

metallurgical

File

003993

An Investigation of  
**THE RECOVERY OF LEAD AND ZINC**

from Grum Ore samples  
submitted by

**CURRAGH RESOURCES**

Progress Report No. 4

Project No. L.R. 4237

NOTE:

This report refers to the samples as received.

The practice of this Company in issuing reports of this nature is to require the recipient not to publish the report or any part thereof without the written consent of Lakefield Research.

LAKEFIELD RESEARCH  
A DIVISION OF FALCONBRIDGE LIMITED  
February 19, 1992

C 917 - - -

# TABLE OF CONTENTS

	Page No.
<b>ABSTRACT</b>	1 - 2
<b>INTRODUCTION</b>	3
<b>SUMMARY AND CONCLUSIONS</b>	4 - 9
1. Description of Samples Used in the Laboratory Testwork	4
2. Laboratory Testwork	4
2.1. Batch Flotation Testwork	4
2.2. Continuous Locked Cycle Tests	5 - 8
2.3. Batch Tests on Grum Siliceous Ore	9
3. Conclusions	9
<b>RECOMMENDATIONS</b>	10 - 13
<b>DISCUSSION</b>	14 - 20
1. Description of Samples Used in the Laboratory Testwork	14 - 15
2. Laboratory Testwork	15
2.1. Preliminary Batch Scale Flotation Testwork	15 - 17
2.2. Effect of Different Regrinding Configurations	17 - 18
2.3. Continuous Locked Cycle Tests	18 - 19
3. Standard Laboratory Tests on Quartzite Ore	19 - 20
<b>DETAILS OF TESTS</b>	21 - 55

# ABSTRACT

Laboratory testwork was conducted on Grum Composite G-3A (similar to Composite G-3 described in Progress Report No. 3 - Project LR-3733) to determine the positioning of the lead regrinding mills in preparation for the Faro Plant processing the Grum Ore.

Because the Grum Ore is finely disseminated and liberation of lead minerals occurs at  $<15 \mu\text{m}$  size, the present Faro regrinding capacity would not provide the required fineness of regrind. Additional regrinding capacity and revision of the existing circuit would be required to provide maximum fineness. From the plant survey data conducted on the lead regrind circuit during treatment of the Vangorda Ore and from this laboratory testwork, it was determined that the lead regrind flowsheet configuration shown in Figure No. 1 would give the maximum regrinding fineness during the treatment of Grum Ore. The results obtained in continuous batch tests using the flowsheet shown in Figure No. 1 are summarized in Table No. 1.

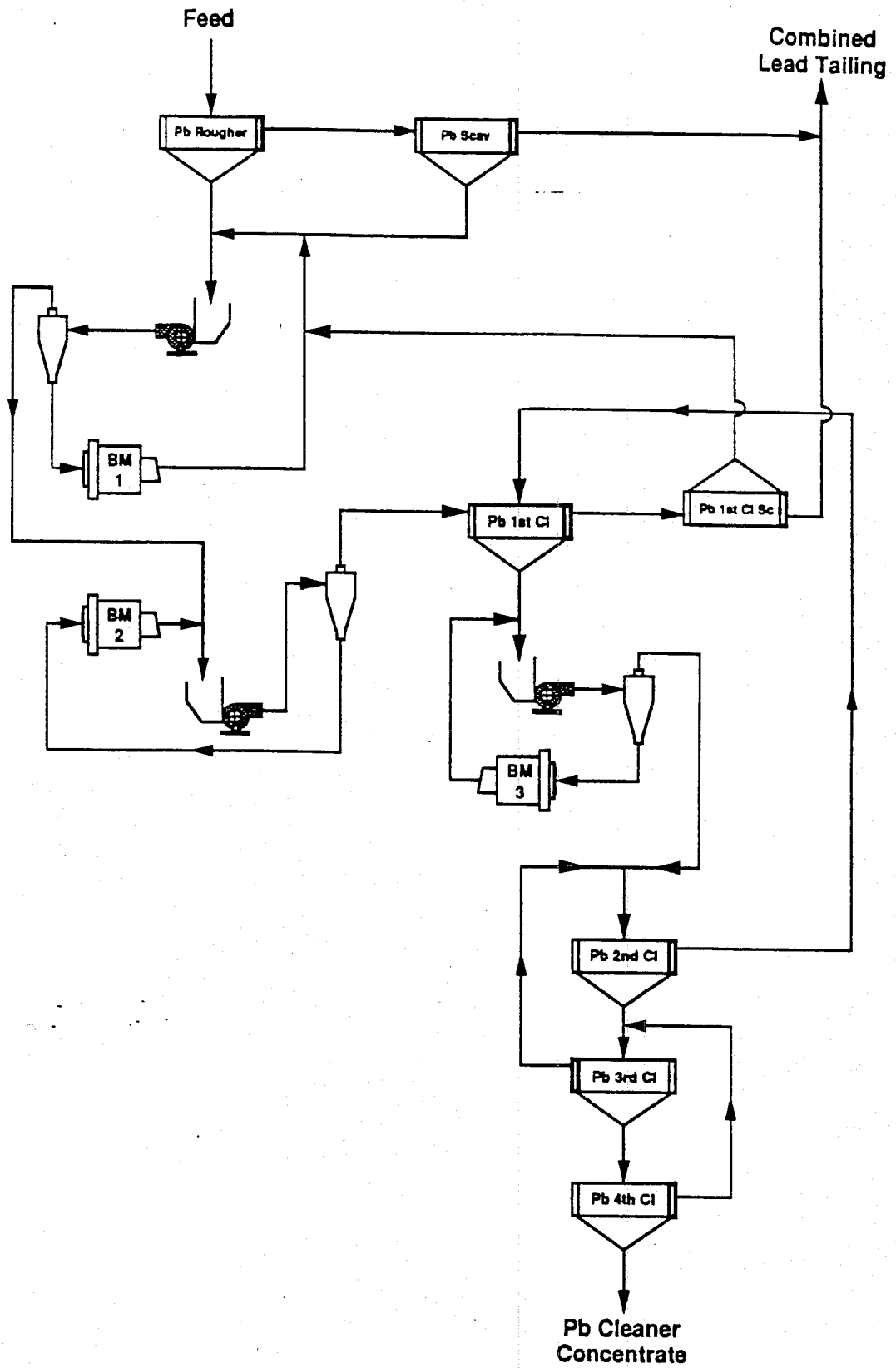
**TABLE NO. 1 :**  
Lead and Zinc Metallurgical Results Obtained Using Two-Stage Lead Concentrate Regrinding

Test No.	Product	Weight %	Assays %, g/t				% Distribution		
			Pb	Zn	Ag	Au	Pb	Zn	Ag
12	Pb Cleaner Conc	6.19	62.8	9.62	72.0	6.10	84.2	6.7	61.1
	Zn Cleaner Conc	13.11	2.36	55.4	82.6	-	6.7	81.1	14.8
	Zn Combined Tail	80.70	0.52	1.35	21.8	-	9.1	12.2	24.1
	Feed	100.00	4.62	8.95	72.9	-	100.0	100.0	100.0

A lead concentrate grade of 62.8% Pb at 84% Pb recovery was obtained using a two-stage lead regrinding flowsheet. In the first stage, the combined lead rougher and scavenger concentrate was reground to  $K_{80} = 16 \mu\text{m}$  and in the second stage, the lead first cleaner concentrate was reground to  $K_{80} = 13 \mu\text{m}$ .

In previous development testwork, it was demonstrated that both lead concentrate grade and recovery are functions of the lead concentrate regrind.

**FIGURE NO. 1 :**  
**Recommended Faro Lead Circuit with Re grind Positioning**



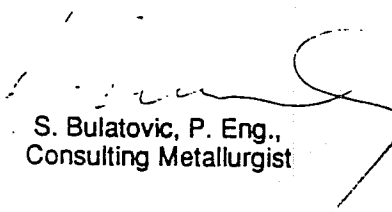
# INTRODUCTION

At a meeting at Lakefield on December 16, 1991 with Mr. G. McDonald of Curragh Resources Inc, the adaptation of the Faro Concentrator for processing of Grum Ore was discussed. Since the present regrinding mills at Faro would not provide the required fineness of lead regrind, additional lead regrinding capacity would be required.

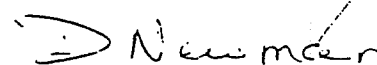
This testwork was designed to determine the positioning of the additional lead regrinding mill in the lead circuit.

During the progress of the testwork, the results were discussed with Mr. McDonald in regular telephone conversations and at a meeting at Lakefield on February 12, 1992.

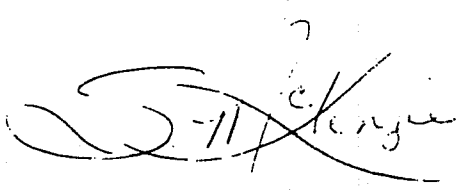
LAKEFIELD RESEARCH



S. Bulatovic, P. Eng.,  
Consulting Metallurgist



D.A. Newman, P. Eng.,  
Project Manager



for R.S. Salter  
General Manager

Experimental Work By: S. Bulatovic  
D. Newman  
D. Lang  
Report Preparation By: S. McKenzie

# SUMMARY AND CONCLUSIONS

## 1. Description of Samples Used in the Laboratory Testwork

The laboratory testwork was carried out on Grum Composite G-3A, which was prepared from the 64 samples used in Composite G-3 in the previous testwork (Project LR-3733, Progress Report No. 3). Composite G-3A assayed 4.8% Pb and 9.1% Zn.

## 2. Laboratory Testwork

### 2.1. Batch Flotation Testwork

This testwork was designed to examine the effect of lead regrinding fineness on the grade-recovery relationship and to define the conditions for continuous locked cycle tests.

The initial batch tests gave low lead concentrate grades (i.e. 51 to 56% Pb) but at higher lead recovery than that obtained in 1990 testwork with Composite G-3.

Typical results obtained with different regrinding configurations are shown in Table No. 2. The highest concentrate grade was obtained in Test 9 using a two-stage regrind, where in the second regrinding stage, the lead first cleaner concentrate was reground.

**TABLE NO. 2 :**  
**Batch Flotation Test Results Obtained with Different Regrinding Configurations**

Test No.	Pb Ro Conc Reqr.		2nd Stage Pb Reqrind		Reagents	Product	Weight %	Assays, %		% Distribution		
	Time min.	K80 µm	Grind Feed	Pb 2nd Cl Feed Time min. K80 µm				Pb	Zn	Pb	Zn	
10	40	-13				Lead: Decr. Primary Grind SD200/ CN and incr. SD200/CN in the regrinds.  Zinc: Standard	Pb 4th Cl Conc	7.61	50.9	15.3	82.6	12.8
							Pb 2nd Cl Conc	8.85	45.5	16.1	85.8	15.6
							Pb 1st Cl Conc	10.66	39.0	16.6	88.6	19.4
							Pb Ro Conc	29.01	15.1	15.6	93.4	49.5
							Pb Ro Tail	70.99	0.43	6.49	6.6	50.5
							Zn Ro Feed	85.76	0.50	7.78	9.2	73.1
							Zn Cl Conc	8.52	1.06	58.9	1.9	54.9
							Zn Ro Conc	22.62	0.96	26.83	4.7	66.5
							Zn Ro Tail	63.13	0.34	0.96	4.6	6.6
							Head (calc.)	100.00	4.69	9.13	100.0	100.0
							9	30	-15	Pb 1st Cl Conc	15	-11
Pb 2nd Cl Conc	6.23	54.9	13.5	73.9	9.1							
Pb 1st Cl Conc	10.65	38.8	17.4	89.4	20.0							
Pb Ro Conc	28.23	15.5	16.3	94.7	49.8							
Pb Ro Tail	71.77	0.34	6.45	5.3	50.2							
Zn Ro Feed	85.96	0.43	7.78	7.9	72.5							
Zn Cl Conc	8.46	1.02	59.9	1.9	55.0							
Zn Ro Conc	22.19	0.93	27.4	4.5	65.9							
Zn Ro Tail	63.77	0.25	0.96	3.4	6.6							
Head (calc.)	100.00	4.63	9.22	100.0	100.0							
8	30	-15	Pb Cl Scav Conc	15	-13	Lead: Decr. Primary Grind SD200/ CN and incr. SD200/CN in the regrinds.  Zinc: Standard						
							Pb 2nd Cl Conc	7.22	43.1	15.5	69.6	12.5
							Pb 1st Cl+Cl Sc Concs	10.81	36.5	16.3	88.5	19.6
							Pb Ro Conc	29.00	14.4	13.0	93.3	41.9
							Pb Ro Tail	71.00	0.42	7.36	6.7	58.1
							Zn Ro Feed	87.76	0.57	8.06	11.2	78.6
							Zn Cl Conc	9.65	1.69	57.3	3.7	61.5
							Zn Ro Conc	24.01	1.28	26.8	6.9	71.6
							Zn Ro Tail	63.74	0.30	1.00	4.3	7.1
							Head (calc.)	100.00	4.47	8.99	100.0	100.0

## 2.2. Continuous Locked Cycle Tests

Continuous locked cycle tests were conducted to determine the positioning of the second lead regrinding stage. In this testwork, three locked cycle tests were performed using different lead regrinding configurations. The conditions and results of these tests are summarized in Table No. 3, and the flowsheets used are shown in Figure No. 2 (Flowsheet 1), Figure No. 3 (Flowsheet 2) and Figure No. 4 (Flowsheet 3).

