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MINES BRANCH INVESTIGATION REPORT IR 61-44

COBBING AND CONCENTRATION TESTS ON A COPPER-BEARING IRON ORE SUBMITTED BY WESTERN FERRIC ORES LIMITED, VANCOUVER, B.C.

by

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MINERAL PROCESSING DIVISION

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SUMMARY OF RESULTS

The sample received was too high in grade for efficient magnetic cobbing.

It was not possible to make a magnetite concentrate assaying below 0.03% copper. Best results were obtained in a minus 100 mesh concentrate which assayed 0.04% copper.

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INTRODUCTION

Location of Property

The property from which this shipment of ore is said to have originated is known as the Iron River deposit near Campbell River on Vancouver Island, British Columbia.

Shipment

The shipment had a total weight of 193 lb and consisted of 146 lb of large pieces and 47 lb of minus $\frac{1}{4}$ in. material. The samples were sent by Mr. C. F. Millar, P. Eng., Western Ferric Ores Ltd., 1718 West 5th Ave., Vancouver, British Columbia.

Purpose of Investigation

It was requested that cobbing tests be done at different sizes to determine the optimum size at which to crush the ore to obtain maximum recovery of iron and copper. It was hoped that by crushing at a coarse size it would be possible to reject a good portion of the gangue but to retain most of the copper and iron. The cobbed concentrate would be sent to a custom milling plant to upgrade the iron and to recover the copper in a separate concentrate.

Sampling and Analysis

As the ore was to be cobbed at coarse sizes, no head sample was cut out of the shipment. An average analysis of the ore calculated from the different tests gave the following values:

Sol Fe	-	60.5 %
Cu	-	0.49 %

DETAILS OF INVESTIGATION

In his letter of September 27, 1960, Mr. Millar asked for cobbing tests to be made on the sample of ore at coarse sizes and also for concentration tests at various grinds down to 100 mesh to determine the copper content of the concentrate. The specifications mentioned were -100 M concentrate assaying 66% Fe and 0.03% Cu, and -10 M concentrate assaying 62% Fe and 0.10% Cu.

In a later letter, dated November 21, 1960, Mr. Millar said they were mainly interested in a product between 10 and 48 mesh with a maximum copper content of 0.12% Cu and he wished to know what the coarsest grind would be that would give this copper assay.

Test No. 1

The sample of coarse ore was crushed to minus 2 in. and passed over a magnetic cobber. The products were crushed to minus 1 in., sampled and recombined. The minus 1 in. material was then passed over the cobber and the material was again crushed, sampled and recombined. This process was repeated at $\frac{1}{2}$ in. size and at $\frac{1}{4}$ in.

Results of Test No. 1

Product	Weight, %	Assays, %		Distn, %	
		Sol Fe	Cu	Sol Fe	Cu
Feed (calcd)	100.0	59.03	0.55	100.0	100.0
Mag conc (-2")	85.0	59.94	0.46	86.3	70.9
Non-mag tailing (-2")	15.0	53.86	1.08	13.7	29.1
Feed (calcd)	100.0	59.10	0.50	100.0	100.0
Mag conc (-1")	91.9	60.78	0.42	94.5	78.0
Non-mag tailing (-1")	8.1	40.00	1.35	5.5	22.0

Results of Test No. 1 (concluded)

Product	Weight, %	Assays, %		Distn, %	
		Sol Fe	Cu	Sol Fe	Cu
Feed (calcd)	100.0	58.51	0.50	100.0	100.0
Mag conc (-½ ")	93.1	60.36	0.42	96.1	78.0
Non-mag tail (-½")	6.9	33.54	1.61	3.9	22.0
Feed (calcd)	100.0	60.39	0.51	100.0	100.0
Mag conc (-¼")	93.6	62.88	0.42	97.5	76.5
Non-mag tail (-¼")	6.4	23.90	1.92	2.5	23.5

Test No. 2

A sample of the -¼ in. material was passed over a Ball Norton magnetic separator. Several passes were made and in each pass a finished concentrate or a tailing was produced. The intensity of the field was reduced in each pass by either reducing the current density or by increasing the gap between the magnets and the belt. Each product was demagnetized before it was repassed over the magnetic separator.

