

MAP NO.: 115 I 7
ASSESSMENT REPORT X
PROSPECTUS
CONFIDENTIAL X
OPEN FILE

DOCUMENT NO: 092859
MINING DISTRICT: WHITEHORSE
TYPE OF WORK: Bulk Sampling
and Metallurgical

REPORT FILED UNDER: Archer, Cathro & Associates Ltd.

DATE PERFORMED: Aug. 19 to Sept 23, 1989

DATE FILED: June 15, 1990

LOCATION: LAT.: 62°21'N
LONG.: 136°41'W

AREA: Carmacks
VALUE \$: 18,572.36

CLAIM NAME & NO.: BOY 20, 22, 24, 51-58, 83, 85
DUN 1F-3F, AC 2F-3F
W 1-49

WORK DONE BY: BACON, DONALDSON & ASSOCIATES LTD.

WORK DONE FOR: ARCHER, CATIRO & ASSOCIATES LIMITED

DATE TO GOOD STANDING:

REMARKS: Six bulk samples were collected from the No. 1 zone of the Williams Creek copper deposit. The samples were metallurgically tested by Bacon, Donaldson in Vancouver. Sampling and testing were done under the direction of R. Quartermain, pres. Western Copper Holdings Ltd. through Consolidated Silver Standard Mines Ltd. Test results indicate that 86.7% of the copper can be extracted from a minimum 3/4" grind in 33 days using sulphuric acid solution strength of 15 g/l.

ARCHER, CATHRO

& ASSOCIATES (1981) LIMITED

CONSULTING GEOLOGICAL ENGINEERS

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BULK SAMPLING
AND
METALLURGICAL INVESTIGATIONS
WILLIAMS CREEK
COPPER PROPERTY

CARMACKS AREA, YUKON TERRITORY
LATITUDE 62°21'N, LONGITUDE 136°41'W
NTS 115I/7

052-59
1098

Alan R. Archer, B.A.Sc., P.Eng.

Consulting Engineer

June 9, 1990

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INTRODUCTION

The Williams Creek copper property, owned by Archer, Cathro & Associates (1981) Limited, was optioned to Western Copper Holdings Limited on August 18, 1989. During the period August 19 to September 23, 1989, Archer, Cathro collected bulk samples from the property on behalf of Western Copper under the writer's supervision. The samples were shipped to Bacon, Donaldson & Associates Ltd. in Richmond, B.C., where test work was begun on October 16, 1989 under the attention of Robert Quartermain, President of Consolidated Silver Standard Mines Ltd., a company associated with Western Copper.

PROPERTY, LOCATION AND ACCESS

The property consists of 67 mineral claims registered with the Whitehorse Mining Recorder as follows:

<u>Claim Name</u>	<u>Grant Number</u>	<u>Expiry Date *</u>
Boy 20	Y51118	March 9, 1995
22	Y51120	March 9, 1995
24	Y51122	March 9, 1995
51-58	Y51149-Y51156	March 9, 1995
83	Y51181	March 9, 1995
85	Y51183	March 9, 1995
Dun 1F-3F	Y59382-Y59384	March 9, 1995
AC 2F-3F	Y91722-Y91723	March 9, 1995
W 1-49	YB26708-YB26756	August 31, 1992

* includes assessment filed on March 1, 1990

The claims are located at latitude 62°21'N and longitude 136°41'W within NTS claim sheet 115I/7. They are accessible by an 11 km four-wheel drive summer road north from Km 35 on the secondary Freegold road that extends west of Carmacks. Carmacks is a small community on the Klondike Highway approximately 176 km north of Whitehorse as illustrated on Figure I on the following page.

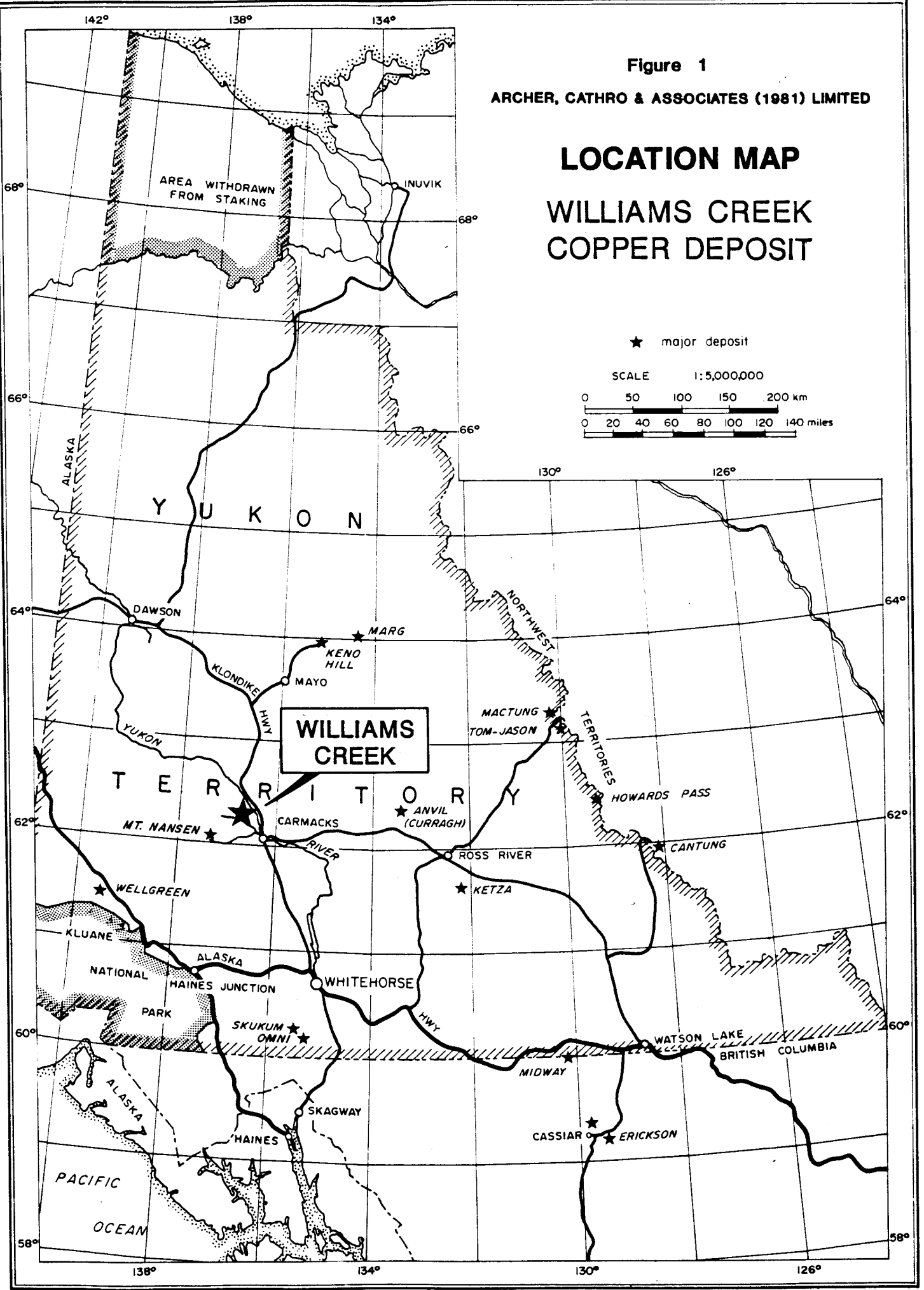
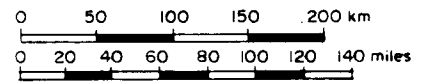
Figure 1

ARCHER, CATHRO & ASSOCIATES (1981) LIMITED

LOCATION MAP WILLIAMS CREEK COPPER DEPOSIT

★ major deposit

SCALE 1:5,000,000



HISTORY

The Williams Creek copper prospect was optioned by Dawson Range Joint Venture (Strauss Exploration, Inc., Great Plains Development of Canada Ltd., Trojan Consolidated Minerals Ltd. and Molybdenum Corporation of America) in 1970 from prospector G. Wing. Exploration during the period 1970 to 1974 included access road construction, geochemical and geophysical surveys, bulldozer trenching and 7433 m of drilling, most of which was directed toward the main, or No. 1, zone. In 1982, Archer Cathro Holdings Limited acquired the Dawson Range Joint Venture properties and its interests were sold to Archer, Cathro & Associates (1981) Limited in 1986 which deepened trenches over the No. 1 zone in 1987.

GEOLOGY AND MINERALIZATION - NO. 1 ZONE

The Williams Creek No. 1 zone lies along a steep southeast-facing ridge at approximately 850 m above sea level. Vegetation consists of spruce and poplar trees up to 30 cm in diameter. Overburden is about 3 m thick and consists mainly of residual till.

The No. 1 zone deposit is a steep-dipping (-70° east) tabular body of weakly schistose rock of diorite composition enclosed by Cretaceous granodiorite. It is believed to be a recrystallized roof pendant of volcanic rocks. The deposit has a sharp footwall contact and a less well defined, somewhat gradational, hanging wall contact. It has a strike length of 550 m at surface, reducing to 335 m at a depth of 365 m below surface and has an average width of 29 m.

Drilling at approximately 122 m centres has traced the deposit to 457 m below surface and shows that it terminates to the north by absorption into the granodiorite and to the south by an assay cutoff due to increasing pyrite.

Mineralization consists of bornite, chalcopyrite and pyrite in disseminations and veinlets and is most abundant in the footwall portion of the deposit. Minor gold and silver values are present and appear to be preferentially contained in the bornite. Small quantities of molybdenite are also present.

The schistose host rock has an unusually high porosity and this has resulted in the copper minerals being almost totally oxidized to malachite and azurite to approximately 244 m below surface. Mineral reserves are divided into oxide and non-oxide portions as summarized below:

	<u>Million Tonnes</u>	<u>% Copper</u>
Oxidized	8.8	1.30
Unoxidized	<u>9.0</u>	<u>.73</u>
Total	17.8	1.00

Assays from composite samples suggest a precious metal content of around 7 g/t silver and 0.7 g/t gold in the oxide reserves and 2.6 g/t silver and 0.4 g/t gold in the unoxidized reserves.

SURFACE BULK SAMPLING - NO. 1 ZONE

A total of 2700 kg of oxidized copper mineralization was collected from four surface trenches on the No. 1 zone by geologists D. Eaton and T. Becker and assistants B. Wengzynowski and F. Gish during the period August 19 to September 23, 1989. The location of the trenches and the No. 1 zone with respect to the mineral claims and access road is illustrated on Figure 2 on the following page.

The No. 1 zone was channel-sampled across its full width in each of the four trenches using a heavy mattock. Samples were collected into 12 l pails and carried to the access road where they were placed into fibreglass

concentrate bags in the back of a pickup truck. Two bags were used, one coloured blue and the other orange. Sample material from the more schistose portions of the zone was put into the blue bag. When the bags were filled, the samples were taken to Canadian Freightways in Whitehorse for delivery to Bacon, Donaldson & Associates Ltd. in Richmond, B.C. A total of 6 concentrate bags, 3 orange coloured and 3 blue coloured, were collected for a combined weight of 2700 kg.

METALLURGICAL TESTING

The metallurgical testing of the bulk sample from the Williams Creek No. 1 zone was contracted to Bacon, Donaldson and a copy of their report dated May 15, 1990 is included in this report as Appendix I. The testing was done under the direction of Robert Quartermain, President, of Western Copper Holding Limited Ltd. through an associated company, Consolidated Silver Standard Mines Ltd.

The purpose of the metallurgical work was to provide detailed information on the amenability of the Williams Creek mineralization to heap leaching with sulphuric acid. Work was started on October 16, 1989 and was completed on April 6, 1990. Test work included six bottle roll sulphuric acid leach tests, one bottle roll ammonia leach test and two larger-scale sulphuric acid column leach tests.