**TABLE NO. 3 :**  
**Continuous Locked Cycle Test Results**

Test No.	Flowsheet	Product	Weight %	Assays %, g/t				% Distribution		
				Pb	Zn	Ag	Au	Pb	Zn	Ag
12	2	Pb Cleaner Conc	6.19	62.8	9.62	6.10	720	84.2	6.7	61.1
		Zn Cleaner Conc	13.11	2.36	55.4	-	82.6	6.7	81.1	14.8
		Zn Combined Tail	80.70	0.52	1.35	-	21.8	9.1	12.2	24.1
		Head (Calc)	100.00	4.62	8.95	-	72.9	100.0	100.0	100.0
13	1	Pb Cleaner Conc	6.27	62.5	10.0	5.36	793	85.3	7.0	67.1
		Zn Cleaner Conc	13.49	2.18	53.8	-	80.2	6.4	81.2	14.6
		Zn Combined Tail	80.24	0.47	1.31	-	16.9	8.3	11.8	18.3
		Head (Calc)	100.00	4.59	8.95	-	74.1	100.0	100.0	100.0
14	3	Pb Cleaner Conc	6.39	61.5	11.6	6.67	740	85.5	8.1	64.6
		Zn Cleaner Conc	13.72	2.11	53.7	-	7.9	6.3	80.7	14.8
		Zn Combined Tail	79.89	0.47	1.28	-	18.8	8.2	11.2	20.6
		Head (Calc)	100.00	4.59	9.13	-	73.2	100.0	100.0	100.0

Flowsheet 1 includes a lead single stage regrind of the combined lead rougher and scavenger concentrate to a  $K_{80}$  of 12  $\mu\text{m}$ . Flowsheet 2 has two stage regrinding, where in the first stage, the lead rougher and scavenger concentrates were reground to  $K_{80} = 15 \mu\text{m}$  and in the second stage the lead first cleaner concentrate was reground to  $K_{80} = 12 \mu\text{m}$ . Flowsheet 3 is similar to Flowsheet 2 with the exception that in the second regrinding stage the combined lead 2nd cleaner tail and 1st cleaner scavenger concentrates are reground.

From the results obtained, the following conclusions are made:

- All three flowsheet configurations gave lead concentrate grades of over 60% Pb at similar recoveries.
- Using Flowsheet 2, a more stable circuit was obtained where a constant lead concentrate grade was obtained in all cycles.

FIGURE NO. 2 :  
Lead Circuit Flowsheet No. 1 - Test 13

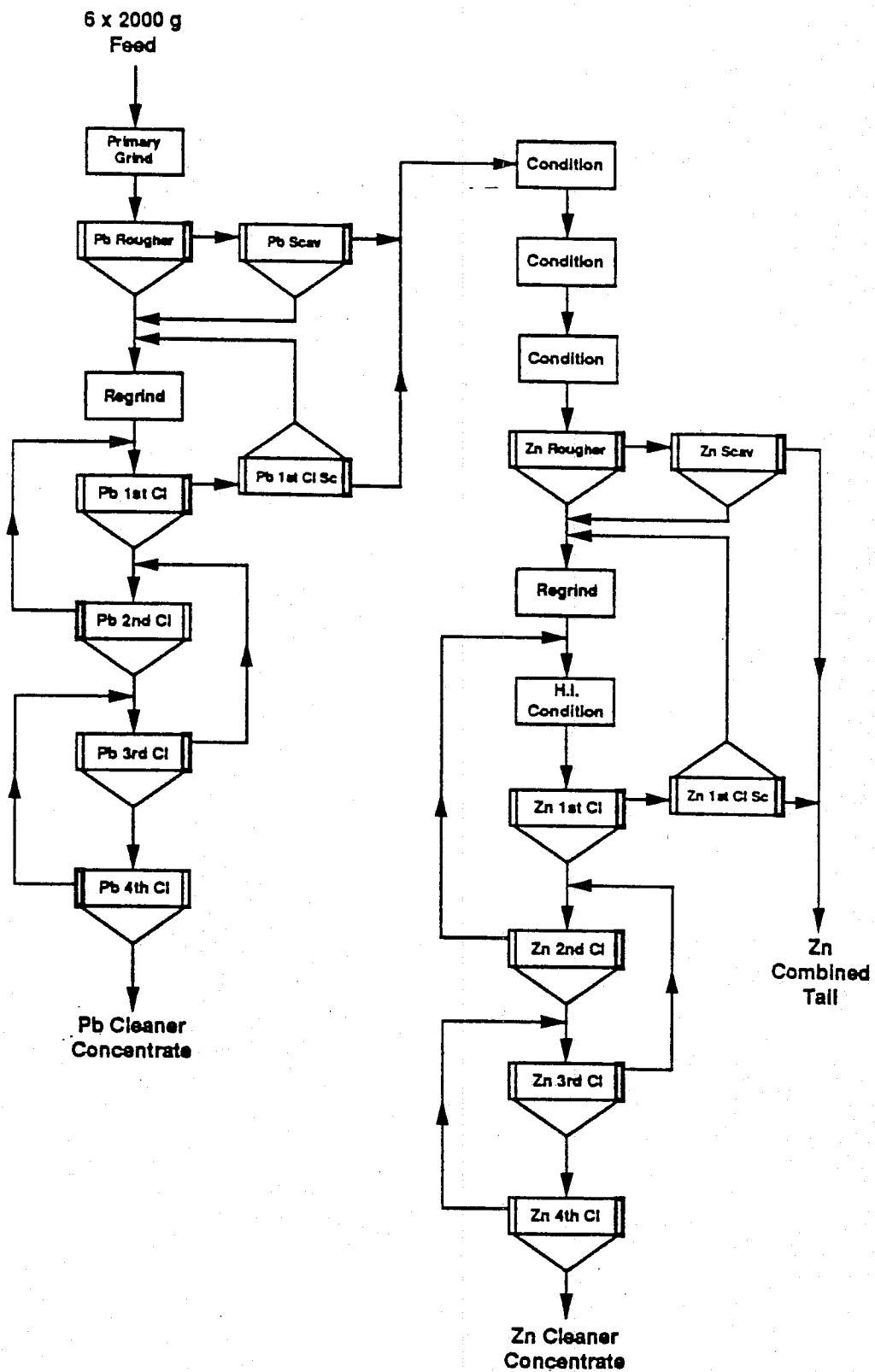


FIGURE NO. 3 :  
Lead Circuit Flowsheet No. 2 - Test 12

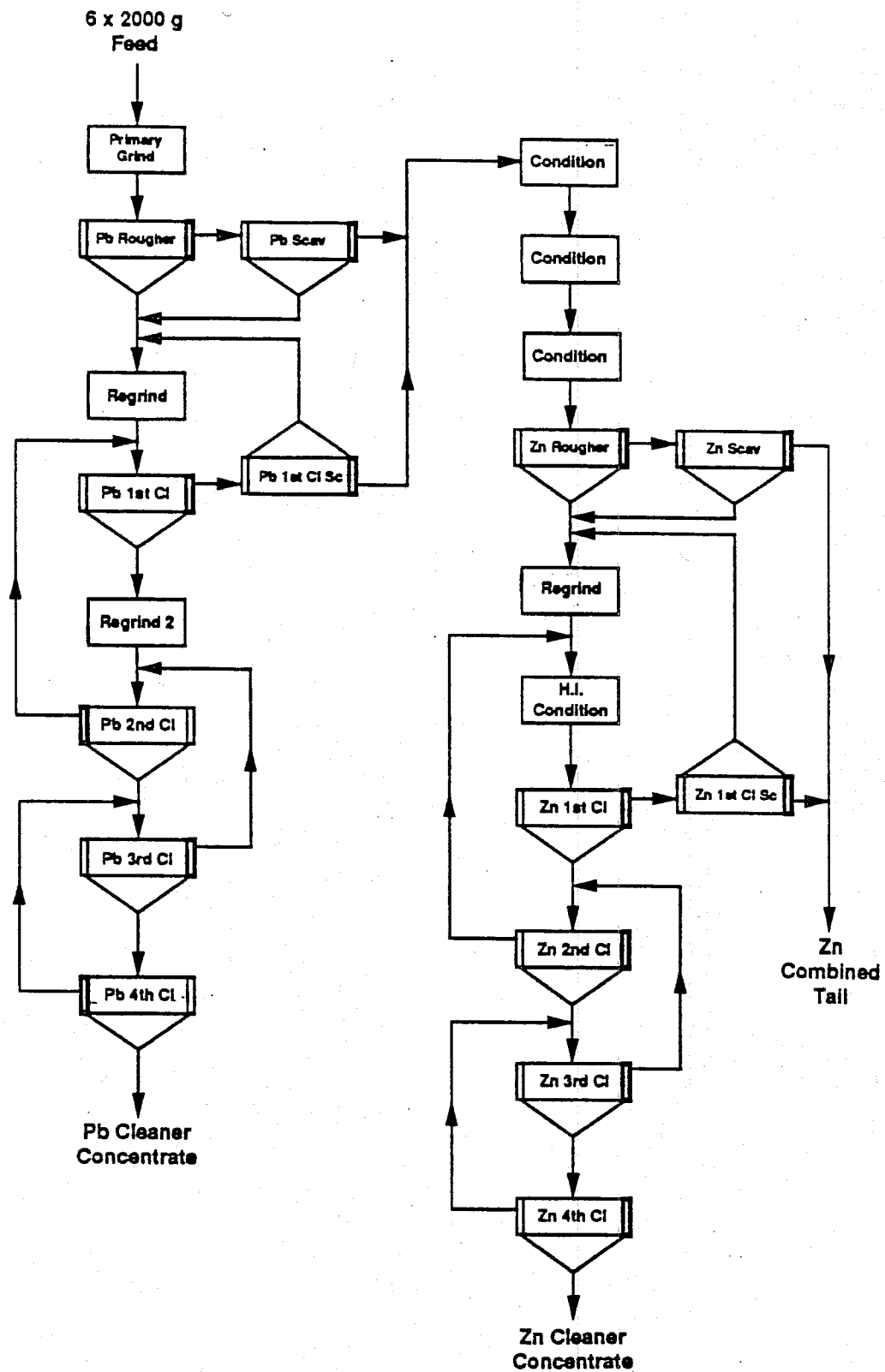
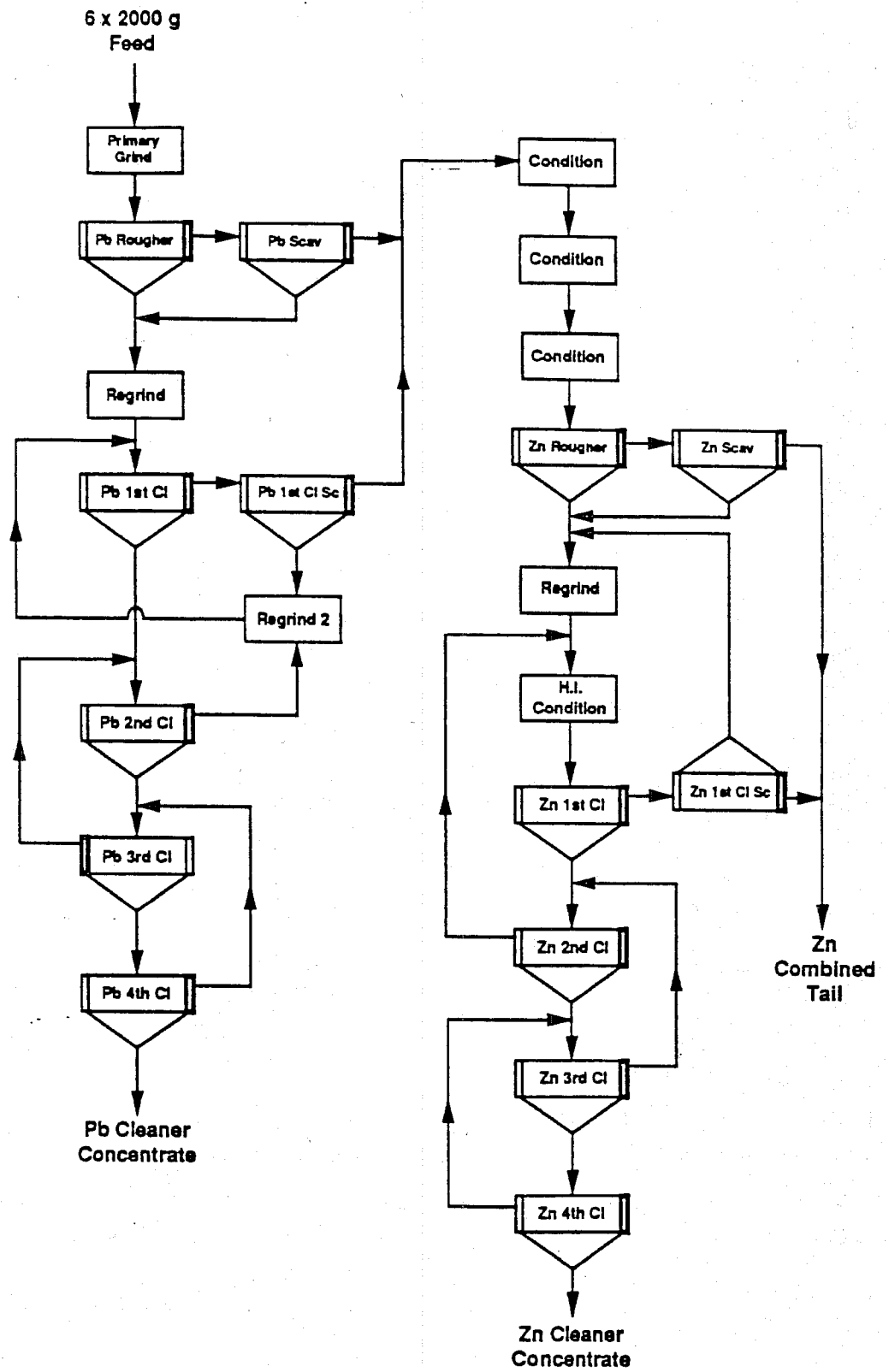


