

An Investigation of
THE RECOVERY OF LEAD AND ZINC

from Vangorda Upper Zone samples
submitted by

CURRAGH RESOURCES

Progress Report No. 1

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NOTE:

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LAKEFIELD RESEARCH
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A B S T R A C T

Ten flotation tests were conducted on samples of near-surface Vangorda ore in order to compare flotation to that of ore from a deeper zone, and to optimize flotation with PKD depressants.

Results are summarized in Table No. 1.

TABLE NO. 1 : Summary of Flotation Results

Test No.	Purpose	Product	Weight %	Assays %		% Distribution	
				Pb	Zn	Pb	Zn
1	Comp. 1 As for Test 40 3458B (with NaCN)	Pb 4th Cleaner Conc	4.28	53.8	12.3	63.3	10.2
		Pb 1st Cleaner Conc	9.83	29.4	16.6	79.3	31.7
		Zn 4th Cleaner Conc	4.98	2.08	51.1	2.8	49.6
		Zn Rougher Conc	14.43	2.29	20.5	9.1	57.6
		Zn Rougher Tail	74.71	0.46	0.45	9.4	6.5
		Head (Calc)	100.00	3.64	5.14	100.0	100.0
3	Comp. 1 with PKD	Pb 4th Cleaner Conc	3.64	61.6	10.8	65.0	8.2
		Pb 1st Cleaner Conc	6.60	42.0	15.8	80.5	21.7
		Zn 4th Cleaner Conc	4.83	1.50	55.4	2.1	55.7
		Zn Rougher Conc	13.82	1.96	23.2	7.9	66.9
		Zn Rougher Tail	79.21	0.47	0.49	10.8	8.1
		Head (Calc)	100.00	3.44	4.80	100.0	100.0
7	Comp. 2 PKD	Pb 4th Cleaner Conc	5.26	52.5	15.9	68.2	15.2
		Pb 1st Cleaner Conc	7.56	42.6	17.5	79.4	24.0
		Zn 4th Cleaner Conc	5.99	1.92	54.8	2.8	59.6
		Zn Rougher Conc	18.76	2.02	19.6	9.4	66.6
		Zn Rougher Tail	73.14	0.55	0.47	9.9	6.2
		Head (Calc)	100.00	4.05	5.51	100.0	100.0
40	Comp. 3 3458B (with NaCN)	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

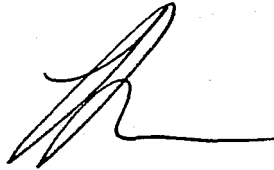
Flotation of near-surface ores provided poorer metallurgy than for Composite 3 (from Project 3458B). Flotation of Composite 2, which was comprised of the upper levels of the near-surface ore (i.e. top 6 m) was especially poor.

Limited optimization with PKD depressant resulted in improved metallurgy.

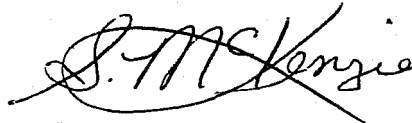
INTRODUCTION

Flotation testwork was conducted on Vangorda near-surface ore, according to Curragh Purchase Requisition No. 023314. Results were reported to Mr. Godfrey McDonald of Curragh Resources as the testwork proceeded.

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SUMMARY AND CONCLUSIONS

1. Description of Samples Used in the Testwork

Two Vangorda ore composites were prepared from ore from 9 drill holes. Composite 1 was prepared from all samples, and Composite 2 was prepared from ore from the upper 6 m of each hole.

Assays of Composites 1 and 2, and of 3458B Composite 3 are presented in Table No. 2.

TABLE NO. 2 : Head Assays

Composite No.	Cu	Pb	Zn	Assays %, g/t			
				Au	Ag	Fe	S
1	0.23	3.67	5.12	1.00	51.4	25.5	25.4
2	0.22	4.30	5.86	0.99	64.8	22.2	26.1
3458B 3	0.15	3.96	5.35	1.57	64.8	21.7	28.2

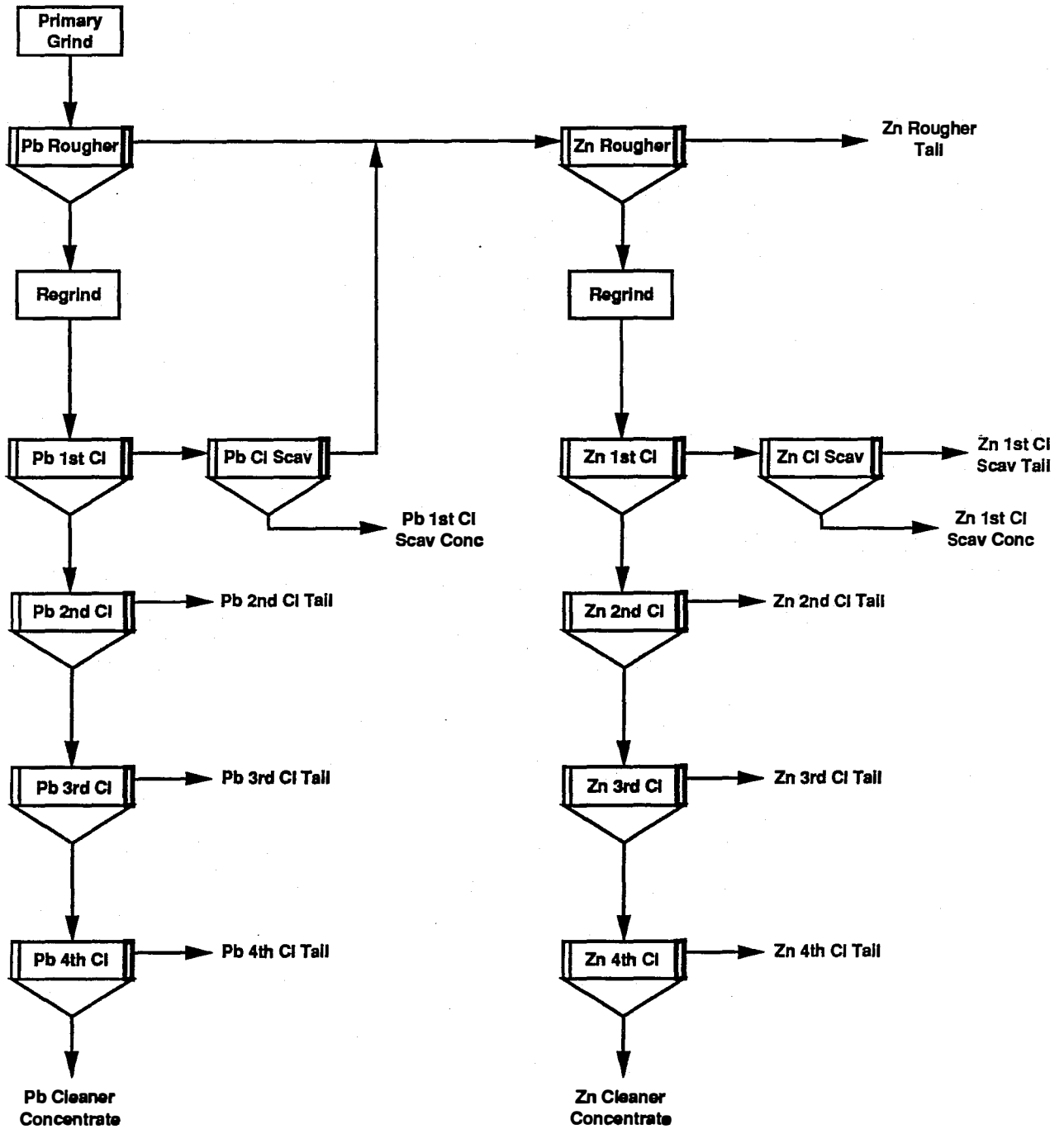
Composite 2 was higher grade than Composite 1.

2. FLOTATION OF COMPOSITE 1

Eight tests were conducted on Composite 1 ore, according to the flowsheet shown in Figure No. 1.

Summary - Continued

FIGURE NO. 1 : Flowsheet



Summary - Continued

The flowsheet and the reagent scheme in the initial test were modelled on Test No. 40 for Composite 3 of Project No. 3458B. The best tests on Composite 1 substituted PKD for cyanide and sodium silicate. The conditions and results are summarized in Table No. 3.

TABLE NO. 3 : Summary of Composite 1 Flotation

A) Conditions:

Test No.	Pb Grind Time		Reagent Additions, g/t				pH	
	Primary min	Regrind min	Pb Circuit		Zn Circuit		Pb	Zn
			Depres. & Mod.	Collector	Depres & Mod.	Collector		
3&8	40	30	Na ₂ CO ₃ = 2500 PKD = 395	A317/3418A=56	Ca(OH) ₂ = 4500 CuSO ₄ = 1700	A343 = 100	9.6	11.3-12
1	40	20	Na ₂ CO ₃ = 2000 NaCN = 320 Na ₂ SiO ₃ = 250	A317/3418A=54	Ca(OH) ₂ = 2250 CuSO ₄ = 800	A350 = 45	9.4-9.8	11.5
40 3458B	40	20	Na ₂ CO ₃ = 2000 NaCN = 320 Na ₂ SiO ₃ = 250	A317/3418A=44	Ca(OH) ₂ = 2250 CuSO ₄ = 800	A350 = 45	9.7	11.5-12

B) Results:

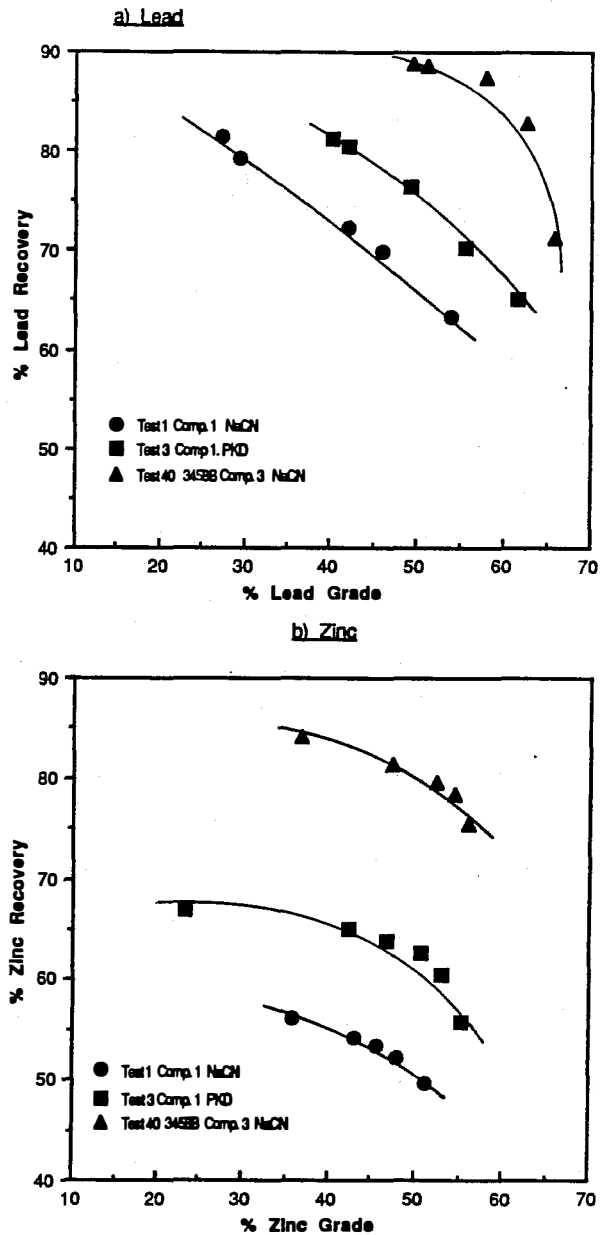
Test No.	Product	Weight %	Assays %, g/t				% Distribution			
			Pb	Zn	Au	Ag	Pb	Zn	Au	Ag
3	Pb 4th Cl Conc	3.64	61.6	10.8	-	-	65.0	8.2	-	-
	Pb 1st Cl Conc	6.60	42.0	15.8	-	-	80.5	21.7	-	-
	Zn 4th Cl Conc	4.83	1.50	55.4	-	-	2.1	55.7	-	-
	Zn Ro Conc	13.82	1.96	23.2	-	-	7.9	66.9	-	-
	Zn Ro Tail	79.21	0.47	0.49	-	-	10.8	8.1	-	-
	Head (Calc)	100.00	3.44	4.80	-	-	100.0	100.0	-	-
8	Pb 4th Cl Conc	2.72	62.8	9.78	20.2	640	51.7	5.7	58.8	35.2
	Pb 1st Cl Conc	5.93	42.1	15.2	10.9	515	75.5	19.2	69.0	61.9
	Zn 4th Cl Conc	5.92	2.06	49.7	0.75	66.0	3.7	62.9	4.8	7.9
	Zn Ro Conc	16.85	2.08	19.5	0.62	58.6	10.6	70.1	11.2	20.0
	Zn Ro Tail	76.79	0.54	0.45	0.23	10.4	12.5	7.4	18.9	16.2
	Head (Calc)	100.00	3.31	4.62	0.93	49.4	100.0	100.0	100.0	100.0
1	Pb 4th Cl Conc	4.28	53.8	12.3	-	-	63.3	10.2	-	-
	Pb 1st Cl Conc	9.83	29.4	16.6	-	-	79.3	31.7	-	-
	Zn 4th Cl Conc	4.98	2.08	51.1	-	-	2.8	49.6	-	-
	Zn Ro Conc	14.43	2.29	20.5	-	-	9.1	57.6	-	-
	Zn Ro Tail	74.71	0.46	0.45	-	-	9.4	6.5	-	-
	Head (Calc)	100.00	3.64	5.14	-	-	100.0	100.0	-	-
40 3458B	Pb 4th Cl Conc	4.38	65.9	7.34	-	-	71.3	6.1	-	-
	Pb 1st Cl Conc	7.00	51.2	8.24	-	-	88.6	10.9	-	-
	Zn 4th Cl Conc	7.10	1.27	56.0	-	-	2.2	75.4	-	-
	Zn Ro Conc	17.09	1.30	26.2	-	-	5.5	84.8	-	-
	Zn Ro Tail	75.63	0.30	0.24	-	-	5.6	3.4	-	-
	Head (Calc)	100.00	4.04	5.27	-	-	100.0	100.0	-	-

Summary - Continued

The flotation response of Composite 1 was poor as compared to Composite 3 of 3458B. Both lead and zinc recoveries and grades were much lower in Test No. 1.

