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Postboks 3021, 7002 Trondheim

Rapportarkivet

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	LR 2570			

Tittel

An investigation of the recovery of gold from samples from Bindal
Progress report No.1

Forfatter	Dato	Bedrift
Williamson, P.	1982	Lakefield Research of Canada Ltd.

Kommune	Fylke	Bergdistrikt	1: 50 000 kartblad	1: 250 000 kartblad
Bindal	Nordland	Nordlandske	18251 18252	

Fagområde	Dokument type	Forekomster
Geokjemi		Bindal
Råstofftype	**Emneord**	
Malm/metall	Au	

Sammendrag

An Investigation of

THE RECOVERY OF GOLD

from samples

submitted by

A/S SULFIDMALM

Progress Report No. 1

Project No. L.R. 2570

Note:

This report refers to the samples as received.

LAKEFIELD RESEARCH OF CANADA LIMITED
Lakefield, Ontario
April 23, 1982

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

In a letter dated December 18, 1981, Mr. Frank Nixon of A/S Sulfidmalm requested metallurgical tests on two samples of a gold-arsenopyrite ore from a Falconbridge Nickel Mines property in Bindal, Norway.

LAKEFIELD RESEARCH OF CANADA LIMITED

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I N D E X

S U M M A R Y

1. Head Analysis

Representative samples were removed from C and F zone ore for analysis.

Element	C Zone	F Zone
Au (g/t)	39.1* (40.9)	7.77**(7.89)
Ag (g/t)	3.3	2.3
As (%)	7.71 (7.26)	10.9 (10.8)
Fe (%)	6.13	9.26
S (%)	3.39 (3.25)	5.05 (4.97)

* average of 32.9, 42.0, 42.4 g/t Au from three head samples

** average of 8.75, 4.97 and 9.60 g/t Au from three head samples

( ) average from testwork

XRF Semi-Quantitative Analysis

Element	C Zone	F Zone
Titanium	ND	T
Chromium	ND	FT
Manganese	T	FT
Iron	LM	M
Cobalt	ND	ND
Nickel	FT	FT
Copper	ND	FT
Zinc	FT	FT
Arsenic	MH	MH
Bismuth	ND	ND
Lead	ND	ND
Uranium	ND	ND
Thorium	ND	ND
Yttrium	FT	FT
Columbium	ND	ND
Molybdenum	ND	ND
Silver	ND	ND
Cadmium	ND	ND
Tin	ND	ND
Antimony	ND	ND

Code:

H - 10% plus

MH - 5-15%

M - 1-10%

LM - .5-5%

L - .1-1%

TL - .05-.5%

T - .01-.1%

FT - Less than .01%

ND - Not detected

Summary - Continued

2. Mineralogy

The mineralogy of the gold-arsenopyrite ores was described in a letter from Mr. Frank Nixon to Lakefield Research, dated December 18, 1981.

C Zone High grade gold mineralization was associated with arsenopyrite in quartz veins. Native gold was intergrown with masses of arsenopyrite grains and as free grains. A few gold inclusions were observed in arsenopyrite grains, which were strongly fractured.

F Zone The granite host rock was cut by arsenopyrite veins which were associated with chlorite alteration along fracture zones. The granite which had been strongly shattered consisted of coarse interlocking feldspars with lesser interstitial and fracture filling quartz. Very little visible gold was observed.

3. Gold Association

The gold association in both ores was determined by a sequential amalgamation and leaching procedure. Each ore was ground to approximately 50 and 80 percent minus 200 mesh. The ground pulp was amalgamated and cyanided to recover available gold. The cyanide residue was leached with HCl and cyanided to determine the gold associated with carbonates. The cyanide residue was leached with HCl and $SnCl_2$ and cyanided to determine the gold associated with iron and metal oxides. The cyanide residue was finally leached with aqua regia to determine the gold associated with sulphides. Gold in the residue from the aqua regia leach was associated with silicates.

The results are presented in Table No. 1. At a grind of about 80% minus 200 mesh a total of 94% of the gold in Sample C was available for recovery by amalgamation/cyanidation. Only 4% was associated with sulphides. At a similar grinding size on Sample F, a total of 88% of the gold was available for recovery by amalgamation/cyanidation. 10% of the gold was associated with sulphides.

Summary - Continued

3. Gold Association - Cont'd

At a coarser grind of about 50 % minus 200 mesh the amount of gold locked into a sulphide matrix increased to 17 % in Sample F.

Table No. 1 - Gold Association

Sample	Zone C		Zone F	
Grind % -200 mesh	46	77	47	82
Available by amalgamation	45	68	41	56
Available by cyanidation	42	26	39	32
Associated with carbonates	6	1	2	2
Associated with iron oxides etc.	1	<1	1	<1
Associated with sulphides	6	4	17	10
Associated with silicates	<1	1	<1	<1

4. Cyanidation

Cyanidation tests were conducted on both samples at three grinding sizes in bottle tests on rolls (1 g/L NaCN, 33 % solids, pH 10.5-11.5, 2 x 24 h). The results are presented in Table No. 2.

A total of 93 % of the gold in Sample C could be recovered by cyanidation at a primary grind of 70 % minus 200 mesh leaving a residue assaying 2.5 g/t Au. A finer grind to 98 % minus 200 mesh reduced the residue assay to 2.1 g/t Au.

A total of 80 % of the gold in Sample F could be recovered by cyanidation at a primary grind of 76 % minus 200 mesh leaving a residue assaying 1.6 g/t Au.

Summary - Continued

4. Cyanidation - Cont'd

Cyanide consumption ranged from 2.6 to 3.4 kg/t and reducing powers ranged from 200 to 260 mL 0.1 N $KMnO_4$/L pregnant solution.

Additional tests are being conducted to examine various methods of reducing the cyanide consumption.

Table No. 2 - Cyanidation of Ore

Test No.	Sample Zone	Grind % -200 mesh	Reagent Cons.		Gold Ext'n %	Residue Assay Au, g/t	Head Assay Au g/t	Reducing Power*	pH Range
			NaCN kg/t	CaO kg/t					
27	C	40	1.5	1.2	90	3.70	37.1	120	10.3-11.4
28	C	70	2.9	1.2	93	2.47	36.8	200	10.3-11.1
29	C	98	3.4	1.5	94	2.06	36.0	220	10.3-11.2
30	F	45	1.3	1.2	73	1.72	6.32	122	10.1-11.5
31	F	76	2.8	2.0	80	1.57	7.76	218	10.1-11.2
32	F	99	3.0	2.1	80	1.37	6.76	259	10.0-11.1

*mL 0.1 N $KMnO_4$/L pregnant solution

5. Flotation

Flotation tests were conducted on both samples at two grinding sizes (approximately 80 and 98 % minus 200 mesh).

Sample C: A primary grind of 80 % minus 200 mesh produced a flotation tailing which represented 75 % of the feed weight and assayed 1.5 g/t Au. The rougher concentrate assayed 170 g Au, 26 % As, and 12 % S at 98 % gold recovery.

Increasing the grinding fineness to 98 % minus 200 mesh did not significantly reduce gold losses in the flotation tailing.

Summary - Continued

5. Flotation - Cont'd

Cleaning tests reduced the concentrate weight by about 50 % with a loss of about 6 % of the gold. The cleaner concentrate from Test 9 represented 13 % of the feed weight and assayed 306 g/t Au, 41 % As, and 19 % S at 92 % gold recovery.

Sample F: A primary grind of 80 % minus 200 mesh produced a flotation tailing which represented 65 % of the feed weight and assayed 0.5 g/t Au. The rougher concentrate assayed 19 g/t Au, 28 % As, and 13 % S at 96 % gold recovery.

Increasing the grinding fineness did not reduce gold loss in the flotation tailing.

Cleaning tests reduced the concentrate weight by about 50 % with a loss of about 10 % of the gold in the cleaner tailings. The cleaner concentrate from Test 10 represente 19 % of the feed weight and assayed 32 g/t Au, 40 % As, and 19 % S at 86 % gold recovery.

The flotation test conditions and results are contained in Table No. 3. Gold grade versus recovery cleaning curves are illustrated in Figures 1 and 2.

Table No. 3 - Flotation Test Conditions and Results

Conditions

Test No.	Sample	Grind %-200 mesh	Rougher Flotation			Regrind min	Cleaner Flotation			Cleaner Feed % -200 mesh
			AX350 g/t	AP208 g/t	Time min.		Stages	AX350 g/t	AP208 g/t	
5	C Zone	77	40	40	12	-	-	-	-	-
9	C Zone	77	40	40	12	-	3	5	5	92
11	C Zone	77	40	40	12	10	3	15	15	99
13	C Zone	97	70	70	15	-	3	10	10	99
15*	C Zone	-	40	40	12	-	3	5	5	-
7	F Zone	82	40	40	12	-	-	-	-	-
10	F Zone	82	40	40	12	-	3	5	5	92
12	F Zone	82	40	40	12	15	3	20	20	99
14	F Zone	97	70	70	15	-	3	10	10	99
16*	F Zone	-	40	40	12	-	3	5	5	-

*10 kg charge for concentrate production

Table No. 3 - Flotation Test Conditions and Results - Cont'd

Results

Test No.	Cleaner Concentrate							Rougher Concentrate							Rougher Tailing						
	Wgt. %	Assay %,g/t			% Dist.			Wgt. %	Assay %,g/t			% Dist.			Wgt. %	Assay %,g/t			% Dist.		
		Au	As	S	Au	As	S		Au	As	S	Au	As	S		Au	As	S	Au	As	S
5	-	-	-	-	-	-	-	27.4	140	25.9	11.3	98	96	97	72.6	1.27	0.39	0.13	2	4	3
9	13.3	306	40.8	19.2	92	77	78	25.4	170	26.0	12.0	98	93	96	74.6	1.46	0.63	0.29	3	7	7
11	9.1	362	39.8	18.7	86	50	53	31.7	118	21.5	9.6	98	95	95	68.3	1.32	0.55	0.26	2	5	6
13	12.0	324	40.2	19.1	93	67	70	36.3	113	18.8	8.7	98	94	95	63.8	1.27	0.69	0.27	2	6	5
15	11.7	303	43.5	19.8	89	69	71	21.3	179	32.2	14.4	96	93	94	78.7	1.90	0.68	0.26	4	7	6
7	-	-	-	-	-	-	-	36.0	20.8	28.5	13.0	97	95	95	64.0	0.42	0.93	0.38	4	6	5
10	19.2	31.5	39.6	18.9	86	72	74	34.7	19.3	28.4	13.3	96	93	94	65.3	0.47	1.10	0.44	5	7	6
12	12.8	51.9	40.7	18.9	75	48	49	40.2	21.0	25.4	11.5	95	94	95	59.8	0.78	1.07	0.44	5	6	5
14	16.7	38.9	37.9	18.9	84	60	63	46.8	15.9	21.0	10.1	96	93	94	53.2	0.54	1.37	0.57	4	7	6
16	17.5	29.8	39.9	19.0	76	64	65	30.5	20.8	32.2	15.2	92	89	91	69.5	0.77	1.69	0.67	8	11	9

