O T T A W A December 26th, 1941.

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of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1128.

Gravity Concentration of Manganese Ore
from A. W. Haddock,
Williams Lake, British Columbia.

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Shipment:

One box of ore, weighing 84 pounds, was received on November 20th, 1941. This sample was taken from the surface across the vein (approximately 4 feet wide and 500 feet long), in two places approximately 30 feet apart.

Purpose of the Investigation:

To determine whether a metallurgical grade of concentrate could be produced from this sample of ore by gravity concentration methods.

The test work showed that a concentrate containing 48.64 per cent manganese, 2.28 per cent iron and 10.7 per cent acid insoluble could be produced, with a recovery of 61.47 per cent.

Characteristics of the Ore:

Six polished sections were prepared and examined microscopically for the purpose of determining the character of the ore.

Gangue -

Gangue material forms the greater portion of the polished sections and consists essentially of impure quartz which bears deep, local stains of iron oxides.

Metallic Minerals -

Two of the polished surfaces are composed of massive, metallic mineral which appears dense and homogeneous to the unaided eye. Under a high-power objective with oil immersion, however, it is seen to be an extremely fine-grained mixture of at least two minerals; one is creamy white, the other is light grey with a bluish tinge. They are so finely intergrown that identification is impossible. The creamy white mineral is anisotropic and gives four extinctions per revolution of the stage; the bluish grey mineral appears to be isotropic.

This fine-textured intergrowth is very hard and powder is obtained with difficulty. The latter is black or very dark brownish black in colour and some of the tiny particles are magnetic. W. V. Smitheringale[Φ] states that

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Φ Etching Tests and X-Ray Examinations of Some Manganese Minerals. By W. V. Smitheringale, Econ. Geol. Vol. XXIV, p. 488, 1929.

(Metallic Minerals, cont'd) -

the powder of braunite ($3MnMnO_3.MnSiO_3$) is slightly magnetic but these particles, like those of magnetite, stand on end when a magnet approaches them. Microchemical tests for manganese and iron gave strong reactions for the former, very weak to negative reactions for the latter.

Pyrolusite is present as disseminated grains, small granular masses, and irregular stringers in gangue. It contains a small amount of gangue as tiny inclusions and as replacement veinlets along cleavage planes. In a small hand specimen of the ore bladed crystals of pyrolusite are visible on hard, dark, dense material, quite probably the fine intergrowth previously described.

In one section there is a small amount of a metallic mineral whose etch reactions correspond more closely to psilomelane ($MnO_2.Mn_2O_3$) than to those of any other manganese mineral described in the literature available at this laboratory. It occurs in gangue as small, dense masses which lack the concentric banding usually shown by polished surfaces of this mineral.

A small amount of "limonite" is visible as rusty brown stains in gangue and as scattered grains and small masses admixed with the manganese minerals.

Sampling and Analysis:

The sample as received was crushed to all minus $\frac{1}{2}$ inch and a head sample for analysis cut out. The chemical analysis gave the following results:

(Continued on next page)

(Sampling and Analysis, cont'd) -

		Per cent
Manganese (total)	-	28.80
MnO_2	-	39.82
SiO_2	-	36.50
Al_2O_3	-	0.94
Iron	-	2.42
Zinc	-	0.05
Copper	-	Trace

Experimental Tests:

The tests were run by gravity concentration using the laboratory Harz jig and Wilfley table.

Test No. 1.

In this test, the ore crushed to minus ½ inch was passed twice through the two-compartment Harz jig. The 'side draw' product from the first compartment was taken as the finished concentrate from both passes. The second jig concentrate was passed over a magnetic separator to remove the magnetite which was present. The 'side draw' product from the second compartment was taken as "middling" from both passes. The tailing after the second pass was rejected. All the fines passing through the 14-mesh jig bedding screen were saved as well as all slimes overflowing from both the concentrate and tailing containers. The jig "middling" was dried and recrushed to minus 14 mesh, combined with the minus 14 mesh and the slimes from the jig, and all passed over the Wilfley table to give the table concentrate, middling, sand, and slime products.