FIGURE NO. 4 :  
Lead Circuit Flowsheet No. 3 - Test 14



### 2.3. Batch Tests on Grum Siliceous Ore

This ore is considered to represent the initial feed to the Faro plant and consists mostly of siliceous gangue, with some carbonaceous gangue. Batch flotation results using the standard Grum procedure (Table 4) were considered satisfactory.

**TABLE NO. 4 :**  
**Batch Flotation Test Results on Grum Siliceous Ore**

Test No.	Conditions	Product	Weight %	Assays, %		% Distribution	
				Pb	Zn	Pb	Zn
15	Similar to Test 12 on the massive sulphide ore.	Pb 4th Cl Conc	1.49	57.7	3.03	61.1	1.3
		Pb 1st Cl Conc	3.77	31.3	6.50	83.9	6.8
		Pb Ro Conc	10.29	12.0	7.70	88.0	21.9
		Pb Ro Tail	89.71	0.19	3.14	12.0	78.1
		Zn Ro Feed	95.14	0.21	3.43	14.4	90.5
		Zn Cl Conc	3.52	0.55	56.4	1.4	54.9
		Zn Ro Conc	7.47	0.59	29.8	3.2	61.6
		Zn Ro Tail	87.67	0.18	1.19	11.2	28.9
		Head (calc.)	100.00	1.41	3.61	100.0	100.0
16	As Test 15 with increased frother in the Pb regrinds and in the Zn rougher and reduced pH in the Zn rougher.	Pb 4th Cl Conc	1.55	58.6	2.67	63.4	1.1
		Pb 1st Cl Conc	4.05	29.9	6.24	84.6	6.9
		Pb Ro Conc	11.02	11.3	6.90	87.3	20.8
		Pb Ro Tail	88.98	0.20	3.26	12.7	79.2
		Zn Ro Feed	94.70	0.22	3.49	14.3	90.3
		Zn Cl Conc	4.05	0.92	54.4	2.6	60.1
		Zn Ro Conc	20.48	0.45	12.2	6.5	68.0
		Zn Ro Tail	74.22	0.15	1.10	7.8	22.3
		Head (calc.)	100.00	1.43	3.66	100.0	100.0

### 3. Conclusions

- The Grum ore is finely disseminated with liberation occurring in the range of 10-15  $\mu\text{m}$  for galena and 15-20  $\mu\text{m}$  for sphalerite. The grades of both lead and zinc concentrates are therefore functions of regrinding fineness of the corresponding rougher concentrates. To provide sufficient regrinding at the Faro Concentrator, additional lead regrinding capacity mill would be required.

- The testwork performed to determine the positioning of a third regrinding mill indicated that technically this regrind mill can be incorporated in either a single stage regrind or in a two stage regrind configuration.

However, two stage regrinding will be more practical from the operational point of view and it would provide a finer regrind for the same power installed.

- Metallurgical results obtained on a quartzite ore zone were satisfactory and saleable lead and zinc concentrates may be obtained.

## RECOMMENDATIONS

Recommendations proposed in this section are based on: (a) the lead circuit surveys conducted at the Faro Concentrator during the processing of Vangorda Ore, (b) laboratory testwork carried out on Grum ore, and (c) continuous locked cycle tests carried out on Grum Composite G-3A and described in this testwork.

Based on the above findings, the following is recommended:

1) Revise the Faro lead circuit flowsheet to include the following:

- arrange the primary lead regrinding mills in series instead of in parallel configuration, as shown in Figure 5. This would improve grinding efficiency and consequently improve size reduction from the current  $K_{80} = 25 \mu\text{m}$  to  $K_{80} = 15 \mu\text{m}$ .
- install an additional regrinding mill to regrind the lead first cleaner concentrate to  $K_{80} = 12 \mu\text{m}$ . The lead circuit roughing, scavenging and cleaning configurations would remain as they are presently.

## 2) Revise the zinc circuit flowsheet as follows:

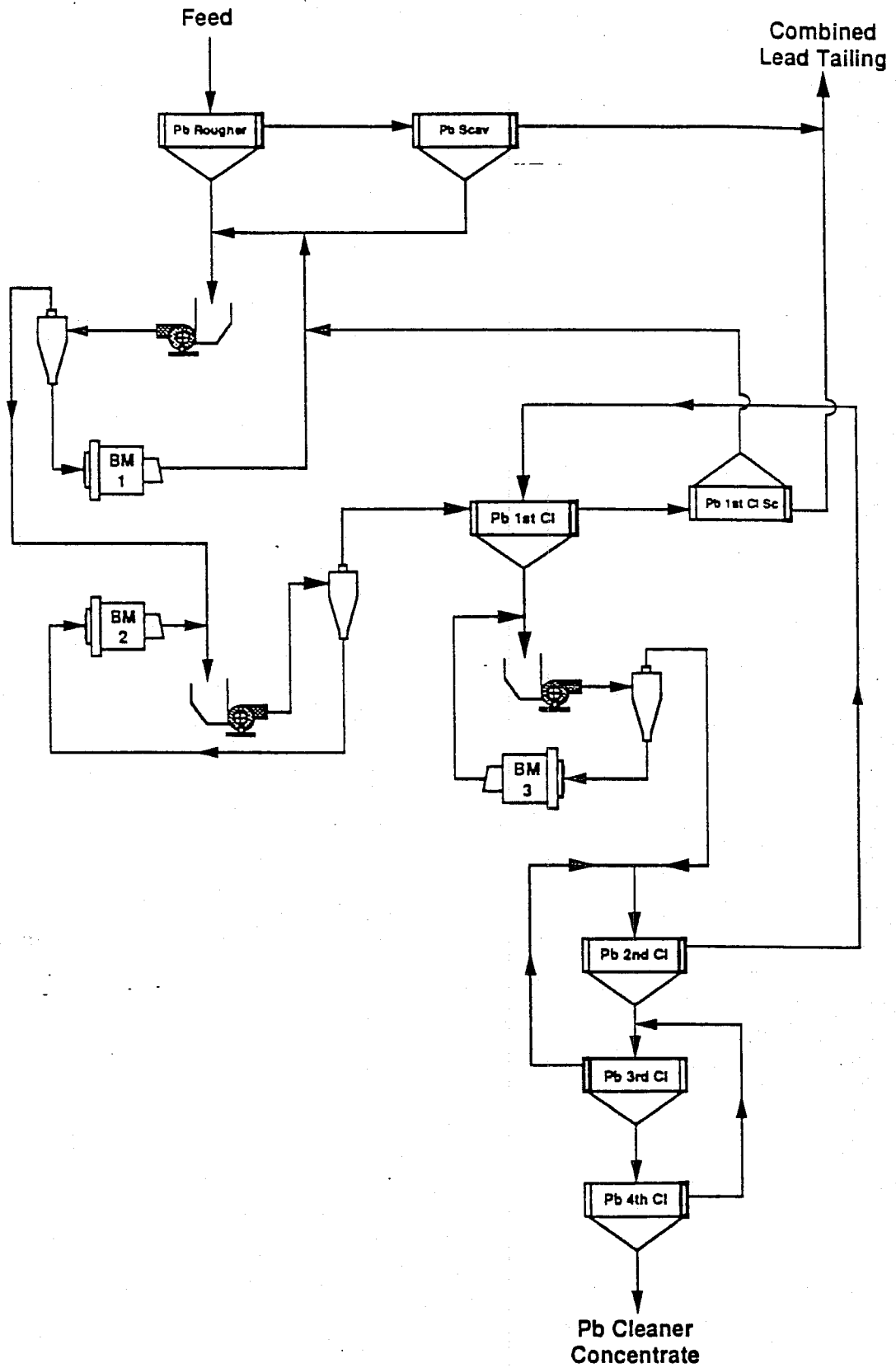
- install high intensity conditioners to condition the zinc first cleaner feed with the following specifications:

No. of Conditioners	2
Dimensions	3 m x 4.2 m
Power	180 HPM
Impeller Type	Hayward Gordon
Mechanism	Hayward Gordon
Speed	Maximum

The feed for the zinc high intensity conditioners will be the zinc regrind cyclone overflow and the column tailing.

- The zinc rougher should be operated in open circuit with the scavenger stage so that the zinc scavenger concentrate will be combined with the rougher concentrate, instead of recycling to the rougher flotation feed.
- Provision for collector and frother additions to the high intensity conditioner must be made.

**FIGURE NO. 5 :**  
**Recommended Faro Lead Circuit with Regrind Positioning**





## DISCUSSION

### 1. Description of Samples Used in the Laboratory Testwork

Flotation testwork was conducted on Composite G-3A, which was prepared from sixty-four individual -13 mm ore samples, which were left over or not used in the preparation of Composite G-3 in 1990 (Project 3733, Progress Report 3). The individual samples used are detailed in Table No. 5.

