Ex 36

Vangorda metallurgy

006712

METALLURGICAL RESPONSE OF VANGORDA ORE

VANGORDA DEPOSIT - EASTERN SECTION

VANGORDA PLATEAU

YUKON TERRITORY

KMO44

Jan 20, 1982

Ex 36.

SUMMARY

The metallurgical response of the ore to the east of 12th parallel was determined by means of standard laboratory tests. The results shown below refer to the unoxidized portion of the ore.

Analytical results suggest that the silver and gold contents of the lead concentrates will be high. In general, the levels of deleterious components will be low in both lead and zinc concentrates.

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KM044

January 20, 1982

Predicted Plant Performance

Product	Assays %				Distribution			
	Au*	Ag*	Pb	Zn	Au	Ag	Pb	Zn
Lead Concentrate	10	500	50	-	55	70	85	-
Zinc Concentrate	-	-	-	49	-	-	-	78

Lead K_{80} is 30 μm. Zinc K_{80} is 25 μm * g/tonne

TABLE OF CONTENTS

APPENDICES

INTRODUCTION

Despite the extensive testwork performed on Vargorda ore, the work had been concentrated on samples taken from the Western section of the deposit during the 1979 redrilling program. A significant tonnage of material in the Eastern end of the deposits, and outside of the preliminary pit limits east of 12th parallel, had not been subjected to a metallurgical evaluation.

where is that 12E?

In December of 1980, Mr. L. P. Taggart of Cyprus Anvil Feasibility and Development Group instructed us to perform an evaluation of the metallurgical response of a sample of ore from the Vangorda deposit.

The sample of ore from the Eastern zone was prepared and testwork commenced in January of 1981. At the conclusion of the test program, we were advised by Mr. Taggart that the sample tested was representative of the unoxidized portion of the ore east of 12th parallel. He mentioned that samples of the oxidized ore would become available for testing at some future date.

THE TEST PROGRAM

1. Test Program Objectives

The objectives of the test program were detailed by Mr. Taggart in December in conversation with laboratory personnel. In order of importance the objectives were:

(a) To determine the probable metallurgical response of the ore samples provided and to construct a metallurgical balance for probable plant performance in the expanded Cyprus Anvil Concentrator.

(b) To examine the concentrates produced and determine the probable chemical composition of these concentrates. We were directed to especially note the levels of deleterious metalloids and the silver and gold.

2. Experimental Procedures

Samples Used in the Program

The sample used in the program was made up from various sections of diamond drill core originating from the 1979 redrilling program on the Vangorda deposits. The core, which was stored in a nitrogen atmosphere at Kamloops, was composited according to instructions from Mr. D. Hanson of Cyprus Anvil.

The composite was crushed to pass ten mesh and riffled down to produce a sample for chemical anlaysis. The remainder of the sample was divided into 2 kg. lots and stored in plastic bags to limit sample oxidation. The chemical composition of the sample is shown below in Table 1.

TABLE 1

Chemical Compositions of Head Sample

	ASSAYS %					
	Ag*	Cu	Pb	Zn	Fe	Po
Vangorda Composite	62	0.18	4.90	5.60	15.6	7.7

* g/tonne

In lithological terms the sample was made up of about 40% type G, 40% type E and the remainder was believed to be type BCD.

Flotation Test Procedure

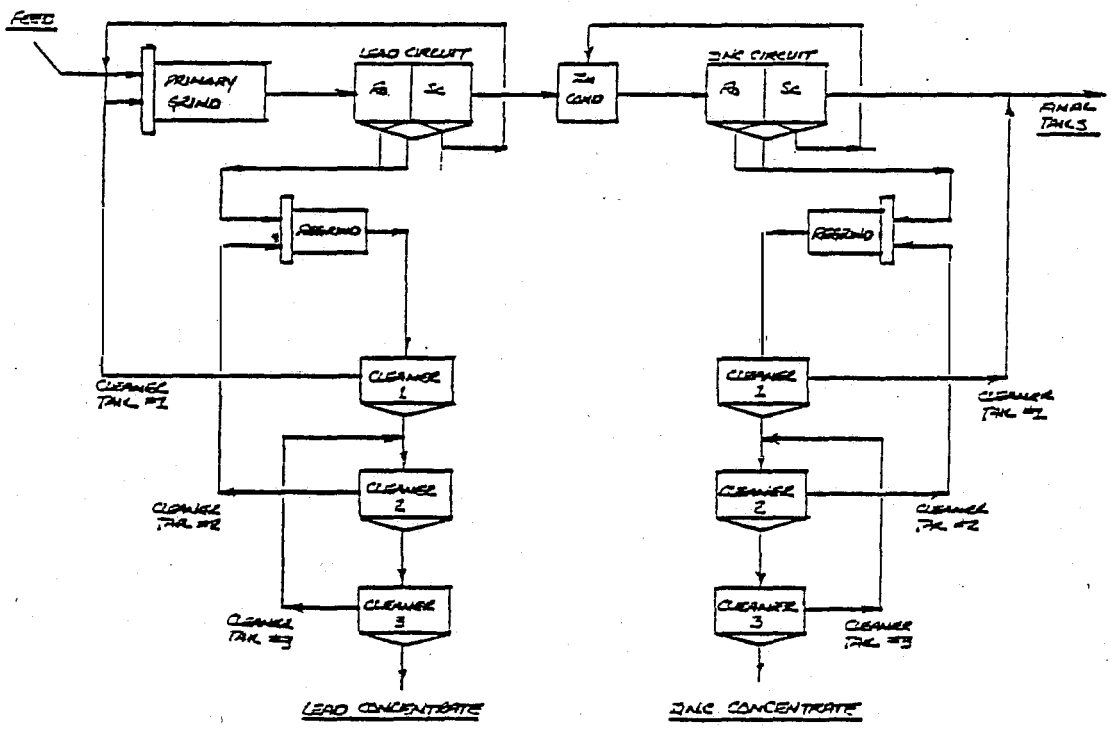
The program objectives were realized by employing various open circuit cleaner tests and finally a locked cycle test to verify the early results and establish the cleaner tails distribution.

