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MINES BRANCH INVESTIGATION REPORT IR 62-81

INVESTIGATION OF IRON ORE FROM IRELAND, SUBMITTED BY COULEE LEAD AND ZINC MINES LIMITED, TORONTO, ONTARIO

by

W. S. JENKINS

MINERAL PROCESSING DIVISION

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W. S. Jenkins*

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SUMMARY OF RESULTS

The shipment assayed 24.68 per cent total iron, 24.44 per cent acid soluble (HCl) iron, 4.87 per cent manganese, 0.41 per cent phosphorus pentoxide and 0.021 per cent sulphur.

A magnetic concentrate from roasted ore assayed 34.04 per cent iron, 5.90 per cent manganese and 31.74 per cent silica. The recovery of iron was 5.1 per cent at a ratio of concentration of 26:1.

A high intensity magnetic concentrate from roasted ore assayed 27.02 per cent iron, 5.05 per cent manganese and 40 per cent silica.

None of the concentrates produced in the tests was of suitable commercial grade. The hematite grains in the ore are very minute and could not be concentrated satisfactorily.

*Senior Scientific Officer, Mineral Processing Division, Mines Branch, Department of Mines and Technical Surveys, Ottawa, Canada.

INTRODUCTION

Shipment

A sample of 10 lb of iron ore was received at the Mineral Processing laboratories on June 27, 1962 from E. P. McDonough, Vice President, Coulee Lead and Zinc Mines Limited, Suite 1109-1110, 55 Yonge Street, Toronto, representing Roche Mines Limited, 605-372 Bay Street, Toronto.

Location of the Property

In his covering letter, Mr. McDonough stated that the sample originated in Ireland.

Purpose of the Investigation

The shipment was submitted for testing to determine the feasibility of economic concentration of ore represented by the shipment.

Description of the Property

No description or exact location of the deposit was given in the covering letter.

SAMPLING AND ANALYSIS OF SHIPMENT

Several samples of the rock were selected for a mineralogical examination by the Mineral Sciences Division, Mines Branch. The remaining material was crushed and a head sample was obtained.

The head sample was analysed and a semi-quantitative spectrographic analysis was made.

TABLE 1

Chemical Analysis of Head Sample*

Total iron	24.68 %
Manganese	4.87 "
Soluble (HCl) iron	24.44 "
Ferrous iron	none detected
Ferric iron	24.68 %
Iron carbonate	none detected
Phosphorus pentoxide	0.41 %
Sulphur	0.021 "
Silica	39.33 "

*From Internal Report MS-AC-62-1005

TABLE 2

Semi-Quantitative Spectrographic Analysis of Head Sample**
In order of decreasing abundance

Major constituents	Fe, Mn, Si
Intermediate constituents	Al
Minor constituents	Na, Ca, Mg, Ti
Trace constituents	Ba, Pb, Cu, Cr, Zr, Ni, V, Co, Ag, Be, Sr, Zn, Sn

**From Internal Report MS-AC-62-757, SL-62-167

MINERALOGICAL EXAMINATION*

The ore is composed of minute hematite grains in a quartz-feldspar matrix. The hematite grains are so small that they cannot be concentrated by mechanical means.

*Test Report M-62-26, Mineralogy Section, Mineral Sciences Division by W. Petruk, August 8, 1962.

SUMMARY OF TEST PROCEDURE AND RESULTS

In all tests the ore was roasted to produce a magnetic oxide. Concentration of the roasted material was attempted by both low and high intensity magnetic separators.

No appreciable weight of concentrate was recovered by the wet drum separator, (Jeffrey-Steffensen). The tailing from the Jeffrey-Steffensen separator was dried and concentrated by a dry belt type separator (Ball-Norton). The concentrate weighed 86.4 per cent of the feed and assayed 27 per cent Fe and 5.10 per cent Mn. The recoveries were 92.5 per cent and 92.0 per cent Mn. The ratio of concentration was 1.2:1.