Substitution of PKD for cyanide and silicate in Test No. 3 improved both Pb and Zn response, but the results were much poorer than Test No. 40, as shown in Figure No. 2.

FIGURE NO. 2 : Summary of Composite 1 Flotation



Summary - Continued

Various parameters were investigated in the lead circuit. Parameters included depressant type and level, collector type, sulphidizer addition, carbonate and collector level, and lead regrind time. Lead flotation was affected as follows:

- Depressant Type and Level:

Increased cyanide (320 to 395 g/t NaCN) resulted in improved Pb selectivity, with higher recoveries. Substitution of PKD for cyanide yielded higher Pb recoveries and slightly higher grades.

Increasing PKD level (395 to 440 g/t) resulted in slightly improved Pb selectivity and recovery.

- Collector Type:

Collector mixture A317/3418A provided much better Pb recoveries and grades than A317/LSB-1.

- Na₂S:

Addition of Na₂S results in lower lead grades and recoveries.

- Carbonate and Collector Levels, and Pb Regrind Time:

These 3 parameters were varied as follows: carbonate additions to the primary grind and Pb regrind were reduced, collector levels were increased, and Pb regrind time was increased. Lead grade was lower and recovery higher in the 4th cleaner concentrate, but the grade-recovery curves were similar.

- Zinc Flotation:

Overall zinc recoveries were less than 50% with cyanide. PKD produced much better recoveries of 51-63 %. The various Pb circuit parameters investigated had the following effects: (a) the alternative collector in Test 4 yielded very poor selectivity towards Zn in the lead circuit as Zn grade in the Pb 1st Cl Conc was over 44 %, and (b) Na₂S addition in Test 5 yielded a low Zn recovery of 51.6 % in the zinc product.

Summary - Continued

Precious Metal Flotation:

Precious metal grades and recoveries were not appreciably affected by the parameters that were varied in the testwork.

Copper Flotation:

Copper was assayed in one test only. The lead product in Test No. 6 contained 60.6 % of the copper, with a grade of 3.30 % Cu.

3. FLOTATION OF COMPOSITE 2

Two tests were conducted on Composite 2 ore, using the same flowsheet used for Composite 1. The conditions and results of the best test are summarized in Table No. 4.

TABLE NO. 4 : Composite 2 Flotation

A) Conditions:

Test No.	Pb Grind Time		Reagent Additions, g/t				pH	
	Primary min	Regrind min	Pb Circuit		Zn Circuit		Pb	Zn
			Depres. & Mod.	Collector	Depres & Mod.	Collector		
7	40	40	Na ₂ CO ₃ = 1750 PKD = 395	A317/3418A=61	Ca(OH) ₂ = 4500 CuSO ₄ = 1700	A343 = 100	8.7-9.5	10.8-12

B) Results:

Test No.	Product	Weight %	Assays %, g/t				% Distribution			
			Pb	Zn	Au	Ag	Pb	Zn	Au	Ag
7	Pb 4th Cl Conc	5.26	52.5	15.9	12.1	636	68.2	15.2	61.7	54.9
	Pb 1st Cl Conc	7.56	42.6	17.5	9.28	552	79.4	24.0	68.2	68.4
	Zn 4th Cl Conc	5.99	1.92	54.8	1.15	62.4	2.8	59.6	6.7	6.1
	Zn Fo Conc	18.76	2.02	19.6	0.72	51.3	9.4	66.6	13.0	15.8
	Zn Fo Tail	73.14	0.55	0.47	0.23	11.8	9.9	6.2	16.4	14.2
	Head (Calc)	100.00	4.05	5.51	1.03	61.0	100.0	100.0	100.0	100.0

In comparison with Composite 1, flotation of Composite 2 with PKD resulted in lower Pb product grades with similar recoveries. Zinc flotation was essentially similar.

Gold and silver recoveries were higher, but the ore was higher grade. Copper recovery was slightly lower, with much lower grade.

Summary - Continued

4. CONCLUSIONS

1. Flotation of the near-surface Vangorda ore resulted in relatively poor flotation response, as compared to 3458B Composite 3 ore. Flotation of the top 6 m of ore was in itself inferior to that of the overall near-surface ore.

2. Optimization of flotation on the near-surface ore was pursued with substitution of cyanide and silicate with PKD. Flotation response was greatly improved with this reagent scheme.

DISCUSSION

1. DESCRIPTION OF SAMPLES USED IN THE TESTWORK

Fifty-eight samples of Vangorda ore were received on April 4, 1990, and designated with LR # 9034059. Total sample weight was 60 kg and most samples weighed about 1 kg. Sample numbers are listed in Table No. 5, with the weights used in the preparation of Composite 1 (500 g was used), unless otherwise stated.

TABLE NO. 5 : Composite 1 Preparation

Hole No. BVU	Sample No.	Sample Weights
21U	16657-16659	16657-346 g; 16658-600 g
22U	16384-16394	
26U	16639-16645	16639-289 g; 16641-418 g
29U	16337-16647	
30U	16133-16138	16627- 144 g
32U	16626-16633	
33U	16399-16405	
34U	16724-16725	
35U	16149-16151	

The ore was composited as follows:

Composite 1: half of most of the samples were composited and stage-crushed to minus 10 mesh. The composite was blended, and riffled into 2 kg charges.

Composite 2: Ore from the upper 6 m of each hole was composited. Sample numbers and weights are shown in Table No. 6. Sample weight was 500 g unless otherwise stated.

TABLE NO. 6 : Composite 2 Preparation

Hole No. BVU	Sample No.	Sample Weights
21U	16657-16659	16657 - 345 g; 16658 - 600 g
22U	16384-16389	
26U	16639-16643	16639 - 285 g; 16641 - 465 g
29U	16337-16341	
30U	16133-16137	16627 - 190 g
32U	16627-16632	
33U	16400-16404	
34U	16724-16725	
35U	16149-16151	

The samples were composited, stage-crushed to minus 10 mesh, blended and riffled into 2 kg charges.

Head assays are presented in Table No. 7.

Discussion - Continued

TABLE NO. 7 : Head Assays

Composite No.	Cu	Pb	Zn	Assays %, g/t			
				Au	Ag	Fe	S
1	0.23	3.67	5.12	1.00	51.4	25.5	25.4
2	0.22	4.30	5.86	0.99	64.8	22.2	26.1
3458B 3	0.15	3.96	5.35	1.57	64.8	21.7	28.2

Cu - calculated head from one test for each composite.

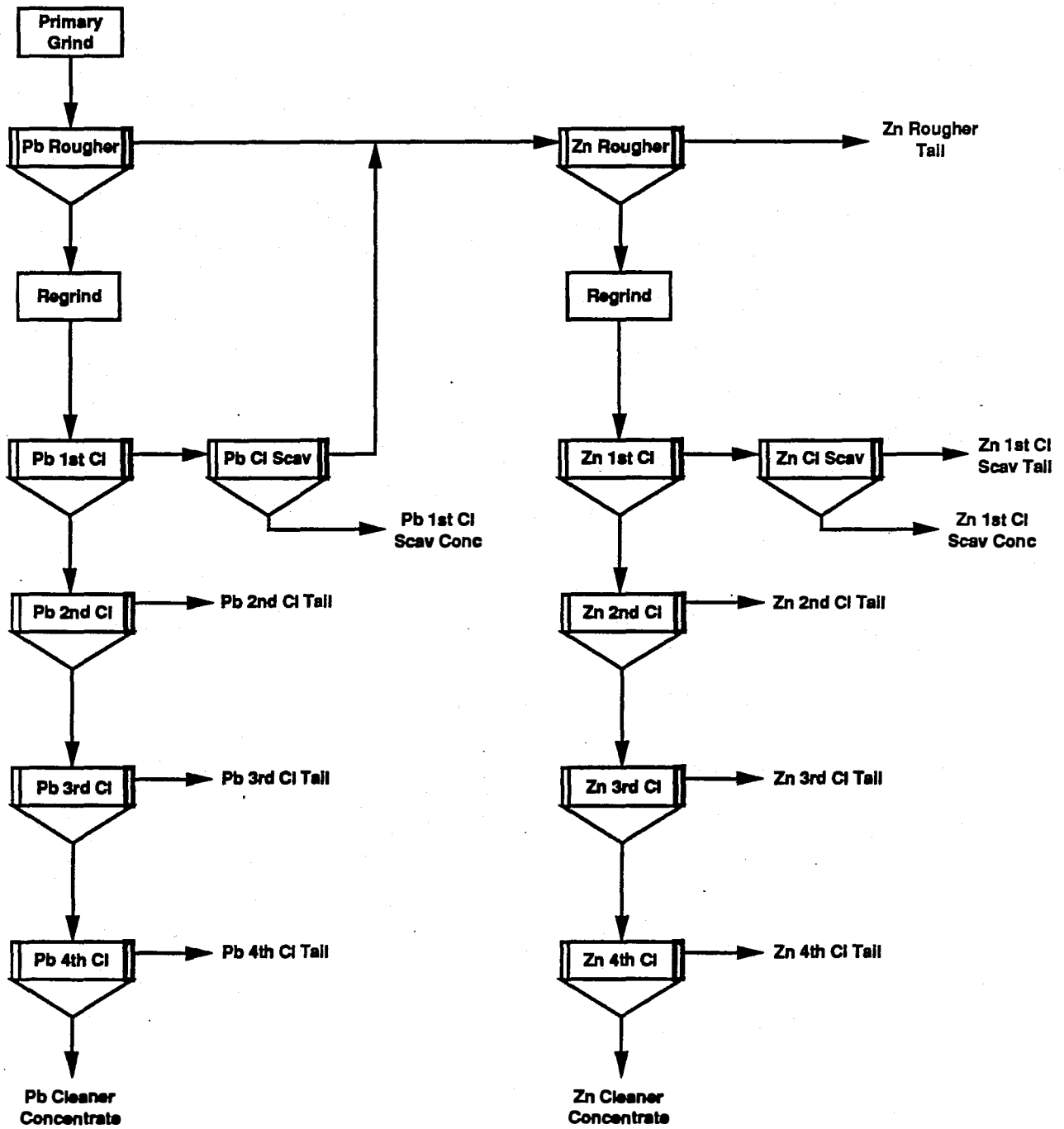
Au - calculated head from 4 tests for Composite 1 and 2 tests for Composite 2.

Composite 1 was lower grade than Composite 2. Lead and zinc grades were similar in Composites 1 and 3458B Composite 3, with Composite 3 higher in gold and silver.

2. FLOTATION OF COMPOSITE 1

Eight flotation tests were conducted on Composite 1 ore, according to the flowsheet in Figure No. 3. The conditions and results are presented in Table No. 8.