FIGURE No 1

ORE ZONE C GOLD GRADE VS RECOVERY

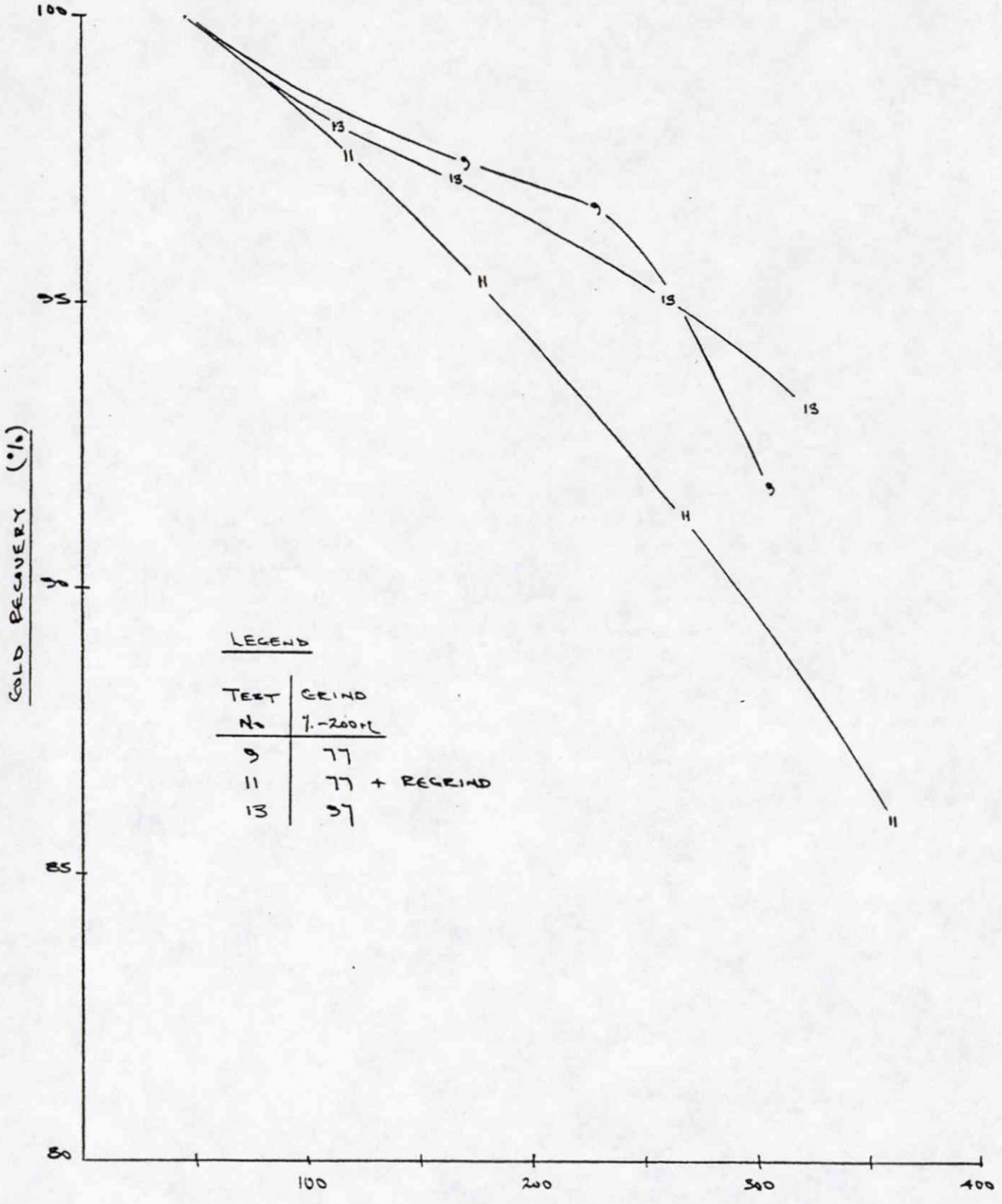
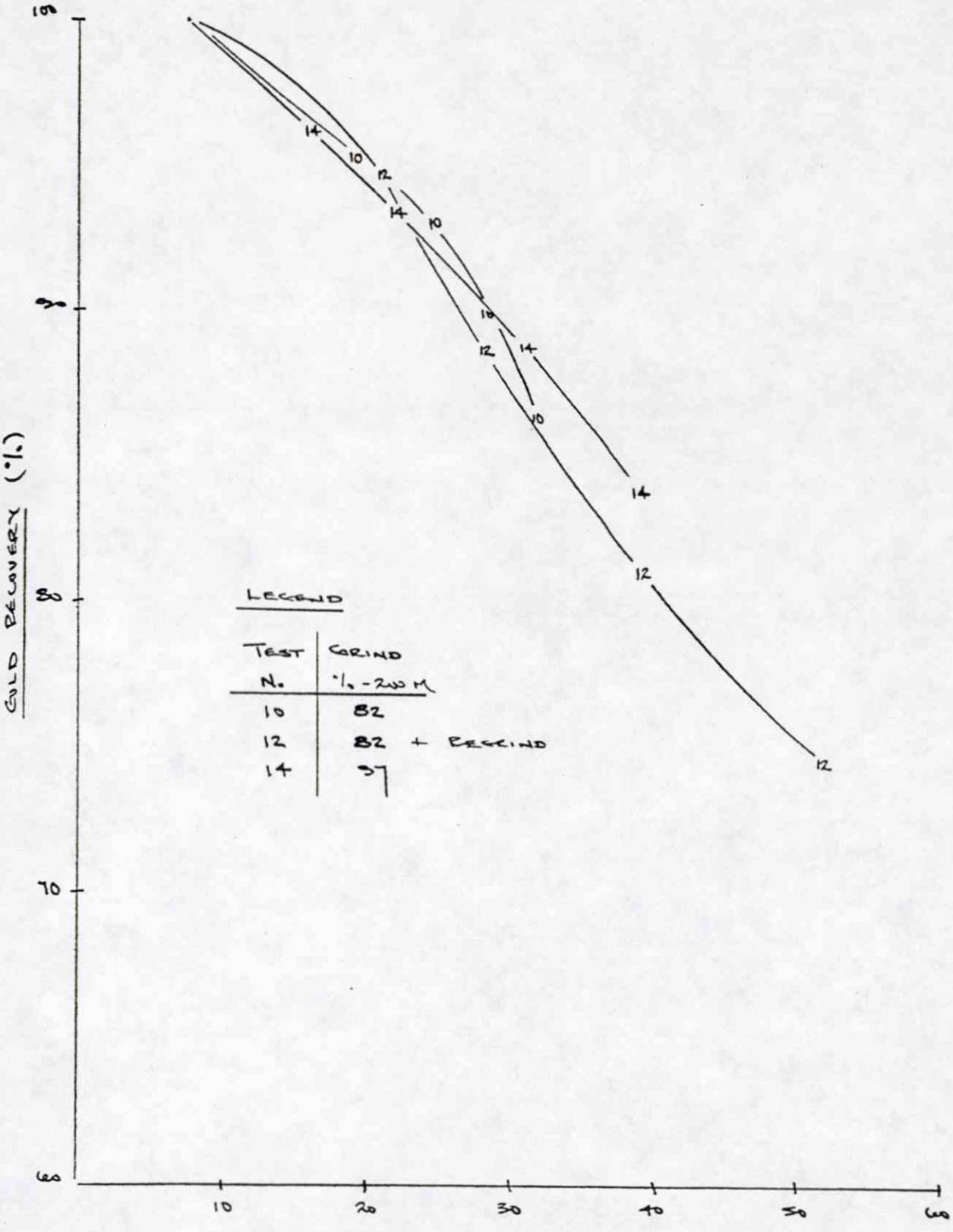


FIGURE No. 2

ORE ZONE F GOLD GRADE VS RECOVERY



Summary - Continued

6. Cyanidation of Flotation Products

Cyanidation tests were conducted on the cleaner concentrate, combined cleaner tailing, and rougher tailing from flotation tests on both samples C and F. The test conditions were 1 g/L NaCN, 33 % solids, pH 10.5-11.5, 2 x 24 h, in bottle test on rolls.

The results which are contained in Table No. 4 showed 85 % gold extraction from the cleaner concentrate, 90 % gold extraction from the rougher concentrate and 93 % overall gold extraction from Sample C.

Sample F produced 64 % gold extraction from the cleaner concentrate, 73 % gold extraction from the rougher concentrate and 76 % overall gold extraction.

Cyanide consumption was significantly lower than cyanide tests on both ground ores. This phenomenon will be examined in further tests.

Table No. 4 - Cyanidation of Flotation Products

Test No.	Sample Zone	Flotation Product	Reagent Cons.*		Gold Ext'n % Au		Residue Assay Au, g/t	Head Assay Au, g/t
			NaCN kg/t	CaO kg/t	Ind.	O'all		
17	C	Cleaner Conc.	0.07	0.07	96	85	13.2	303
19	C	Cleaner Tail.	0.09	0.14	76	5	6.2	29
6	C	Rougher Tail.	0.20	0.30	74	3	0.5	1.9
18	F	Cleaner Conc.	0.15	0.13	85	64	5.6	30
20	F	Cleaner Tail.	0.08	0.13	57	9	3.6	8.7
8	F	Rougher Tail.	0.20	0.30	42	3	0.4	0.8

*overall

Summary - Continued

7. Roasting and Cyanidation of Flotation Products

The cleaner concentrates and combined cleaner tailings from flotation tests on both Samples C and F were roasted in a muffle furnace in two stages at 575°C and 625°C to eliminate the arsenic and exfoliate the sulphides to expose the gold for recovery by cyanidation.

Efficient arsenic and sulphur elimination was achieved in the tests. Gold recovery from Sample C increased by 2 % from the cleaner concentrate and by 3 % from the rougher concentrate. This data confirmed the gold association testwork in Section 3 which showed approximately 4 % of the gold associated with sulphides.

Gold recovery from Sample F increased by 6 % from the cleaner concentrate and by 9 % from the rougher concentrate. This data also confirmed the gold association result in Section 3 which showed approximately 10 % gold association with sulphides at a primary grind of about 80 % minus 200 mesh.

The results are tabulated in Table No. 5.

Table No. 5 - Effect of Roasting in Cyanide Recovery

Test No.	Sample Zone	Flotation Product	Treatment	Reagent Cons.*		Gold Ext'n % Au		Residue Assay		
				NaCN kg/t	CaO kg/t	Ind.	O'all	Au g/t	As %	S %
17	C	Cleaner Conc.	As Rec'd	0.07	0.07	96	85	13.2	43.5	19.8
21	C	Cleaner Conc.	Roasted	0.10	0.19	97	87	15.0	1.1	<0.1
19	C	Cleaner Tail.	As Rec'd	0.09	0.14	76	5	6.2	18.4	7.7
23	C	Cleaner Tail.	Roasted	0.05	0.08	87	6	3.8	3.3	0.5
18	F	Cleaner Conc.	As Rec'd	0.15	0.13	85	64	5.6	39.9	19.0
22	F	Cleaner Conc.	Roasted	0.16	0.33	93	70	5.0	1.3	<0.1
20	F	Cleaner Tail.	As Rec'd	0.08	0.13	57	9	3.6	21.7	10.0
24	F	Cleaner Tail.	Roasted	0.16	0.25	70	12	3.3	3.3	0.2

*overall

R E C O M M E N D A T I O N S

Additional cyanidation tests are being conducted on Sample C to determine the cause and to examine methods of reducing cyanide consumption.

SAMPLE PREPARATION

On March 5, 1982, 2 drums of F Zone and 1 drum of C Zone gold-arsenopyrite ore were received from A/S Sulfidmalm.

The 2 drums of F Zone were combined, jaw and cone crushed to -10 mm and riffled to reject 3/4 to storage. The remaining 1/4 was roll crushed to -1.7 mm (10 mesh) and riffled into 15 x 2 kg and 1 x 10 kg test charges and a head sample for analysis. Three separate assay samples were prepared for gold analysis.

The drum of C Zone was jaw and cone crushed to -10 mm and riffled to reject 1/2 to storage. The remaining 1/2 was roll crushed to -1.7 mm (10 mesh) and riffled into 15 x 2 kg and 1 x 10 kg test charges and a head sample for analysis. Three separate assay samples were prepared for gold analysis.