Concentrate from a wet belt type (Crockett) separator assayed 28.1 per cent Fe, 4.69 per cent Mn and 39.78 per cent SiO_2 with no appreciable concentration of -100 m ore.

Concentration of -150 m roasted ore by the Jones high intensity separator was not successful. A concentrate recovered at 0 amp assayed 29.83 per cent Fe, 4.91 per cent Mn and 37.44 per cent SiO_2 ; at 5 amp the concentrate assayed 26.29 per cent Fe, 5.09 per cent Mn and 40.72 per cent SiO_2 . The calculated analysis of the combined concentrate was 27.02 per cent Fe, 5.05 per cent Mn and 40.0 per cent SiO_2 . The recoveries were 91.8 per cent Fe, and 89.7 per cent Mn at a ratio of concentration 1.1:1.

DETAILS OF TESTS

Test 1 - Magnetic Concentration of Roasted Ore

A 500 g sample of -35 m ore was roasted in a closed retort with city gas*for 15 minutes. The retort was heated to 675°C in an electrically heated furnace with thermostatic controls. After passing gas for 15 min, the retort was removed from the furnace and cooled by a water spray. During heating and cooling periods nitrogen gas was passed through the retort. The excess gas from the retort was ignited and allowed to burn during the roasting period.

The roasted ore was stage ground in a ball mill to -100 m and concentrated by a Jeffrey-Steffensen wet drum separator. The concentrate weighed 12 g. The tailing was dried and concentrated on a Ball-Norton dry belt separator, which recovered a concentrate weighing 86.4 per cent of the roasted ore. A portion of the Ball-Norton concentrate was reconcentrated by the Davis tube separator.

*city gas - natural gas in this and subsequent tests

TABLE 3

Results of Magnetic Concentration by Jeffrey-Steffensen Separator

Product	Weight %	Analysis, % ** Fe	Mn	R/C
Feed	100.0			
Mag conc	2.6	not assayed		39:1
Midds	-			
Tailing	97.4	25.78	4.86	

TABLE 4

Results of Magnetic Concentration of Jeffrey-Steffensen Tailing by Ball-Norton Separator

Product	Weight %		Analysis % **			Distn %		R/C
	In test	In orig feed	Fe	Mn	Insol	Fe	Mn	
Feed*	100.0	97.4	25.89	4.91		100.0	100.0	
Mag conc	88.7	86.4	27.00	5.10	44.12	92.5	92.0	1.16:1
Tailing	11.3	11.0	17.22	3.45		7.5	8.0	

*Calculated
**From Internal Report MS-AC-62-768
R/C = ratio of concentration

Additional analyses of the concentrate

P_2O_5	0.44 %
S	0.058"

TABLE 5

Results of Magnetic Concentration of Ball-Norton Concentrate by Davis Tube Separator

Product	Weight %		Analysis % **			Distn %				R/C
						In test		In orig feed		
	In test	In orig feed	Fe	Mn	Insol	Fe	Mn	Fe	Mn	
Feed*	100.0	86.4	26.57	4.99		100.0	100.0	92.5	92.0	
Mag conc	30.4	26.3	28.96	5.05	38.28	33.1	30.8	30.7	28.3	3.8:1
Tailing	69.6	60.1	25.52	4.96	-	66.9	69.2	61.8	63.7	

*Calculated
**From Internal Report MS-AC-62-788

Test 2 - Magnetic Concentration of Roasted Ore, Roasting in Air followed by Reducing Roast

A 500 g sample of -35 m ore was roasted in open dish at 675°C for 15 min. The material was charged to the closed retort and roasted with city gas for 15 minutes at 675°C. The charge was cooled and ground in a ball mill for 10 minutes. The ground material was magnetically concentrated by the Jeffrey-Steffensen wet drum separator. The tailing was reconcentrated by the Crockett wet belt separator.