FIGURE NO. 3 : Flowsheet



Discussion - Continued

TABLE NO. 8 : Composite 1 Flotation

A) Conditions:

Test No.	Pb Grind Time		Reagent Additions, g/t				pH	Zn
	Primary min	Regrind min	Depres. & Mod.	Pb Circuit Collector	Zn Circuit Depres & Mod.	Zn Circuit Collector		
1	40	20	Na ₂ CO ₃ = 2000 NaCN = 320 Na ₂ SiO ₃ = 250	A317/3418A=54	Ca(OH) ₂ = 2500 CuSO ₄ = 800	A350=45	9.4-9.8	11.5
2	40	20	Na ₂ CO ₃ = 2000 NaCN = 395 Na ₂ SiO ₃ = 250	A317/3418A=51.5	Ca(OH) ₂ = 5000 CuSO ₄ = 800	A350=55	9.7	11.8-12.1
3	40	30	Na ₂ CO ₃ = 2500 PKD = 395	A317/3418A=56	Ca(OH) ₂ = 4500 CuSO ₄ = 1700	A343=100	9.6	11.3-12.0
4	40	30	Na ₂ CO ₃ = 2500 PKD = 395	A3M/LSB-1=95.5	-	-	9.5-9.8	-
5	40	30	Na ₂ CO ₃ = 2500 Na ₂ S = 800 PKD = 395	A317/3418A=64	Ca(OH) ₂ = 4500 CuSO ₄ = 1700	A343=100	9.8-9.5	11.8-12.0
6	40	40	Na ₂ CO ₃ = 1750 PKD = 325	A317/3418A=63.5	Ca(OH) ₂ = 4500 CuSO ₄ = 1700	A343=100	8.6-9.5	10.8-12.0
8	40	30	Na ₂ CO ₃ = 2500 PKD = 395	A317/3418A=58.5	Ca(OH) ₂ = 4500 CuSO ₄ = 1700	A343=100	9.4-9.5	11.3-11.5
10	40	30	Na ₂ CO ₃ = 2500 PKD = 440	A317/3418A=60.5	Ca(OH) ₂ = 4500 CuSO ₄ = 1700	A343=100	9.4-10.0	11.5-12.0

B) Results:

Test No.	Product	Weight %	Assays %, g/t				% Distribution			
			Pb	Zn	Au	Ag	Pb	Zn	Au	Ag
1	Pb 4th Cl Conc	4.28	53.8	12.3	-	-	63.3	10.2	-	-
	Pb 1st Cl Conc	9.83	29.4	16.6	-	-	79.3	31.7	-	-
	Zn 4th Cl Conc	4.98	2.08	51.1	-	-	2.8	49.6	-	-
	Zn Ro Conc	14.43	2.29	20.5	-	-	9.1	57.6	-	-
	Zn Ro Tail	74.71	0.46	0.45	-	-	9.4	6.5	-	-
	Head (Calc)	100.00	3.64	5.14	-	-	100.0	100.0	-	-
2	Pb 4th Cl Conc	4.52	54.8	12.1	-	-	69.4	11.4	-	-
	Pb 1st Cl Conc	8.11	36.4	14.4	-	-	82.7	24.3	-	-
	Zn 4th Cl Conc	3.33	0.95	54.3	-	-	0.9	37.7	-	-
	Zn Ro Conc	13.43	1.68	23.3	-	-	6.3	65.2	-	-
	Zn Ro Tail	78.12	0.48	0.50	-	-	10.5	8.1	-	-
	Head (Calc)	100.00	3.57	4.80	-	-	100.0	100.0	-	-

Discussion - Continued

B) Results:

Test No.	Product	Weight %	Assays %, g/t				% Distribution			
			Pb	Zn	Au	Ag	Pb	Zn	Au	Ag
3	Pb 4th Cl Conc	3.64	61.6	10.8	-	-	65.0	8.2	-	-
	Pb 1st Cl Conc	6.60	42.0	15.8	-	-	80.5	21.7	-	-
	Zn 4th Cl Conc	4.83	1.50	55.4	-	-	2.1	55.7	-	-
	Zn Ro Conc	13.82	1.96	23.2	-	-	7.9	66.9	-	-
	Zn Ro Tail	79.21	0.47	0.49	-	-	10.8	8.1	-	-
	Head (Calc)	100.00	3.44	4.80	-	-	100.0	100.0	-	-
4	Pb 4th Cl Conc	3.03	57.4	12.4	-	-	51.5	7.9	-	-
	Pb 1st Cl Conc	9.28	28.6	22.4	-	-	78.5	43.9	-	-
	Pb Ro Conc	21.25	14.0	13.8	-	-	88.1	61.8	-	-
	Pb Ro Tail	78.75	0.51	2.29	-	-	11.9	38.2	-	-
	Head (Calc)	100.00	3.38	4.73	-	-	100.0	100.0	-	-
5	Pb 4th Cl Conc	3.57	56.4	13.1	17.0	572	60.9	10.0	57.6	41.0
	Pb 1st Cl Conc	6.69	38.2	19.0	10.2	458	77.2	27.2	64.7	61.5
	Zn 4th Cl Conc	4.48	1.65	53.9	1.39	67.5	2.2	51.6	5.9	6.1
	Zn Ro Conc	14.26	1.88	19.4	0.89	63.9	8.1	59.1	12.0	18.3
	Zn Ro Tail	78.13	0.50	0.43	0.27	9.8	11.8	7.2	20.0	15.4
	Head (Calc)	100.00	3.31	4.68	1.06	49.8	100.0	100.0	100.0	100.0
6	Pb 4th Cl Conc	4.22	55.4	12.2	13.6	616	70.3	11.1	55.4	53.0
	Pb 1st Cl Conc	6.02	43.6	14.1	10.3	523	78.9	18.3	60.2	64.2
	Zn 4th Cl Conc	5.30	1.32	52.5	2.52	56.1	2.1	59.9	12.9	6.1
	Zn Ro Conc	15.59	1.63	20.2	1.24	47.6	7.6	67.9	18.7	15.1
	Zn Ro Tail	77.61	0.49	0.52	0.23	11.0	11.4	8.7	17.3	17.4
	Head (Calc)	100.00	3.33	4.65	1.03	49.1	100.0	100.0	100.0	100.0
8	Pb 4th Cl Conc	2.72	62.8	9.78	20.2	694	51.7	5.7	58.8	35.2
	Pb 1st Cl Conc	5.93	42.1	15.2	10.9	515	75.5	19.2	69.0	61.9
	Zn 4th Cl Conc	5.92	2.06	49.7	0.75	66.0	3.7	62.9	4.8	7.9
	Zn Ro Conc	16.85	2.08	19.5	0.62	58.6	10.6	70.1	11.2	20.0
	Zn Ro Tail	76.79	0.54	0.45	0.23	10.4	12.5	7.4	18.9	16.2
	Head (Calc)	100.00	3.31	4.67	0.93	49.4	100.0	100.0	100.0	100.0
10	Pb 4th Cl Conc	4.16	57.4	11.2	14.9	605	70.7	10.2	63.2	49.9
	Pb 1st Cl Conc	6.69	41.7	15.4	10.0	498	82.6	22.6	68.1	66.2
	Zn 4th Cl Conc	4.74	1.52	52.8	0.79	64.0	2.1	54.8	3.8	6.0
	Zn Ro Conc	18.06	1.32	16.1	0.53	42.9	7.1	63.7	9.7	15.4
	Zn Ro Tail	74.47	0.41	0.45	0.27	10.7	9.0	7.3	20.5	15.8
	Head (Calc)	100.00	3.38	4.57	0.98	50.4	100.0	100.0	100.0	100.0

2.1. Comparison with Vangorda Composite 3 Flotation

Test No. 1 was modelled on Test No. 40 from Project 3458B. The conditions and results are summarized in Table No. 9 and Figure No. 4.

Discussion - Continued

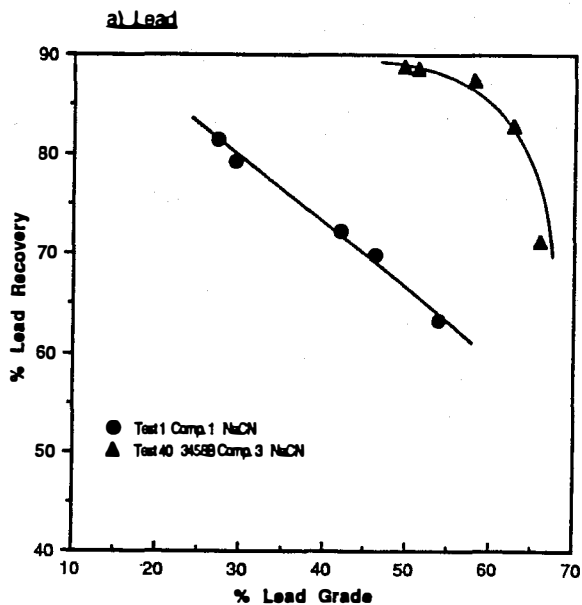
TABLE NO. 9 : Comparison of Composite 1 and 3458B Composite 3 Flotation

A) Conditions:

Test No.	Pb Grind Time		Reagent Additions, g/t				pH	
	Primary min	Regrind min	Pb Circuit		Zn Circuit		Pb	Zn
			Depres. & Mod.	Collector	Depres & Mod.	Collector		
1	40	20	Na ₂ CO ₃ = 2000 NaCN = 320 Na ₂ SiO ₃ = 250	A317/3418A=54	Ca(OH) ₂ = 2250 CuSO ₄ = 800	A350=45	9.4-9.8	11.5
40 3458B	40	20	Na ₂ CO ₃ = 2000 NaCN = 320 Na ₂ SiO ₃ = 250	A317/3418A=44	Ca(OH) ₂ = 2250 CuSO ₄ = 800	A350=45	9.7	11.5- 12.0

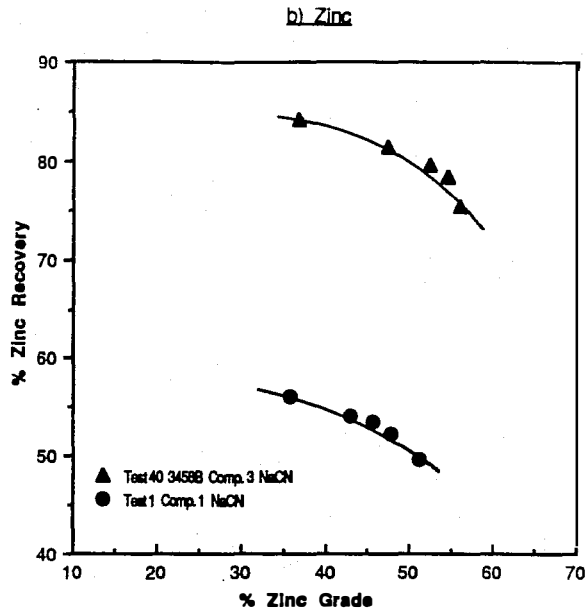
B) Results:

Test No.	Product	Weight %	Assays %		% Distribution	
			Pb	Zn	Pb	Zn
1	Pb 4th Cl Conc	4.28	53.8	12.3	63.3	10.2
	Pb 1st Cl Conc	9.83	29.4	16.6	79.3	31.7
	Zn 4th Cl Conc	4.98	2.08	51.1	2.8	49.6
	Zn Ro Conc	14.43	2.29	20.5	9.1	57.6
	Zn Ro Tail	74.71	0.46	0.45	9.4	6.5
	Head (Calc)	100.00	3.64	5.14	100.0	100.0
40 3458B	Pb 4th Cl Conc	4.38	65.9	7.34	71.3	6.1
	Pb 1st Cl Conc	7.00	51.2	8.24	88.6	10.9
	Zn 4th Cl Conc	7.10	1.27	56.0	2.2	75.4
	Zn Ro Conc	17.09	1.30	26.2	5.5	84.8
	Zn Ro Tail	75.63	0.30	0.24	5.6	3.4
	Head (Calc)	100.00	4.04	5.27	100.0	100.0

FIGURE NO. 4 : Summary of Composite 1 Flotation

Discussion - Continued

FIGURE NO. 4 : continued



Lead and zinc recoveries and grades were considerably lower for Composite 1 than for 3458B Composite 3.

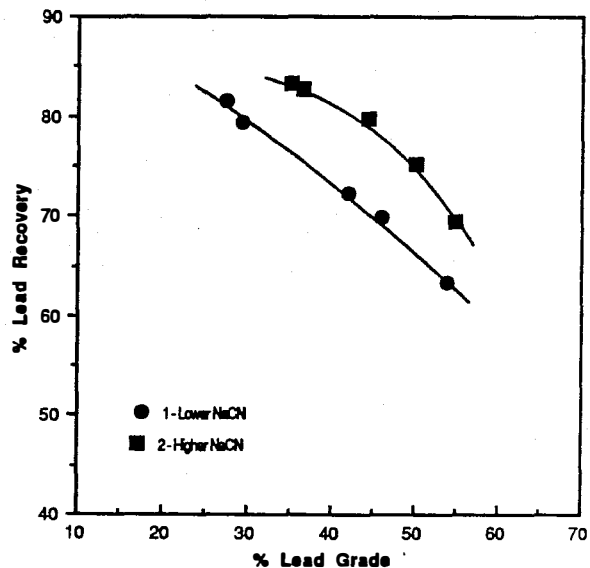
2.2. Effect of Cyanide Level

Tests 1 and 2 were conducted with Na_2SiO_3 and NaCN . Test 1 produced a lead concentrate grading 53.8 % Pb with a 63 % Pb recovery. The zinc concentrate was 51.1 % Zn grade with a 50 % Zn recovery. Lead and zinc distributions in the tailing were 9.4 % and 6.5 % respectively.

Increasing the lead circuit cyanide level from 320 to 395 g/t (150 to 200 g/t in the primary grind) resulted in improved metallurgy with a 6 % increase in lead recovery, as shown in Figure No. 5.

Zinc selectivity in the lead circuit was similar in both tests. A poor zinc recovery of 38 % was achieved in Test No. 2.