**TABLE NO. 5 :**  
**Composition of Composite G-3A**

Sample No.	Length m	Weight g/m	Wt Used, g	Wt %	Sample No.	Length m	Weight g/m	Wt Used, g	Wt %
16956	2.7	400	1080	1.1	30520	3.5	400	1400	1.4
16957	3.0	400	1200	1.2	30521	3.4	400	1360	1.4
16958	3.5	400	1400	1.4	30522	4.4	400	1760	1.8
16960	3.2	400	1280	1.3	30523	4.2	400	1680	1.7
16961	3.4	400	1360	1.4	30524	3.7	400	1480	1.5
16962	1.0	400	400	0.4	30813	4.0	400	1600	1.6
16970	3.8	400	1520	1.5	30814	3.3	400	1320	1.3
16971	5.5	400	2200	2.2	30815	7.4	400	2960	3.0
16972	4.3	400	1720	1.7	30870	4.4	400	1760	1.8
16973	4.8	0	0	0.0	30871	4.0	400	1600	1.6
16974	1.1	400	440	0.4	30873	4.7	400	1880	1.9
16975	4.7	400	1880	1.9	30874	4.7	400	1880	1.9
16976	4.6	400	1840	1.9	30875	5.6	400	2240	2.3
16977	4.5	400	1800	1.8	30876	5.0	180	900	0.9
16978	3.5	400	1400	1.4	30877	3.4	400	1360	1.4
16979	4.7	400	1880	1.9	30878	5.2	400	2080	2.1
30426	2.2	400	880	0.9	30879	4.2	400	1680	1.7
30427	6.0	400	2400	2.4	30880	2.8	0	0	0.0
30428	5.0	400	2000	2.0	30886	5.7	400	2280	2.3
30429	5.1	400	2040	2.1	30887	3.9	400	1560	1.6
30430	2.8	400	1120	1.1	30888	4.7	400	1880	1.9
30431	3.4	400	1360	1.4	30889	5.6	400	2240	2.3
30432	5.0	400	2000	2.0	30890	4.7	351	1650	1.7
30433	4.0	400	1600	1.6	30891	4.0	400	1600	1.6
30434	4.5	400	1800	1.8	30892	4.8	400	1920	1.9
30435	4.6	400	1840	1.9	30893	2.2	400	880	0.9
30436	4.0	400	1600	1.6	30942	2.5	400	1000	1.0
30437	4.4	400	1760	1.8	30943	7.0	400	2800	2.8
30438	4.0	400	1600	1.6	30944	3.9	400	1560	1.6
30439	4.3	400	1720	1.7	30945	2.2	400	880	0.9
30440	3.6	400	1440	1.5	30946	2.9	400	1160	1.2
30441	3.6	400	1440	1.5					
30455	2.2	400	880	0.9					
					Total	259.0	-	99230	100.0

Two samples of Grum Ore, one termed "Metabasite with disseminated sulphides" and the other "Quartzite with disseminated sulphides" were received on January 30, 1992 (LR 9238427). The two samples (quarter core) were mixed in roughly equal proportions and prepared for flotation testwork. This composite was termed "CI Quartzite Ore".

The head assays of the two composites used in the testwork are shown in Table No. 6.

**TABLE NO. 6 :**  
Head Assays of Composite G-3A

Element	Assays %, g/t	
	Composite G-3A	CI Quartzite Ore
Cu	0.13	0.024
Pb	4.80	1.44
Zn	9.19	3.78
Fe	20.6	8.49
S	25.7	6.25
Au	0.85	0.24
Ag	80.2	26.7

The lead, zinc and silver grades of Composite G-3A were higher than those of G-3, and sulphide content was lower.

## **2. Laboratory Testwork**

### **2.1. Preliminary Batch Scale Flotation Testwork**

This testwork was designed to determine the conditions of evaluation of the positioning of the lead concentrate regrind mills. The conditions and results of these tests are summarized in Table No. 7.

TABLE NO. 7 :  
Preliminary Lead Circuit Batch Test Conditions and Results

Test No.	Pb Ro Conc Time min.	Regr. K80 $\mu$ m	2nd Stage Pb Re grind		Reagents	Product	Weight %	Assays, %		% Distribution		
			Grind Feed	Pb 2nd Cl Feed Time min.				Pb	Zn	Pb	Zn	
1	30	15	-	-	-	Standard	Pb 4th Cleaner Conc	7.23	51.1	14.4	79.9	11.7
							Pb 1st Cleaner Conc	12.72	33.4	17.1	91.8	24.4
							Pb Rougher Conc	29.76	14.8	14.2	95.1	47.4
							Pb Rougher Tail	70.24	0.32	6.68	4.9	52.6
							Pb 1st Cl Scav Tail	14.42	0.68	11.4	2.1	18.4
							Head Calc.	100.00	4.62	8.92	100.0	100.0
3	30	~15	-	-	-	Increased PKD-C in the Pb 1st Cl Conc Re grind.	Pb 4th Cleaner Conc	4.58	55.9	12.6	57.1	6.5
							Pb 1st Cleaner Conc	13.60	30.0	17.4	91.1	26.9
							Pb Rougher Conc	30.95	13.7	14.3	94.6	50.3
							Pb Rougher Tail	69.05	0.35	6.35	5.4	49.7
							Pb 1st Cl Scav Tail	14.88	0.70	11.2	2.3	18.9
							Head Calc.	100.00	4.48	8.82	100.0	100.0
7	30	~15	-	-	-	Standard	Pb 4th Cleaner Conc	6.55	53.5	13.9	77.3	10.3
							Pb 1st Cleaner Conc	11.62	35.1	16.8	89.9	22.1
							Pb Rougher Conc	32.18	13.3	13.8	94.6	50.3
							Pb Rougher Tail	67.82	0.36	6.47	5.4	49.7
							Pb 1st Cl Scav Tail	18.29	0.68	11.3	2.7	23.4
							Head Calc.	100.00	4.54	8.82	100.0	100.0
2	40	13	-	-	-	Standard	Pb 4th Cleaner Conc	7.00	52.0	14.3	79.6	11.2
							Pb 1st Cleaner Conc	10.65	37.9	16.5	88.3	19.7
							Pb Rougher Conc	29.39	14.6	14.8	94.1	48.7
							Pb Rougher Tail	70.61	0.38	6.51	5.9	51.3
							Pb 1st Cl Scav Tail	15.78	0.87	12.8	3.0	22.6
							Head Calc.	100.00	4.57	8.96	100.0	100.0
4	30	~15	1st Cl Conc	15	11	50 g/t of PKD-C in the Pb 1st Cl Conc Re gr.	Pb 4th Cleaner Conc	5.68	54.7	13.0	70.4	8.4
							Pb 1st Cleaner Conc	14.85	27.7	16.9	93.4	28.6
							Pb Rougher Conc	32.35	13.1	13.8	95.9	50.9
							Pb Rougher Tail	67.65	0.27	6.36	4.1	49.1
							Pb 1st Cl Scav Tail	14.68	0.48	11.0	1.6	18.4
							Head Calc.	100.00	4.41	8.76	100.0	100.0
5	30	~15	1st Cl Scav Conc	15	15	50 g/t of PKD-C in the Pb 1st Cl Scav Conc Re gr.	Pb 4th Cleaner Conc	9.59	43.7	16.4	89.1	17.9
							Pb 1st Cl+Cl Scav Conc	18.49	23.9	16.6	93.9	34.8
							Pb Rougher Conc	35.52	12.6	13.3	95.3	53.6
							Pb Rougher Tail	64.48	0.34	6.33	4.7	46.4
							Pb 1st Cl Scav Tail	17.03	0.41	9.71	1.5	18.8
							Head Calc.	100.00	4.70	8.80	100.0	100.0
6	30	~15	1st Cl Scav Conc	15	13	50 g/t of PKD-C in the Pb 1st Cl Scav Conc Re gr.	Pb 4th Cleaner Conc	6.30	56.8	12.7	77.6	9.0
							Pb 1st Cl+Cl Scav Conc	13.38	31.8	16.7	92.1	25.2
							Pb Rougher Conc	32.23	13.6	13.5	95.0	49.3
							Pb Rougher Tail	67.77	0.34	6.62	5.0	50.7
							Pb 1st Cl Scav Tail	18.86	0.70	11.30	2.9	24.1
							Head Calc.	100.00	4.61	8.85	100.0	100.0
11	30	~15	1st Cl Scav Conc	15	~13	Decr. Primary Grind SD200/CN and incr. SD200/CN in the re grinds.	Pb 4th Cleaner Conc	6.56	56.2	13.3	79.5	9.9
							Pb 1st Cl+Cl Scav Conc	12.24	34.5	17.6	90.9	24.3
							Pb Rougher Conc	29.24	15.0	16.1	94.5	53.4
							Pb Rougher Tail	70.76	0.36	5.82	5.5	46.6
							Pb 1st Cl Scav Tail	17.00	0.97	15.10	3.6	29.1
							Head Calc.	100.00	4.64	8.84	100.0	100.0

From the results obtained, the following observations are made:

- Under standard flotation conditions with lower SD200/NaCN additions, concentrate grades of between 51% Pb and 53% Pb were obtained at relatively high lead recoveries (Tests 1, 2 and 7). These results were comparable to the results obtained in 1990 testwork on G-3 Composite (Table 8).

**TABLE NO. 8 :**  
Lead Batch Test Results Obtained on G-3 Composite in 1990 Testwork  
- Effect of Levels of SD200/NaCN Mixture

Test No.	SD200/NaCN, g/t			Product	Weight %	Assays %		% Distribution	
	Grind	Regrind	Cls			Pb	Zn	Pb	Zn
136	150	100	40	Pb 4th Cl Conc	5.43	55.4	6.93	74.9	5.1
				Pb 1st Cl + Scav Concs	15.58	23.1	11.3	89.6	24.0
				Pb 1st Cl Scav Tail	16.75	0.68	10.2	2.8	23.3
				Pb Rougher Tail	67.67	0.45	5.70	7.6	52.7
				Head (Calc)	100.00	4.02	7.33	100.0	100.0
137	250	75	60	Pb 4th Cl Conc	5.08	57.0	7.28	71.9	5.1
				Pb 1st Cl + Scav Concs	13.04	27.2	12.1	88.2	21.7
				Pb 1st Cl Scav Tail	19.09	0.68	12.2	3.2	32.1
				Pb Rougher Tail	67.87	0.51	4.95	8.6	46.2
				Head (Calc)	100.00	4.03	7.27	100.0	100.0
138	350	50	60	Pb 4th Cl Conc	4.35	60.4	6.34	66.9	3.8
				Pb 1st Cl + Scav Concs	12.70	27.4	12.1	88.5	21.4
				Pb 1st Cl Scav Tail	18.91	0.65	13.0	3.1	34.2
				Pb Rougher Tail	68.39	0.48	4.67	8.4	44.4
				Head (Calc)	100.00	3.93	7.19	100.0	100.0
139	250	75	60	Pb 4th Cl Conc	3.69	63.1	5.89	59.1	3.1
				Pb 1st Cl + Scav Concs	11.60	30.0	11.5	88.4	19.0
				Pb 1st Cl Scav Tail	18.15	0.80	12.9	3.7	33.2
				Pb Rougher Tail	70.25	0.44	4.79	7.9	47.8
				Head (Calc)	100.00	3.94	7.04	100.0	100.0

The dosages of SD200/NaCN in the tests shown in Table No. 7 were slightly higher than that used in Test 136 (Table 8).

- With the use of two-stage regrinding in Tests 6 and 11, the lead concentrate grade improved slightly.

## 2.2. Effect of Different Regrinding Configurations

Further tests were conducted with both lead and zinc flotation to examine the effect of different regrinding configurations. The conditions and results of these tests are summarized in Table No. 9.

**TABLE NO. 9 :**  
**Batch Flotation Test Results Obtained with Different Regrinding Configurations**

Test No.	Pb Ro Conc Regr.		2nd Stage Pb Regrind		Reagents	Product	Weight %	Assays, %		% Distribution		
	Time min.	K80 $\mu\text{m}$	Grind Feed	Pb 2nd Cl Feed Time min.				Pb 2nd Cl Feed K80 $\mu\text{m}$	Pb	Zn	Pb	Zn
10	40	-13	-	-	-	Lead: Decr. Primary Grind SD200/ CN and incr. SD200/CN in the regrinds.  Zinc: Standard	Pb 4th Cl Conc	7.61	50.9	15.3	82.6	12.8
							Pb 2nd Cl Conc	8.85	45.5	16.1	85.8	15.6
							Pb 1st Cl Conc	10.66	39.0	16.6	88.6	19.4
							Pb Ro Conc	29.01	15.1	15.6	93.4	49.5
							Pb Ro Tail	70.99	0.43	6.49	6.6	50.5
							Zn Ro Feed	85.76	0.50	7.78	9.2	73.1
							Zn Cl Conc	8.52	1.06	58.9	1.9	54.9
							Zn Ro Conc	22.62	0.96	26.83	4.7	66.5
							Zn Ro Tail	63.13	0.34	0.96	4.6	6.6
							Head (calc.)	100.00	4.69	9.13	100.0	100.0
9	30	-15	Pb 1st Cl Conc	15	-11	Lead: Decr. Primary Grind SD200/ CN and incr. SD200/CN in the regrinds.  Zinc: Standard	Pb 4th Cl Conc	4.76	62.3	11.4	64.1	5.9
							Pb 2nd Cl Conc	6.23	54.9	13.5	73.9	9.1
							Pb 1st Cl Conc	10.65	38.8	17.4	89.4	20.0
							Pb Ro Conc	28.23	15.5	16.3	94.7	49.8
							Pb Ro Tail	71.77	0.34	6.45	5.3	50.2
							Zn Ro Feed	85.96	0.43	7.78	7.9	72.5
							Zn Cl Conc	8.46	1.02	59.9	1.9	55.0
							Zn Ro Conc	22.19	0.93	27.4	4.5	65.9
							Zn Ro Tail	63.77	0.25	0.96	3.4	6.6
							Head (calc.)	100.00	4.63	9.22	100.0	100.0
8	30	-15	Pb Cl Scav Conc	15	-13	Lead: Decr. Primary Grind SD200/ CN and incr. SD200/CN in the regrinds.  Zinc: Standard	Pb 4th Cl Conc	3.35	47.2	14.8	35.4	5.5
							Pb 2nd Cl Conc	7.22	43.1	15.5	69.6	12.5
							Pb 1st Cl+Cl Sc Concs	10.81	36.5	16.3	88.5	19.6
							Pb Ro Conc	29.00	14.4	13.0	93.3	41.9
							Pb Ro Tail	71.00	0.42	7.36	6.7	58.1
							Zn Ro Feed	87.76	0.57	8.06	11.2	78.6
							Zn Cl Conc	9.65	1.69	57.3	3.7	61.5
							Zn Ro Conc	24.01	1.28	26.8	6.9	71.6
							Zn Ro Tail	63.74	0.30	1.00	4.3	7.1
							Head (calc.)	100.00	4.47	8.99	100.0	100.0

The highest lead concentrate grade was obtained with the use of two stage regrinding (Test No. 9). Regrinding of the lead first cleaner scavenger concentrate and second cleaner tailing gave poor lead metallurgical results (Test 8).