TABLE 6

Results of Magnetic Concentration by Jeffrey-Steffensen Separator

Product	Weight %	Analysis % **			Distn %		R/C
		Fe	Mn	SiO_2	Fe	Mn	
Feed*	100.0	25.46	4.66		100.0	100.0	
Mag conc	3.8	34.04	5.90	31.74	5.1	4.9	26:1
Midds	15.2	29.34	5.81	37.60	17.5	18.9	
Tailing*	81.0	24.32	4.39	-	77.4	76.2	

*Calculated
**From Internal Report MS-AC-62-1007

TABLE 7

Results of Magnetic Concentration of Jeffrey-Steffensen Tailing by Crockett Separator

Product	Weight %		Analysis % **			Distn %				R/C
	In test	In orig feed	Fe	Mn	SiO_2	In test		In orig feed		
						Fe	Mn	Fe	Mn	
Feed*	100.0	81.0	24.32	4.39		100.0	100.0	77.4	76.2	
Mag conc	40.2	32.5	28.10	4.69	39.78	46.4	42.9	35.9	32.7	3.1:1
Tailing	59.8	48.5	21.79	4.19	-	53.6	57.1	41.5	43.5	

*Calculated
**From Internal Report MS-AC-62-1007

Test 3 - Magnetic Concentration of Roasted Ore

A 500 g sample of -35 m ore was roasted first by passing air through the retort at a temperature of 675°C for 15 minutes then city gas for 15 min at the same temperature. The retort was cooled under nitrogen by water spray. The roasted ore was ball milled and concentrated by the Crockett Separator. A screen test was made on the concentrate.

TABLE 8

Results of Magnetic Concentration of Roasted Ore by Crockett Separator

Product	Weight %	Analysis % **				Distn %		R/C
		Fe	Mn	SiO_2	Insol	Fe	Mn	
Feed*	100.0	25.82	4.99			100.0	100.0	
Mag conc	55.9	28.23	5.05	39.54	43.80	61.1	56.5	1.8:1
Tailing	44.1	22.77	4.92	-	-	38.9	43.5	

*Calculated
**From Internal Report MS-AC-62-1007

TABLE 9

Screen Test on Magnetic Concentrate

Mesh	Wt %
+ 65	5.7
+100	18.6
+150	22.8
+200	16.6
+325	11.2
-325	25.1
	100.0

Test 4 - Magnetic Concentration of Roasted Ore by High Intensity Jones Separator

A 500 g sample of -150 m ore was roasted by city gas at 675°C for 15 minutes. After cooling, the roasted ore was ball milled for 10 minutes and concentrated by the Jones high intensity separator. The first pass was made at 0 amp. The products were a concentrate, a middling and a tailing. The middling and tailing were combined and repassed at 5 amp, giving a concentrate, a middling and a tailing.

TABLE 10

Results of High Intensity Magnetic Concentration by Jones Separator

Product	Weight %	Analysis % **			Distn %		R/C
		Fe	Mn	SiO_2	Fe	Mn	
Feed*	100.0	26.31	5.04		100.0	100.0	
Mag conc at 0 amp	18.6	29.83	4.91	37.44	21.0	18.1	5.4:1
Mag conc at 5 amp	70.8	26.29	5.09	40.72	70.8	71.6	1.4:1
Midds at 5 amp	6.2	21.32	4.83	-	5.1	5.9	
Tailing at 5 amp	4.4	18.80	5.00	-	3.1	4.4	
Combined concs*	89.4	27.02	5.05	40.0	91.8	89.7	1.12:1

*Calculated
**From Internal Report MS-AC-62-1041

CONCLUSIONS

The investigation showed that the iron and manganese could not be concentrated to an acceptable grade by roasting to reduce hematite to a magnetic oxide and recovering iron as a magnetic concentrate by either low or high intensity separation. Although the iron minerals became magnetic, they could not be separated from silica and insoluble gangue minerals.

After examining the ore specimens, Dr. Haycock, Section Head of the Mineralogy Section, Mineral Sciences Division, told the writer that the hematite grains were of the order of one micron or less in size, in which case it would not be possible to concentrate the hematite to an acceptable grade.

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