

006204

To Ron Murarka

Date July 20, 1983

From Sibyl Frei

Subject Copper Pre-float Testing: Locked Cycle Tests on 2BCD and 2EF Ores.CONCLUSIONS:

1. A final copper concentrate grade of 10% was obtained for both 2BCD and 2EF ore best locked cycle tests.
2. Only 37% to 45% copper recovery was obtained in these locked cycle tests.
3. In the best 2BCD and 2EF locked cycle tests, 15% or less lead was recovered, 10% or less silver was recovered and less than 1% of the iron was recovered into the copper concentrate.
4. Stability was not achieved in these locked cycle tests even though 6 cycles were performed.

RECOMMENDATIONS:

1. A copper concentrate not be produced by pre-flotation.
2. Method development for rougher and cleaner tests be linked to any examination of locked cycle test methods for copper flotation.

DISCUSSION:

The locked cycle tests were performed for a copper pre-flotation circuit only. All grinds were done using 1 kg/tonne Na_2SO_3 but no NaCN. MIBC frother was used as necessary during the rougher and cleaning stages. A summary of the test conditions is presented in Table 1.

Stability was not achieved in these locked cycle tests even though 6 cycles were performed. In 2BCD test F-1, the last two cycles were close to stable which was the only test that showed signs of reaching stability. In contrast, the 2EF test C-1 had an initial copper grade of 19.6% which dropped steadily throughout the cycles to a 9.6 % Cu grade in the final cycle.

DISCUSSION (cont'd):

During the 2EF locked cycle test, it was noted that a large amount of sample was being recirculated from cycle to cycle. A calculation of circulating loads for this test (see table 2) shows a very large amount of sample mass being recirculated in the fourth cleaning stage particularly. The amount of copper metal being recirculated increased steadily from the first through the fourth cleaning stages which is opposite to the trend observed from the ore type lead and zinc locked cycle tests performed in January and February, 1983.

S. Frei

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TABLE 1: Locked Cycle Test Conditions

Ore Type	Test No.	Charge per Cycle (kg)	pH Range	Condition of First Cleaner	Z-11 additions (gm/tonne)					
					to grind	to rougher	to first cleaner	to second cleaner	to third cleaner	to fourth cleaner
2BCD	F-1	1	normal	closed	40	10	none	none	none	none
2BCD	F-2	1	low	closed	100	50	10	15	10	not performed
2BCD	F-3	1	normal	open	40	10	none	none	none	none
2EF	C-1	2	normal	closed	50	15	5	2.5	none	none

TABLE 11: Circulating Loads in the 2EF Copper Locked Cycle Test

STAGE	COPPER CIRCUIT	
	Mass Balance (%)	Metal Balance (%)
1 st Cleaner	128	10
2 nd Cleaner	70	18
3 rd Cleaner	77	38
4 th Cleaner	216	95

LOCKED CYCLE CLEANER TEST "To upgrade COPPER"

ORETYPE and Test Description	SAMPLE	WTS	ASSAYS					DISTRIBUTION				
			Pb	Zn	Fe	Cu	Ag	Pb	Zn	Fe	Cu	Ag
No K ₂ Cr ₂ O ₇ No NaCN 1kg/r Na ₂ SO ₃ Low Z-11	Cu Conc I	56.3	64.90	4.79	6.1	2.64	27.90	10.74	0.41	0.26	5.50	6.57
	II	36.7	62.20	4.32	6.5	4.38	27.60	6.71	0.24	0.18	5.95	4.24
	III	11.3	32.80	6.95	12.7	11.60	22.15	1.09	0.12	0.11	4.85	1.05
	IV	5.8	23.30	6.47	15.3	16.10	19.93	0.40	0.06	0.07	3.45	0.48
	V	13.3	39.10	7.29	12.0	11.30	25.37	1.53	0.14	0.12	5.56	1.41
	VI	13.8	42.10	6.93	10.6	9.95	24.67	1.71	0.15	0.11	5.08	1.42
<u>Prim. Grind</u> Na ₂ CO ₃ 3kg/r Na ₂ SO ₃ 1kg/r Z-11 50gr/r 25 min grind	Tails I	1835.8	0.74	5.25	11.5	0.19	0.90	3.99	14.81	15.70	12.90	6.91
	II	1937.8	1.52	5.73	11.6	0.17	1.36	8.66	17.06	16.72	12.19	11.03
	III	1934.2	1.82	5.69	11.8	0.11	1.62	10.35	16.91	16.98	7.87	13.11
	IV	1933.5	1.70	5.62	11.7	0.12	1.58	9.66	16.70	16.83	8.58	12.78
	V	1977.8	1.83	5.77	12.3	0.11	1.71	10.64	17.54	18.10	8.05	14.15
	VI	1578.0	1.57	5.34	11.7	0.13	1.55	7.28	12.95	13.73	7.59	10.24
<u>1st CLR</u> PH to 9.5	4 th CLR Hs VI	30.4	58.50	8.65	5.5	2.19	22.29	5.23	0.40	0.12	2.46	2.84
	3 rd CLR Hs VI	60.1	53.70	9.55	6.3	1.20	23.05	9.49	0.88	0.28	2.67	5.80
	2 nd CLR Hs VI	88.6	41.50	10.68	8.9	0.68	17.61	10.81	1.45	0.59	2.23	6.53
	1 st CLR Hs VI	13.8	42.10	6.93	10.6	9.95	24.67	1.71	0.15	0.11	5.08	1.42
<u>2nd CLR</u> PH to 9.6	HEADS	1527.2	2.95	5.64	11.66	0.23	2.07	100.00	100.00	100.00	100.00	100.00
<u>3rd CLR</u> PH to 9.8		Wts	Pb	Zn	Fe	Cu	Ag	Pb	Zn	Fe	Cu	Ag
	Cu Conc	13.55	40.60	7.11	11.3	10.62	25.02	15.00	0.96	0.71	40.28	10.47
<u>4th CLR</u> PH to 10.0	Tails	1777.9	1.70	5.56	12.0	0.12	1.63	84.60	99.03	99.29	59.72	89.53
	HEADS	1791.45	1.99	5.57	12.0	0.20	1.81	100.00	100.00	100.00	100.00	100.00