The batch tests followed standard procedures with grinding taking place in a soda ash-cyanide environment. Following the production of a lead rougher scavenger concentrate a regrinding stage with soda ash and cyanide preceded the cleaner circuits. The lead first cleaner tailing was added to the lead rougher tailing.

Zinc circuit operation nearly paralleled the lead circuit with regrinding of the rougher scavenger concentrates. All zinc circuit operations were conducted in the presence of lime to assist in iron and residual lead mineral rejection.

In the locked cycle test, which was a conventional five stage procedure, the lead first cleaner tails were routed to the primary grinding mill and the other cleaner tailings recycled to the previous cleaner circuit feed. Zinc flotation occurred after a conditioning stage and the zinc cleaner tailings were recycled to the appropriate cleaner stage. The zinc first cleaner tailing was, however, directed to tailings to simulate the use of a re-treatment circuit. A flowsheet diagram for the cycle test procedure is shown below.

Cycle Test Flowsheet



ANALYSIS AND DISCUSSION OF RESULTS

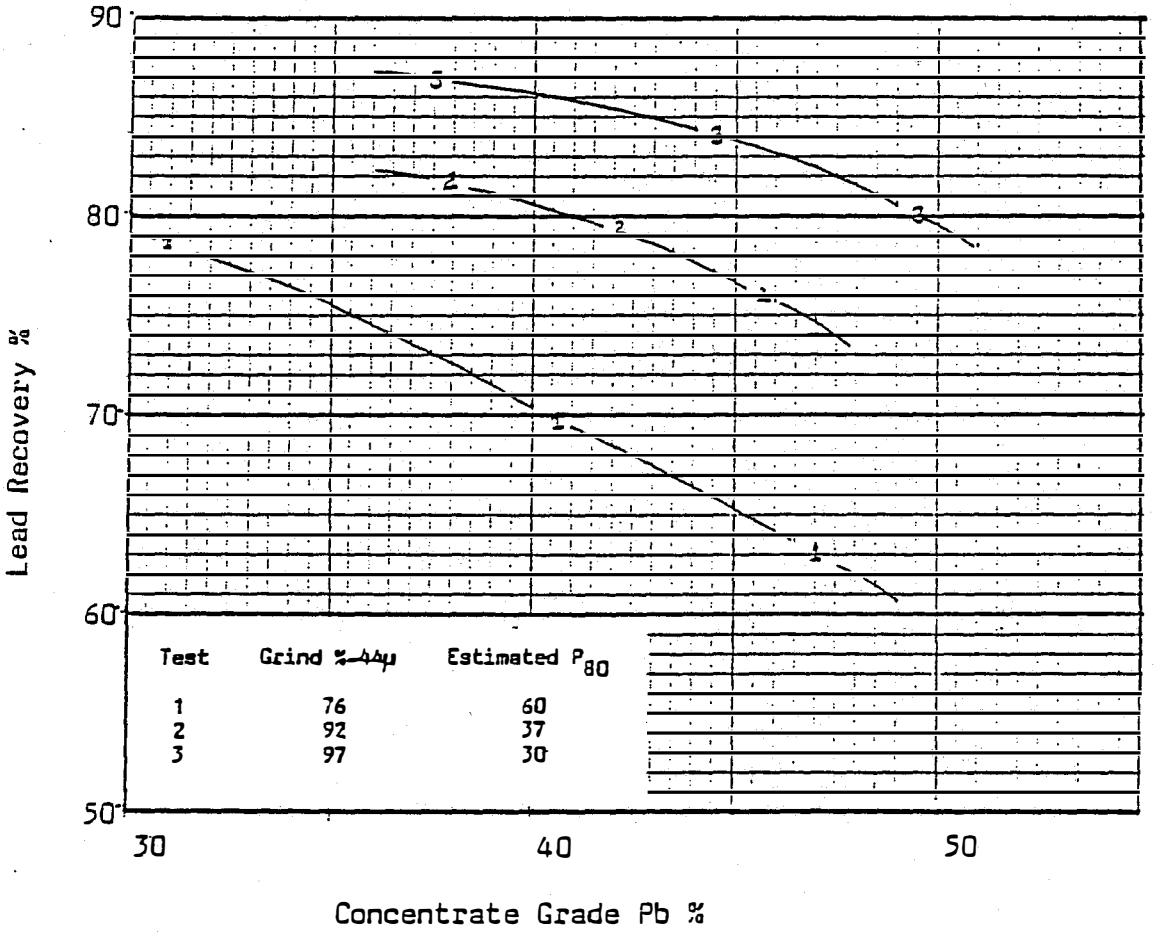
The preliminary tests were performed for the purposes of determining the primary grind, regrind and reagent pattern required for ore treatment. The standard soda ash cyanide scheme was selected as the basis of the test program with minor variations from test to test.

1. Primary Grind Effects

The ore tested was very friable and some very fine grind levels were recorded during test-work. The lead metallurgy appeared to be most responsive to finer grinds. The results of the primary grind tests are summarized in Graphs 1 and 2.

