O T T A W A May 4th, 1943.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1399.

Concentration of Chromite Ore from
Rock Creek, British Columbia.

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Shipment:

Six samples of chromite ore, of a total net weight of 500 pounds, were received on March 5th, 1943. The shipment was submitted by Thomas Muir, 471 East 49th Avenue, Vancouver, B.C.

Location of the Property:

The property is known as the "Don Group" of mineral claims and is located near Rock Creek, British Columbia.

Purpose of the Investigation:

The shipment was submitted for the determination of the grade of the various samples, and the grade of concentrate and chrome:iron ratio which could be obtained from ore of this grade and character.

The six samples submitted were described as follows:

South No. 1 (paper in sack), from narrow lens.

No. 2 (painted on sack) - (Described as from a
No. 3 (painted on sack) - (longer narrow lens.

South No. 2, from Lenses 4 and 5.

No. 4 South, from the largest lens.

No. 4-A, had no tag or description and was assumed to be "the small sample from separate narrow part of Lens 4 about 100 feet farther along," mentioned in Mr. Muir's letter of Feb. 5th, 1943.

Character of the Ore:

Selected hand specimens from each of the six samples were used to make polished sections which were subjected to a microscopic examination.

Gangue -

The gangue is composed of a very soft grey material which forms the ground mass for the metallic mineralization. It seems to consist of greenish-grey talcose rock.

Metallic Minerals -

Chromite is abundantly disseminated through gangue as jagged, corroded grains moderately coarse to very fine in size, with the finer sizes predominating. It is badly pitted and severely fractured but is comparatively free of inclusions, although most of the fractures are filled with gangue.

Pyrite is visible as rare, tiny grains in gangue and in chromite, but no magnetite was observed in the polished sections.

(Continued on next page)

(Character of the Ore, cont'd) -

Grain Size of the Chromite -

Due to the abundance of chromite grains in the finer sizes, the amount of microscopic work necessary to give anything like a complete grain size analysis would be very exhaustive, and even after such work the results would be probably no better than a close approximation. However, in order to obtain some idea of the ore minerals' grain size, a traverse was made across the sections during which over one hundred grains were measured, with the following results:

Largest - 780 microns (-20+28 Tyler mesh).
Smallest - 4 microns (-2300 Tyler mesh).
Average - 54 microns (-200+280 Tyler mesh).

After grinding, the average size may be even smaller than this on account of the severely fractured condition of the chromite.

Sampling and Analysis:

Each lot of ore was crushed minus $\frac{1}{4}$ inch, sampled, and assayed for chromium and iron.

Sample No.	Weight, pounds	Assays, per cent: Cr_2O_3	Fe	Ratio Cr:Fe
South No. 1 (narrow lens)	100	32.11	10.59	2.07:1.
No. 2	79	35.28	10.27	2.35:1.
South No. 2	90	32.51	10.27	2.17:1.
No. 3	82	33.34	10.43	2.19:1.
No 4 (south)	97	30.69	10.12	2.08:1.
No. 4-A from narrow part of No. 4	52	30.71	10.33	2.03:1.

Investigative Procedure:

Each lot of ore was sampled and assayed separately.

A small composite sample of the ore was made up, crushed minus 14 mesh, and screened on various screens. This

(Investigative Procedure, cont'd) -

sized feed was concentrated on a Wilfley table.

The concentrate from each sized feed was examined microscopically to note the character of the concentrate and the amount of attached gangue.

A portion of the minus 100 mesh concentrate was concentrated magnetically, to determine the amount of magnetite in the ore. Another portion was concentrated on the superpanner.

The remainder of the ore was crushed and a sized feed was concentrated on a Wilfley table. The concentrates and samples of feed, middling and tailing were returned to Mr. Muir.

Results of Tests:

Grinding minus 48 mesh gave a concentrate of 44 per cent Cr_2O_3.

Grinding minus 100 mesh increased the grade to 50.25 per cent Cr_2O_3.

Grinding minus 200 mesh gave a concentrate assaying 52.8 per cent Cr_2O_3 and 17.6 per cent iron.

In none of the tests was the ratio of Cr:Fe raised above 2.1:1.

Details of Tests:

Test No. 1. - Table Concentration.

In order to determine the grade and character of concentrate that could be obtained from the ore, a composite sample of approximately 25 pounds was used. It was obtained by cutting out 5 per cent of the weight of each sample.

The composite sample was crushed minus 14 mesh and screened on 35-, 48-, 65- and 100-mesh screens. Each screen product was concentrated separately on a Wilfley table. Portions of each concentrate were examined by means of a

(Test No. 1, cont'd) -

binocular microscope to determine the amount of gangue present adhering to the chromite.

The chrome:iron ratio of each concentrate was calculated.