Screen Analyses

Zone F - Head

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 10	0.8	0.8	99.2
14	15.3	16.1	83.9
20	15.5	31.6	68.4
28	14.1	45.7	54.3
35	10.7	56.4	43.6
48	9.5	65.9	34.1
65	7.1	73.0	27.0
100	5.8	78.8	21.2
150	5.1	83.9	16.1
200	3.9	87.8	12.2
270	3.3	91.1	8.9
400	2.4	93.5	6.5
- 400	6.5	100.0	-
Total	100.0	-	-

Sample Preparation - Continued

Screen Analyses - Cont'd

Zone C - Head

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 10	0.6	0.6	99.4
14	16.8	17.4	82.6
20	16.8	34.2	65.8
28	15.9	50.1	49.9
35	10.6	60.7	39.3
48	9.1	69.8	30.2
65	6.0	75.8	24.2
100	5.1	80.9	19.1
150	4.5	85.4	14.6
200	3.2	88.6	11.4
270	2.6	91.2	8.8
400	1.5	92.7	7.3
- 400	7.3	100.0	-
Total	100.0	-	-

I N V E N T O R Y

The following samples are on hand at Lakefield.

12 kg	-	10 mm C Zone
1 x 2 kg	-	1.7 mm (10 mesh) C Zone
100 kg	-	10 mm F Zone
3 x 2 kg	-	1.7 mm (10 mesh) F Zone
1 x 250 g	-	Cleaner Concentrate Test 15 C Zone
4 x 250 g	-	Cleaner Concentrate Test 16 F Zone
2 x 250 g	-	Combined Cleaner Tailing Test 16 F Zone

DETAILS OF TESTS

Test No. 1

Purpose: To determine the Au association of Zone C Sample.

Procedure:

A 2 kg -10 mesh sample was ground and filtered. Two 500 gram samples were cut as opposite 1/8 th's of the filter cake. One 500 gram sample was used as a head sample for screen analysis.
The second 500 gram sample was amalgamated with 10 g of mercury for one hour at pH 10.5 with NaOH. The mercury was recovered by elutriation.
The amalgamation residue was cyanided in a 2.5 litre bottle for 24 hours. The pH was maintained at 11.5 with $Ca(OH)_2$ and the solution strength maintained at 1.0 g/L NaCN.
The cyanide residue was filtered washed 3 times with water and dried. The solution and residue were sampled and analysed for Au and Ag.
A 100 gram sample was riffled from the cyanide leach residue for further leaching tests.
This sample was leached in 200 mL of concentrated HCl for one hour at 100°C (slight boil) to dissolve carbonate(s). The pulp was filtered and the residue was water washed 3 times. The solution was assayed for Au. The acid leached residue was repulped with 200 mL of water and cyanided at pH 11 with 20 g/L NaCN for 1h, filtered, and washed 3 times with water.
The cyanide solution was assayed for Au.
To determine the Au in association with iron oxides, the leach residue was leached for 1 h at 100°C (slight boil) in concentrated HCl with stannous chloride. The pulp was filtered and washed 3 times with water. The residue was cyanided at pH 11.0 in 200 mL of 20 g/L NaCN, for 1 h, filtered and washed 3 times with water.
The leach residue was leached for 1 h at 100°C in 200 mL of aqua regia. The pulp was filtered and washed. The aqua regia leach was repeated once to ensure complete dissolution of the sulphides. The pulp was filtered, washed and the solution and residue were assayed for Au.

Feed: 2000g minus 10 mesh Zone C ore.

Grind: 20 minutes at 66% solids in lab ball mill.

Conditions:

Amalgamation:	Feed	- 500 g ground ore
	% solids	- 33
	Time	- 1 h
	Mercury	- 10 g
Condition No. 1:	Feed	- 500 g amalgamation tailing
	% Solids	- 33
	Solution	- pH 10.5 - 11.5 adjusted with $Ca(OH)_2$
		- NaCN - 1 g/L

Test No. 1 - Continued

Reagent Balance

Time	Added, Grams				Residual		Consumed		pH	R.P.*
	Actual		Equivalent		Grams		Grams			
Hours	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
0-2	1.05	1.00	1.00	0.72	0.90	-	0.10	-	11.7	-
2-8	0.10	-	0.10	-	0.96	-	0.04	-	11.4	-
8-24	0.04	-	0.04	-	1.00	0.27	-	0.45	11.3	60
Total	1.19	1.00	1.14	0.72	1.00	0.27	0.14	0.45	-	-

Reagent Consumption (kg per metric ton of cyanide feed) NaCN: 0.28 CaO: 0.90

Final Solution Volumes: 2240 mL

*Reducing Power: mL 0.1 N $KMnO_4$/L pregnant solution

HCl Leach:
- Feed - NaCN No. 1 Leach Residue
- % Solids - 33
- Solution - Conc. HCl
- Temp. - 100°C
- Time - 1 h

Cyanidation No. 2:
- Feed - HCl Leach Residue
- % Solids - 33
- Solution - pH 11.0 adjusted with NaOH
- NaCN 20 g/L
- Time - 1 h

$HCl/SnCl_2$ Leach:
- Feed - NaCN No. 2 Leach Residue
- % Solids - 33
- Solution - 200 mL Conc. HCl
- 20 mL 5% $SnCl_2$
- Temp. - 100°C
- Time - 1 h
- Observations - No colour change with $SnCl_2$

Cyanidation No. 3:
- Feed - $HCl/SnCl_2$ Leach Residue
- % Solids - 33
- Solution - pH 11.0 adjusted with NaOH
- NaCN 20 g/L
- Time - 1 h

Aqua-Regia Leach:
- Feed - NaCN No. 3 Leach Residue
- % Solids - 33
- Solution - 160 mL HCl + 40 mL HNO_3
- Temp. - 100°C
- Time - 1 h
- Repeat - 1 time

Test No. 1 - Continued

Metallurgical Results

Amalgamation and Cyanidation No. 1

Product	Amount	Assays, mg/L, g/t		% Distribution	
		Au	Ag	Au	Ag
1. Hg Amalgam	10 g	-	-	44.6	-
2. 24 h Cyanide Solution	2240 mL	3.84	0.33	41.3	51.7
3. 24 h Cyanide Residue	490.4 g	5.97	1.40	14.1	48.3
Head (Calculated)	490.4 g	42.4	2.91	100.0	100.0

Overall Results

Product	Amount	Assays, mg/L, g/t	% Distribution
		Au	Ag
1. Amalgam	-	-	44.7
2. NaCN Leach No. 1	456.7 mL	3.84	41.4
3. HCl Leach Solution	480 mL	0.006	0.1
4. NaCN Leach No. 2	500 mL	0.49	5.8
5. HCl/$SnCl_2$ Leach	500 mL	0.002	0.0
6. NaCN Leach No. 3	510 mL	0.11	1.3
7. Aqua Regia	890 mL	0.30	6.3
8. Residue	70.0 g	0.22	0.4
Head (Calculated)	100.0 g	42.3	100.0

Screen Analysis - 20 Minutes/2 kg Zone C

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 35	0.3	0.3	99.7
48	2.1	2.4	97.6
65	7.3	9.7	90.3
100	14.2	23.9	76.1
150	16.8	40.7	59.3
200	13.7	54.4	45.6
270	10.9	65.3	34.7
400	7.7	73.0	27.0
- 400	27.0	100.0	-
Total	100.0	-	-

Test No. 2

Purpose: To determine the gold association of Zone F sample.

Procedure: As per test No. 1.

Feed: 2000 grams minus 10 mesh Zone F ore.

Grind: 20 minutes at 66% solids in lab ball mill.

Conditions: As per test No. 1

Reagent Balance - Cyanidation No. 1

Time	Added, Grams				Residual		Consumed		R.P.*
	Actual		Equivalent		Grams		Grams		
Hours	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO	
0-2	1.05	1.00	1.00	0.72	0.90	-	0.10	-	-
2-8	0.10	-	0.10	-	0.96	-	0.04	-	-
8-24	0.04	-	0.04	-	1.00	0.27	-	0.45	60
Total	1.19	1.00	1.14	0.72	1.00	0.27	0.14	0.45	-

Reagent Corsumption (kg per metric ton of cyanide feed) NaCN: 0.28 CaO: 0.90

Final Solution Volumes: 2120 mL

* Reducing Power: mL 0.1 N $KMnO_4$/L pregnant solution

Metallurgical Results

Amalgamation and Cyanidation No. 1

Product	Amount	Assays, g/t, mg/L		% Distribution	
		Au	Ag	Au	Ag
1. Hg Amalgam	10 g	-	-	40.2	-
2. 24 h Cyanide Solution	2120 mL	0.76	0.14	37.6	28.8
3. Residue	494.1 g	1.92	1.50	22.2	71.2
Head (Calculated)	494.1 g	8.66	2.10	100.0	100.0

Test No. 2 - Continued

Metallurgical Results - Cont'd

Overall Results

Product	Amount	Assays, g/t, mg/L	% Distribution
		Au	Au
1. Amalgam	-	-	41.1
2. NaCN Leach No. 1	429 mL	0.76	38.3
3. HCl Leach Solution	480 mL	0.003	0.1
4. NaCN Leach No. 2	470 mL	0.041	2.2
5. HCl/$SnCl_2$ Leach	550 mL	0.002	0.1
6. NaCN Leach No. 3	540 mL	0.02	1.3
7. Aqua Regia	920 mL	0.15	16.2
8. Residue	66.4 g	0.09	0.7
Head (Calculated)	100.0 g	8.52	100.0

Screen Analysis

20 minutes/2 kg Zone F

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 20	0.1	0.1	99.9
28	0.1	0.2	99.8
35	0.2	0.4	99.5
48	1.6	2.0	98.0
65	5.7	7.7	92.3
100	13.0	20.7	79.3
150	17.8	38.5	61.5
200	14.8	53.3	46.7
270	11.2	64.5	35.5
400	8.4	72.9	27.1
- 400	27.1	100.0	-
Total	100.0	-	-

Test No. 3

Purpose: To repeat test No. 1, but at a finer grind.

Procedure: As per test No. 1.

Feed: 2000 grams minus 10 mesh Zone C ore.

Grind: 40 minutes at 66% solids in lab ball mill.

Conditions: As per test No. 1.

Reagent Balance - Cyanidation No. 1

Time	Added, Grams				Residual		Consumed		pH	R.P
	Actual		Equivalent		Grams		Grams			
Hours	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
0-2	1.05	1.00	1.00	0.72	0.88	-	0.12	-	11.7	-
2-8	0.12	-	0.12	-	0.94	-	0.06	-	11.4	-
8-24	0.06	-	0.06	-	1.00	0.24	-	0.48	11.3	60
Total	1.23	1.00	1.18	0.72	1.00	0.24	0.18	0.48	-	-

Reagent Consumption (kg per metric ton of cyanide feed) NaCN: 0.36 CaO: 0.96

Final Solution Volumes: 2100 mL

*Reducing Power: mL 0.1 N $KMnO_4$/L pregnant solution

Test No. 3 - Continued

Metallurgical Results

Amalgamation & Cyanidation No. 1

Product	Amount	Assays, mg/L, g/t		% Distribution	
		Au	Ag	Au	Ag
1. Hg Amalgam	10 g	-	-	67.3	-
2. 24 h Cyanide Solution	2100 mL	3.25	0.29	25.4	48.4
3. Cyanide Residue	498.7 g	3.94	1.30	7.3	51.6
Head (Calculated)	498.7 g	53.9	2.53	100.0	100.0

Overall Results

Product	Amount	Assays, mg/L, g/t	% Distribution
		Au	Au
1. Amalgam	-	-	67.7
2. NaCN Leach No. 1	421 mL	3.25	25.6
3. HCl Leach Solution	470 mL	0.002	0.0
4. NaCN Leach No. 2	460 mL	0.16	1.4
5. HCl/$SnCl_2$ Leach	510 mL	<0.001	-
6. NaCN Leach No. 3	500 mL	0.04	0.4
7. Aqua Regia	880 mL	0.26	4.3
8. Residue	67.9 g	0.50	0.6
Head (Calculated)	100.0 g	53.5	100.0

Screen Analysis

40 minutes/2 kg Zone C

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	0.1	0.1	99.9
100	1.3	1.4	98.6
150	6.6	8.0	92.0
200	14.6	22.6	77.4
270	16.6	39.2	60.8
400	13.3	52.5	47.5
- 400	47.5	100.0	-
Total	100.0	-	-

Test No. 4

Purpose: To repeat test No. 2, but at a finer grind.

