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CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES

OTTAWA

MINES BRANCH INVESTIGATION REPORT IR 71-3

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**LIBERATION AND FLOTATION  
CHARACTERISTICS OF SILVER-COPPER ORE  
FROM SMITHERS, B. C. SUBMITTED BY  
KENNCO EXPLORATIONS (CANADA) LIMITED**

IR 71-3

by

**W. ARTHUR WALL AND R. W. BRUCE**

**MINERAL PROCESSING DIVISION**

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*June 8/71*  
C-10  
IR 71-3  
GEOLOGICAL FILES

JANUARY 1971

01-7988775-

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LIBERATION AND FLOTATION CHARACTERISTICS OF SILVER-COPPER  
ORE FROM SMITHERS, B. C.  
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W. Arthur Wall\* and R. W. Bruce\*\*

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SUMMARY OF RESULTS

A flotation investigation was carried out to determine the fineness of grind for the liberation of the valuable constituents in the ore and their flotation characteristics.

Flotation tests resulted in a primary concentrate assaying 40.9 oz silver per ton and 3.66 per cent copper, and containing 61.8 per cent of the silver and 70.1 per cent of the copper in the feed (Test 9). Cleaning the rougher concentrate produced a final concentrate assaying 96.72 oz silver per ton and 10.0 per cent copper, but containing only 40.4 per cent of the silver and 52.8 per cent of the copper in the feed.

The results of the flotation testwork coupled with the mineralogical investigation and the size analysis of a sample of the flotation tailing indicate that the above flotation results are essentially as good as can be expected.

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## INTRODUCTION

### Location of Property

The property from which this sample was obtained is called the Sam Goosly Prospect and is located at 54° 11' 15" North Latitude, 126° 16' 15" West Longitude. The property is southeast of Smithers, British Columbia.

### Shipment

Five sacks of ore weighing 330 pounds were received on November 27, 1969.

### Purpose of Investigation

This deposit of ore reportedly contains some tens of millions of tons of material grading 0.7 per cent copper, 4.0 to 5.0 ounces silver, and 0.04 ounces gold per ton. Kennecott Copper Corporation has conducted considerable research work on this ore at their Salt Lake City Laboratory but they were not able to make a marketable grade of copper concentrate from this material.

The Non-Ferrous Minerals Section of the Mineral Processing Division was asked to carry out some metallurgical research on this ore. It was agreed that the Mineral Processing Division would have a mineralogical study done on this sample, and would carry out a limited investigation of flotation characteristics of the ore.

### Sampling and Analysis

Six hand specimens were selected for microscopic examination. The remainder of the ore was crushed to minus half-inch and split into two equal parts. One portion was crushed to minus 10-mesh size and split into 2000-gram samples. One 2000-gram sample was split into halves and one half submitted for microscopic investigation. The remaining half was pulverized, and one portion submitted for chemical analysis and another for semi-quantitative spectrographic analysis.

The chemical analysis of the head sample is shown in Table 1. The semi-quantitative spectrochemical analysis is shown in Table 2.

TABLE 1

<u>Head Sample Analysis</u>		
Gold <sup>(1)</sup>	0.0475	oz/ton
Silver <sup>(1)</sup>	5.115	oz/ton
Total Copper <sup>(1)</sup>	0.42	per cent
Non-Sulphide Copper <sup>(1)</sup>	0.08	per cent
Iron <sup>(2)</sup>	4.58	per cent
Total Sulphur <sup>(2)</sup>	1.57	per cent
Sulphide Sulphur <sup>(2)</sup>	1.47	per cent
Sulphate Sulphur <sup>(2)</sup>	0.10	per cent

(1) From Internal Reports MS-AC-69-946 and 70-104.

(2) From Bondar-Clegg Report A-7-70.

TABLE 2

<u>Semi-Quantitative Spectrochemical Analysis*</u>		
Principal Constituent	> 1.0%	Al, Fe, Si
Prominent Constituent	< 1.0% > 0.1%	Cu, Ba, Ti
Minor Constituent	< 0.1%	Ag, Bi, Ca, Cr, Mg, Mn, Mo, Ni, Pb, V, Zn

\* From Internal Report MS-AC-69-898.

#### MINERALOGICAL EXAMINATION\*

The ore is composed of a fine-grained matrix of quartz and mica (sericite) with small amounts of clay, chlorite, barite, and a deep red biotite, which may be titaniferous. Distributed throughout this matrix is a variety of fine-grained ore minerals.