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• METALLURGICAL RESPONSE OF INDIVIDUAL CYCLES •

ORETYPE and Test Description	SAMPLE	WTS	ASSAYS					DISTRIBUTION				
			Pb	Zn	Fe	Cu	Ag	Pb	Zn	Fe	Cu	Ag
CYCLE 1	Cu Conc	567	64.90	4.79	6.1	2.64	27.90	72.90	2.72	1.60	29.88	48.74
	TAILS	1835.8	0.74	5.25	11.5	0.19	0.90	27.10	97.28	98.40	70.12	51.26
	HEADS	1892.1	2.65	5.24	11.3	0.26	1.70	100.00	100.00	100.00	100.00	100.00
CYCLE 2	Cu Conc	367	62.20	4.32	6.5	4.38	27.60	43.66	1.41	1.05	32.79	27.76
	TAILS	1937.8	1.52	5.73	11.6	0.17	1.36	56.34	98.59	98.95	67.21	72.24
	HEADS	1974.5	2.65	5.70	11.5	0.25	1.85	100.00	100.00	100.00	100.00	100.00
CYCLE 3	Cu Conc	11.3	32.80	6.95	12.7	11.60	22.15	9.52	0.71	0.62	38.12	7.40
	TAILS	1934.2	1.82	5.69	11.8	0.11	1.62	90.47	99.29	99.38	61.88	42.60
	HEADS	1945.5	2.00	5.70	11.8	0.18	1.74	100.00	100.00	100.00	100.00	100.00
CYCLE 4	Cu Conc	5.8	23.30	6.47	15.3	16.10	19.93	3.95	0.34	0.39	28.70	3.64
	TAILS	1933.5	1.70	5.62	11.7	0.12	1.58	96.05	99.66	99.61	71.30	46.35
	HEADS	1939.3	1.76	5.62	11.7	0.17	1.63	100.00	100.00	100.00	100.00	100.00
CYCLE 5	Cu Conc	13.3	39.10	7.29	12.0	11.30	25.37	12.56	0.84	0.65	40.86	9.07
	TAILS	1977.8	1.83	5.77	12.3	0.11	1.71	87.44	99.16	99.35	59.14	90.93
	HEADS	1991.1	2.08	5.78	12.3	0.18	1.87	100.00	100.00	100.00	100.00	100.00
CYCLE 6	Cu Conc	13.8	42.10	6.93	10.6	9.95	24.67	19.00	1.12	0.79	40.10	12.22
	TAILS	1578.0	1.57	5.34	11.7	0.13	1.55	81.00	98.88	99.21	59.90	87.78
	HEADS	1591.8	1.92	5.35	11.7	0.22	1.75	100.00	100.00	100.00	100.00	100.00

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F-2 2BCD Locked Cycle Test - Low pH - First Cleaner Open

TABLE I

ORETYPE and Test Description	SAMPLE	WTS	ASSAYS					DISTRIBUTION					
			Pb	Zn	Fe	Cu	Ag	Pb	Zn	Fe	Cu	Ag	
<u>F-2</u> 2BCD locked cycle test -6 cycles -prod. Cu conc. only -cleaning stages at pH = 5.5 using H ₂ SO ₃ as the pH modifier. -open 1 st cleaner	Cu CC ₃ I	33.0	53.00	6.40	9.8	2.71	25.35	7.39	0.47	0.35	5.98	5.31	
	II	5.1	42.30	3.82	12.9	8.85	23.70	0.91	0.04	0.07	3.02	0.77	
	III	12.7	38.00	4.43	15.7	5.91	20.64	2.04	0.13	0.22	5.02	1.67	
	IV	22.7	46.60	3.98	13.4	3.57	23.27	4.47	0.20	0.33	5.42	3.36	
	V	16.4	36.00	4.65	16.3	5.54	19.70	2.50	0.17	0.29	6.07	2.05	
	VI	32.2	38.30	3.90	16.3	2.91	19.62	5.21	0.28	0.57	6.27	4.01	
	Cu CT ₁ I	65.5	13.40	3.97	23.4	0.34	6.43	3.71	0.58	1.67	1.49	2.68	
	II	105.9	25.80	4.88	19.3	0.47	11.92	11.55	1.16	2.23	3.33	8.02	
	III	115.3	25.50	5.24	19.1	0.52	12.21	12.43	1.35	2.40	4.01	8.94	
	IV	87.0	21.10	5.07	20.3	0.49	10.02	7.76	0.99	1.92	2.85	5.54	
	V	114.0	25.50	5.16	19.1	0.43	12.01	12.29	1.32	2.37	3.28	8.70	
	VI	77.1	22.00	5.38	19.7	0.44	10.42	7.17	0.93	1.65	2.27	5.10	
	Fin. Tls. (total)	7245.6	0.64	5.66	10.8	0.10	0.90	19.60	91.89	85.25	48.45	41.43	
	Cu CT ₂ VI	25.8	20.90	6.39	19.0	0.98	11.20	2.28	0.37	0.53	1.69	1.84	
	Cu CT ₃ VI	7.0	23.90	7.00	17.9	1.85	13.37	0.71	0.11	0.14	0.87	0.59	
	Calc. HEAD	7965.3	2.97	5.60	11.5	0.19	1.97	100.0	100.0	100.0	100.0	100.0	
	<u>F-2</u> average of cycles 4, 5 and 6	Cu CC ₃	23.8	40.30	4.18	15.3	4.01	20.86	24.87	1.34	2.39	36.97	19.17
		Cu CT ₁	92.7	22.87	5.20	19.7	0.45	10.82	55.06	6.50	11.99	16.18	38.79
		Fin. Tls.	1207.6	0.64	5.66	10.8	0.10	0.90	20.07	92.16	85.62	46.85	42.03
		Calc. HEAD	1324.1	2.91	5.60	11.5	0.19	1.95	100.0	100.0	100.0	100.0	100.0

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2BCD Locked Cycle Test - Averages by Cycle

TABLE II

ORETYPE and Test Description	SAMPLE	WTS	ASSAYS					DISTRIBUTION				
			Pb	Zn	Fe	Cu	Ag	Pb	Zn	Fe	Cu	Ag
F-2 cycle 1 (2BCD)	CuCC ₃	33.0	53.00	6.40	9.8	2.71	25.35	51.45	2.89	2.17	38.47	35.68
	CuCT ₁	65.5	13.40	3.97	23.4	0.34	6.43	25.82	3.56	10.29	9.58	17.96
	Fin.Tls.	1207.6	0.64	5.66	10.8	0.10	0.90	22.73	93.55	87.54	51.95	46.36
	CALC HEAD	1306.1	2.60	5.59	11.4	0.18	1.80	100.0	100.0	100.0	100.0	100.0
F-2 cycle 2 (2BCD)	CuCC ₃	5.1	42.30	3.82	12.9	8.85	23.70	5.80	0.26	0.43	20.93	4.89
	CuCT ₁	105.9	25.80	4.88	19.3	0.47	11.92	73.43	7.01	13.49	23.08	51.11
	Fin.Tls.	1207.6	0.64	5.66	10.8	0.10	0.90	20.77	92.72	86.08	55.99	44.00
	CALC HEAD	1318.6	2.82	5.59	11.5	0.16	1.87	100.0	100.0	100.0	100.0	100.0
F-2 cycle 3 (2BCD)	CuCC ₃	12.7	38.00	4.43	15.7	5.91	20.64	11.50	0.75	1.29	29.35	9.51
	CuCT ₁	115.3	25.50	5.24	19.1	0.52	12.21	70.08	8.06	14.26	33.12	51.07
	Fin.Tls.	1207.6	0.64	5.66	10.8	0.10	0.90	18.42	91.19	84.45	66.71	39.42
	CALC HEAD	1335.6	3.14	5.61	11.6	0.19	2.06	100.0	100.0	100.0	100.0	100.0
F-2 cycle 4 (2BCD)	CuCC ₃	22.7	46.60	3.98	13.4	3.57	23.27	28.85	1.23	2.01	33.15	21.24
	CuCT ₁	87.0	21.10	5.07	20.3	0.49	10.02	50.07	5.99	11.69	17.44	35.05
	Fin.Tls.	1207.6	0.64	5.66	10.8	0.10	0.90	21.08	92.79	86.30	49.40	43.70
	CALC HEAD	1317.3	2.78	5.59	11.5	0.19	1.89	100.0	100.0	100.0	100.0	100.0
F-2 cycle 5 (2BCD)	CuCC ₃	16.4	36.00	4.65	16.3	5.54	19.70	13.83	1.02	1.73	34.86	11.63
	CuCT ₁	114.0	25.50	5.16	19.1	0.43	12.01	68.08	7.84	14.06	18.81	49.27
	Fin.Tls.	1207.6	0.64	5.66	10.8	0.10	0.90	18.10	91.14	84.21	46.33	39.11
	CALC HEAD	1338.0	3.19	5.61	11.6	0.19	2.08	100.0	100.0	100.0	100.0	100.0
F-2 cycle 6 (2BCD)	CuCC ₃	32.2	38.30	3.90	16.3	2.91	19.62	33.31	1.70	3.48	37.72	25.05
	CuCT ₁	77.1	22.00	5.38	19.7	0.44	10.42	45.81	5.62	10.07	13.66	31.86
	Fin.Tls.	1207.6	0.64	5.66	10.8	0.10	0.90	20.88	92.67	86.45	48.62	43.09
	CALC HEAD	1316.9	2.81	5.60	11.5	0.19	1.92	100.0	100.0	100.0	100.0	100.0

