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BENEFICIATION TESTS ON AN IRON ORE FROM THE BEAR RIVER PROPERTY OF PACIFIC GIANT STEEL ORES LTD., WHITEHORSE, YUKON TERRITORY

by

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MINERAL PROCESSING DIVISION

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SUMMARY OF RESULTS

Analysis of a head sample showed the ore to contain 62.9% Sol Fe, 8.4% Si O_2, and 0.06% P. Mineralogical examination indicated that the ore is composed of coarse and fine grained hematite with quartz filling the interstitial spaces between the grains of hematite.

Results of gravity separation, high intensity wet magnetic separation, flotation, and gravity combined with flotation or high intensity wet magnetic separation of the gravity tailing are summarized below:

	Conc. Analysis %		Recovery %
	Sol Fe	Si O_2	Sol Fe
Gravity separation	67.0	2.8	78.7
High intensity wet mag. sep	67.2	2.9	90.7
Silica flotation	66.6	3.0	95.3
Comb. gravity & flotation	67.2	2.4	94.5
Comb. gravity & mag sep	66.8	3.4	94.4

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INTRODUCTION

Pacific Giant Steel Ores Ltd. has an iron ore deposit on the Bear river located about 100 miles northeast of Mayo, Yukon Territory, at latitude 64° 50' and longitude 134° 15'.

The deposit consists of massive hematite which occurs in several outcrops, and lower grade ore which is hematite dispersed through the host rock.

The sample of massive hematite received for this investigation was said to be of the kind occurring in the outcrops.

Shipment

A shipment of 200 lb. of iron ore was received on Nov. 26, 1964. The shipment was submitted by Mr. G.R.E. Leverman, Secretary-Treasurer, Pacific Giant Steel Ores Ltd., P.O. Box 1039, Whitehorse, Yukon Territory.

Purpose of Investigation

The investigation was to carry out preliminary beneficiation tests to determine the concentration characteristics of the ore.

Mr. Leverman, in his letter of March 29, 1965, asked that high-intensity magnetic separation tests be made along with other methods of treatment.

Sampling and Analysis

The sample of lump ore was crushed to ½ in. and after picking out several pieces as specimens for mineralogical examination the remainder of the sample was crushed to minus 10 mesh and split into 2,000 gram samples. One of these samples was used as a head sample for mineralogical examination, semi-quantitative spectrographic analysis, and chemical analysis, and the remaining samples were used for the investigation.

Chemical analysis of the head sample gave the following results:

Table 1

Chemical Analysis of the Head Sample		
Fe	-	62.9%
SiO_2	-	8.4%
P	-	0.06%

A semi-quantitative spectrographic analysis of the head sample gave the following results.

Table 2

Spectrographic Analysis of the Head Sample *	
Elements	%
Ca	0.26
Mg,Al	0.20
Ni	0.12
Co	0.06
Mn,V,Mo,Cu	0.04
Cr	0.03
Ti	0.01

Mineralogical Examination**

The ½ in. pieces of ore are composed of massive hematite. The hematite in some of the chips is very fine grained (see Figure 1), while in others the grains are comparatively coarse (see Figure 2). The interstitial spaces between the grains in both types are filled with quartz.

The head sample contains hematite, quartz, and trace amounts of pyrrhotite, apatite, calcite, feldspar, a clay material, sericite, chlorite, and hornblende.

