MAR 19570003: BURMIS

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DEPARTMENT OF MINES & TECHNICAL SURVEYS
552 Booth Street

OTTAWA CANADA

Mines Branch

Division of Mineral Dressing
& Process Metallurgy

January 10, 1957

The following is the second progress report on the mineral dressing investigation of the three samples of iron ore received at the Mines Branch on August 3rd, 1956. Final report is given in Investigation No. MD3187, April 18, 1957

The chemical analyses of the head samples cut from each sample gave the following results:

Head Sample	ASSAYS, Per Cent						
	Fe	TiO_2	Mn	SiO_2	CaO	MgO	P
No. 1	39.25	5.78	0.28	17.33	4.39	1.66	0.18
No. 2	47.10	6.20	0.32	10.17	2.29	1.36	0.22
No. 3	33.75	6.19	0.21	25.46	4.70	2.82	0.17

Head Sample	ASSAYS, Per Cent					
	S	Al_2O_3	ZrO_2	V_2O_3	Inso.	L.O.I.
No. 1	0.053	6.70	0.10	0.29	19.0	7.20
No. 2	0.030	3.84	0.24	0.38	12.1	7.06
No. 3	0.049	5.18	0.12	0.28	29.2	5.09

The preliminary investigation indicated that the three samples are very similar, differing only in the amounts of magnetite and gangue minerals contained in each sample, and also that fine grinding in the order of 150 to 200 mesh is necessary to produce commercial grades of iron concentrates.

Composite samples prepared by mixing equal parts by weight of Samples No. 1, 2, and 3 were ground to minus 150 mesh and fed to a Crokett type wet magnetic separator and a Jeffrey-Steffensen wet megnetic separator, respectively.

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The Crokett magnetic separator gave a concentrate assaying 54.0 per cent iron with a recovery of 79.1 per cent. No middling product is produced by this machine.

In an attempt to recover the non-magnetic iron, the tailing from the Crockett was passed over a Wilfley table. However, the table concentrate assayed less in iron than did table tailing.

The following is the result of Test No. 4 in which a composite sample of the ore, ground to minus 150 mesh, was fed to a Jeffrey-Steffensen magnetic separator.

Results of Test No. 4

Product	Weight %	Assays, per cent			Distribution, per cent		
		Fe	TiO_2	SiO_2	Fe	TiO_2	SiO_2
Magnetic Conc.	36.7	62.4	4.30	2.00	57.7	25.7	4.3
Magnetic Midds.	9.0	56.0	6.14	5.32	12.7	9.0	2.8
Magnetic Tailing	54.3	21.6	7.40	29.20	29.6	65.3	92.9
Feed #	100.0	39.7	6.15	17.07	100.0	100.0	100.0

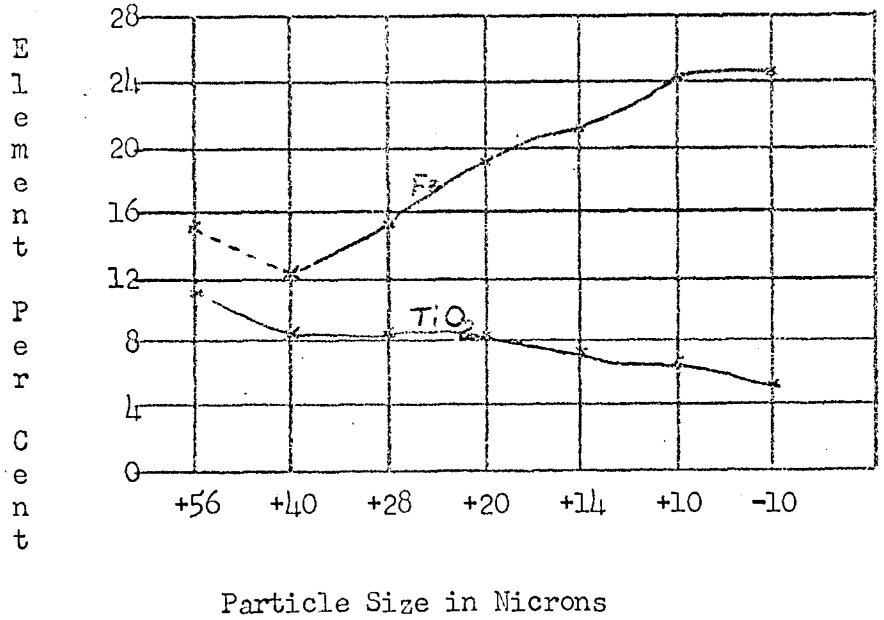
\# Calculated.

The high iron tailing losses in this and other tests prompted an extensive microscopic investigation of the gangue minerals in three samples of ore to determine the mode of occurrence of the non-magnetic iron with a view to explaining these losses.

The results of this investigation indicated that other than magnetite and ilmenite, the only iron-bearing mineral identified and which could account for the high iron content of the tailing was limonite. The calcite and dolomite proved to be almost completely free of iron. No. siderite was present and although some chlorite which is a hydrous iron-magnesium silicate was found, the amount of this mineral was small and could account for no more than 2 or 3 per cent of the iron.

Since limonite is an extremely friable mineral and has a strong tendency to slime, it was felt that the highest tailing loss of iron would, therefore, be in the finest size. To confirm this, an infrasizer analysis was carried on the tailing from Test No. 4.

The following graph illustrating the results from the infrasizer analysis of this tailing shows that as the particle sizes decrease, the percentage of iron increases and the percentage of TiO_2 decreases.



From the results of microscopic and infrasizer analyses it was concluded that the high tailing loss is due to the mineral limonite, and because of the nature of this mineral, it precludes the use of any standard ore dressing method for its recovery. However, an attempt was made to recover the limonitic iron by treating the tailing from magnetic separation by a reducing roast to convert this iron oxide to magnetite which might then be recovered by magnetic concentration.

Four samples of the tailing from Test No. 4 were roasted under an atmosphere of producer gas at various temperatures and lengths of time. The resulting calcines were tested for the recovery of the artificial magnetite in a Davis Tube magnetic separator.

The results of these tests were not encouraging. Many of the grains were only weakly magnetic. The grades of the concentrates varied between 35.4 to 39.6 per cent iron with the percentage of iron recovered being in roughly the same order. Microscopic examination of the roasted products showed almost all the mineral particles present in the calcine were magnetic to some degree. The weakly magnetic grains consisted of gangue minerals partially surrounded by a thin dusting of magnetite which persists even after wasing and drying. This magnetite coating was the result of the limonite slimes in the tailing being converted to a slime coating of magnetite and appeared to be baked onto the surface of all the minerals in the tailing, making a separation most difficult.

The investigation so far has indicated that straight magnetic separation on a Jeffrey-Steffensen type of machine at a grind of minus 150 mesh or finer offers the only possible method of obtaining a commercial grade of iron concentrate. However, the high titanium oxide content of this concentrate (4.3% TiO_2 in Test No. 4) may make it unacceptable as blast furnace feed.

Tests have been carried out in which each of the three samples of ore were ground to minus 200 mesh and fed separately to a Jeffrey-Steffensen Magnetic Separator. These tests will show if any one of the samples is better suited than the others for the recovery of the iron by magnetic concentration, and also see if the TiO_2 content of the concentrates can be lowered.

When the results of this last series of tests are received, they will be forwarded to you.

Yours very truly

"R.W. Bruce"

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