150	4.0	78.9	21.1
200	3.7	82.6	17.4
270	3.5	86.1	13.9
400	2.9	89.0	11.0
- 400	11.0	100.0	--
Total	100.0	-	-

-200 mesh Product

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 200	5.5	5.5	94.5
270	24.0	29.5	80.5
400	18.8	48.3	51.7
- 400	51.7	100.0	-
Total	100.0	-	-

BOND BALL MILL CLOSED CIRCUIT GRINDABILITY TEST

Sample: Composite 4

Mesh of Grind: 150 Mesh

Feed: 19.6 % Passing 150 Mesh

Cycle	New Feed g	Number of Revolutions	grams of minus 150 mesh			
			In Mill Product	In Mill Feed	Net Product	Net Per Revolution
1	1373	150	497	269	228	1.52
2	497	194	373	97	276	1.42
3	373	225	438	73	365	1.62
4	438	189	412	86	326	1.72
5	412	181	404	81	323	1.78
6	404	176	392	79	313	1.78
7	392	176	404	78	326	1.85

Unit Volume (700 ml) = 1373 g in mill : Equivalent to 1961 kg/m³ at minus 10 mesh

Ideal potential product = 392 g

Average of last 3 periods: 400 g : 243 % circulating load

1.80 Net g minus 150 mesh per revolution

Bonds Formula

$$W_i = \frac{44.5}{S^{0.23} \times N^{0.82} \times \left\{ \frac{10}{\sqrt{P}} - \frac{10}{\sqrt{F}} \right\}}$$

where:	W	=	Work Index (Bond)	=	11.57
	S	=	Screen size, in μm	=	104
	N	=	Net grams of undersize produced per revolution of test mill	=	1.80
	P	=	Size in μm , 80% passing in product	=	81
	F	=	Size in μm , 80% passing in feed	=	1150

Composite 4 - Bond Work Index - Continued

SCREEN ANALYSES-10 Mesh Feed

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 10	1.6	1.6	98.4
14	17.9	19.5	80.5
20	15.1	34.6	65.4
28	15.1	49.7	50.3
35	10.8	60.5	39.5
48	7.0	67.5	32.5
65	5.0	72.5	27.5
100	4.0	76.5	23.5
150	3.9	80.4	19.6
200	3.2	83.6	16.4
270	3.0	86.6	13.4
400	2.9	89.5	10.5
- 400	10.5	100.0	-
Total	100.0	-	-

-150 mesh Product

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 150	1.8	1.8	98.2
200	24.2	26.0	74.0
270	17.9	43.9	56.1
400	13.3	57.2	42.8
- 400	42.8	100.0	-
Total	100.0	-	-