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ZBCD LOCKED-CYCLE TEST (First Cleaner Open)

ORETYPE and Test Description	SAMPLE	WT	ASSAYS					DISTRIBUTION				
			Pb	Zn	Fe	Cu	Ag	Pb	Zn	Fe	Cu	Ag
Reagents were identical to F-1 Grind: 2kg ore 66% sol. 1 kgf Na ₂ SO ₃ 3 kgf Na ₂ CO ₃ 40 gf Z-11 30 min. Rougher: 10 gf Z-11 pH = 9.5 First Cleaner: (open) no Z-11 pH = 9.5 Second Cleaner: no Z-11 pH = 9.6 Third Cleaner: no Z-11 pH = 9.8 Fourth Cleaner: no Z-11 pH = 10.0	CuCC ₄ I	5.7	17.30	6.24	17.3	18.40	20.35	.3	.1	.1	4.4	.5
	II	10.9	39.70	4.78	11.3	11.50	25.97	1.2	.1	.1	5.5	1.1
	III	46.1	63.00	4.37	5.4	4.23	31.13	8.3	.3	.2	8.6	5.8
	IV	22.5	56.00	4.29	7.2	6.67	29.74	3.6	.2	.1	6.6	2.7
	V	29.3	48.70	4.46	6.4	5.57	30.42	4.1	.2	.1	7.2	3.6
	VI	28.5	54.90	5.55	6.4	5.44	28.83	4.5	.2	.1	6.8	3.3
	CuCT ₁ I	56.9	10.20	8.64	10.6	.23	5.53	1.7	.7	.4	.6	1.3
	II	57.0	6.71	7.09	10.8	.18	3.67	1.1	.6	.4	.5	.8
	III	53.9	8.68	7.37	11.0	.22	4.24	1.3	.6	.4	.5	.9
	IV	78.1	10.80	7.57	10.6	.25	5.39	2.4	.9	.6	.9	1.7
	V	71.9	6.46	6.78	11.2	.20	3.68	1.3	.7	.6	.6	1.1
	VI	68.9	6.62	6.92	10.9	.20	3.40	1.3	.7	.5	.6	.9
	CuRoTb I	1833.6	1.31	5.64	11.9	.10	1.20	6.9	15.1	15.2	8.1	8.9
	II	1884.4	1.42	5.77	11.9	.10	1.40	7.7	15.8	15.7	8.3	10.6
	III	1891.0	1.43	5.49	12.3	.09	1.32	7.8	15.1	16.2	7.5	10.1
	IV	1870.1	1.21	5.71	12.1	.10	1.17	6.5	15.6	15.8	8.2	8.8
	V	1873.5	1.39	5.77	11.9	.09	1.29	7.5	15.7	15.6	7.4	9.7
	VI	1865.1	1.40	5.58	12.8	.12	1.46	7.5	15.2	16.7	9.9	11.0
	CuCT ₄ IV	58.2	63.00	7.23	4.1	1.19	27.65	10.5	.6	.2	3.1	6.5
	CuCT ₅ VI	61.6	39.50	7.77	5.9	.82	23.78	7.0	.7	.3	2.2	5.9
	CuCT ₂ VI	75.2	35.60	9.82	9.0	.60	15.85	7.7	1.1	.5	2.0	4.8
	Heads	11,942.1	2.92	5.75	12.0	.19	2.08	100.0	100.0	100.0	100.0	100.0

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TABLE 2 (cont'd on Table 3)

2BCD Cu Locked-Cycle Test - Metallurgy Calculated by Cycle

ORETYPE and Test Description	SAMPLE	WTS	ASSAYS					DISTRIBUTION				
			Pb	Zn	Fe	Cu	Ag	Pb	Zn	Fe	Cu	Ag
I	CuCC4	5.7	17.30	6.24	17.3	18.40	20.35	3.21	.33	.44	34.57	4.40
	CuCT ₁	56.9	10.20	8.64	10.6	.23	5.53	18.89	4.52	2.67	4.31	11.94
	CuROT ₁₅	1833.6	1.31	5.64	11.9	.10	1.20	78.19	95.18	96.70	60.44	83.48
	Heads	1896.2	1.62	5.73	11.9	.16	1.34					
II	CuCC4	10.9	39.70	4.78	11.3	11.50	25.97	12.38	.46	.53	37.77	9.06
	CuCT ₁	57.0	6.71	7.09	10.8	.18	3.67	10.94	3.57	2.65	3.09	6.70
	CuROT ₁₅	1884.4	1.42	5.77	11.9	0.10	1.40	70.57	96.02	96.52	56.78	84.46
	Heads	1952.3	1.79	5.80	11.9	.17	1.60					
III	CuCC4	46.1	63.00	4.37	5.4	4.23	31.13	47.94	1.83	1.03	51.55	34.49
	CuCT ₁	53.9	8.08	7.37	11.0	.22	4.24	7.20	3.61	2.46	3.13	5.49
	CuROT ₁₅	1891.0	1.43	5.49	12.3	.09	1.32	44.68	94.46	96.55	44.99	59.99
	Heads	1991.0	3.04	5.52	12.1	.19	2.09					
IV	CuCC4	22.5	56.00	4.29	7.2	6.67	29.74	28.80	.85	.69	42.31	20.45
	CuCT ₁	78.1	10.80	7.57	10.6	.25	5.39	19.28	5.20	3.51	5.50	12.87
	CuROT ₁₅	1870.1	1.21	5.71	12.1	.10	1.17	51.72	93.91	95.85	52.72	66.88
	Heads	1970.7	2.22	5.77	11.98	.18	1.66					
V	CuCC4	29.3	48.70	4.46	6.4	5.57	30.42	31.69	1.14	.80	45.91	24.94
	CuCT ₁	71.9	6.46	6.78	11.2	.20	3.68	10.32	4.26	3.46	4.05	7.40
	CuROT ₁₅	1873.5	1.39	5.77	11.9	.09	1.29	57.84	94.55	95.68	47.44	67.62
	Heads	1974.7	2.28	5.79	11.8	.18	1.81					

July 13/83

To Ron Murarka

Date July 20, 1983

From Sibyl Frei

Subject Copper Pre-flotation Testing : 2BCD Collector/Promoter Tests.

CONCLUSIONS:

1. Potassium amyl xanthate (PAX) is a very strong, non-selective collector. For copper flotation, lower dosages of PAX are required (12 gm/tonne PAX addition produced the best results of these tests).
2. The addition of promoter as well as collector to the grind and to all rougher and scavenger stages provided for the best metallurgical performance in these tests.
3. Of the promoters tested in conjunction with PAX, SPELD 3730 was the best for copper flotation (see table 1) with SPELD N-30 and SPELD 3459 also showing significantly better metallurgy at low PAX addition than the bulk of these tests.

