O T T A W A October 16th, 1940.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 908.

Concentration Tests on a Sample of Rejects from a Washing Operation Conducted on Manganese Ore by the Atlantic Manganese Corporation in Nova Scotia.

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

CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

O T T A W A October 16th, 1940.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 908.

Concentration Tests on a Sample of Rejects from a Washing Operation Conducted on Manganese Ore by the Atlantic Manganese Corporation in Nova Scotia.

Shipment:

One drum containing 112 pounds of the product was received on July 30th, 1940. The shipment was submitted by H. N. Munro, Secretary, Atlantic Manganese Corporation Limited, Box 6, Truro, Nova Scotia.

Location of Property:

This product originated at a property located at New Ross, in Lunenburg county, Nova Scotia.

Character of the Sample:

The sample contained pyrolusite and hematite with a granitic gangue. No polished sections were made for microscopic examination.

Sampling and Assaying:

A sample was cut from the shipment without crushing, was assayed, and reported as follows:

Manganese	-	28.67 per cent
Iron	-	19.68 "

Experimental Tests:

A series of small-scale flotation and gravity concentration tests was conducted in which it was found that the sizes coarser than 4 mesh when separated from the gangue gave a product assaying almost 50 per cent manganese with a little better than 8 per cent of iron. Separation of iron from the manganese by flotation or by gravity concentration alone was found to be inefficient. A heavy solution separation merely separated the gangue minerals from the metallic minerals and made no separation at all of iron from manganese.

It was therefore found necessary to resort to a reducing roast to convert the hematite to magnetite and concentrate with a magnetic separator. By this means a product assaying 54 per cent manganese and 1.7 per cent iron was obtained.

The tests are described in detail as follows:

Details of Experimental Tests:

Test No. 1.

A sample of the material was screen sized as follows:

Mesh size	Weight, per cent	Cumulative weight, per cent
+ 4	5.7	5.7
- 4 + 14	27.8	33.5
- 14 + 20	7.9	41.4
- 20 + 28	6.7	48.1
- 28 + 35	7.1	55.2
- 35 + 48	5.2	60.4
- 48 + 65	4.8	65.2
- 65 +100	5.3	70.5
-100	29.5	100.0

Samples of the different size fractions were treated to see what grade of manganese product could be obtained.

The gangue was hand sorted out of the fraction coarser than 4 mesh. The fractions between 4 and 28 mesh were treated in a small jig and those between 28 and 48 mesh were treated on a superpanner. Everything finer than 48 mesh was floated.

The manganese products obtained by the different operations were assayed and reported as follows. No attempt was made to calculate recoveries owing to the small amount of feed for the jigs which resulted in a small amount of product discharged at the gate while a relatively large amount was retained in the bed.

Mesh	Product Obtained	Assays, per cent Mn	Fe
+ 4	Hand sorted concentrate	49.95	8.24
- 4 +14	Jig concentrate	36.00	23.94
-14 +28	Jig concentrate	21.45	36.20
-28 +48	Panner concentrate	28.12	30.73
-48	Flotation concentrate	37.50	12.86

(Continued on next page)

(Test No. 1, cont'd) -

From the above assays it is evident that, with the possible exception of the coarsest size, there is no separation of the iron from the manganese owing to the intimate association of the two minerals as well as the fact that they are both of nearly the same specific gravity. It therefore seems that the gangue should be removed by gravity concentration, yielding a manganese-iron product that will have to be subjected to a reducing roast followed by magnetic concentration to take out the magnetite formed in the roast.

Test No. 2.

About 90 pounds of the material was treated in a three-compartment jig. Concentrates and hutch products were taken from the first two compartments along with a sand and a slime tailing. The clean-up from the jig beds was another product.

The sand tailing along with the jig clean-up and the two hutch products was ground through 14 mesh and tabled to further reduce the gangue content.

The table tailing was added to the original slime tailing and the table concentrate along with both jig concentrates was roasted for one half hour at a temperature of 1100° F. with 1.5 per cent of fuel oil added as a reducing agent. The roasted product was then treated in a magnetic separator, giving a magnetic product assaying 58.04 per cent iron and 7.22 per cent manganese and a non-magnetic product assaying 54.16 per cent

(Test No. 2, cont'd) -

manganese and 1.71 per cent iron.

Flotation tests were conducted on samples of table tailing plus jig slime tailing, but so far no product has been obtained that is high enough in manganese for a finished product or low enough in insoluble matter to be sent to the roasting operation.