### 2.3. Continuous Locked Cycle Tests

Locked cycle tests were carried out to determine the best lead regrind circuit configuration. The flowsheets used in these tests are shown in Figure No. 2 (Test 13), Figure No. 3 (Test 12) and Figure No. 4 (Test 14). The results of these tests are summarized in Table No. 10.

The zinc circuit flowsheet was the same in all tests.

The lead and zinc metallurgical results in all three locked cycle tests were similar.

**TABLE NO. 10 :**  
**Locked Cycle Test Results**

Test No.	Flowsheet	Product	Weight %	Assays, %/g/t				% Distribution			
				Pb	Zn	Ag	Au	Pb	Zn	Ag	Au
12	Pb 1st Cl Conc Regrind	Pb Cleaner Conc	6.19	62.8	9.62	720	6.10	84.2	6.7	61.1	-
		Zn Cleaner Conc	13.11	2.36	55.4	82.6	-	6.7	81.1	14.8	-
		Overall Tail	80.71	0.52	1.35	21.8	-	9.1	12.2	24.1	-
		Head(calc)	100.00	4.62	8.95	72.9	-	100.0	100.0	100.0	-
13	Single Regrind	Pb Cleaner Conc	6.27	62.5	10.0	793	5.36	85.3	7.0	67.1	-
		Zn Cleaner Conc	13.49	2.18	53.8	80.2	-	6.4	81.2	14.6	-
		Overall Tail	80.24	0.47	1.31	16.9	-	8.3	11.8	18.3	-
		Head(calc)	100.00	4.59	8.95	74.1	-	100.0	100.0	100.0	-
14	Middlings Regrind	Pb Cleaner Conc	6.39	61.5	11.6	740	6.67	85.5	8.1	64.6	-
		Zn Cleaner Conc	13.72	2.11	53.7	79.0	-	6.3	80.7	14.8	-
		Overall Tail	79.89	0.47	1.28	18.8	-	8.2	11.2	20.6	-
		Head(calc)	100.00	4.59	9.13	73.2	-	100.0	100.0	100.0	-

However, two stage regrinding gave more stable lead concentrate grade than the single stage regrind (Test 13) or the two stage regrind with regrinding of middlings (Test 14).

### 3. Standard Laboratory Tests on Quartzite Ore

Two standard laboratory tests were conducted on Grum quartzite Cl Ore which would be processed initially. This ore is low grade and assayed 1.44% Pb and 3.78% Zn. The results of these tests are summarized in Table No. 11.

The processing characteristics of this ore were similar to those of low sulphide Grum ore. In both tests, reasonably good concentrate grades were produced, but with low zinc recovery.

High zinc losses in the zinc flotation tailing may be due to the presence of oxide zinc minerals. This was confirmed in the previous testwork with low sulphide Grum ore where in some cases up to 2% zinc was in the form of zinc silicates (testwork completed in 1977).

*\* Metabasalt sample*

**TABLE NO. 11 :**  
**Standard Laboratory Test Results on Grum Quartzite Ore**

Test No.	Conditions	Product	Weight %	Assays, %		% Distribution	
				Pb	Zn	Pb	Zn
15	Similar to Test 12 on the massive sulphide ore.	Pb 4th Cl Conc	1.49	57.7	3.03	61.1	1.3
		Pb 1st Cl Conc	3.77	31.3	6.50	83.9	6.8
		Pb Ro Conc	10.29	12.0	7.70	88.0	21.9
		Pb Ro Tail	89.71	0.19	3.14	12.0	78.1
		Zn Ro Feed	95.14	0.21	3.43	14.4	90.5
		Zn Cl Conc	3.52	0.55	56.4	1.4	54.9
		Zn Ro Conc	7.47	0.59	29.8	3.2	61.6
		Zn Ro Tail	87.67	0.18	1.19	11.2	28.9
		Head (calc.)	100.00	1.41	3.61	100.0	100.0
16	As Test 15 with increased frother in the Pb regrinds and in the Zn rougher and reduced pH in the Zn rougher.	Pb 4th Cl Conc	1.55	58.6	2.67	63.4	1.1
		Pb 1st Cl Conc	4.05	29.9	6.24	84.6	6.9
		Pb Ro Conc	11.02	11.3	6.90	87.3	20.8
		Pb Ro Tail	88.98	0.20	3.26	12.7	79.2
		Zn Ro Feed	94.70	0.22	3.49	14.3	90.3
		Zn Cl Conc	4.05	0.92	54.4	2.6	60.1
		Zn Ro Conc	20.48	0.45	12.2	6.5	68.0
		Zn Ro Tail	74.22	0.15	1.10	7.8	22.3
		Head (calc.)	100.00	1.43	3.66	100.0	100.0

# DETAILS OF TESTWORK

100  
101  
102  
103  
104  
105  
106  
107  
108  
109  
110  
111  
112  
113  
114  
115  
116  
117  
118  
119  
120  
121  
122  
123  
124  
125  
126  
127  
128  
129  
130  
131  
132  
133  
134  
135  
136  
137  
138  
139  
140  
141  
142  
143  
144  
145  
146  
147  
148  
149  
150  
151  
152  
153  
154  
155  
156  
157  
158  
159  
160  
161  
162  
163  
164  
165  
166  
167  
168  
169  
170  
171  
172  
173  
174  
175  
176  
177  
178  
179  
180  
181  
182  
183  
184  
185  
186  
187  
188  
189  
190  
191  
192  
193  
194  
195  
196  
197  
198  
199  
200



SIZE ANALYSIS : 40 Minute Primary Ball Mill Grind of Composite G-3A

Microns	Mesh	Weight Grams	% Weight		
			Ind.	Cum.	Passing
208	65	0.0	0.0	0.0	100.0
147	100	0.3	0.2	0.2	99.8
104	150	3.2	1.8	1.9	98.1
74	200	9.9	5.5	7.4	92.6
53	270	20.0	11.0	18.4	81.6
38	400	30.0	16.5	35.0	65.0
-38	-400	117.9	65.0	100.0	-
	Total	181.3	100.0	-	-

K80= 52  $\mu$ m

**Test No. 1**

Purpose: A preliminary test with 30 minutes of Pb regrinding.

Procedure: Similar to Test 141, Project 3733.

Feed: 2000 grams of minus 10 mesh G-3A ore.

Grind: 40 minutes at 65% solids in a lab ball mill. Pb regrind in rod mill.

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Na <sub>2</sub> CO <sub>3</sub>	SD200* Cyanide	A317 3418A	MIBC	Grind	Cond.	Froth	
Primary Grind	1500	250	8	-	40	-	-	-
Pb Rougher	-	-	40	12.5	-	1	4.5	9.4
	-	-	15	5	-	1	3	9.1
Pb Conc Re grind	250	75	10	-	30	-	-	-
Pb 1st Cleaner	-	-	-	5	-	1	3	-
	-	-	5	2.5	-	1	1	-
Pb 1st Cl Scav	-	-	5	2.5	-	1	2	8.7
Pb 2nd Cleaner	-	20	-	-	-	1	2.5	-
	-	-	5	2.5	-	1	2	-
Pb 3rd Cleaner	-	20	-	2.5	-	1	2	-
	-	-	2.5	2.5	-	1	2	-
Pb 4th Cleaner	-	20	2.5	2.5	-	1	3	-

\*SD/200/NaCN = 1:1

A317/3418A = 1:1

**METALLURGICAL RESULTS**

Product	Weight		Assays, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1 Pb 4th Cleaner Conc	143.6	7.23	51.1	14.4	79.9	11.7
2 Pb 4th Cleaner Tail	12.3	0.62	19.7	21.1	2.6	1.5
3 Pb 3rd Cleaner Tail	21.4	1.08	15.5	21.9	3.6	2.6
4 Pb 2nd Cleaner Tail	75.3	3.79	6.85	20.3	5.6	8.6
5 Pb 1st Cl Scav Conc	51.9	2.61	2.13	15.6	1.2	4.6
6 Pb 1st Cl Scav Tail	286.2	14.42	0.68	11.4	2.1	18.4
7 Pb Rougher Tail	1394.4	70.24	0.32	6.68	4.9	52.6
Head Calc.	1985.1	100.00	4.62	8.92	100.0	100.0

**Combined Products**

Products 1-2 (Pb 3rd Cl Conc)	7.85	48.6	14.9	82.6	13.1
Products 1-3 (Pb 2nd Cl Conc)	8.93	44.6	15.8	86.2	15.8
Products 1-4 (Pb 1st Cl Conc)	12.72	33.4	17.12	91.8	24.4
Products 1-5 (Pb 1st+Cl Scav Concs)	15.34	28.0	16.86	93.0	29.0
Products 1-6 (Pb Rougher Conc)	29.76	14.8	14.22	95.1	47.4
Products 6-7 (Zn Rougher Feed)	84.66	0.38	7.48	7.0	71.0

**Test No. 2**

Purpose: As for Test 1, but with 40 minutes of Pb regrinding.

Procedure: As indicated below.

Feed: 2000 grams of minus 10 mesh G-3A ore.

Grind: 40 minutes at 65% solids in a lab ball mill. Pb regrind in rod mill.

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Na <sub>2</sub> CO <sub>3</sub>	SD200 Cyanide	A317 3418A	MIBC	Grind	Cond.	Froth	
Primary Grind	1500	250	8	-	40	-	-	-
Pb Rougher	-	-	40	10	-	1	4.5	9.2
	-	-	15	5	-	1	3	-
Pb Conc Re grind	250	75	10	-	40	-	-	-
Pb 1st Cleaner	-	-	-	5	-	1	2.7	9.1
	-	-	5	2.5	-	1	0.7	-
Pb 1st Cl Scav	-	-	5	2.5	-	1	2	-
Pb 2nd Cleaner	-	20	-	2.5	-	1	2	9.1
	-	-	5	2.5	-	1	2.5	-
Pb 3rd Cleaner	-	20	-	2.5	-	1	2	-
	-	-	2.5	2.5	-	1	2	-
Pb 4th Cleaner	-	20	-	2.5	-	1	3	-

**METALLURGICAL RESULTS**

Product	Weight		Assays, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1 Pb 4th Cleaner Conc	139.2	7.00	52	14.3	79.6	11.2
2 Pb 4th Cleaner Tail	13.0	0.65	23.5	22.5	3.4	1.6
3 Pb 3rd Cleaner Tail	14.1	0.71	14.1	20.8	2.2	1.6
4 Pb 2nd Cleaner Tail	45.5	2.29	6.2	20.3	3.1	5.2
5 Pb 1st Cl Scav Conc	58.8	2.96	4.36	19.6	2.8	6.5
6 Pb 1st Cl Scav Tail	313.8	15.78	0.87	12.8	3.0	22.6
7 Pb Rougher Tail	1404.2	70.61	0.38	6.51	5.9	51.3
Head Calc.	1988.6	100.00	4.57	8.96	100.0	100.0

**Combined Products**

Products 1-2 (Pb 3rd Cl Conc)	7.65	49.6	15.0	83.0	12.8
Products 1-3 (Pb 2nd Cl Conc)	8.36	46.6	15.5	85.2	14.5
Products 1-4 (Pb 1st Cl Conc)	10.65	37.9	16.5	88.3	19.7
Products 1-5 (Pb 1st+Cl Scav Concs)	13.61	30.6	17.2	91.1	26.1
Products 1-6 (Pb Rougher Conc)	29.39	14.6	14.8	94.1	48.7
Products 6-7 (Zn Rougher Feed)	86.39	0.47	7.66	8.9	73.9

**Test No. 3**

Purpose: As for Test 1, but increase SD200/cyanide in cleaning.