Procedure: As per test No. 1.

Feed: 2000 grams minus 10 mesh Zone F ore.

Grind: 40 minutes at 66% solids in lab ball mill.

Conditions: As per test No. 1.

Reagent Balance - Cyanidation No. 1

Time	Added, Grams				Residual		Consumed		R.P.*
	Actual		Equivalent		Grams		Grams		
Hours	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO	
0-2	1.05	1.00	1.00	0.72	0.88	-	0.12	-	-
2-8	0.12	-	0.12	-	0.91	-	0.09	-	-
8-24	0.09	-	0.09	-	1.00	0.30	-	0.42	60
Total	1.26	1.00	1.21	0.72	1.00	0.30	0.21	0.42	-

Reagent Consumption (kg per metric ton of cyanide feed) NaCN: 0.42 CaO: 0.84

Final Solution Volumes: 2060

* Reducing Power : mL 0.1 N $KMnO_4$/L of pregnant solution

Test No. 4 - Continued

Metallurgical Results

Amalgamation & Cyanidation No. 1

Product	Amount	Assays, mg/L, g/t		% Distribution	
		Au	Ag	Au	Ag
1. Amalgam	10 g	-	-	53.5	-
2. 24 h Cyanida Solution	2060 mL	0.71	0.13	30.0	25.4
3. Cyanide Residue	495.9 g	1.61	1.60	16.5	74.6
Head (Calculated)	495.9 g	9.80	2.1	100.0	100.0

Overall Results

Product	Amount	Assays, mg/L, g/t	% Distribution
		Au	Au
1. Amalgam	-	-	55.7
2. NaCN Leach No. 1	416 mL	0.71	31.6
3. HCl Leach Solution	440 mL	0.004	0.2
4. NaCN Leach No. 2	500 mL	0.027	1.5
5. $HCl/SnCl_2$ Leach	540 mL	<0.001	-
6. NaCN Leach No. 3	480 mL	0.012	0.6
7. Aqua Regia	940 mL	0.10	10.1
8. Residue	66.4 g	0.04	0.3
Head (Calculated)	100.0 g	9.34	100.0

Screen Analysis

40 minute Grind

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 65	0.1	0.1	99.9
100	0.8	0.9	99.1
150	4.8	5.7	94.3
200	11.9	17.6	82.4
270	17.4	35.0	65.0
400	14.6	49.6	50.4
- 400	50.4	100.0	-
Total	100.0	-	-

Test No. 5

Purpose: To examine the flotation response of C Zone ore.

Procedure: As below.

Feed: 2 kg minus 10 mesh C Zone

Grind: 40 minutes at 66% solids in ball mill.

Conditions:

Stage	Reagents Added, g/tonne			Time, minutes			pH
	AX350	AF208	DF250	Grind	Cond.	Froth	
Grind	-	-	-	40	-	-	-
Rougher 1	20	20	10	-	2	4	7.8
Rougher 2	10	10	5	-	1	4	-
Rougher 3	10	10	5	-	1	4	-

Stage	Rougher
Flotation Cell	1000 g D-1
Speed: r.p.m.	1800
% Solids	33

Observations:

The ground sample appeared liberated.
The arsenopyrite floated very well.
Strong first stage flotation.
The second and third stages floated coarse arsenopyrite and some middlings.

Test No. 5 - Continued

Metallurgical Results

Product	Weight	Assays, %, g/tonne			% Distribution		
	%	Au	As	S	Au	As	S
1. Rougher Conc. 1	19.61	189.27	32.3	14.2	94.4	85.9	87.4
2. Rougher Conc. 2	4.31	22.30	12.8	5.25	2.4	7.5	7.1
3. Rougher Conc. 3	3.44	8.99	5.94	2.32	0.8	2.8	2.5
4. Rougher Tailing	72.64	1.27	0.39	0.13	2.3	3.8	3.0
Head (Calculated)	100.00	39.31	7.37	3.18	100.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 & 2	23.92	159.2	28.8	15.6	96.8	93.4	94.5
Products 1 to 3	27.36	140.3	25.9	11.3	97.6	96.2	97.0

Test No. 6

Purpose: To cyanide the flotation tailing from test No. 5.

Procedure: The sample was pulped with water in a two litre bottle. NaCN and lime were added and the cyanidation was carried out on rolls in 1 x 24 hour stage. The pulp was filtered and the residue washed three times with water.

Feed: 500 g flotation tailing from test No. 5.

Solution Volume: 1000 mL Pulp Density 33% solids

Solution Composition: 1.0 g/L NaCN

pH Range: 10.5 - 11.5 with $Ca(OH)_2$

Grind: Nil

Reagent Balance

Time	Added, Grams				Residual		Consumed		pH		R.P.*
	Actual		Equivalent		Grams		Grams				
Hours	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO			
0-2	1.0	0.17	0.95	0.13	0.84	-	0.11	-	10.9	10.4	-
2-7	0.12	0.07	0.11	0.05	0.95	0.02	0	0.16	10.9	10.7	-
7-24	-	0.05	-	0.04	0.93	0.03	0.02	0.03	11.0	10.6	22.4
Total	1.12	0.29	1.06	0.22	0.93	0.03	0.13	0.19	-	-	-

Reagent Consumption (kg/t of cyanide feed) NaCN: 0.26 CaO: 0.38

* Reducing Power: mL 0.1 N $KMnO_4$/L pregnant solution

Metallurgical Results

Product	Amount	Assays, mg/L, g/t	% Distribution
		Au	Au
1. Solution	2210 mL	0.22	74.2
2. Residue	497.2 g	0.34	25.8
Head (Calc.)	497.2 g	1.32	100.0

Comments: Efficient recovery of gold from rougher tailing.

Test No. 7

Purpose: To repeat test No. 5 on F Zone ore.

Procedure: As below.

Feed: 2 kg minus 10 mesh F Zone.

Grind: 40 minutes at 66% solids in ball mill.

Conditions:

Stage	Reagents Added, g/tonne			Time, minutes	
	AX350	AF208	DF250	Cond.	Froth
Grind	-	-	-	-	-
Rougher 1	20	20	10	2	4
Rougher 2	10	10	5	1	4
Rougher 3	10	10	5	1	4

Stage	Rougher
Flotation Cell	1000 g D-1
Speed: r.p.m.	1800
% Solids	33

Observations:

Sample appeared high grade arsenopyrite.
Some arsenopyrite present as pepper inclusions in silicates. These particles remained in the flotation tailing.

Metallurgical Results

Product	Weight	Assays, %, g/tonne			% Distribution		
	%	Au	As	S	Au	As	S
1. Rougher Conc. 1	22.40	30.53	35.8	16.5	88.1	73.9	75.3
2. Rougher Conc. 2	9.39	5.76	20.3	8.79	7.0	17.6	16.8
3. Rougher Conc. 3	4.18	2.74	7.82	3.45	1.5	3.0	2.9
4. Rougher Tailing	64.03	0.42	0.93	0.38	3.5	5.5	5.0
Head (Calculated)	100.00	7.76	10.8	4.91	100.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 & 2	31.79	23.21	31.3	14.22	95.1	91.5	92.1
Products 1 to 3	35.97	20.83	28.5	12.97	96.6	94.5	95.0

Test No. 8

Purpose: To cyanide the flotation tailing from test No. 7.

Procedure: The sample was pulped with water in a two litre bottle. NaCN and lime were added and the cyanidation was carried out on rolls in 1 - 24 hour stage. The pulp was filtered and the residue washed three times with water.

Feed: 500 g flotation tailing from test No. 7.

Solution Volume: 1000 mL Pulp Density 33% solids

Solution Composition: 1.0 g/L NaCN

pH Range: 10.5 - 11.5 with $Ca(OH)_2$

Reagent Balance:

Time	Added, Grams				Residual		Consumed		pH		R.P.*
	Actual		Equivalent		Grams		Grams				
Hours	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO			
0-2	1.0	0.20	0.95	0.15	0.83	-	0.12	-	11.2	10.3	-
2-5	0.13	0.08	0.12	0.06	0.92	0.02	0.03	0.19	10.9	10.6	-
5-24	0.03	0.07	0.03	0.05	0.93	0.03	0.02	0.04	11.0	10.5	32.4
Total	1.16	0.35	1.10	0.26	0.93	0.03	0.17	0.23	-	-	-

Reagent Consumption (kg/t of cyanide feed) NaCN: 0.34 CaO: 0.46

*Reducing Power: mL 0.1 N $KMnO_4$/L pregnant solution

Metallurgical Results

Product	Amount	Assays, mg/L, g/t	% Distribution
		Au	Au
1. Solution	2130 mL	0.041	42.2
2. Residue	496.7 g	0.24	57.8
Head (Calc.)	496.7 g	0.41	100.0

Test No. 9

Purpose: To examine the cleaning characteristics of ore sample C.

Procedure: As below.

Feed: 2 kg minus 10 mesh ore sample Zone C.

Grind: 40 minutes at 66% solids in lab ball mill.

Conditions:

Stage	Reagents Added, g/t			Time, minutes		
	AX350	AF208	DF250	Grind	Cond.	Froth
Grind	-	-	-	40	-	-
Rougher 1	20	20	10	-	2	4
Rougher 2	10	10	5	-	1	4
Rougher 3	10	10	5	-	1	4
1st Cleaner	-	-	-	-	1	5
	5	5	-	-	1	2
2nd Cleaner	-	-	-	-	1	5
3rd Cleaner	-	-	-	-	1	4

Stage	Rougher	Cleaner
Flotation Cell	1000 g D-1	500 g D-1
Speed: r.p.m.	1800	1200
% Solids	33	

Observations:

Rougher - as per test No. 5
- some sulphides present as small attachments on large gangue particles

Cleaners - most of the arsenopyrite floated rapidly. The first cleaner required additional collector to float large sulphide particles and sulphide middlings.
- water cleaning was used in later stages
- 2nd & 3rd cleaner tailings contained middlings and large arsenopyrite grains
- all cleaner tailings appeared high in slimes

Test No. 9 - Continued

Metallurgical Results

Product	Weight	Assays, %, g/tonne			% Distribution		
	%	Au	As	S	Au	As	S
1. Cleaner Concentrate	13.27	306.30	40.8	19.2	91.8	76.5	77.8
2. 3rd Cleaner Tailing	1.87	41.43	22.6	10.6	1.8	6.0	6.1
3. 2nd Cleaner Tailing	3.63	38.42	13.6	5.39	3.1	7.0	6.0
4. 1st Cleaner Tailing	6.65	5.63	4.18	1.74	0.8	3.9	3.5
5. Rougher Tailing	74.58	1.46	0.63	0.29	2.5	6.6	6.6
Head (Calculated)	100.00	44.28	7.06	3.27	100.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 & 2	15.14	273.59	38.55	18.14	93.6	82.5	83.9
Products 1 to 3	18.77	228.11	33.73	15.67	96.7	89.5	89.9
Products 1 to 4	25.42	169.91	26.00	12.03	97.5	93.4	93.4
Products 2 to 4	12.15	20.94	9.83	4.19	5.7	16.9	15.6

Screen Analysis

Combined Cleaner Products

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 100	0.1	0.1	99.9
150	1.6	1.7	98.3
200	6.6	8.3	91.7
270	13.5	21.8	78.2
400	14.9	36.7	63.3
- 400	63.3	100.0	-
Total	100.0	-	-

Test No. 10

Purpose: To examine the cleaning characteristics of ore sample F.