RECOMMENDATIONS:

1. A weaker collector than PAX be tried in copper pre-flotation.
2. These and other promoters be used in conjunction with weaker collectors in further Cu pre-flotation testwork.

DISCUSSION :

A series of Cu pre-float rougher tests were performed using PAX and various RESINEX Corporation promoters. For each test, 1 kg. of 2BCD ore was used as charge to the rod mill and ground to a P_{80} of approximately 50 microns using 1 kg/tonne Na_2SO_3 (with Na_2CO_3 as the pH modifier). After raising the pH to 9.5 with Na_2CO_3 , one 2 minute rougher concentrate was collected and then two 1-minute scavenger concentrates were collected. MIBC frother was used as necessary.

The first tests (G-1 and G-2) established the necessary level of PAX addition to the grind and the start of the roughing stage only.

Next a series of tests (G-3 through G-9) were attempted with each of the promoters (separately) added in a 1:1 ratio to PAX with 50% of the promoter being added at the start of the roughing stage and 25% being added before each of the 2 scavengers.

DISCUSSION (cont'd):

Another series of tests (G-10 through G-16) were tried where only 30% of the PAX used in each stage of the preceding tests was added. As well, the addition points for the promoters were changed to 50% added to the grind, 25% at the start of roughing and 25% prior to collection of the first scavenger concentrate (with dosages the same in the previous test series).

Finally, the three most promising tests of the G-10 to G-16 series were repeated with the same dosages of PAX and promoter added to the grind but no collector or promoter added to the rougher or scavenger stages (see tests G-17, G-18 and G-19).

As PAX is a very strong collector, throughout these tests quite a bit of Pb was recovered into the "copper concentrate" even though in grinding no NaCN was used and Na₂SO₃ was added in an attempt to depress Pb and float Cu.

On the following pages, the final results and metallurgical balances for the collector/promoter testwork has been summarized.

Table 2 summarizes the promoters that were tested in this series of copper pre-float testing.

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TABLE 1: Results from the Three Most Promising Tests

TEST NO.	PAX Addition (gm/tonne)		PROMOTER Addition (gm/tonne)			ROUGHER CONCENTRATE METALLURGY				
	to grind	to rougher	name	to grind	to ro/sc	Copper (%)		Lead (%)		Silver(%)
						grade	recovery	grade	recovery	recovery
G-16	10	2	3730	20	20	3.83	76.2	44.8	37.1	2.7
G-10	10	2	N-30	20	20	3.54	80.8	41.2	35.8	27.8
G-13	10	2	3459	20	20	2.21	81.3	50.9	66.5	50.5

TABLE 2: PROMOTERS TESTED

PROMOTER	Metals Promoted	Metals not Selective Toward	Recommended Dosage
SPELD 1334	Cu, Pb, Ag	pyrite	20-100 gm/tonne
SPELD 1335	Pb, Ag, Cu, Au	iron sulphides	20-100 gm/tonne
SPELD 3459	Cu, Zn, Ag, Au, Ni, Co, Sb	iron ores	10-100 gm/tonne
SPELD 3700	Cu, Zn	pyrite & other iron ores	20-80 gm/tonne
SPELD 3710	Au, Ag, Cu, Zn	Pb	20-80 gm/tonne
SPELD 3730	Zn	Pb	20-80 gm/tonne
SPELD N-30	Pb, Cu (oxidized)	—	20-80 gm/tonne

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TABLE 1

2BCD Cu-Preflood: Collector/Promoter Testing

ORETYPE and Test Description	SAMPLE	WTS	ASSAYS					DISTRIBUTION				
			Pb	Zn	Fe	Cu	Ag	Pb	Zn	Fe	Cu	Ag
1. 315-P collector (Potassium Amyl Xanthate) 70 g/t	CuRo	54.00	46.10	8.22	8.80	1.64	22.79	74.74	7.65	3.84	77.10	57.48
	CuSc ₁	22.40	15.80	13.90	14.10	.61	9.05	10.63	5.37	2.56	11.75	9.47
	CuSc ₂	15.50	5.67	13.90	14.10	.25	4.05	2.64	3.71	1.77	3.33	2.93
	CuScTls	908.10	.44	5.32	12.90	.01	.71	12.00	83.27	91.83	7.81	30.12
	Heads	7000.00	3.33	5.80	12.36	.12	2.14					
2. 315-P 40 g/t	CuRo	39.19	51.50	7.29	6.70	2.21	25.75	65.68	4.94	2.18	77.38	51.68
	CuSc ₁	19.10	22.40	15.90	11.30	.65	11.31	13.96	5.27	1.80	11.12	11.09
	CuSc ₂	12.40	8.58	16.30	12.50	.29	4.81	3.47	3.51	1.29	3.22	3.06
	CuScTls	924.60	.86	5.38	12.30	.01	.72	16.89	86.28	94.73	8.28	34.17
	Heads	995.20	3.08	5.79	12.06	.11	1.96					
3. 315-P 40g/t (prom) N-30 40g/t	CuRo	48.00	45.00	8.76	7.90	1.72	22.32	72.20	7.63	3.15	77.22	54.56
	CuSc ₁	21.70	15.70	14.60	12.70	.56	8.53	11.39	5.75	2.29	11.37	9.43
	CuSc ₂	12.00	7.17	15.00	13.10	.25	4.46	2.88	3.27	1.31	2.81	2.73
	CuScTls	920.60	.44	4.99	12.20	.01	.71	13.54	83.36	93.26	8.61	33.29
	Heads	1002.30	2.98	5.50	12.02	.11	1.96					
4. 315-P 40g/t (prom) 1334 40g/t	CuRo	46.20	46.70	7.97	7.90	1.78	22.62	74.26	6.90	3.17	79.82	55.51
	CuSc ₁	14.20	18.10	13.60	12.70	.60	9.21	8.85	3.62	1.57	8.27	6.95
	CuSc ₂	10.90	8.25	13.90	13.10	.27	4.98	3.10	2.84	1.24	2.86	2.88
	CuScTls	932.30	.43	4.96	11.60	.01	.70	13.80	86.64	94.02	9.05	34.66
	Heads	1003.60	2.89	5.32	11.46	.10	1.88					

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TABLE II

2BCD Cu Re-float : Collector / Promoter Testing

ORETYPE and Test Description	SAMPLE	WTS	ASSAYS					DISTRIBUTION				
			Pb	Zn	Fe	Cu	Ag	Pb	Zn	Fe	Cu	Ag
5. 315-P 40g/t (prom) 1335 40g/t	CuRo	51.50	45.70	8.07	8.60	1.70	21.90	76.18	7.25	3.59	75.01	58.20
	CuSc ₁	15.10	17.20	13.70	13.30	.54	8.93	8.41	3.61	1.63	6.99	6.96
	CuSc ₂	8.90	8.78	13.20	14.00	.28	5.12	2.53	2.05	1.01	2.14	2.35
	CuSCTIs	926.10	.43	5.39	12.50	.02	.68	12.89	87.09	93.78	15.87	32.49
	Heads	1001.60	3.08	5.72	12.32	.12	1.93					
6. 315-P 40g/t (prom) 3459 40g/t	CuRo	44.10	50.80	7.74	7.20	1.92	25.22	73.17	5.98	2.64	72.46	55.72
	CuSc ₁	15.80	20.20	14.90	12.40	.67	10.21	10.42	4.13	1.63	9.06	8.08
	CuSc ₂	12.60	7.67	14.70	12.90	.25	4.65	3.16	3.25	1.35	2.70	2.94
	CuSCTIs	922.20	.44	5.36	12.30	.02	.72	13.25	86.64	94.38	15.78	33.26
	Heads	994.70	3.08	5.74	12.08	.12	2.01					
7. 315-P 40g/t (prom) 3700 40g/t	CuRo	49.30	46.80	8.31	8.66	1.69	23.16	75.71	7.06	3.44	78.35	57.98
	CuSc ₁	17.40	17.20	14.20	13.40	.61	9.08	9.82	4.26	1.89	9.98	8.02
	CuSc ₂	11.90	6.91	14.80	14.50	.27	4.49	2.70	3.03	1.40	3.02	2.71
	CuSCTIs	919.30	.39	5.41	12.50	.01	.67	11.77	85.66	93.27	8.65	31.28
	Heads	997.90	3.05	5.82	12.35	.11	1.97					
8. 315-P 40g/t (prom) 3710 40g/t	CuRo	52.40	45.20	8.34	8.60	1.73	21.75	76.50	7.58	3.68	81.02	56.80
	CuSc ₁	16.80	16.20	13.90	13.00	.53	8.59	8.79	4.05	1.78	7.96	7.19
	CuSc ₂	12.80	7.04	14.20	14.30	.25	4.39	2.91	3.15	1.49	2.86	2.80
	CuSCTIs	912.80	.40	5.38	12.50	.01	.73	11.79	85.21	93.05	8.16	33.21
	Heads	994.8	3.11	5.79	12.33	.11	2.02					

