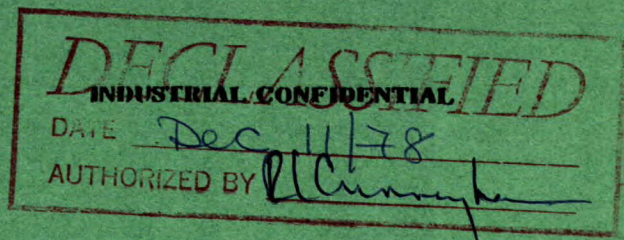


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MINES BRANCH INVESTIGATION REPORT IR 61-79

**MAGNETIC CONCENTRATION OF TITANIFEROUS
MAGNETITE FROM SAGUENAY EXPLORATION
AND MINING, INC., OUTREMONT, QUEBEC**

by

R. S. KINASEVICH

MINERAL PROCESSING DIVISION

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MAGNETIC CONCENTRATION OF TITANIFEROUS MAGNETITE
FROM SAGUENAY EXPLORATION AND MINING, INC.,
OUTREMONT, QUEBEC

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R. S. Kinasevich^{*}

SUMMARY OF RESULTS

A preliminary cobbing test, using a Crockett magnetic separator, rejected 44.1% by weight of the feed as a non-magnetic tailing. A concentrate containing 72.2% of the soluble iron was recovered, with a grade improved to 52.4% Fe from 40.6% Fe. In addition, reductions occurred in the following constituents:

SiO₂ - from 11.62% to 4.82%,

TiO₂ - from 17.2% to 11.71%.

(See Table 2)

Subsequent treatment of the Crockett tailing by gravity and high intensity magnetic separation indicated that the latter method could produce a higher recovery of TiO₂, at the expense of grade, than tabling. Conversely, tabling produced a higher grade TiO₂ concentrate with a decrease in recovery. (Tables 3 and 4).

Four samples of the -20M feed were ground to different degrees of fineness, and each was treated in the Jeffrey-Steffensen magnetic separator. On a sample ground to all -100M, which was the finest grind, the combined concentrate and middling products assayed 59.7% sol Fe, 1.46% SiO₂, and 10.06% TiO₂. The recovery of the soluble iron was 62.6% at a ratio of concentration of 2.33 to 1 (Table 9). These results correspond quite well with those obtained from a Davis tube test on a sample which had also been ground to all -100M (Table 1).

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INTRODUCTION

Shipment

On March 27, 1961, 300 lb of lump, titaniferous magnetite ore was received at the Mineral Processing Division's laboratories. The ore was sent by Saguenay Exploration and Mining, Inc., which has offices at 753 Wilder Ave., Outremont, Quebec.

Location of Property

According to his letter of March 21 last, Mr. C. A. Magnan, secretary of the above mentioned company, stated the shipment was representative of a titaniferous magnetite deposit discovered in Kenogami township of the Chicoutimi district of Quebec.

Purpose of Investigation

In his covering letter, Mr. Magnan requested that an investigation be made on the sample to determine if marketable iron concentrates could be made.

Sampling and Analysis

The ore was crushed to 1/4 in. and mixed thoroughly. A 75 lb representative portion was obtained and crushed further to all -20M. A representative head sample was sent for spectrographic and chemical analysis.

The following elements were detected spectrographically in order of decreasing abundance:

Major	-	Fe, Al, Si, Mg, Ti (2%)
Intermediate	-	Ca, Mn, V
Minor	-	Ni, Cr, Co, Cu (0.01%), Zn (trace)

The chemical analysis of the head sample is tabulated below:

<u>Constituent</u>	<u>Assay, %</u>
Total Fe	41.75
Sol Fe	40.85
SiO ₂	11.62
Insol	22.62
P	0.02
S	0.038
TiO ₂	17.1

DETAILS OF INVESTIGATION

Davis Tube Test on Head Sample

From the -20M head sample, 50 g was ground to -100M and concentrated in the Davis tube laboratory magnetic separator. The results are given in Table 1.

