Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

CANMET
Canada Centre for Mineral and Energy Technology
Centre canadien de la technologie des minéraux et de l'énergie

TECHNICAL REVIEW OF ORE DRESSING INVESTIGATIONS ON CANADIAN CHROMITE ORES CONDUCTED AT CANMET FROM 1918 TO 1976

D. Raicevic
Ore Processing Laboratory
Metallic Minerals Section

OCTOBER 1976

MINERALS RESEARCH PROGRAM
MINERAL SCIENCES LABORATORIES
CANMET REPORT 76–39

Available by mail from:

Printing and Publishing
Supply and Services Canada,
Ottawa, Canada K1A 0S9

CANMET
Energy, Mines and Resources Canada,
555 Booth St.,
Ottawa, Canada K1A 0G1

or through your bookseller.

Catalogue No. M38-13/76-39 Price: Canada: $1.75
ISBN 0-660-00759-2 Other countries: $2.10

Price subject to change without notice.

En vente par la poste:

Imprimerie et Édition
Approvisionnements et Services Canada,
Ottawa, Canada K1A 0S9

CANMET
Énergie, Mines et Ressources Canada,
555, rue Booth
Ottawa, Canada K1A 0G1

ou chez votre libraire,

Nº de catalogue M38-13/76-39 Prix: Canada: $1.75
ISBN 0-660-00759-2 Autres pays: $2.10

Prix sujet à changement sans avis préalable.

CANMET Report 76-39, prepared as
MINERAL SCIENCES LABORATORIES REPORT MRP/MSL 76-264 (IR)

TECHNICAL REVIEW OF ORE DRESSING INVESTIGATIONS ON CANADIAN CHROMITE ORES CONDUCTED AT CANMET FROM 1918 TO 1976*

by

D. Raicevic**

ABSTRACT

This report gives summaries of investigations related to the mineralogy and concentration of ores from Canadian chromite deposits conducted at CANMET (formerly Mines Branch) between 1918 and 1976. The mineralogy of each ore sample received and the mineral dressing methods applied for preparation of a chromite concentrate are outlined in general terms. Only a summary of the results from each investigation is recorded as details of the mineralogy, the methods applied and results obtained can be found in reports of the original investigations***

The possibility of bringing some of the more promising chromite deposits into production is also discussed.

---

* Minerals Research Program, Processing Contribution No. 33

** Research Scientist, Ore Processing Laboratory, Mineral Sciences Laboratories, Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Ottawa, Canada.

*** Photostats of the original MD and IR Investigations can be obtained from the CANMET Library at a nominal cost.

Rapport de CANMET 76-39, préparé sous forme de
RAPPORT DES LABORATOIRES DES SCIENCES MINERALES MRP/MSL 76-264 (IR)

UNE REVUE TECHNIQUE DES RECHERCHES EFFECTUEES PAR CANMET ENTRE LES ANNEES 1918 ET 1976 SUR LE TRAITEMENT DES MINERAIS CANADIENS DE CHROMITE*

par

D. Raicevic**

RESUME

Ce rapport présente les sommaires d'études effectuées par CANMET (l'ancienne Direction des Mines) entre les années 1918 et 1976, qui portaient sur la minéralogie et la concentration des minerais provenant de gisements canadiens de chromite. On donne un aperçu général de la minéralogie de chaque échantillon de minerai reçu ainsi que des méthodes de préparation d'un concentré de chromite. On ne retrouve, dans le présent rapport, qu'un sommaire des résultats obtenus pour chacune des études, étant donné que la minéralogie, les méthodes de traitement et les résultats finals sont détaillés dans les rapports originaux***

On invoque la possibilité d'amener à la production certains des gisements de chromite les plus prometteurs.

---

*Programme de recherche minière, Contribution au traitement n° 33.

**Chercheur scientifique, Laboratoire de traitement du minerai, Laboratoires des sciences minérales, Centre canadien de la technologie des minéraux et de l'énergie, Ministère de l'Energie, des Mines et des Ressources, Ottawa, Canada.

***On peut se procurer des photocopies des études originales MD et IR à la bibliothèque de CANMET à un prix minime.

CONTENTS

INTRODUCTION

Chromium is an essential industrial commodity in any industrialized country. Although Canada has some chromite ores, domestic needs are met through imports from South Africa and Rhodesia. It would be of great strategic importance if the domestic chromite deposits could become a source for Canadian chromite requirements, particularly if foreign sources become unavailable.