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ZBCD Cu Prefloat: Collector/Promoter Testing

ORETYPE and Test Description	SAMPLE	WTs	ASSAYS					DISTRIBUTION				
			Pb	Zn	Fe	Cu	Ag	Pb	Zn	Fe	Cu	Ag
9. 315-P 40g/t (prom) 3730 40g/t	Cu Ro Conc	47.60	49.40	7.66	7.50	1.97	24.61	71.36	6.31	2.91	74.86	55.09
	Cu Sc ₁	18.00	17.30	14.60	11.40	.96	9.60	9.45	4.55	1.67	8.05	8.13
	Cu Sc ₂	11.30	7.72	14.10	12.50	.26	4.65	2.65	2.76	1.15	2.35	2.47
	Cu Sc Tls	923.80	.59	5.40	12.50	.02	.79	16.54	86.38	94.26	14.75	34.32
	Heads	1000.70	3.29	5.77	12.24	.13	2.13					
10. 315-P 12g/t (prom) N-30 40g/t	Cu Ro Conc	25.60	41.20	7.82	8.50	3.54	20.24	35.79	3.61	1.81	80.80	27.77
	Cu Sc ₁	19.20	35.40	10.64	8.50	.49	15.10	23.07	3.69	1.36	8.39	15.54
	Cu Sc ₂	10.00	18.40	12.60	10.60	.26	8.69	6.24	2.28	.88	2.32	4.66
	Cu Sc Tls	952.00	1.08	5.26	12.10	.01	1.02	34.89	90.42	95.95	8.49	52.04
	Heads	1006.80	2.93	5.50	11.92	.11	1.85					
11. 315-P 12g/t (prom) 1334 40g/t	Cu Ro Conc	46.90	49.90	7.94	7.40	1.87	23.64	75.43	6.58	2.80	79.92	57.35
	Cu Sc ₁	20.30	15.40	13.90	13.40	.49	7.95	10.08	4.98	2.19	9.06	8.35
	Cu Sc ₂	12.30	6.08	14.00	13.40	.24	4.12	2.41	3.04	1.33	2.69	2.62
	Cu Sc Tls	914.30	.41	5.29	12.70	.01	.67	12.08	85.40	93.68	8.33	31.68
	Heads	993.80	3.12	5.70	12.47	.11	1.95					
12. 315-P 12g/t (prom) 1335 40g/t	Cu Ro Conc	45.40	48.30	8.17	7.40	1.83	22.88	73.01	6.83	2.83	78.91	53.87
	Cu Sc ₁	19.90	17.00	14.40	12.30	.57	8.42	11.26	5.28	2.06	9.64	8.69
	Cu Sc ₂	12.40	6.93	14.40	12.80	.23	4.05	2.86	3.29	1.34	2.71	2.60
	Cu Sc Tls	920.00	.42	4.99	12.10	.01	.73	12.87	84.59	93.77	8.74	34.83
	Heads	997.70	3.01	5.44	11.90	.11	1.93					

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TABLE IV

ZBCD, Cu Prefloat i Collector/Promoter Testing

ORETYPE and Test Description	SAMPLE	WTS	ASSAYS					DISTRIBUTION				
			Pb	Zn	Fe	Cu	Ag	Pb	Zn	Fe	Cu	Ag
13. 315-P 12 g/T (prom) 3459 40 g/T	CuRoConc.	41.30	50.90	8.29	7.30	2.21	24.98	66.47	5.49	2.51	81.26	50.52
	CuSc ₁	17.60	26.00	13.40	10.60	.50	12.78	14.47	3.78	1.55	7.83	11.01
	CuSc ₂	12.00	11.71	14.40	11.70	.25	6.12	4.44	2.77	1.17	2.67	3.60
	CuSCTIs	924.90	.50	5.93	12.30	.01	.77	14.62	87.96	94.76	8.23	34.87
	Heads	995.80	3.18	6.26	12.06	.11	2.05					
14. 315-P 12 g/T (prom) 3700 40 g/T	CuRoConc.	55.80	44.50	9.47	8.10	1.66	22.34	78.26	8.33	3.70	80.75	58.77
	CuSc ₁	19.00	14.60	13.70	12.60	.55	7.88	8.74	4.11	1.96	9.11	7.06
	CuSc ₂	12.00	5.53	13.50	13.10	.21	3.48	2.09	2.55	1.29	2.20	1.97
	CuSCTIs	910.50	.38	5.92	12.50	.01	.75	10.90	85.01	93.06	7.94	32.20
	Heads	997.30	3.18	6.36	12.26	.12	2.13					
15. 315-P 12 g/T (prom) 3710 40 g/T	CuRoConc.	55.00	44.40	10.16	8.20	1.72	21.75	76.90	9.31	3.70	81.56	56.27
	CuSc ₁	19.60	14.60	13.50	11.80	.50	7.95	9.01	4.41	1.90	8.45	7.33
	CuSc ₂	11.90	6.28	13.30	12.20	.21	3.90	2.35	2.64	1.19	2.15	2.18
	CuSCTIs	909.10	.41	5.52	12.50	.01	.80	11.74	83.64	93.21	7.84	34.21
	Heads	995.60	3.19	6.03	12.25	.12	2.14					
16. 315-P 12 g/T (prom) 3730 40 g/T	CuRoConc.	26.30	44.80	7.41	7.60	3.83	21.72	37.05	3.18	1.63	76.20	2.65
	CuSc ₁	21.00	36.20	12.10	8.20	.46	14.92	23.91	4.14	1.40	7.31	2.11
	CuSc ₂	10.60	19.10	13.60	9.50	.29	8.72	6.37	2.35	.82	2.33	1.07
	CuSCTIs	936.20	1.11	5.92	12.60	.02	1.18	32.68	90.33	96.15	14.16	94.18
	Heads	994.10	3.20	6.17	12.24	.13	2.09					

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Table X
ZBCD Cu Prefbat : Collector / Promoter Testing

