

TR 7-171-176

R. 398

CONCENTRATION OF CHROMITE AND MAGNETITE FROM
ANDERSON CREEK, BEACONSFIELD

Sample

Fourteen samples, each weighing between 5 and 30 pounds, were received from the Chief Geologist.

Sample No.	Location	Footage
R.398/1.	Area 1, Trench 1	0 - 2' 6"
2.	Trench 1	2' 6" - 4' 6"
3.	Trench 2	0 - 2' 6"
4.	Trench 2	2' 6" - 4' 2"
5.	Trench 3	0 - 3'
6.	Trench 4	0 - 6'
7.	Trench 4	6' - 13'
8.	Area 2, Bore 1	0 - 7'
9.	Area 3, Bore 2	0 - 4'
10.	Bore 2	4' - 14'
11.	Bore 3	0 - 8'
12.	Bore 4	0 - 5'
13.	Bore 4	5' - 11'
14.	Bore 5	0 - 6'

Samples R.398/3 and R.398/4 were combined for purposes of this investigation.

All samples contained appreciable clay. Some samples contained material up to about one inch size.

The principal minerals in the coarse fractions of the sample were:—

Sample No.	Description
R.398/1.	Iron minerals and quartzite.
2.	Weathered serpentine.
3.	Iron minerals and quartzite.
4.	
5.	Iron minerals.
6.	Earthy iron minerals.
7.	Earthy iron minerals.
8.	Iron minerals and weathered serpentine.
9.	Weathered serpentine and iron minerals.
10.	Weathered serpentine.
11.	Iron minerals.
12.	Weathered serpentine and iron minerals.
13.	Schist.
14.	Iron minerals.

The iron minerals are mostly nodular, from about 20 mesh size up to about quarter inch size. There were some aggregates of magnetite up to about one inch size. The iron minerals exhibit a wide range of magnetic properties and specific gravities, and range from magnetite nodules to nodules of earthy iron oxides.

Investigation

The investigation was carried out to obtain data relating to the quantity and quality of the chromite concentrates recoverable from the various samples.

The magnetite was also concentrated from the various samples.

Summary

A series of samples from Anderson Creek, Beaconsfield, have been tested for chromite and magnetite concentration. The relative quantities and compositions of the chromite and magnetite concentrates obtained by gravity and magnetic separation are tabulated below.

Chromite Concentrates (minus 30 mesh)

Sample No.	Weight Recovery	Percent							Chromium Iron Ratio
		Cr ₂ O ₃	Fe	Al ₂ O ₃	TiO ₂	SiO ₂	MgO		
R.398/1.	0.9	60.5	15.2	6.9	1.0	1.3	8.6	2.7	
2.	0.1	57.4	17.9	6.9	0.4	2.0	8.5	2.2	
3. }	1.5	59.6	15.5	7.1	1.6	1.3	8.6	2.6	
4.									
5.	4.0	61.0	15.1	7.5	0.9	0.8	8.8	2.8	
6.	0.4	55.6	18.4	8.3	0.4	0.9	8.0	2.1	
7.	0.7	46.5	28.0	7.2	0.1	0.6	6.5	1.1	
8.	1.0	61.5	15.6	7.7	0.6	0.7	8.9	2.7	
9.	1.1	63.8	14.2	6.8	0.2	0.3	9.1	3.1	
10.	0.5	59.8	17.2	6.7	0.2	0.7	9.1	2.4	
11.	0.8	55.1	20.4	6.5	1.0	1.2	6.8	1.9	
12.	2.5	63.1	14.6	7.2	0.3	0.5	9.1	3.0	
13.	0.2	61.2	14.2	7.5	0.3	1.6	10.0	3.0	
14.	4.3	60.7	16.1	7.1	0.5	0.7	8.7	2.6	

Small quantities of minus 10 mesh plus 30 mesh chromite concentrates were also produced, but due to the small quantities involved, these concentrates were not assayed.

Magnetite Concentrates

Sample No.	Weight Recovery	Percent		
		Cr ₂ O ₃	Ni	Fe
R.398/1.	11.7	1.9	0.17	57.7
2.	Nil			
3. }	14.6	2.1	0.18	58.0
4.				
5.	28.1	1.7	0.02	54.5
6.	2.0	2.9	0.09	56.9
7.	Nil			
8.	9.0	2.7	0.13	58.7
9.	3.4	2.5	0.26	58.0
10.	0.4	3.2	0.23	57.0
11.	4.1	3.2	0.09	56.2
12.	0.3	3.6	0.14	50.8
13.	Nil			
14.	8.8	2.2	0.13	58.0

Pilot Scale Test

A pilot scale concentration test was carried out on composite sample of five of the original samples. The test involved agitation, desliming by cycloning, gravity concentration by tabling, magnetic separation of the iron minerals and chromite, and final upgrading of the chromite concentrate by further gravity concentration. It was found that the rougher gravity concentrates must be closely sized before magnetic separation and final upgrading of high grade chromite concentrates are to be produced.