Gravity Concentration Results;

Product	Weight, per cent	Assays, per cent			Distribution, per cent		
		Mn	Fe	Insol.	Mn	Fe	Insol.
Jig conc. No. 1	13.9	39.45	21.92	2.07	25.8	21.1	2.2
Jig conc. No. 2	5.6	39.35	30.58	3.15	5.7	8.7	1.0
Hutch No. 1	7.2	33.75	25.34	4.82	8.4	9.3	1.9
Hutch No. 2	5.8	30.00	26.04	7.42	6.0	7.7	2.4
Jig clean-up	4.7	27.00	27.36	9.41	4.4	6.6	2.5
Sand tailing	43.6	21.90	16.48	31.48	33.1	36.6	76.6
Slime tailing	14.2	33.60	13.88	16.87	16.6	10.0	13.4
Feed (cal.)	100.0	28.86	19.65	17.91	100.0	100.0	100.0

The jig concentrates combined with the table concentrates obtained from the four products so treated weighed 40.5 pounds and contained 47.5 per cent of the manganese in the original feed to the jig.

To the combined concentrates was added 1.5 per cent of fuel oil to produce a thin film of oil on the particles. The charge was then put into a metal container with an 0.5 inch outlet tube and placed in a retort previously heated to 1100° F. The charge was left in the retort for one half hour, then taken out and cooled, without exposure to the air. After cooling, the roasted product was treated on a dry magnetic separator which gave a high-iron magnetic product and a high-manganese non-magnetic product.

(Continued on next page)

(Test No. 2, cont'd) -

Results of Magnetic Concentration:

Product	Weight, per cent	Assays, per cent			Distribution, per cent		
		Mn	Fe	Insol.	Mn	Fe	Insol.
Magnetic product	48.5	7.22	58.04	4.00	11.1	97.0	72.4
Non-magnetic product	51.5	54.16	1.71	9.90	88.9	3.0	27.6
Roasted product (cal.)	100.0	31.39	29.03	7.04	100.0	100.0	100.0

The recovery of manganese in the non-magnetic product is .˙. 88.9 X 47.5 = 42.2 per cent of the manganese in the original feed to the jig. Any increased recovery of manganese will depend on the possibility of successfully floating a high-manganese product from the table tailing and jig slimes. No satisfactory solution for this problem has, as yet, been found.

Conclusions:

The results of tests conducted on this material indicate that the coarsest part of it is the richest in manganese and should be taken out without crushing. This can best be done by feeding the unsized material to a jig and taking off a high manganese-iron product low in gangue. The jig tailings with one or more of the hutch products should then be crushed and sized for tabling. The table concentrate along with the jig concentrates can then be given a magnetizing roast and treated on a magnetic separator to remove the magnetite.

The roasting operation could best be done in

(Conclusions, cont'd) -

a rotary type kiln such as has been used for production of sponge iron. This kiln is 22 feet long and made of boiler plate. It is built in three sections, the feed end being 12 feet long and 2 feet in diameter with a brick lining leaving an effective diameter of 15 inches. The discharge end is 6 feet long by 3.5 feet in diameter with a brick lining leaving an effective diameter of 2.5 feet. These two sections are joined by a conical section 4 feet long. The kiln is set at a slope of 0.5 inch per foot. The feed end is open and connected to a stack while the discharge end is fairly well closed to exclude excess air. The finished product discharges through a small tube fixed in the discharge end cover plate.

Heat is supplied by an oil burner at the discharge end of the kiln, the hot gases travelling counter to the charge. The reducing medium, in this case fuel oil, will be mixed with the material and fed into the kiln.

The speed of the kiln should be regulated so that the charge will remain in it for half an hour with a temperature of 850° to 1100° Fahrenheit.

The time necessary for reduction varies inversely as the temperature within these limits for a given size of product, a finer product requiring less time than a coarser one.

The operation of this retort for production of sponge iron is described fully in U. S. Bureau of Mines Report of Investigations No. 2656, published in November, 1924.

(Continued on next page)

(Conclusions, cont'd) -

The use of fuel oil in a retort of this type may cause some difficulty, depending on how well the draft can be controlled. It may happen that the oil would all be volatilized before any of it reached the reduction zone. If this should be the case, then petroleum coke might be used in its place. Petroleum coke, we understand, is obtainable at Halifax and will leave no residue to dilute the finished product.

While somewhat more than 1 per cent of iron remained in the finished product from this test work, indications are that the iron content could be reduced still further under ideal operating conditions.

oooooooooo
oooo
oo

JDJ:PES.