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MAGNETIC CONCENTRATION TESTS ON THE S. R. FOUND MAGNETITE SHIPMENT FROM SHARBOT LAKE REGION, ONT.

by

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MINERAL DRESSING AND PROCESS METALLURGY DIVISION

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SUMMARY OF RESULTS

The purpose of this investigation was to try to obtain, preferably by dry magnetic concentration, a concentrate that would assay 65-68% Fe.

In Test 8-A a Ball Norton concentrate, assaying 67.1% total Fe with a recovery of 86.0%, was obtained from a 2000 g sample that had been ground to 100% -14 mesh.

In Test 10 a sample, ground to 100% -28 mesh and concentrated in the Ball Norton dry magnetic separator yielded a concentrate that assayed 70.6% total Fe at a recovery of 87.7%.

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INTRODUCTION

Shipment

On September 9, 1958, the Mines Branch Laboratories received a shipment of magnetite ore, weighing about 300 lb, from Mr. S. R. Found, No. 4 Keiller Circle, Dorval, Quebec.

Location

In a letter dated August 16, preceding the shipment, Mr. Found stated that the sample had been taken from a mill feed ore dump which is on a property located 9 miles north of Sharbot Lake, and 2 miles east of Clarendon Station in Ontario. This area is about 70 miles west and south of Ottawa, Ontario.

Purpose of Investigation

In his letter, Mr. Found also mentioned that samples had previously been sent to the Ontario Research Foundation in Toronto, for Davis tube tests. A copy of their report of investigation showed that a recovery of 89.4% total iron could be obtained in a concentrate grading 71.6% Fe at a grind of 100% -100 mesh.

The Research Foundation suggested that further testing be done at coarser sizes to obtain a concentrate grading 65-68% Fe. The main purpose of the tests at the Mines Branch was to determine the suitable liberation size of magnetite in order to obtain the recommended grade of concentrate.

Sampling and Analysis

Three hand specimens were selected and sent for polished section study.

The shipment was crushed to -1/4 in., mixed thoroughly, and a 70 lb head sample was riffled out by standard methods and finally ground to -10 mesh. A 5 lb head sample was cut out and sent for a chemical analysis. A small portion of this sample was sent for a spectrographic analysis which indicated the presence of the following elements in decreasing order of abundance:

I - Fe, principal constituent

II - Ca, Si, Mg, Al, Na

III - Mn, Ti

IV - V, Ni, Cu, Co, Ba, Zr

V - Cr, B, Be

The chemical analysis of the head sample gave the following results:

Constituent	Percent
Fe	30.32
SiO_2	30.08
TiO_2	0.36
S	0.132
P	0.071
Ag	trace

MINERALOGICAL EXAMINATION*

Three polished sections were prepared from the sample and were examined microscopically for the purpose of studying the

*From Mineralogical Report M-1613-E, September 19, 1958 by W. E. White.

characteristics of the ore. Mineral identifications are based on optical and physical properties and on X-ray powder samples taken from the polished surfaces during the microscopical examination.

Gangue

On the whole, gangue material is slightly more abundant than ore minerals by volume in the three polished sections and is composed essentially of amphibole with minor amounts of admixed calcite and epidote.

Metallic Minerals

To unaided eyes, metallic mineralization is seen to be fairly strong in two of the three polished sections and almost absent in the third. Each of the two sections with megascopically visible metallics, is attracted to a small horseshoe magnet brought close to its polished surface but the sparsely mineralized section is not so affected.

Under a microscope, the ore minerals, named in order of decreasing abundance, are seen to be magnetite, hematite and pyrite. Magnetite preponderates and is the only readily abundant ore mineral in the three polished sections. It predominates largely as coarse granular masses (Figure 1) but a small percentage is disseminated through gangue as subhedral crystals and anhedral particles which range down to very fine sizes, especially in the sparsely mineralized section (Figure 2). Inclusions of gangue are fairly common in magnetite but most of them are large enough to be released by moderately fine grinding.

Hematite is locally visible as occasionaly small grains which are usually along magnetite borders or associated with gangue inclusions, (Figure 1). As represented in the three polished sections, the total quantity of hematite present in the ore is relatively very small.

A few tiny particles of pyrite, possibly a half dozen in all, the largest being about 30 microns (-400+560 mesh) across, occur in magnetite and, therefore, as exhibited by three polished sections, the amount of sulphide in the ore is practically negligible.