Research*Desliming and Sizing*

The various samples were pulped with water and the clay dispersed with sodium silicate and agitation. It was difficult to disperse the clay from some samples.

After dispersion the pulp was screened on 10 mesh and 30 mesh screens. The minus 30 mesh material was thoroughly deslimed by decantation. The relative proportions of the various fractions are tabulated below.

Sample No.	Plus 10 mesh	Percent Weight			Clay-like slimes	Total
		Minus 10 mesh plus 30 mesh	Deslimed minus 30 mesh			
R.398/1.	30.7	15.8	11.1	42.4	100.0	
2.	61.1	11.7	9.0	18.2	100.0	
3. }	40.4	11.7	14.7	33.2	100.0	
4. }						
5.	43.4	19.0	15.0	22.6	100.0	
6.	15.8	6.7	21.1	56.4	100.0	
7.	13.3	17.4	32.6	36.7	100.0	
8.	21.6	11.6	12.1	54.7	100.0	
9.	11.4	8.0	9.3	71.3	100.0	
10.	18.6	18.0	16.6	46.8	100.0	
11.	10.5	8.2	13.4	67.9	100.0	
12.	6.8	7.3	22.6	63.3	100.0	
13.	42.7	14.7	17.8	24.8	100.0	
14.	30.8	7.0	23.8	38.4	100.0	

Concentration of Chromite

No chromite was found in any of the plus 10 mesh fractions.

A gravity concentrate was obtained by panning the minus 10 mesh plus 30 mesh fractions. This concentrate was then treated on the Rapid high intensity magnetic separator to give—

- (a) a magnetite concentrate.
- (b) a weakly magnetic concentrate of earthy iron oxides which was discarded.
- (c) a feebly magnetic concentrate containing chromite and some earthy iron oxides.
- (d) a non-magnetic fraction which was discarded.

A chromite concentrate was obtained from the feebly magnetic product (c) by panning. In most cases only a very small quantity of chromite concentrate was made. Difficulty was experienced in panning this chromite to a high grade concentrate due to the relative coarse size of the material, and the small differences in specific gravities of the chromite and some of the iron oxides in the product.

The chromite concentrates were weighed, but were not assayed due to the relatively small amount of them.

The deslimed minus 30 mesh material was concentrated on the laboratory Deister table. The table concentrate was treated on the Rapid high intensity magnetic separator to give—

- (a) high and weakly magnetic products which were discarded.
- (b) a feebly magnetic chromite concentrate.
- (c) a non-magnetic fraction which was discarded.

The highly magnetic products consisted mainly of magnetite dust, and did not represent any significant weight of the sample, although they would significantly down grade a straight gravity chromite concentrate unless removed. The chromite concentrates were further upgraded by panning to remove the small quantities of iron minerals remaining in the concentrates.

The quantities of plus 30 mesh and minus 30 mesh chromite concentrates are tabulated below.

Sample R.398/7 contained earthy iron oxide coated particles with magnetic properties and specific gravities very close to those of chromite, and it was not possible to upgrade this concentrate to the same extent as the others.

Sample	Concentrate Percent Weight				
	Plus 30 mesh	Minus 30 mesh	Magnetite	Discards	Composite
R.398/1.	0.2	0.9	11.7	87.2	100.0
2.	Trace	0.1	Nil	99.9	100.0
3.	} 0.3	1.5	14.6	83.6	100.0
4.					
5.	0.3	4.0	28.1	67.6	100.0
6.	Trace	0.4	2.0	97.6	100.0
7.	0.2	0.7	Nil	99.1	100.0
8.	0.1	1.0	9.0	89.9	100.0
9.	0.1	1.1	3.4	95.4	100.0
10.	Trace	0.5	0.4	99.1	100.0
11.	0.1	0.8	4.1	95.0	100.0
12.	0.1	2.5	0.3	97.1	100.0
13.	Trace	0.2	Nil	99.8	100.0
14.	0.4	4.3	8.8	86.5	100.0

Sizings were carried out on three samples of minus 30 mesh chromite concentrates. There was no surplus concentrate from other samples for sizing determinations.