Six copper-bearing minerals were identified in the sample. These include chalcopyrite, tennantite-tetrahedrite, digenite, malachite, and covellite, of which chalcopyrite is the most prevalent.

The chalcopyrite in the ore is generally very fine-grained. It occurs largely as disseminated grains in gangue, intergrowths with pyrite, tennantite-tetrahedrite and arsenopyrite, and as combinations with pyrite,

\*From Mines Branch Investigation Report IR 70-11 by D.R. Owens

magnetite or rutile in gangue. The chalcopyrite ranges in size from less than one to about 300 microns; the majority of these grains are smaller than 60 microns. The chalcopyrite, due to its small size, contains only a few inclusions of the other minerals in the ore.

Significant amounts of tennantite-tetrahedrite are present in the ore. The silver content varies from a low of 0.2 to a high of 3.8 per cent silver. The tennantite-tetrahedrite grains vary in size from 2 to 50 microns.

One grain of gold, approximately 10 microns in size, was found as an inclusion in chalcopyrite.

It is stated in the report that all of the economic minerals in the ore are very fine-grained and will probably be difficult to liberate by normal grinding methods. It was also reported that the presence of a large proportion of fine-grained mica and a smaller amount of clay would probably increase the problems of beneficiating this ore.

#### OUTLINE OF INVESTIGATION

A number of flotation tests were carried out on ore ground to various degrees of fineness and with various combinations of reagents. The fineness of grind was varied from 47 per cent to 98 per cent minus 325 mesh in flotation tests in which the pH of the pulp ranged from 3.0 to 10.0 with various combinations of promoters and frothers.

Full details of all tests are shown in the Mines Branch Test Reports in Appendix A.

#### DISCUSSION OF RESULTS

Fourteen flotation tests were performed in this investigation to determine the effect of grind, pH, flotation conditions, and reagents on grade and recovery of the silver and copper minerals. The flotation tailing of each test was screened to determine the screen analysis of the tailing. The grind varied from 47.0 per cent minus 325 mesh in Test 1 to 98.8 per cent minus 325 mesh in Test 14. The best recoveries were obtained in Test 9 in which the ore was ground to 75.2 per cent minus 325 mesh. Test 9 flotation tailing assayed 1.75 oz silver per ton and 0.10 per cent copper, and contained 26.1 per cent of the silver and 18.9 per cent of the copper in the feed. Test 11, with a grind of 89.8 per cent minus 325 mesh, was carried out with the same flotation conditions and reagents as Test 9 but gave inferior results.

Tests 5 to 10 inclusive were carried out on ore ground to the same degree of fineness (75.2 per cent minus 325 mesh). Various combinations of pH and flotation reagents were investigated. The flotation conditions and reagents used in Test 9 resulted in the highest recovery of silver and copper in the concentrate, and a tailing with the lowest amount of silver and copper.

Tests 11 to 14 inclusive were carried out on ore ground to different degrees of fineness from 89.8 to 98.8 per cent minus 325 mesh. Flotation conditions and reagents similar to those used in Test 9 were employed in these tests. The results of these tests were better than those of tests carried out at a coarser grind with the exception of Test 9. It should be pointed out that the silver and copper assays of the cleaned concentrates produced in Tests 11, 12, 13, and 14 were considerably higher than the assays of clean concentrate in Test 9.

A sample of the flotation tailing from Test 4 was submitted to the Mineral Sciences Division for mineralogical examination to determine the mineralogical composition which results in the high silver and copper content. The Mineral Sciences report (MS-70-47) covering this mineralogical examination is attached as Appendix B. This report states, "The copper content is due mainly to the presence of chalcopyrite; the silver to tennantite or tetrahedrite. Both free and combined grains were observed but the proportions of the two types could not be determined because of the extremely fine grain size".

Another portion of Test 4 flotation tailing was sized in a Cyclo-Sizer and the various size fractions assayed for silver and copper. The size distribution, assays, and metal distribution are shown on Test 4 Data Sheet No. 2. It can be seen that there is no concentration of the silver and copper values in any particular size. The silver and copper are disseminated throughout the gangue, and finer grinding will not materially increase the recovery of copper and silver.