Procedure: As below.

Feed: 2 kg minus 10 mesh ore sample Zone F.

Grind: 40 minutes at 66% solids in lab ball mill.

Conditions:

Stage	Reagents Added, g/tonne			Time, minutes		
	AX350	AF208	DF250	Grind	Cond.	Froth
Grind	-	-	-	40	-	-
Rougher 1	20	20	10	-	2	4
Rougher 2	10	10	5	-	1	4
Rougher 3	10	10	5	-	1	4
1st Cleaner	-	-	-	-	1	5
..	5	5	-	-	1	2
2nd Cleaner	-	-	-	-	1	5
3rd Cleaner	-	-	-	-	1	4

Stage	Rougher		Cleaner	
Flotation Cell	1000 g	D-1	500 g	D-1
Speed: r.p.m.	1800		1200	
% Solids	33			

Observations:

Flotation appeared as per test No. 9.
The silica & sulphide middlings present during cleaning consisted of smaller sulphide inclusions.

Test No. 10 - Continued

Metallurgical Results

Product	Weight	Assays, %, g/tonne			% Distribution		
	%	Au	As	S	Au	As	S
1. Cleaner Concentrate	19.20	31.56	39.6	18.9	86.3	72.0	73.9
2. 3rd Cleaner Tailing	3.14	8.58	28.0	12.8	3.8	8.3	8.2
3. 2nd Cleaner Tailing	4.45	4.80	17.8	7.71	3.0	7.5	7.0
4. 1st Cleaner Tailing	7.94	2.20	7.20	3.18	2.5	5.4	5.1
5. Rougher Tailing	65.27	0.47	1.10	0.44	4.4	6.8	[illegible]
Head (Calculated)	100.00	7.02	10.6	4.91	100.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 & 2	22.34	28.33	38.0	18.04	90.1	80.3	82.1
Products 1 to 3	26.79	24.42	34.6	16.33	93.1	87.8	89.1
Products 1 to 4	34.73	19.34	28.4	13.32	95.6	93.2	94.2
Products 2 to 4	15.53	4.24	14.4	6.42	9.3	21.2	20.3

Screen Analysis

Combined Cleaner Products

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 100	0.1	0.1	99.9
150	1.4	1.5	98.5
200	6.3	7.8	92.2
270	14.8	22.6	77.4
400	16.4	39.0	61.0
- 400	61.0	100.0	-
Total	100.0	-	-

Test No. 11

Purpose: To determine the effect of regrinding the rougher concentrate before cleaning.

Procedure: As below.

Feed: 2 kg minus 10 mesh ore sample Zone C.

Grind: 40 minutes at 66% solids in lab ball mill.

Conditions:

Stage	Reagents Added, g/tonne			Time, minutes		
	AX350	AF208	DF250	Grind	Cond.	Froth
Grind	-	-	-	40	-	-
Rougher 1	20	20	10	-	2	4
Rougher 2	10	10	5	-	1	4
Rougher 3	10	10	5	-	1	4
Regrind	-	-	-	10	-	-
1st Cleaner	5	5	5	-	1	3
	5	5	5	-	1	3
	5	5	5	-	1	3
2nd Cleaner	-	-	-	-	1	5
3rd Cleaner	-	-	-	-	1	4

Stage	Regrind
Flotation Cell	Ball Mill

Test No. 11 - Continued

Metallurgical Results

Product	Weight	Assays, %, g/tonne			% Distribution		
	%	Au	As	S	Au	As	S
1. Cleaner Concentrate	9.09	361.52	39.8	18.7	86.0	50.3	52.8
2. 3rd Cleaner Tailing	3.93	51.58	26.5	11.8	5.3	14.5	14.4
3. 2nd Cleaner Tailing	7.59	20.72	16.4	6.74	4.1	17.3	15.9
4. 1st Cleaner Tailing	11.07	7.55	8.25	3.33	2.2	12.7	11.[illegible]
5. Rougher Tailing	68.32	1.32	0.55	0.26	2.4	5.2	5.5
Head (Calculated)	100.00	38.2	7.19	3.22	100.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 & 2	13.02	267.97	35.8	16.61	91.3	64.8	67.2
Products 1 to 3	20.61	176.91	28.6	12.98	95.4	82.1	83.1
Products 1 to 4	31.68	117.73	21.5	9.61	97.6	94.8	94.5
Products 2 to 4	22.59	19.63	14.2	5.95	11.6	44.5	41.7

Screen Analysis

Combined Cleaner Products

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 150	0.1	0.1	99.9
200	0.8	0.9	99.1
270	3.5	4.4	95.6
400	7.1	11.5	88.5
- 400	88.5	100.0	-
Total	100.0	-	-

Test No. 12

Purpose: To examine the effect of regrinding sample F before cleaning.

Procedure: As below.

Feed: 2 kg minus 10 mesh ore sample Zone F.

Grind: 40 minutes at 66% solids in lab ball mill.

Conditions:

Stage	Reagents Added, grams/tonne			Time, minutes			pH
	AX350	AF208	DF250	Grind	Cond.	Froth	
Grind	-	-	-	40	-	-	-
	-	-	-	-	-	-	7.9
Rougher 1	20	20	10	-	2	4	-
Rougher 2	10	10	5	-	1	4	-
Rougher 3	10	10	5	-	1	4	-
Regrind	-	-	-	15	-	-	-
1st Cleaner	10	10	5	-	1	5	-
	10	10	5	-	1	5	-
2nd Cleaner	-	-	-	-	1	5	-
3rd Cleaner	-	-	-	-	1	4	-

Observations:

Roughing appeared normal
1st cleaner tailing high in silicates with small sulphide inclusions.
3rd cleaner tailing contained concentrate free arsenopyrite.

Test No. 12 - Continued

Metallurgical Results

Product	Weight	Assays, %, g/tonne			% Distribution		
	%	Au	As	S	Au	As	S
1. Cleaner Concentrate	12.82	51.86	40.7	18.9	74.5	48.0	49.4
2. 3rd Cleaner Tailing	5.73	10.29	30.7	14.1	6.6	16.2	16.5
3. 2nd Cleaner Tailing	9.63	7.07	19.9	8.80	7.6	17.6	17.3
4. 1st Cleaner Tailing	12.03	4.53	11.1	4.70	6.1	12.3	11.5
5. Rougher Tailing	59.79	0.78	1.07	0.44	5.2	5.9	5.3
Head (Calculated)	100.00	8.93	10.9	4.91	100.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 & 2	18.55	39.0	37.6	17.4	81.1	64.2	65.9
Products 1 to 3	28.18	28.1	31.6	14.5	88.7	81.8	83.2
Products 1 to 4	40.21	21.0	25.4	11.5	94.8	94.1	94.7
Products 2 to 4	27.39	6.63	18.3	8.11	20.3	46.1	45.3

Screen Analysis

Combined Cleaner Products

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 150	0.1	0.1	99.9
200	0.7	0.8	99.2
270	3.0	3.8	96.2
400	7.7	11.5	88.5
- 400	88.5	100.0	-
Total	100.0	-	-

Test No. 13

Purpose: To repeat test No. 9, but increase primary grind.

Procedure: As below.

Feed: 2 kg minus 10 mesh ore sample Zone C.

Grind: 60 minutes at 66% solids.

Conditions:

Stage	Reagents Added, g/tonne			Time, minutes			pH
	AX350	AF208	DF250	Grind	Cond.	Froth	
Grind	-	-	-	60	-	-	-
Rougher 1	20	20	10	-	2	5	7.8
Rougher 2	15	15	5	-	1	5	-
Rougher 3	15	15	5	-	1	5	-
1st Cleaner	-	-	-	-	1	5	-
	10	10	5	-	1	5	-
2nd Cleaner	-	-	-	-	1	5	-
3rd Cleaner	-	-	-	-	1	4	-

Test No. 13 - Continued

Metallurgical Results

Product	Weight	Assays, %, g/tonne			% Distribution		
	%	Au	As	S	Au	As	S
1. Cleaner Concentrate	12.03	324.07	40.2	19.1	93.2	66.6	69.5
2. 3rd Cleaner Tailing	3.30	23.32	20.5	9.33	1.9	9.3	9.3
3. 2nd Cleaner Tailing	9.43	9.33	10.3	4.43	2.1	13.4	12.6
4. 1st Cleaner Tailing	11.49	3.22	2.95	0.99	0.9	4.7	3.
5. Rougher Tailing	63.75	1.27	0.69	0.27	1.9	6.0	5.2
Head (Calculated)	100.00	41.8	7.26	3.31	100.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 & 2	15.33	259.33	36.0	17.0	95.1	75.9	78.8
Products 1 to 3	24.76	164.12	26.2	12.2	97.2	89.3	91.4
Products 1 to 4	36.25	113.12	18.8	8.65	98.1	94.0	94.8
Products 2 to 4	24.22	8.34	8.20	3.47	4.9	27.4	25.3

Screen Analyses

Rougher Tailing

Mesh Size (Tyler)	% Retained		% Passing Cumulative
	Individual	Cumulative	
+ 100	0.1	0.1	99.9
150	0.7	0.8	99.2
200	3.9	4.7	95.3
270	12.8	17.5	82.5
400	17.4	34.9	65.1
- 400	65.1	100.0	-
Total	100.0	-	-

Combined Cleaner Products

+ 150	0.1	0.1	99.9
200	1.3	1.4	98.6
270	4.8	6.2	93.8
400	8.8	15.0	85.0
- 400	85.0	100.0	-
Total	100.0	-	-

Test No. 13 - Continued

Screen Analysis of Ground Product

Product	Weight	Cumulative, % Passing				
	%	100	150	200	270	400
Combined Cleaner Product	36.3	100.0	99.9	98.6	93.8	85.0
Rougher Tailing	63.7	99.9	99.2	95.3	82.5	65.1
Head (Calculated)	100.0	99.9	99.5	96.5	86.6	72.4

Test No. 14

Purpose: To repeat test No. 10, but increase grinding time.

Procedure: As below.

Feed: 2 kg minus 10 mesh ore sample Zone F.

Grind: 60 minutes at 66% solids.