FIGURE NO. 5 : Effect of Cyanide Level on Lead Flotation

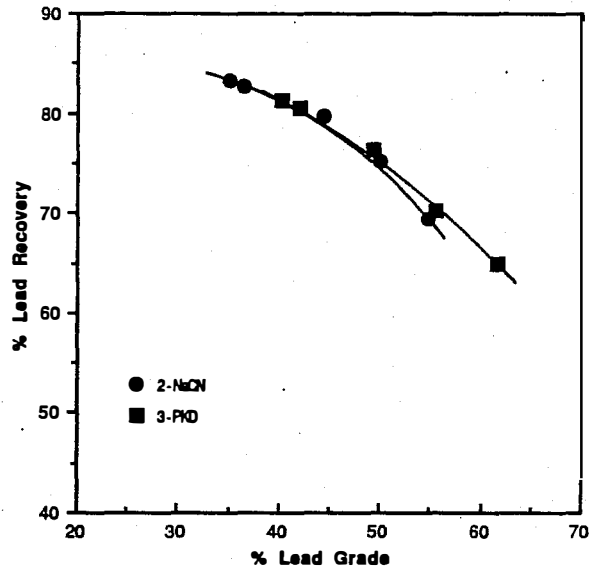


Discussion - Continued

2.3. Effect of Depressant Type

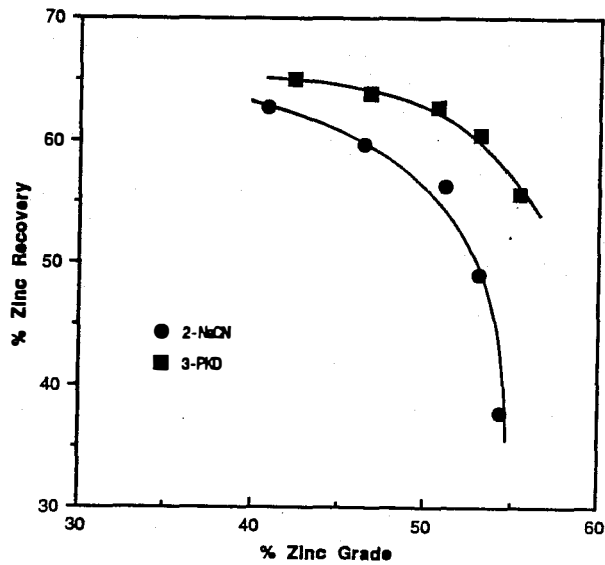
PKD replaced cyanide-silicate in Test No. 3. Product lead grades were significantly improved with the PKD, as shown in Figure No. 6.

FIGURE NO. 6 : Effect of Depressant Types on Lead Flotation



Zinc selectivity in the lead circuit was similar. Zinc flotation was improved with a 55.7 % Zn recovery in the zinc product, as shown in Figure No. 7.

FIGURE NO. 7 : Effect of Depressant Type on Zn Flotation



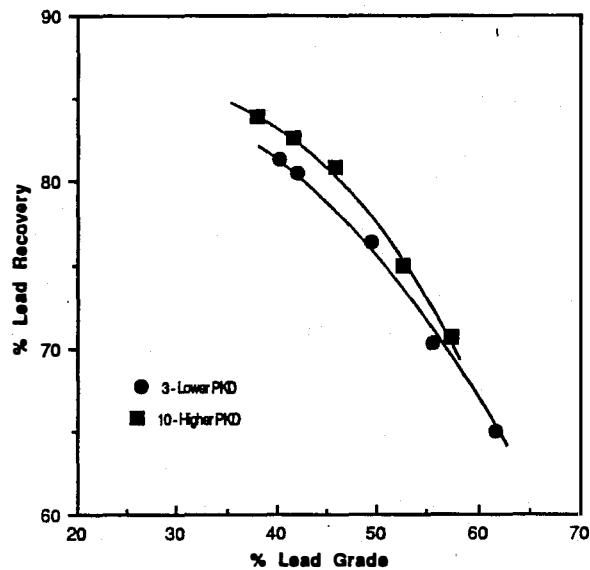
All subsequent tests were conducted with PKD.

Discussion - Continued

2.4. Effect of PKD Level

PKD level in the Pb regrind circuit was increased in Test No. 10 from 75 to 120 g/t. The higher addition provided a higher lead product grade (61.6 % versus 57.4 %), with a 6 % reduction in recovery (65 % versus 71 %), as shown in Figure No. 8.

FIGURE NO. 8 : Effect of Lead Regrind PKD Addition on Lead Flotation



Zinc selectivity in the lead circuit and flotation in the zinc circuit were not appreciably affected.

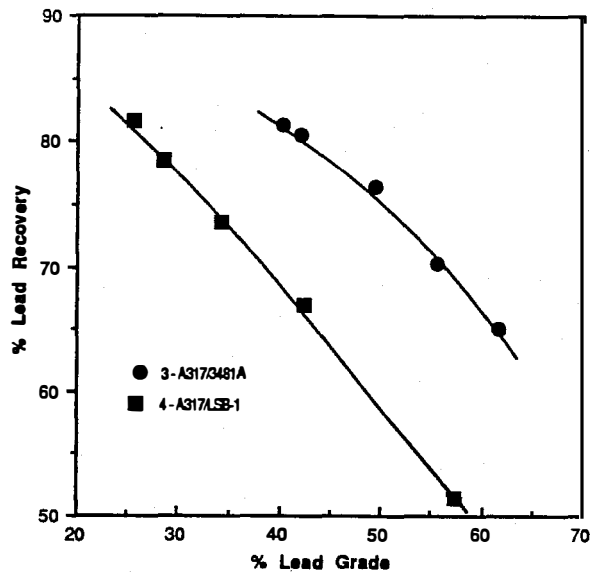
Gold recovery in the lead concentrate was 63 % with a grade of 14.9 g/t. Silver recovery was 50 %, with a grade of 600 g/t. Gold and silver losses in the Zn scavenger tails were 21 % and 16 % respectively.

2.5. Effect of Collector Type

Flotation with collector A317:3418A, used in Tests 1 to 3, was compared with flotation with collector mixture A317:LSB-1 in Test No. 4. Lead flotation with the new collector was poorer, with a 4 % decrease in Pb product Pb grade and a 14 % decrease in Pb recovery to 51.5 %, as shown in Figure No. 9.

Discussion - Continued

FIGURE NO. 9 : Effect of Collector Type on Lead Flotation

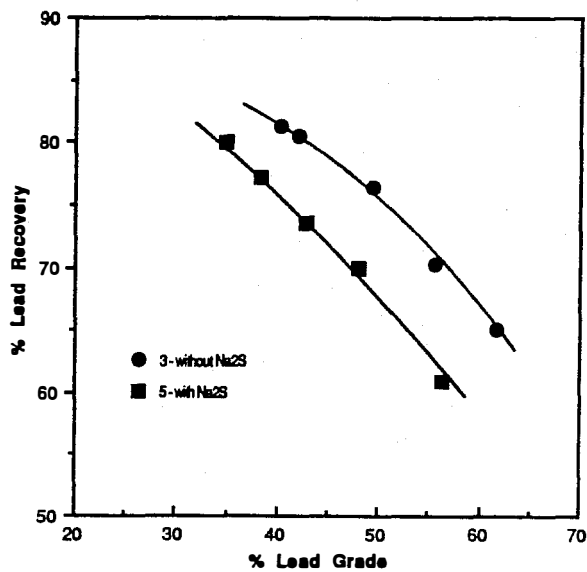


Zinc selectivity in the Pb circuit was somewhat poorer than with the A317:3418A. No further tests were conducted with the A317:LSB-1 collector.

2.6. Effect of Na_2S

Na_2S was added to the primary and lead regrind stages in Test 5. Lead flotation was relatively poor, as lead recovery in the 4th cleaner cleaner concentrate was 60.9 %, reduced 4 % from that in Test No. 3, as shown in Figure No. 10.

FIGURE NO. 10 : Effect of Na_2S on Lead Flotation



Discussion - Continued

Zinc selectivity in the Pb circuit was slightly poorer than in Test No. 3.

Gold and silver recoveries were roughly similar to those in Test No. 8, with a lower silver recovery.

2.7. Effect of Other Parameters

The following changes were made in Test No. 6 :

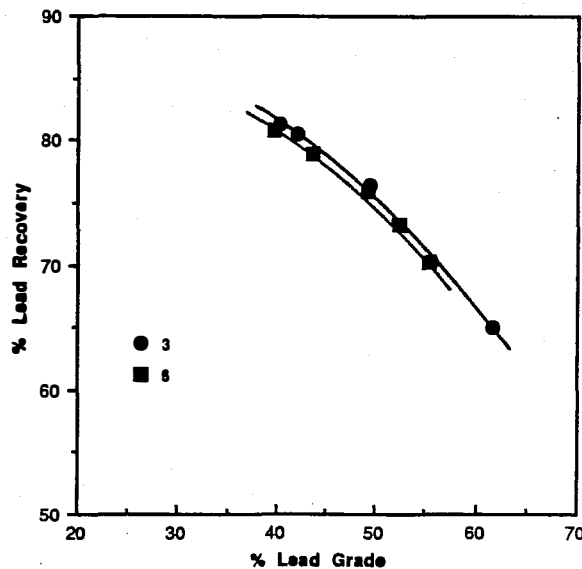
- carbonate levels in the primary and Pb regrind stages were reduced.
- collector additions in lead rougher and cleaner flotation were increased.
- lead regrinding time was increased.

The metallurgy was affected in the following ways:

- lead flotation was roughly similar, but lower Pb grades (6%) and higher recoveries (5%), were achieved in the 3rd and 4th cleaners (Figure No. 11).
- zinc selectivity in the lead circuit was similar.
- zinc recovery in the zinc product was higher (59.9 % in Test 6, 55.7 % in Test 3), and product grade was lower (52.5 % in Test 6, 55.4 % in Test 3 - Figure No. 10).
- gold and silver recoveries in the zinc concentrate were higher than in Test 8.

FIGURE NO. 11 : Effect of Other Parameters

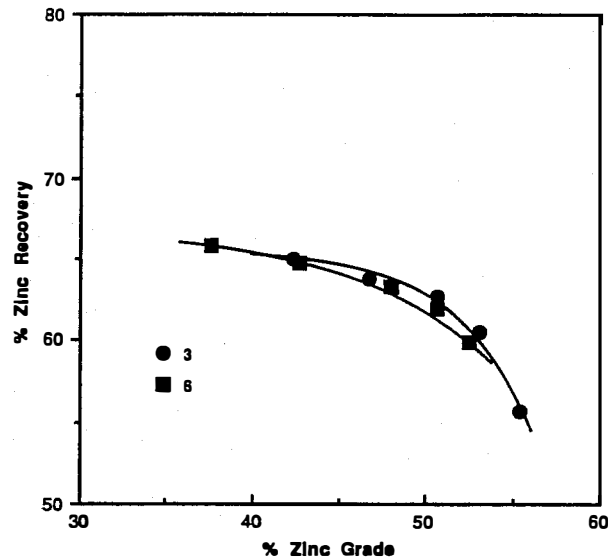
a) Pb



Discussion - Continued

FIGURE NO. 11 ; Continued

b) Zn



Copper recovery in the lead product was 60.6 % in Test No. 6 and the grade was 3.30 % Cu.

2.8. Reproducibility Tests

The conditions of Test No. 3 were duplicated in Test No. 10. Lead grades were similar, but recoveries were higher throughout the circuit. Zinc grades were higher, with a lower final product zinc recovery.

3. FLOTATION OF COMPOSITE 2

Two tests were conducted with the higher grade Composite 2 ore. Test conditions were similar to those in Test No. 3 and Test No. 6, with carbonate, collector level, and Pb regrind time varied. Test conditions and results are summarized in Table No. 10.

Discussion - Continued

TABLE NO. 10 : Composite 2 Flotation

A) Conditions:

Test No.	Pb Grind Time		Reagent Additions, g/t				pH	
	Primary min	Regrind min	Pb Circuit		Zn Circuit		Pb	Zn
			Depres. & Mod.	Collector	Depres & Mod.	Collector		
7	40	40	Na ₂ CO ₃ = 1750 PKD = 395	A317/3418A=61	Ca(OH) ₂ = 4500 CuSO ₄ = 1700	A343 = 100	8.7-9.5	10.8-12.0
9	40	30	Na ₂ CO ₃ = 2500 PKD = 395	A317/3418A=56	Ca(OH) ₂ = 4500 CuSO ₄ = 1700	A343 = 100	9.4-9.8	11.2-12.0

B) Results:

Test No.	Product	Weight %	Assays %, g/t				% Distribution			
			Pb	Zn	Au	Ag	Pb	Zn	Au	Ag
7	Pb 4th Cl Conc	5.26	52.5	15.9	12.1	636	68.2	15.2	61.7	54.9
	Pb 1st Cl Conc	7.56	42.6	17.5	9.28	552	79.4	24.0	68.2	68.4
	Zn 4th Cl Conc	5.99	1.92	54.8	1.15	62.4	2.8	59.6	6.7	6.1
	Zn Ro Conc	18.76	2.02	19.6	0.72	51.3	9.4	66.6	13.0	15.8
	Zn Ro Tail	73.14	0.55	0.47	0.23	11.8	9.9	6.2	16.4	14.2
	Head (Calc)	100.00	4.05	5.51	1.03	61.0	100.0	100.0	100.0	100.0
9	Pb 4th Cl Conc	4.94	49.6	16.9	12.2	575	61.4	15.0	63.3	43.6
	Pb 1st Cl Conc	7.63	40.1	18.4	8.37	497	76.7	25.1	67.4	58.2
	Zn 4th Cl Conc	5.96	1.83	53.9	0.69	68.8	2.7	57.6	4.3	6.3
	Zn Ro Conc	19.58	2.36	18.4	0.51	59.3	11.6	64.6	10.6	17.8
	Zn Ro Tail	72.06	0.55	0.44	0.27	19.7	9.9	5.7	20.5	21.8
	Head (Calc)	100.00	3.99	5.58	0.95	65.2	100.0	100.0	100.0	100.0

3.1. Effect of Process Parameters

In the lead circuit, carbonate additions were reduced, collector levels were increased, and lead regrinding time was increased in Test No. 7. The results showed the following:

- flotation of both lead and zinc was less selective in Test No. 9, with reduced product grades.
- gold grades and recoveries in the lead circuit were similar in both tests.
- silver grades and recoveries were lower in Test No. 9.

