Beach Area
Black Sands
(copies in files)

JOHNSON PROCESS

Chromite Recovery -- Oregon Beach Sands

May 18, 1942

During the past two years we have made several tests on samples of Oregon beach sands which have been submitted to us from various deposits.

All of our tests have shown a combined process treatment as the most suitable procedure. First, a wet gravity concentration is indicated to eliminate any overburden, sand, etc., and to produce a rough gravity concentrate consisting of the heavier minerals, such as ilmenite, magnetite, chromite, zircon, gold and platinum. Next, these heavier minerals may be dried and then separated electrostatically, Finally, if it is possible and profitable to produce higher chrome-iron ratio concentrates, a further separation of the electrostatic concentrates may be made magnetically to remove any free magnetic iron minerals, and iron filings produced by wear on the handling equipment.

For the tests covered in this report, we have selected three samples which we believe represent the so-called "black sands." In chromite content these will nearly equal gravity-separation rough concentrates, when operating the gravity concentrators for the production of clean tailings and highest recovery of chromite.

In order to provide representative working conditions, we divided each sample into duplicate head feeds, one to be concentrated by wet jigs and electrostatic, the other by wet tables and electrostatic.

The object of these tests is to indicate the efficiency of the combined concentrating treatment in recovering chromite concentrates to meet the requirements of the Metals Reserve Company at highest recovery and lowest cost.

(Test No. 1582 (Sample No. 1)

Wet Jig -- Electrostatic

Wet Jig Concentration

Products	% Weights	% Cr_2O_3	Units	Distribution
Head feed	100.00	24.74	24.74	100.0
Concentrates	72.30	29.60	21.40	86.5
Middlings	8.70	24.00	2.09	8.4
Tailings	19.00	6.60	1.25	5.1
	100.00		24.64	100.0

Recovery of Cr_2O_3 -- 95.70%
Ratio of Concentration 1.27 : 1
Note: Middlings returned to head feed in circulation.

Electrostatic Concentration

Products	% Weights	% Cr_2O_3	Units	Distribution
Jig Concentrates (head feed)	100.00	29.60	21.40	100.00
Concentrates	61.30	41.15	25.22	85.23
Middlings	6.80	33.15	2.25	7.61
Tailings	31.90	7.65	2.12	7.16
	100.00		29.59	100.00

Recovery of Cr_2O_3 -- 91.08%
Ratio of concentration -- 1.53 : 1
Note: Middlings returned to head feed in circulation.
Combined recovery of Cr_2O_3 -- 87.16%
Ratio of Concentration -- 1.94 : 1

Test No. 1583 (Sample No. 2)

Wet Jig -- Electrostatic

Wet Jig Concentration

Products	% Weights	% Cr_2O_3	Units	Distribution
Head Feed	100.00	26.22	26.22	100.0
Concentrates	88.20	27.37	24.14	92.0
Middlings	5.30	24.40	1.29	4.9
Tailings	6.50	12.65	.82	3.1
	100.00		26.25	100.0

Recovery of Cr_2O_3 -- 96.23%
Ratio of Concentration -- 1.08 : 1
Note: Middlings returned to head feed in circulation.

Electrostatic Concentration

Products	% Weights	% Cr_2O_3	Units	Distribution
Jig Concentrates (head feed)	100.00	27.37	27.37	100.0
Concentrates	63.50	41.59	26.40	96.5
Middlings	2.30	23.50	.54	2.0
Tailings	34.20	1.24	.42	1.5
	100.00		27.36	100.0

Recovery of Cr_2O_3 -- 98.4%
Ratio of Concentration -- 1.54 : 1
Note: Middlings returned to head feed in circulation.
Combined recovery of Cr_2O_3 -- 94.69%
Ratio of Concentration -- 1.66 : 1

Test No. 1584 (Sample No. 3)

Wet Jig -- Electrostatic

Wet Jig Concentration

Products	% Weights	% Cr_2O_3	Units	Distribution
Head Feed	100.00	25.45	25.45	100.00
Concentrates	69.20	29.30	20.27	79.6
Middlings	12.00	27.00	3.24	12.7
Tailings	18.80	10.50	1.97	7.7
	100.00		25.48	100.0

Recovery of Cr_2O_3 -- 91.55%
Ratio of Concentration -- 1.26 : 1
Note: Middlings returned to head feed in circulation.

Electrostatic Concentration

Products	% Weights	% Cr_2O_3	Units	Distribution
Jig Concentrates (head feed)	100.00	29.30	29.30	100.0
Concentrates	61.7	41.68	25.70	87.9
Middlings	7.0	32.30	2.26	7.7
Tailings	31.3	4.13	1.29	4.4
	100.0		29.25	100.0

Recovery of Cr_2O_3 -- 95.35%
Ratio of Concentration -- 1.49 : 1
Note: Middlings returned to head feed in circulation.
Combined recovery of Cr_2O_3 -- 87.29%
Ratio of Concentration -- 1.88 : 1

Test No. 1585 (Duplicate Sample No. 1-A)

Wet Table -- Electrostatic

Wet Table Concentration

Products	% Weights	% Cr_2O_3	Units	Distribution
Head Feed	100.00	24.56	24.56	100.0

Wet Table Concentration

Products	% Weights	% Cr_2O_3	Units	Distribution
Concentrates	74.60	28.10	20.96	85.0
Tailings	25.40	13.87	3.52	14.4
	100.00		24.48	100.0