* From Internal Report SL 64-198
** From Internal Report MS 64-120 W. Petruk

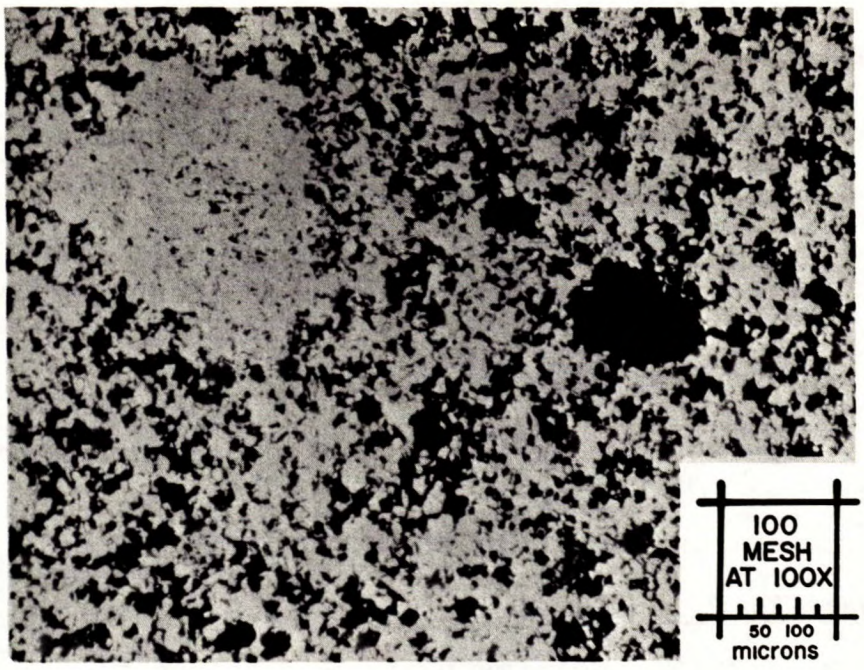

Figure 1 - Photomicrograph of a polished section showing the massive fine textured hematite (white), and interstitial quartz (grey). The black areas represent pits.

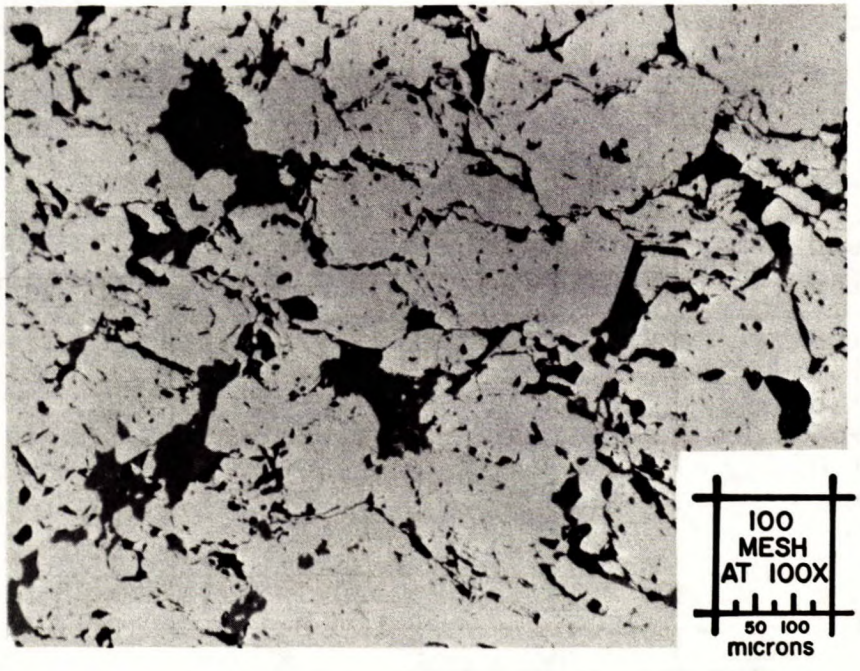

Figure 2 - Photomicrograph of a polished section showing the massive coarse textured hematite (white), and interstitial quartz (grey).

Outline of Investigation Procedures

Four different methods were used to beneficiate the ore:

1 - Gravity separation using a Deister shaking table.

2 - Magnetic separation using a Jones high intensity wet magnetic separator.

3 - Flotation in which the silica was floated.

4 - Gravity separation combined with magnetic separation or flotation of the gravity tailing.

DETAILS OF INVESTIGATION

Tabling Tests 1, 2, and 3

Two thousand gram samples were ground to -28 mesh, -35 mesh, and -65 mesh and passed over a laboratory concentrating table with the middling returned to give a final concentrate and tailing. Results of screen tests of the ground ore are shown in Table 3 and the tabling tests in Table 4.