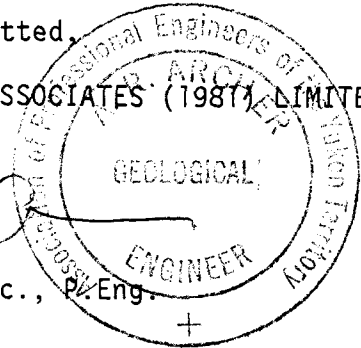
Test results indicated that 86.7% of the copper can be extracted from a minimum 3/4 inch grind in 33 days using a sulphuric acid solution strength of 15 g /l.

Respectfully submitted,

ARCHER, CATHRO & ASSOCIATES (1987) LIMITED

A.R.A.

A.R. Archer, B.A.Sc., P.Eng.



/mjm

APPENDIX I
METALLURGICAL INVESTIGATION OF
WILLIAMS CREEK COPPER OXIDE ORE
BACON, DONALDSON & ASSOCIATES LTD.


**METALLURGICAL INVESTIGATION
OF
WILLIAMS CREEK COPPER OXIDE ORE**

Prepared for:

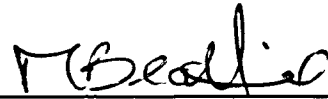
**CONSOLIDATED SILVER STANDARD MINES LTD.
400 - 1199 W. Hastings Street
Vancouver, B.C.
V6E 3T5**

Attention: Robert Quartermain

**File Number: M90-001
May 15, 1990**



Ed Henriouille, B.A.Sc.



Dr. M.J.V. Beattie, P.Eng.



1.0 INTRODUCTION

At the request of Mr. Robert Quartermain of Consolidated Silver Standard Mines Ltd, metallurgical test work was carried out on bulk samples of oxide copper ore from the Williams Creek property. Two composites of run of mine sized ore were provided, with an average head grade of approximately 1.5% Cu. Total testwork in this investigation consisted of six bottle roll sulphuric acid leach tests, one bottle roll ammonia leach test, and two larger-scale sulphuric acid column leach tests. The purpose of the investigation was to provide detailed metallurgical information on the amenability of the Williams Creek ore to heap leaching with sulphuric acid.

This investigation was initiated by a phone call to Bacon, Donaldson & Associates (BDA) by Mr. Robert Quartermain on August 29, 1989. Further correspondence followed to define more fully the scope of the investigation. Actual testwork began on October 16, 1989. Throughout this investigation, testwork results were provided to Mr. Quartermain as soon as they became available.



2.0 SUMMARY

Bottle roll sulphuric acid leaching tests indicated that copper extractions of 80-85% Cu could be obtained for both ore composites at a fairly coarse crush (minus 3/4 inch). Net sulphuric acid consumption for these tests was 26-28 kg/tonne.

Two column leach tests conducted on 50:50 blends of composite Orange and composite Blue at a 3/4 inch crush yielded final copper extractions of 85.0% Cu (Column 1) and 86.7% Cu (Column 2). Both tests were identical, but Column 2 involved more intensive leaching in the beginning of the leach; solution strength was 20 g/l H₂SO₄ initially (compared to 15 g/l for Column 1), and solution flowrate was 100 ml/min initially (compared to 20 ml/min for Column 1). The more intensive leaching employed in Column 2 greatly increased the copper extraction rate, with Column 2 reaching 80% copper extraction within 15 days (compared to 60 days for Column 1).

With the shorter test duration, Column 2 had a marginally lower net sulphuric acid consumption; 48 kg/tonne compared to 51 kg/tonne for Column 1.

One bottle roll test utilizing ammonia leaching of the copper was performed. This test resulted in low copper extraction and this process route was not investigated further.

3.0 ORE CHARACTERIZATION

On September 6, 1989 approximately 2700 kg (6000 lbs) of damp, minus 15 cm (6 inch) copper oxide ore was received by Bacon, Donaldson and Associates at their facilities in Richmond, B.C. The shipment consisted of two separate ore composites: Composite Orange and Composite Blue. Approximately equal proportions of each composite were received.

The composites were jaw crushed separately to approximately minus 3 cm. It should be noted that some of the material crushed in a distinctly slabby manner, with pieces up to 10 or 12 cm along their long axis and less than 3 cm along their short axis. This was not a major occurrence however, with the total amount of slabby breakage estimated to be less than 1% by weight.

Sample cuts were taken from each composite for head analysis. This information is presented in Table 3.1 along with the average back calculated head grades from testwork.

Table 3.1
Head Assay Summary

Composite	Assay Type	Total Copper % Cu	Oxide Copper as % Cu	Total Iron % Fe
Orange	Assay	1.32	1.26	4.00
	Avg. Back-Calc.	1.54	1.43	3.84
Blue	Assay	1.68	1.60	4.60
	Avg. Back-Calc.	1.65	1.57	4.77
50:50 Mix	Assay	1.50	1.43	4.80
	Avg. Back-Calc.	1.56	-	4.11



4.0 BOTTLE ROLL LEACHING

In total, 7 bottle roll tests were conducted in this study. Six of these were sulphuric acid leaches conducted at various ore sizes to determine the optimum feed size for each composite, and to establish the plateau for copper extraction that could be expected in subsequent column leach testing. The final bottle roll test (L7) was an ammonia leach on a 50:50 mix of composites Orange and Blue to determine the general amenability of the ore to leaching with an ammonia solution. All bottle roll tests were conducted on 4 to 5 kg of ore at 50 to 55% solids. All leach solutions were changed and analyzed incrementally to provide extraction data.

4.1 Bottle Roll Sulphuric Acid Leaching

Six bottle roll sulphuric acid leach tests were conducted in this study. The tests investigated three different ore sizes on both Composite Orange and Composite Blue. All other test parameters were similar:

- 4000 - 5000 g dry ore
- 50 - 55% solids
- 15 g/l H_2SO_4 solution strength
- 166 hour duration (approximately 7 days)

The results of the six tests are summarized in Table 4.1 and the complete details are presented in Appendix I.

Table 4.1
Bottle Roll Sulphuric Acid Leaching

Test No.	Composite	Ore Size	Tailings %Cu ^{Total}	Copper Extraction %	Net Acid Consumption Kg/tonne
L1	Blue	1-1.5 inch	0.38	74.7	29.3
L3	Blue	3/4 inch	0.35	80.6	27.9
L5	Blue	1/4-3/8 inch	0.34	80.3	23.8
L2	Orange	1-1.5 inch	0.52	66.3	28.0
L4	Orange	3/4 inch	0.28	82.3	26.4
L6	Orange	1/4-3/8 inch	0.20	86.6	26.5

The results in Table 4.1 indicate that Composite Orange shows greater sensitivity to crush size than Composite Blue. However, for both composites, the 3/4 inch size is adequate to achieve 80% copper extraction

In Table 4.1, the acid consumption figures shown are the net consumptions. These are calculated from the gross acid consumptions shown in the detailed balances (Appendix D) by correcting for the acid which occurs as copper.

Figures 4.1 and 4.2 illustrate the copper extraction as a function of time for the six tests. The curves indicate that the extraction rates have all levelled off by 166 hours, and it is likely that the final numbers have approached the ultimate extractions for these test parameters.