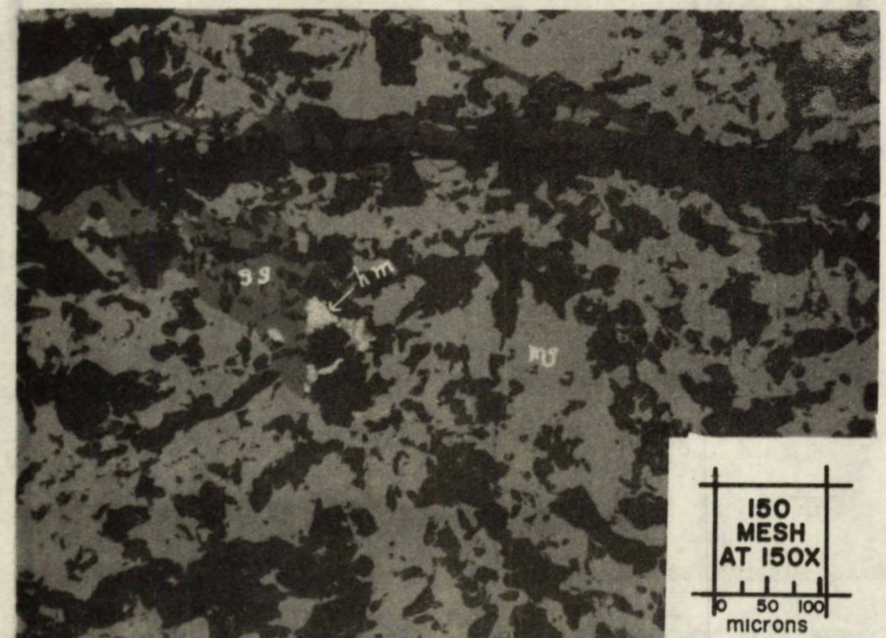

Figure 1. - Massive magnetite (mg), medium grey, containing an irregular inclusion of gangue (gg), dark grey, with which a few particles of hematite (hm), white, are associated; note also the veinlets of gangue transecting magnetite near top of picture; polishing pits are black.

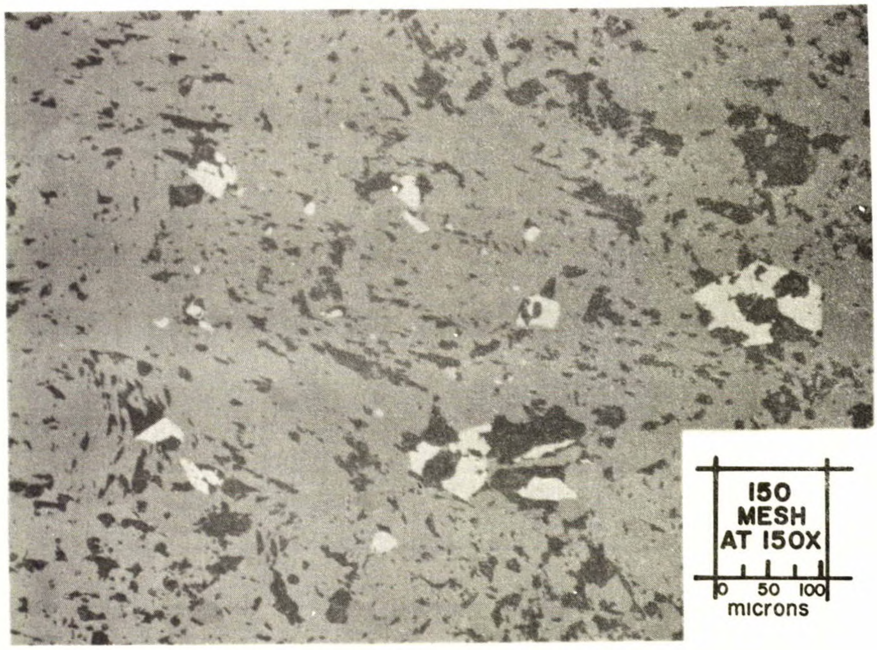

Figure 2. - Photomicrograph of typical field in sparsely mineralized section showing magnetite particles (white) disseminated through gangue (grey); polishing pits are black.

DETAILS OF INVESTIGATIONS

Five samples, each weighing 1000 g, were ground separately to different degrees of fineness. A portion of each of the ground samples was sent for a chemical analysis and a screen test. From the rejects, 50 g was used for Davis tube tests. The results of the Davis tube tests are given in Table 1.