Discussion - Continued

3.2. Comparison with Composite 1Tests 3 and 9:

Flotation of Composite 2 in Test No. 9 resulted in lower Pb grades and similar Pb recoveries with respect to Composite 1 in Test No. 3. In the zinc circuit, Composite 2 provided lower zinc grades in the early cleaner stages, and similar grades in the final product. Recoveries were generally similar, but slightly lower.

Tests 6 and 7:

Flotation of Composite 2 in Test No. 7 also resulted in lower lead grades, with similar recoveries. Zinc flotation was similar.

Gold recoveries were higher in Test No. 7, with slightly lower grades. Silver recoveries were also higher, with higher grades. Silver recoveries were also higher, with higher grades.

Copper recovery in Test No. 7 was 58 %, which was very slightly lower than in Test No. 6 on Composite 1. Product grade in Test No. 7 was 2.42 % Cu, which was lower than in Test No. 6.

In summary, flotation of Composite 2 resulted in poorer Pb selectivity and similar zinc metallurgy. Precious metal recoveries were slightly higher.

4. FLOTATION REAGENTS

The reagents used in the testwork are listed in Table No. 11.

TABLE NO. 11 : Flotation Reagents

Reagent	Formula	Supplier
<u>Modifiers & Depressants</u>		
Sodium Carbonate	Na ₂ CO ₃	Nymoc
Sodium Silicate	Na ₂ SiO ₃	Nymoc
Sodium Cyanide	NaCN	Nymoc
PKD	Mixture	Hart Chemical
Hydrated Lime	Ca(OH) ₂	Nymoc
Cupric Sulphate	CuSO ₄	Nymoc
<u>Collectors</u>		
A317/3418A	Na Isobutyl xanthate / Phosphine (1:1)	Cyanamid/Cyanamic
A317/LSB-1	Na Isobutyl xanthate / Na di-sec butyl dithiophosphate (1:1)	Cyanamid/Hoechst
A343	Na isobutyl xanthate	Cyanamid
A350	K amyl xanthate	Cyanamid
<u>Frothers</u>		
MIBC	Methyl isocarbinol	Bate Chemical
DF1012	Frother	Dow

DETAILS OF TESTS

TEST NO. 1

Purpose: Preliminary flotation on the new Vangorda ore sample.

Procedure: As for Test 40 (Project 3458B).

Feed: 2000 grams of minus 10 mesh Composite 1 ore.

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	A31Z 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Primary Grind	2000	150	-	-	-	40	-	-	-
Pb Rougher	-	-	10	15	-	-	1	4	9.4
Pb Scavenger	-	-	5	10	-	-	1	3	-
	-	-	5	10	-	-	1	3	-
Pb Regrind	-	50	20	-	-	20	-	-	-
Pb 1st Cleaner	-	20	-	5	100	-	1	4	9.4
	-	-	1.0	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cleaner	-	50	-	2.5	50	-	1	5	-
	-	-	4	10	-	-	1	5	-
Pb 3rd Cleaner	-	25	-	5	50	-	1	4	9.6
	-	-	2	-	-	-	1	3	-
Pb 4th Cleaner	-	25	-	2.5	50	-	1	3	9.8
	-	-	2	-	-	-	1	2	-
Feed: Pb Ro + 1st Cl Scav Tails:									
Zinc Circuit:	Ca(OH) ₂	CuSO ₄	A350	DF1012					
Condition 1	1250	-	-	-	-	-	5	-	11.5
2	-	800	-	-	-	-	5	-	10.6
Zn Ro 1	-	-	20	10	-	-	2	4	-
2	-	-	10	-	-	-	1	3	-
Zn Regrind (PM)	250	-	-	-	-	10	-	-	-
HS Condition	-	-	10	-	-	-	15	-	10.2
Zn 1st Cleaner	-	-	-	-	-	-	1	4	-
Zn 1st Cl Scav	-	-	5	5	-	-	1	4	-
Zn 2nd Cleaner	250	-	-	-	-	-	1	4	11.5
Zn 3rd Cleaner	250	-	-	-	-	-	1	3	11.6
Zn 4th Cleaner	250	-	-	-	-	-	1	3	-

Metallurgical Balance

Test No. 1

Product	Weight		Assays ,%		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner. Conc.	86.4	4.28	53.8	12.3	63.3	10.2
2. Pb 4th Cl. Tail	25.1	1.24	19.3	17.4	6.6	4.2
3. Pb 3rd Cl. Tail	14.8	0.73	11.7	20.7	2.4	3.0
4. Pb 2nd Cl. Tail	72.2	3.58	7.25	20.6	7.1	14.3
5. Pb 1st Cl. Scav. Conc.	20.8	1.03	7.56	20.5	2.1	4.1
6. Zn Cleaner Conc.	100.6	4.98	2.08	51.1	2.8	49.6
7. Zn 4th Cl. Tail	12.9	0.64	4.34	22.4	0.8	2.8
8. Zn 3rd Cl. Tail	7.9	0.39	5.15	14.0	0.6	1.1
9. Zn 2nd Cl. Tail	9.2	0.46	5.17	8.25	0.6	0.7
10. Zn 1st Cl. Scav. Conc.	31.5	1.56	3.56	6.37	1.5	1.9
11. Zn 1st Cl. Scav. Tail.	129.3	6.40	1.57	1.23	2.8	1.5
12. Zn Scav. Tail	1508.4	74.71	0.46	0.45	9.4	6.5
Head Calc.	2019.1	100.00	3.64	5.14	100.0	100.0

Combined Products

Products 1+2		5.52	46.03	13.45	69.8	14.5
Products 1-3		6.26	42.01	14.30	72.2	17.4
Products 1-4		9.83	29.37	16.59	79.3	31.7
Products 1-5		10.86	27.30	16.96	81.5	35.9
Products 6+7		5.62	2.34	47.84	3.6	52.3
Products 6-8		6.01	2.52	45.64	4.2	53.4
Products 6-9		6.47	2.71	43.00	4.8	54.1
Products 6-10		8.03	2.87	35.88	6.3	56.1
Products 6-11		14.43	2.29	20.51	9.1	57.6
Products 6-12		89.14	0.76	3.70	18.5	64.1
Products 11+12		81.11	0.55	0.51	12.2	8.1

TEST NO. 2

Purpose: Repeat Test 1, but with increased NaCN to the Pb primary and regrind and a finer Pb regrind. Lime additions were doubled in the Zn circuit.

Procedure: Similar to Test 62 (Project 3458B).

Feed: 2000 grams of minus 10 mesh Vangorda Composite 1 ore.

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	A31Z 3418A	MIBC	Na ₂ SiO ₃	Grind	Cond.	Froth	
Primary Grind	2000	200	-	-	-	40	-	-	-
Pb Rougher	-	-	10	15	-	-	1	4	9.7
Pb Scavenger	-	-	5	10	-	-	1	3	-
	-	-	2.5	10	-	-	1	3	-
Pb Regrind	-	75	20	-	-	20	-	-	-
Pb 1st Cleaner	-	20	-	5	100	-	1	4	-
	-	-	1.0	5	-	-	1	6	-
Pb 1st Cl Scav	-	-	5	5	-	-	1	3	-
Pb 2nd Cleaner	-	50	-	2.5	50	-	1	4	9.4
	-	-	4	10	-	-	1	4	-
Pb 3rd Cleaner	-	25	-	5	50	-	1	4	9.5
	-	-	2	5	-	-	1	3	-
Pb 4th Cleaner	-	25	-	5	50	-	1	3	9.7
	-	-	2	5	-	-	1	3	-
Feed: Pb Ro + 1st Cl Scav Tails:									
Zinc Circuit:	Ca(OH) ₂	CuSO ₄	A350	DF1012					
Condition 1	2500	-	-	-	-	-	5	-	-
2	-	800	-	-	-	-	5	-	11.8
Zn Ro 1	-	-	20	10	-	-	2	4	-
2	-	-	10	5	-	-	1	3	-
Zn Regrind (PM)	1000	-	-	-	-	30	-	-	-
HS Condition	-	-	15	-	-	-	10	-	11.7
Zn 1st Cleaner	-	-	-	-	-	-	1	5	-
Zn 1st Cl Scav	-	-	10	5	-	-	1	3	-
Zn 2nd Cleaner	500	-	-	-	-	-	1	4	12.0
Zn 3rd Cleaner	500	-	-	-	-	-	1	3	12.1
Zn 4th Cleaner	500	-	-	-	-	-	1	2	12.1

Metallurgical Balance

Test No. 2

Product	Weight		Assays ,%		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner. Conc.	89.5	4.52	54.8	12.1	69.4	11.4
2. Pb 4th Cl. Tail	16.8	0.85	24.2	15.8	5.8	2.8
3. Pb 3rd Cl. Tail	20.6	1.04	15.4	17.8	4.5	3.9
4. Pb 2nd Cl. Tail	33.6	1.70	6.27	17.8	3.0	6.3
5. Pb 1st Cl. Scav. Conc.	6.9	0.35	5.27	32.8	.5	2.4
6. Zn Cleaner Conc.	66	3.33	0.95	54.3	0.9	37.7
7. Zn 4th Cl. Tail	22	1.11	1.38	49.5	0.4	11.5
8. Zn 3rd Cl. Tail	16.8	0.85	2.44	40.6	0.6	7.2
9. Zn 2nd Cl. Tail	17.6	0.89	3.28	18.4	0.8	3.4
10. Zn 1st Cl. Scav. Conc.	23.6	1.19	3.39	12.10	1.1	3.0
11. Zn 1st Cl. Scav. Tail.	119.8	6.05	1.46	1.95	2.5	2.5
12. Zn Scav. Tail	1546.4	78.12	0.48	0.5	10.5	8.1
Head Calc.	1979.6	100.00	3.57	4.80	100.0	100.0

Combined Products

Products 1+2		5.37	49.96	12.68	75.2	14.2
Products 1-3		6.41	44.35	13.52	79.7	18.0
Products 1-4		8.11	36.38	14.41	82.7	24.3
Products 1-5		8.46	35.10	15.17	83.2	26.7
Products 6+7		4.45	1.06	53.10	1.3	49.1
Products 6-8		5.29	1.28	51.10	1.9	56.3
Products 6-9		6.18	1.57	46.39	2.7	59.7
Products 6-10		7.38	1.86	40.85	3.8	62.7
Products 6-11		13.43	1.68	23.32	6.3	65.2
Products 6-12		91.54	0.66	3.85	16.8	73.3
Products 11+12		84.17	0.55	0.60	13.0	10.6

TEST NO. 3

Purpose: To investigate PKD complex and its effect on Pb and Zn flotation from Vangorda ore, with a finer regrind.

Procedure: Similar to Test 152 (Project 3733).

Feed: 2000 grams of minus 10 mesh Vangorda Composite 1 ore.