#### CONCLUSIONS

The investigation of the flotation characteristic showed that the production of a marketable grade of copper concentrate from this ore will be extremely difficult, if not impossible. In Test 9, which gave the highest recoveries of any of the tests conducted, the cleaned concentrate assayed only 3.66 per cent copper and 40.9 oz silver per ton, with recoveries of 70.1 per cent and 61.8 per cent respectively.

The highest grade concentrate obtained in the investigation assayed 10.0 per cent copper and 96.7 oz silver per ton, with recoveries of 52.8 per cent and 40.4 per cent respectively. These results were obtained only after grinding to nearly all minus 400 mesh.

The poor grades and recoveries of valuable constituents in the ore were attributed to their extremely fine-grained occurrence. This was confirmed by mineralogical examination of the ore and of a sample of the flotation tailing. Sub-sieve size analyses of the flotation tailing also indicated that the chalcopyrite and tennantite-tetrahedrite were not free but were present in the tailing as finely-disseminated middling particles.

#### ACKNOWLEDGEMENTS

The authors wish to acknowledge the assistance of the following members of the Mineral Sciences Division: Mr. D.R. Owens, who carried out the mineralogical examinations of the ore; Mr. D.P. Palombo, who performed the spectrographic analysis; Messrs. J. Cloutier, R. Craig, C.A. Derry, R. Donahoe, J. Graham, J.C. Hole, P. Lanthier, P.E. Maloughney, and C. Smith, who carried out the chemical analysis.



APPENDICES

APPENDIX A

Test Data Sheets

Abbreviations used in Data Report Sheets

RM	Rod Mill
CaO	Lime
Z-6	Potassium Amyl Xanthate
404	Aero Promoter 404
DF 250	Dowfroth 250 - Frother
Aero 31	Aerofloat 31 - Promoter
Z-200	Isopropyl Ethyl Thiono Carbamate - Promoter
Amo Phos 317	Mono-ammonium Phosphate - Modifier
Na <sub>2</sub> CO <sub>3</sub>	Sodium Isobutyl Zanthate
CA	Sodium Carbonate
H <sub>2</sub> SO <sub>4</sub>	Cresylic Acid
3501	Sulphuric Acid
	Aero Promoter 3501

# MINES BRANCH FLOTATION TEST REPORT

TEST NO. 1	SAMPLE: Kennco Exploration (Canada) Limited						DATE: Jan. 16, 1970						
OBJECT OF TEST: Preliminary Grinding and Concentration Test						CHARGE: 2000-g							
						TESTED BY: W.A.W.							
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton								
					CaO	Z-6	404	DF250					
Grinding (58.4%-200m)	30	67		7x14 R M									
Conditioning	15	50	10.2	2000-g cell	4.0	0.10	0.05	0.04					
Flotation	5	25											
Scavenging	5	25	9.5			0.10	0.10						
Cleaning	3			500-g cell									
PRODUCT	WT %	ANALYSIS %						DISTRIBUTION %					
		Ag(1)	Cu(2)					Ag	Cu				
Cu clean conc	2.5	22.31	2.86					10.8	18.1				
Cu clean tail	4.0	22.66	2.02					17.6	20.5				
Scavenger conc	3.9	17.40	1.35					13.2	13.3				
Rougher tail	89.6	3.36	0.212					58.4	48.1				
Feed (calcd)	100.0	5.15	0.395					100.0	100.0				
Cu rougher conc (calcd)	6.5	22.52	2.34					28.4	38.6				
REMARKS: Grind 47.0 per cent minus 325 mesh.													
(1) From Internal Report MS-AC-70-107													
(2) From Bondar & Clegg Report A-10-70													

## MINES BRANCH FLOTATION TEST REPORT

TEST NO. 2	SAMPLE: Kennco Exploration (Canada) Limited						DATE: Jan. 19, 1970							
OBJECT OF TEST: Regrind Concentrate before Cleaning						CHARGE: 2000-g								
						TESTED BY: W.A.W.								
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					CaO	Z-6	404	DF250	Aero31					
Grinding (58.4%-200m)	30	67		7x14 R M										
Conditioning	15	50	10.6	2000-g cell	4.0	0.10	0.05	0.04	0.05					
Flotation	11	30	10.0			0.10	0.05		0.05					
Grind conc	45			Pebble Mill										
Cleaning	5			500-g cell			0.025	0.02						
Recleaning	1			250-g cell										
PRODUCT	WT %	ANALYSIS %						DISTRIBUTION %						
		Ag(1)	Cu(2)					Ag	Cu					
Copper clean conc	2.3	53.5	6.08					24.2	35.0					
Cu clean tail (combined)	12.3	9.37	0.72					22.6	22.3					
Rougher tail	85.4	3.17	0.20					53.2	42.7					
Feed (calcd)	100.0	5.09	0.40					100.0	100.0					
Rougher conc (calcd)	14.6	16.33	1.57					46.8	57.3					
REMARKS: (1) From Internal Report MS-AC-70-107 (2) From Bondar-Clegg & Co. Report A-13-70														