Conditions:

Stage	Reagents Added, g/tonne			Time, minutes		
	AX350	AF208	DF250	Grind	Cond.	Froth
Grind	-	-	-	60	-	-
Rougher 1	20	20	10	-	2	5
Rougher 2	15	15	5	-	1	5
Rougher 3	15	15	5	-	1	5
1st Cleaner	-	-	-	-	1	5
	10	10	5	-	1	5
2nd Cleaner	-	-	-	-	1	5
3rd Cleaner	-	-	-	-	1	4

Metallurgical Results

Product	Weight	Assays, %, g/t			% Distribution		
	%	Au	As	S	Au	As	S
1. Cleaner Concentrate	16.67	38.9	37.9	18.9	83.8	59.7	62.6
2. 3rd Cleaner Tailing	5.66	6.86	23.9	10.9	5.0	12.8	12.3
3. 2nd Cleaner Tailing	10.01	3.63	14.4	6.46	4.7	13.6	12.9
4. 1st Cleaner Tailing	14.48	1.47	5.09	2.22	2.8	7.0	6.2
5. Rougher Tailing	53.18	0.54	1.37	0.57	3.7	6.9	6.0
Head (Calculated)	100.00	7.74	10.6	5.03	100.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 & 2	22.33	30.78	34.4	16.9	88.8	72.5	74.9
Products 1 to 3	32.34	22.38	28.2	13.6	93.5	86.1	87.8
Products 1 to 4	46.82	15.91	21.0	10.1	96.3	93.1	94.0
Products 2 to 4	30.15	3.20	11.7	5.26	12.5	33.4	31.4

Test No. 14 - Continued

Screen Analyses

Rougher Tailing

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 65	0.1	0.1	99.9
100	0.1	0.2	99.8
150	0.5	0.7	99.3
200	3.3	4.0	96.0
270	11.3	15.3	84.7
400	17.4	32.7	67.3
- 400	67.3	100.0	-
Total	100.0	-	-

Combined Cleaner Products

+ 150	0.1	0.1	99.9
200	0.9	1.0	99.0
270	4.7	5.7	94.3
400	10.4	16.1	83.9
- 400	83.9	100.0	-
Total	100.0	-	-

Screen Analysis of Ground Product

Product	Weight	Cumulative, % Passing				
	%	100	150	200	270	400
Combined Cleaner Product	46.8	100.0	99.9	99.0	94.3	83.9
Rougher Tailing	53.2	99.8	99.3	96.0	84.7	67.3
Head (Calculated)	100.0	99.9	99.5	97.4	89.2	75.1

Test No. 15

Purpose: To repeat test No. 9, but using a 10 kg charge.

Procedure: As below.

Feed: 10 kg of minus 10 mesh ore sample Zone C.

Grind: 40 minutes at 66% solids in the large ball mill.

Conditions:

Stage	Reagents Added, g/tonne			Time, minutes		
	AX350	AF206	DF250	Grind	Cond.	Froth
Grind	-	-	-	40	-	-
Rougher 1	20	20	10	-	2	4
Rougher 2	10	10	5	-	1	4
Rougher 3	10	10	5	-	1	4
1st Cleaner	-	-	-	-	1	5
	-	5	5	-	1	2
2nd Cleaner	-	-	-	-	1	5
3rd Cleaner	-	-	-	-	1	4

Stage	Rougher	Cleaners
Flotation Cell	Agitair	1000 g D-1
Speed: r.p.m.		1800

Test No. 15 - Continued

Metallurgical Results

Product	Weight	Assays, %, g/tonne			% Distribution		
	%	Au	As	S	Au	As	S
1. Cleaner Concentrate	11.72	302.59	43.5	19.8	89.4	68.9	71.1
2. 3rd Cleaner Tailing	1.34	72.24	34.2	15.6	2.4	6.2	6.4
3. 2nd Cleaner Tailing	3.23	38.00	28.6	11.4	3.1	12.5	11.3
4. 1st Cleaner Tailing	4.99	10.70	7.62	3.25	1.3	5.2	4.9
5. Rougher Tailing	78.72	1.90	0.68	0.26	3.8	7.2	6.3
Head (Calculated)	100.00	39.7	7.40	3.27	100.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 & 2	13.06	278.95	42.5	19.4	91.8	75.1	77.5
Products 1 to 3	16.29	231.18	39.8	17.8	94.9	87.6	88.8
Products 1 to 4	21.28	179.48	32.2	14.4	96.2	92.8	93.7
Products 2 to 4	9.56	28.55	18.4	7.73	6.8	23.9	22.6

Test No. 16

Purpose: To repeat test No. 15, but on sample F.

Procedure: As below.

Feed: 10 kg of minus 10 mesh ore sample Zone F.

Grind: 40 minutes at 66% solids in the large ball mill.

Conditions:

Stage	Reagents Added, g/tonne			Time, minutes		
	AX350	AF208	DF250	Grind	Cond.	Froth
Grind	-	-	-	40	-	-
Rougher 1	20	20	10	-	1	4
Rougher 2	10	10	5	-	1	4
Rougher 3	10	10	5	-	1	4
1st Cleaner	-	-	-	-	1	5
	-	5	5	-	1	2
2nd Cleaner	-	-	-	-	1	5
3rd Cleaner	-	-	-	-	1	4

Stage	Rougher	Cleaners
Flotation Cell	Agitair	1000 g D-1
Speed: r.p.m.		1800

Test No. 16 - Continued

Metallurgical Results

Product	Weight	Assays, %, g/tonne			% Distribution		
	%	Au	As	S	Au	As	S
1. Cleaner Concentrate	17.50	29.77	39.9	19.0	75.8	63.6	65.4
2. 3rd Cleaner Tailing	3.30	18.32	33.6	15.8	8.8	10.1	10.3
3. 2nd Cleaner Tailing	4.67	7.48	26.0	11.9	5.1	11.1	10.9
4. 1st Cleaner Tailing	4.99	3.50	9.87	4.33	2.5	4.5	4.2
5. Rougher Tailing	69.54	0.77	1.69	0.67	7.8	10.7	9.2
Head (Calculated)	100.00	6.87	11.0	5.08	100.0	100.0	100.0

Calculated Grades and Recoveries

Products 1 & 2	20.80	27.95	38.9	18.5	84.6	73.7	75.7
Products 1 to 3	25.47	24.20	36.5	17.3	89.7	84.8	86.6
Products 1 to 4	30.46	20.81	32.2	15.2	92.2	89.3	90.8
Products 2 to 4	12.96	8.71	21.7	9.98	16.4	25.7	25.4

Test No. 17

Purpose: To perform a standard cyanidation test on the cleaner concentrate from flotation test No. 15.

Procedure: The sample was pulped with water in a two litre bottle. NaCN and lime were added and the cyanidation was carried out on rolls in 1 x 24 hour stage.

Feed: 250 g of cleaner concentrate from test No. 15.

Solution Volume: 500 mL Pulp Density 33% solids

Solution Composition: 1.0 g/L NaCN

pH Range: 10.5 - 11.5 with $Ca(OH)_2$

Reagent Balance:

Time	Added, Grams				Residual		Consumed		pH	
	Actual		Equivalent		Grams		Grams			
Hours	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
0-3	0.53	0.25	0.50	0.19	0.40	0.05	0.10	0.14	11.6	11.5
3-8	0.11	0	0.10	0	0.48	0.05	0.02	0	11.5	11.5
8-24	0.02	0	0.02	0	0.48	0.04	0.02	0.01	11.5	11.2
Total	0.66	0.25	0.62	0.19	0.48	0.04	0.14	0.15	-	-

Reagent Consumption (kg/t of cyanide feed) NaCN: 0.56 CaO: 0.60

Metallurgical Results

Product	Amount	Assays, mg/L, g/t	% Distribution
		Au	Au
Solution	1350 mL	52.8	95.6
Residue	247.2 g	13.17	4.4
Head (Calc.)	247.2 g	301.54	100.0

Test No. 18

Purpose: To perform a standard cyanidation test on the cleaner concentrate from flotation test No. 16.

Procedure: The sample was pulped with water in a two litre bottle. NaCN and lime were added and the cyanidation was carried out on rolls in one 24 hour stage.

Feed: 250 g of cleaner concentrate from test No. 16.

Solution Volume: 500 mL Pulp Density 33% solids

Solution Composition: 1.0 g/L NaCN

pH Range : 10.5 - 11.5 with $Ca(OH)_2$

Reagent Balance:

Time	Added, Grams				Residual		Consumed		pH	
	Actual		Equivalent		Grams		Grams			
Hours	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
0-3	0.53	0.25	0.50	0.19	0.43	0.04	0.07	0.15	11.5	11.3
3-8	0.07	0	0.07	0	0.46	0.03	0.04	0.01	11.3	11.1
8-24	0.04	0	0.04	0	0.40	0.01	0.10	0.02	11.1	10.6
Total	0.64	0.25	0.61	0.19	0.40	0.01	0.21	0.18	-	-

Reagent Consumption (kg/t of cyanide feed) NaCN: 0.84 CaO: 0.72

Metallurgical Results

Product	Amount	Assays, mg/L, g/t	% Distribution
		Au	Au
Solution	1290 mL	6.15	85.0
Residue	248.0 g	5.63	15.0
Head (Calc.)	248.0 g	37.62	100.0

Test No. 19

Purpose: To perform a standard cyanidation test on the combined cleaner tailings from flotation test No. 15.

Procedure: The sample was pulped with water in a two litre bottle. NaCN and lime were added and the cyanidation was carried out on rolls in one 24 hour stage.

Feed: 250 g of combined cleaner tailings test No. 15.

Solution Volume: 500 mL Pulp Density 33% solids

Solution Composition: 1.0 g/L NaCN

pH Range: 10.5 - 11.5 with $Ca(OH)_2$

Reagent Balance:

Time	Added, Grams				Residual		Consumed		pH	
	Actual		Equivalent		Grams		Grams			
Hours	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
0-3	0.53	0.20	0.50	0.15	0.33	0	0.17	0.15	11.4	10.0
3-8	0.18	0.15	0.17	0.11	0.45	0	0.05	0.11	11.2	10.6
8-24	0.05	0.15	0.05	0.11	0.48	0.01	0.02	0.10	11.4	10.6
Total	0.76	0.50	0.72	0.37	0.48	0.01	0.24	0.36	-	-

Reagent Consumption (kg/t of cyanide feed) NaCN: 0.96 CaO: 1.44

Metallurgical Results

Product	Amount	Assays, mg/L, g/t	% Distribution
		Au	Au
Solution	1350 mL	3.54	75.8
Residue	248.5 g	6.17	24.2
Head (Calc.)	248.5 g	25.39	100.0

Test No. 20

Purpose: To perform a standard cyanidation test on the combined cleaner tailings from flotation test No. 16.

Procedure: The sample was pulped with water in a two litre bottle. NaCN and lime were added and the cyanidation was carried out on rolls in one 24 hour stage.

Feed: 250 g of combined cleaner tailings test No. 16.

Solution Volume: 500 mL Pulp Density 33% solids

Solution Composition: 1.0 g/L NaCN

pH Range: 10.5 - 11.5 with $Ca(OH)_2$

Reagent Balance:

Time	Added, Grams				Residual		Consumed		pH	
	Actual		Equivalent		Grams		Grams			
Hours	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
0-3	0.53	0.20	0.50	0.15	0.39	0	0.11	0.15	11.5	10.3
3-8	0.12	0.15	0.11	0.11	0.48	0.02	0.02	0.09	11.5	11.1
8-24	0.02	0	0.02	0	0.48	0.01	0.02	0.01	11.1	10.6
Total	0.67	0.35	0.63	0.26	0.48	0.01	0.15	0.25	-	-

Reagent Consumption (kg/t of cyanide feed) NaCN: 0.60 CaO: 1.00

Metallurgical Results

Product	Amount	Assays, mg/L, g/t	% Distribution
		Au	Au
Solution	1350 mL	0.88	57.2
Residue	248.7 g	3.57	42.8
Head (Calc.)	248.7 g	8.36	100.0

Test No. 21

Purpose:	To investigate the effect of roasting the cleaner concentrate from test No. 15 followed by acid leaching and cyanidation.
Roast Feed:	250 g of cleaner concentrate from flotation test No. 15, Zone C ore.
Roast Conditions:	A two stage roast was performed in a muffle furnace with constant rabbling. During the first stage the sample was maintained at a temperature of 575°C for 45 minutes. After the fuming had stopped the sample was brought up to 625°C for 30 mintues. The sample was air cooled and weighed.
Acid Leach Feed:	127.9 g of calcine.
Acid Leach Conditions:	The calcine was acid leached for one hour at 80°C, with a pulp density of 33% solids using 5 g/L of H_2SO_4. After leaching, the sample was filtered and displacement washed 3 times using water.
Cyanidation Feed:	127.9 g of acid leach residue.
Cyanidation Conditions:	A standard cyanidation was carried out on the acid leach residue. The residue was repulped to 33% solids in a two litre bottle, the cyanide strength was controlled at 1.0 g/L and the pH was maintained with lime at 10.5 - 11.5. After 24 hours the pulp was filtered and the residue washed 3 times with water.

