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RECOVERY OF CHROMITE FROM RECLAIMED FOUNDRY SAND

by

G.W. Riley

Mineral Processing Division

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SUMMARY OF RESULTS

Chromite concentrates containing 42.18% Cr_2O_3 and 4.56% SiO_2 with a recovery of 97.6% of the Cr_2O_3 were produced from the bulk shipment of the reclaimed sand by a laboratory ring-type high-intensity dry magnetic separator. By using a pilot-plant three-roll, high-intensity dry magnetic separator, a concentrate was produced in one pass assaying 36.07% Cr_2O_3 and 10.87% SiO_2 with a recovery of 97.1% of the Cr_2O_3. Repassing of the first concentrate produced a second concentrate assaying 38.44% Cr_2O_3 and 6.40% SiO_2 with a recovery of 94.5% of the Cr_2O_3.

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

INTRODUCTION

Mr. M.A. Notte, Plant Manager, Hawker Siddeley Canada Ltd., Canadian Steel Foundries Division, Montreal, in his letter of July 4, 1968, requested a laboratory investigation to determine a method for separating chromite from their reclaimed foundry sand.

Chromite sand, assaying 45.8% Cr_2O_3 and 2.8% SiO_2, is used as a facing sand and is backed by silica sand in the production of heavy steel castings. Both sands are reclaimed after the castings are made but are then used in their combined state as backing sand where the chromite is of little value. By recovering the chromite as a separate product the company hopes to reuse chromite in its original application as a facing sand. The consumption of chromite sand for facing material amounts to 10,000 tons per year so a considerable saving could be made if this material could be recovered.

The laboratory investigation indicated that dry high-intensity magnetic separation could produce an acceptable chromite concentrate. On September 16, 1968 an additional request was received from Mr. W.A. Laurin, Plant Engineer, Canadian Steel Foundries, Montreal, for a pilot-plant test on the reclaimed sand to confirm laboratory tests and to produce sufficient chromite concentrate for casting tests. The tests were made using a three-roll high-intensity magnetic separator and the products were returned to Canadian Steel Foundries for evaluation.

Shipments

A 40-lb sample of reclaimed sand was received on July 15, 1968. On September 19, 1968 a 1-ton shipment for pilot-plant tests was received. The shipments were submitted by Mr. W.A. Laurin, Plant Engineer, Hawker Siddeley Canada Ltd., Canadian Steel Foundries Division, Montreal, Quebec.

Details of the Investigation

Preliminary Sample - A head sample was riffled out of the sample received and a size distribution was determined. Results are shown in Table 1.

TABLE 1

Size Distribution of Preliminary Sample

Mesh Tyler	Weight %
-14+20	0.3
-20+28	0.9
-28+35	6.3
-35+48	22.8
-48+65	35.9
-65+100	20.6
-100+150	10.0
-150+200	2.6
-200	0.6
Total	100.0

Test 1

Wet gravity separation using a shaking table was tried to produce a chromite concentrate. Results of Test 1 are shown in Table 2.

TABLE 2

Test 1 - Tabling

Product	Weight %	Analysis % Cr_2O_3	Distn % Cr_2O_3
Table conc	51.7	33.96	97.4
Table tails	48.3	0.96	2.6
Feed (calcd)	100.0	18.02	100.0
(assay)		18.44	

A band of white material was seen on the upper side of the concentrate band and included with the concentrate. To reject this material, the concentrate was treated in a Stearns, laboratory, ring-type, high-intensity, dry magnetic separator at 1½ amp giving a field strength of 5000 gauss. The white material was successfully rejected as a non-magnetic product. Results of the test are shown in Table 3.

TABLE 3

Test 1 - High-intensity Magnetic Separation

Product	Weight %	Analysis % Cr_2O_3	Distn % Cr_2O_3
Mag conc	41.5	42.12	97.0
Non-mag	10.2	0.76	0.4
Table conc	51.7	33.96	97.4

*A mineralogical examination was made of the non-magnetics to identify the non-metallic minerals. These minerals were found to be quartz and zircon with quartz predominating.

Test 2

A test using high-intensity magnetic separation at the same settings as for Test 1 was made on the material as received. Results of the test are shown in Table 4.

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*Internal Report MS 68-55 by E. Nickel

TABLE 4

Test 2 - High-Intensity Magnetic Separation

Product	Weight %	Analysis % Cr_2O_3	Distn % Cr_2O_3
Mag conc	43.3	41.24	99.1
Non-mag	56.7	0.30	0.9
Feed (calcd)	100.0	18.03	100.0

The size distribution of the magnetic concentrates from Tests 1 and 2 is shown in Table 5.

