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MINES BRANCH INVESTIGATION REPORT IR 61-27

MAGNETIC CONCENTRATION OF IRON FROM COPPER FLOTATION TAILINGS FROM THE BENSON LAKE, B.C., PROPERTY OF C.M. & S. CO. LIMITED

by

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MINERAL PROCESSING DIVISION

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SUMMARY OF RESULTS

Wet drum magnetic concentration of a copper flotation tailing assaying 28.5% sol iron and 0.23% copper, gave a final product assaying 63.22% sol iron, 0.05% copper, and about 7% SiO_2, with a recovery of 72.2% of the iron.

As received, the tailing was 66.0% -200 mesh. After treatment on the Jeffrey-Steffensen separator, the concentrate was reground to 85.5% -200 mesh and retreated on the same separator to obtain the final product. Davis tube retreatment of the tailing from the initial Jeffrey-Steffensen test yielded a very minor amount of concentrate which did not affect the overall recovery of soluble iron but did reduce the overall grade of concentrate to 62.5%.

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INTRODUCTION

Shipment

A total of 212 lb of copper flotation tailing was shipped in two drums to the Mineral Processing Division's laboratories on October 28, 1960.

Location of Property

The sample represented a mixture of copper flotation tailing from batch tests done on the ore from the Benson Lake (formerly Coast Copper) mine on Vancouver Island, B.C. This property is owned by the Consolidated Mining and Smelting Co. of Canada, Ltd., Trail, B.C.

Purpose of Investigation

In a letter dated October 4, 1960, Mr. A. G. Robertson, Superintendent of Concentration, C.M. & S. Co., requested magnetic concentration tests on the sample to produce a concentrate assaying 60% or more in iron, with less than 0.1% copper. A copy of the results of the company's investigations, was also included with the letter.

Sampling and Analysis

The tailings were mixed and pulped thoroughly in a conditioner, from which a 50 lb (dry weight) sample was taken for test work. This sample was then split in half -- one portion to be used for Jeffrey-Steffensen concentration, the other for a screen test, and chemical and spectrographic analysis.

The following elements, in order of decreasing abundance, were detected spectrographically:

I	Si, Fe, principal constituents
II	Ca, Mg, Al
III	Mn, Cu
IV	Ti (0.07%), Co
V	V, Ni, Cr, Ba, Sn, Zn, Na

The screen test and the chemical analysis of the head sample are given below.

Screen Test		Chemical Analysis	
Mesh	Wt % on mesh	Constituent	%
+65	1.0	Total Fe	30.02
+100	3.7	Soluble Fe	28.50
+150	10.4	Cu	0.23
+200	18.9	S	0.34
-200	66.0	Insol	43.88
Total	100.0		

No mineralogical investigation was done on a sample of the tailing since the mineralogy was described in the company's report.

DETAILS OF THE INVESTIGATION

Three main tests were made: two magnetic separations with intermediate stage grinding, and one Davis tube test.

Test 1 - Jeffrey-Steffensen Test on As-received Feed

A total of 21.2 lb of the material, as-received, was treated on the Jeffrey-Steffensen triple drum wet magnetic separator. The tailing, middling, and concentrate drums were set at 2.2, 1.7 and 0.7 amps, respectively. The results are given in Table 1.

TABLE 1

Jeffrey-Steffensen Results for Test 1

Product	Weight, %	Assay, %						Sol Fe, Distn, %
		Total Fe	Sol Fe	Cu	S	Insol	SiO_2	
Conc	33.6	62.60	62.14	0.08	0.25	10.12	8.66	73.1
Midd	5.7	21.29	19.49	0.19	0.32	54.58		3.9
Tail	60.7	13.04	10.82	0.29	0.34	61.44		23.0
Total*	100.0	30.16	28.56	0.21	0.31	43.80		100.0

*calculated

Test 2 - Further Treatment of Jeffrey Concentrate

From the magnetic concentrate, 1752 g was ground to 85.5% -200 mesh, and repassed through the Jeffrey-Steffensen separator, with each drum set at the maximum 2.2 amps. Table 2 contains the results from this work.

TABLE 2

Results from Retreating the Magnetic Concentrate

Product	Weight, %	Assay, %						Sol Fe, Distn, %
		Total Fe	Sol Fe	Cu	S	Insol	SiO_2	
Conc	94.5	64.41	63.63	0.05	0.22	9.04	6.88	96.7
Midd	2.7	52.12	48.77	0.06	0.58	26.66		2.1
Tail	2.8	29.05	26.19	0.09	0.78	49.14		1.2
Total*	100.0	63.09	62.18	0.05	0.25	10.64		100.0

*calculated

The concentrate and middling from the retreatment can be combined and still provide a satisfactory product, as seen in Table 3.