Procedure: As indicated below.

Feed: 2000 grams of minus 10 mesh G-3A ore.

Grind: 40 minutes at 65% solids in a lab ball mill. Pb regrind in rod mill.

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Na <sub>2</sub> CO <sub>3</sub>	SD200 Cyanide	A317 3418A	MIBC	Grind	Cond.	Froth	
Primary Grind	1500	250	8	-	40	-	-	-
Pb Rougher	-	-	40	10	-	1	5	9.1
	-	-	20	5	-	1	3	-
	-	-	10	5	-	1	3	-
Pb Conc Regrind	250	120	10	-	30	-	-	-
Pb 1st Cleaner	-	-	-	5	-	1	3	9.1
	-	-	5	2.5	-	1	1	-
Pb 1st Cl Scav	-	-	5	2.5	-	1	2	-
Pb 2nd Cleaner	-	30	-	-	-	1	3	-
	-	-	5	2.5	-	1	2	-
Pb 3rd Cleaner	-	38	-	2.5	-	1	2	-
	-	-	-	2.5	-	1	0.7	-
Pb 4th Cleaner	-	20	-	1.3	-	1	2	8.4
	-	-	1.3	1.3	-	1	1	-

**METALLURGICAL RESULTS**

Product	Weight		Assays, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1 Pb 4th Cleaner Conc	90.6	4.58	55.9	12.6	57.1	6.5
2 Pb 4th Cleaner Tail	38.1	1.93	29	20.2	12.5	4.4
3 Pb 3rd Cleaner Tail	57.4	2.90	24.6	20.6	15.9	6.8
4 Pb 2nd Cleaner Tail	82.8	4.19	5.98	19.2	5.6	9.1
5 Pb 1st Cl Scav Conc.	48.8	2.47	2.25	16.1	1.2	4.5
6 Pb 1st Cl Scav Tail	294.4	14.88	0.7	11.2	2.3	18.9
7 Pb Rougher Tail	1365.8	69.05	0.35	6.35	5.4	49.7
Head Calc.	1977.9	100.00	4.48	8.82	100.0	100.0

**Combined Products**

Products 1-2 (Pb 3rd Cl Conc)	6.51	47.9	14.8	69.5	11.0
Products 1-3 (Pb 2nd Cl Conc)	9.41	40.7	16.6	85.5	17.7
Products 1-4 (Pb 1st Cl Conc)	13.60	30.0	17.4	91.1	26.9
Products 1-5 (Pb 1st+Cl Scav Concs)	16.06	25.8	17.2	92.3	31.4
Products 1-6 (Pb Rougher Conc)	30.95	13.7	14.3	94.6	50.3
Products 6-7 (Zn Rougher Feed)	83.94	0.41	7.21	7.7	68.6

**SIZE ANALYSIS**

Product: Test No. 4 Reground Lead 1st Cleaner Concentrate S.G. - 5.00

Mesh	Weight Grams	% Weight		
		Ind.	Cum.	Passing
28.9 $\mu$	0.00	0.0	0.0	100.0
22.4	0.22	0.4	0.4	99.6
15.6	2.25	4.5	4.9	95.1
10.7	9.50	19.0	23.9	76.1
8.3	5.96	11.9	35.9	64.1
-8.3	32.07	64.1	100.0	-
Total	50.00	100.0	-	-

K80=11  $\mu$ m

**SIZE ANALYSIS**

Product: Test No. 5 Lead 1st Cleaner and 1st Cleaner  
Scavenger Concentrates

S.G.- 4.97

Mesh	Weight Grams	% Weight		
		Ind.	Cum.	Passing
28.9 $\mu$	0.65	1.3	--- 1.3	98.7
22.4	1.23	2.5	3.8	96.2
15.6	7.04	14.1	17.8	82.2
10.7	10.59	21.2	39.0	61.0
8.3	4.54	9.1	48.1	51.9
-8.3	25.95	51.9	100.0	-
Total	50.00	100.0	-	-

K80=15  $\mu$ m

**SIZE ANALYSIS**

Product: Test No. 6 Pb 2nd Cleaner Feed

S.G. - 5.23

Mesh	Weight Grams	% Weight		
		Ind.	Cum.	Passing
28.5 $\mu$	0.25	0.5	0.5	99.5
22.1	0.78	1.6	2.1	97.9
15.4	5.74	11.5	13.5	86.5
10.6	9.95	19.9	33.4	66.6
8.2	4.51	9.0	42.5	57.5
-8.2	28.77	57.5	100.0	-
Total	50.00	100.0	-	-

K80= 13  $\mu$ m

**Test No. 8**

**Purpose:** Similar to Test 6, but with lime in the lead circuit and adjustment of SD200/cyanide additions.

**Procedure:** Pb Cl Scav Tail sampled for assay. Zinc flotation as in Test 141, Project 3733.

**Feed:** 2000 grams of minus 10 mesh G-3A ore.

**Grind:** 40 minutes at 65% solids in a lab ball mill. Zinc regrind in the pebble mill.

**Conditions:**

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) <sub>2</sub>	SD200 Cyanide	A317 3418A	MIBC	Grind	Cond.	Froth	
Primary Grind	700	200	8	-	40	-	-	-
Pb Rougher	-	-	40	10	-	1	4	9.2
	-	-	12.5	5	-	1	3	-
Pb Ro Conc Reagr	200	150	6	-	30	-	-	-
Pb 1st Cleaner	-	-	-	5	-	1	1.2	9.0
Pb 1st Cl Scav	-	-	-	2.5	-	1	1.3	-
	-	-	2.5	2.5	-	1	1.3	-
Pb Cl Scav Conc	-	-	-	-	-	-	-	-
Regrind	-	50	-	-	15	-	-	-
Combine Pb 1st Cl Conc and reground Pb 1st Cl Scav Conc.								
Pb 2nd Cleaner	-	-	2.5	10	-	1	2.5	9.0
Pb 3rd Cleaner	-	20	2.5	5	-	1	2.3	9.2
Pb 4th Cleaner	-	20	2.5	2.5	-	1	2	-
<b>Zinc Circuit:</b>		<b>CuSO<sub>4</sub></b>	<b>A343</b>	<b>DF1012</b>				
Condition	2000	-	-	-	-	5	-	11.6
Condition	-	1000	-	-	-	5	-	-
Zn Rougher	-	-	40	2.5	-	3	4	11.8
	-	-	20	2.5	-	1	3	-
	-	-	10	2.5	-	1	2	-
Zn Conc Reagrind*	1000	100	-	-	30	-	-	-
H.I. Conditioning	-	-	25	2.5	-	15	-	-
Zn 1st Cleaner	-	-	-	-	-	-	6	11.8
	-	-	10	2.5	-	1	3	-
Zn 1st Cl Scav	-	-	5	2.5	-	1	1	-
Zn 2nd Cleaner	500	-	-	-	-	1	5	11.9
Zn 3rd Cleaner	500	-	-	-	-	1	4	11.9
Zn 4th Cleaner	500	-	-	-	-	1	4	12.2

pebble mill

**Test No. 9**

Purpose: Similar to Test 8, but regrind Pb 1st cleaner concentrate.

Procedure: As indicated below.

Feed: 2000 grams of minus 10 mesh G-3A ore.

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

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) <sub>2</sub>	SD200 Cyanide	A317 3418A	MIBC	Grind	Cond.	Froth	
Primary Grind	700	200	8	-	40	-	-	-
Pb Rougher	-	-	40	10	-	1	4	9.4
	-	-	12.5	5	-	1	3	-
Pb Ro Conc Regr	200	150	6	-	30	-	-	-
Pb 1st Cleaner	-	-	-	5	-	1	2.5	-
Pb 1st Cl Scav	-	-	5	2.5	-	1	2	-
Pb 1st Cl Conc	-	-	-	-	-	-	-	-
Regrind	-	50	-	-	15	-	-	-
Pb 2nd Cleaner	-	-	5	7.5	-	1	2.5	8.8
Pb 3rd Cleaner	-	20	2.5	7.5	-	1	2.5	8.8
	-	-	2.5	-	-	-	0.5	-
Pb 4th Cleaner	-	20	1.3	2.5	-	1	2.5	9.3
<b>Zinc Circuit:</b>		<b>CuSO<sub>4</sub></b>	<b>A343</b>	<b>DF1012</b>				
Condition	2000	-	-	-	-	5	-	-
Condition	-	1000	-	-	-	5	-	-
Zn Rougher	-	-	40	2.5	-	3	4	11.8
	-	-	20	2.5	-	1	3	-
	-	-	10	2.5	-	1	2	-
Zn Conc Regrind*	1000	100	-	-	30	-	-	-
H.I. Conditioning	-	-	25	2.5	-	15	-	-
Zn 1st Cleaner	-	-	-	-	-	-	5	11.9
	-	-	10	2.5	-	1	2	-
Zn 1st Cl Scav	-	-	5	2.5	-	1	1	-
Zn 2nd Cleaner	500	-	-	-	-	1	5	12.1
Zn 3rd Cleaner	500	-	-	-	-	1	4	-
Zn 4th Cleaner	500	-	-	-	-	1	4	12.4

\*pebble mill

**Test No. 10**

Purpose: Similar to Test 8, but with single stage Pb regrinding.

Procedure: As indicated below.

Feed: 2000 grams of minus 10 mesh G-3A ore.

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

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) <sub>2</sub>	SD200 Cyanide	A317 3418A	MIBC	Grind	Cond.	Froth	
Primary Grind	700	200	8	-	40	-	-	-
Pb Rougher	-	-	40	10	-	1	4	9.3
	-	-	12.5	5	-	1	3	-
Pb Ro Conc Regr	200	150	-	-	40	-	-	-
Pb 1st Cleaner	-	-	-	5	-	1	2.7	9.6
Pb Cleaner Scav	-	-	5	7.5	-	1	2	-
Pb 2nd Cleaner	-	50	5	7.5	-	1	2.5	9.5
Pb 3rd Cleaner	-	20	2.5	5	-	1	2.7	9.1
Pb 4th Cleaner	-	20	1.3	2.5	-	-	2.3	-

**Zinc Circuit:**

	Reagents Added, grams per tonne					Time, minutes			pH
	Ca(OH) <sub>2</sub>	CuSO <sub>4</sub>	A343	DF1012	SD200	Grind	Cond.	Froth	
Condition	2000	-	-	-	-	-	5	-	-
Condition	-	1000	-	-	-	-	5	-	-
Zn Rougher	-	-	40	2.5	-	-	3	4	11.8
	-	-	20	2.5	-	-	1	3	-
	-	-	10	2.5	-	-	1	2	-
Zn Conc Regr*	1000	100	-	-	200	30	-	-	-
H.I. Cond	-	-	25	-	-	-	15	-	-
Zn 1st Cleaner	-	-	-	-	-	-	-	5	12.0
	-	-	10	2.5	-	-	1	3	-
Zn 1st Cl Scav	-	-	5	.5	-	-	1	1	-
Zn 2nd Cleaner	500	-	-	-	-	-	1	4	12.3
Zn 3rd Cleaner	500	-	-	-	-	-	1	4	12.4
Zn 4th Cleaner	500	-	-	-	-	-	1	4	12.4

\*pebble mill

**Test No. 11**

Purpose: Similar to Test 8, but increase Pb recovery.

Procedure: As indicated below.

Feed: 2000 grams of minus 10 mesh G-3A ore.