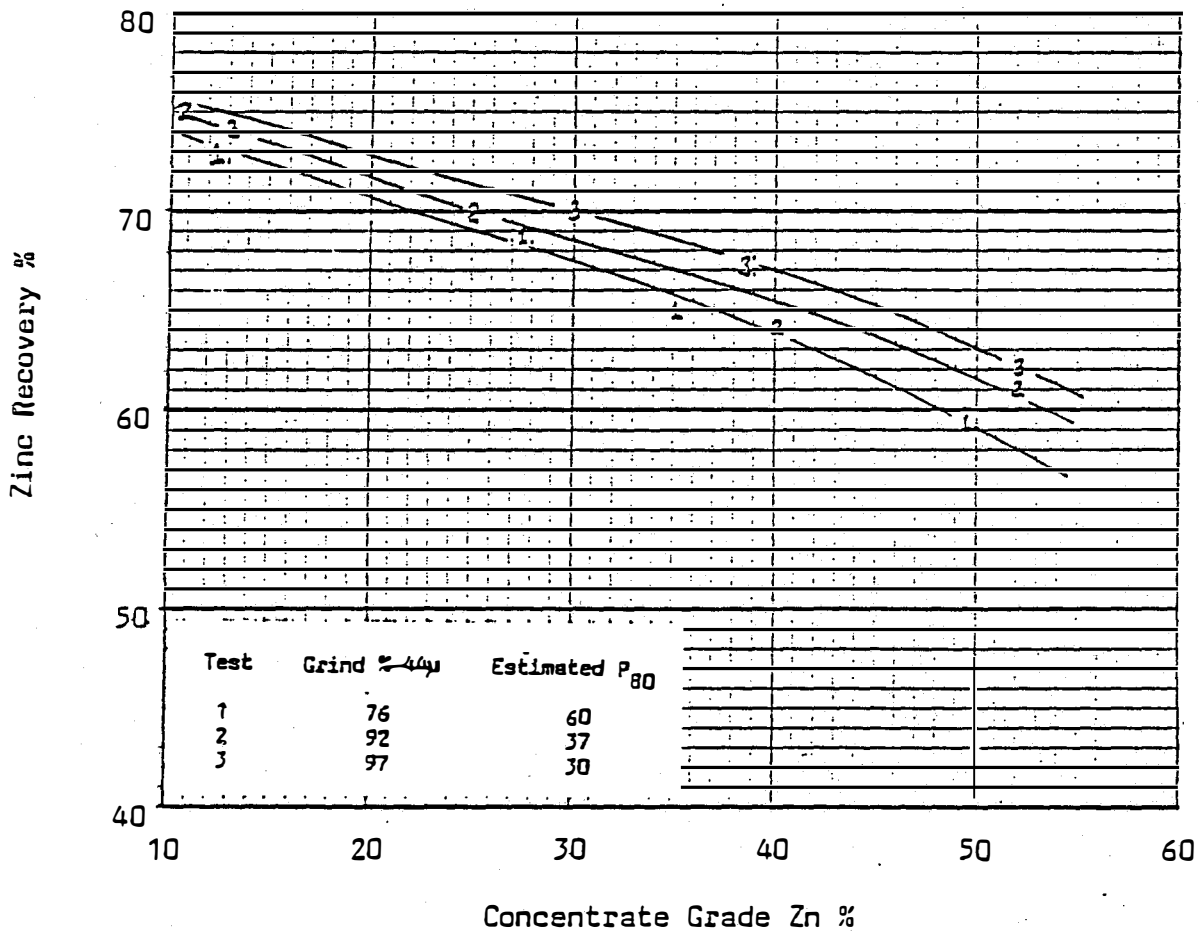
GRAPH 1

Effect of Primary Grind on Lead Metallurgy



GRAPH 2

Effect of Primary Grind on Zinc Metallurgy



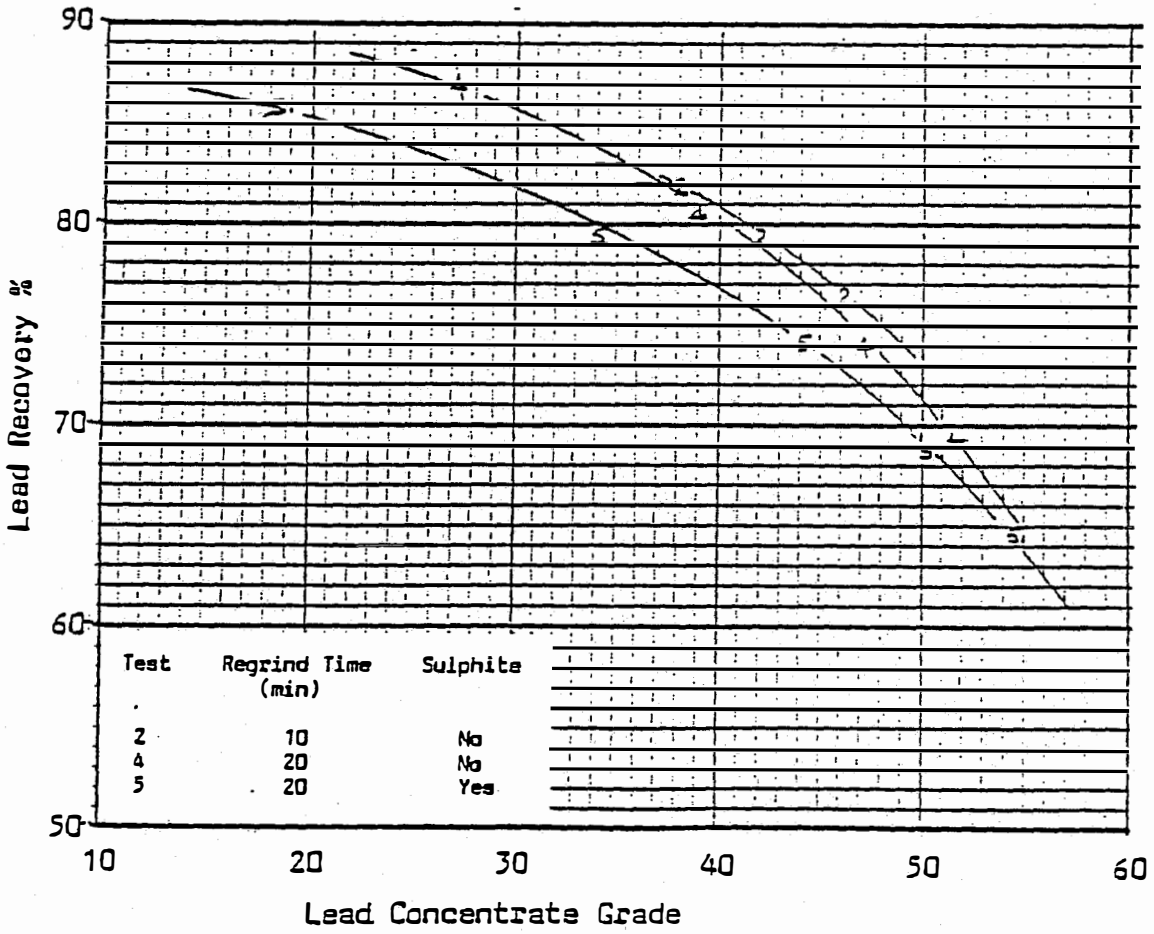
2. Regrinding Sulphite Effects

Poor lead concentrate grade in the early tests prompted an investigation of lead regrinding effects. Increased regrinding did not appear to improve lead concentrate grade, nor did the addition of sodium sulphite. The results of these tests are shown graphically below in Graph 3.

GRAPH 3

Effect on Lead Metallurgy

of Regrinding and Sulphite



3. Cycle Test

The cycle test was performed in a standard flotation circuit using a fine primary grind estimated to be about 35 um K_{80}, and regrinding of the rougher concentrates. The results were analysed using the three product formulas.

TABLE 2

Projected Cycle Test Results - Test 6

Product	Weight %	Assays %		Distribution	
		Pb	Zn	Pb	Zn
Feed	100.00	4.72	5.43	100.00	100.00
Lead Concentrate	9.39	43.3	8.64	86.1	14.9
Zinc Concentrate	8.50	1.88	46.43	3.39	72.7
Tails	82.11	.60	.82	10.5	12.4

While in all cycles it was difficult to achieve good lead concentrate grades, circuit stability was acceptable. However, in the zinc circuit severe stability problems in Cycle V reduced the zinc grade significantly. Accordingly, the predicted plant performance for this ore was adjusted to reflect slightly better zinc concentrate grade than that shown above. Also the high lead recovery, which was probably the result of pulling too hard, was reduced.

TABLE 3

Predicted Plant Performance

Product	Assays %				Distribution			
	Au*	Ag*	Pb	Zn	Au	Ag	Pb	Zn
Lead Concentrate	10	500	50	-	55	70	85	-
Zinc Concentrate	-	-	-	49	-	-	-	78

* g/tonne

4. Concentrate Quality

Some of the test concentrates were composited and assayed for elements of interest. The results are shown below in Table 4.

TABLE 4

Chemical Composition of Concentrates

Product	Assays %						
