O T T A W A September 18th, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1301.

Recovery of Chrome-Nickel-Iron Concentrate from Asbestos Tailing Supplied by the Canadian Johns-Manville Company, Asbestos, Quebec.

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Shipment:

Three carloads of tailing were received, as follows:

June 1st, 1942	-	73 tons
June 8th, 1942	-	35 "
July 21st, 1942	-	33 "

The samples were submitted by the Canadian Johns-Manville Company, Asbestos, Quebec.

Location of Property:

The property from which this material was taken is located at Asbestos, in Wolfe county, Quebec.

Character of the Sample:

The material received was all minus 16 mesh. It consisted chiefly of serpentine, both crystalline and fibrous. It also carried about 6 to 7 per cent of iron in the form of magnetite, as well as small amounts of nickel and chromium. An earlier shipment was all minus 20 mesh and for purposes of comparison some table concentration tests were made on this material and are included in the present report.

Sampling and Assaying:

Samples taken from the feeder during daily runs were assayed and averaged as follows:

	Fe, per cent	Ni, per cent	Cr_2O_3, per cent
First two carloads -	6.91	0.22	0.53
Third carload -	6.36	0.20	0.53

Experimental Tests:

Concentration of the magnetite and nickel, with rejection of as much chromium as possible, was tried by four different methods, as follows:

(1) Magnetic concentration of the material as received.

(2) Desliming feed in a classifier and sending sands to magnetic concentrator.

(3) Dry magnetic concentration of material as received, followed by table concentration of dry magnetic concentrate.

(4) Desliming feed in a launder-type classifier with sands going to tables for concentration. Table concentrates were treated on a magnetic machine to throw out the chromium.

Overall ratios of concentration, grades of concentrate, and recoveries by the different methods are as follows:

(Continued on next page)

(Experimental Tests, cont'd) -

Method	Ratio of concentration	Assay of concentrate, per cent Fe	Ni	Cr_2O_3	Recovery of concentrate, per cent Fe	Ni	Cr_2O_3
1	31.32:1.	52.11	0.46	0.80	25.08	7.39	4.66
2	36.26:1.	50.29	0.62	1.36	23.42	9.21	4.84
3	31.40:1.	54.50	-	-	29.51	-	-
4	23.6:1.*	59.70	0.58	1.73	36.69	13.15	15.70

* Magnetic concentrate from table concentrate.

Details of Tests:

Tests typical of each method will be described in detail, as follows:

Test No. 1. - Magnetic Concentration.

The asbestos tailing was fed through a rod mill with ten rods in it, merely to break up lumps and thoroughly wet the material with as little grinding as possible.

The rod mill discharge, at 4,000 pounds per hour, was then fed to a 12" wet magnetic machine of the travelling-belt type. This machine produced a concentrate, a middling, and a tailing. The concentrate was a finished product, while the middling was dewatered in a classifier, reground, and recirculated over the magnetic machine. The non-magnetic tailing was treated on a full-size Wilfley table, producing a magnetite concentrate high in chromium, a middling, and a tailing which went to waste, along with the dewatering classifier overflow from the magnetic circuit. The table middling was returned in batches to the dewatering classifier in the magnetic circuit.

(Continued on next page)

(Details of Tests, cont'd) -

Results of Test No. 1:

Product	Weight, per cent	Assays, per cent			Distribution, per cent		
		Fe	Ni	Cr_2O_3	Fe	Ni	Cr_2O_3
Concentrate	3.19	52.11	0.46	0.80	25.08	7.39	4.66
Tailing	96.81	5.13	0.19	0.54	74.92	92.61	95.34
Feed	100.00	6.63	0.20	0.55	100.00	100.00	100.00

Ratio of concentration = 31.32:1.

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Test No. 2. - Magnetic Concentration after Desliming.

In this test the asbestos tailing was fed to the rod mill to break up the lumps and thoroughly wet the material. The rod mill discharge was fed to a classifier, the overflow from which was allowed to go to waste while the sands were fed to a wet magnetic separator, the same one that was used in Test No. 1. From this point on, the flow-sheet was the same as Test No. 1.

The feed rate was 3,960 pounds per hour and the desliming classifier sand return was measured at 1,965 pounds per hour, giving a ratio of concentration of 2.02:1 in the desliming operation. Treatment of the classifier sands in the magnetic machine resulted in a further ratio of concentration of 17.95:1.

The overall ratio of concentration for the two operations is, therefore, 2.02 x 17.95 = 36.26:1.

Results of Desliming Operation:

Product	Weight, per cent	Assays, per cent			Distribution, per cent total		
		Fe	Ni	Cr_2O_3	Fe	Ni	Cr_2O_3
Feed	100.00	5.92	0.22	0.58	100.00	100.00	100.00
Class. sand	49.50	6.90	0.22	0.63	57.69	49.50	53.77
Class. overflow (cal.)	50.50	4.96	0.22	0.53	42.31	50.50	46.23

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(Test No. 2, cont'd) -

Results of Magnetic Concentration:

Product	Weight, per cent	Assays, per cent			Distribution, per cent content		
		Fe	Ni	Cr_2O_3	Fe	Ni	Cr_2O_3
Concentrate	5.57	50.29	0.62	1.36	40.60	18.60	9.01
Tailing	94.43	4.34	0.16	0.81	59.40	81.40	90.99
Feed	100.00	6.90	0.19	0.84	100.00	100.00	100.00

Metal recoveries in concentrate, expressed in terms of the original feed content, are:

Iron	-	23.42 per cent.
Nickel	-	9.21 "
Chromic oxide	-	4.84 "

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Test No. 3. - Dry Magnetic Separation with Table Concentration of the Magnetic Product.