Acid Leaching of Williams Creek Ore

Cu Extraction VS. Time

COMPOSITE BLUE

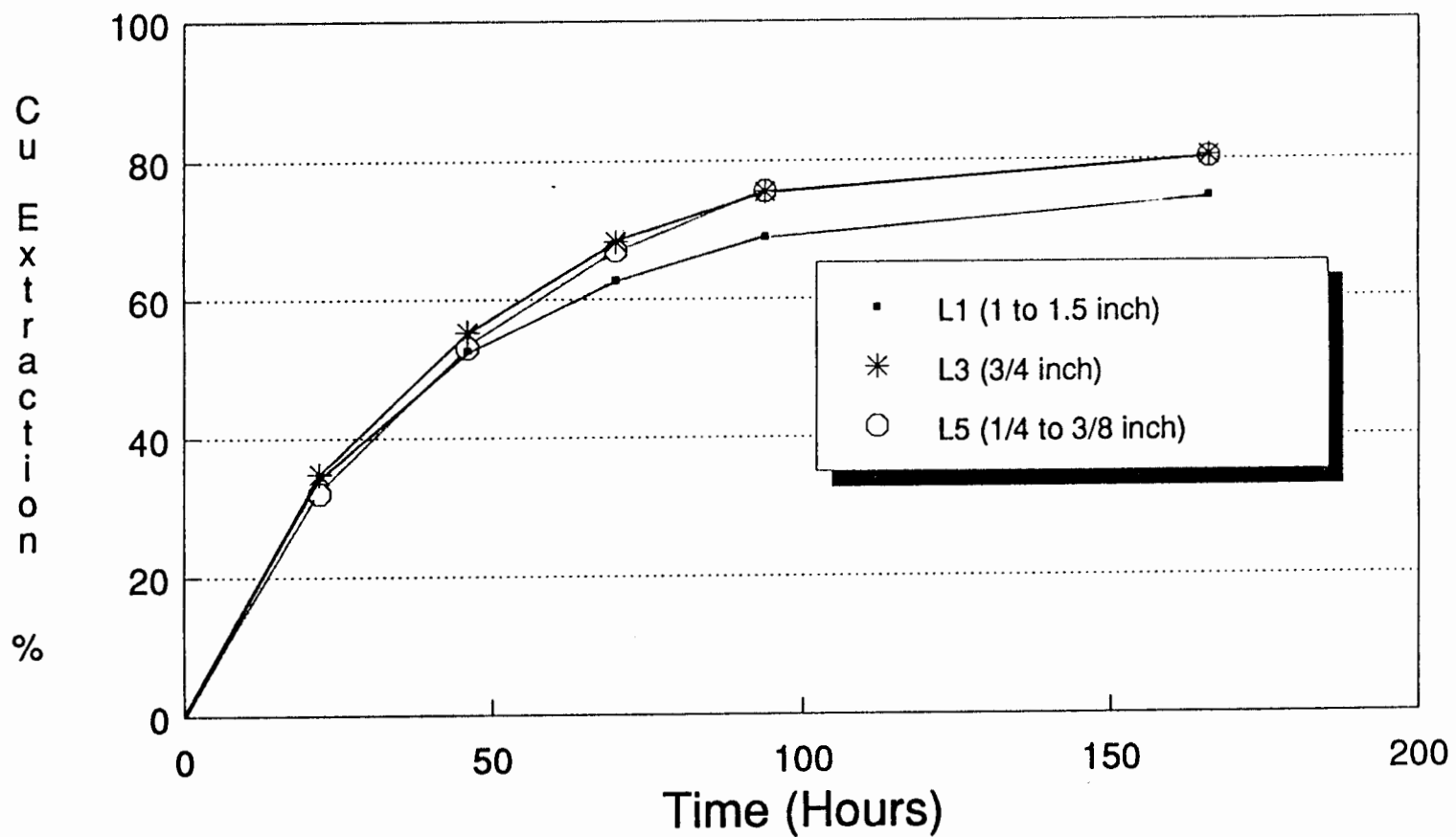


Figure 4.1

Acid Leaching of Williams Creek Ore

Cu Extraction VS. Time

COMPOSITE ORANGE

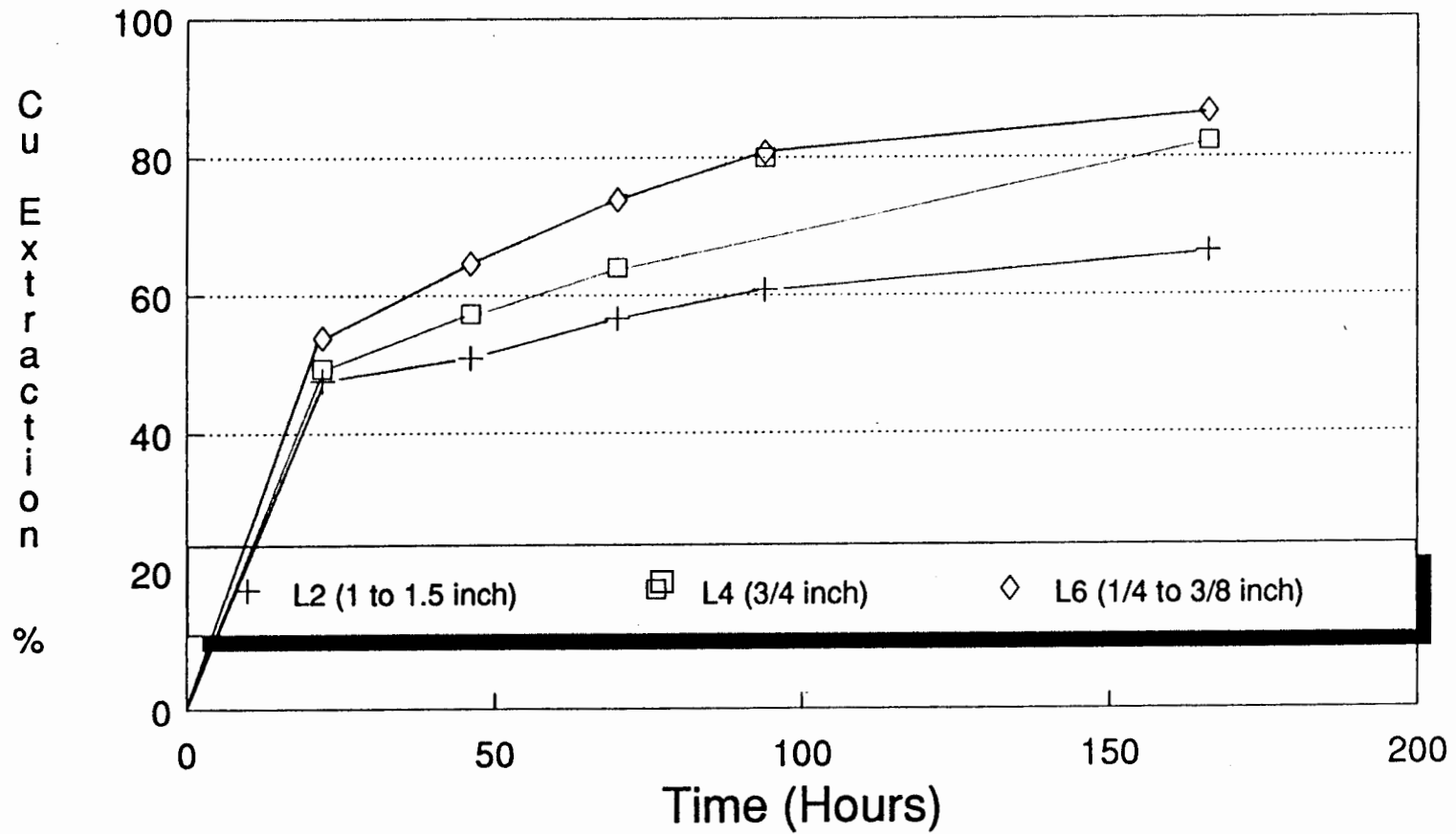


Figure 4.2

4.2 Bottle Roll Ammonia Leaching

A single bottle roll ammonia leach test was conducted on a 50:50 blend of Composite Orange and Composite Blue. The ore was crushed to 3/4 inch and leached for 10 days at 50% solids with a "0.25M NH_4OH + 0.25M $(\text{NH}_4)_2\text{CO}_3$ " strength ammonia solution. The leach solution was changed daily for the first 96 hours and then after a total of 7 and 8 days.

Final extraction for this test was 57.7% copper and the final tailings assayed 0.70% Cu^T . These results are considerably worse than the comparable test (L3 and L4) with sulphuric acid. The ammonia leach extraction rate is compared to the rates of tests L3 and L4 in figure 4.3.

Since this test was preliminary in nature, no analyses were performed to establish reagent consumption. However, the motivation for the test was the fact that the contained iron and carbonate minerals would not be dissolved under the leach conditions.

Leaching of Williams Creek Ore

Cu Extraction VS. Time

Comparison of Acid & Ammonia Leaching

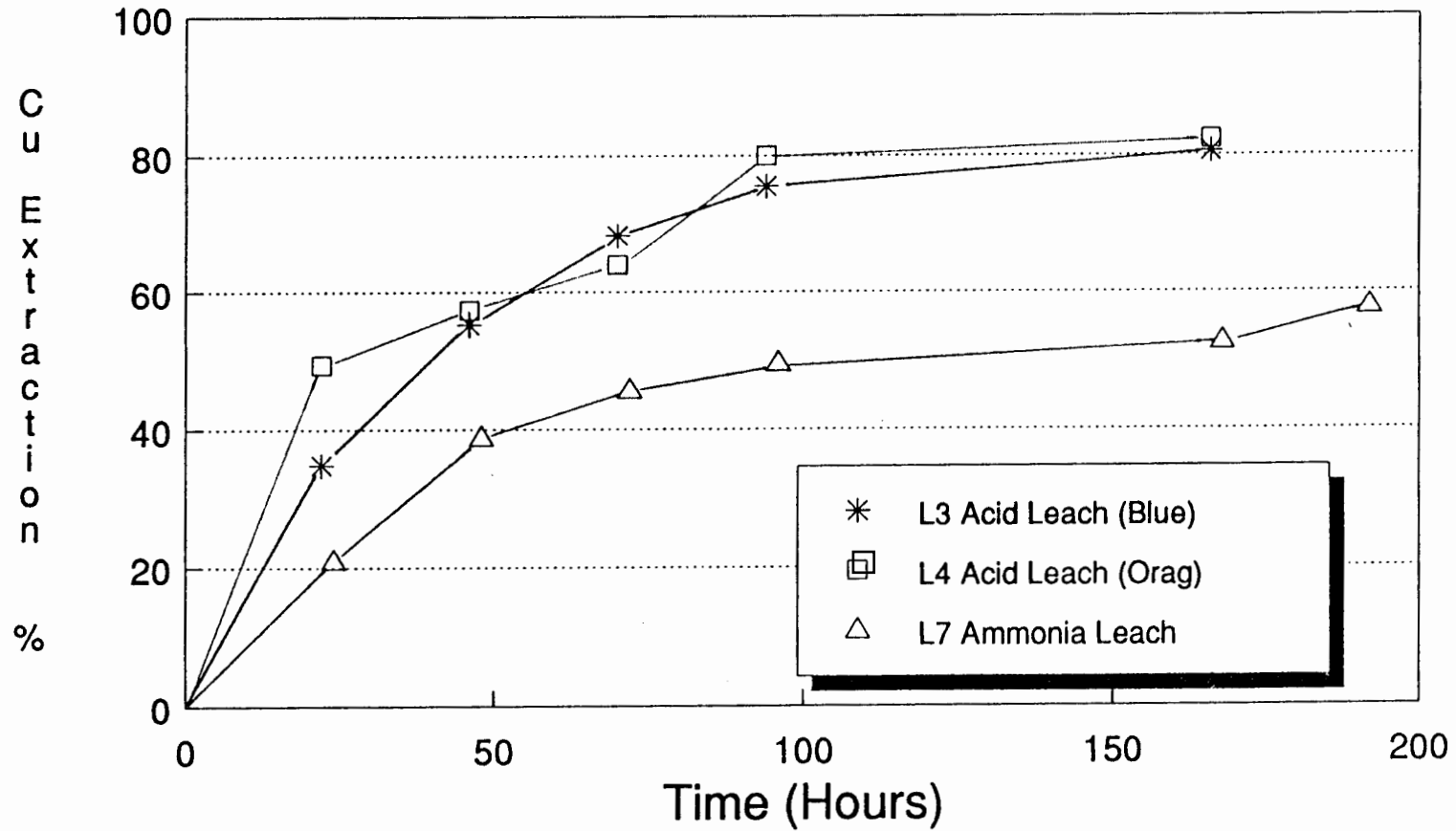


Figure 4.3



5.0 COLUMN LEACHING

Two separate column leach tests were conducted on 50:50 blends of minus 3/4 inch Orange and Blue composites. Both tests utilized a 12 foot by 1 foot diameter PVC plastic pipe for a column container. Sulphuric acid leach solutions were pumped continuously by metering pumps to the drip point at the top of the column. A special drip arrangement ensured that the contents of the column were uniformly wetted through the cross sectional area. Both columns were loaded by pre-wetting the blended ore with an 18 g/l H₂SO₄ solution at a solution - solids ratio of 3%. Both columns contained approximately 375 kg of ore.

Regular maintenance of the columns consisted of collecting and weighing the pregnant (out) solution in its entirety. This solution was then sampled for assay, with a further 2 litres saved in a glass bottle for future reference. The remaining pregnant solution was neutralized and discarded. Feed solution (in) was topped up at the appropriate solution strength and the metering pumps were checked periodically to ensure they were delivering the correct flowrate.

To end the columns, feed solution was stopped and the columns were allowed to drain for a period of days. Following this, the columns were flushed twice with water at a high flow rate. The out solutions from the washes were collected and assayed. Finally, the columns were dumped, the solids examined visually to determine if there were indications of solution channelling, then the solids were dried and sampled for assay and size analysis.

The two column tests in this investigation differed in that the first column was leached slowly, with low solution strengths and flowrates. This test had a duration of 78 days. The second column was leached more intensely, with high solution strengths and high flowrates for the initial part of the test. This type of intensive leaching at the beginning of a test is known as "pugging". Column 2 had a duration of 33 days.

5.1 Column Test 1

Column test 1 was leached for 78 days (including draining and washing) and reached a final copper extraction of 85.0%. Figure 5.1 illustrates the extraction rate for copper over the duration of the test. The curve depicts a long climb up to the final extraction of 85% Cu; 60% extraction was not reached until day 32, and 80% until day 60.

Column 1 began leaching with a solution strength of 15 g/l H_2SO_4 at a flowrate of 20ml/min and this was continued until day 54 when the iron content of the out solution reached 3.0 g/l Fe. After day 54, the feed strength was cut back to 10 g/l H_2SO_4 and this was maintained for the duration of the test. The lower feed strength had an immediate effect on the amount of iron being leached; the next out solution assayed only 1.84 g/l Fe. Figure 5.2 illustrates the iron and copper concentration of the pregnant solution over time. The test was ended when the copper concentration of the pregnant solution had decreased to approximately 0.5 g/l.

Column 1 had a total acid consumption of 70.6 kg H_2SO_4 per tonne of ore. Of this, 19.1 kg/tonne was consumed by the copper and would be recovered in a solution processing plant. Correcting for the dissolved copper, the net acid consumption for column 1 was 51.5 kg/tonne.

When column 1 was dismantled, visual inspection of the tailings indicated that all the material had leached evenly with no indications of channelling. The tailings were dried, then sampled for assay and size analysis.

At the request of the client, gold and silver assays were also conducted on the tailings for column 1. The assay indicated values of 0.51 g/tonne Au and 4.53 g/tonne Ag.