	Au*	Ag*	Fe	Hg*	As	Sb	Insol
Lead Concentrate	10	500	12	58	0.1	0.1	5
Zinc Concentrate	5	70	8	300	0.1	0.02	3

Note: Above data based on assays of products from test work. * g/tonne

APPENDIX I

DETAILS OF EQUIPMENT USED

APPENDIX I

Details of Equipment Used in Testwork

A. Grinding

Rod Mill	- Steel container 21.5 cm ø x 40.5 cm. Charge 25 kg steel rods approx. 2.0 cm. ø.
Ball Mill	- Steel container 21.5 cm ø x 18 cm. Charge 5 kg steel balls - graded charge 0.5 - 3.0 cm ø.
Drive for Mill	- Twin rolls, one drive, one idle. Both 12.5 ø x 122 cm.
	- Motor 0.37 KWH at 1725 RPM full load.
	- Mill speed approximately 80 RPM.
Bond Mill	- Standard Bond mill for determination of mean work index of ore.

B. Flotation

Denver D2 Flotation Machine	- Used for roughing and scavenger at 1500 RPM with a 5.5 L stainless steel tank.
	- For first cleaner work with a 2.5 L stainless steel tank.
Denver D1 Flotation Machine	- Used for all cleaning stages at 1500 RPM with a 2.5 L stainless steel tank.
Galigher Agitair LA500	- Used for general purpose work with 5.5 L, 2.5 L and 1.5 L perspex flotation tanks and with 25 L stainless steel tank for large volume work.

C. Instrumentation

Orion Specific Ion Meter 401	- Used for pH control on the rougher and scavenger circuits.
Fisher Digital pH Meter 609	- Used for pH control on the cleaning circuits.
Kalnew 12701 Microscope	- Used for microscopic examination of various minerals.
Swift 80 Microscope	- Used for microscopic examination of various minerals.

D. Particle Sizing

Andreasen Pipet	- Used for determining the distribution of particle sizes less than 74 μm.
Warman Cyclosizer	- Used for determining the distribution of particle sizes less than 74 μm.

APPENDIX II

TECHNICAL DATA FOR TESTS 1 - 6 INCLUSIVE

This appendix contains the relevant technical details of the flotation tests, together with assay values for the various products and metallurgical balances.