## MINES BRANCH FLOTATION TEST REPORT

TEST NO. 3		SAMPLE: Kemco Exploration (Canada) Limited						DATE: Jan. 23, 1970						
OBJECT OF TEST: Finer Grind								CHARGE: 2000-g						
								TESTED BY: W.A.W.						
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					CaO	Z-200	404	DF250	Aero31	Amo Phos				
Grinding (98.3%-200m)	60	67		7x14 R.M.										
Conditioning	15	35	9.6	2000-g cell	4.0	0.10	0.05							
Copper flotation	5	22	7.5					0.04						
Scavenger No. 1	5	22				0.10			0.05					
Scavenger No. 2	5		7.5			0.05			0.05	4.0				
PRODUCT	WT %	ANALYSIS %						DISTRIBUTION %						
		Ag <sup>(1)</sup>	Cu <sup>(2)</sup>					Ag	Cu					
Copper conc	7.4	35.26	3.42					48.8	60.1					
Scavenger conc No. 1	4.5	9.36	0.58					7.9	6.2					
Scavenger conc No. 2	5.6	5.87	0.35					6.2	4.7					
Rougher tail	82.5	2.405	0.148					37.1	29.0					
Feed (calcd)	100.0	5.34	0.42					100.0	100.0					
<b>REMARKS:</b> Grind 80.4 per cent minus 325 mesh. (1) From Internal Report MS-AC-70-112 (2) From Bondar-Clegg & Co. Report A-19-70														

# MINES BRANCH FLOTATION TEST REPORT

Sheet 1 of 2

TEST NO. 4	SAMPLE: Kennco Exploration (Canada) Limited						DATE: Jan. 29, 1970							
OBJECT OF TEST: Different Flotation Reagents - Cyclosize Float Tails						CHARGE: 2000-g								
						TESTED BY: W.A.W.								
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					Amo Phos	317	404	DF250	Na <sub>2</sub> CO <sub>3</sub>	Z-200				
Grinding (100%-200 m)	60	67		7x14 R M										
Conditioning	5	35	7.2	2000-g cell	4.0									
Flotation No. 1	4	20	7.2			0.10	0.10	0.06						
Conditioning	5	20	8.5						4.0	0.15				
Flotation No. 2	15	20	8.4											
PRODUCT	WT %	ANALYSIS %						DISTRIBUTION %						
		Ag(1)	Cu(2)					Ag	Cu					
Float conc No. 1	5.9	42.12	3.79					54.6	58.6					
Float conc No. 2	13.1	6.325	0.41					15.2	14.1					
Rougher tail	81.0	2.05	0.129					30.2	27.3					
Feed (calcd)	100.0	5.47	0.38					100.0	100.0					
REMARKS: (1) From Internal Report MS-AC-70-122														
(2) From Bondar-Clegg & Co. Ltd. Report A-28-70														

# MINES BRANCH FLOTATION TEST REPORT

Sheet 2 of 2

TEST NO. 4	SAMPLE: Kennco Exploration (Canada) Limited	DATE: Jan. 29, 1970
OBJECT OF TEST:		CHARGE:
		TESTED BY:

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
Cyclosize flotation tailings														

PRODUCT	WT %	ANALYSIS % (1)					DISTRIBUTION %				
		Ag		Cu			Ag		Cu		
+40.6 micron	4.4	1.91		0.18*			4.7		6.2		
+30.9 "	10.7	2.105		0.14			12.4		11.6		
+22.5 "	22.0	1.965		0.13			23.8		22.5		
+15.5 "	24.8	1.735		0.12			23.7		23.3		
+11.9 "	16.9	1.645		0.11			15.3		14.7		
Slime	21.2	1.715		0.13			20.1		21.7		
Rougher tail (calcd)	100.0	1.81		0.129			100.0		100.0		