Table 3

Results of Screen Tests

Mesh Tyler	Weight %		
	-28 mesh	-35 mesh	-65 mesh
+28	-	-	-
- 28+35	18.6	-	-
- 35+48	13.3	16.6	-
- 48+65	10.0	14.6	-
- 65+100	9.5	11.7	12.4
-100+150	10.3	13.0	22.6
-150+200	6.2	7.1	10.9
-200+325	9.4	10.3	15.0
-325	22.7	26.7	39.1
Total	100.0	100.0	100.0

Table 4

Results of Tabling Tests

Test 1. - 28 mesh

Product	Weight % Original ore	Analysis % SolFe	Analysis % SiO_2	Distribution % Sol Fe
Table conc	75.2	65.2	5.6	77.9
Table tailing	24.8	56.2	16.8	22.1
Feed (calcd)	100.0	63.0	8.3	100.0

Test 2. - 35 mesh

Table conc	75.2	65.7	4.7	78.5
Table tailing	24.8	54.4	19.4	21.5
Feed (calcd)	100.0	62.9	8.3	100.0

Test 3. - 65 mesh

Table conc	73.7	67.0	2.8	78.7
Table tailing	26.3	50.9	23.2	21.3
Feed (calcd)	100.0	62.8	8.2	100.0

Test 4. Magnetic Separation of Tailing from Test 3

The tailing from Test 3 was passed through the Jones high intensity separator at 10.0 amp to produce a magnetic iron concentrate.

The results are shown in Table 5.

Table 5

Results of Jones Magnetic Separator Test 4

Product	Weight % Original ore	Analysis % SolFe	Analysis % SiO_2	Distribution % Sol Fe
Mag conc	16.2	61.7	8.8	16.2
Middling	5.6	32.3	47.5	2.9
Non Mag tailing	4.5	29.7	50.2	2.2
Feed (calcd)	26.3	49.9	24.1	21.3

The combined table concentrate and Jones magnetic concentrate give a weight recovery of 89.9% of the original feed and contain 66.1% Sol Fe and 3.9% SiO_2 with 94.9% Sol Fe recovery.

Tests 5 and 6

A sample of ore was ground to minus 65 mesh and passed over a laboratory table to produce a high grade concentrate. The tailing was then ground to minus 150 mesh and split into several fractions for magnetic separation and silica flotation tests.

A sample of the minus 150 mesh table tailing was treated in a Jones magnetic separator at 10.0 amp. The results are shown in Table 6.

Table 6

Results of Tabling and Magnetic Separation Test 5

Products	Weight % Original ore	Analysis % Sol Fe	Analysis % SiO_2	Distribution % Sol Fe
Tabling				
Table conc	61.8	67.8	2.0	66.5
Table tailing	38.2	55.2*	18.2*	33.5
Feed	100.0	63.0*	8.2*	100.0
Magnetic Separation				
Mag conc	27.3	64.4	6.6	27.9
Middling	5.7	32.9	47.1	2.9
Non mag tailing	5.2	31.9	47.1	2.7
Table tailing	38.2	55.2*	18.2*	33.5
Table conc	61.8	67.8	2.0	66.5
Mag conc	27.3	64.4	6.6	27.9
Comb conc	89.1	66.8*	3.4*	94.4

* Calculated

A sample of the minus 150 mesh table tailing was treated by flotation. The pulp was made alkaline with NaOH and conditioned for 5 minutes at pH 10.0 with 4 lb. of Amioca starch per ton and 0.64 lb. of dodecylamine hydrochloride per ton. After conditioning for 5 min, 0.05 lb. of methyl isobutyl carbinol per ton was added and silica was floated for 5 min. The results of the test are shown in Table 7.

Table 7

Results of Tabling and Flotation Test 6

Product	Weight % Original ore	Analysis % Sol Fe	Analysis % SiO_2	Distribution % Sol Fe
Tabling				
Table conc	61.8	67.8	2.0	66.8
Table tailing	38.2	54.6*	19.1*	33.2
Feed	100.0	62.8*	8.2*	100.0
Flotation				
SiO_2 float	11.7	29.6	55.0	5.5
Fe conc	26.5	65.7	3.2	27.7
	38.2	54.6*	19.1*	33.2
Table conc	61.8	67.8	2.0	66.8
Flotation Fe conc	26.5	65.7	3.2	27.7
Comb Fe conc	88.3	67.2*	2.4*	94.5

* Calculated

High Intensity Wet Magnetic Separation Tests

Jones wet magnetic separator tests were made at 10.0 amps with ore stage-ground to minus 100 mesh, minus 150 mesh, and minus 250 mesh. A test was also made at 15.0 amps on ore ground to minus 250 mesh the middlings were repassed to increase the overall Sol Fe recovery. The results of the tests are shown in Table 8.