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	PKD	A317/3418A	MIBC	Grind	Cond.	Froth	
Primary Grind	2000	250	8	-	40	-	-	-
Pb Rougher 1	-	-	10	10	-	1	5	9.4
2	-	-	5	5	-	1	3	-
3	-	-	2.5	5	-	1	3	-
Pb Conc Regrind	500	75	15	-	30	-	-	-
Pb 1st Cleaner	-	-	-	5	-	1	3	9.8
	-	-	3	5	-	1	3	-
Pb Cleaner Scav	-	-	5	5	-	1	2	-
Pb 2nd Cleaner	-	30	-	5	-	1	3	9.5
	-	-	5	2.5	-	1	2	-
Pb 3rd Cleaner	-	20	-	5	-	1	2	9.4
	-	-	2.5	2.5	-	1	2	-
Pb 4th Cleaner	-	20	-	2.5	-	1	3	8.7
Feed: Pb Ro + Pb 1st Cl Scav Tails.								
Zn Circuit:	Ca(OH) ₂	CuSO ₄	A343	DF1012				
Condition 1	2000	-	-	-	-	5	-	-
2	-	1500	-	-	-	5	-	11.3
Zn Rougher 1	-	-	40	10	-	1	3	-
2	-	-	10	5	-	1	2	-
Zn Conc Regrind	1000	200	-	-	30	-	-	-
HS Condition	-	-	40	2.5	-	15	-	-
Zn 1st Cleaner	-	-	-	-	-	-	5	11.5
Zn 1st Cl Scav	-	-	10	5	-	1	2	-
Zn 2nd Cleaner	500	-	-	-	-	1	3	12.0
Zn 3rd Cleaner	500	-	-	-	-	1	2.5	12.0
Zn 4th Cleaner	500	-	-	-	-	1	2	12.0

Metallurgical Balance

Test No. 3

Product	Weight		Assays ,%		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner. Conc.	72.4	3.64	61.6	10.8	65.0	8.2
2. Pb 4th Cl. Tail	14.3	0.72	25.2	25.7	5.3	3.8
3. Pb 3rd Cl. Tail	19.6	0.98	21.5	23.2	6.1	4.8
4. Pb 2nd Cl. Tail	25.2	1.27	11.1	18.8	4.1	5.0
5. Pb 1st Cl. Scav. Conc.	7.3	0.37	7.72	43.7	.8	3.3
6. Zn Cleaner Conc.	96.1	4.83	1.50	55.4	2.1	55.7
7. Zn 4th Cl. Tail	12.9	0.65	4.54	36.2	0.9	4.9
8. Zn 3rd Cl. Tail	9.5	0.48	5.73	21.5	0.8	2.1
9. Zn 2nd Cl. Tail	12.3	0.62	4.52	8.82	0.8	1.1
10. Zn 1st Cl. Scav. Conc.	15.9	0.80	3.56	7.26	0.8	1.2
11. Zn 1st Cl. Scav. Tail.	128.6	6.46	1.32	1.38	2.5	1.9
12. Zn Scav. Tail	1577.4	79.21	0.47	0.49	10.8	8.1
Head Calc.	1991.5	100.00	3.44	4.80	100.0	100.0

Combined Products

Products 1+2		4.35	55.60	13.26	70.3	12.0
Products 1-3		5.34	49.31	15.09	76.4	16.8
Products 1-4		6.60	41.99	15.80	80.5	21.7
Products 1-5		6.97	40.18	17.27	81.3	25.1
Products 6+7		5.47	1.86	53.13	3.0	60.5
Products 6-8		5.95	2.17	50.59	3.7	62.7
Products 6-9		6.57	2.39	46.66	4.6	63.8
Products 6-10		7.37	2.52	42.39	5.4	65.0
Products 6-11		13.82	1.96	23.23	7.9	66.9
Products 6-12		93.03	0.69	3.87	18.7	74.9
Products 11+12		85.66	0.53	0.56	13.3	9.9

TEST NO. 4

Purpose: Repeat Test 3, but replace 3418A with LSB-1.

Procedure: As for Test No. 3.

Feed: 2000 grams of minus 10 mesh Vangorda Composite 1 ore.

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	PKD	A317/LSB-1	MIBC	Grind	Cond.	Froth	
Primary Grind	2000	250	8	-	40	-	-	-
Pb Rougher 1	-	-	35	10	-	1	4	9.5
2	-	-	5	5	-	1	3	-
3	-	-	5	5	-	1	3	-
Pb Conc Re grind	500	75	15	-	30	-	-	-
Pb 1st Cleaner	-	-	10	5	-	1	5	9.9
	-	-	5	5	-	1	2	-
Pb Cleaner Scav	-	-	2.5	5	-	1	3	-
Pb 2nd Cleaner	-	30	2.5	-	-	1	3	9.8
	-	-	5	5	-	1	3	-
Pb 3rd Cleaner	-	20	-	2.5	-	1	3	9.7
	-	-	2.5	5	-	1	2	-
Pb 4th Cleaner	-	20	-	-	-	1	3	-

Metallurgical Balance

Test No. 4

Product	Weight		Assay,%		% Distribution	
	g	%	Pb	Zn	Pb	Zn
1. Pb Cleaner. Conc.	60.4	3.03	57.4	12.4	51.5	7.9
2. Pb 4th Cl. Tail	45.9	2.30	22.6	30.3	15.4	14.8
3. Pb 3rd Cl. Tail	38.7	1.94	11.7	32.4	6.7	13.3
4. Pb 2nd Cl. Tail	40.0	2.01	8.28	18.6	4.9	7.9
5. Pb 1st Cl. Scav. Conc.	29.4	1.47	7.13	30.8	3.1	9.6
6. Pb 1st Cl. Scav. Tail.	209.4	10.50	2.09	3.74	6.5	8.3
7. Pb Scav. Tail.	1570.1	78.75	0.51	2.29	11.9	38.2
Head Calc.	1993.9	100.00	3.38	4.73	100.0	100.0

Combined Products

Products 1+2		5.33	42.37	20.13	66.9	22.7
Products 1-3		7.27	34.19	23.40	73.6	36.0
Products 1-4		9.28	28.59	22.37	78.5	43.9
Products 1-5		10.75	25.64	23.52	81.6	53.5
Products 1-6		21.25	14.01	13.75	88.1	61.8
Products 6+7		89.25	0.70	2.46	18.4	46.5

TEST NO. 5

Purpose: Repeat the general conditions of Test 3, but add 600 g/t of Na₂S to the Primary grind and 200 g/t to the Pb regrind.

Procedure: As for Test 3.

Feed: 2000 grams of minus 10 mesh Composite 1 ore.

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

Conditions:

	Reagents Added, grams per tonne					Time, minutes			pH
	Na ₂ S	Na ₂ CO ₃	PKD	A317 3418A	MIBC	Grind	Cond.	Froth	
Primary Grind	600	2000	250	8	-	40	-	-	-
Pb Rougher 1	-	-	-	10	10	-	1	5	9.8
2	-	-	-	5	5	-	1	3	-
3	-	-	-	2.5	5	-	1	3	-
Pb Conc Reagr	200	500	75	15	-	30	-	-	-
Pb 1st Cleaner	-	-	-	10	5	-	1	3	10.5
	-	-	-	5	5	-	1	3	-
Pb 1st Cl Scav	-	-	-	1.0	5	-	1	2	-
Pb 2nd Cleaner	-	-	30	-	5	-	1	3	-
	-	-	-	5	2.5	-	1	3	-
Pb 3rd Cleaner	-	-	20	-	5	-	1	3	9.5
	-	-	-	2.5	2.5	-	1	2	-
Pb 4th Cleaner	-	-	20	-	2.5	-	1	4.5	-
Feed: Pb Ro + 1st Cl Scav Tails:									
Zinc Circuit:	Ca(OH) ₂	CuSO ₄	A343	DF1012					
Condition 1	2000	-	-	-	-	-	5	-	-
2	-	1500	-	-	-	-	5	-	-
Zn Ro 1	-	-	40	10	-	-	1	3	11.8
2	-	-	10	5	-	-	1	2	-
Zn Reagrind (PM)	1000	200	-	-	-	30	-	-	-
HS Condition	-	-	40	2.5	-	-	15	-	-
Zn 1st Cleaner	-	-	-	-	-	-	-	5	11.8
Zn 1st Cl Scav	-	-	10	5	-	-	1	2	-
Zn 2nd Cleaner	500	-	-	-	-	-	1	3	12.0
Zn 3rd Cleaner	500	-	-	-	-	-	1	2.5	-
Zn 4th Cleaner	500	-	-	-	-	-	1	2	12.0

Metallurgical Balance

Test No. 5

Product	Weight		Assays,%g/t				% Distribution			
	g	%	Pb	Zn	Au	Ag	Pb	Zn	Au	Ag
1. Pb Cleaner. Conc.	70.9	3.57	56.4	13.1	17.03	572.7	60.9	10.0	57.6	41.0
2. Pb 4th Cl. Tail	24.7	1.24	24.0	27.9	3.0	392.5	9.0	7.4	3.5	9.8
3. Pb 3rd Cl. Tail	17.3	0.87	14.3	29.6	2.23	337.2	3.8	5.5	1.8	5.9
4. Pb 2nd Cl. Tail	20.0	1.01	11.8	19.7	1.83	239.2	3.6	4.2	1.7	4.8
5. Pb 1st Cl. Scav. Conc.	18.2	0.92	10.30	33.3	3.86	261.4	2.9	6.5	3.3	4.8
6. Zn Cleaner Conc.	89	4.48	1.65	53.9	1.39	67.5	2.2	51.6	5.9	6.1
7. Zn 4th Cl. Tail	7.2	0.36	4.98	28.4	1.72	122.6	0.5	2.2	0.6	0.9
8. Zn 3rd Cl. Tail	7.1	0.36	6.37	18.6	1.97	182.1	0.7	1.4	0.7	1.3
9. Zn 2nd Cl. Tail	12.1	0.61	4.67	7.84	1.39	121.4	0.9	1.0	0.8	1.5
10. Zn 1st Cl. Scav. Conc.	16.3	0.82	3.43	5.56	1.32	117.6	0.9	1.0	1.0	1.9
11. Zn 1st Cl. Scav. Tail.	151.5	7.63	1.27	1.17	0.42	43.1	2.9	1.9	3.0	6.6
12. Zn Scav. Tail	1551.8	78.13	0.50	0.43	0.27	9.8	11.8	7.2	20.0	15.4
Head Calc.	1986.1	100.00	3.31	4.68	1.06	49.8	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		4.81	48.03	16.92	13.40	526.1	69.9	17.4	61.1	50.8
Products 1-3		5.68	42.86	18.87	11.69	497.2	73.6	22.9	62.9	56.7
Products 1-4		6.69	38.19	18.99	10.20	458.4	77.2	27.2	64.7	61.5
Products 1-5		7.61	34.83	20.72	9.44	434.6	80.1	33.7	68.0	66.4
Products 6+7		4.84	1.90	51.99	1.41	71.62	2.8	53.8	6.5	7.0
Products 6-8		5.20	2.21	49.70	1.45	79.2	3.5	55.2	7.2	8.3
Products 6-9		5.81	2.46	45.31	1.45	83.6	4.3	56.3	8.0	9.8
Products 6-10		6.63	2.58	40.39	1.43	87.8	5.2	57.2	9.0	11.7
Products 6-11		14.26	1.88	19.41	0.89	63.9	8.1	59.1	12.0	18.3
Products 6-12		92.39	0.71	3.36	0.37	18.2	19.9	66.3	32.0	33.6
Products 11+12		85.76	0.57	0.50	0.28	12.8	14.7	9.1	23.0	22.0

TEST NO. 6

Purpose: Repeat the general conditions of Test 3, but with the following changes.

Procedure: Reduce Na_2CO_3 from 2000 to 1500 g/t in the Primary grind and to 250 g/t in the Pb regrind. Increase collector from 8 to 12 g/t in the Primary grind and increase Pb regrinding time to 40 minutes.

Feed: 2000 grams of minus 10 mesh Vangorda Composite 1 ore.

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

Conditions:

Stage	Reagents Added, grams per tonne				Time, minutes			pH
	Na_2CO_3	PKD	A317/3418A	MIBC	Grind	Cond.	Froth	
Primary Grind	1500	250	12	-	40	-	-	-
Pb Rougher 1	-	-	10	10	-	1	5	8.5
2	-	-	5	5	-	1	3	-
3	-	-	5	5	-	1	3	-
4	-	-	2.5	5	-	1	-	-
Pb Conc Regrind	250	75	15	-	40	-	-	-
Pb 1st Cleaner	-	-	-	5	-	1	5	9.5
	-	-	2.5	5	-	1	3	-
Pb Cleaner Scav	-	-	-	5	-	1	3	-
Pb 2nd Cleaner	-	30	-	-	-	1	3	-
	-	-	5	5	-	1	2	-
	-	-	1.5	2.5	-	1	3	-
Pb 3rd Cleaner	-	20	-	2.5	-	1	3	-
	-	-	2.5	5	-	1	3	-
Pb 4th Cleaner	-	20	-	2.5	-	1	2	-
	-	-	2.5	2.5	-	1	2	-
Feed: Pb Ro + Pb 1st Cl Scav Tails.								
Zinc Circuit:	$\text{Ca}(\text{OH})_2$	CuSO_4	A343	DF1012				
Condition 1	2000	-	-	-	-	5	-	-
2	-	1500	-	-	-	5	-	10.8
Zn Rougher 1	-	-	40	10	-	1	3	-
2	-	-	10	5	-	1	2	-
Zn Conc Regrind	1000	200	-	-	30	-	-	-
HS Condition	-	-	40	2.5	-	15	-	-
Zn 1st Cleaner	-	-	-	-	-	-	5	11.5
Zn 1st Cl Scav	-	-	10	5	-	1	2	-
Zn 2nd Cleaner	500	-	-	-	-	1	3	11.8
Zn 3rd Cleaner	500	-	-	-	-	1	2.5	12.0
Zn 4th Cleaner	500	-	-	-	-	1	2	-