A sample of the tailing was fed to a dry magnetic separator at the rate of 5 tons per hour. In this machine the feed was carried on a belt over a set of polarizing magnets and then around a magnetic drum where the separation was made. The magnetic concentrate was sent to tables for further treatment and the non-magnetic tailing went to waste.

Best results were obtained on the table with a long stroke and a feed rate of 1,500 pounds of magnetic concentrate per hour.

Results of Magnetic Separation:

Product	Weight, per cent	Assays, per cent			Distribution, per cent		
		Fe	Ni	Cr_2O_3	Fe	Ni	Cr_2O_3
Mag. conc.	11.98	25.53	0.34	0.80	44.52	18.79	18.49
Non-mag. tailing	88.02	4.33	0.20	0.48	55.48	81.21	81.51
Feed (cal.)	100.00	6.87	0.22	0.52	100.00	100.00	100.00

Ratio of concentration = 8.35:1.

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(Test No. 3, cont'd) -

Results of Table Concentration:

Product	Weight, per cent	Assay, per cent Fe	Distribution, per cent Fe
Table conc.	26.60	54.50	66.28
Table tailing	73.40	10.05	33.72
Table feed (cal.)	100.00	21.88	100.00

Ratio of concentration on tables = 3.76:1.

Overall ratio of concentration, 3.76 x 8.35, = 31.40:1.

Iron recovered in table concentrate, expressed in terms of the original feed content, 66.28 x 44.52 = 29.51 per cent.

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Test No. 4. - Table Concentration After Desliming.

This test was done on an earlier shipment of tailing that was all minus 20 mesh. The material was fed to a hydraulic classifier at the rate of 3,000 pounds per hour. The classifier fines were discarded and the sands treated on tables. The table concentrate was later treated on a magnetic machine to remove as much of the chromium as possible.

Results of Table Concentration:

Product	Weight, per cent	Assays, per cent			Distribution, per cent		
		Fe	Ni	Cr_2O_3	Fe	Ni	Cr_2O_3
Feed	100.00	7.14	0.23	0.48	100.0	100.0	100.0
Concentrate	5.11	53.61	0.61	4.54	38.4	13.6	48.4
Tailing (cal.)	94.89	4.63	0.21	0.26	61.6	86.4	51.6

Ratio of concentration = 19.55:1.

Treatment of a sample of the table concentrate on a magnetic machine gave the following results:

(Continued on next page)

(Test No. 4, cont'd) -

Product	Weight, per cent	Assays, per cent			Distribution, per cent		
		Fe	Ni	Cr_2O_3	Fe	Ni	Cr_2O_3
Magnetic conc.	82.76	59.70	0.58	1.73	95.54	96.70	32.44
Non-mag. tailing	17.04	13.52	0.096	17.50	4.46	3.30	67.56
Table conc. (cal.)	100.00	51.71	0.50	4.41	100.00	100.00	100.00

Ratio of concentration after magnetic concentration of table concentrate = 23.6:1.

Metal recoveries in magnetic concentrate, expressed in terms of the original feed content, are:

Iron	- 95.54 x 38.4	=	36.69	per cent.
Nickel	- 96.70 x 13.6	=	13.15	"
Chromic oxide	- 32.44 x 48.4	=	15.70	"

The following table gives a comparison of results obtained by magnetic and table concentration, both operating on deslimed feed:

Method	Tons of concentrate from 100 tons of original feed		Assays, per cent			Distribution, per cent total		
	Iron concentrate	Chromium conc.	Fe	Ni	Cr_2O_3	Fe	Ni	Cr_2O_3
Magnetic concentration	2.76	-	50.29	0.62	1.36	23.42	9.21	4.84
Table concentration followed by mag. concentration	4.23	-	59.70	0.58	1.73	36.69	13.15	15.70
"	-	0.87	13.52	0.096	17.50	1.71	0.45	32.70

CONCLUSIONS:

The foregoing tests have been conducted to compare the results obtained by the different methods. Tests Nos. 1 to 3 were conducted on material minus 16 mesh while Test No. 4 was conducted on material minus 20 mesh. The finer-sized material used in Test No. 4 will, to some extent, account for the higher recoveries in this test. The higher chromium recovery is not desirable but the use of a weaker magnetic field might reduce the chromium content in the final concentrate, with some attendant loss of iron and perhaps nickel.

The tests have shown that if either magnetic or table concentration is used the feed should first be deslimed. Both tables and magnetic machines operate more efficiently on the deslimed sand than on the original feed and even though 50 per cent of the original feed be sent to waste from the desliming classifier the final recovery of iron will be about the same as if everything had been treated.

By magnetic concentration the chromium will be all lost except an undesirable quantity that remains with the magnetics. By table concentration the chromium will be recovered with the magnetite and can be separated later by magnetic concentration of the table concentrate, giving a product that might be sold for its chromium content. The table showing the comparison of results obtained by magnetic and table concentration shows a decided advantage for the tables but it should be remembered that they operated on minus 20 mesh feed. It is estimated that 200tables will be sufficient to treat 2,000 tons of original feed per day after the feed has been deslimed.

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