Results of Test No. 2

Product	Weight, %	Assays, %		Distn, %	
		Sol Fe	Cu	Sol Fe	Cu
Feed (calcd)	100.0	62.91	0.72	100.0	100.0
Non-mag tailing 0.5 amp 0.5" gap	7.9	26.40	0.45	3.3	5.0
Non-mag tailing 0.5 amp 1.0" gap	2.5	49.41	2.16	1.9	7.4
Non-mag tailing 0.4 amp 1.0" gap	7.7	61.3	2.24	7.5	23.8

Results of Test No. 2 (concluded)

Product	Weight, %	Assays, %		Distn, %	
		Sol Fe	Cu	Sol Fe	Cu
Non-mag tailing 0.3 amp 1.0" gap	37.1	66.6	0.92	39.3	47.1
Mag conc 0.3 amp 1.0" gap	24.2	67.3	0.27	25.9	9.0
Mag conc 0.5 amp 1.5" gap	20.6	67.4	0.27	22.1	7.7

Test No. 3

A sample of $-\frac{1}{4}$ in. material was crushed to -10 M and split into two fractions. One fraction was passed over a Ball Norton magnetic separator at 0.5 amp and $\frac{3}{4}$ in. gap. The second fraction was passed over a Crockett magnetic separator.

Results of Test No. 3

Product	Weight, %	Assays, %		Distn, %	
		Sol Fe	Cu	Sol Fe	Cu
Feed (calcd)	100.0	63.3	0.62	100.0	100.0
B.N. mag conc	91.3	66.86	0.28	96.5	41.9
B.N. non-mag tailing	8.7	25.36	4.10	3.5	58.1
Feed (calcd)	100.0	62.5	0.63	100.0	100.0
Crockett mag conc	92.6	65.80	0.35	97.5	50.8
Crockett non-mag tailing	7.4	21.38	4.18	2.5	49.2

Test No. 4

A sample of ore from the main lot was stage ground to -100 M and passed over a Jeffrey-Steffensen magnetic separator.

Results of Test No. 4

Product	Weight, %	Assays, %		Distn, %	
		Sol Fe	Cu	Sol Fe	Cu
Feed (calcd)	100.0	62.77	0.51	100.0	100.0
Mag cl conc	80.8	69.59	0.04	89.6	5.8
Mag cl tailing	4.2	63.51	0.42	4.2	4.0
Non-mag tailing	15.0	25.79	3.08	6.2	90.2

Screen Test of Concentrate

Mesh	Wt, %
-100 +150	11.8
-150 +200	18.0
-200 +325	34.0
-325	36.2

Tests No. 5, 6 and 7

Samples of the ore were ground in one stage for 30 min, 10 min, and 5 min respectively, and then passed over a Jeffrey-Steffensen magnetic separator.

Results of Test No. 5 (30 min grind)

Product	Weight, %	Assays, %		Distn, %	
		Sol Fe	Cu	Sol Fe	Cu
Feed (calcd)	100.0	59.70	0.41	100.0	100.0
Mag cl conc	73.3	69.48	0.048	85.3	9.8
Mag cl tailing	6.5	64.55	0.22	7.0	2.4
Non-mag tailing	20.2	22.60	1.78	7.7	87.8

Screen Test of Concentrate

Mesh	Wt, %
-65 +100	0.2
-100 +150	0.3
-150 +200	2.0
-200	97.5

Results of Test No. 6 (10 min grind)

Product	Weight, %	Assays, %		Distn, %	
		Sol Fe	Cu	Sol Fe	Cu
Feed (calcd)	100.0	60.67	0.44	100.0	100.0
Mag cl conc	78.5	69.16	0.089	89.5	15.9
Mag cl tailing	4.4	59.52	0.42	4.3	4.5
Non-mag tailing	17.1	22.0	2.02	6.2	79.6

Screen Test of Concentrate

Mesh	Wt, %
+48	0.4
-48 +65	0.8
-65 +100	2.7
-100 +150	13.0
-150 +200	15.8
-200	67.3

Results of Test No. 7 (5 min grind)

Product	Weight, %	Assays, %		Distn, %	
		Sol Fe	Cu	Sol Fe	Cu
Feed (calcd)	100.0	61.41	0.42	100.0	100.0
Mag cl conc	83.9	67.80	0.14	92.6	28.6
Mag cl tailing	4.1	51.88	0.77	3.5	7.1
Non-mag tailing	12.0	20.0	2.26	3.9	64.3

Screen Test of Concentrate

Mesh	Wt, %
+20	1.5
-20 +28	0.8
-28 +35	1.2
-35 +48	2.4
-48 +65	6.8
-65 +100	14.3
-100 +150	18.5
-150 +200	14.4
-200	40.1

Test No. 8

A sample of ore was ground to the same fineness as in Test No. 6, with 1.0 lb of soda ash added to the grind. A copper concentrate was floated for 10 minutes using 0.1 lb of Reagent Z-5 and 0.06 lb of Dowfroth 250 per ton of feed. After flotation the tailing was passed over a Jeffrey-Steffensen separator to produce a magnetic concentrate.