The primary objective of this report is to study mineralogical and beneficiation results of past investigations and to determine whether some of the more promising Canadian chromite deposits could be brought into production by applying current beneficiation technology.

Chromium uses

Chromium is used in three major fields: metallurgical, refractory and chemical.

In the metallurgical field, which accounts for about 60% of the world's consumption, the chromium is added to iron, nickel and other metals to improve their strength, corrosion and oxidation resistance. In addition, chromium helps to refine the grain structure in iron castings. Chromium is added to iron and steel in the form of a ferrochromium alloy produced from chromium-bearing ores. Chromium is added to other metals in the form of chromium metal. Most of the chromium ores in the world are used for the preparation of ferrochromium alloys with some also going into the production of chromium metal mainly for chromium plating.

In the refractory field, which accounts for about 27% of the world's production, the chromium is used mainly in the form of mineral chromite to manufacture refractory bricks and furnace linings.

In the chemical field, which accounts for about 13% of the world's consumption, chromium metal is used for making paint pigment, plating of other metals and preparation of chemical compounds for tanning, textiles, dyes, preservatives and fungicides.

General characteristics and classification of chromium ores

Chromium is never found in the free metallic state in nature but is associated with other elements in a large number of minerals of which the only commercially important one is chromite.

The theoretical formula of pure chromite is $FeO.Cr_2O_3$ with a chromic oxide (Cr_2O_3) content of 68% and 32% FeO.

In nature, chromite is rarely, if ever, found in the pure state, but rather as a combination of oxides of chromium and iron with varying amounts of gangue minerals-magnesium, aluminum and silicon oxides. The general formula of this impure chromite mineral is $(Fe,Mg)O(Cr,Al,Fe)_2O_3$. Sometimes calcium is also present in its crystal structure, making it even less pure.

Chromite minerals vary in colour from dark brown to jet black and usually occur in a massive form with a granular structure, although individual crystals are octahedral. The interstitial material usually consists of magnesium silicates. Compared with most other minerals, it is fairly soft, its hardness being 5.5 on Mohs scale. Its density ranges from 4.6 for high-grade ores to 4.0 for low-grade ores. Its melting

point varies with composition in the range of 1545 to 1730°C. It has a lustre approaching that of metals and is almost insoluble in acids.

Chromite deposits result by segregation from ultrabasic magma and are associated with periodotites, pyroxenites or amphibolites as are Norwegian deposits, with serpentine derived from them as in the Urals and New Caledonia or with talc-schists or magnesite as in Southern Rhodesia and India. It is often associated with other minerals including nickel, cobalt, gold, platinum, titaniferous magnetite, magnesite, talc and chrysotile asbestos but seldom with iron oxides.

Most foreign ores are of sufficiently high grade to be marketed without beneficiation other than hand picking.

Chromium ores are classified into three major groups according to chemical composition and use:

(a) metallurgical-grade ores, used for production of chromium metal and ferrochromium alloys;

(b) refractory-grade ores, used for preparation of refractories;

(c) chemical-grade ores, used for preparation of chromium chemicals.

Major variations in the chemical composition of chromite ores or concentrates are in the chromium and iron contents and in the amount of gangue material - SiO_2, MgO, Al_2O_3 and CaO - as well as in the amount of phosphorus and sulphur. In addition, a very important factor in the chromite ores of the metallurgical and chemical grades is the chromium to iron ratio (Cr:Fe).

Based on physical characteristics, chromium ores are classified as:

(i) friable, and

(ii) hard lumpy

The friable type, although hard and excessively abrasive as mined, crumbles when handled or even on exposure to the atmosphere, while hard-lumpy ores retain their hardness indefinitely.

General specifications for the chromite ores or concentrates required by the industry are given in the following table:

Specifications for chromite ores or concentrates required by industry(1,4,7,8)

Metallurgical Grade	Refractory Grade	Chemical Grade
>48% Cr_2O_3 (30.5% Cr) >2.8 Cr:Fe ratio <3% SiO_2* <25% MgO + Al_2O_3 + CaO <0.1% P <0.1% S Preferably hard and lumpy ore	Approx. 32% Cr_2O_3 Approx. 25% Al_2O_3 <12% Fe (total) < 6% SiO_2 Preferably hard and lumpy ore	Approx. 45% Cr_2O_3 <20% Fe (total) Cr:Fe ≈ 1.6:1 <15% Al_2O_3 <5% SiO_2 Friable ores acceptable

*Undesirable.