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TEST NO. 1

PURPOSE: Preliminary Flotation Tests

PROCEDURE: Grind and float a lead concentrate, regrind and clean three times; Float a zinc concentrate, regrind and clean three times

FEED: Vangorda Composite

GRIND: 8 minutes in laboratory rod mill at 65% solids

STAGE	REAGENTS ADDED g/tonne						TIME, MINUTES			pH	
	Na_2CO_3	NaCN	Z-11	$CuSO_4$	LIME		GRIND	COND	FROTH	START	FINISH
PRIMARY GRIND	1500	300					8				9.1
LEAD RO/SC			100					2	7	9.1	9.0
LEAD REGRIND	500	200					10				
LEAD 1ST CLEANER			30					2	7	10.2	9.8
LEAD 2ND CLEANER	300		20					2	5	10.3	10.1
LEAD 3RD CLEANER	300		10					2	4	10.4	10.0
ZINC CONDITIONING				1000				10		11.0	11.0
ZINC RO/SC			90					2	9	11.0	11.0
ZINC REGRIND				150	500		10				
ZINC 1ST CLEANER			40					2	7	11.5	11.6
ZINC 2ND CLEANER			10					2	5	12.0	12.0
ZINC 3RD CLEANER			10					2	3	12.3	12.0

TEST NO. 1

PRODUCT	WEIGHT	ASSAYS %				DISTRIBUTION			
	%	Pb	Zn			Pb	Zn		
LEAD CLEANER CONC. 3	6.47	47.20	8.12			63.32	9.67		
LEAD CLEANER TAILS 3	1.83	17.50	9.90			6.65	3.34		
LEAD CLEANER TAILS 2	4.01	10.60	9.90			8.82	7.32		
ZINC CLEANER CONC. 3	6.35	2.56	49.50			3.37	57.90		
ZINC CLEANER TAILS 3	3.76	3.83	10.60			2.99	7.48		
ZINC CLEANER TAILS 2	3.45	4.00	5.20			2.86	3.30		
ZINC CLEANER TAILS 1	18.28	1.39	1.28			5.27	4.31		
TAILS	55.84	0.58	0.65			6.72	6.68		
CALCULATED HEAD	100.00	4.82	5.43			100.00	100.00		

KM044

TEST NO. 2

PURPOSE: Preliminary Test

PROCEDURE: Repeat Test 1 but at finer primary grind

FEED: Vangorda Composite

GRIND: 12 minutes in laboratory rod mill at 65% solids

STAGE	REAGENTS ADDED g/tonne						TIME, MINUTES			pH	
	Na_2CO_3	NaCN	Z-11	$CuSO_4$	LIME		GRIND	COND	FROTH	START	FINISH
PRIMARY GRIND	1500	300					12				8.6
LEAD RO/SC			80					2	7	9.1	9.0
LEAD REGRIND	500	200					10				
LEAD 1ST CLEANER			30					2	7	9.9	9.5
LEAD 2ND CLEANER			20					2	5	10.3	10.2
LEAD 3RD CLEANER			20					2	4	10.4	10.2
ZINC CONDITIONING				1000				10		11.0	11.0
ZINC RO/SC			40					2	9	11.0	10.7
ZINC REGRIND							10				
ZINC 1ST CLEANER			10					2	5	12.0	12.2
ZINC 2ND CLEANER			10					2	4	12.3	12.1
ZINC 3RD CLEANER			-					2	3	12.2	12.2

TEST NO. 2

PRODUCT	WEIGHT	ASSAYS %				DISTRIBUTION			
	%	Pb	Zn			Pb	Zn		
LEAD CLEANER CONC. 3	8.04	45.60	8.39			76.39	12.80		
LEAD CLEANER TAILS 3	1.01	14.60	9.10			3.06	1.74		
LEAD CLEANER TAILS 2	1.31	9.20	10.20			2.52	2.54		
ZINC CLEANER CONC. 3	6.22	1.67	51.70			2.17	61.03		
ZINC CLEANER TAILS 3	2.16	1.35	6.60			0.61	2.71		
ZINC CLEANER TAILS 2	6.19	2.26	5.10			2.92	5.99		
ZINC CLEANER TAILS 1	24.86	0.99	1.00			5.13	4.72		
TAILS	50.21	0.69	0.89			7.22	8.48		
CALCULATED HEAD	100.00	4.80	5.27			100.00	100.00		

KM044

TEST NO. 3

PURPOSE: Preliminary Test

PROCEDURE: Repeat Test 1 but attempt reverse separation on the lead concentrate

FEED: Vangorda Deposit

GRIND: 18 minutes in laboratory rod mill at 65% solids

STAGE	REAGENTS ADDED g/tonne						TIME, MINUTES			pH	
	Na_2CO_3	NaCN	Z-11	$CuSO_4$	LIME	$Na_2S_2O_5$	GRIND	COND	FROTH	START	FINISH
PRIMARY GRIND	1500	300					18				
LEAD RO/SC			100					2	7	9.1	9.0
LEAD REGRIND	500	200					10				
LEAD 1ST CLEANER			30					2	8	10.3	10.0
LEAD 2ND CLEANER			20					2	5	10.4	10.5
LEAD 3RD CLEANER			10					2	3	10.4	10.2
REVERSE FLOTATION						2000		5	5	5.2	5.4
ZINC CONDITIONING				1000				10		11.0	11.0
ZINC RO/SC			70					2	9	11.0	11.0
ZINC REGRIND				150	500		10				
ZINC 1ST CLEANER			40					2	7	11.5	11.4
ZINC 2ND CLEANER			20					2	5	12.1	12.0
ZINC 3RD CLEANER			10					2	3	12.3	12.4

TEST NO. 3

PRODUCT	WEIGHT	ASSAYS %				DISTRIBUTION			
	%	Pb	Zn			Pb	Zn		
LEAD CLEANER CONC. 3	5.71	46.80	9.73			55.80	10.22		
LEAD CLEANER TAILS 3	1.34	13.60	11.50			3.81	2.84		
LEAD CLEANER TAILS 2	1.92	6.10	11.20			2.44	3.95		
ZINC CLEANER CONC. 3	6.49	1.49	52.00			2.02	62.12		
ZINC CLEANER TAILS 3	3.00	1.98	9.30			1.24	5.13		
ZINC CLEANER TAILS 2	3.03	2.19	4.70			1.39	2.62		
ZINC CLEANER TAILS 1	18.38	0.86	1.21			3.30	4.09		
REJECT CONCENTRATE	2.01	57.80	3.90			24.31	1.45		
TAILS	58.11	0.47	0.71			5.70	7.59		
CALCULATED HEAD	100.00	4.79	5.44			100.00	100.00		