TABLE 1

Results of Davis Tube Test

Product	Weight %	Assay, %				Distribution %		
		Tot Fe	Sol Fe	SiO ₂	TiO ₂	Sol Fe	SiO ₂	TiO ₂
Conc	44.3	60.4	59.4	1.45	9.52	64.0	5.5	25.0
Tail	55.7	27.4	26.6	-	22.76	36.0	94.5	75.0
Calcd Head	100.0	42.0	41.1		16.90	100.0	100.0	100.0

On the basis of the soluble iron assays, the amount of magnetic iron is 26.3%, and the ratio of concentration is 2.26 to 1.

Cobbing Tests on -20M Feed

Three wet cobbing tests were done, using the Crockett magnetic separator, on riffled portions of the -20M head sample. A preliminary cobbing test was done to determine what portion of the

feed could be rejected as tailing. In two other tests, attempts were made to obtain TiO₂ concentrates from the Crockett tailings, first by tabling, then by high intensity magnetic concentration in the Jones separator.

Tables 2, 3 and 4 contain the results of these cobbing tests.

TABLE 2

Preliminary Crockett Cobbing Test Results at -20M

Product	Weight %	Assay, %					Distribution, %		
		Sol Fe	SiO ₂	TiO ₂	P	S	Sol Fe	SiO ₂	TiO ₂
Conc	55.9	52.4	4.82	11.71	<0.02	0.031	72.2	23.2	43.9
Tail	44.1	25.6	-	24.1			27.8	76.8	56.1
Calcd Head	100.0	40.6	-	17.2			100.0	100.0	100.0

TABLE 3

Crockett and Jones Magnetic Separation Results at -20M

Product	Weight %	Assay, %			Distn, %		Ratio of concentration
		Sol Fe	SiO ₂	TiO ₂	Sol Fe	TiO ₂	
Crockett conc	55.0	53.6	3.16	11.4	71.8	36.6	1.82 to 1
Jones conc (TiO ₂ conc)	37.8	27.2	12.28	25.9	25.0	57.1	
Jones midd	4.9	22.0	19.76	19.3	2.6	5.6	
" tail	2.3	10.2	-	5.2	0.6	0.7	
Calcd Head	100.0	41.1	-	17.2	100.0	100.0	

TABLE 4

Results from Crockett and Table Concentration

Product	Weight %	Assay, %			Distn, %		Ratio of concentration
		Sol Fe	SiO ₂	TiO ₂	Sol Fe	TiO ₂	
Crockett conc	55.0	53.6	4.06	11.3	72.0	36.2	1.82 to 1
Table conc (TiO ₂ conc)	15.3	30.9	5.22	39.1	11.6	34.8	
Table midd	20.2	22.3	19.22	16.3	11.0	19.1	
" tail	9.5	23.4	-	17.9	5.4	9.9	
Calcd Head	100.0	40.95	-	17.2	100.0	100.0	

Jeffrey-Steffensen Wet Magnetic Separator Tests

Four tests were done on 2000 g samples which were ground to different degrees of fineness. For each of the tests, the tailing, middling and concentrate drums were operated at 2.2, 1.7 and 0.7 amp respectively.

Table 5 lists the size distribution of each of the four samples treated in the Jeffrey-Steffensen triple drum separator. The results of these tests are given in Tables 6 to 9.

TABLE 5

Size Distribution of Jeffrey-Steffensen Feed Samples

Sample	Weight Retained, %			
	A	B	C	D
Grind Time, min	20	30	45	60
-65 +100 M	3.4	1.4	0.3	
-100 +150 M	12.3	5.0	1.9	0.8
-150 +200 M	18.2	13.0	6.6	2.7
-200 +325 M	23.7	80.6	22.5	16.6
-325	42.4		68.7	79.9
Total	100.0	100.0	100.0	100.0

TABLE 6

Results of Jeffrey-Steffensen Test on Sample A

Product	Weight %	Assay, %			Distn, % Sol Fe	Ratio of concentration
		Sol Fe	SiO ₂	TiO ₂		
Conc	41.8	59.8	1.30	9.84	60.9	2.39 to 1
Midd	5.7	47.0	7.28	13.08	6.5	
Tail	52.5	25.5	-	-	32.6	
Calcd Head	100.0	41.07	-	-	100.0	