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

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) <sub>2</sub>	SD200 Cyanide	A317 3418A	MIBC	Grind	Cond.	Froth	
Primary Grind	700	200	8	-	40	-	-	-
Pb Rougher	-	-	40	10	-	1	4	9.4
Pb Ro Conc Regr	-	-	12.5	5	-	1	3	-
Pb 1st Cleaner	200	150	6	-	30	-	-	-
Pb 1st Cl Scav	-	-	-	5	-	1	1.3	9.8
Pb Cl Scav Conc	-	-	-	-	-	-	1.5	-
Regrind	-	-	3.7	2.5	-	-	1	-
Pb 2nd Cleaner	-	50	-	-	15	-	-	-
Pb 2nd Cleaner	-	-	5	5	-	1	2.5	9.0
Pb 3rd Cleaner	-	-	2.5	-	-	-	0.5	-
Pb 3rd Cleaner	-	20	-	5	-	1	2.7	8.9
Pb 4th Cleaner	-	20	1.3	2.5	-	1	2.5	-

**METALLURGICAL RESULTS**

Product	Weight		Assays, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1 Pb 4th Cleaner Conc	131.2	6.56	56.2	13.3	79.5	9.9
2 Pb 4th Cleaner Tail	11.8	0.59	20.2	24	2.6	1.6
3 Pb 3rd Cleaner Tail	23.4	1.17	14.8	24.1	3.7	3.2
4 Pb 2nd Cleaner Tail	78.3	3.92	6.04	21.8	5.1	9.7
5 Pb 1st Cl Scav Tail	340.0	17.00	0.97	15.1	3.6	29.1
6 Pb Rougher Tail	1415.2	70.76	0.36	5.82	5.5	46.6
Head Calc.	1999.9	100.00	4.64	8.84	100.0	100.0

**Combined Products**

Products 1-2 (Pb 3rd Cl Conc)	7.15	53.2	14.2	82.1	11.5
Products 1-3 (Pb 2nd Cl Conc)	8.32	47.8	15.6	85.8	14.7
Products 1-4 (Pb 1st Cl+Cl Scav Concs)	12.24	34.5	17.6	90.9	24.3
Products 1-5 (Pb Rougher Conc)	29.24	15.0	16.1	94.5	53.4
Products 5-6 (Zn Rougher Feed)	87.76	0.48	7.62	9.1	75.7

**Test No. 12**

Product	Weight		Assays, %/g/t				% Distribution			
	g	%	Pb	Zn	Ag	Au	Pb	Zn	Ag	Au
1 Pb Cl Conc A	18.5	0.15	56.4	9.21	773	23.6	1.9	0.2	1.6	-
2 Pb Cl Conc B	122.0	1.02	65.2	8.52	705	6.2	14.4	1.0	9.6	-
3 Pb Cl Conc C	129.7	1.08	65.6	8.41	710	5.96	15.4	1.0	10.3	-
4 Pb Cl Conc D	125.5	1.05	66.1	8.28	734	5.43	15.0	1.0	10.3	-
5 Pb Cl Conc E	129.4	1.08	63.1	9.37	711	6.53	14.8	1.1	10.2	-
6 Pb Cl Conc F	136.3	1.14	62.5	9.85	728	5.69	15.4	1.3	11.0	-
7 Pb 4th Cl Tail F	59.8	0.50	29.1	21.9	506	-	3.1	1.2	3.4	-
8 Pb 3rd Cl Tail F	79.2	0.66	15.2	24.4	371	-	2.2	1.8	3.3	-
9 Pb 2nd Cl Tail F	129.5	1.08	7.32	24.1	298	-	1.7	2.9	4.3	-
10 Pb 1st Cl Scav Conc F	52.1	0.43	5.28	21.9	214	-	0.5	1.1	1.2	-
11 Zn Cl Conc A	199.8	1.67	2.26	55.9	69.7	-	0.8	10.4	1.6	-
12 Zn Cl Conc B	222.0	1.85	2.82	55.7	76.1	-	1.1	11.5	1.9	-
13 Zn Cl Conc C	240.9	2.01	3	55.2	84.3	-	1.3	12.4	2.3	-
14 Zn Cl Conc D	227.0	1.89	2.83	55.9	83.8	-	1.2	11.8	2.1	-
15 Zn Cl Conc E	219.9	1.83	2.36	55.2	86.4	-	0.9	11.3	2.1	-
16 Zn Cl Conc F	213.8	1.78	2.37	55.6	78.7	-	0.9	11.1	1.9	-
17 Zn 4th Cl Tail F	50.2	0.42	3.9	39.5	135	-	0.4	1.8	0.8	-
18 Zn 3rd Cl Tail F	97.4	0.81	3.71	34.8	133	-	0.7	3.2	1.4	-
19 Zn 2nd Cl Tail F	129.2	1.08	2.96	24.7	113	-	0.7	3.0	1.6	-
20 Zn 1st Cl Scav Conc F	26.3	0.22	3	11.5	135	-	0.1	0.3	0.4	-
21 Zn 1st Cl Scav Tail A	211.2	1.76	0.53	1.47	24.7	-	0.2	0.3	0.6	-
22 Zn 1st Cl Scav Tail B	235.2	1.96	0.94	1.88	39.1	-	0.4	0.4	1.0	-
23 Zn 1st Cl Scav Tail C	258.7	2.16	0.91	2.28	40	-	0.4	0.6	1.2	-
24 Zn 1st Cl Scav Tail D	271.7	2.27	0.99	2.63	60.5	-	0.5	0.7	1.8	-
25 Zn 1st Cl Scav Tail E	216.5	1.81	1.46	3.66	86.2	-	0.6	0.7	2.1	-
26 Zn 1st Cl Scav Tail F	197.2	1.65	1.56	3.1	77.2	-	0.6	0.6	1.7	-
27 Zn Scavenger Tail A	1228.0	10.25	0.25	0.86	9.1	-	0.6	1.0	1.2	-
28 Zn Scavenger Tail B	1325.5	11.06	0.36	1.04	12.4	-	0.9	1.3	1.8	-
29 Zn Scavenger Tail C	1314.0	10.96	0.33	0.95	11.2	-	0.8	1.2	1.6	-
30 Zn Scavenger Tail D	1335.4	11.14	0.35	1.02	11.9	-	0.8	1.3	1.8	-
31 Zn Scavenger Tail E	1416.1	11.81	0.39	1.04	13.1	-	1.0	1.4	2.1	-
32 Zn Scavenger Tail F	1368.2	11.41	0.36	1.06	12.6	-	0.9	1.4	1.9	-
Head (calc)	11986.2	100.00	4.62	8.95	74.9	-	100.0	100.0	100.0	-

**Combined Products**

Comb Pb Conc 1 to 6	5.52	64.2	8.91	719	-	76.8	5.5	53.0	-
Comb Pb Cl Tails 7 to 10	2.67	13.0	23.4	341	-	7.5	7.0	12.2	-
Comb Zn Cl Conc 11 to 16	11.04	2.62	55.6	80.1	-	6.3	68.6	11.8	-
Comb Zn Cl Tails 17 to 20	2.53	3.36	29.3	125	-	1.8	8.3	4.2	-
Comb Zn Cl Scav Tails 21 to 26	11.60	1.05	2.49	54.0	-	2.6	3.2	8.4	-
Comb Zn Ro Sc Tails 27 to 32	66.64	0.34	1.00	11.8	-	4.9	7.4	10.5	-

**Projected Results Cycles E, F**

Pb Cleaner Conc	6.19	62.8	9.62	720	-	84.2	6.7	61.1	-
Zn Cleaner Conc	13.11	2.36	55.4	82.6	-	6.7	81.1	14.8	-
Overall Tail	80.71	0.52	1.35	21.8	-	9.1	12.2	24.1	-
Head(calc)	100.00	4.62	8.95	72.9	-	100.0	100.0	100.0	-

**Test No. 13**

Purpose: To repeat the conditions of Test 13, but omit the lead 2nd regrinding stage.

Procedure: Similar to Test 12.

Feed: 6 x 2000 grams of minus 10 mesh G-3A ore.

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

Conditions:

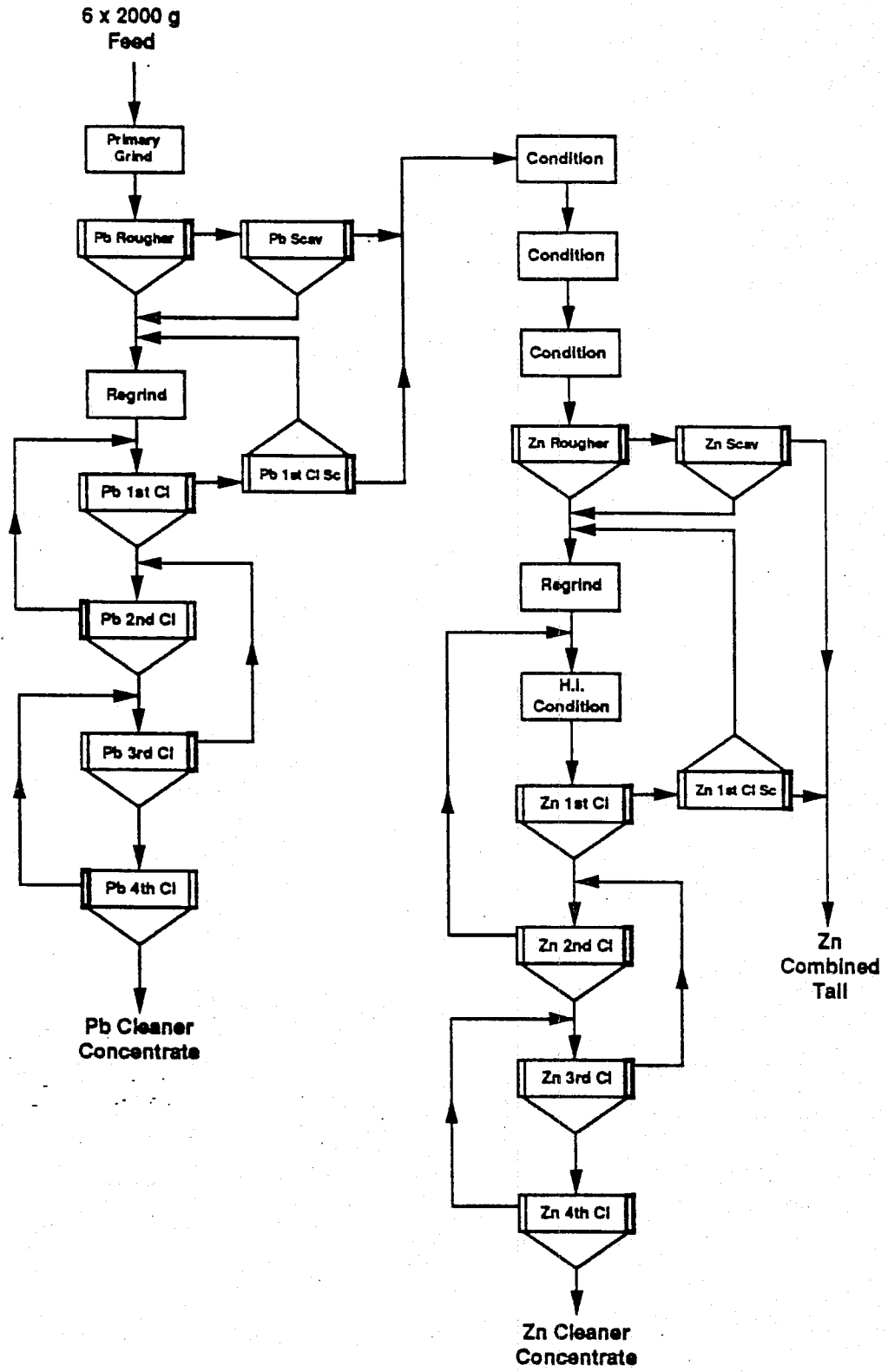
Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) <sub>2</sub>	SD200 Cyanide	A317 3418A	MIBC	Grind	Cond.	Froth	
Primary Grind	700	200	8	-	40	-	-	-
Pb Rougher	-	-	40	25	-	1	4	9.0
			12	5	-	1	3	-
Pb Regrind	150	150	8	10	45	-	-	-
Pb 1st Cleaner	-	-	-	-	-	1	3	9.0
			2	2	-	1	3	-
Pb 1st Cl Scav	-	-	2	5	-	1	2	-
Pb 2nd Cleaner	-	50	-	6	-	2	4	9.1
Pb 3rd Cleaner	-	20	-	4	-	2	3	9.1
Pb 4th Cleaner	-	20	-	-	-	2	3	9.1