REMARKS: Flotation tailings washed in hot water and methyl hydrate before sizing.  
 \* Calculated  
 (1) From Internal Report MS-AC-70-175 and 198

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## MINES BRANCH FLOTATION TEST REPORT

TEST NO. 5	SAMPLE: Kennco Exploration (Canada) Limited							DATE: April 28, 1970						
OBJECT OF TEST: Flotation at acid pulp.							CHARGE: 2000-g							
							TESTED BY: W.A.W.							
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					C.A.	H <sub>2</sub> SO <sub>4</sub>	317	404	CaO	Na <sub>2</sub> CO <sub>3</sub>	Aero31			
Grinding(97.4%-200m)	60	67		7 x 14 RM										
Conditioning	2	45		2000-g cell	0.12									
Flotation No. 1	3	30	6.6											
Conditioning	2		3.0		0.08	12.0								
Flotation No. 2	5		4.3											
Conditioning	2						0.05	0.05						
Flotation No. 3	5		4.0											
Conditioning	5		8.5				0.05	0.05	4.0	12.0	0.04			
Flotation No. 4	4		8.5											
PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %						
		Ag		Cu				Ag		Cu				
No. 1 Concentrate	4.8		22.04		1.90				20.5		22.2			
No. 2 Concentrate	3.0		52.26		4.66				30.4		34.2			
No. 3 Concentrate	2.8		18.14		1.62				9.8		11.2			
No. 4 Concentrate	1.5		7.51		0.65				2.2		2.4			
Rougher tailing	87.9		2.18		0.14				37.1		30.0			
Feed (calcd)	100.0		5.16		0.41				100.0		100.0			
REMARKS: * From Internal Report MS-AC-70-524 and 535.														



# MINES BRANCH FLOTATION TEST REPORT

TEST NO. 6	SAMPLE: Kennco Exploration (Canada) Limited	DATE: April 29, 1970
OBJECT OF TEST: Pulp washed before flotation		CHARGE: 2000-g
		TESTED BY: W.A.W.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					C.A.	317	404	Na <sub>2</sub> CO <sub>3</sub>	Z-200					
Grinding (97.1%-200m)	60	57		7 x/4 RM										
Washing														
Conditions	5	45	6.5	2000-g cell	0.16									
Flotation No. 1	3	30												
Conditioning	1	20				0.10	0.10							
Flotation No. 2	5	20	6.4											
Conditioning			8.7					4.0	0.15					
Flotation No. 3	15	20												

PRODUCT	WT %	ANALYSIS % *						DISTRIBUTION %				
		Ag		Cu				Ag		Cu		
No. 1 concentrate	2.1		37.56		3.32				15.2		16.9	
No. 2 concentrate	5.7		18.03		1.91				19.8		26.3	
No. 3 concentrate	5.8		16.52		1.36				18.4		19.1	
Rougher tailing	86.4		2.81		0.18				46.6		37.7	
Feed (Calcd)	100.0		5.20		0.41				100.0		100.0	

REMARKS: Ground pulp filtered and washed twice in filter with hot water.  
 \* From Internal Report MS-AC-70-524 and 535.

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## MINES BRANCH FLOTATION TEST REPORT

TEST NO. 7	SAMPLE: Kennco Exploration (Canada) Limited	DATE: May 20, 1970
OBJECT OF TEST: Repeat of Test No. 4 plus Re grind of Rougher Conc.		CHARGE: 2000-g
TESTED BY: W.A.W.		

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					Amo Phos	317	404	DF250	Na <sub>2</sub> CO <sub>3</sub>	Z-200				
Grind (97.1%-200m)	60	67		7x14 RM										
Condition	5	35		2000-g cell	4.0									
Float No. 1	4	20	6.5			0.10	0.20	0.08						
Condition	5	20	8.4						5.0	0.10				
Float No. 2	15	20	8.4				0.10			0.10				
Grind concentrate	45			Pebble Mill										
Clean conc No. 1	5			500-g cell			0.025	0.01						
Clean conc No. 2	2			250-g cell										