Test No. 21 - Continued

Reagent Balance:

Time	Added, Grams				Residual		Consumed		pH	
	Actual		Equivalent		Grams		Grams			
Hours	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
0-2	0.27	0.13	0.26	0.10	0.18	0	0.08	0.10	11.6	9.8
2-8	0.08	0.10	0.08	0.08	0.23	0.01	0.03	0.07	11.2	10.8
8-24	0.03	0.05	0.03	0.04	0.26	0.01	0	0.04	11.4	10.8
Total	0.38	0.36	0.37	0.22	0.26	0.01	0.11	0.21	-	-

Reagent Consumption (kg/t of cyanide feed) NaCN: 0.86 CaO: 1.64

Metallurgical Results

Product	Amount	Assays, %, ~~g~~/L, g/t			% Distribution
		Au	As	S	Au
1. Acid Leach Solution	860 ml	-	-	-	-
2. Cyanide Solution	1000 mL	67.0	-	-	97.3
3. Residue	125.6 g	14.95	1.13	<0.05	2.7
Head (Calculated)	250.0 g	275.5	-	-	100.0

Test No. 22

Purpose: To repeat test No. 21, but on the cleaner concentrate from test No. 16.

Roast Feed: 250 g of cleaner concentrate from flotation test No. 16, Zone F ore.

Roast Conditions: As for test No. 21.

Acid Leach Feed: 132.2 g of calcine.

Acid Leach Conditions: As for test No. 21.

Cyanidation Feed: 132.2 g of acid leach residue.

Cyanidation Conditions: As for test No. 21.

Reagent Balance:

Time	Added, Grams				Residual		Consumed		pH	
	Actual		Equivalent		Grams		Grams			
Hours	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
0-2	0.28	0.13	0.27	0.10	0.15	0	0.12	0.10	11.1	9.4
2-8	0.13	0.15	0.12	0.11	0.27	0	0	0.11	11.1	10.5
8-24	0	0.05	0	0.04	0.27	0	0	0.04	11.1	10.5
Total	0.41	0.33	0.39	0.25	0.27	0	0.12	0.25	-	-

Reagent Consumption (kg/t of cyanide feed) NaCN: 0.91 CaO: 1.89

Metallurgical Results

Product	Amount	Assays, %, mg/L, g/t			% Distribution
		Au	Au	S	Au
1. Acid Leach Solution	865 mL	-	-	-	-
2. Cyanide Solution	1070 mL	7.80	-	-	92.8
3. Residue	130.3 g	4.97	1.30	<0.05	7.2
Head (Calculated)	250.0 g	36.00	-	-	100.0

Test No. 23

Purpose: To investigate the effect of roasting a sample of combined cleaner tailings from test No. 15 followed by acid leaching and cyanidation.

Roast Feed: 250 g of combined cleaner tailing from flotation test No. 15, Zone C ore.

Roast Conditions: As for test No. 21.

Acid Leach Feed: 210.0 g of calcine.

Acid Leach Conditions: As for test No. 21.

Cyanidation Feed: 210.0 g of acid leach residue.

Cyanidation Conditions: As for test No. 21.

Reagent Balance:

Time	Added, Grams				Residual		Consumed		pH	
	Actual		Equivalent		Grams		Grams			
Hours	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
0-2	0.45	0.15	0.43	0.11	0.35	0.01	0.08	0.10	11.4	10.6
2-8	0.08	0.10	0.08	0.08	0.39	0.03	0.04	0.06	11.5	11.3
8-24	0.04	0	0.04	0	0.43	0.02	0	0.01	11.3	10.8
Total	0.57	0.25	0.53	0.19	0.43	0.02	0.12	0.17	-	-

Reagent Consumption (kg/t of cyanide feed) NaCN: 0.57 CaO: 0.81

Metallurgical Results

Product	Amount	Assays, %, mg/L, g/t			% Distribution
		Au	As	S	Au
1. Acid Leach Solution	990 mL	-	-	-	-
2. Cyanide Solution	1135 mL	4.63	-	-	86.9
3. Residue	204.6 g	3.84	3.34	0.53	13.1
Head (Calculated)	250.0 g	24.2	-	-	100.0

Test No. 24

Purpose: To repeat test No. 23, but on the combined cleaner tailings from test No. 16.

Roast Feed: 250 g of combined cleaner tailing from flotation test No. 16, Zone F ore.

Roast Conditions: As for test No. 21.

Acid Leach Feed: 196.7 g of clacine.

Acid Leach Conditions: As for test No. 21.

Cyanidation Feed: 196.7 g of acid leach residue.

Cyanidation Conditions: As for test No. 21.

Reagent Balance:

Time	Added, Grams				Residual		Consumed		pH	
	Actual		Equivalent		Grams		Grams			
Hours	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
0-2	0.42	0.15	0.40	0.11	0.16	0	0.24	0.11	11.1	9.1
2-8	0.25	0.25	0.24	0.19	0.40	0	0	0.19	11.2	10.1
8-24	0	0.10	0	0.08	0.40	0	0	0.08	11.0	10.3
Total	0.67	0.50	0.64	0.38	0.40	0	0.24	0.38	-	-

Reagent Consumption (kg/t of cyanide feed) NaCN: 1.22 CaO: 1.93

Metallurgical Results

Product	Amount	Assays, %, mg/L, g/t			% Distribution
		Au	As	S	Au
1. Acid Leach Solution	1000 mL	-	-	-	-
2. Cyanide Solution	1095 mL	1.37	-	-	70.4
3. Residue	192.0 g	3.26	3.27	0.18	29.6
Head (Calculated)	250.0 g	8.52	-	-	100.0

Test No. 25

Purpose: To cyanide the flotation tailing from Test 13.

Procedure: The sample was pulped with water in a 2 liter bottle. NaCN and lime were added and the cyanidation was carried out on rolls in one 24 hour stage. The pulp was filtered and the residue washed three times with water.

Feed: 500 g flotation tailing from Test 13.

Solution Volume: 1000 mL Pulp Density 33 % solids

Solution Composition: 1.0 gpL NaCN

pH Range: 10.5-11.5 with $Ca(OH)_2$

Reagent Balance:

Time Hours	Added, grams				Residual		Consumed		pH	R.P.*
	Actual		Equivalent		Grams		Grams			
	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
0-2	1.06	0.20	1.00	0.15	1.00	0.00	0.00	0.15	11.0-10.3	-
2-9	0.00	0.10	0.00	0.08	0.90	0.00	0.10	0.08	10.8-10.4	-
9-20	0.11	0.20	0.10	0.15	1.00	0.05	0.00	0.10	11.3-10.9	-
20-24	0.00	0.00	0.00	0.00	1.00	0.04	0.00	0.01	10.9-10.8	46
Total	1.17	0.50	1.10	0.38	1.00	0.04	0.10	0.34	-	-

Reagent Consumption (kg/tonne of cyanide feed) NaCN: 0.20 CaO : 0.68

*Reducing Power: mL 0.1 N $KMnO_4$/L pregnant solution

Metallurgical Results

Product	Amount	Assays, mg/L,g/t Au	% Distribution Au
24 h Cyanide Preg. + Wash	2280 mL	0.20	74.6
24 h Residue	498.3 g	0.31	25.4
Head (Calculated)	500.0 g	1.22	100.0

Comments: The results were similar to Test 6 at a primary grind of 77 % -200 mesh.

Test No. 26

Purpose: To cyanide the flotation tailing from Test 14.

Procedure: Same as Test 25.

Feed: 500 g flotation tailing from Test 14.

Solution Volume: 1000 mL Pulp Density 33 % solids

Solution Composition: 1.0 gpL NaCN

pH Range: 10.5-11.5 with $Ca(OH)_2$

Reagent Balance:

Time Hours	Added, grams				Residual		Consumed		pH	R.P.
	Actual		Equivalent		Grams		Grams			
	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
0-2	1.06	0.20	1.00	0.15	0.90	0.00	0.10	0.15	10.9-10.2	-
2-9	0.11	0.10	0.10	0.08	0.90	0.00	0.10	0.08	10.6-10.3	-
9-20	0.11	0.20	0.10	0.15	1.00	0.05	0.00	0.10	11.2-10.9	-
20-24	0.00	0.00	0.00	0.00	1.00	0.04	0.00	0.01	10.9-10.8	85
Total	1.28	0.50	1.20	0.38	1.00	0.04	0.20	0.34	-	-

*Reducing Power: mL 0.1 N $KMnO_4$/L pregnant solution

Reagent Consumption (kg/t of cyanide feed) NaCN: 0.40 CaO: 0.68

Metallurgical Results

Product	Amount	Assays, mg/L,g/t Au	% Distribution Au
24 h Cyanide Preg. + Wash	2130 mL	0.051	44.7
24 h Residue	498.7 g	0.27	55.3
Head (Calculated)	500.0 g	0.49	100.0

Comments: The results were similar to Test 8 at a primary grind of 82 % -200 mesh.

Test No. 27

Purpose: To investigate the cyanidation response of Sample C.

Procedure: The sample was ground, filtered and pulped with water in a 2 liter bottle. NaCN and lime were added and the cyanidation was carried out on rolls in two 24 hour stages with the solution being changed after each stage. Between each stage the pulp was filtered and the residue washed three times with water. The residue was then repulped with fresh cyanide solution and the test continued.

Feed: 500 g minus 10 mesh Sample C.

Solution Volume: 1000 mL Pulp Density 33 % solids

Solution Composition: 1.0 gpL NaCN

pH Range: 10.5-11.5 with $Ca(OH)_2$

Grind: 5 minutes at 66 % solids in the lab rod mill.

Reagent Balance:

Time Hours	Added, grams				Residual		Consumed		pH	R.P.*
	Actual		Equivalent		Grams		Grams			
	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
1st Stage										
0-2	1.06	0.30	1.00	0.23	0.65	0.01	0.35	0.22	11.4-10.6	-
2-5	0.37	0.20	0.35	0.15	1.00	0.05	0.00	0.11	11.4-11.0	-
5-20	0.00	0.00	0.00	0.00	0.95	0.01	0.05	0.04	11.0-10.3	-
20-24	0.05	0.10	0.05	0.08	0.80	0.04	0.20	0.05	11.1-10.8	120
2nd Stage										
24-30	1.06	0.30	1.00	0.23	1.90	0.05	0.10	0.18	11.6-10.9	-
30-48	0.11	0.00	0.10	0.00	0.95	0.03	0.05	0.02	10.9-10.0	72
Total	2.65	0.90	2.50	0.69	1.75	0.07	0.75	0.62	-	-

*Reducing Power: mL 0.1 N $KMnO_4$/L pregnant solution

Reagent Consumption (kg/tonne of cyanide feed) NaCN: 1.50 CaO: 1.24

Metallurgical Results

Product	Amount	Assays, mg/L, g/t Au	% Distribution Au
24 h Cyanide Preg. + Wash	2000 mL	8.15	87.8
48 h Cyanide Preg. + Wash	2000 mL	0.24	2.6
48 h Residue	484.3 g	3.70	9.6
Head (Calculated)	500.0 g	37.14	100.0

Test No. 27 - Continued

Screen Analysis - 48 h Cyanide Residue

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 35	1.3	1.3	98.7
48	6.4	7.7	92.3
65	10.6	18.3	81.7
100	12.9	31.2	68.8
150	15.8	47.0	53.0
200	13.2	60.2	39.8
270	9.8	70.0	30.0
400	6.7	76.7	23.3
- 400	23.3	100.0	-
Total	100.0	-	-

Test No. 28

Purpose: To repeat Test 27 but at a finer grind.