ORETYPE and Test Description	SAMPLE	WTS	ASSAYS					DISTRIBUTION											
			Pb	Zn	Fe	Cu	Ag	Pb	Zn	Fe	Cu	Ag							
17. 315-P 10g/T (prom) N-30 20g/T (to grind only)	Cu Bo Conc	26.70	37.50	8.85	9.00	3.43	19.78												
	Cu Sc ₁	15.50	32.60	11.66	8.20	.62	14.46												
	Cu Sc ₂	11.60	19.40	12.51	9.80	.38	9.14												
	Cu S Tls	947.00	1.55	5.68	13.10	.07	1.52												
	Heads	1000.20	3.19	5.93	12.88	.17	2.29												
18. 315-P 10g/T (prom) 3459 20g/T (to grind only)	Cu Bo Conc	44.80	44.00	8.84	7.00	2.19	23.10												
	Cu Sc ₁	19.00	18.90	14.40	10.30	.51	9.08												
	Cu Sc ₂	14.60	8.14	14.30	11.70	.28	4.42												
	Cu S Tls	929.80	.62	5.44	12.80	.07	.79												
	Heads	1008.20	3.00	5.89	12.48	.18	1.99												
19. 315-P 10g/T (prom) 3730 20g/T (to grind only)	Cu Bo Conc	29.20	41.30	8.91	8.40	3.14	20.86												
	Cu Sc ₁	16.60	29.00	11.84	8.70	.56	13.65												
	Cu Sc ₂	11.60	16.70	12.20	10.00	.33	7.68												
	Cu S Tls	947.60	1.32	5.56	12.70	.07	1.37												
	Heads	1005.00	3.12	5.84	12.48	.17	2.21												

July 13/83

To Ron Murarka

Date July 20, 1983

From Sibyl Frei

Subject Copper Pre-float Testing: Large scale tests.

CONCLUSIONS:

1. In the large scale 2BCD and 2EF Cu tests performed to date, we have been unable to duplicate the results we have obtained on the small scale (see table 1), with concentrate weights produced on the small scale being relatively small.
2. In duplicate 2BCD large scale tests the repeatability of the results is poor (see also table 1).

RECOMMENDATIONS:

1. Once an optimum reagent scheme is determined on a small scale, methods development for large scale testing must be undertaken.

RESULTS:

The final results and metallurgical balances as determined for the large scale tests are summarized in table 2.

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Sibyl Frei
Senior Metallurgical Technician

TABLE 1: A Comparison of Duplicate Large and Small Scale Tests.

ORE TYPE	TEST NUMBER	SIZE OF TEST	ROUGHER CONCENTRATE METALLURGY					
			Weight %	Copper (%)		Lead (%)		Silver (%)
				Grade	Recovery	Grade	Recovery	Recovery
2BCD	B-7	small	16.1	0.88	78.7	16.2	87.8	83.5
	B-8	small	17.3	0.79	61.8	15.5	88.1	82.5
	E-3	large	7.1	1.69	44.6	26.4	62.8	46.5
	E-5	large	9.4	1.03	51.8	26.5	81.2	61.0
2BCD	B-12	small	27.5	0.57	64.3	9.7	88.9	83.4
	E-4	large	9.4	1.39	46.8	23.4	76.5	60.1
2EF	A-7	small	6.2	2.49	73.4	43.3	71.6	57.4
	B-1	large	1.4	4.39	23.0	5.5	2.0	27

To Ron Murarka

Date

July 20, 1983

From SiByl Frei

Subject Copper Pre-float Testing: Z-11 and Na₂SO₃ addition level Tests.

CONCLUSIONS:

1. The highest Cu rougher grades obtained for 2EF and 2H ores were in tests with 1 kg/tonne Na₂SO₃ and 30 gm/tonne Z-11 in the grind as well as 30 gm/tonne Z-11 added to the start of the roughing stage (30/30 gm/tonne Z-11 additions) (at 4.4% and 8.0% Cu respectively) whereas the low pH test produced the best Cu grade for 2BCD ore at 5.0%.
2. For 2EF and 2H ores, tests using 1 kg/tonne Na₂SO₃ and high (150/75 gm/tonne) Z-11 additions produced the best Cu rougher recoveries (at 77.4% and 78.0 % respectively) whereas the best Cu rougher recovery for 2BCD (at 78.7%) was with 1 kg/tonne Na₂SO₃ and 100/50 gm/tonne Z-11 additions.
3. For all three ore types tested, the best Cu first cleaner grades were obtained in the tests with 1 kg/tonne Na₂SO₃ and 50 gm/tonne Z-11 added to the grind, 15 gm/tonne Z-11² added at the start of roughing and 5 gm/tonne Z-11 added in the first cleaning stage (50/15/5 gm/tonne). For 2BCD ore this grade was 9.5% Cu, for 2EF ore the grade obtained was 14.7% Cu and for 2H the grade was 18.8% Cu.
4. The best first cleaner recovery was obtained with a different set of test conditions for each ore type. A 51.0% Cu recovery was achieved for 2BCD ore at 2 kg/tonne Na₂SO₃ and 50/15/5 gm/tonne Z-11 additions. For 2EF ore, 69.4% Cu recovery was obtained with 1 kg/tonne Na₂SO₃ and 50/30/20 gm/tonne Z-11 additions. A 1 kg/tonne Na₂SO₃ and 100/50/30 gm/tonne Z-11 addition test produced the best 2H ore Cu recovery at 67.9%.
5. For both 2BCD and 2EF ores, the low pH test produced a reasonable rougher grade at 5.0% and 4.7% Cu respectively whereas the 2H ore grade obtained was less than 1% Cu.
6. The affect of Na₂SO₃ addition changes was not at all consistent in these ore type tests. At low Z-11 additions in 2BCD ore testing, increasing Na₂SO₃ addition decreased Cu grade while improving Cu recovery whereas the opposite trend was observed at high Z-11 additions to 2BCD ore. For 2EF ore, increasing the Na₂SO₃ addition improved Cu grade and recovery at all Z-11 additions levels.

Conclusions cont'd:

- The tests performed on 2H ore at low Z-11 additions showed overall improved Cu circuit performance as Na_2SO_3 addition increased whereas the high Z-11 addition tests showed Cu circuit performance dropping as Na_2SO_3 addition increased.
7. Above a maximum of 50 to 70 gm/tonne Z-11 added to the grind specifically, Cu grade dropped for all ore types.
 8. The bulk of these tests were performed without NaCN in the grind as testwork with 2BCD and 2EF ores showed improvement over tests with 10 gm/tonne NaCN in the grind either through improved Cu grades/recoveries or through decreased Pb and Ag recoveries in the Cu circuit.
 9. The majority of the 2BCD tests were run at a 15 minute primary grind whereas one test run at a 20 minute primary grind showed slightly negative effects on the Cu circuit.

RECOMMENDATIONS:

1. Should more testwork on reagent usage in Cu pre-float circuits be attempted, improvements in the testing method must first be examined as repeatability was very poor in the duplicate (2BCD) tests.

DISCUSSION:

These tests were all performed with one kilogram of ore as charge to the rod mill. The primary grind time employed was sufficient to obtain a P_{80} of approximately 50 microns. A rougher concentrate was collected at pH=9.5 for 3 minutes using MIBC frother as necessary. In some tests, the concentrate was cleaned through one two-minute cleaning stage without regrinding, again using MIBC frother as necessary. This procedure was arbitrarily used and should further reagent testwork be performed, some method development should be done prior to the additional reagent testwork.

The first pre-float Cu reagent testwork was done on 2BCD ore. Following these tests, 2EF and then 2H ores were tested with the same reagent schemes as employed with the 2BCD ore (see table 1) although more of these later tests were taken through to the first cleaning stage with additional Z-11 usage.