PRODUCT	WT %	ANALYSIS %*					DISTRIBUTION %			
		Ag oz/ton	Cu	NSCu	SCu	Ag	Cu	NSCu	SCu	
Clean conc (1)	2.8	70.80	7.30	0.48	6.82	39.9	53.1	22.0	58.8	
Clean tail No. 1	10.6	8.12	0.48	0.13	0.35	17.4	13.3	23.7	11.4	
Clean tail No. 2	2.1	20.82	1.33	0.34	0.99	8.8	7.3	11.9	6.4	
Rougher tail	84.5	1.99	0.12	0.03	0.09	33.9	26.3	42.4	23.4	
Feed (calculated)	100.0	4.96	0.38	0.06	0.32	100.0	100.0	100.0	100.0	

REMARKS: \*From Internal Report MS-AC-70-564, 568, 592 and 621.  
 (1) Sulphur Assay = 31.49%  
       Insol " = 23.37%  
       CO<sub>2</sub> " = 0.04%

# MINES BRANCH FLOTATION TEST REPORT

TEST NO. 8	SAMPLE: Kennco Exploration (Canada) Limited						DATE: May 21, 1970							
OBJECT OF TEST: Different Reagents						CHARGE: 2000-g								
						TESTED BY: W.A.W.								
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					Amo Phos	CaO	3501	404	DF250	Z-200				
Grind (96.0%-200m)	60	57		7x14 RM										
Condition	5	40	9.0	2000-g cell	4.0	6.0								
Float	5	30	9.0				0.10	0.20	0.06					
Condition	5									0.10				
Float	10	30	9.0				0.10							
PRODUCT	WT %	ANALYSIS %*					DISTRIBUTION %							
		Ag oz/ton	Cu				Ag	Cu						
No. 1 Cu conc	7.45	33.68	3.28				47.7	59.7						
No. 2 Cu conc	5.76	6.71	0.46				7.3	6.3						
Rougher tail	86.79	2.73	0.16				45.0	34.0						
Feed (calculated)	100.0	5.26	0.41				100.0	100.0						
REMARKS: *From Internal Report MS-AC-70-564 and 568.														

## MINES BRANCH FLOTATION TEST REPORT

TEST NO. 9	SAMPLE: Kennco Exploration (Canada) Limited						DATE: June 17, 1970							
OBJECT OF TEST: pH adjustment with NA <sub>2</sub> CO <sub>3</sub>						CHARGE: 2000-g								
						TESTED BY: WAW								
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					Na <sub>2</sub> CO <sub>3</sub>	404	A 31	Z-200	DF250					
Grind (97.4%-200m)	60	67		7x14 R M										
Condition	15	40	8.0	2000 g. cell	4.0	0.10	0.04							
Flotation	4	25	8.0					0.10						
Scavenger No. 1	5	25	8.0					0.10	0.06					
Scavenger No. 2	5	25	7.5			0.10								
PRODUCT	WT %	ANALYSIS *					DISTRIBUTION %							
		Ag oz/ton	Cu %				Ag		Cu					
No. 1 conc.	8.0	40.9	3.66				61.8		70.1					
No. 2 conc.	7.2	5.96	0.45				8.1		7.7					
No. 3 conc.	5.7	3.69	0.25				4.0		3.3					
Rougher tail	79.1	1.75	0.10				26.1		18.9					
Feed (calcd.)	100.0	5.29	0.42				100.0		100.0					
REMARKS: * From Internal Reports MS-AC 70-634 and 636.														

# MINES BRANCH FLOTATION TEST REPORT

TEST NO. 10	SAMPLE: Kennco Exploration (Canada) Limited						DATE: July 8, 1970						
OBJECT OF TEST: Repeat of Test-9.						CHARGE: 2000-g							
						TESTED BY: WAW							
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton								
					Na <sub>2</sub> CO <sub>3</sub>	404	A31	Z-200					
Grind (96.0%-200m)	60	57		7 x 14 RM	4.0	0.20	0.05						
Condition	2	45	8.5	2000-g cell				0.08					
Float No. 1	3.5	30	8.5				0.03						
Condition	1.5					0.20	0.03	0.08					
Float No. 2	1.5		9.1										
PRODUCT	WT %	ANALYSIS *					DISTRIBUTION %						
		Ag oz/t	Cu%				Ag		Cu				
No. 1 conc	7.7	30.88	3.14				47.6		57.4				
No. 2 conc	13.3	7.28	0.58				19.4		18.2				
Rougher tail	79.0	2.09	0.13				33.0		24.4				
Feed (calcd)	100.0	5.00	0.42				100.0		100.0				
REMARKS: * From Internal Report MS-AC-70-720 and 730.													