TABLE 1

Results of Davis Tube Tests

Test No. 1 - Sample Ground to 99.4% -100 Mesh

Product	Weight, %	Assay, %		Iron Distribution, %	
		Total Fe	Acid Soluble Fe	Total Fe	Acid Soluble Fe
Conc.	42.6	71.2	71.2	86.6	96.5
Tailing	57.4	8.25	1.91	13.4	3.5
Calculated Head	100.0	35.0	31.4	100.0	100.0

Test No. 2 - Sample Ground to 99.7% -65 Mesh

Conc.	43.2	71.4	71.2	86.8	96.9
Tailing	56.8	8.25	1.71	13.2	3.1
Calculated Head	100.0	35.5	31.6	100.0	100.0

Test No. 3 - Sample Ground to 100% -48 Mesh

Conc.	43.5	71.3	71.1	87.1	96.6
Tailing	56.5	8.15	1.91	12.9	3.4
Calculated Head	100.0	35.6	32.0	100.0	100.0

Test No. 4 - Sample Ground to 99.9% -35 Mesh

Conc.	42.6	70.62	70.62	86.5	96.4
Tailing	57.4	8.20	1.85	13.5	3.6
Calculated Head	100.0	34.80	31.2	100.0	100.0

Table 1 (cont'd)

Test No. 5 - Sample Ground to 100% -28 Mesh

Product	Weight, %	Assay, %		Iron Distribution, %	
		Total Fe	Acid Soluble Fe	Total Fe	Acid Soluble Fe
Conc.	45.0	70.12	70.12	87.1	97.8
Tailing	55.0	8.50	1.20	12.9	2.2
Calculated Head	100.0	36.3	32.3	100.0	100.0

Impurities in the concentrate from Test No. 5 assayed as follows: S - 0.007%; P - 0.005%; SiO_2 - 1.10%; TiO_2 - 0.050%.

Test No. 6 - Magnetic Separation of -¼ in. Feed to the Roche Belt-Type Magnetic Separator

The purpose of this test was to determine if a suitable concentrate could be made from the material which had been crushed to all -¼ in.

The -¼ in. feed was passed through the Roche magnetic separator and the first split was made at an amperage setting of 5. The tailing was cleaned by repassing it through the separator using a wider splitter setting and an amperage of 7.5.

The cleaner tailing was recleaned with the splitter half-closed and at the same amperage setting.

The recleaner tailing was passed through the machine again, this time using a maximum setting of 10 amp for the drum magnet and 7.5 amp for the energizer.

All of the concentrates were combined, as were the tailing products, and were sampled for assaying.

Table 2 shows the results of Test No. 6.

TABLE 2

Results of Test on Roche Magnetic Separator

Product	Weight, %	Assay, %			Iron Distribution, %	
		Total Fe	Acid Soluble Fe	SiO_2	Total Fe	Acid Soluble Fe
Conc.	70.75	43.26	39.83	21.86	91.6	95.6
Tailing	29.25	9.65	4.40	46.30	8.4	4.4
Calculated Head	100.00	33.4	29.5	29.01	100.0	100.0

Tests Nos. 7-A to 10 consist of a series of tests performed on 2000 g samples which had been ground to coarse sizes and then passed through dry and wet magnetic separators in parallel to obtain comparable results on samples ground to the same fineness. With exception of Test No. 9, the concentrates were cleaned once by repassing them through the machines.

These tests are more fully described below.

Test No. 7-A - Crockett Test on -10 Mesh Sample

A sample, weighing 2000 g, which had been crushed to all -10 mesh, was passed through the Crockett wet magnetic separator. Table 3 lists the results of this test.

TABLE 3

Results of Crockett Test on -10 Mesh Material

Product	Weight, %	Assay, %			Iron Distribution, %	
		Total Fe	Acid Soluble Fe	SiO_2	Total Fe	Acid Soluble Fe
Conc.	51.5	59.15	57.34	9.16	87.9	96.5
Tailing	48.5	8.60	2.20	46.76	12.1	3.5
Calculated Head	100.0	34.60	30.57	27.42	100.0	100.0

Test No. 7-B - Ball Norton Test on -10 Mesh Feed

The Ball Norton magnetic separator was set at full amperage, and 2000 g of -10 mesh dry material was passed through the separator.