Conc & Midd	47.5	58.3	2.02	10.23	67.4	2.11 to 1
Tail	52.5	25.5	-	-	32.6	
Calcd Head	100.0	41.07	-	-	100.0	

TABLE 7

Results of Jeffrey-Steffensen Test on Sample B

Product	Weight %	Assay, %			Distn, % Sol Fe	Ratio of concentration
		Sol Fe	SiO ₂	TiO ₂		
Conc	39.8	60.0	1.14	9.81	57.9	2.51 to 1
Midd	6.9	51.2	5.54	11.83	8.6	
Tail	53.3	25.9	-	-	33.5	
Calcd Head	100.0	41.21	-	-	100.0	

Conc & Midd	46.7	58.7	1.79	10.11	66.5	2.14 to 1
Tail	53.3	25.9	-	-	33.5	
Calcd Head	100.0	41.21	-	-	100.0	

TABLE 8

Results of Jeffrey-Steffensen Test on Sample C

Product	Weight %	Assay, %			Distn, % Sol Fe	Ratio of concentration
		Sol Fe	SiO ₂	TiO ₂		
Conc	37.3	60.2	1.28	9.60	54.8	2.68 to 1
Midd	7.5	53.0	4.38	12.04	9.7	
Tail	55.2	26.3	-	-	35.5	
Calcd Head	100.0	40.95	-	-	100.0	

Conc & Midd	44.8	59.0	1.80	10.01	64.5	2.23 to 1
Tail	55.2	26.3	-	-	35.5	
Calcd Head	100.0	40.95	-	-	100.0	

TABLE 9

Results of Jeffrey-Steffensen Test on Sample D

Product	Weight %	Assay, %			Distn, % Sol Fe	Ratio of concentration
		Sol Fe	SiO ₂	TiO ₂		
Conc	34.0	60.8	0.98	9.76	50.5	2.94 to 1
Midd	8.9	55.6	3.30	11.20	12.1	
Tail	57.1	26.8	-	-	37.4	
Calcd Head	100.0	40.92	-	-	100.0	

Conc & Midd	42.9	59.7	1.46	10.06	62.6	2.33 to 1
Tail	57.1	26.8	-	-	37.4	
Calcd Head	100.0	40.92	-	-	100.0	

CONCLUSIONS AND DISCUSSION

In all of the tests, the amount of TiO_2 in the final iron concentrate was well above that allowed for marketable iron concentrates. Cobbing at -20M recovered 70.0 to 72.2% of the soluble iron, but also 36.6 to 43.9% of the TiO_2 .

Although cobbing produced a concentrate with lower TiO_2 and SiO_2 grades than in the -20M feed, magnetic concentration of samples ground considerably finer did not indicate that better results could be obtained by further comminution and concentration of the cobbed concentrate. Jeffrey-Steffensen tests on samples ground to different degrees of fineness, as shown in Table 5, improved the soluble iron grade only slightly, but the amount of TiO_2 in the concentrates remained over 9% in all cases, and was hardly affected by grinding. In fact, the grade of TiO_2 differed in the order of 2% between concentrates produced at -20M and those ground considerably finer for Davis tube and the Jeffrey-Steffensen tests.

Since no mineralogical examination was made on samples of the shipment, the nature of the association of the magnetite and ilmenite is unknown. However, the consistency of the TiO_2 assays with the degree of grinding indicates that economic liberation of these minerals would be very difficult.

Although the recovery of the soluble iron is low, even for the Davis tube test, this is only because the soluble iron includes that contributed by the ilmenite. If the amount of soluble iron associated with ilmenite is subtracted from the determined values, the result gives the amount of soluble iron in the form of magnetite.

This is, of course, assuming that magnetite and ilmenite are the two iron-bearing minerals. Applying this assumption to the Davis tube test, the recovery of soluble iron as magnetite would be about 80% or even higher, rather than 64.0%, shown in Table 1. However, as mentioned before, the grade of TiO_2 is too high.

ACKNOWLEDGEMENT

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