Test No. 6

Product	Weight		Assays,%g/t					% Distribution				
	g	%	Cu	Pb	Zn	Au	Ag	Cu	Pb	Zn	Au	Ag
1. Pb Cleaner. Conc.	80.4	4.22	3.3	55.4	12.2	13.55	616.4	60.6	70.3	11.1	55.4	53.0
2. Pb 4th Cl. Tail	8.5	0.45	2.64	22.5	24.7	4.42	452.2	5.1	3.0	2.4	1.9	4.1
3. Pb 3rd Cl. Tail	9.1	0.48	1.41	17.9	22.8	2.88	367.8	2.9	2.6	2.3	1.3	3.6
4. Pb 2nd Cl. Tail	16.6	0.87	0.63	11.4	13.4	1.8	198.1	2.4	3.0	2.5	1.5	3.5
5. Pb 1st Cl. Scav. Conc.	14.7	0.77	0.9	8.82	30.7	5.1	208.7	3.0	2.0	5.1	3.8	3.3
6. * Pb 1st Cl. Scav. Tail.	128.1	6.73	0.19	2.51	11.9	1.36	58.1	5.6	5.1	17.2	8.9	8.0
7. Zn Cleaner Conc.	101	5.30	0.21	1.32	52.5	2.52	56.1	4.8	2.1	59.9	12.9	6.1
8. Zn 4th Cl. Tail	7.2	0.38	0.59	3.66	25.4	1.48	101.1	1.0	0.4	2.1	0.5	0.8
9. Zn 3rd Cl. Tail	8.5	0.45	0.54	3.73	13.6	1.48	93.7	1.0	0.5	1.3	0.6	0.9
10. Zn 2nd Cl. Tail	17.4	0.91	0.48	3.51	6.96	0.95	83.6	1.9	1.0	1.4	0.8	1.6
11. Zn 1st Cl. Scav. Conc.	21	1.10	0.32	2.75	5.11	1.13	68.1	1.5	0.9	1.2	1.2	1.5
12. Zn 1st Cl. Scav. Tail.	141.8	7.45	0.13	1.22	1.25	0.35	28.7	4.2	2.7	2.0	2.5	4.4
13. Zn Scav. Tail	1477.7	77.61	0.034	0.49	0.52	0.23	11.0	11.5	11.4	8.7	17.3	17.4
Head Calc.	1903.9	100.00	0.23	3.33	4.65	1.03	49.1	100.0	100.0	100.0	100.0	100.0

Combined Products

*Calculated

Products 1+2	4.67	3.24	52.25	13.40	12.68	600.7	65.7	73.3	13.5	57.3	57.1
Products 1-3	5.15	3.07	49.06	14.27	11.77	579.1	68.6	75.9	15.8	58.7	60.7
Products 1-4	6.02	2.71	43.61	14.14	10.32	523.9	71.0	78.9	18.3	60.2	64.2
Products 1-5	6.79	2.51	39.65	16.03	9.73	488.1	74.0	80.9	23.4	64.0	67.5
*Products 1-6	13.52	1.35	21.17	13.97	5.56	274.08	79.6	86.0	40.7	72.9	75.4
Products 6+7	5.68	0.24	1.48	50.70	2.45	59.09	5.8	2.5	62.0	13.5	6.8
Products 6-8	6.13	0.26	1.64	47.99	2.38	61.6	6.9	3.0	63.3	14.1	7.7
Products 6-9	7.04	0.29	1.88	42.67	2.19	64.5	8.8	4.0	64.7	15.0	9.2
Products 6-10	8.15	0.29	2.00	37.58	2.05	65.0	10.3	4.9	65.9	16.2	10.8
Products 6-11	15.59	0.21	1.63	20.23	1.24	47.6	14.5	7.6	67.9	18.7	15.1
Products 6-12	93.21	0.06	0.68	3.82	0.40	17.1	26.0	19.1	76.6	36.0	32.5
Products 11+12	85.06	0.04	0.55	0.58	0.24	12.5	15.7	14.2	10.7	19.8	21.7

Product: Flotation Feed

Test No: 6

SG : 4.17

Mesh	Weight Grams	% Weight		
		Ind.	Cum.	Passing
200m	2.63	5.3	5.3	94.7
270	4.79	9.6	14.8	85.2
30.9μ	8.71	17.4	32.3	67.7
23.9	5.87	11.7	44.0	56.0
16.7	7.06	14.1	58.1	41.9
11.5	5.62	11.2	69.4	30.6
8.9	1.19	2.4	71.7	28.3
-8.9	14.13	28.3	100.0	-
Total	50.00	100.0	-	-

TEST NO. 7

Purpose: Repeat the conditions of Test 6 on Composite 2 ore.

Procedure: As for Test 6.

Feed: 2000 grams of minus 10 mesh Vangorda Composite 2 ore.

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	PKD	A317/3418A	MIBC	Grind	Cond.	Froth	
Primary Grind	1500	250	12	-	40	-	-	-
Pb Rougher 1	-	-	10	10	-	1	5	8.7
2	-	-	5	5	-	1	3	-
3	-	-	5	5	-	1	3	-
Pb Conc Re grind	250	75	15	-	40	-	-	-
Pb 1st Cleaner	-	-	-	5	-	1	5	9.5
	-	-	2.5	5	-	1	3	-
Pb Cleaner Scav	-	-	1.0	5	-	1	2	-
Pb 2nd Cleaner	-	30	-	5	-	1	3	-
	-	-	5	2.5	-	1	2	-
	-	-	1.5	5	-	1	3	-
Pb 3rd Cleaner	-	20	-	5	-	1	3	-
	-	-	2.5	2.5	-	1	3	-
Pb 4th Cleaner	-	20	-	2.5	-	1	2	-
	-	-	1.5	5	-	1	2	-
Feed: Pb Ro + Pb 1st Cl Scav Tails.								
Zinc Circuit:	Ca(OH) ₂	CuSO ₄	A343	DF1012				
Condition 1	2000	-	-	-	-	5	-	-
2	-	1500	-	-	-	5	-	10.8
Zn Rougher 1	-	-	40	10	-	1	3	-
2	-	-	10	5	-	1	2	-
Zn Conc Re grind	1000	200	-	-	30	-	-	-
HS Condition	-	-	40	2.5	-	15	-	-
Zn 1st Cleaner	-	-	-	-	-	-	5	11.5
Zn 1st Cl Scav	-	-	10	5	-	1	2	-
Zn 2nd Cleaner	500	-	-	-	-	1	3	11.8
Zn 3rd Cleaner	500	-	-	-	-	1	2.5	12.0
Zn 4th Cleaner	500	-	-	-	-	1	2	-

Test No. 7

Product	Weight		Assays,%,g/t					% Distribution				
	g	%	Cu	Pb	Zn	Au	Ag	Cu	Pb	Zn	Au	Ag
1. Pb Cleaner. Conc.	99	5.26	2.42	52.5	15.9	12.05	636.0	58.0	68.2	15.2	61.7	54.9
2. Pb 4th Cl. Tail	14	0.74	1.61	26.2	27.4	3.45	473.5	5.5	4.8	3.7	2.5	5.8
3. Pb 3rd Cl. Tail	12.1	0.64	1.35	19.4	23.3	3.27	374.4	4.0	3.1	2.7	2.0	3.9
4. Pb 2nd Cl. Tail	17.1	0.91	0.83	14.8	14.5	2.24	254.4	3.4	3.3	2.4	2.0	3.8
5. Pb 1st Cl. Scav. Conc.	10.1	0.54	0.55	10.00	32.1	4.61	186.3	1.3	1.3	3.1	2.4	1.6
6. * Pb 1st Cl. Scav. Tail.	156.5	8.32	0.15	3.73	13.3	1.14	70.9	5.7	7.7	20.1	9.2	9.7
7. Zn Cleaner Conc.	112.6	5.99	0.2	1.92	54.8	1.15	62.4	5.4	2.8	59.6	6.7	6.1
8. Zn 4th Cl. Tail	9.9	0.53	0.54	5.98	24.4	1.60	124.7	1.3	0.8	2.3	0.8	1.1
9. Zn 3rd Cl. Tail	8	0.43	0.65	6.16	13.9	1.41	129.8	1.3	0.6	1.1	0.6	0.9
10. Zn 2nd Cl. Tail	16.9	0.90	0.44	4.32	6.1	1.00	94.2	1.8	1.0	1.0	0.9	1.4
11. Zn 1st Cl. Scav. Conc.	24.2	1.29	0.31	3.15	3.73	0.94	73.5	1.8	1.0	0.9	1.2	1.6
12. Zn 1st Cl. Scav. Tail.	181.3	9.64	0.12	1.32	1.03	0.31	30.0	5.3	3.1	1.8	2.9	4.7
13. Zn Scav. Tail	1376	73.14	0.033	0.55	0.47	0.23	11.8	11.0	9.9	6.2	16.4	14.2
Head Calc.	1881.2	100.00	0.22	4.05	5.51	1.03	61.0	100.0	100.0	100.0	100.0	100.0

Combined Products

*Calculated

Products 1+2	6.01	2.32	49.24	17.32	10.98	615.9	63.4	73.0	18.9	64.2	60.7
Products 1-3	6.65	2.23	46.36	17.90	10.24	592.5	67.4	76.1	21.6	66.2	64.6
Products 1-4	7.56	2.06	42.56	17.49	9.28	551.9	70.8	79.4	24.0	68.2	68.4
Products 1-5	8.10	1.96	40.40	18.46	8.97	527.6	72.1	80.7	27.1	70.6	70.1
*Products 1-6	16.42	1.04	21.82	15.85	5.00	296.15	77.8	88.4	47.2	79.8	79.7
Products 6+7	6.51	0.23	2.25	52.34	1.19	67.43	6.7	3.6	61.9	7.5	7.2
Products 6-8	6.94	0.25	2.49	49.99	1.20	71.3	8.0	4.3	63.0	8.1	8.1
Products 6-9	7.84	0.27	2.70	44.95	1.18	73.9	9.8	5.2	63.9	9.0	9.5
Products 6-10	9.12	0.28	2.76	39.14	1.14	73.8	11.6	6.2	64.8	10.1	11.0
Products 6-11	18.76	0.20	2.02	19.56	0.72	51.3	16.9	9.4	66.6	13.0	15.8
Products 6-12	91.90	0.07	0.85	4.37	0.33	19.9	27.9	19.3	72.9	29.4	29.9
Products 11+12	82.78	0.04	0.64	0.54	0.24	13.9	16.2	13.1	8.0	19.3	18.9

Product: Flotation Feed

Test No: 7

SG : 4.21

Mesh	Weight Grams	% Weight		
		Ind.	Cum.	Passing
200m	2.94	5.9	5.9	94.1
270	4.56	9.1	15.0	85.0
30.9µ	8.61	17.2	32.2	67.8
23.9	6.09	12.2	44.4	55.6
16.7	6.86	13.7	58.1	41.9
11.5	5.22	10.4	68.6	31.4
8.9	1.41	2.8	71.4	28.6
-8.9	14.31	28.6	100.0	-
Total	50.00	100.0	-	-

TEST NO. 8

Purpose: To product the flotation conditions of Test 3.

Procedure: As for Test 3.

Feed: 2000 grams of minus 10 mesh Vangorda Composite 1 ore.

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	PKD	A317/3418A	MIBC	Grind	Cond.	Froth	
Primary Grind	2000	250	8	-	40	-	-	-
Pb Rougher 1	-	-	10	10	-	1	5	9.4
2	-	-	5	5	-	1	3	-
3	-	-	5	5	-	1	3	-
Pb Conc Re grind	500	75	15	-	30	-	-	-
Pb 1st Cleaner	-	-	-	5	-	1	3	9.8
	-	-	3	5	-	1	3	-
Pb 1st Cl Scav	-	-	5	5	-	1	2	-
Pb 2nd Cleaner	-	30	-	5	-	1	3	9.5
	-	-	5	2.5	-	1	2	-
Pb 3rd Cleaner	-	20	-	5	-	1	2	-
	-	-	2.5	2.5	-	1	2	-
Pb 4th Cleaner	-	20	-	2.5	-	1	3	-
Feed: Pb Ro + Pb 1st Cl Scav Tails.								
Zinc Circuit:	Ca(OH) ₂	CuSO ₄	A343	DF1012				
Condition 1	2000	-	-	-	-	5	-	-
2	-	1500	-	-	-	5	-	11.3
Zn Rougher 1	-	-	40	10	-	1	3	-
2	-	-	10	5	-	1	2	-
Zn Conc Re grind	1000	200	-	-	30	-	-	-
HS Condition	-	-	40	2.5	-	15	-	-
Zn 1st Cleaner	-	-	-	5	-	-	5	11.5
Zn 1st Cl Scav	-	-	10	5	-	1	2	-
Zn 2nd Cleaner	500	-	-	-	-	1	3	-
Zn 3rd Cleaner	500	-	-	-	-	1	2.5	-
Zn 4th Cleaner	500	-	-	-	-	1	2	-