TABLE 4

Results of Ball Norton Test on -10 Mesh Feed

Conc.	49.0	60.96	59.46	8.08	86.4	95.6
Tailing	51.0	9.20	2.60	46.00	13.6	4.4
Calculated Head	100.0	34.54	30.43	27.36	100.0	100.0

Test No. 8-A - Ball Norton Test in -14 Mesh Feed

The 2000 g sample was ground to 100% -14 mesh, dried, and then passed through the Ball Norton separator, which was set at maximum amperage.

Table 5 contains the results of the above test.

TABLE 5

Results of Ball Norton Test on -14 Mesh Feed

Conc.	44.9	67.1	66.6	3.50	86.0	92.0
Tailing	55.1	8.80	4.63	46.30	14.0	8.0
Calculated Head	100.0	35.0	32.5	27.07	100.0	100.0

Test 8-B - Crockett Test on -14 Mesh Feed

This test was similar to the previous one except that the feed was passed through the Crockett wet magnetic separator.

TABLE 6

Results of Crockett Test on -14 Mesh Feed

Product	Weight, %	Assay, %			Iron Distribution, %	
		Total Fe	Acid Soluble Fe	SiO_2	Total Fe	Acid Soluble Fe
Conc.	43.8	68.4	68.2	2.48	85.4	93.7
Tailing	56.2	9.15	3.32	45.1	14.6	6.3
Calculated Head	100.0	35.09	31.85	26.39	100.0	100.0

Test No. 9 - Jeffrey-Steffensen Test on -14 Mesh Feed

Two 2000 g samples were ground separately to 100% -14 mesh, combined, and then sampled for assay purposes. The remainder of the material was treated on the Jeffrey-Steffensen triple drum wet magnetic separator. The test was performed at amperage settings of 2.2, 1.2, and 0.7 amp for the tailing, middling, and concentrate drums, respectively.

TABLE 7

Results of Test in Jeffrey-Steffensen Separator on -14 Mesh Feed

Conc.	40.0	70.2	69.4	1.28	80.5	88.5
Middling	4.0	44.7	39.9	21.8	5.1	5.1
Tailing	56.0	8.95	3.37	45.7	14.4	6.4
Calculated Head	100.0	34.85	31.35	26.98	100.0	100.0

Test No. 10 - Ball Norton Test on -28 Mesh Feed

The purpose of this test was to duplicate Test No. 5 on a larger scale to determine if the same grade and recovery could be obtained.

The 2000 g sample was ground to 100% -28 mesh and passed through the Ball Norton set at maximum amperage.

TABLE 8

Results of Ball Norton Test on -28 Mesh Feed

Product	Weight, %	Assay, %			Iron Distribution, %	
		Total Fe	Acid Soluble Fe	SiO_2	Total Fe	Acid Soluble Fe
Conc.	46.3	70.6	66.19	3.08	87.7	94.5
Tailing	53.7	8.65	3.42	46.20	12.3	5.5
Calculated Head	100.0	37.3	32.4	27.23	100.0	100.0

As the tests were proceeding, Mr. Found also requested that the specific gravity of the ore be determined. From the 70 lb head sample, a small representative sample weighing about 1000 g was sent for a gravity determination. Two separate determinations on the sample gave values of 3.66 and 3.67.

CONCLUSIONS AND DISCUSSION

The tests performed in the Davis tube gave results that were quite similar to each other. These tests showed that a grind as coarse as 100% -28 mesh would liberate enough magnetite that could be concentrated to the desired grade with a satisfactory recovery.

Test No.6, where the feed was crushed only to 100% $-\frac{1}{4}$ in. did not yield a concentrate of satisfactory grade or recovery to make a direct blast furnace feed.

The desired grade of 65-68% total Fe was obtained in Tests Nos. 8-A, 8-B, 9 and 10, with Test No. 10 producing a concentrate of highest grade and recovery. Tests Nos. 8-A and 8-B indicated that on a sample ground to all -14 mesh, almost identical grades and recoveries could be obtained by means of either a dry or wet magnetic concentration process.

In Test No. 9, a concentrate grading 70.2% total Fe but with a recovery of 80.5% was obtained. However, the recovery could be improved by regrinding the middling product and recirculating it back to the feed.

The best combination of grade and recovery was obtained from Test No. 10, where dry magnetic concentration was employed. The concentrate obtained from the sample which had been ground to 100% -28 mesh, assayed 70.6% total Fe with a recovery of 87.7%.

The assay on the head sample showed that very small amounts of sulphur, phosphorus, and titanium dioxide were present. Subsequent grinding and magnetic concentration of the samples further reduced the amount of these minor constituents in the magnetite concentrates.

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