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TEST NO. 4

PURPOSE: Attempt to improve metallurgy by increasing iron rejection

PROCEDURE:

FEED: Vangorda - Eastern Section

GRIND: 12 minutes in laboratory rod mill at 65% solids

STAGE	REAGENTS ADDED g/tonne						TIME, MINUTES			pH	
	Na_2CO_3	NaCN	Z-11	$CuSO_4$	LIME		GRIND	COND	FROTH	START	FINISH
PRIMARY GRIND	2000	300					12				9.7
LEAD RO/SC			150					2	10	9.7	9.3
LEAD REGRIND	2000	300					20				10.8
LEAD 1ST CLEANER			100					2	7	10.8	10.7
LEAD 2ND CLEANER			30					2	5	10.5	10.1
LEAD 3RD CLEANER			10					2	4	10.0	9.8
LEAD 4TH CLEANER			10					2	3	10.0	9.8

TEST NO. 4

PRODUCT	WEIGHT	ASSAYS %				DISTRIBUTION			
	%	Pb	Zn			Pb	Zn		
LEAD CLEANER CONC. 4	6.73	51.40	7.58			69.57	8.80		
LEAD CLEANER TAILS 4	1.11	20.90	11.70			4.67	2.24		
LEAD CLEANER TAILS 3	2.26	12.10	12.60			5.49	4.90		
LEAD CLEANER TAILS 2	5.49	6.30	11.70			6.96	11.08		
LEAD CLEANER TAILS 1	17.91	1.73	7.56			6.23	23.34		
TAILS	66.49	0.53	4.33			7.00	49.63		
CALCULATED HEAD	100.00	4.97	5.80			100.00	100.00		

KM044

TEST NO. 5

PURPOSE: Attempt to improve metallurgy by improving iron rejection using sodium sulphite

PROCEDURE:

FEED: Vangorda - Eastern Section

GRIND: 12 minutes in laboratory rod mill at 65% solids

STAGE	REAGENTS ADDED g/tonne						TIME, MINUTES			pH	
	Na_2CO_3	NaCN	Z-11	$CuSO_4$	LIME	Na_2SO_3	GRIND	COND	FROTH	START	FINISH
PRIMARY GRIND	2000	300				1000	12				9.4
LEAD RO/SC			150					2	9	9.3	9.2
LEAD REGRIND	2000	300				500	20				11.0
LEAD 1ST CLEANER			80					2	7	11.0	10.7
LEAD 2ND CLEANER			30					2	5	10.6	10.4
LEAD 3RD CLEANER			20					2	4	10.3	10.2
LEAD 4TH CLEANER			10					2	3	10.2	10.0

TEST NO. 5

PRODUCT	WEIGHT	ASSAYS %				DISTRIBUTION			
	%	Pb	Zn			Pb	Zn		
LEAD CLEANER CONC.4	6.13	53.50	7.79			65.01	8.49		
LEAD CLEANER TAILS4	0.93	22.20	12.60			4.08	2.08		
LEAD CLEANER TAILS3	1.49	16.90	13.20			4.98	3.49		
LEAD CLEANER TAILS2	3.46	8.39	12.80			5.76	7.88		
LEAD CLEANER TAILS1	12.16	2.76	9.56			6.65	20.66		
TAILS	75.83	0.90	4.26			13.52	57.41		
CALCULATED HEAD	100.00	5.05	5.63			100.00	100.00		

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TEST NO. 6 - Cycle 1

PURPOSE: Locked Cycle Test - Vangorda Ore Eastern Section

PROCEDURE: Standard five cycle locked procedure

FEED:

GRIND: 20 minutes in laboratory rod mill at 65% solids

STAGE	REAGENTS ADDED g/tonne.						TIME, MINUTES			pH	
	Na_2CO_3	NaCN	$CuSO_4$	Z-11	LIME		GRIND	COND	FROTH	START	FINISH
PRIMARY GRIND	2000	200					20				9.6
LEAD RO								2	4	9.6	
LEAD SC				100							9.4
LEAD REGRIND.	1000	200					10				
LEAD 1ST CLEANER				40				2	8	10.4	10.3
LEAD 2ND CLEANER				10				2	4	10.5	10.3
LEAD 3RD CLEANER				10				2	3	10.5	10.3
ZINC CONDITIONING			1000					10		11.0	11.0
ZINC RO/SC				80				2	8	11.0	11.0
ZINC REGRIND			250		500		10	2			
ZINC 1ST CLEANER				60				2	7	11.5	11.4
ZINC 2ND CLEANER				30				2	4	12.0	12.0
ZINC 3RD CLEANER				20				2	3	12.4	12.4

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TEST NO. 6 - Cycle 2

STAGE	REAGENTS ADDED g/tonne						TIME, MINUTES			pH	
	Na_2CO_3	NaCN	$CuSO_4$	Z-11	LIME		GRIND	COND	FROTH	START	FINISH
PRIMARY GRIND	2000	200					20				8.9
LEAD RO				50				2	4	9.5	9.5
LEAD SC				50					4	9.5	9.4
LEAD REGRIND	1000	200					10				10.8
LEAD 1ST CLEANER				60				2	8	10.8	10.3
LEAD 2ND CLEANER				20				2	4	10.5	10.4
LEAD 3RD CLEANER				10				2	3	10.5	10.3
ZINC CONDITIONING			1000					10		11.0	11.0
ZINC RO/SC				80				2	8	11.0	11.0
ZINC REGRIND			250		500		10				
ZINC 1ST CLEANER				60				2	7	11.5	11.5
ZINC 2ND CLEANER				30				2	4	12.0	12.0
ZINC 3RD CLEANER				20				2	3	12.4	12.4