Mesh	Percent Weight			
	B.S. Screen	R.398/5	R.398/12	R.398/14
Plus 44 mesh	9	5	12
60 mesh	18	15	17
85 mesh	26	26	23
100 mesh	8	8	9
150 mesh	20	20	18
200 mesh	10	13	8
Minus 200 mesh	9	13	13
Composite	100	100	100

These three sizings are comparatively uniform.

Concentration of Magnetite

The plus 10 mesh fractions were roll crushed to minus 5 mesh, and then sized on 10, 22, 44 and 72 mesh screens. The various sized fractions were treated in the Rapid high intensity magnetic separator to give—

- (a) a highly magnetic concentrate.
- (b) weakly magnetic and non-magnetic fractions which were discarded. These fractions were examined for chromite without success.

The magnetite concentrates from previous chromite concentration of the minus 10 mesh plus 30 mesh fractions were added to the concentrates above. The combined magnetic concentrates were upgraded slightly by panning.

The relative quantities of the various magnetite concentrates are shown in the preceding tabulation.

Pilot Scale Chromite Concentration Test

A composite sample of about 58 pounds dry weight was made up from the unused portions of samples R.398/4, R.398/5, R.398/7, R.398/10 and R.393/11.

The used portions of these samples had been broken to minus $\frac{3}{4}$ inch lumps several weeks previously, and had almost dried out during this time. The basic object of this pilot scale test was to determine if the clay could be broken up effectively without the use of chemical dispersants.

The composite sample was agitated in the Denver conditioner for 30 minutes at a density of 1.32, i.e., at approximately 38 percent solids. A thick viscous pulp resulted, but all clay lumps were effectively broken. It is not known if similar treatment would be effective on material containing large wet lumps of clay.

The pulp was screened on a 22 mesh screen, and the oversize discarded. The minus 22 mesh material was diluted to density 1.20, i.e., 25 percent solids, and deslimed in the 3 inch Warman cyclone at 25 pounds per square inch pressure. The cyclone overflow was discarded.

The cyclone underflow was diluted to density 1.20 and recycled—the underflow was again diluted and recycled.

The deslimed cyclone underflow was then tabled to give a mixed chromite-magnetite concentrate.

The rougher table concentrate was dried and screened on 30, 44, 60, 85, 100, 150 and 200 mesh screens, and the various fractions treated on the Rapid high intensity magnetic separator to give—

- (a) a strongly magnetic magnetite concentrate.
- (b) a weakly magnetic concentrate of earthy iron mineral nodules.
- (c) a feebly magnetic concentrate containing chromite and some iron minerals.
- (d) a small quantity of non-magnetics.

The feebly magnetic products were panned to give a comparatively clean chromite concentrate.

Proportions of the various products are tabulated below:—

Product	Percent Weight
Chromite concentrate	1.1
Magnetite concentrate	3.0
Panned tailings and non magnetics	1.7
Rougher table concentrate	5.8
Table tailing	13.0
Cyclone underflow	18.8
Cyclone overflow	62.9
Minus 200 Mesh	9.4
Plus 22 mesh material	100.0
Plus 22 mesh material	18.3
Composite	100.0

The chromite concentrate amounting to 1.1 percent by weight of the composite sample was not assayed, but it can be assumed that the grade is similar to individual chromite concentrates reported earlier. A sizing of the concentrate showed—

Fraction B.S. Screen	Percent Weight	
	Initial	Cumulative
Plus 30 mesh	3.9	3.9
44 mesh	12.4	16.3
60 mesh	16.0	32.3
85 mesh	22.8	55.1
100 mesh	8.4	63.5
150 mesh	19.6	83.1
200 mesh	7.5	90.6
Minus 200 mesh	9.4	100.0
Composite	100.0	—

Discussion

Breaking up of the clay in the pilot plant scale test presented little difficulty, but on an industrial scale large wet lumps of clay may be more difficult to break up and the use of a log-washer or a scrubber would probably be necessary. Many samples contain over 50 percent by weight of the clay-like slimes, and disposal of the pulp containing this material may present major problems on an industrial scale. It will not be possible to readily reclaim much water from these clay pulps. Assuming—

- (a) a production of 5,000 tons of chromite per year
- (b) a recovery of 2 percent by weight of chromite concentrate
- (c) a clay content of 50 percent of the raw material

then approximately 120,000 tons of clay slimes in pulp form will have to be disposed of per year.

Concentration and upgrading of the chromite after desliming is not difficult provided the rougher concentrate is closely sized for magnetic separation and final upgrading.

A specification for chemical grade chromite requires—

Cr ₂ O ₃	over 54 percent
Al ₂ O ₃	14 percent maximum
SiO ₂	3 percent maximum

The concentrate would easily meet these specifications. Chromium iron ratio is not important.