Recovery of Cr_2O_3 -- 85.95%
Ratio of Concentration -- 1.33 : 1

Electrostatic Concentration

Products	% Weights	% Cr_2O_3	Units	Distribution
Table Concentrates (Head Feed)	100.00	28.10	28.10	100.0
Concentrates	53.70	40.20	21.59	76.6
Middlings	11.70	27.50	3.23	11.5
Tailings	34.60	9.68	3.35	11.9
	100.00		28.17	100.0

Recovery of Cr_2O_3 -- 86.34%
Ratio of Concentration -- 1.66 : 1
Note: Middlings returned to head feed in circulation.
Combined recovery of Cr_2O_3 -- 74.21%
Ratio of Concentration -- 2.21 : 1

Test No. 1586 (Duplicate Sample No. 2-A)

Wet Table -- Electrostatic

Wet Table Concentration

Products	% Weights	% Cr_2O_3	Units	Distribution
Head Feed	100.00	26.22	26.22	100.0
Concentrates	90.70	27.24	24.70	94.3
Tailings	9.30	16.15	1.49	5.7
	100.00		26.19	100.0

Recovery of Cr_2O_3 -- 91.92%
Ratio of Concentration -- 1.15 : 1

Electrostatic Concentration

Products	% Weights	% Cr_2O_3	Units	Distribution
Table Concentrates (Head Feed)	100.00	27.24	27.24	100.0
Concentrates	62.80	41.59	26.11	96.0

Products	% Weights	% Cr_2O_3	Units	Distribution
Middlings	2.40	28.30	.67	2.5
Tailings	34.80	1.20	.41	1.5
	100.00		27.19	100.0

Recovery of Cr_2O_3 -- 98.45%
Ratio of Concentration -- 1.55 : 1
Note: Middlings returned to head feed in circulation.
Combined recovery of Cr_2O_3 -- 90.5%
Ratio of Concentration -- 1.78 : 1

Test No. 1587 (Duplicate Sample No. 3-A)

Wet Table -- Electrostatic

Wet Table Concentration

Products	% Weights	% Cr_2O_3	Units	Distribution
Head Feed	100.00	25.31	25.31	100.0
Concentrates	91.50	26.59	24.32	95.6
Tailings	8.50	13.29	1.12	4.4
	100.00		25.44	100.0

Recovery of Cr_2O_3 -- 94.4%
Ratio of Concentration -- 1.11 : 1

Electrostatic Concentration

Products	% Weights	% Cr_2O_3	Units	Distribution
Table Concentrates (Head Feed)	100.00	26.59	26.59	100.0
Concentrates	54.40	40.49	22.02	83.0
Middlings	12.40	27.98	3.46	13.0
Tailings	33.20	3.24	1.07	4.0
	100.00		26.55	100.0

Recovery of Cr_2O_3 -- 95.45%
Ratio of Concentration -- 1.61 : 1
Note: Middlings returned to head feed in circulation.
Combined recovery of Cr_2O_3 -- 90.62%
Ratio of Concentration -- 1.77 : 1

The chrome-iron ratio of the electrostatic concentrates is as follows:

Test No.	Cr_2O_3	FeO	Ratio
1582	41.15	28.17	1.285 : 1
1583	41.59	28.44	1.29 : 1
1584	41.68	28.26	1.30 : 1
1585	40.20	26.73	1.32 : 1
1586	41.59	28.53	1.28 : 1
1587	40.49	29.48	1.21 : 1

A composite sample of the electrostatic concentrates produced in these tests contained 41.15% Cr_2O_3 and 28.27 FeO. The chrome-iron ratio was 1.280 : 1.

These concentrates meet the "Low Grade B" specifications with a base price of $24.00 per long dry ton for ore containing 40.0% Cr_2O_3, with an increase of $.60 per ton for each unit or fraction in excess of 40.0% Cr_2O_3. The value of the average electrostatic concentrates is $24.69 per long ton.

The combined electrostatic concentrates from these tests were passed over a magnetic separator to remove any free magnetic iron minerals and iron from the wear on handling equipment.

Magnetic Concentration

Products	% Weights	% Cr_2O_3	Units	Distribution
Electrostatic Concentrates (Head Feed)	100.00	41.15	41.15	100.0
Magnetic concentrates	86.50	44.84	38.79	94.5
Magnetic Tailings	13.15	16.74	2.26	5.5
	100.00		41.05	100.0

Recovery of Cr_2O_3 -- 94.65%
Ratio of Concentration -- 1.15 : 1

The Cr_2O_3 is increased 3.69% and the FeO is reduced from 28.27% to 25.47%, which changes the chrome-iron ratio from 1.28 : 1 (electrostatic concentrates) to 1.55 : 1 (Magnetic Concentrates), increasing the chromite value from $24.69 per ton to $26.90 per dry long ton.

In increasing the Cr_2O_3 content by magnetic separation, we have slightly increased production cost and lost as tailings 13.15% by weight, which should not be put back in the head feed. Therefore, we have the following comparison:

100 tons Electrostatic Concentrates averaging 41.15% Cr_2O_3
@ $24.69.....$ 2,469.00

86.5 tons Magnetic Concentrates averaging 44.84% Cr_2O_3
@ $26.90.....$ 2,326.85

Difference $ 143.15

There appears to be a metallurgical limit, as well as an economical limit, to mechanical concentration, with regard to increasing the chromo-iron ratio to the "Low Grade A" classification requiring a 2 : 1 ratio.

The new roasting and leaching process developed by the Bureau of Mines however, combined with mechanical concentration, should produce the highest-grade chromite from the Oregon beach sands.

Respectfully submitted,

RITTER PRODUCTS CORPORATION

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