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TEST NO. 6 - Cycle 3

STAGE	REAGENTS ADDED g/tonne						TIME, MINUTES			pH	
	Na_2CO_3	NaCN	$CuSO_4$	Z-11	LIME		GRIND	COND	FROTH	START	FINISH
PRIMARY GRIND	2000	200					20				8.7
LEAD RO				50				2	4	9.5	9.5
LEAD SC				50				2	4	9.5	9.5
LEAD REGRIND	1000	200					10				
LEAD 1ST CLEANER				60				2	8	10.7	10.3
LEAD 2ND CLEANER				20				2	4	10.5	10.3
LEAD 3RD CLEANER				10				2	3	10.5	10.3
ZINC CONDITIONING			1000					10		11.3	11.0
ZINC RO/SC				80				2	8	11.2	11.0
ZINC REGRIND			250		500		10				
ZINC 1ST CLEANER				60				2	7	11.5	11.4
ZINC 2ND CLEANER				30				2	4	12.2	12.1
ZINC 3RD CLEANER				20				2	3	12.4	12.3

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TEST NO. 6 - Cycle 4

STAGE	REAGENTS ADDED g/tonne						TIME, MINUTES			pH	
	Na_2CO_3	NaCN	$CuSO_4$	Z-11	LIME		GRIND	COND	FROTH	START	FINISH
PRIMARY GRIND	2000	200					20				8.7
LEAD RO				50				2	4	9.5	9.5
LEAD SC				50				2	4	9.5	9.5
LEAD REGRIND	1000	200					10				
LEAD 1ST CLEANER				60				2	8	10.8	10.3
LEAD 2ND CLEANER				20				2	4	10.5	10.2
LEAD 3RD CLEANER				10				2	3	10.5	10.3
ZINC CONDITIONING			1000					10		11.4	11.3
ZINC RO/SC				80				2	8	11.3	11.2
ZINC REGRIND			250		500		10				
ZINC 1ST CLEANER				60				2	7	11.5	11.5
ZINC 2ND CLEANER				30				2	4	12.0	12.0
ZINC 3RD CLEANER				10				2	3	12.4	12.4

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TEST NO. 6 - Cycle 5

STAGE	REAGENTS ADDED g/tonne						TIME, MINUTES			pH	
	Na_2CO_3	NaCN	$CuSO_4$	Z-11	LIME		GRIND	COND	FROTH	START	FINISH
PRIMARY GRIND	2000	200					20				8.7
LEAD RO				50				2	4	9.8	9.7
LEAD SC				50				2	4	9.7	9.5
LEAD REGRIND	1000	200					10				
LEAD 1ST CLEANER				60				2	8	10.9	10.3
LEAD 2ND CLEANER				30				2	4	10.5	10.2
LEAD 3RD CLEANER				10				2	3	10.5	10.3
ZINC CONDITIONING			1000					10		11.4	11.2
ZINC RO/SC				80				2	8	11.2	11.0
ZINC REGRIND			250		1000		10				
ZINC 1ST CLEANER				60				2	8	11.5	11.5
ZINC 2ND CLEANER				30				2	4	12.2	12.2
ZINC 3RD CLEANER				10				2	3	12.4	12.3

TEST NO. 6

Product	Weight %	Assays %			Distribution		
		Pb	Zn	Fe	Pb	Zn	Fe
Lead Concentrate V	1.70	47.5	8.35	11.4	17.10	2.62	.76
Lead Concentrate IV	2.24	37.0	9.27	14.7	17.55	3.83	1.29
Lead Concentrate III	1.66	47.5	8.09	10.9	16.70	2.47	.71
Lead Concentrate II	1.94	42.8	8.20	12.7	17.58	2.93	.96
Lead Concentrate I	1.24	50.3	7.84	9.2	13.21	1.79	.45
Lead Cleaner Tails 3	.30	11.6	13.3	26.5	.74	.74	.31
Lead Cleaner Tails 2	1.08	6.23	11.9	29.2	1.42	2.37	1.23
Lead Scavenger Concentrate	1.65	4.54	11.8	32.0	1.59	3.59	2.07
Zinc Concentrate V	1.83	2.14	42.9	11.2	.83	14.47	.80
Zinc Concentrate IV	1.44	1.74	48.6	8.40	.53	12.90	.47
Zinc Concentrate III	1.54	1.70	48.6	8.34	.55	13.79	.50
Zinc Concentrate II	1.36	1.40	47.6	8.84	.40	11.93	.47
Zinc Concentrate I	1.24	1.41	48.1	8.38	.37	10.99	.41
Zinc Cleaner Tails 3	.55	2.65	8.67	22.1	.31	.88	.48
Zinc Cleaner Tails 2	1.41	2.40	5.99	28.8	.72	1.56	1.59
Zinc Cleaner Tails 1 - V	1.70	1.61	2.72	32.4	.58	.85	2.15
Zinc Cleaner Tails 1 - IV	1.84	1.82	2.81	32.1	.71	.95	2.31
Zinc Cleaner Tails 1 - III	1.32	1.62	2.47	32.4	.45	.60	1.67
Zinc Cleaner Tails 1 - II	1.36	1.72	2.43	33.8	.50	.61	1.80
Zinc Cleaner Tails 1 - I	.87	2.27	3.88	32.9	.42	.62	1.12
Zinc Scavenger Concentrate	1.89	1.18	3.47	37.4	.47	1.21	2.77
Tails V	14.13	.47	.65	27.6	1.41	1.69	15.26
Tails IV	16.97	.50	.61	30.1	1.80	1.91	19.98
Tails III	14.48	.49	.61	28.1	1.50	1.63	15.92
Tails II	14.06	.50	.70	27.1	1.49	1.81	14.91
Tails I	10.18	.48	.65	24.1	1.03	1.22	9.60
Calculated Head	100.00	4.72	5.43	25.56	100.00	100.00	100.00