A number of the 2BCD tests were duplicates to the roughing stage (where the rougher concentrate product of some tests were used in subsequent potassium dichromate testing for Cu/Pb separation). An examination of the results from these duplicate test show a very long degree of error. This lack of repeatability indicates that method development and procedural im-

improvements must be performed in the metallurgical laboratory.

The final results and metallurgical balances from all of these Z-11 and Na_2SO_3 addition tests follow on the subsequent pages. It must be noted that, where potassium dichromate was used in the cleaning stage of a particular test, the calculated rougher metallurgy is reported as the final product as only the rougher portion of the test involves the pre-flotation of copper.

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TABLE 1: Same Test Numbers by Ore Type

2BCD Ore	2EF Ore	2H Ore
B-1	A-3	A-2
B-2 / B-3	A-4	A-4
B-4 / B-5	A-5	A-5
B-6	A-6	A-6
B-7 / B-8	A-7	A-7
B-9	A-8	A-8
B-10	A-9	A-9
B-12	A-10	A-10
B-13	A-11	A-11
B-14	A-12	A-12

2BCD Cu, Pre-float tests - series B (considering only the portion of the test without $K_2Cr_2O_7$)

	ORE TYPE and Test Description	SAMPLE	WTS	ASSAYS					DISTRIBUTION				
				Pb	Zn	Fe	Cu	Ag	Pb	Zn	Fe	Cu	Ag
B-1	2BCD ore - 1kg charge grind: 1kg/t Na_2SO_3 10g/t NaCN 30g/t z-11 rougher: 30g/t z-11 pH=9.5	Cu Ro Conc	134.2	19.4	9.03	11.9	1.04	7.05	83.3	18.4	12.5	61.4	63.0
		Cu Ro Tls	854.3	.61	6.30	13.1	.10	.65	16.7	81.6	87.5	38.6	37.0
		CALC HEAD	988.5	3.16	6.67	12.9	.23	1.52	100.0	100.0	100.0	100.0	100.0
B-2	2BCD ore - 1kg charge grind: 1kg/t Na_2SO_3 NO NaCN 30g/t z-11 rougher: 30g/t z-11 pH=9.6	Cu Ro Conc	129.0	17.0	8.93	12.6	1.07	6.37	72.1	18.8	12.8	62.9	56.8
		Cu Ro Tls	868.3	.98	6.16	12.7	.09	.72	27.9	81.2	87.2	37.1	43.2
		CALC HEAD	997.3	3.05	6.52	12.7	.22	1.45	100.0	100.0	100.0	100.0	100.0
B-3	2BCD ore - 1kg charge as per B-2 but did first cleaner with $K_2Cr_2O_7$ (not reported here)	Calc. Ro Conc	87.9	12.6	10.13	11.5	1.61	5.02	35.7	13.5	7.8	61.5	29.8
		Cu Ro Tls	912.8	2.19	6.24	13.0	.10	1.14	64.3	86.4	92.2	39.6	70.1
		CALC HEAD	1000.7	3.10	6.58	12.9	.23	1.48	100.0	100.0	100.0	100.0	100.0
B-4	2BCD ore - 1kg charge grind: 1kg/t Na_2SO_3 NO NaCN 50g/t z-11 rougher: 30g/t z-11 (not reported) pH=9.5	Calc Ro Conc	84.4	24.01	7.85	11.8	1.47	8.81	70.55	11.17	7.30	69.21	60.81
		Cu Ro Tls	909.6	.93	5.80	13.8	.06	.53	29.45	88.83	92.70	30.79	39.19
		CALC HEAD	994.0	2.89	5.97	13.7	.18	1.23	100.0	100.0	100.0	100.0	100.0
B-5	2BCD - 1kg charge Same as B-4 (ie 1 st clnr not reported)	Calc Ro Conc	94.9	24.70	8.59	12.2	1.41	9.12	77.24	13.29	8.45	74.31	61.74
		Cu Ro Tls	906.7	.76	5.86	13.8	.05	.59	22.76	86.71	91.55	25.69	38.26
		CALC HEAD	1001.6	3.03	6.12	13.6	.18	1.40	100.0	100.0	100.0	100.0	100.0

2BCD Cu Pre-float tests - series B (considering only the portion of the test without $K_2Cr_2O_7$)

ORETYPE and Test Description	SAMPLE	WTS	ASSAYS					DISTRIBUTION				
			Pb	Zn	Fe	Cu	Ag	Pb	Zn	Fe	Cu	Ag
3-11 2BCD ore - 1kg charge same as B-7 except used 5min longer primary grind time. (1st clar not reported)	Calc Ro Conc	204.4	12.67	6.38	16.9	.72	4.96	86.27	19.16	30.58	60.74	73.14
	Cu Ro Tls	792.8	.52	6.94	9.9	.12	.47	13.73	80.84	69.42	39.26	26.86
	CALC HEAD	997.2	3.01	6.83	11.8	.24	1.39	100.0	100.0	100.0	100.0	100.0
3-12 2BCD ore - 1kg charge grind: 1kg/t Na_2SO_3 NO NaCN 150g/t Z-11 rougher: 75g/t Z-11 PH=9.5 DUPLICATES LARGE E-4 TEST	Cu Ro Conc	274.3	9.71	5.07	20.4	.57	3.84	88.88	19.91	51.07	64.27	83.37
	Cu Ro Tls	724.5	.46	7.72	7.4	.12	.29	11.12	80.09	48.93	35.73	16.63
	CALC HEAD	998.8	3.00	6.99	11.0	.24	1.26	100.0	100.0	100.0	100.0	100.0
-13 2BCD ore - 1kg charge grind: 2kg/t Na_2SO_3 NO NaCN 50g/t Z-11 rougher: 15g/t Z-11 PH=9.5 1st cleaner: 5g/t Z-11	Cu CC ₁	23.9	30.60	10.26	9.9	5.33	12.26	24.61	3.74	2.04	51.02	19.25
	Cu CT ₁	34.2	9.74	9.67	10.2	.28	3.52	11.21	5.04	3.01	3.84	7.91
	Calc Cu Ro Conc	58.1	18.32	9.91	10.1	2.36	7.12	35.82	8.78	5.05	54.86	27.16
	Cu Ro Tls	939.4	2.03	6.37	11.7	.12	1.18	64.18	91.22	94.94	45.15	72.84
	CALC HEAD	997.5	2.98	6.58	11.6	.25	1.53	100.0	100.0	100.0	100.0	100.0
-14 2BCD ore - 1kg charge grind: NO Na_2SO_3 NO NaCN NO Z-11 rougher: 20g/t Z-11 LOW PH PH=5.3	Cu Ro Conc	24.0	18.30	10.00	12.5	4.99	7.69	14.82	3.63	2.48	45.02	12.97
	Cu Ro Tls	974.9	2.59	6.54	12.1	.15	1.27	85.18	96.37	97.52	54.98	87.03
	CALC HEAD	998.9	2.97	6.66	12.1	.27	1.42	100.0	100.0	100.0	100.0	100.0
4 2BCD ore - 8kg charge as test B-12 but on large Scale	Cu Ro Conc	753.6	23.40	6.21	15.4	1.39	9.19	76.54	8.50	11.95	46.76	60.12
	Cu Ro Tls	7246.4	.75	6.88	11.8	.17	.63	23.46	91.50	88.05	53.24	39.88
	CALC HEAD	8000.0	2.88	6.82	12.1	.28	1.44	100.0	100.0	100.0	100.0	100.0