Results of Test No. 8

Product	Weight, %	Assays, %	Distn, %
		Cu	Cu
Feed (calcd)	100.0	0.47	100.0
Cu rougher conc	1.7	15.74	57.4
Mag cl conc	76.7	0.08	12.8
Mag cl tailing	4.4	0.27	2.1
Non-mag tailing	17.2	0.76	27.7

Test No. 9

A sample of ore was ground for 20 minutes and then floated for 4 minutes using 0.1 lb of Reagent 325 and 0.03 lb of Dowfroth 250 per ton of feed. The flotation tailing was passed over a Jeffrey-Steffensen magnetic separator.

Results of Test No. 9

Product	Weight, %	Assays, %		Distn, %	
		Sol Fe	Cu	Sol Fe	Cu
Feed (calcd)	100.0	60.00	0.45	100.0	100.0
Cu rougher conc	1.2	37.20	18.32	0.7	48.9
Mag cl conc	75.8	69.58	0.068	87.9	11.1
Mag cl tailing	4.4	62.67	0.22	4.6	2.2
Non-mag tailing	18.6	21.30	0.92	6.8	37.8

Screen Test of Concentrate

Mesh	Wt, %
-100 +150	1.2
-150 +200	6.7
-200	92.1

Test No. 10

A sample of ore was ground to the same fineness as in Test No. 5 and then floated for 10 minutes using 0.1 lb of Reagent Z-5 and 0.06 lb of Dowfroth 250 per ton of feed. The flotation tailing was passed over a Jeffrey-Steffensen magnetic separator.

Results of Test No. 10

Product	Weight, %	Assays, %		Distn, %	
		Sol Fe	Cu	Sol Fe	Cu
Feed (calcd)	100.0	60.57	0.47	100.0	100.0
Cu rougher conc	2.4	44.81	11.65	1.8	59.6
Mag cl conc	74.2	70.23	0.056	86.0	8.5
Mag cl tailing	5.8	63.63	0.17	6.1	2.1
Non-mag tailing	17.6	20.95	0.77	6.1	29.8

Test No. 11

A sample of ore was ground to the same fineness as in Tests No. 6 and 8 and passed over a Jeffrey-Steffensen magnetic separator. The non-magnetic tailing was deslimed and floated for 4 minutes with 0.1 lb of Reagent 325 and 0.03 lb of Dowfroth 250 per ton of original feed.

Results of Test No. 11

Product	Weight, %	Assays, %		Distn, %	
		Sol Fe	Cu	Sol Fe	Cu
Feed (calcd)	100.0	61.33	0.41	100.0	100.0
Mag cl conc	80.7	69.45	0.086	91.4	16.9
Mag cl tailing	4.4	56.45	0.58	4.0	6.4
Cu rougher conc	1.2	-	19.57	-	57.6
Flotation tailing	13.7	20.46	0.57	4.6	19.1

CONCLUSIONS

The sample of ore received was too high in grade for efficient magnetic cobbing at coarse sizes. There was very little upgrading and the percentage of iron lost was almost equal to the weight rejected. At minus $\frac{1}{4}$ in. it was possible to reject 18.1% of the weight with a loss of 12.7% of the iron.

Grinding the ore to minus 100 mesh and concentrating it magnetically gave the best results. A magnetic concentrate assaying 69.59% iron and 0.04% copper was produced. Recovery of iron was 89.6% and 90.2% of the copper was rejected into the non-magnetic tailing.

In none of the tests was the copper content of the concentrate found to be below 0.03%.

To obtain a product with a maximum copper content of 0.10%, the ore was ground to 67.3% minus 200 mesh and a concentrate containing 69.16% iron and 0.089% copper was obtained. It is probable that a slightly coarser grind would keep the copper content below 0.10%.

Flotation of copper was not successful. In all tests recovery was low and the removal of some of the copper before magnetic concentration did not lower the copper content of the final iron concentrate.

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