Column Leaching of Williams Creek Ore

Cu Extraction vs Time

Column #1

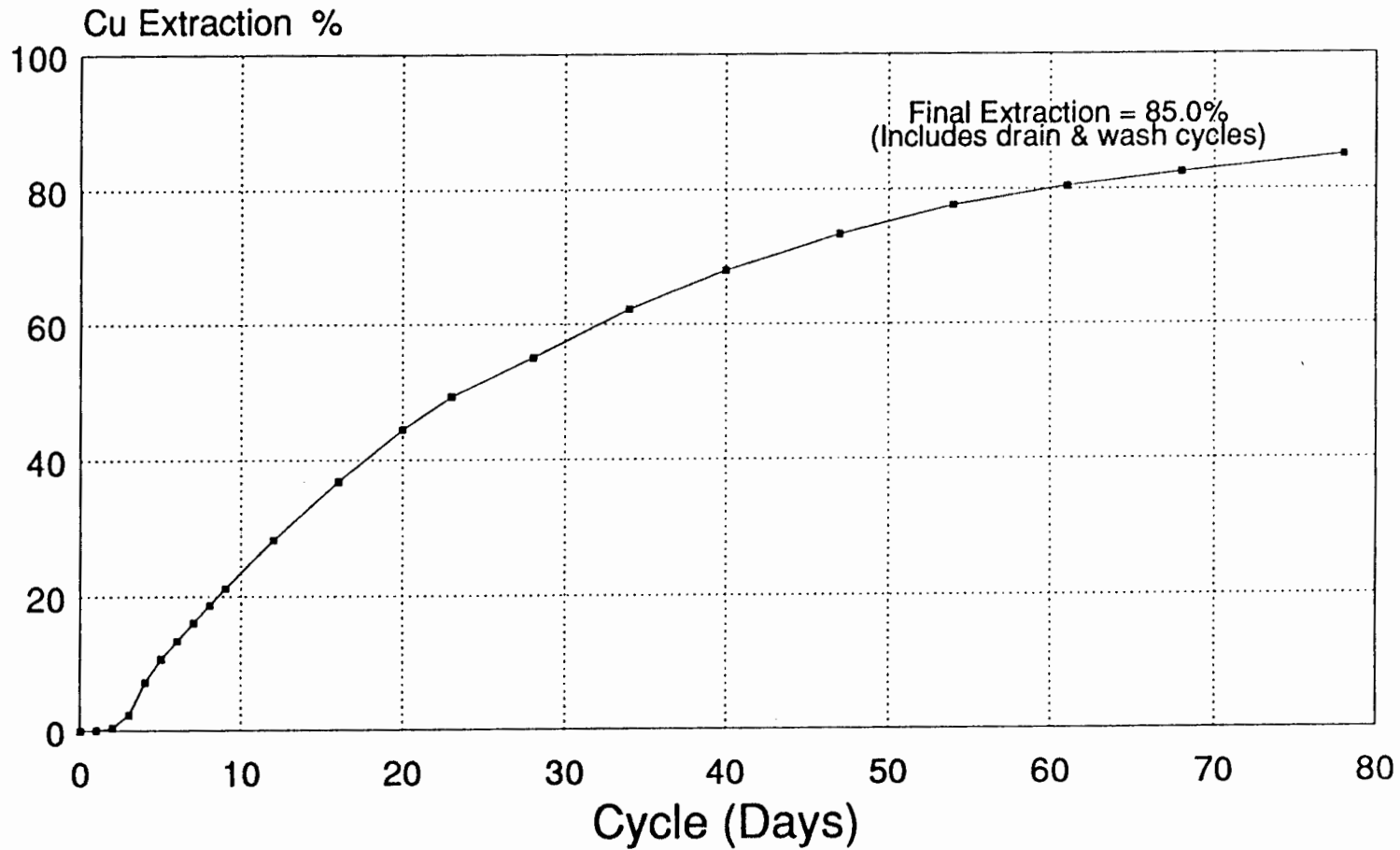


Figure 5.1

Column Leaching of Williams Creek Ore

Cu and Fe Concentration vs Time

Column #1

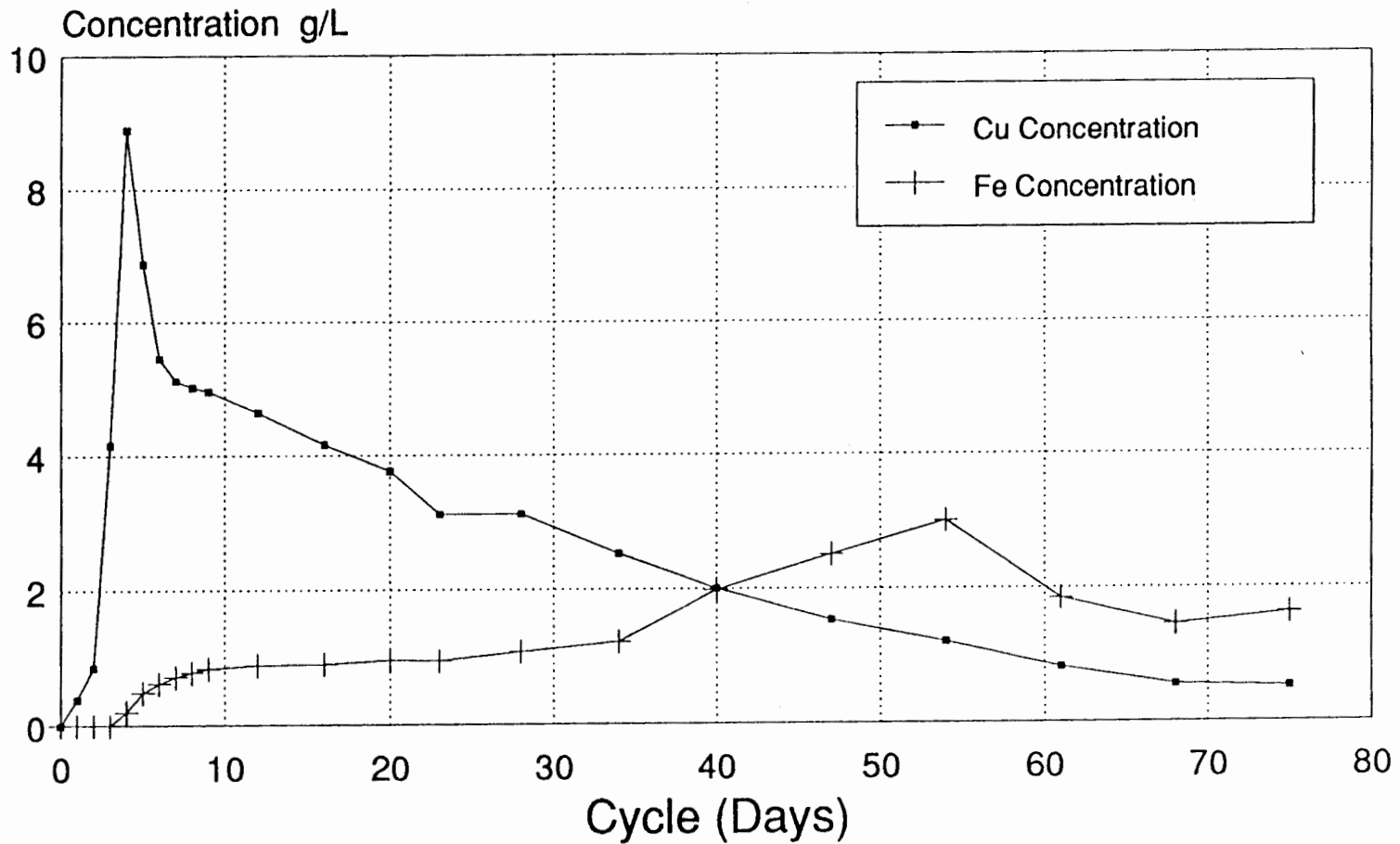


Figure 5.2

5.2 Column Test 2

Column test 2 was leached for 33 days (including draining and washing) and reached a final copper extraction of 86.7%. Figure 5.3 illustrates the rate of copper extraction over the course of the test. For this test, with its more intensive leaching, copper extraction progressed rapidly and reached 60% within 5 days, and 80% within 15 days.

Column 2 began leaching with a solution strength of 20 g/l H_2SO_4 and a flowrate of 100 ml/min (compared to 15 g/l H_2SO_4 and 20 ml/min for column 1) and maintained this until day 6 when the feed solution was cut back to 15 g/l H_2SO_4 . Finally, on day 15 the feed strength was cut back to 10 g/l H_2SO_4 . Throughout this test, iron content of the out solution did not exceed 2.0 g/l Fe. Flowrate of feed solution was cut back periodically through the course of the test and by the end of the test it was down to 20 ml/min. Figure 5.4 illustrates the copper and iron concentration of the pregnant solution over time. As for column 1, the test was ended when the copper concentration in the pregnant solution had decreased to approximately 0.5 g/L.

Column 2 had a total acid consumption of 69.1 kg H_2SO_4 per tonne of ore. Of this, 21.1 kg/tonne was consumed by this dissolving copper. After correcting for dissolved copper, net acid consumption for column 2 was 48 kg/tonne.

Upon dismantling of column 2, visual inspection of the tailings indicated even leaching with no apparent channelling. The dried tailings were sampled for assay and size analysis.

While column test 2 was in progress several pieces of the ore were placed in acid solution. This solution was changed periodically to ensure the availability of acid and to maximize the diffusion gradient for acid and copper. Upon the completion of column test 2 the pieces of rock were broken in half to observe the extent to which copper leaching had progressed. The copper oxide had been leached to a depth of 4 to 5mm. Inside this leached rim the rock contained visible copper "oxide" minerals.