## MINES BRANCH FLOTATION TEST REPORT

TEST NO. 11	SAMPLE: Kennco Exploration (Canada) Limited						DATE: Sept. 24, 1970							
OBJECT OF TEST: Repeat of Test 9 at finer grind.						CHARGE: 2000-g								
						TESTED BY: WAW								
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					Na <sub>2</sub> CO <sub>3</sub>	404	A31	Z-200	DF250					
Grind (1)	75	67		7 x 14 RM										
Condition	15	35	8.0	2000-g cell	4.0	0.10	0.04							
Flotation	4	25	8.0				0.06	0.10	0.02					
Scav float No. 1	5	25	8.0					0.10						
Scav float No. 2	5	25	7.5			0.10								
Clean total conc	2			1000-g cell										
Reclean	1			500-g cell										
Re-reclean	1			250-g cell										
PRODUCT	WT %	ANALYSIS *				DISTRIBUTION %								
		Ag oz/ton	Cu%			Ag		Cu						
Clean conc	4.2	60.60	6.00			50.3		58.9						
Cleaner tail	5.1	6.93	0.45			7.0		5.4						
Reclean & Re-reclean tail	1.5	27.86	1.89			8.3		6.5						
Rougher conc (calcd)	10.8	30.70	2.81			65.6		70.8						
Rougher tail	89.2	1.95	0.14			34.4		29.2						
Feed	100.0	5.05	0.43			100.0		100.0						
REMARKS: * From Internal Reports MS-AC-70-899 and 907. (1) Flotation tailing 85.4 per cent minus 400 mesh.														

# MINES BRANCH FLOTATION TEST REPORT

TEST NO. 12		SAMPLE: Kennco Exploration (Canada) Limited						DATE: Sept. 25, 1970					
OBJECT OF TEST:		Finer grind.						CHARGE: 2000-g					
								TESTED BY: WAW					
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton								
					Amo Phos	317	404	DF250	Na <sub>2</sub> CO <sub>3</sub>	Z-6	CaO		
Grind (1)	75	57		7 x 14 RM									
Condition	15	35	6.5	2000-g cell	4.0	0.10	0.10						
Flotation	4	20	6.9					0.08					
Condition	10	20	8.5						4.0	0.10			
Flotation	3	20	8.5										
Condition	5	25	10.3			0.10					8.0		
Flotation	15	25	9.8			0.10							
Clean combined conc	3		8.0	500-g cell				0.01					
Reclean	2		7.9	250-g cell									
Re-reclean	1		7.9										
PRODUCT	WT %	ANALYSIS *					DISTRIBUTION %						
		Ag oz/ton	Cu%				Ag		Cu				
Clean conc	4.3	60.49	6.17				51.4		61.8				
No. 1 clean tail	9.0	6.86	0.43				12.2		9.1				
No. 2 clean tail	1.4	16.48	1.17				4.6		3.7				
No. 3 clean tail	0.7	28.71	2.33				4.0		3.7				
Rougher conc (calcd)	15.4	23.70	2.18				72.2		78.3				
Rougher tail	84.6	1.66	0.11				27.8		21.7				
Feed	100.0	5.05	0.43				100.0		100.0				

REMARKS: \* From Internal Reports MS-AC-70-898 and 907.  
 (1) Flotation tailing 93.2 per cent minus 400 mesh.

## MINES BRANCH FLOTATION TEST REPORT

TEST NO. 13	SAMPLE: Kennco Exploration (Canada) Ltd.						DATE: Oct. 1, 1970							
OBJECT OF TEST: Repeat of Test 11 with finer grind.						CHARGE: 2000-g								
						TESTED BY: WAW								
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					Na <sub>2</sub> CO <sub>3</sub>	Z-200	404	A31	DF250					
Grind*	90	57		7 x 14 RM										
Condition	15	35	8.5	2000-g cell	6.0		0.10	0.03						
Flotation	5	25	8.5			0.05			0.02					
Scavenging	15	25	8.5			0.05	0.10							
Cleaning	2			500-g cell										
Recleaning	1			250-g cell										
PRODUCT	WT %	ANALYSIS (1)					DISTRIBUTION %							
		Ag oz/ton	Cu%				Ag		Cu					
Clean conc	4.7	54.58	5.50				54.2		62.9					
Clean & reclean tail	3.9	13.12	0.80				10.8		7.5					
Ro conc (calcd)	8.6	35.78	3.37				65.0		70.4					
Scav conc	1.9	11.57	0.79				4.7		3.6					
Rougher tail	89.5	1.60	0.12				30.3		26.0					
Feed (calcd)	100.0	4.73	0.41				100.0		100.0					
REMARKS: * Flotation tailing 96.7 per cent minus 400 mesh. (1) From Internal Reports MS-AC-70-983 and 987.														



