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July 4th, 1941.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1042.

Concentration of Magnetite from
the Rankin Iron Mines,
Hastings County, Ontario.

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BUREAU OF MINES
DIVISION OF METALLIC MINERALS
—
ORE DRESSING AND
METALLURGICAL LABORATORIES



CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

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Shipments:

On January 7th, 1941, 11 bags of ore, total weight 600 pounds, were received from Mr. W. J. Robbins, Bancroft, Ontario, shipped under instructions of Mr. W. G. Hubler (Toronto), from the Frobisher Exploration Company Limited, Toronto, Ontario. A further 5-ton sample was received on February 28th, 1941.

600-POUND LOT.

The preliminary shipment of 11 bags consisted of 11 samples taken from various places on the property. Some of these samples were weathered and leached, leaving the magnetite in a friable condition. Others were dense magnetite. Considerable pyrite was present.

Microscopic examination of polished sections shows the mineralization to be heavy and to consist of two types, iron oxide and sulphides. Each type is roughly separated from the other. There is considerable admixture, however, with grains of magnetite included in the sulphides and particles of the latter scattered unevenly throughout masses of magnetite.

Magnetite -

Massive and disseminated as coarse to fine irregular grains with the large sizes predominating. It contains numerous inclusions of gangue and rare small grains of pyrrhotite and chalcopyrite as well as narrow veinlets and patches of "limonite".

Pyrite -

Largely as fine-textured masses enclosing numerous grains of magnetite and gangue, occasional pyrrhotite and chalcopyrite. It is rather extensively fractured and veined with gangue, chalcopyrite and limonite. Although many of the magnetite grains are enclosed in apparently dense material, many also occur along fractures in pyrite and appear to have been deposited later than the iron sulphides.

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(600-Pound Lot, cont'd) -

Pyrrhotite -

Locally abundant in gangue as small masses and irregular grains, also as small inclusions in pyrite and magnetite.

Chalcopyrite -

Occurs as small masses in the other sulphides.

Limonite -

Locally abundant in gangue, associated with chalcopyrite.

Experimental Procedure:

The eleven samples were mixed and crushed to approximately 1-inch size and screened as below. A head sample was cut out and analysed, with the following results:

Iron	(Fe)	-	45.62
Silica	(SiO ₂)	-	17.09
Sulphur	(S)	-	1.58
Manganese	(Mn)	-	0.26
Phosphorus	(P)	-	0.124

Screened Products.		Weight,
Mesh	:	per cent
+ 1"	:	4.2
-1" + 3"	:	10.0
-3" + 4"	:	21.7
-4" + 4 mesh	:	23.6
-4 + 8 "	:	5.6
-8 +10 "	:	7.7
-10 +14 "	:	3.2
-14 +35 "	:	2.1
-35 +48 "	:	9.6
-48 +60 "	:	3.2
-60 mesh	:	2.1
	:	7.0
		<hr/>
		100.0

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(600-Pound Lot, cont'd) -

Each sized fraction, or a representative portion, was passed through a magnetic separator. The sizes from 1 in. to $+\frac{1}{4}$ in. were treated on a Stearns drum separator, and the intermediate sizes from $-\frac{1}{4}$ in. to +48 mesh were concentrated on a Ball-Norton machine, while the finest sizes were passed through a Dings Davis tube concentrator.

Results:

Fraction: size	PRODUCT	Weight, per cent of fraction	Weight, per cent of total	Analysis, per cent			
				Fe	S	Insol.	P
+1"	:Concentrate	: 4.2	: 0.2	59.69	0.85	11.80	0.125
	:Middling	: 8.3	: 0.3	47.95			
	:Tailing	: 87.5	: 3.7	32.16			
-1" + $\frac{3}{4}$ "	:Concentrate	: 5.4	: 0.5	59.29	0.93	12.16	0.095
	:Middling	: 7.1	: 0.7	57.62			
	:Tailing	: 87.5	: 0.8	30.89			
- $\frac{3}{4}$ " + $\frac{1}{2}$ "	:Concentrate	: 13.8	: 3.0	62.71	0.86	8.76	0.085
	:Middling	: 12.2	: 2.6	56.04			
	:Tailing	: 74.0	: 16.1	30.78			
- $\frac{1}{2}$ " + $\frac{1}{4}$ "	:Concentrate	: 43.2	: 10.2	61.70	1.18	11.53	0.095
	:Middling	: 3.0	: 0.7	45.08			
	:Tailing	: 53.8	: 12.7	25.22			
- $\frac{1}{4}$ " + 4 mesh	:Concentrate	: 73.7	: 4.1	53.66	1.85	21.36	0.125
	:Tailing	: 26.3	: 1.5	14.87			
-4+8 mesh	:Concentrate	: 73.3	: 5.6	62.70	1.26	-	0.085
	:Tailing	: 26.7	: 2.1				
- 8+10 mesh	:Concentrate	: 82.3	: 2.6	63.40	1.50	-	0.087
	:Tailing	: 17.7	: 0.6	23.02			
-10+14 mesh	:Concentrate	: 82.1	: 1.7	65.42	1.33	-	0.06
	:Tailing	: 17.9	: 0.4	24.12			
-14+35 mesh	:Concentrate	: 86.0	: 8.3	67.53	1.16	-	0.056
	:Tailing	: 14.0	: 1.3	15.67			
-35+48 mesh	:Concentrate	: 74.3	: 2.4	67.13	1.31	4.04	0.027
	:Tailing	: 25.7	: 0.8				
-48+60 mesh	:Concentrate	: 61.7	: 1.3	67.33	1.15	4.00	0.022
	:Tailing	: 38.3	: 0.8				
-60 mesh	:Concentrate	: 40.6	: 2.8	69.34	0.90	2.00	0.027
	:Tailing	: 59.4	: 4.2				

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(600-Pound Lot, cont'd) -

At the conclusion of these individual tests, all products were united, crushed and screened to pass 6 mesh. The sample was then magnetically concentrated on a Roche wet magnetic separator.

Results:

Product	: Weight, : pounds	: Analysis, per cent			
		: Fe	: S	: SiO ₂	: P
Feed	: 503	45.62	1.58	17.09	0.124
Roche magnetic concentrate:	289	64.74	1.27	1.48	0.048
Roche non-magnetic tailing:	214	11.13			

Ratio of concentration = 1.55:1 = 64.5 per cent of feed weight.

Recovery of iron = 91.3 per cent.

A few preliminary sintering tests were made on the Roche magnetic concentrate. Varying percentages of coke, water and concentrate were used. The sulphur was reduced to 0.19 per cent in some of the trials.

5-TON LOT.

The 5-ton lot was crushed -6 mesh and run through the Roche concentrator.

Assays:

Feed	-	Fe,	38.25	per cent
		SiO ₂ ,	17.85	"
		S,	2.21	"
		P,	0.135	"

Concentrate	-	56.42	per cent Fe
Tailing	-	5.82	" "

Ratio of concentration = 1.5:1.

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(5-Ton Lot, cont'd) -

A middling product which was produced on the above operation, amounting to 1,827 pounds, was ground -14 mesh and passed over the Roche magnetic separator where a concentrate and a tailing were obtained.

Results:

Feed	-	28.01	per cent Fe
Concentrate	-	62.45	" "
Tailing	-	7.05	" "

The first concentrate obtained, together with the tailing from the re-treated middling, were combined, ground wet in a ball mill in closed circuit with a 16-mesh screen, and concentrated on the Roche machine.

Product	Assays, per cent			
	Fe	P	S	SiO ₂
Feed	46.43			
Concentrate	68.17	0.023	0.32	2.45
Tailing	7.45			

Ratio of concentration = 1.6:1.

A 24-mesh screen was substituted for the 16-mesh screen with the following results:

Product	Assays, per cent			
	Fe	P	S	SiO ₂
Feed	46.43			
Concentrate	69.31	0.012	0.54	1.58
Tailing	6.74			

Ratio of concentration = 1.6:1.

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(5-Ton Lot, cont'd) -

Screen analyses were made of the concentrates.

M E S H	-16 MESH		-24 MESH	
	Weight, per cent	Assay, Fe, per cent	Weight, per cent	Assay, Fe, per cent
- 16 + 20	1.5)	63.07		
- 20 + 28	8.0)			
- 28 + 35	13.1)		11.3	66.30
- 35 + 48	16.9	66.30	18.5	68.91
- 48 + 65	16.6	68.91	20.0	68.10
- 65 +100	10.9	68.91	15.8	69.92
-100	33.0	69.11	34.4	70.72

Conclusions:

The results of the above investigation show that with a grind of from 6 to 8 mesh a concentrate containing over 60 per cent iron can be obtained with a ratio of concentration of approximately 1.5:1. The sulphur content of the concentrate is high. Sintering of the magnetic concentrate will be necessary.

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