Table 8

Results of Jones Magnetic Separator Tests

Test 7. Minus 100 mesh, 10.0 amp

Product	Weight % Original ore	Analysis % Sol Fe	Analysis % SiO_2	Distribution % Sol Fe
Mag conc	77.7	67.1	2.9	82.8
Middling	14.1	52.7	21.3	11.8
Non mag tailing	8.2	41.1	34.4	5.4
Feed (calcd)	100.0	62.9	8.1	100.0

Test 8. Minus 150 mesh, 10.0 amp

Mag conc	69.1	67.5	2.1	74.5
Middling	18.1	55.9	17.5	16.1
Non mag tailing	12.8	45.9	30.0	9.4
Feed (calcd)	100.0	62.6	8.5	100.0

Test 9. Minus 250 mesh, 10.0 amp

1st Mag conc	76.0	67.9	2.1	82.0
2nd Mag conc	6.8	64.1	7.3	6.9
2nd Middling	2.6	33.9	45.9	1.4
1st Non mag tailing	11.0	43.5	33.3	7.6
2nd Non mag tailing	3.6	37.1	40.1	2.1
Feed (calcd)	100.0	63.0	8.4	100.0
Comb 1st and 2nd mag conc	82.8	67.6	2.5	88.9

Test 10. Minus 250 mesh, 15.0 amp

1st Mag conc	79.9	67.5	2.5	86.1
2nd Mag conc	4.6	62.1	9.0	4.6
2nd Middling	2.6	30.5	49.1	1.3
1st Non mag tailing	10.2	41.3	35.4	6.7
2nd Non mag tailing	2.7	31.1	48.4	1.3
Feed (calcd)	100.0	62.6	8.6	100.0
Comb 1st and 2nd mag conc	84.5	67.2	2.9	90.7

Silica Flotation. Test 11

A sample of ore was ground to minus 150 mesh and a number of silica flotation tests were made. The best results were obtained when the pulp was conditioned for 5 min. with 4 lb. of Amioca per ton at pH 10.0; 2.5 lb. of Armeen L-11 per ton was then added, and, after 2 minutes conditioning, silica was floated for 8 min. The silica rougher float was cleaned without reagent additions to produce a silica cleaner float and a middling. The results of the test are shown in Table 9.

Table 9

Test 11, Silica Flotation of Minus 150 Mesh Ore

Product	Weight % Original ore	Analysis %		Distribution %
		Sol Fe	SiO_2	
SiO_2 cleaner float	10.2	28.7	56.0	4.7
Middling	7.7	62.8	8.4	7.7
Fe product	82.1	67.0	2.5	87.6
Feed (calcd)	100.0	62.8	8.4	100.0

The combined Fe product and middling would give a product containing 66.6% Sol Fe and 3.0% SiO_2 with a Sol Fe recovery of 95.3%.

CONCLUSIONS

The results show that the sample of high grade massive hematite ore can be upgraded by either gravity separation, high intensity wet magnetic separation, or flotation.

Gravity concentration of the ore ground to minus 65 mesh produced an iron concentrate containing 2.8% SiO_2, 67.0% Sol Fe, with a Sol Fe recovery of 78.7%

High intensity wet magnetic concentration of the ore ground to 250 mesh produced a concentrate which contained 2.9% SiO_2, 67.2% Sol Fe, with a Sol Fe recovery of 90.7%.

Flotation of the ore ground to 150 mesh and the silica floated produced an iron concentrate which contained 3.0% SiO_2 66.6% Sol Fe with 95.3% Sol Fe recovery. Reagent costs would be high so the feasibility of flotation would depend on further testing.

Gravity separation combined with flotation of the gravity tailing after it was ground to minus 150 mesh produced a combined concentrate containing 2.4% SiO_2, 67.2% Sol Fe with a Sol Fe recovery of 94.5%. Gravity separation combined with high intensity wet magnetic concentration of the gravity tailing after grinding to minus 150 mesh produced a combined concentrate containing 3.4% SiO_2, 66.8% Sol Fe with a 94.4% Sol Fe recovery.

All methods investigated produced acceptable grades of iron concentrates. The best overall results were obtained by the combination gravity plus flotation test with flotation the best of the individual methods tested although cost would be high.

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