# MINES BRANCH FLOTATION TEST REPORT

TEST NO. 14	SAMPLE: Kennco Exploration (Canada) Limited						DATE: Oct. 9, 1970							
OBJECT OF TEST: Regrind of concentrate before cleaning						CHARGE: 2000-g								
						TESTED BY: WAW								
OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					Na <sub>2</sub> CO <sub>3</sub>	Z-200	404	DF 250	A31					
Grind (1)	50	57		7 x 14 RM										
Condition	15	35	7.7	2000-g cell	4.0		0.10		0.04					
Float No. 1	4	25	8.0			0.10			0.06					
Float No. 2	5		8.0			0.10		0.03						
Float No. 3	5		7.5				0.10							
Filter combined conc														
Grind conc	45			Pebble Mill										
Clean conc	2			500-g cell			0.05	0.02						
Reclean conc	1			250-g cell										
PRODUCT	WT %	ANALYSIS (2)					DISTRIBUTION %							
		Ag oz/ton	Cu%				Ag		Cu					
Reclean conc	2.1	96.72	10.00				40.4		52.8					
Cleaner tail	11.7	8.07	0.50				18.8		14.8					
Reclean tail	1.5	35.43	2.41				10.5		9.0					
Rougher conc (calcd)	15.3	22.92	1.99				69.7		76.6					
Rougher tail	84.7	1.80	0.11				30.3		23.4					
Feed (calcd)	100.0	5.03	0.40				100.0		100.0					
REMARKS: (1) Flotation tailing 97.2 per cent minus 400 mesh. (2) From Internal Reports MS-AC-70-996 and 70-1004.														

## MINERAL SCIENCES DIVISION

## Mineralogy Section

## INTERNAL REPORT MS - 70-47

TITLE: Mineralogical Examination of a Mill Product obtained from beneficiation tests on a Copper Ore from Kennco Explorations (Canada) Limited.

SAMPLE: A sample of a mill product, labelled "Float-tailing, Test No. 4", was received from Mr. A. Wall of the Mineral Processing Division on April 4, 1970. The sample, all minus 325 mesh in size, was reported by Mr. Wall to contain 2.04 ounces of silver per ton, and 0.128 per cent copper.

PURPOSE: To determine the reason for the high silver and copper content of the mill product.

RESULTS: The mill product was found to consist of small lumps or aggregates of mineral grains. It was, therefore, sieved through a 200 mesh screen to break up these aggregates into individual grains so that polished sections could be prepared. While screening the mill product it was noticed that, while most of it passed through the screen, about one fourth remained as small hard balls (spherical agglomerates) which showed a distinct colour difference. These two fractions were then examined as separate samples. The minerals were identified by microscopical examination of polished sections and oil immersion mounts, and by X-ray diffractometer and electron microprobe analysis.

Both fractions consist almost entirely of the gangue minerals-quartz and mica. The spherical agglomerate is distinguished from the sieved fraction by its generally finer grain size, lower content of metallic minerals and the apparent absence of analcite (which was detected in the sieved sample).

The metallic minerals in both fractions are composed essentially of magnetite, with much smaller amounts of chalcopyrite, tennantite, covellite, digenite(?), hematite, sphalerite, goethite, pyrite and rutile. The copper content is due mainly to the presence of chalcopyrite; the silver-- to tennantite or tetrahedrite.

Both free and combined grains of the metallic minerals were observed, but the proportions of the two types could not be determined because of the extremely fine grain size - mainly less than 15 microns in diameter.

Approved: \_\_\_\_\_

Section Head

Signed: \_\_\_\_\_

Mineralogy Section

Dated: May 11, 1970.

- COPIES TO: 1. Mr. A. Wall, Mineral Processing Division  
 2. D. Owens, Mineral Sciences Division  
 3. Divisional Files  
 4. Section Files  
 5. Reports Secretary Files