Metallurgical Balance

Test No. 8

Product	Weight		Assays, %g/t				% Distribution			
	g	%	Pb	Zn	Au	Ag	Pb	Zn	Au	Ag
1. Pb Cleaner. Conc.	53.5	2.72	62.8	9.78	20.2	639.7	51.7	5.7	58.8	35.2
2. Pb 4th Cl. Tail	23.8	1.21	34.4	20.7	4.46	543.0	12.6	5.4	5.8	13.3
3. Pb 3rd Cl. Tail	13.7	0.70	22.8	24	2.65	442.4	4.8	3.6	2.0	6.2
4. Pb 2nd Cl. Tail	25.7	1.31	16.3	16.5	1.73	268.6	6.4	4.6	2.4	7.1
5. Pb 1st Cl. Scav. Conc.	8.4	0.43	10.60	35.8	1.89	221.4	1.4	3.3	0.9	1.9
6. * Pb 1st Cl. Scav. Tail.	157.1	7.98	4.35	10.8	0.95	89.3	10.5	18.4	8.1	14.4
7. Zn Cleaner Conc.	116.4	5.92	2.06	49.7	0.75	66.0	3.7	62.9	4.8	7.9
8. Zn 4th Cl. Tail	11.8	0.60	5.35	18.2	1.31	131.8	1.0	2.3	0.8	1.6
9. Zn 3rd Cl. Tail	12.3	0.63	5.35	10.6	1.14	133.5	1.0	1.4	0.8	1.7
10. Zn 2nd Cl. Tail	21.3	1.08	3.81	4.88	1.25	142.7	1.2	1.1	1.4	3.1
11. Zn 1st Cl. Scav. Conc.	25.9	1.32	2.77	3.38	0.74	64.9	1.1	1.0	1.0	1.7
12. Zn 1st Cl. Scav. Tail.	143.9	7.31	1.16	0.88	0.30	26.6	2.6	1.4	2.4	3.9
13. Zn Scav. Tail	1511	76.79	0.54	0.45	0.23	10.4	12.5	7.4	18.9	16.2
Head Calc.	1967.7	100.00	3.31	4.67	0.93	49.4	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		3.93	54.06	13.14	15.35	609.9	64.3	11.0	64.6	48.5
Products 1-3		4.62	49.35	14.78	13.44	584.7	69.1	14.6	66.6	54.8
Products 1-4		5.93	42.07	15.16	10.86	515.1	75.5	19.2	69.0	61.9
Products 1-5		6.36	39.96	16.54	10.26	495.4	76.9	22.5	69.9	63.8
*Products 1-6		14.34	20.14	13.35	5.08	269.31	87.4	40.9	78.0	78.3
Products 6+7		6.52	2.36	46.80	0.80	72.06	4.7	65.2	5.6	9.5
Products 6-8		7.14	2.62	43.63	0.83	77.4	5.7	66.6	6.4	11.2
Products 6-9		8.22	2.78	38.53	0.89	86.0	6.9	67.8	7.8	14.3
Products 6-10		9.54	2.78	33.68	0.87	83.1	8.0	68.7	8.9	16.1
Products 6-11		16.85	2.08	19.45	0.62	58.6	10.6	70.1	11.2	20.0
Products 6-12		93.64	0.82	3.87	0.30	19.1	23.1	77.5	30.1	36.2
Products 11+12		84.10	0.59	0.49	0.24	11.8	15.1	8.8	21.3	20.1

TEST NO. 9

Purpose: Repeat the flotation conditions of Test 3 on Composite 2 ore.

Procedure: As for Test 3.

Feed: 2000 grams of minus 10 mesh Vangorda Composite 2 ore.

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	PKD	A317/3418A	MIBC	Grind	Cond.	Froth	
Primary Grind	2000	250	8	-	40	-	-	-
Pb Rougher 1	-	-	10	10	-	1	5	9.4
2	-	-	5	5	-	1	3	-
3	-	-	5	5	-	1	3	-
Pb Conc Re grind	500	75	15	-	30	-	-	-
Pb 1st Cleaner	-	-	-	5	-	1	3	9.8
-	-	-	3	5	-	1	3	-
Pb Cleaner Scav	-	-	2.5	5	-	1	2	-
Pb 2nd Cleaner	-	30	-	5	-	1	3	-
-	-	-	5	2.5	-	1	2	-
Pb 3rd Cleaner	-	20	-	5	-	1	2	-
-	-	-	2.5	2.5	-	1	2	-
Pb 4th Cleaner	-	20	-	5	-	1	3	-
Feed: Pb Ro + Pb 1st Cl Scav Tails.								
Zinc Circuit:	Ca(OH) ₂	CuSO ₄	A343	DF1012				
Condition 1	2000	-	-	-	-	5	-	-
2	-	1500	-	-	-	5	-	11.5
Zn Rougher 1	-	-	40	10	-	1	3	-
2	-	-	10	5	-	1	2	-
Zn Conc Re grind	1000	200	-	-	30	-	-	-
HS Condition	-	-	40	2.5	-	15	-	-
Zn 1st Cleaner	-	-	-	5	-	1	5	11.8
Zn 1st Cl Scav	-	-	10	5	-	1	2	-
Zn 2nd Cleaner	500	-	-	-	-	1	3	12.0
Zn 3rd Cleaner	500	-	-	-	-	1	2.5	-
Zn 4th Cleaner	500	-	-	-	-	1	2	-

Metallurgical Balance

Test No. 9

Product	Weight		Assays,%,g/t				% Distribution			
	g	%	Pb	Zn	Au	Ag	Pb	Zn	Au	Ag
1. Pb Cleaner. Conc.	97.5	4.94	49.6	16.9	12.15	575.1	61.4	15.0	63.3	43.6
2. Pb 4th Cl. Tail	13	0.66	31.4	22.9	1.77	466.9	5.2	2.7	1.2	4.7
3. Pb 3rd Cl. Tail	16.3	0.83	25.6	22	1.56	400.8	5.3	3.3	1.4	5.1
4. Pb 2nd Cl. Tail	23.9	1.21	15.7	19.3	1.21	259.8	4.8	4.2	1.5	4.8
5. Pb 1st Cl. Scav. Conc.	14.4	0.73	9.86	35	1.92	196.1	1.8	4.6	1.5	2.2
6. * Pb 1st Cl. Scav. Tail.	161.3	8.17	4.58	14.8	0.71	82.3	9.4	21.7	6.1	10.3
7. Zn Cleaner Conc.	117.7	5.96	1.83	53.9	0.69	68.8	2.7	57.6	4.3	6.3
8. Zn 4th Cl. Tail	8.9	0.45	6.11	26	1.07	139.8	0.7	2.1	0.5	1.0
9. Zn 3rd Cl. Tail	9.7	0.49	6.86	14.1	1.04	140.0	0.8	1.2	0.5	1.1
10. Zn 2nd Cl. Tail	19.7	1.00	5.57	6.07	0.73	107.5	1.4	1.1	0.8	1.6
11. Zn 1st Cl. Scav. Conc.	26.3	1.33	4.53	4.17	0.78	112.5	1.5	1.0	1.1	2.3
12. Zn 1st Cl. Scav. Tail.	204.3	10.35	1.69	0.87	0.31	35.0	4.4	1.6	3.4	5.6
13. Zn Scav. Tail	1422.7	72.06	0.55	0.44	0.27	19.7	9.9	5.7	20.5	21.8
Head Calc.	1974.4	100.00	3.99	5.58	0.95	65.2	100.0	100.0	100.0	100.0

Combined Products

Products 1+2		5.60	47.46	17.61	10.93	562.4	66.6	17.7	64.5	48.3
Products 1-3		6.42	44.65	18.17	9.72	541.6	71.9	20.9	65.8	53.4
Products 1-4		7.63	40.06	18.35	8.37	496.9	76.7	25.1	67.4	58.2
Products 1-5		8.36	37.42	19.80	7.81	470.7	78.5	29.7	68.9	60.4
*Products 1-6		16.53	21.19	17.33	4.30	278.75	87.9	51.4	75.0	70.7
Products 6+7		6.41	2.13	51.94	0.72	73.79	3.4	59.7	4.8	7.3
Products 6-8		6.90	2.47	49.25	0.74	78.5	4.3	60.9	5.4	8.3
Products 6-9		7.90	2.86	43.79	0.74	82.2	5.7	62.0	6.2	10.0
Products 6-10		9.23	3.10	38.08	0.74	86.5	7.2	63.0	7.2	12.3
Products 6-11		19.58	2.36	18.41	0.51	59.3	11.6	64.6	10.6	17.8
Products 6-12		91.64	0.94	4.28	0.32	28.2	21.5	70.3	31.1	39.6
Products 11+12		82.40	0.69	0.49	0.28	21.6	14.3	7.3	23.9	27.3

TEST NO. 10

Purpose: Repeat the conditions of Test 3, but increase the PKD in the Pb regrind to 120 g/t and the A317/3418A to 20 g/t.

Procedure: As shown below.

Feed: 2000 grams of minus 10 mesh Vangorda Composite 1 ore.

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	PKD	A317/3418A	MIBC	Grind	Cond.	Froth	
Primary Grind	2000	250	8	-	40	-	-	-
Pb Rougher 1	-	-	10	10	-	1	5	9.4
2	-	-	5	5	-	1	3	-
3	-	-	5	5	-	1	3	-
Pb Conc Re grind	500	120	20	-	30	-	-	-
Pb 1st Cleaner	-	-	-	5	-	1	3	10.0
-	-	-	-	5	-	1	3	-
Pb Cleaner Scav	-	-	5	5	-	1	2	-
Pb 2nd Cleaner	-	30	-	5	-	1	3	-
-	-	-	5	2.5	-	1	3	-
Pb 3rd Cleaner	-	20	-	5	-	1	3	-
-	-	-	2.5	2.5	-	1	2	-
Pb 4th Cleaner	-	20	-	2.5	-	1	3	-
-	-	-	-	1.0	-	1	1	-
Feed: Pb Ro + Pb 1st Cl Scav Tails.								
Zinc Circuit:	Ca(OH) ₂	CuSO ₄	A343	DF1012				
Condition 1	2000	-	-	-	-	5	-	-
2	-	1500	-	-	-	5	-	11.5
Zn Rougher 1	-	-	40	10	-	1	3	-
2	-	-	10	5	-	1	2	-
Zn Conc Re grind	1000	200	-	-	30	-	-	-
HS Condition	-	-	40	2.5	-	15	-	-
Zn 1st Cleaner	-	-	-	-	-	1	5	11.8
Zn 1st Cl Scav	-	-	10	5	-	1	2	-
Zn 2nd Cleaner	500	-	-	-	-	1	3	12.0
Zn 3rd Cleaner	500	-	-	-	-	1	2.5	-
Zn 4th Cleaner	500	-	-	-	-	1	2	-

Metallurgical Balance

Test No. 10

Product	Weight		Assays,%g/t				% Distribution			
	g	%	Pb	Zn	Au	Ag	Pb	Zn	Au	Ag
1. Pb Cleaner. Conc.	81.4	4.16	57.4	11.2	14.93	604.6	70.7	10.2	63.2	49.9
2. Pb 4th Cl. Tail	13	0.66	21.7	24.6	2.44	434.5	4.3	3.6	1.6	5.7
3. Pb 3rd Cl. Tail	22.7	1.16	17.4	24.3	1.95	353.1	6.0	6.2	2.3	8.1
4. Pb 2nd Cl. Tail	13.8	0.71	8.13	16.9	1.34	168.1	1.7	2.6	1.0	2.4
5. Pb 1st Cl. Scav. Conc.	15.1	0.77	5.46	38	2.25	171.5	1.2	6.4	1.8	2.6
6. * Pb 1st Cl. Scav. Tail.	195.1	9.97	1.87	13.3	0.69	53.6	5.5	29.0	7.0	10.6
7. Zn Cleaner Conc.	92.7	4.74	1.52	52.8	0.79	64.0	2.1	54.8	3.8	6.0
8. Zn 4th Cl. Tail	8.3	0.42	3.01	26.5	1.08	97.6	0.4	2.5	0.5	0.8
9. Zn 3rd Cl. Tail	8.5	0.43	3.15	15.6	1.10	103.5	0.4	1.5	0.5	0.9
10. Zn 2nd Cl. Tail	19.8	1.01	2.49	6.79	0.79	75.0	0.7	1.5	0.8	1.5
11. Zn 1st Cl. Scav. Conc.	25.4	1.30	2.24	4.25	0.75	61.2	0.9	1.2	1.0	1.6
12. Zn 1st Cl. Scav. Tail.	198.7	10.16	0.85	1.01	0.30	22.6	2.6	2.2	3.1	4.6
13. Zn Scav. Tail	1457	74.47	0.41	0.45	0.27	10.7	9.0	7.3	20.5	15.8
Head Calc.	1956.4	100.00	3.38	4.57	0.98	50.4	100.0	100.0	100.0	100.0

Combined Products

Products 1+2	4.83	52.48	13.05	13.21	581.2	75.0	13.8	64.8	55.7
Products 1-3	5.99	45.68	15.23	11.03	537.0	80.9	20.0	67.1	63.8
Products 1-4	6.69	41.72	15.40	10.01	498.1	82.6	22.6	68.1	66.2
Products 1-5	7.46	37.97	17.74	9.20	464.3	83.9	29.0	69.9	68.8
*Products 1-6	17.44	17.32	15.20	4.33	229.39	89.4	58.0	76.9	79.4
Products 6+7	5.16	1.64	50.64	0.81	66.76	2.5	57.2	4.3	6.8
Products 6-8	5.60	1.76	47.92	0.84	69.6	2.9	58.7	4.8	7.7
Products 6-9	6.61	1.87	41.62	0.83	70.4	3.7	60.2	5.6	9.2
Products 6-10	7.91	1.93	35.48	0.82	68.9	4.5	61.4	6.6	10.8
Products 6-11	18.06	1.32	16.10	0.53	42.9	7.1	63.7	9.7	15.4
Products 6-12	92.54	0.59	3.51	0.32	17.0	16.1	71.0	30.1	31.2
Products 11+12	84.63	0.46	0.52	0.27	12.1	11.6	9.6	23.6	20.4