Column Leaching of Williams Creek Ore

Cu Extraction vs Time

Column #2

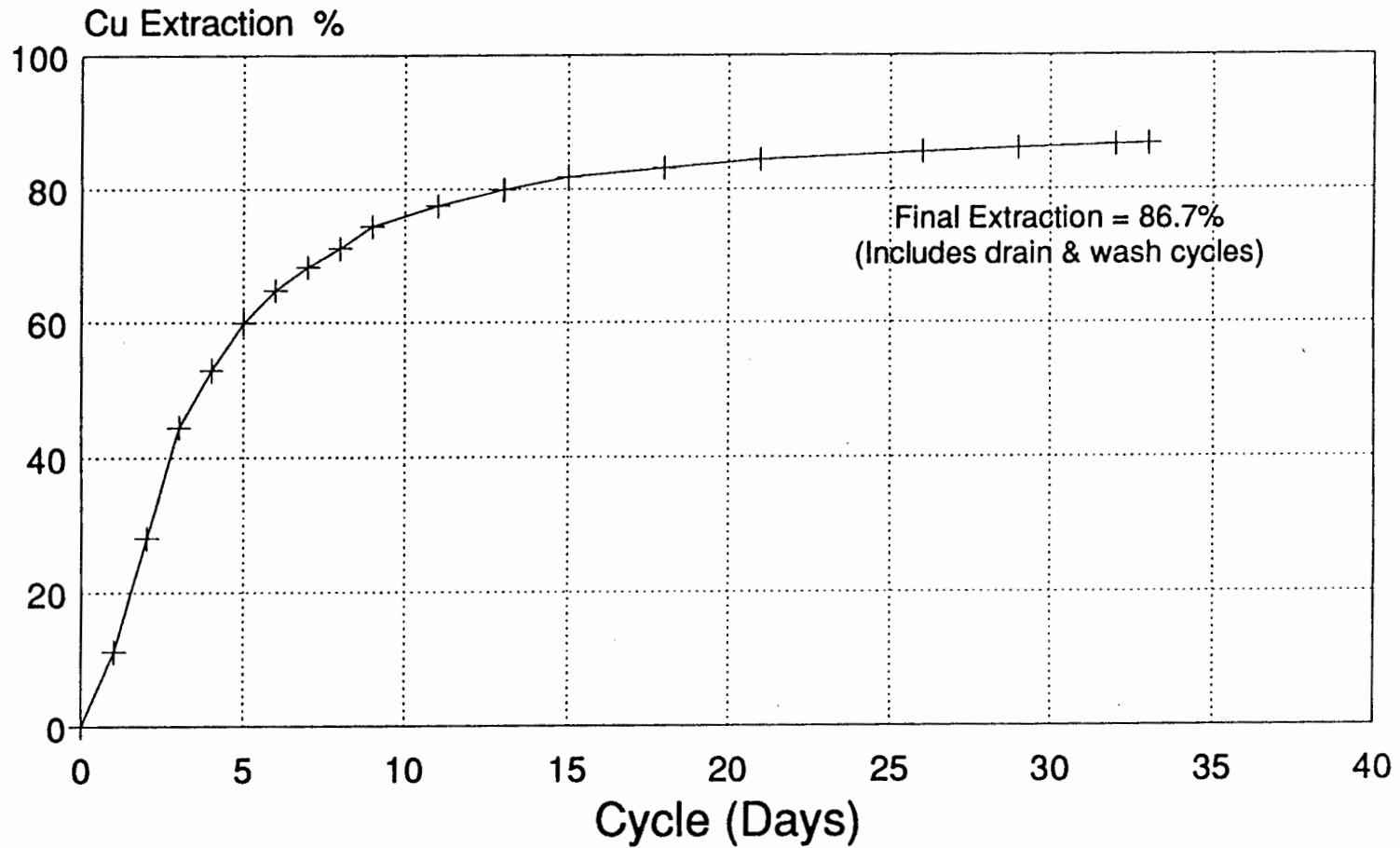


Figure 5.3

Column Leaching of Williams Creek Ore

Cu and Fe Concentration vs Time

Column #2

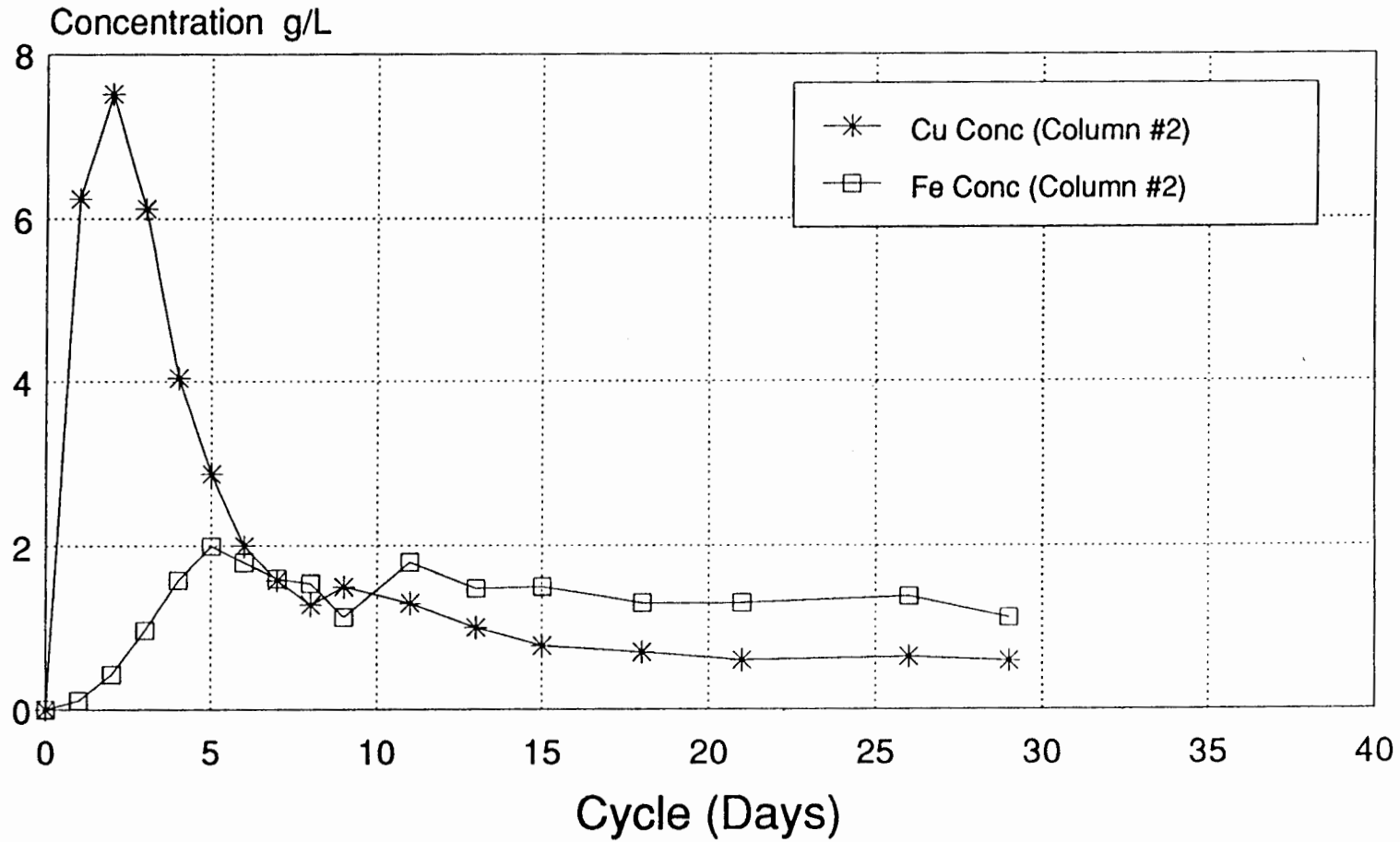


Figure 5.4

5.3 Comparison: Column 1 vs Column 2

Table 5.1 summarizes the important information from both column tests.

Table 5.1
Comparison: Column 1 and Column 2

Test No.	Composite	Ore Size	Duration (Days)	Tailings %Cu ^{Total}	Copper Extraction %	Net Acid Consumption Kg/tonne
Column 1	50:50 Mix	3/4"	78	0.22	85.0	51
Column 2	50:50 Mix	3/4"	33	0.21	86.7	48

Figure 5.5 illustrates the dramatic difference in copper extraction rates for the two tests.

It can be seen from the information in Table 5.1 and the graph in figure 5.5 that column 2 has given better results than column 1; copper extraction occurred much quicker and acid consumption was lower for column 2.

Column Leaching of Williams Creek Ore

Cu Extraction vs Time

Comparison of Column #1 & Column #2

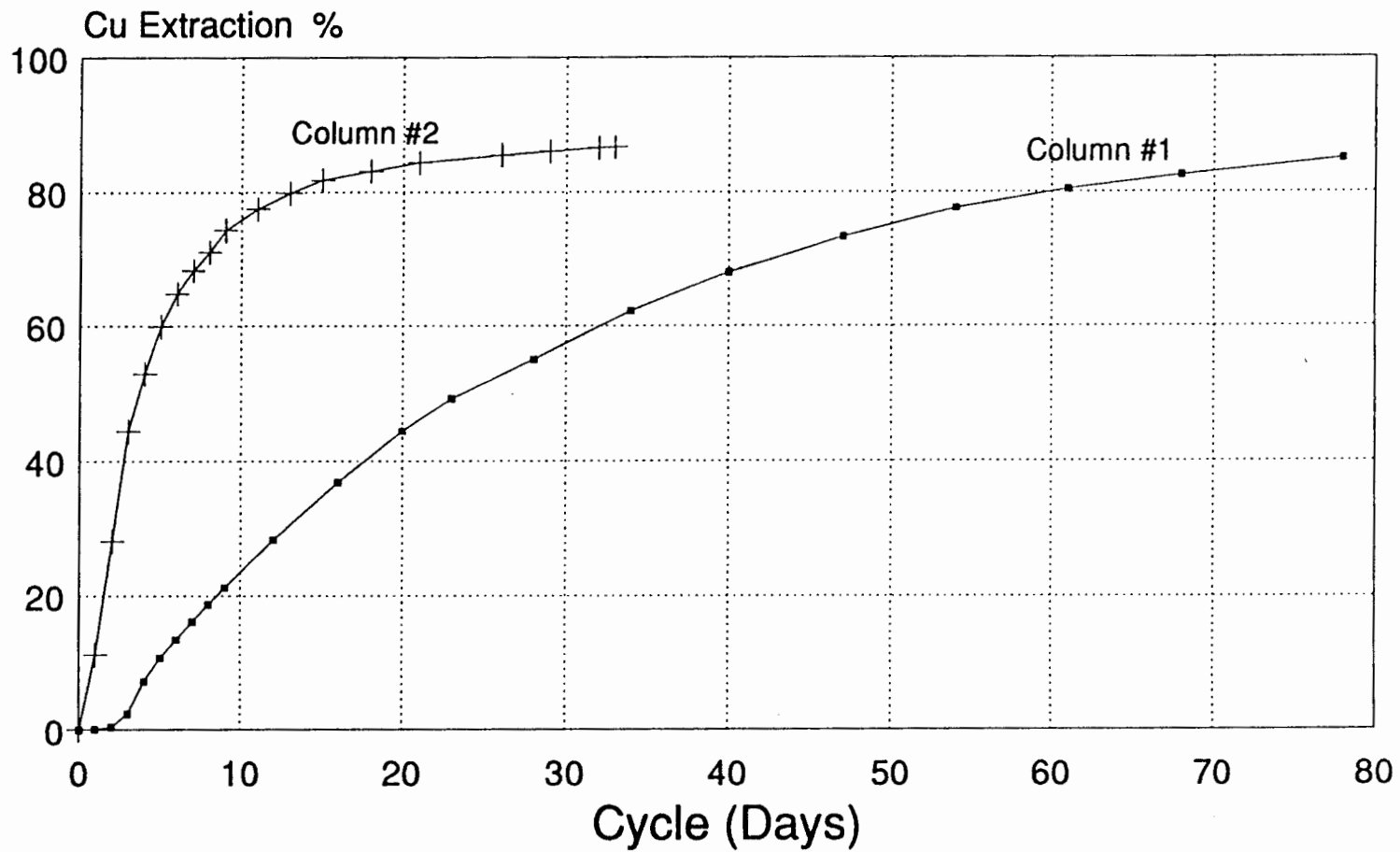


Figure 5.5

APPENDIX I
Bottle Roll Sulphuric Acid Leaching

BOTTLE ROLL SULPHURIC ACID LEACHING OF COPPER OXIDE ORES

File No: M90-001

Date: 16-Oct-89

Test No: L1

Sample Description: COMP BLUE (Size: 1 to 1.5 Inch)

TEST CONDITIONS:

Solids: 4809.3 g
 H₂O: 4150.7 g
 % Solids: 54%
 Solution Strength: 15 g/l H₂SO₄
 Test Duration: 166 hours

TEST DESCRIPTION:

-solids and acid solution combined in large bottle
 -bottles placed on rollers
 -each day, acid solution decanted and replaced with fresh solution
 -decanted solution analyzed for Cu, Fe, free acid, and pH
 -test ended after 166 hours
 -solids washed and wash solutions analyzed
 -final solids assayed for TOTAL COPPER, OXIDE COPPER, IRON

TEST RESULTS:

Solution Analyses:

TIME	SAMPLE SIZE (g)	COPPER		IRON		H ₂ SO ₄		pH
		(g/l)	(g)	(g/l)	(g)	(g/l)	(g)	
22	2919	5.00	14.60	0.03	0.09	0.29	0.85	2.9
46	2780	5.60	15.57	0.24	0.67	0.45	1.25	2.8
70	2622	3.60	9.44	0.55	1.44	0.71	1.86	2.6
94	2548	2.44	6.22	0.09	0.23	0.91	2.32	2.7
166	2319	1.92	4.45	1.33	3.08	0.79	1.83	2.5
wash	4411	0.83	3.66	0.81	3.57	1.07	4.72	2.2
TOTAL			53.93		9.08		12.83	

Solids Analyses:

TIME	SAMPLE SIZE (g)	TOTAL COPPER		OXIDE COPPER		IRON	
		(%)	(g)	(%)	(g)	(%)	(g)
166	4809.3	0.38	18.28	0.28	13.47	4.60	221.23
TOTAL			18.28		13.47		221.23

CALCULATIONS:

TIME	COPPER EXTRACTION		IRON EXTRACTION		ACID CONSUMPTION	
	INDV. %	CUM. %	INDV. %	CUM. %	INDV. kg/tonne	CUM. kg/tonne
22	34.55%	34.55%	0.06%	0.06%	12.70	12.70
46	18.07%	52.62%	0.41%	0.47%	8.79	21.49
70	10.08%	62.70%	0.86%	1.33%	8.19	29.67
94	6.31%	69.00%	-0.21%	1.12%	7.62	37.29
166	5.59%	74.59%	2.35%	3.47%	7.57	44.86
wash	0.10%	74.69%	0.47%	3.94%	1.73	46.59
TOTAL		74.69%		3.94%		46.59

HEAD GRADE:

	<u>TOTAL COPPER</u>	<u>OXIDE COPPER</u>	<u>IRON</u>
ASSAY HEAD	1.68%	1.60%	4.60%
CALCULATED HEAD	1.50%	1.40%	4.79%

SIZE DISTRIBUTION
SAMPLE NO. M90-001 L1
Bottle Roll Tails

Size Fraction (mesh)	Individual Percentage Retained %	Cumulative Percentage Passing %
	+ 1"	83.4
- 1"	+ 3/4"	70.5
- 3/4"	+ 1/2"	65.4
- 1/2"	+ 3/8"	62.7
- 3/8"	+ 4 mesh	60.1
- 4	+ 6	59.6
- 6	+ 8	59.1
- 8	+ 10	58.5
- 10	+ 14	58.0
- 14	+ 20	57.6
- 20	+ 28	57.0
- 28	+ 35	55.0
- 35	+ 48	53.6
- 48	+ 65	52.3
- 65	+ 100	51.1
- 100	+ 150	49.7
- 150	+ 200	47.8
- 200		47.8

BOTTLE ROLL SULPHURIC ACID LEACHING OF COPPER OXIDE ORES

File No: M90-001

Date: 16-Oct-89

Test No: L2

Sample Description: COMP ORANGE (Size: 1 to 1.5 Inch)

TEST CONDITIONS:

Solids: 4897 g
 H₂O: 4458 g
 % Solids: 52%
 Solution Strength: 15 g/l H₂SO₄
 Test Duration: 166 hours

TEST DESCRIPTION:

-solids and acid solution combined in large bottle
 -bottles placed on rollers
 -each day, acid solution decanted and replaced with fresh solution
 -decanted solution analyzed for Cu, Fe, free acid, and pH
 -test ended after 166 hours
 -solids washed and wash solutions analyzed
 -final solids assayed for TOTAL COPPER, OXIDE COPPER, IRON

TEST RESULTS:

Solution Analyses:

TIME	SAMPLE SIZE (g)	COPPER		IRON		H ₂ SO ₄		pH
		(g/l)	(g)	(g/l)	(g)	(g/l)	(g)	
22	3193	6.76	21.58	0.33	1.05	0.33	1.05	2.7
46	3019	4.12	12.44	0.66	1.99	1.13	3.41	2.3
70	2838	2.12	6.02	1.49	4.23	2.73	7.75	2.2
94	2701	1.43	3.86	1.16	3.13	3.99	10.78	2.2
166	2506	1.50	3.76	2.10	5.26	1.91	4.79	2.2
wash	5054	0.49	2.48	0.78	3.94	2.67	13.49	2.2
TOTAL			50.14		19.61		41.27	

Solids Analyses:

TIME	SAMPLE SIZE (g)	TOTAL COPPER		OXIDE COPPER		IRON	
		(%)	(g)	(%)	(g)	(%)	(g)
166	4897	0.52	25.46	0.31	15.18	3.20	156.70
TOTAL			25.46		15.18		156.70

CALCULATIONS:

TIME	COPPER EXTRACTION		IRON EXTRACTION		ACID CONSUMPTION	
	INDV. %	CUM. %	INDV. %	CUM. %	INDV. kg/tonne	CUM. kg/tonne
22	47.62%	47.62%	1.00%	1.00%	13.35	13.35
46	3.28%	50.90%	1.14%	2.13%	8.84	22.19
70	5.71%	56.61%	3.09%	5.23%	7.09	29.29
94	4.15%	60.76%	1.61%	6.84%	5.96	35.25
166	5.48%	66.24%	3.97%	10.81%	7.97	43.22
wash	0.08%	66.32%	0.32%	11.12%	0.56	43.78
TOTAL		66.32%		11.12%		43.78

HEAD GRADE:

	<u>TOTAL COPPER</u>	<u>OXIDE COPPER</u>	<u>IRON</u>
ASSAY HEAD	1.32%	1.26%	4.00%
CALCULATED HEAD	1.54%	1.33%	3.60%

SIZE DISTRIBUTION
SAMPLE NO. M90-001 L2
Bottle Roll Tails

Size Fraction (mesh)	Individual Percentage Retained %	Cumulative Percentage Passing %
+ 1"	25.2	74.8
- 1" + 3/4"	18.8	56.1
- 3/4" + 1/2"	8.4	47.7
- 1/2" + 3/8"	4.6	43.1
- 3/8" + 4 mesh	3.4	39.7
- 4 + 6	0.9	38.8
- 6 + 8	0.6	38.2
- 8 + 10	0.5	37.7
- 10 + 14	0.3	37.4
- 14 + 20	0.3	37.1
- 20 + 28	0.1	37.0
- 28 + 35	0.2	36.8
- 35 + 48	0.1	36.7
- 48 + 65	0.2	36.5
- 65 + 100	0.2	36.3
- 100 + 150	0.4	35.9
- 150 + 200	0.7	35.2
- 200	35.2	

BOTTLE ROLL SULPHURIC ACID LEACHING OF COPPER OXIDE ORES

File No: M90-001

Date: 16-Oct-89.

Test No: L3

Sample Description: COMP BLUE (Size: 3/4 Inch)

TEST CONDITIONS:

Solids: 4538.2 g
 H₂O: 4450.8 g
 % Solids: 50%
 Solution Strength: 15 g/l H₂SO₄
 Test Duration: 166 hours

TEST DESCRIPTION:

-solids and acid solution combined in large bottle
 -bottles placed on rollers
 -each day, acid solution decanted and replaced with fresh solution
 -decanted solution analyzed for Cu, Fe, free acid, and pH
 -test ended after 166 hours
 -solids washed and wash solutions analyzed
 -final solids assayed for TOTAL COPPER, OXIDE COPPER, IRON

TEST RESULTS:

Solution Analyses:

TIME	SAMPLE SIZE (g)	COPPER		IRON		H ₂ SO ₄		pH
		(g/l)	(g)	(g/l)	(g)	(g/l)	(g)	
22	2812	5.32	14.96	0.02	0.06	0.29	0.82	2.7
46	2733	6.68	18.26	0.12	0.33	0.33	0.90	2.9
70	2524	5.00	12.62	0.40	1.01	0.50	1.26	2.8
94	2424	3.52	8.53	0.07	0.17	0.66	1.60	2.7
166	2362	2.54	6.00	1.08	2.55	0.56	1.32	2.6
wash	3595	1.50	5.39	0.75	2.70	0.63	2.26	2.5
TOTAL			65.76		6.81		8.17	

Solids Analyses:

TIME	SAMPLE SIZE (g)	TOTAL COPPER		OXIDE COPPER		IRON	
		(%)	(g)	(%)	(g)	(%)	(g)
166	4538.2	0.35	15.88	0.23	10.44	4.20	190.60
TOTAL			15.88		10.44		190.60

CALCULATIONS:

TIME	COPPER EXTRACTION		IRON EXTRACTION		ACID CONSUMPTION	
	INDV. %	CUM. %	INDV. %	CUM. %	INDV. kg/tonne	CUM. kg/tonne
22	34.81%	34.81%	0.05%	0.05%	14.43	14.43
46	20.38%	55.20%	0.25%	0.30%	9.08	23.50
70	13.09%	68.29%	0.81%	1.11%	8.67	32.17
94	7.26%	75.55%	-0.24%	0.87%	7.91	40.08
166	5.36%	80.91%	2.44%	3.31%	7.76	47.84
wash	-0.36%	80.55%	0.14%	3.45%	2.36	50.20
TOTAL		80.55%		3.45%		50.20

HEAD GRADE:

	<u>TOTAL COPPER</u>	<u>OXIDE COPPER</u>	<u>IRON</u>
ASSAY HEAD	1.68%	1.60%	4.60%
CALCULATED HEAD	1.80%	1.68%	4.35%

SIZE DISTRIBUTION
SAMPLE NO. M90-001 L3
Bottle Roll Tails

Size Fraction (mesh)	Individual Percentage Retained %	Cumulative Percentage Passing %
+ 1"	0	100.0
- 1" + 3/4"	2.0	98.0
- 3/4" + 1/2"	12.5	85.5
- 1/2" + 3/8"	6.2	79.3
- 3/8" + 4 mesh	7.5	71.8
- 4 + 6	2.1	69.7
- 6 + 8	1.6	68.1
- 8 + 10	1.8	66.3
- 10 + 14	1.4	65.0
- 14 + 20	1.5	63.5
- 20 + 28	1.0	62.5
- 28 + 35	2.7	59.9
- 35 + 48	2.4	57.4
- 48 + 65	2.6	54.8
- 65 + 100	2.6	52.2
- 100 + 150	2.5	49.7
- 150 + 200	2.2	47.4
- 200	47.4	

BOTTLE ROLL SULPHURIC ACID LEACHING OF COPPER OXIDE ORES

File No: M90-001

Date: 16-Oct-89

Test No: L4

Sample Description: COMP ORANGE (Size: 3/4 inch)

TEST CONDITIONS:

Solids: 4805.3 g
 H₂O: 4167.7 g
 % Solids: 54%
 Solution Strength: 15 g/l H₂SO₄
 Test Duration: 166 hours

TEST DESCRIPTION:

-solids and acid solution combined in large bottle
 -bottles placed on rollers
 -each day, acid solution decanted and replaced with fresh solution
 -decanted solution analyzed for Cu, Fe, free acid, and pH
 -test ended after 166 hours
 -solids washed and wash solutions analyzed
 -final solids assayed for TOTAL COPPER, OXIDE COPPER, IRON

TEST RESULTS:

Solution Analyses:

TIME	SAMPLE SIZE (g)	COPPER		IRON		H ₂ SO ₄		pH
		(g/l)	(g)	(g/l)	(g)	(g/l)	(g)	
22	2927	7.45	21.81	0.29	0.85	0.27	0.79	2.8
46	2914	5.16	15.04	0.58	1.69	0.62	1.81	2.6
70	2813	2.80	7.88	0.93	2.62	1.37	3.85	2.3
94	2637	3.80	10.02	0.15	0.40	2.36	6.22	2.2
166	2263	1.80	4.07	1.58	3.58	1.36	3.08	2.2
wash	3362	1.09	3.66	1.14	3.83	1.21	4.07	2.3
TOTAL			62.48		12.96		19.82	

Solids Analyses:

TIME	SAMPLE SIZE (g)	TOTAL COPPER		OXIDE COPPER		IRON	
		(%)	(g)	(%)	(g)	(%)	(g)
166	4805.3	0.28	13.45	0.22	10.57	3.60	172.99
TOTAL			13.45		10.57		172.99

CALCULATIONS:

TIME	COPPER EXTRACTION		IRON EXTRACTION		ACID CONSUMPTION	
	INDV. %	CUM. %	INDV. %	CUM. %	INDV. kg/tonne	CUM. kg/tonne
22	49.38%	49.38%	0.78%	0.78%	12.78	12.78
46	7.93%	57.30%	0.98%	1.77%	8.67	21.44
70	6.71%	64.01%	1.70%	3.47%	8.07	29.51
94	15.94%	79.95%	-0.36%	3.11%	7.12	36.63
166	2.08%	82.03%	3.43%	6.55%	7.80	44.44
wash	0.25%	82.28%	0.42%	6.97%	2.05	46.49
TOTAL		82.28%		6.97%		46.49

HEAD GRADE:

	<u>TOTAL COPPER</u>	<u>OXIDE COPPER</u>	<u>IRON</u>
ASSAY HEAD	1.32%	1.26%	4.00%
CALCULATED HEAD	1.58%	1.52%	3.87%

SIZE DISTRIBUTION
SAMPLE NO. M90-001 L4
Bottle Roll Tails

Size Fraction (mesh)	Individual Percentage Retained %	Cumulative Percentage Passing %
+ 1"	0	100.0
- 1" + 3/4"	8.9	91.1
- 3/4" + 1/2"	25.5	65.6
- 1/2" + 3/8"	10.3	55.3
- 3/8" + 4 mesh	9.5	45.7
- 4 + 6	2.0	43.8
- 6 + 8	1.5	42.3
- 8 + 10	1.5	40.8
- 10 + 14	1.0	39.8
- 14 + 20	1.0	38.9
- 20 + 28	0.6	38.3
- 28 + 35	1.3	37.0
- 35 + 48	1.0	36.0
- 48 + 65	0.9	35.1
- 65 + 100	0.7	34.4
- 100 + 150	0.6	33.8
- 150 + 200	0.7	33.2
- 200	33.2	

BOTTLE ROLL SULPHURIC ACID LEACHING OF COPPER OXIDE ORES

File No: M90-001

Date: 16-Oct-89

Test No: L5

Sample Description: COMP BLUE (Size: 1/4 to 3/8 inch)

TEST CONDITIONS:

Solids: 4595.3 g
 H₂O: 4395.7 g
 % Solids: 51%
 Solution Strength: 15 g/l H₂SO₄
 Test Duration: 166 hours

TEST DESCRIPTION:

-solids and acid solution combined in large bottle
 -bottles placed on rollers
 -each day, acid solution decanted and replaced with fresh solution
 -decanted solution analyzed for Cu, Fe, free acid, and pH
 -test ended after 166 hours
 -solids washed and wash solutions analyzed
 -final solids assayed for TOTAL COPPER, OXIDE COPPER, IRON

TEST RESULTS:

Solution Analyses:

TIME	SAMPLE SIZE (g)	COPPER		IRON		H ₂ SO ₄		pH
		(g/l)	(g)	(g/l)	(g)	(g/l)	(g)	
22	2750	4.80	13.20	0.03	0.08	0.17	0.47	3.4
46	2494	6.60	16.46	0.15	0.37	0.21	0.52	3.2
70	2430	5.36	13.02	0.39	0.95	0.38	0.92	2.9
94	2341	3.88	9.08	0.62	1.45	0.67	1.57	2.7
166	2166	2.88	6.24	1.03	2.23	0.44	0.95	2.7
wash	3387	1.70	5.76	0.69	2.34	0.36	1.22	2.7
TOTAL			63.76		7.42		5.66	

Solids Analyses:

TIME	SAMPLE SIZE (g)	TOTAL COPPER		OXIDE COPPER		IRON	
		(%)	(g)	(%)	(g)	(%)	(g)
166	4595.3	0.34	15.62	0.23	10.57	5.00	229.77
TOTAL			15.62		10.57		229.77

CALCULATIONS:

TIME	COPPER EXTRACTION		IRON EXTRACTION		ACID CONSUMPTION	
	INDV. %	CUM. %	INDV. %	CUM. %	INDV. kg/tonne	CUM. kg/tonne
22	32.03%	32.03%	0.07%	0.07%	14.19	14.19
46	20.92%	52.95%	0.24%	0.31%	8.84	23.02
70	13.95%	66.90%	0.60%	0.91%	7.86	30.89
94	8.70%	75.60%	0.85%	1.76%	7.45	38.34
166	5.50%	81.10%	1.35%	3.11%	7.52	45.86
wash	-0.78%	80.32%	0.02%	3.13%	2.30	48.17
TOTAL		80.32%		3.13%		48.17

HEAD GRADE:

	<u>TOTAL COPPER</u>	<u>OXIDE COPPER</u>	<u>IRON</u>
ASSAY HEAD	1.68%	1.60%	4.60%
CALCULATED HEAD	1.73%	1.62%	5.16%

SIZE DISTRIBUTION
SAMPLE NO. M90-001 L5
Bottle Roll Tails

Size Fraction (mesh)	Individual Percentage Retained %	Cumulative Percentage Passing %	
	+ 1"	0	100.0
- 1"	+ 3/4"	0	100.0
- 3/4"	+ 1/2"	0.9	99.1
- 1/2"	+ 3/8"	4.1	95.1
- 3/8"	+ 4 mesh	15.6	79.5
- 4	+ 6	4.5	75.0
- 6	+ 8	3.1	71.8
- 8	+ 10	3.3	68.5
- 10	+ 14	2.6	65.9
- 14	+ 20	2.8	63.1
- 20	+ 28	1.8	61.3
- 28	+ 35	4.2	57.1
- 35	+ 48	3.7	53.3
- 48	+ 65	4.0	49.4
- 65	+ 100	3.7	45.7
- 100	+ 150	3.4	42.3
- 150	+ 200	2.8	39.6
- 200		39.6	

BOTTLE ROLL SULPHURIC ACID LEACHING OF COPPER OXIDE ORES

File No: M90-001

Date: 16-Oct-89

Test No: L6

Sample Description: COMP ORANGE (Size: 1/4 to 3/8 inch)

TEST CONDITIONS:

Solids: 4787 g
 H₂O: 4150 g
 % Solids: 54%
 Solution Strength: 15 g/l H₂SO₄
 Test Duration: 166 hours

TEST DESCRIPTION:

-solids and acid solution combined in large bottle
 -bottles placed on rollers
 -each day, acid solution decanted and replaced with fresh solution
 -decanted solution analyzed for Cu, Fe, free acid, and pH
 -test ended after 166 hours
 -solids washed and wash solutions analyzed
 -final solids assayed for TOTAL COPPER, OXIDE COPPER, IRON

TEST RESULTS:

Solution Analyses:

TIME	SAMPLE SIZE (g)	COPPER		IRON		H ₂ SO ₄		pH
		(g/l)	(g)	(g/l)	(g)	(g/l)	(g)	
22	2750	7.40	20.35	0.28	0.77	0.24	0.66	2.7
46	2863	6.08	17.41	0.57	1.63	0.29	0.83	2.9
70	2689	3.52	9.47	0.85	2.29	0.90	2.42	2.5
94	2488	2.44	6.07	0.12	0.30	1.51	3.76	2.3
166	2281	1.98	4.52	1.45	3.31	1.03	2.35	2.3
wash	3777	1.03	3.89	0.90	3.40	0.84	3.17	2.4
TOTAL			61.70		11.69		13.19	

Solids Analyses:

TIME	SAMPLE SIZE (g)	TOTAL COPPER		OXIDE COPPER		IRON	
		(%)	(g)	(%)	(g)	(%)	(g)
166	4787	0.2	9.57	0.15	7.18	3.80	181.91
TOTAL			9.57		7.18		181.91

CALCULATIONS:

TIME	COPPER EXTRACTION		IRON EXTRACTION		ACID CONSUMPTION	
	INDV. %	CUM. %	INDV. %	CUM. %	INDV. kg/tonne	CUM. kg/tonne
22	53.82%	53.82%	0.75%	0.75%	12.80	12.80
46	10.78%	64.60%	0.89%	1.64%	8.44	21.23
70	9.30%	73.90%	1.46%	3.10%	8.27	29.50
94	6.83%	80.73%	-0.42%	2.68%	7.39	36.89
166	6.01%	86.74%	3.12%	5.80%	7.43	44.32
wash	-0.17%	86.57%	0.24%	6.04%	2.12	46.44
TOTAL		86.57%		6.04%		46.44

HEAD GRADE:

	<u>TOTAL COPPER</u>	<u>OXIDE COPPER</u>	<u>IRON</u>
ASSAY HEAD	1.32%	1.26%	4.00%
CALCULATED HEAD	1.49%	1.44%	4.04%

SIZE DISTRIBUTION
SAMPLE NO. M90-001 L6

Bottle Roll Tails

Size Fraction (mesh)	Individual Percentage Retained %	Cumulative Percentage Passing %
+ 1"	0	100.0
- 1" + 3/4"	0	100.0
- 3/4" + 1/2"	1.2	98.8
- 1/2" + 3/8"	4.4	94.4
- 3/8" + 4 mesh	30.1	64.3
- 4 + 6	9.2	55.1
- 6 + 8	5.0	50.1
- 8 + 10	4.3	45.8
- 10 + 14	2.6	43.3
- 14 + 20	2.2	41.0
- 20 + 28	1.4	39.7
- 28 + 35	3.2	36.5
- 35 + 48	2.8	33.7
- 48 + 65	2.7	31.1
- 65 + 100	2.3	28.8
- 100 + 150	1.9	26.9
- 150 + 200	1.4	25.5
- 200	25.5	

APPENDIX II
Bottle Roll Ammonia Leaching

BOTTLE ROLL AMMONIA LEACHING OF COPPER OXIDE ORES

File No: M90-001

Date: 12-Mar-90

Test No: L7

Sample Description: ORANGE ZONE:BLUE ZONE 50:50 COMPOSITE 3/4" CRUSH

TEST CONDITIONS:

TEST DESCRIPTION:

Solids: 4000 g
 H₂O: 4000 g
 % Solids: 50%
 Solution Strength: .25 M NH₄OH + .25 M (NH₄)₂CO₃ ↵
 Test Duration: 10 days

-solids and ammonia solution combined in large bottle
 -bottles placed on rollers
 -each day, ammonia sol'n decanted and replaced with fresh sol'n
 -decanted solution analyzed for Cu, Fe, and pH
 -test ended after ten (10) days
 -solids washed and wash solutions analyzed
 -final solids assayed for TOTAL COPPER, OXIDE COPPER, IRON

TEST RESULTS:

Solution Analyses:

TIME hours	SAMPLE SIZE (g)	COPPER		IRON		pH
		(g/l)	(g)	(g/l)	(g)	
24	3359	3.36	11.29	0.00	0.00	9.5
48	2986	3.48	10.39	0.00	0.00	9.3
72	2961	2.04	6.04	0.00	0.00	9.3
96	2833	1.20	3.40	0.00	0.00	9.4
168	2810	0.86	2.42	0.00	0.00	9.4
192	2710	0.98	2.66	0.00	0.00	9.4
wash	4835	0.34	1.64	0.00	0.00	9.2
TOTAL			37.84		0.00	

Solids Analyses:

TIME	SAMPLE SIZE (g)	TOTAL COPPER		OXIDE COPPER		IRON	
		(%)	(g)	(%)	(g)	(%)	(g)
192	4000	0.7	28.00	0.66	26.40	4.80	192.00
TOTAL			28.00		26.40		192.00

CALCULATIONS:

TIME hours	COPPER EXTRACTION		IRON EXTRACTION	
	INDV. %	CUM. %	INDV. %	CUM. %
24	20.90%	20.90%	0.00%	0.00%
48	17.89%	38.79%	0.00%	0.00%
72	6.83%	45.61%	0.00%	0.00%
96	3.95%	49.56%	0.00%	0.00%
168	3.07%	52.63%	0.00%	0.00%
192	4.41%	57.04%	0.00%	0.00%
wash	0.67%	57.70%	0.00%	0.00%
TOTAL		57.70%		0.00%

HEAD GRADE:

	<u>TOTAL COPPER</u>	<u>OXIDE COPPER</u>	<u>IRON</u>
ASSAY HEAD	1.50%	1.43%	4.80%
CALCULATED HEAD	1.65%	1.61%	4.80%

APPENDIX III
Column Leaching

M90-001: WILLIAMS CREEK COPPER COLUMN #1

DATE	LEACH CYCLE	LITRES		FLOW (ml/min)		H2SO4 (g/l)		CONSUMPTION H2SO4				PREGNANT SOLUTION			CALCULATED		
		IN	OUT	IN (Aim)	OUT (Actual)	IN	OUT	GRAMS IND.	CUM.	Kg/tonne (TOTAL)	Kg/tonne (As Cu)	Fe (g/l)	COPPER (g/l) (g total)		% COPPER EXTRACTED IND.	CUM.	
Nov	30	1	29.43	10.05	20	7.0	14.79	0.05	638.8	638.8	1.69	0.02	0.00	0.39	3.92	0.1%	0.1%
Dec	1	2	26.70	24.11	20	16.7	14.79	0.09	392.6	1031.5	2.73	0.10	0.00	0.86	20.74	0.4%	0.4%
	2	3	27.96	25.78	20	17.9	14.79	0.13	410.2	1441.6	3.81	0.54	0.00	4.16	107.25	2.0%	2.4%
	3	4	27.96	29.80	20	20.7	14.79	0.17	408.5	1850.2	4.90	1.62	0.20	8.90	265.19	4.8%	7.2%
	4	5	28.27	27.46	20	19.1	14.79	0.03	417.3	2267.5	6.00	2.39	0.49	6.88	188.92	3.4%	10.7%
	5	6	27.75	27.98	20	19.4	14.79	0.05	408.9	2676.4	7.08	3.01	0.62	5.45	152.51	2.8%	13.4%
	6	7	28.86	28.19	20	19.6	14.79	0.14	422.9	3099.3	8.20	3.60	0.72	5.12	144.35	2.6%	16.1%
	7	8	28.54	28.77	20	20.0	14.79	0.16	417.5	3516.8	9.31	4.19	0.78	5.02	144.44	2.6%	18.7%
	8	9	27.71	27.81	20	19.3	14.79	0.20	404.3	3921.1	10.38	4.75	0.84	4.96	137.93	2.5%	21.2%
	11	12	83.65	84.13	20	19.5	14.79	0.09	1229.6	5150.6	13.63	6.34	0.89	4.64	390.34	7.1%	28.3%
	15	16	114.55	112.27	20	19.5	14.79	0.28	1662.7	6813.3	18.03	8.24	0.90	4.16	467.06	8.5%	36.8%
Jan	19	20	114.01	111.14	20	19.3	14.79	0.43	1638.4	8451.7	22.37	9.95	0.96	3.76	417.87	7.6%	44.4%
	22	23	85.18	85.00	20	19.7	14.79	0.86	1186.7	9638.5	25.51	11.03	0.95	3.12	265.20	4.8%	49.2%
	27	28	106.08	101.70	20	14.1	14.79	0.92	1475.3	11113.7	29.41	12.32	1.08	3.12	317.31	5.8%	55.0%
	2	34	163.60	157.59	20	18.2	14.79	0.96	2268.4	13382.2	35.41	13.94	1.22	2.52	397.12	7.2%	62.2%
	8	40	167.24	160.49	20	18.6	14.79	0.40	2409.2	15791.4	41.79	15.25	1.98	2.00	320.98	5.8%	68.0%
	15	47	196.22	192.61	20	19.1	14.79	0.29	2846.2	18637.6	49.32	16.44	2.50	1.52	292.76	5.3%	73.4%
	22	54	199.00	193.27	20	19.2	14.79	1.00	2749.9	21387.5	56.60	17.38	3.00	1.20	231.93	4.2%	77.6%
Feb	29	61	197.36	192.24	20	19.1	9.86	0.98	1757.6	23145.1	61.25	18.03	1.84	0.82	157.64	2.9%	80.4%
	5	68	200.94	197.60	20	19.6	9.86	0.82	1819.3	24964.3	66.06	18.48	1.45	0.56	110.65	2.0%	82.5%
	12	75	187.00	181.18	20	18.0	9.86	0.56	1742.4	26706.7	70.67	18.86	1.62	0.52	94.21	1.7%	84.2%
Wash	13	76	0.00	7.42	0	5.2	0.00	0.56	-4.2	26702.5	70.66	18.88	1.38	0.66	4.89	0.1%	84.3%
	77	100.00	95.26	50	66.2	0.00	0.31	-29.5	26673.0	70.58	19.03	0.50	0.38	36.58	0.7%	84.9%	
Wash 2	78	100.00	103.24	50	71.7	0.00	0.11	-11.4	26661.6	70.55	19.05	0.10	0.05	5.37	0.1%	85.0%	

4675.17

COLUMN TAILS:

DATE	CYCLE	TOTAL SOLIDS (g)	Total Copper		Oxide Copper		Iron	
			%	grams	%	grams	%	grams
Feb 16	78	377896	0.218	823.81	0.155	585.74	3.16	11941.51

CALCULATED HEAD GRADE: 1.46% Cu 3.99% Fe

CALCULATED TOTAL METAL: 5498.99 g Cu 15090.6 g Fe

SIZE DISTRIBUTION

SAMPLE NO. M90-001

Williams Creek Column Tails # 1

Size Fraction (mesh)	Individual Percentage Retained %	Cumulative Percentage Passing %
+ 1"	1.3	98.7
- 1" + 3/4"	20.3	78.4
- 3/4" + 1/2"	24.8	53.6
- 1/2" + 3/8"	9.7	43.9
- 3/8" + 3 mesh	6.5	37.4
- 3 + 4 mesh	4.9	32.5
- 4 + 6	3.2	29.3
- 6 + 8	3.2	26.1
- 8 + 10	2.6	23.5
- 10 + 14	2.2	21.3
- 14 + 20	2.4	18.9
- 20 + 28	1.4	17.5
- 28 + 35	4.0	13.5
- 35 + 48	2.3	11.2
- 48 + 65	2.0	9.2
- 65 + 100	1.9	7.3
- 100 + 150	1.5	5.8
- 150 + 200	1.2	4.6
- 200 + 325	1.2	3.4
- 325	3.4	

M90-001: WILLIAMS CREEK COPPER COLUMN #2

DATE	LEACH CYCLE	LITRES		FLOW (ml/min)		H2SO4 (g/l)		CONSUMPTION H2SO4				PREGNANT SOLUTION			CALCULATED		
		IN	OUT	IN (Aim)	OUT (Actual)	IN	OUT	GRAMS IND.	CUM.	Kg/tonne (TOTAL)	Kg/tonne (As Cu)	Fe (g/l)	COPPER (g/l) (g total)		% COPPER EXTRACTED IND.	CUM.	
Mar	9	1	137.77	105.87	100	73.5	19.72	0.38	2887.1	2887.1	7.72	2.72	0.11	6.24	660.65	11.2%	11.2%
Mar	10	2	134.14	133.36	100	92.6	19.72	0.65	2558.5	5445.6	14.56	6.85	0.43	7.52	1002.90	17.0%	28.1%
	11	3	149.27	156.85	100	108.9	19.72	1.21	2753.9	8199.5	21.93	10.81	0.97	6.12	959.93	16.2%	44.4%
	12	4	133.32	125.20	100	86.9	19.72	3.41	2202.2	10401.7	27.82	12.89	1.58	4.04	505.80	8.6%	52.9%
	13	5	136.23	144.16	100	100.1	19.72	5.05	1958.3	12360.1	33.06	14.60	2.00	2.88	415.18	7.0%	59.9%
	14	6	143.94	143.80	100	99.9	14.79	4.18	1527.7	13887.8	37.14	15.78	1.80	2.00	287.59	4.9%	64.8%
	15	7	131.43	131.01	100	91.0	14.79	4.05	1413.2	15301.0	40.92	16.64	1.60	1.58	206.99	3.5%	68.3%
	16	8	130.28	130.96	100	90.9	14.79	4.57	1328.3	16629.4	44.48	17.33	1.54	1.28	167.63	2.8%	71.1%
	17	9	128.15	130.01	100	90.3	14.79	4.91	1257.0	17886.4	47.84	18.13	1.13	1.50	195.01	3.3%	74.4%
	19	11	141.49	139.99	50	48.6	14.79	2.84	1695.0	19581.4	52.37	18.88	1.80	1.30	181.98	3.1%	77.5%
	21	13	141.94	143.07	50	49.7	14.79	3.11	1654.3	21235.7	56.80	19.47	0.48	1.00	143.07	2.4%	79.9%
	23	15	142.25	141.40	50	49.1	9.86	2.16	1097.2	22332.9	59.73	19.92	1.50	0.78	110.29	1.9%	81.8%
	26	18	113.00	114.27	30	26.5	9.86	1.11	987.3	23320.3	62.37	20.25	1.30	0.70	79.99	1.4%	83.1%
	29	21	122.36	122.36	30	28.3	9.86	0.87	1100.1	24420.3	65.31	20.55	1.30	0.60	73.42	1.2%	84.4%
Apr	3	26	94.64	100.64	20	14.0	9.86	1.03	829.5	25249.8	67.53	20.82	1.38	0.64	64.41	1.1%	85.5%
Apr	6	29	71.27	65.09	20	15.1	9.86	0.47	672.2	25921.9	69.33	20.98	1.12	0.59	38.40	0.6%	86.1%
Wash	1	32	144.55	141.36	100	98.2	0.00	0.12	-17.0	25905.0	69.28	21.10	0.56	0.21	29.69	0.5%	86.6%
Wash	1	33	126.36	140.27	100	97.4	0.00	0.47	-65.9	25839.0	69.11	21.13	0.08	0.04	6.17	0.1%	86.7%

5129.11

COLUMN TAILS:

DATE	CYCLE	TOTAL SOLIDS (g)	Total Copper		Oxide Copper		Iron	
			%	grams	%	grams	%	grams
Apr 12	33	373897	0.21	785.18	0.16	598.24	2.84	10618.67

CALCULATED HEAD GRADE: 1.58% Cu 3.55% Fe

CALCULATED TOTAL METAL: 5914.30 g Cu 13284.58 g Fe

SIZE DISTRIBUTION

SAMPLE NO: M90-001 Cu Column #2 Tails

Size Fraction	Individual Percentage Retained	Cumulative Percentage Passing	
	+3/4"	11.3	88.7
-3/4"	+1/2"	19.6	69.1
-1/2"	+3/8"	7.0	62.1
-3/8"	+ 3 mesh	5.1	57.0
- 3	+ 4 mesh	4.3	52.7
- 4	+ 6 mesh	4.5	48.2
- 6	+ 8 mesh	3.9	44.3
- 8	+ 10 mesh	4.3	40.0
- 10	+ 14 mesh	3.8	36.2
- 14	+ 20 mesh	4.5	31.7
- 20	+ 28 mesh	4.8	26.9
- 28	+ 35 mesh	5.3	21.5
- 35	+ 48 mesh	4.5	17.0
- 48	+ 65 mesh	3.7	13.3
- 65	+100 mesh	4.2	9.0
-100	+150 mesh	2.3	6.8
-150	+200 mesh	2.2	4.6
-200		4.6	

APPENDIX II
LIST OF PERSONNEL

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LIST OF PERSONNEL

<u>Name</u>	<u>Position</u>	<u>Dates Employed</u>
A.R. Archer	Project planner	August 18, 19
W.D. Eaton	Geologist and project supervision	August 22-24
T. Becker	Geologist	August 21-22; Sept. 23
B. Wengzynowski	Assistant	August 21-22
F. Gish	Assistant	September 27
J. Mariacher	Assistant	August 18-24


APPENDIX III

AUTHOR'S STATEMENT OF QUALIFICATIONS

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AUTHOR'S STATEMENT OF QUALIFICATIONS

I, Alan R. Archer, with business addresses in Whitehorse, Yukon Territory and Vancouver, British Columbia, and residential address in West Vancouver, British Columbia, do hereby declare:

1. I am a 1957 graduate of the University of British Columbia in geological engineering.
2. I have been engaged in geological engineering for over thirty-two years, the past twenty-four of which have been as a senior partner with Archer, Cathro & Associates Limited and its successor, Archer, Cathro & Associates (1981) Limited.
3. I am a registered professional engineer in British Columbia and in Yukon Territory.
4. I have supervised the work described in this report.


Alan R. Archer, B.A.Sc., P.Eng.