Results of Table Concentration:

-14+35 mesh ore.

Product	Weight, per cent	Assays, per cent Cr_2O_3	Assays, per cent Fe	Distribution, per cent Cr_2O_3	Distribution, per cent Fe	Ratio of concentration
Feed	100.0	33.91	10.87	100.0	100.0	
Concentrate	42.6	36.44	11.79	45.7	46.2	2.35:1.
Middling	56.7	32.16	10.22	53.8	53.4	1.76:1.
Tailing	0.7	21.69	7.04	0.5	0.4	

Cr:Fe ratio of concentrate, 2.11:1.

-35+48 mesh ore.

Product	Weight, per cent	Assays, per cent Cr_2O_3	Assays, per cent Fe	Distribution, per cent Cr_2O_3	Distribution, per cent Fe	Ratio of concentration
Feed	100.0	35.66	11.63	100.0	100.0	
Concentrate	51.4	41.96	13.66	60.5	60.4	1.95:1.
Middling	46.4	29.55	9.65	38.4	38.5	2.16:1.
Tailing	2.2	17.29	5.74	1.1	1.1	

Cr:Fe ratio of concentrate, 2.10:1.

-48+65 mesh ore.

Product	Weight, per cent	Assays, per cent Cr_2O_3	Assays, per cent Fe	Distribution, per cent Cr_2O_3	Distribution, per cent Fe	Ratio of concentration
Feed	100.0	35.77	11.65	100.0	100.0	
Concentrate	53.4	44.42	14.44	66.3	66.2	1.87:1.
Middling	39.9	30.03	9.23	33.5	31.6	2.51:1.
Tailing	6.7	11.32	3.81	0.2	2.2	

Cr:Fe ratio of concentrate, 2.10:1.

-65+100 mesh ore.

Product	Weight, per cent	Assays, per cent Cr_2O_3	Assays, per cent Fe	Distribution, per cent Cr_2O_3	Distribution, per cent Fe	Ratio of concentration
Feed	100.0	37.07	12.09	100.0	100.0	
Concentrate	37.6	47.03	15.85	47.7	49.3	2.66:1.
Middling	46.7	37.22	11.73	46.9	45.3	2.14:1.
Tailing	15.7	12.74	4.17	5.4	5.4	

Cr:Fe ratio of concentrate, 2.03:1.

-100 mesh ore.

Product	Weight, per cent	Assays, per cent Cr_2O_3	Assays, per cent Fe	Distribution, per cent Cr_2O_3	Distribution, per cent Fe	Ratio of concentration
Feed	100.0	27.68	9.00	100.0	100.0	
Concentrate	5.0	50.25	17.16	9.1	9.5	20:1.
Middling	30.7	46.06	14.90	51.1	50.9	
Sand Tailing	3.8	18.14	5.63	2.5	2.4	
Slime "	30.9	17.81	5.53	19.9	19.0	
" Overflow	29.6	16.30	5.53	17.4	18.2	

Cr:Fe ratio of concentrate, 2.00:1.

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(Test No. 1, cont'd) -

A portion of the minus 100 mesh concentrate was sized -100+150 mesh, -150+200 mesh, and -200 mesh. These products were further concentrated by means of the Haultain superpanner and the concentrates so obtained were analysed for Cr_2O_3 and Fe. The Cr:Fe ratio was then calculated.

Product	Assays, per cent: Cr_2O_3	Fe	Cr:Fe ratio
-100+150 mesh	50.88	17.19	2.03:1.
-150+200 "	51.34	17.31	2.03:1.
-200 mesh	52.81	17.63	2.05:1.

The tests made by superpanning indicate the analysis of the pure chromite mineral. When ground to 200 mesh the chromite contains 52.81 per cent Cr_2O_3, 17.63 per cent iron.

Portions of the above products were also subjected to magnetic concentration to determine the amount of magnetite present in the concentrate.

Results of Magnetic Concentration:

-100+150 mesh.

Product	Weight, per cent:	Assays, per cent: Cr_2O_3	Fe	Cr:Fe ratio
Feed	100.00	47.27	15.23	2.12:1.
Magnetics	0.10	-	-	
Non-magnetics	99.90	47.22	15.54	2.08:1.

-150+200 mesh.

Feed	100.00	48.07	15.86	2.07:1.
Magnetics	0.18	-	-	
Non-magnetics	99.82	48.54	16.06	2.07:1.

-200 mesh.

Feed	100.00	50.58	16.38	2.11:1.
Magnetics	0.06	-	-	
Non-magnetics	99.94	51.29	16.79	2.09:1.

(Continued on next page)

(Test No. 1, cont'd) -

The tests show that there was practically no magnetite in the concentrate. The Cr:Fe ratio was not improved by magnetic concentration.