All the products were dried, weighed and sampled for analysis.

(Continued on next page)

(Test No. 1, cont'd) -

Results of Test No. 1.

Product	Weight, per cent	Assay, per cent			Distribution, per cent		
		Mn	Fe	Acid insoluble	Mn	Fe	Acid insoluble
1st jig conc.	24.62	46.68	1.94	14.64	39.48	19.36	9.61
2nd jig conc. (non-magnetic)	9.58	37.13	5.25	28.94	12.22	20.39	7.39
2nd jig conc. (magnetic)	0.13	12.38	17.43	52.98	0.05	0.92	0.18
Jig tailing	29.79	14.76	2.20	60.48	15.11	26.57	48.05
Table conc.	6.74	46.84	2.30	11.12	10.85	6.28	2.00
Table middling	10.49	30.39	2.25	30.94	10.95	9.57	8.66
Table sand	14.50	15.84	2.05	52.06	7.89	12.05	20.13
Table slime	4.15	24.15	2.89	35.89	3.45	4.86	3.98
Feed (cal.)	100.00	29.11	2.46	37.49	100.00	100.00	100.00

A composite concentrate consisting of the 1st jig concentrate, 2nd jig concentrate and the table concentrate gives the following results:

	Assay, per cent	Recovery, per cent	Ratio of concentration
Manganese -	44.47	62.55	2.45:1.
Iron -	2.77		
Acid insoluble -	17.41		

It will be seen from the above figures, and from the remarks under "Characteristics of the Ore," that when the ore is jigged at minus ½ inch the gangue particles are not sufficiently freed from the manganese oxides to allow the production of a high-grade concentrate with a low acid insoluble content.

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Test No. 2.

In this test, in an attempt to raise the grade of concentrate, the ore was crushed to minus ¼ inch. After this crushing stage all the minus 14 mesh material formed was screened out. The -¼ inch +14 mesh material was passed once

(Test No. 2, cont'd) -

through the laboratory Harz jig to produce a concentrate and a tailing. The magnetic portion of the jig concentrate was removed and called the jig "middling". The jig tailing was dried and recrushed to minus 14 mesh, combined with the minus 14 mesh fines from the first crushing stage, and passed over the Wilfley table to produce the table concentrate, middling and tailing. (All the slimes were combined with the table sand tailing).

All products were dried, weighed and sampled for analysis.

Results of Test No. 2.

Product	Weight, per cent	Assay, per cent			Distribution, per cent		
		Mn	Fe	Acid insoluble	Mn	Fe	Acid insoluble
Jig conc.	21.87	49.20	2.16	11.14	37.57	20.31	6.57
Jig middling	0.90	19.12	8.55	45.13	0.60	3.31	1.09
Table conc.	14.32	47.78	2.46	10.04	23.90	15.16	3.87
Table middling	19.19	25.52	2.38	40.60	17.11	19.65	20.98
Table tailing	43.72	13.63	2.21	57.32	20.82	41.57	67.49
Feed (cal.)	100.00	28.62	2.32	37.13	100.00	100.00	100.00

A composite concentrate consisting of the jig concentrate and the table concentrate gives the following results:

	Assay, per cent	Recovery, per cent	Ratio of concentration
Manganese -	48.64	61.47	2.76:1.
Iron -	2.28		
Acid insoluble -	10.70		

From the results of this test it will be noted that when the ore was crushed to a fine size before jigging and tabling a concentrate was produced which could be considered to be adequate for metallurgical grade ore.

Conclusions:

Although these tests have shown that the sample of ore submitted for investigation is amenable to standard methods of gravity concentration, by which a metallurgical grade of concentrate was produced, it must be recommended that the whole orebody be completely sampled across full mining widths and a larger sample (500 to 1,000 pounds) be submitted for further test work.

These preliminary tests on the small sample show that if the orebody is sufficiently large and if a grade comparable with the sample submitted can be maintained, large-scale operations should be undertaken.

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