TABLE 5

Tests 1 and 2 - Size Distribution, Magnetic Concentrates

Mesh Size Tyler	Mag Conc Test 1	Mag Conc Test 2
-14+20	-	0.4
-20+28	1.0	1.5
-28+35	11.7	11.4
-35+48	26.1	24.5
-48+65	32.3	30.6
-65+100	17.6	18.3
-100+150	8.2	9.1
-150+200	2.1	0.4
-200	1.0	3.8
Total	100.0	100.0

Bulk Shipment

Test 3 - A head sample was riffled out of the shipment and a test was made using a Stearns, ring-type, high-intensity magnetic separator operated under the same conditions as for Test 2. Results of Test 3 are shown in Table 6.

TABLE 6

Test 3 - Magnetic Separation

Product	Weight %	Analysis %		Distn %	
		Cr_2O_3	SiO_2	Cr_2O_3	SiO_2
Mag conc	42.0	42.18	4.56	97.6	3.5
Non-mags	58.0	0.76	91.48	2.4	96.5
Feed (calcd)	100.0	18.16	54.97	100.0	100.0
(assay)		17.69			

A few preliminary tests were done using an electrostatic separator but the results were not satisfactory. The best weight recovery obtained was about 32% with most of the losses appearing to be in the finer sizes.

Test 4

The remainder of the bulk shipment was treated by a Dings, Type IR, induced, 10-inch, three-roll, high-intensity, dry, magnetic separator. The magnetic separator was operated at 5.0 amp to give magnetic intensity at the face of the rolls of about 2800 gauss for the first roll, 5500 gauss for the second roll and 6800 gauss for the third roll. Speed of the rolls was 115 rpm and the feed rate was 150 lb per inch of roll per hour. The magnetic concentrates from the three rolls were combined and a portion of the combined concentrate repassed at the same field strengths and roll speeds but with different splitter positions and a lower feed rate of 100 lb per inch of roll per hour. Results of the test are shown in Table 7.

TABLE 7

Test 4 - Dings, 3-Roll, Magnetic Separator

Product	Weight %	Analysis %		Distn %	
		Cr_2O_3	SiO_2	Cr_2O_3	SiO_2
1st Roll mags	2.8	37.67	9.04	6.3	0.5
2nd Roll mags	25.5	36.34	8.96	55.4	4.1
3rd Roll mags	16.7	35.40	14.08	35.4	4.3
Primary non-mags	55.0	0.89	90.92	2.9	91.1
Feed (calcd)	100.0	16.72	54.90	100.0	100.0
1st Roll mags	3.8	38.43	8.00	8.7	0.6
2rd Roll mags	28.9	39.18	5.98	67.7	3.1
3rd Roll mags	8.4	35.97	7.12	18.1	1.1
Secondary non-mags	3.9	11.12	57.96	2.6	4.1
Comb primary mags	45.0	36.07	10.87	97.1	8.9
Comb secondary mags	41.1	38.44	6.40	94.5	4.8

Size distributions of the feed, the primary and secondary magnetics, and the primary non-magnetics are shown in Table 8.

TABLE 8

Size-Distribution of the Feed, Magnetic Concentrates and Non-Magnetics from the Bulk Shipment

Mesh Tyler	Weight %			
	Feed	Primary Mags	Secondary Mags	Primary Non-Mags
-10+14	0.1	0.1	-	0.1
-14+20	0.4	0.2	0.2	0.4
-20+28	2.0	1.7	1.8	1.3
-28+35	12.3	14.0	14.1	8.7
-35+48	34.3	32.3	29.0	39.0
-48+65	33.3	30.5	31.3	36.0
-65+100	12.7	14.1	15.5	11.2
-100+150	4.0	5.5	6.4	2.8
-150+200	0.7	1.3	1.4	0.4
-200	0.2	0.3	0.3	0.1
Total	100.0	100.0	100.0	100.0

DISCUSSION OF RESULTS

The size-distribution showed that the reclaimed sand contained only a small percentage of minus-100-mesh material and was in a size range suitable for treatment by gravity separation or high-intensity magnetic separation. The tabling tests on the preliminary sample showed that a considerable amount of quartz with a minor amount of zircon was concentrated with the chromite. This material was successfully rejected as a non-magnetic by high-intensity magnetic separation of the table concentrate. However, because the present sand-reclamation system produced a dry product the company preferred to use a dry method of treatment.

CONCLUSIONS

Chromite concentrates, acceptable for use as facing sand, can be produced by high-intensity, dry, magnetic separation of the reclaimed foundry sand. The primary non-magnetic rejects will be acceptable for use as silica sand.

Electrostatic separation is not as successful as high-intensity, dry, magnetic separation.

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