TABLE 3

Results of Table 2 with Concentrate and Middling Combined

Product	Weight, %	Assay, %					Sol Fe Distn, %
		Total Fe	Sol Fe	Cu	S	Insol	
Conc and Midd	97.2	64.07	63.22	0.05	0.23	9.53	98.8
Tail	2.8	29.05	26.19	0.09	0.78	49.14	1.2
Total	100.0	63.09	62.18	0.05	0.25	10.64	100.0

The overall recovery from this two-stage separation is 72.2%.

Test 3 - Davis tube Treatment on Jeffrey Tailing from First Separation

Since the Jeffrey-Steffensen tailing from Test 1A contained 23.0% of the soluble iron, 50 g of this product was ground to all -200 mesh, and was then concentrated in the Davis tube high intensity wet magnetic separator. The results in Tables 4 and 5 show that the Jeffrey-Steffensen had recovered practically all of the recoverable soluble iron, as the recovery of the latter had been scarcely affected.

TABLE 4

Davis Tube Concentration of Primary Jeffrey Tailing

Product	Weight, %	Assay, %		Sol Fe Distn, %
		Sol Fe	Cu	
Conc	1.4	33.47	0.20	95.9
Tail	98.6	11.10	0.33	4.1
Total	100.0	11.41	0.33	100.0

TABLE 5

Combined Results of Davis Tube Test and Jeffrey-Steffonsen Test 1A

Product	Weight, %	Assay, %		Units		Sol Fe Distn, %
		Sol Fe	Cu	Sol Fe	Cu	
Jeffrey conc	33.6	62.14	0.08	2088	2.69	72.2
D. T. conc	0.8	33.47	0.20	27	0.16	1.0
Jeffrey midd	5.7	19.49	0.19	111	1.08	3.8
D. T. tail	59.9	11.10	0.33	665	19.76	23.0
Total	100.0	28.91	0.24	2891	23.69	100.0

The combined concentrates assay 61.48% sol Fe, and 0.083% Cu, with a total recovery of 73.2% of the iron.

The overall metallurgy obtained from the treatment of the original sample of copper flotation tailing by the three methods used can be seen in Table 6 which contains the combined results of Tables 1, 3 and 4.

TABLE 6

Overall Metallurgy from Tests on Cu Flotation Tailing
(Tables 1, 3, & 4 combined)

Product	Weight, %	Assay, %					Distn, Sol Fe %
		Total Fe	Sol Fe	Cu	S	Insol	
Conc & midd Test 2	32.6	64.07	63.22	0.05	0.23	9.53	71.3
D.T. Conc, 3	0.8	-	33.47	0.20	-	-	0.9
Jeffrey midd Test 1	5.7	21.29	19.49	0.19	0.32	54.58	3.9
Jeffrey tail Test 2	1.0	29.05	26.19	0.09	0.78	49.14	0.9
D.T. tail Test 3	59.9	-	11.10	0.33	-	-	23.0
Total	100.0		28.90	0.23			100.0

Combining the Jeffrey-Steffensen concentrate and middling from Test 1B with Davis tube concentrate of Test 1C yields a product assaying 62.15% soluble iron and 0.05% copper with a total recovery of 72.2% of the iron. The amount of silica in this composite concentrate can be estimated to be approximately 7%, on the basis of a 6.88% silica assay being equivalent to an insol assay of 9.04%, as given in Table 2.

CONCLUSION AND DISCUSSION

Wet magnetic concentration of the copper flotation tailing as-received yielded a product of 62.14% sol iron, 0.08% Cu, and 8.66% SiO_2. This satisfied the company's request for a concentrate of 60% plus Fe, with Cu less than 0.1%. Recovery of iron was 73.1%.

A more attractive product, based on lower Cu and SiO_2 assays, was obtained by finer grinding of the first magnetic concentrate to 85.5% -200M, followed by a second step of magnetic concentration.

Although the tailing from the initial Jeffrey-Steffensen test contained 23.0% of the soluble iron, a Davis tube test on a sample of this tailing did not recover a sufficient amount to improve the recovery. The intensities used on the Jeffrey-Steffensen separator were sufficient to recover practically all of the magnetic material present.

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