APPENDIX III

COMPARISON OF ASSAY DATA AND SPECIAL ASSAYS

TABLE III - 1

Comparison of Assay Data

Product	Assays %	
	Pb	Zn
Assayed Head	4.90	5.60
Calculated Average	4.86	5.50
Standard Deviation	0.12	0.19

Note: Assumes cycle test calculated head is one result only

TABLE III - 2

Special Assays

Product	Assays %						
	Au*	Ag*	Fe	Hg*	As	Sb	Insol
Final Tails	0.34	-	-	-	-	-	-
Lead Concentrate	9.5	530	11.8	58	.10	.11	5.15
Zinc Concentrate	4.9	74	7.6	210	.07	.02	2.73

* g/tonne

APPENDIX IV

SCREEN ANALYSES AND CYCLOSIZING DATA

SCREEN ANALYSES

TEST NO. 1

MESH SIZE TYLER	APERTURE MICRONS	% RETAINED		% PASSING
		INDIVIDUAL	CUMULATIVE	CUMULATIVE
65	212	0.02	0.02	99.98
100	150	0.02	0.04	99.96
150	106	1.07	1.11	98.89
200	74	5.88	6.99	93.01
325	44	16.55	23.54	76.46
-325	-	76.46	100.00	

TEST NO. 2

MESH SIZE TYLER	APERTURE MICRONS	% RETAINED		% PASSING
		INDIVIDUAL	CUMULATIVE	CUMULATIVE
65	212	0.02	0.02	99.98
100	150	0.04	0.06	99.94
150	106	0.09	0.15	99.85
200	74	1.40	1.55	98.45
325	44	6.77	8.32	91.68
-325	-	91.68	100.00	

TEST NO. 3

MESH SIZE TYLER	APERTURE MICRONS	% RETAINED		% PASSING
		INDIVIDUAL	CUMULATIVE	CUMULATIVE
65	212	0.02	0.02	99.98
100	150	0.02	0.04	99.96
150	106	0.09	0.13	99.87
200	74	0.19	0.32	99.68
325	44	2.53	2.85	97.15
-325	-	97.15	100.00	

SCREEN ANALYSES

TEST NO. 4

MESH SIZE	APERTURE	% RETAINED		% PASSING
TYLER	MICRONS	INDIVIDUAL	CUMULATIVE	CUMULATIVE
65	212	0.01	0.01	99.99
100	150	0.05	0.06	99.94
150	106	0.13	0.19	99.81
200	74	1.58	1.77	98.23
325	44	9.67	11.44	88.56
-325	-	88.56	100.00	

TEST NO. 5

MESH SIZE	APERTURE	% RETAINED		% PASSING
TYLER	MICRONS	INDIVIDUAL	CUMULATIVE	CUMULATIVE
65	212	0.01	0.01	99.99
100	150	0.02	0.03	99.97
150	106	0.18	0.21	99.79
200	74	1.49	1.70	98.30
325	44	10.98	12.68	87.32
-325	-	87.32	100.00	

KAMLOOPS RESEARCH AND ASSAY LABORATORY LTD.

WARMAN CYCLOSIZER RESULTS

CLIENT Cyprus Anvil Mining Corp. KM044 DATE January 21, 1982

SAMPLE NUMBER	Test 6 Tails	Test 1 Pb Con	Test 1 Zn Con	
SAMPLE WEIGHT	50.00	41.40	40.5	
TEMPERATURE °C	8.8	8.0	8.0	
SAMPLE SPECIFIC GRAVITY	3.57	4.79	3.76	
FLOWRATE mm	180	180	180	
ELUTRIATION TIME min	20	20	20	
CORRECTION FACTORS (temp)	1.165	1.18	1.18	
(sp. gr.)	.80	.66	.77	
(flow)	1.012	1.012	1.012	
(time)	.955	.955	.955	
OVERALL CORRECTION FACTOR	.900	.753	.878	
SAMPLE WT CYCLONE NO. 1	6.24	6.49	2.80	
NO. 2	7.02	7.12	4.25	
NO. 3	9.64	9.54	7.01	
NO. 4	7.30	7.33	7.08	
NO. 5	3.93	3.59	4.47	
% RETAINED CYCLONE NO. 1	12.48	15.68	6.91	
NO. 2	14.04	17.2	10.5	
NO. 3	19.28	23.0	17.3	
NO. 4	14.60	17.7	17.5	
NO. 5	7.86	8.67	11.0	
% PASSING CYCLONE NO. 1	87.5	84.3	93.1	
NO. 2	73.5	67.1	82.6	
NO. 3	54.2	44.1	65.3	
NO. 4	39.6	26.4	47.8	
NO. 5	31.7	17.8	36.8	
de CYCLONE NO. 1	40.3	33.7	39.3	
NO. 2	28.1	23.6	27.4	
NO. 3	19.5	16.3	19.1	
NO. 4	13.7	11.4	13.3	
NO. 5	10.7	9.0	10.4	

CALIBRATION DATA	REMARKS:
di CYCLONE NO. 1 = 44.7	P_{80} - Pb Conc = 30 µm
NO. 2 = 31.3	P_{80} - Zn Conc = 25 µm
NO. 3 = 21.7	P_{80} - Tails = 34 µm
NO. 4 = 15.2	
NO. 5 = 11.9	