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A microscopic examination of portions of the concentrates shows the following:

On -14+35 Mesh Concentrate -

The chromite was not freed at this size. The chromite particles contained small particles of gangue. Some of the gange particles were shot with minute particles of chromite.

On -35+48 Mesh Concentrate -

Chromite was not freed at this size. A considerable amount of gangue was attached to chromite.

On -48+65 Mesh Concentrate -

Chromite was not freed at this size. Considerable amount of fine particles of gangue seen in the particles of chromite.

On -65+100 Mesh Concentrate -

Chromite not free of gangue at this size. Some particles appear to be pure chromite, others contain minute particles and clusters of gangue, and others have varying amounts, up to one half of the particle, made up of gangue.

On -100 Mesh Concentrate -

Even at minus 100 mesh some particles of chromite have attached gangue. Others have gangue particles intermixed. The larger proportion of chromite particles appear to be free of gangue at this size.

(Details of Tests, cont'd) -

Test No. 2. - Table Concentration.

The remaining ore, approximately 420 pounds, was concentrated to recover as much chromite concentrate as possible.

Each lot of ore was split into two halves, and the halves were combined to form two composite samples. One of these was ground minus 48 mesh and the other was ground minus 65 mesh.

The minus 48 mesh ore was sized -48+65, -65+100, and -100 mesh. The minus 65 mesh ore was also sized -65+100 and -100 mesh. The sized portions were tabled separately and the products were assayed.

Results:

-48 mesh ore.

Product	Weight in pounds	Assays, per cent Cr_2O_3	Assays, per cent Fe	Recovery of Cr_2O_3, per cent	Cr:Fe ratio
Feed	211.0	32.63	10.64		
Concentrate	62.0	48.08	15.99	43.3	2.06:1.
Middling	-	32.82	-		
Tailing	-	15.79	-		

-65 mesh ore.

Product	Weight in pounds	Assays, per cent Cr_2O_3	Assays, per cent Fe	Recovery of Cr_2O_3, per cent	Cr:Fe ratio
Feed	208.0	32.77	10.85		
Concentrate	72.0	49.11	16.71	51.9	1.97:1.
Middling	-	29.86	-		
Tailing	-	17.33	-		

Analysis of the concentrates included the following determinations:

Concentrate	-48 mesh - Per cent	-65 mesh - Per cent
SiO_2	3.84	3.20
CaO	Trace.	Trace.
MgO	12.13	12.53
Al_2O_3	10.29	9.16

In making these concentrates, the middlings were

(Test No. 2, cont'd) -

not re-treated, as in practice they would be reground prior to being reconcentrated. Re-treating of the middlings would result in a considerably greater recovery than that indicated in this test.

SUMMARY AND CONCLUSIONS:

The investigation discloses that the chromite particles contain gangue down to very fine sizes; approximately -100+150 mesh is reached before gangue is entirely separated.

The examination of the polished sections discloses much fracturing of the chromite, with gangue filling many of the fractures.

The absence of any appreciable amount of magnetite in the samples indicates that magnetic concentration will not improve the grade of concentrate or the chrome-iron ratio.

The chrome-to-iron ratio, Cr:Fe 2:1, is very unfavourable.

This grade of material at present is not classed as a commercial product.

There are two methods of treating chromite concentrates to improve the chromium-to-iron ratio. One is by acid leaching; the other is by smelting in an electric furnace, as practiced by the Chromium Mining and Smelting Co. Ltd., Sault Ste. Marie, Ontario.

The flow-sheet which has become more or less standard for milling chromite ores is one in which the ore is first broken in a jaw crusher, followed by a secondary crusher which reduces the ore to ball mill size. This size depends on the size of ball mill and the fineness of grind

(Summary and Conclusions, cont'd) -

required to liberate the chromite grains. For a small mill it would not be necessary to screen out the fines between the primary and secondary crushers. If the ball mill is large enough the jaw crusher could be set close enough to feed direct to the fine-ore bin from which the ball mill is fed, thus doing away with a secondary crusher. The ball mill discharge should then pass over a vibrating screen, the openings of which are of the proper size to produce a concentrate of the required grade. A classifier should not be used in place of the screen. The oversize from the screen is returned to the ball mill.

The pulp passing through the screen should then be fed to a hydraulic sizer making from three to five sized products. These constitute the table feeds. There should be at least three tables concentrating the discharges from the hydraulic sizer. Concentrates, middlings and tailings are taken off each table. The middlings should be dewatered and reground.

In a small plant the thickened middling can be reground in the primary ball mill. In a larger plant a separate mill should be used.

In the flow-sheet as outlined, a recovery of 70 per cent or better may be expected, with a grade of concentrate of 48 per cent Cr_2O_3 and a chromium-to-iron ration of 2:1, on ore similar in character to that submitted for this investigation.

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