Procedure: Same as Test 27.

Feed: 500 g minus 10 mesh Sample C.

Solution Volume: 1000 mL Pulp Density 33 % solids

Solution Composition: 1.0 gpL NaCN

pH Range: 10.5-11.5 with $Ca(OH)_2$

Grind: 10 minutes at 66 % solids in the lab rod mill.

Reagent Balance:

Time Hours	Added, grams				Residual		Consumed		pH	R.P.*
	Actual		Equivalent		Grams		Grams			
	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
1st Stage										
0-2	1.06	0.30	1.00	0.23	0.15	0.05	0.85	0.18	11.5-11.0	-
2-5	0.89	0.00	0.85	0.00	0.85	0.05	0.15	0.00	11.1-10.9	-
5-20	0.26	0.00	0.25	0.00	0.85	0.01	0.25	0.04	10.9-10.3	-
20-24	0.16	0.10	0.15	0.08	1.00	0.04	0.00	0.05	10.9-10.5	200
2nd Stage										
24-30	1.06	0.30	1.00	0.23	0.85	0.03	0.15	0.20	11.6-10.5	-
30-48	0.16	0.20	0.15	0.15	0.95	0.03	0.05	0.15	11.1-10.1	88
Total	3.59	0.90	3.40	0.69	1.95	0.07	1.45	0.62	-	-

Reducing Power: mL 0.1 N $KMnO_4$/L pregnant solution

Reagent Consumption (kg per tonne of cyanide feed) NaCN: 2.90 CaO: 1.24

Metallurgical Results

Product	Amount	Assays, mg/L, g/t Au	% Distribution Au
24 h Cyanide Preg. + Wash	2000 mL	8.55	93.1
48 h Cyanide Preg. + Wash	2000 mL	0.04	0.4
48 h Residue	484.0 g	2.47	6.5
Head (Calculated)	500.0 g	36.76	100.0

Test No. 28 - Continued

Screen Analysis - 48 h Cyanide Residue

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 65	0.2	0.2	99.8
100	1.1	1.3	98.7
150	8.7	10.0	90.0
200	19.9	29.9	70.1
270	18.3	48.2	51.8
400	11.9	60.1	39.9
- 400	39.9	100.0	-
Total	100.0	-	-

Test No. 29

Purpose: To repeat Test 28 but at a finer grind.

Procedure: Same as Test 27.

Feed: 500 g minus 10 mesh Sample C.

Solution Volume: 1000 mL Pulp Density 33 % solids

Solution Composition: 1.0 gpL NaCN

pH Range: 10.5-11.5 with $Ca(OH)_2$

Grind: 20 minutes at 66 % solids in the lab rod mill.

Reagent Balance:

Time Hours	Added, grams				Residual		Consumed		pH	R.P.*
	Actual		Equivalent		Grams		Grams			
	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
1st Stage										
0-2	1.06	0.30	1.00	0.23	0.10	0.04	0.90	0.19	11.3-10.6	-
2-5	0.95	0.20	0.90	0.15	0.80	0.03	0.20	0.16	11.2-10.9	-
5-20	0.32	0.00	0.30	0.00	0.85	0.01	0.25	0.02	10.9-10.3	-
20-24	0.16	0.15	0.15	0.11	0.95	0.07	0.05	0.05	10.9-10.6	220
2nd Stage										
24-30	1.06	0.30	1.00	0.23	0.80	0.01	0.20	0.22	11.6-10.4	-
30-48	0.21	0.20	0.20	0.15	0.90	0.03	0.10	0.13	11.0- 9.9	96
Total	3.76	1.15	3.55	0.87	1.85	0.10	1.70	0.77	-	-

*Reducing Power: mL 0.1 N $KMnO_4$/L pregnant solution

Reagent Consumption (kg per tonne of cyanide feed) NaCN: 3.40 CaO: 1.54

Metallurgical Results

Product	Amount	Assays, mg/L, g/t Au	% Distribution Au
24 h Cyanide Preg. + Wash	2040 mL	8.35	93.8
48 h Cyanide Preg. + Wash	2000 mL	0.04	0.5
48 h Residue	504.0 g	2.06	5.7
Head (Calculated)	504.0 g	36.01	100.0

Test No. 29 - Continued

Screen Analysis - 48 h Cyanide Residue

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 100	0.1	0.1	99.9
150	0.2	0.3	99.7
200	1.4	1.7	98.3
270	9.2	10.9	89.1
400	18.6	29.5	70.5
- 400	70.5	100.0	-
Total	100.0	-	-

Test No. 30

Purpose: To investigate the cyanidation response of Sample F.

Procedure: Same as Test 27.

Feed: 500 g minus 10 mesh ore Sample F.

Solution Volume: 1000 mL Pulp Density 33 % solids

Solution Composition: 1.0 gpL NaCN

pH Range: 10.5-11.5 with $Ca(OH)_2$

Grind: 5 minutes at 66 % solids in the lab rod mill.

Reagent Balance:

Time Hours	Added, grams				Residual		Consumed		pH	R.P.*
	Actual		Equivalent		Grams		Grams			
	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
1st Stage										
0-2	1.06	0.30	1.00	0.23	0.75	0.02	0.25	0.21	11.4-10.7	-
2-5	0.26	0.20	0.25	0.15	0.95	0.08	0.05	0.09	11.5-11.2	-
5-20	0.05	0.00	0.05	0.00	0.90	0.04	0.10	0.04	11.2-10.6	-
20-24	0.11	0.10	0.10	0.08	0.95	0.06	0.05	0.06	11.2-10.9	122
2nd Stage										
24-30	1.06	0.30	1.00	0.23	1.85	0.07	0.15	0.16	11.6-10.9	-
30-48	0.16	0.00	0.15	0.00	0.95	0.03	0.05	0.04	10.9-10.1	64
Total	2.70	0.90	2.55	0.69	1.90	0.09	0.65	0.60	-	-

*Reducing Power: mL 0.1 N $KMnO_4$/L pregnant solution

Reagent Consumption (kg/tonne of cyanide feed) NaCN: 1.30 CaO: 1.20

Metallurgical Results

Product	Amount	Assays, mg/L,g/t Au	% Distribution Au
24 h Cyanide Preg. + Wash	2040 mL	1.11	71.5
48 h Cyanide Preg. + Wash	2000 mL	0.02	1.3
48 h Residue	498.4 g	1.72	27.2
Head (Calculated)	500.0 g	6.32	100.0

Test No. 30 - Continued

Screen Analysis - 48 h Cyanide Residue

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 65	5.5	5.5	94.5
100	13.1	18.6	81.4
150	20.7	39.3	60.7
200	15.7	55.0	45.0
270	11.8	66.8	33.2
400	8.0	74.8	25.2
- 400	25.2	100.0	-
Total	100.0	-	-

Test No. 31

Purpose: To repeat Test 30 but at a finer grind.

Procedure: Same as Test 27.

Feed: 500 g minus 10 mesh ore.

Solution Volume: 1000 mL Pulp Density 33 % solids

Solution Composition: 1.0 g/L NaCN

pH Range: 10.5-11.5 with $Ca(OH)_2$

Grind: 10 minutes at 66 % solids in the lab rod mill.

Reagent Balance:

Time Hours	Added, grams				Residual		Consumed		pH	R.P.*
	Actual		Equivalent		Grams		Grams			
	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
1st Stage										
0-2	1.06	0.30	1.00	0.23	0.15	0.07	0.85	0.16	11.4-10.7	-
2-6	0.89	0.20	0.85	0.15	0.85	0.10	0.15	0.12	11.2-10.8	-
6-24	0.26	0.10	0.25	0.08	0.91	0.08	0.19	0.10	11.1-10.2	218
2nd Stage										
24-29	1.06	0.30	1.00	0.23	0.85	0.03	0.15	0.20	10.8-10.1	-
29-34	0.16	0.20	0.15	0.15	0.95	0.07	0.05	0.11	10.9-10.2	-
34-45	0.05	0.20	0.05	0.15	1.00	0.05	0.00	0.17	10.8-10.3	-
45-48	0.00	0.20	0.00	0.15	1.00	0.08	0.00	0.12	10.7-10.5	80
Total	3.48	1.50	3.30	1.14	1.91	0.16	1.39	0.98	-	-

*Reducing Power: mL 0.1 N $KMnO_4$/L pregnant solution

Reagent Consumption (kg/tonne of cyanide feed) NaCN: 2.78 CaO: 1.96

Metallurgical Results

Product	Amount	Assays, mg/L, g/t Au	% Distribution Au
24 h Solution	2020 mL	1.39	72.2
48 h Solution	2000 mL	0.15	7.7
Residue	501.0 g	1.57	20.1
Head (Calc.)	501.0 g	7.76	100.0

Test No. 31 - Continued

Screen Analysis - 48 h Cyanide Residue

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 65	0.3	0.3	99.7
100	0.6	0.9	99.1
150	6.0	6.9	93.1
200	17.0	23.9	76.1
270	20.1	44.0	56.0
400	14.0	58.0	42.0
- 400	42.0	100.0	-
Total	100.0	-	-

Test No. 32

Purpose: To repeat Test 31, but at a finer grind.

Procedure: Same as Test 27.

Feed: 500 g minus 10 mesh ore.

Solution Volume: 1000 mL Pulp Density 33 % solids

Solution Composition: 1.0 gpl NaCN

pH Range: 10.5-11.5 with $Ca(OH)_2$

Grind: 20 minutes at 66 % solids in the lab rod mill.

Reagent Balance:

Time Hours	Added, grams				Residual		Consumed		pH	R.P.*
	Actual		Equivalent		Grams		Grams			
	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
1st Stage										
0-2	1.06	0.30	1.00	0.23	0.10	0.07	0.90	0.16	11.5-10.6	-
2-6	0.95	0.20	0.90	0.15	0.85	0.09	0.15	0.13	11.1-10.6	-
6-24	0.26	0.20	0.25	0.15	0.91	0.08	0.19	0.16	11.0-10.0	259
2nd Stage										
24-29	1.06	0.30	1.00	0.23	0.85	0.03	0.15	0.20	10.8-10.0	-
29-34	0.16	0.20	0.15	0.15	0.90	0.06	0.10	0.12	10.9-10.4	-
34-45	0.11	0.20	0.10	0.15	1.00	0.05	0.00	0.16	10.8-10.2	-
45-48	0.00	0.20	0.00	0.15	1.00	0.08	0.00	0.12	10.7-10.5	112
Total	3.60	1.60	3.40	1.21	1.91	0.16	1.49	1.05	-	-

*Reducing Power: mL 0.1 N $KMnO_4$/L pregnant solution

Reagent Consumption (kg/tonne of cyanide feed) NaCN: 2.98 CaO: 2.10

Metallurgical Results

Product	Amount	Assays, mg/L,g/t Au	% Distribution Au
24 h Solution	2020 mL	1.24	73.3
48 h Solution	2000 mL	0.11	6.5
Residue	504.2 g	1.37	20.2
Head (Calc.)	504.2 g	6.76	100.0

Test No. 32 - Continued

Screen Analysis - 48 h Cyanide Residue

Mesh Size (Tyler)	% Retained		% Passing
	Individual	Cumulative	Cumulative
+ 100	0.1	0.1	99.9
150	0.1	0.2	99.8
200	0.4	0.6	99.4
270	5.2	5.8	94.2
400	15.1	20.9	79.1
- 400	79.1	100.0	-
Total	100.0	-	-

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