Cu Pre-float Tests

TABLE I

anal	IPE Description	SAMPLE	WTS.	ASSAYS					Distribution					
				Pb	Zn	Fe	Cu	Ag	Pb	Zn	Fe	Cu	Ag	
A-1	·ZEE - no Na ₂ SO ₃													
	- 10g/t NaCN	Cu/Pb conc	87.4	28.7	5.97	22.6	.66	8.83	74.6	12.5	5.8	57.5	47.5	
	- 30g/t Z-11 to grind	Cu/Pb Tls	916.5	.93	4.00	35.1	.10	.93	25.4	87.5	94.2	42.5	52.5	
	- 50g/t Z-11 to flot.	Heads	1003.9	3.35	4.17	34.0	.15	1.62	100.0	100.0	100.0	100.0	100.0	
A-2	·ZEF - with Na ₂ SO ₃													
	- 10g/t NaCN	Cu/Pb conc	56.1	9.31	7.55	29.1	.99	3.12	15.4	9.4	4.8	37.1	12.2	
	- 30g/t Z-11 to grind	Cu/Pb Tls	942.0	3.06	4.33	34.2	.10	1.34	84.6	90.6	95.2	62.9	87.8	
	- 30g/t Z-11 to Flot.	Heads	998.1	3.41	4.51	33.9	.15	1.44	100.0	100.0	100.0	100.0	100.0	

June 2/83

• 2EF Cu Prefloat test • Group A

July 13.83

ORETYPE and Test Description	SAMPLE	WTS	ASSAYS					DISTRIBUTION				
			Pb	Zn	Fe	Cu	Ag	Pb	Zn	Fe	Cu	Ag
1kg _T Na ₂ SO ₃ A-3	Cu Ro conc	36.1	33.00	7.68	18.0	4.36	8.87	31.29	5.22	2.11	73.10	25.10
30g _T Z-11 to grind	Tails	965.2	2.71	5.22	31.3	0.06	0.99	68.71	94.78	97.89	26.90	74.90
30g _T Z-11 to Rougher (REPEAT of 2BCD-B-1)	HEADS	1001.3	3.80	5.31	30.8	0.22	1.27	100.00	100.00	100.00	100.00	100.00
1kg _T Na ₂ SO ₃ A-4	Cu CC ₁	20.2	46.50	5.23	12.5	6.69	12.31	23.55	1.96	0.82	65.87	21.18
30g _T Z-11 to grind	Cu Ct ₁	15.5	14.00	10.52	24.8	0.75	3.82	5.44	3.03	1.26	5.67	5.04
30g _T Z-11 to Ro.	Rougher Conc	95.7	32.39	7.53	17.8	4.11	8.62	28.99	4.99	2.08	71.54	26.22
20g _T Z-11 to 1 st CLR	Tails	973.5	2.91	5.25	30.8	0.06	0.89	71.01	95.01	97.92	28.47	73.78
(REPEAT of 2BCD-B-3)	HEADS	1009.2	3.95	5.33	30.3	0.20	1.16	100.00	100.00	100.00	100.00	100.00
1kg _T Na ₂ SO ₃ A-5	Cu CC ₁	15.7	38.10	6.18	14.3	8.75	10.17	15.56	1.79	0.73	69.37	15.18
50g _T Z-11 to grind	Cu Ct ₁	13.0	10.22	11.54	26.0	0.90	3.08	3.46	2.76	1.10	5.91	3.81
30g _T Z-11 to Ro.	Rougher Conc	28.7	25.47	8.61	19.6	5.20	6.96	19.02	4.55	1.83	75.28	18.99
20g _T Z-11 to 1 st CLR	Tails	979.2	3.18	5.29	30.8	0.05	0.87	80.99	95.45	98.17	24.72	81.01
(REPEAT of 2BCD-B-4)	HEADS	1007.9	3.81	5.38	30.5	0.20	1.04	100.00	100.00	100.00	100.00	100.00
1kg _T Na ₂ SO ₃ A-6	Cu CC ₁	13.0	36.00	5.90	14.9	10.11	9.59	11.65	1.35	0.63	63.97	9.33
70g _T Z-11 to grind	Cu Ct ₁	13.8	9.89	10.96	25.2	1.10	3.24	3.40	2.67	1.13	7.39	3.35
30g _T Z-11 to Ro.	Rougher Conc	26.8	22.52	8.51	20.2	3.47	6.32	15.05	4.02	1.76	71.36	12.68
20g _T Z-11 to 1 st CLR	Tails	980.8	3.48	5.54	30.7	0.06	1.19	84.95	95.97	98.23	28.64	87.33
(REPEAT of 2BCD-B-6)	HEADS	1007.6	3.99	5.62	30.4	0.20	1.33	100.00	100.00	100.00	100.00	100.00

July 13/83

• 2EF Cu PREFLOAT TEST • Group A

July 13, 83

ORETYPE and Test Description	SAMPLE	WTS	ASSAYS					DISTRIBUTION				
			Pb	Zn	Fe	Cu	Ag	Pb	Zn	Fe	Cu	Ag
1kg _T Na ₂ SO ₃ A-7 100g _T Z-11 to grind 50g _T Z-11 to Ro. 30g _T Z-11 to 1 st clnr (REPEAT of 2BCD-B-7)	CuCC ₁	44.3	57.90	3.53	9.6	3.29	14.69	67.71	3.03	1.40	68.50	53.55
	CuCl ₁	18.4	8.10	10.82	21.0	0.57	2.51	3.93	3.86	1.63	4.93	3.80
	ROUGHER CONC	62.7	43.28	5.67	14.7	2.49	11.12	71.64	6.89	3.03	73.43	57.35
	TAILS	942.2	1.14	5.10	31.3	0.06	0.55	28.35	93.11	96.97	26.57	42.65
	HEADS	1004.9	3.77	5.14	30.3	0.21	1.21	100.00	100.00	100.00	100.00	100.00
1kg _T Na ₂ SO ₃ A-8 50g _T Z-11 to grind 15g _T Z-11 to Ro. 5g _T Z-11 to 1 st clnr (REPEAT of 2BCD-B-9)	CuCC ₁	7.7	16.40	7.86	19.3	14.70	5.31	3.20	1.08	0.48	61.75	3.63
	CuCl ₁	18.0	13.60	9.86	25.0	1.15	3.78	6.20	3.18	1.45	11.29	6.04
	ROUGHER CONC	25.7	14.44	9.26	23.3	5.21	4.24	9.40	4.26	1.93	73.04	9.67
	TAILS	988.1	3.62	5.41	30.9	0.05	1.03	90.60	95.74	98.08	26.95	90.33
	HEADS	1013.8	3.89	5.51	30.7	0.18	1.11	100.00	100.00	100.00	100.00	100.00
2kg _T Na ₂ SO ₃ A-9 100g _T Z-11 to grind 50g _T Z-11 to Ro. 30g _T Z-11 to 1 st clnr (REPEAT of 2BCD-B-10)	CuCC ₁	10.4	19.20	7.89	19.6	11.40	5.75	5.45	1.59	0.66	59.62	5.53
	CuCl ₁	17.9	5.21	10.20	27.5	1.20	1.80	2.54	3.53	1.59	10.80	2.98
	ROUGHER CONC	28.3	10.35	9.35	24.6	4.95	3.25	7.99	5.12	2.25	70.42	8.51
	TAILS	980.5	3.44	5.01	30.8	0.06	1.01	92.01	94.89	97.75	29.58	91.50
	HEADS	1008.8	3.63	5.13	30.6	0.20	1.07	100.00	100.00	100.00	100.00	100.00

July 13/83