**Zinc Circuit:**

	Reagents Added, grams per tonne					Time, minutes			pH
	Ca(OH) <sub>2</sub>	CuSO <sub>4</sub>	A343	DF1012	SD200	Grind	Cond.	Froth	
Condition	2000	-	-	-	-	-	5	-	-
Condition	-	1000	-	-	-	-	5	-	-
Zn Rougher	-	-	60	2.5	-	-	3	4	11.7
			-	-	-	-	1	3	-
			10	2.5	-	-	1	2.5	-
Zn Conc Regr*	1000	100	-	-	100	30	-	-	-
H.I. Cond	-	-	25	2.5	-	-	15	-	-
Zn 1st Cleaner	-	-	-	-	-	-	-	5	-
			10	2.5	-	-	1	2	-
Zn 1st Cl Scav	-	-	5	2.5	-	-	1	1.5	-
Zn 2nd Cleaner	200	-	-	-	-	-	1	4	11.8
Zn 3rd Cleaner	200	-	-	-	-	-	1	4	11.8
Zn 4th Cleaner	200	-	-	-	-	-	1	3	11.9

\*pebble mill

Test No. 13 Flowsheet



**Test No. 14**

Product	Weight		Pb	Assays,%g/t			Au	% Distribution			Au
	g	%		Zn	Ag	Pb		Zn	Ag	Au	
1 Pb Cl Conc A	86.0	0.72	65.7	9.7	758	9.4	10.3	0.8	7.3	-	
2 Pb Cl Conc B	106.8	0.89	64.8	9.96	780	6.83	12.6	1.0	9.3	-	
3 Pb Cl Conc C	142.3	1.19	55.1	13.9	703	6.74	14.2	1.8	11.1	-	
4 Pb Cl Conc D	105.4	0.88	61.2	11.7	727	7.01	11.7	1.1	8.5	-	
5 Pb Cl Conc E	108.4	0.90	62.7	11.1	794	6.4	12.3	1.1	9.6	-	
6 Pb Cl Conc F	128.7	1.07	60.4	12.1	695	6.9	14.1	1.4	9.9	-	
7 Pb 4th Cl Tail F	44.0	0.37	37.6	19.8	506	-	3.0	0.8	2.5	-	
8 Pb 3rd Cl Tail F	63.3	0.53	29	21.9	435	-	3.3	1.3	3.1	-	
9 Pb 2nd Cl Tail F	64.0	0.53	17.5	22.4	329	-	2.0	1.3	2.3	-	
10 Pb 1st Cl Scav Conc F	85.2	0.71	14.1	26	449	-	2.2	2.0	4.3	-	
11 Zn Cl Conc A	208.4	1.74	1.73	55.9	66.5	-	0.7	10.6	1.5	-	
12 Zn Cl Conc B	244.8	2.04	2.13	55.2	76.5	-	0.9	12.3	2.1	-	
13 Zn Cl Conc C	226.6	1.89	1.82	54.5	70.6	-	0.7	11.3	1.8	-	
14 Zn Cl Conc D	253.9	2.12	1.96	53.7	72	-	0.9	12.4	2.0	-	
15 Zn Cl Conc E	256.2	2.14	1.78	53	77.1	-	0.8	12.4	2.2	-	
16 Zn Cl Conc F	266.5	2.22	2.42	54.4	80.8	-	1.2	13.2	2.4	-	
17 Zn 4th Cl Tail F	43.2	0.36	3.27	24.9	119	-	0.3	1.0	0.6	-	
18 Zn 3rd Cl Tail F	75.2	0.63	3	20.8	112	-	0.4	1.4	0.9	-	
19 Zn 2nd Cl Tail F	148.4	1.24	2.28	13.6	90.5	-	0.6	1.8	1.5	-	
20 Zn 1st Cl Scav Conc F	51.8	0.43	2.3	7.09	91	-	0.2	0.3	0.5	-	
21 Zn 1st Cl Scav Tail A	167.5	1.40	0.72	1.77	29.5	-	0.2	0.3	0.5	-	
22 Zn 1st Cl Scav Tail B	168.2	1.40	0.78	2.09	29.7	-	0.2	0.3	0.6	-	
23 Zn 1st Cl Scav Tail C	203.1	1.69	0.87	2.05	36.1	-	0.3	0.4	0.8	-	
24 Zn 1st Cl Scav Tail D	256.9	2.14	1.02	2.46	42.3	-	0.5	0.6	1.2	-	
25 Zn 1st Cl Scav Tail E	197.5	1.65	1.19	3	57.5	-	0.4	0.5	1.3	-	
26 Zn 1st Cl Scav Tail F	284.6	2.37	1.13	2.32	47.6	-	0.6	0.6	1.5	-	
27 Zn Scavenger Tail A	1300.0	10.84	0.34	0.96	10.3	-	0.8	1.1	1.5	-	
28 Zn Scavenger Tail B	1366.5	11.40	0.42	1.24	12.2	-	1.0	1.5	1.9	-	
29 Zn Scavenger Tail C	1307.0	10.90	0.34	1.1	11.7	-	0.8	1.3	1.7	-	
30 Zn Scavenger Tail D	1354.9	11.30	0.35	1.04	12.1	-	0.9	1.3	1.8	-	
31 Zn Scavenger Tail E	1401.3	11.69	0.37	1.11	13.7	-	0.9	1.4	2.1	-	
32 Zn Scavenger Tail F	1275.2	10.63	0.32	0.96	12.1	-	0.7	1.1	1.7	-	
Head (calc)	11991.8	100.00	4.59	9.13	75.0	-	100.0	100.0	100.0	-	

**Combined Products**

Comb Pb Conc 1 to 6	5.65	61.1	11.61	739	-	75.2	7.2	55.7	-
Comb Pb Cl Tails 7 to 10	2.14	22.7	23.0	425	-	10.6	5.4	12.1	-
Comb Zn Cl Conc 11 to 16	12.14	1.99	54.4	74.3	-	5.3	72.3	12.0	-
Comb Zn Cl Tails 17 to 20	2.66	2.59	15.8	100	-	1.5	4.6	3.5	-
Comb Zn Cl Scav Tails 21 to 26	10.66	0.98	2.31	41.5	-	2.3	2.7	5.9	-
Comb Zn Ro Sc Tails 27 to 32	66.75	0.36	1.07	12.0	-	5.2	7.8	10.7	-

**Projected Results Cycles E, F**

Pb Cleaner Conc	6.39	61.5	11.6	740	-	85.5	8.1	64.6	-
Zn Cleaner Conc	13.72	2.11	53.7	79.0	-	6.3	80.7	14.8	-
Overall Tail	79.89	0.47	1.28	18.8	-	8.2	11.2	20.6	-
Head(calc)	100.00	4.59	9.13	73.2	-	100.0	100.0	100.0	-

**Test No. 15**

Purpose: Preliminary test on quartzite CI ore.

Procedure: Similar to Test 12 on bulk sulphide composite G-3A, with less collector (CI Composite was prepared from equal weights of metabasite ore with disseminated sulphides and quartzite ore with disseminated sulphides).

Feed: 2000 grams of minus 10 mesh quartzite CI Composite.

Grind: 37.5 minutes at 65% solids in a lab ball mill (Mill #1).

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Ca(OH) <sub>2</sub>	SD200 Cyanide	A317 3418A	MIBC	Grind	Cond.	Froth	
Primary Grind	700	200	8	-	37.5	-	-	-
Pb Rougher	-	-	20	10	-	1	3	9.2
	-	-	10	5	-	1	-	-
Pb Ro Conc Reqr	150	150	8	-	30	-	-	-
Pb 1st Cleaner	-	-	-	2.5	-	-	2	9.8
	-	-	2.5	2.5	-	1	0.7	-
Pb 1st CI Scav	-	-	2.5	5	-	1	1.5	9.2
Pb 1st CI Conc	-	-	-	-	-	-	-	-
Regrind	50	50	2.5	10	15	-	-	-
Pb 2nd Cleaner	-	-	-	-	-	-	1.5	9.7
	-	-	-	2.5	-	1	0.5	-
Pb 3rd Cleaner	-	20	-	5	-	-	2.5	9.1
Pb 4th Cleaner	-	20	-	-	-	1	2	-

**Zinc Circuit:**

	Reagents Added, grams per tonne					Time, minutes			pH
	Ca(OH) <sub>2</sub>	CuSO <sub>4</sub>	A343	DF1012	SD200	Grind	Cond.	Froth	
Condition	2000	-	-	-	-	-	5	-	11.8
Condition	-	1000	-	-	-	-	5	-	11.7
Zn Rougher	-	-	20	5	-	-	3	2	11.6
	-	-	10	2.5	-	-	1	0.7	-
Zn Conc Reqr*	1000	100	-	-	100	30	-	-	-
H.I. Cond	-	-	12.5	2.5	-	-	15	-	-
Zn 1st Cleaner	-	-	-	-	-	-	-	2	11.7
	-	-	5	2.5	-	-	1	1	-
Zn 1st CI Scav	-	-	5	2.5	-	-	1	1.5	-
Zn 2nd Cleaner	200	-	-	-	-	-	1	1.7	11.8
Zn 3rd Cleaner	200	-	-	-	-	-	1	1.5	11.5
Zn 4th Cleaner	200	-	-	-	-	-	1	2	11.8

\*pebble mill

**SIZE ANALYSIS**

Product: Test No. 15 Zn Rougher Tail

Microns	Mesh	Weight Grams	% Weight		
			Ind.	Cum.	Passing
208	65	0.0	0.0	0.0	100.0
147	100	0.8	0.6	0.6	99.4
104	150	4.2	3.3	3.9	96.1
74	200	10.8	8.5	12.5	87.5
53	270	17.9	14.1	26.6	73.4
38	400	19.9	15.7	42.3	57.7
-38	-400	73.0	57.7	100.0	-
	Total	126.6	100.0	-	-

K80 = 61  $\mu$ m

## Test No. 16

Product	Weight		Assays, %		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cl. Conc.	30.6	1.55	58.6	2.67	63.4	1.1
2. Pb 4th Cl. Tail	8.0	0.40	34.5	5.59	9.8	0.6
3. Pb 3rd Cl. Tail	9.3	0.47	13.8	8.54	4.5	1.1
4. Pb 2nd Cl. Tail	32.2	1.63	6.04	9.13	6.9	4.1
5. Pb 1st Cl.Sc Conc	18.5	0.94	1.61	8.46	1.1	2.2
6a. Pb 1st Cl Sc Tail (to Zn Ro)	113.1	5.72	0.39	7.1	1.6	11.1
6b. Pb 1st Cl Sc Tail (Sample)	6.3	0.32	0.39	7.1	0.1	0.6
7. Zn Cl Conc	80.0	4.05	0.92	54.4	2.6	60.1
8. Zn 4th Cl Tail	1.6	0.08	1.27	16.4	0.1	0.4
9. Zn 3rd Cl Tail	7.7	0.39	1.28	13.4	0.3	1.4
10. Zn 2nd Cl Tail	23.8	1.20	0.59	4.17	0.5	1.4
11. Zn 1st Cl Sc Conc	34.4	1.74	0.55	2.96	0.7	1.4
12. Zn 1st Cl Sc Tail	257.5	13.02	0.25	0.96	2.3	3.4
13. Zn Ro Tail	1467.7	74.22	0.15	1.1	7.8	22.3
Head Calc.	1977.6	100.00	1.43	3.66	100.0	100.0

## Combined Products

Products 1+2 (Pb 3rd Cl Conc)	1.95	53.6	3.28	73.2	1.7
Products 1-3 (Pb 2nd Cl Conc)	2.42	45.9	4.30	77.7	2.8
Products 1-4 (Pb 1st Cl Conc)	4.05	29.9	6.24	84.6	6.9
Products 1-5 (Pb 1st Cl + Cl Scav Concs)	4.99	24.6	6.66	85.7	9.1
Products 1-6 (Pb Ro Conc)	11.02	11.3	6.90	87.3	20.8
Pb Ro Tail	88.98	0.20	3.26	12.7	79.2
Products 6a-6b (Pb 1st Cl Scav Tail)	6.04	0.39	7.10	1.6	11.7
Products 7-13 (Zn Ro Feed)	94.70	0.22	3.49	14.3	90.3
Products 7-8 (Zn 3rd Cl Conc)	4.13	0.93	53.7	2.7	60.4
Products 7-9 (Zn 2nd Cl Conc)	4.52	0.96	50.2	3.0	61.9
Products 7-10 (Zn 1st Cl Conc)	5.72	0.88	40.5	3.5	63.2
Products 7-10 (Zn 1st Cl+Cl Scav Concs)	7.46	0.80	31.7	4.2	64.6
Products 7-12 (Zn Ro Conc)	20.48	0.45	12.2	6.5	68.0
Products 12+13 (Zn Tails)	87.24	0.16	1.08	10.1	25.7
Products 6a +12 +13 (Comb Tails)	87.56	0.17	1.10	10.2	26.3