Supply of chromium ores and concentrates

Over 90% of non-Communist reserves of chromium-bearing ores are located in South Africa and Rhodesia. These two countries supply about 52% of non-Communist requirements of chromite ores or concentrates, South Africa about 1.7 million metric tons per year and Rhodesia about 0.5 million.

The chemical composition of the various chromite ores from major world producers are given in the following table(8):

Chemical characteristics of chromite ores from major world producers

Country and Type of ore produced	Cr_2O_3	Total Fe	Al_2O_3	MgO	CaO	SiO_2	Cr:Fe Ratio
Rhodesia							
(Selukwe)							
Metallurgical	47.0	9.34	12.64	15.50	1.80	5.70	3.4:1
Refractory	42.6	12.2	13.80	15.80	0.32	8.60	2.4:1
(Dyke)							
Refractory	50.70	12.75	13.00	13.20	0.75	4.33	2.7:1
Metallurgical	48.50	14.2	11.50	13.40	0.80	5.6	2.4:1
U.S.S.R							
Metallurgical	53.90	9.80	9.60	13.30	1.1	5.80	3.7:1
Refractory	39.10	10.90	17.4	16.10	0.7	9.4	2.5:1
Turkey							
Metallurgical	48.30	10.95	13.00	16.84	0.95	5.07	3.01:1
Refractory	37.00	11.80	24.34	17.73	0.22	4.33	2.36:1
Philippines							
(Masinloc)							
Refractory	33.35	10.30	28.23	19.56	0.45	4.58	2.2:1
South Africa		FeO					
Chrome conc	50.7	21.0	11.9	12.8	0.1	1.6	..
Chrome conc	49.2	22.6	13.9	11.7	..	1.9	..
Chrome conc	45.2	26.6	15.4	9.6	0.9	2.1	..
Friable ore	49.7	20.9	12.0	13.0	0.1	2.5	..
Hard, lumpy ore	42.5	25.0	15.0	12.0	0.1	4.0	..

Chromite ores and concentrates are supplied by the producing countries in all three grades-metallurgical, refractory and chemical-the first being in greatest demand. The consuming countries process the concentrates to produce ferrochromium, refractories and chromium chemicals.

It appears that imports of the refractory and chemical grade ores will continue, providing the present political problems in both South Africa and Rhodesia are solved.

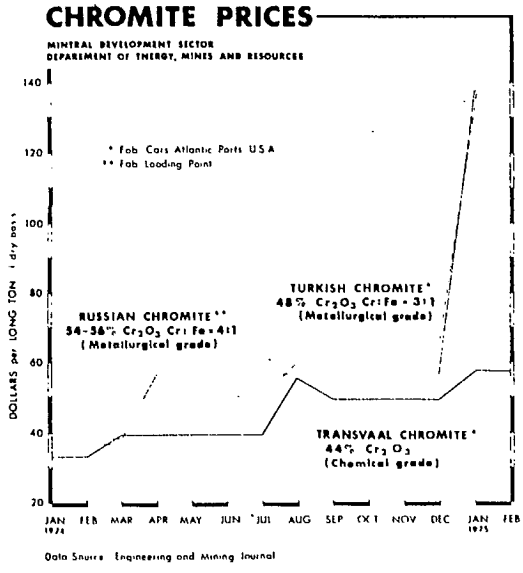
The South African supply of the metallurgical grade chromite concentrate, however, will be affected by two major developments presently taking place there. The first relates to a steady increase in the internal consumption of the concentrate in South Africa itself which is expected to reach 330,000 metric tons by 1980[10]. In other words, by 1980 the South African exports of metallurgical grade chromite concentrate will be reduced by 330,000 metric tons. To partially minimize the negative effect of the export reduction of chromite concentrate, new processes, (Showa Denko and Nippon Kokan) have been developed for pelletizing and treating high-grade chromite fines of South African chromite ores which would otherwise be discarded. The pellets so produced will be sold to partially compensate for the reduced export of the metallurgical-grade lump ores, or they can be reduced (deoxidized) and then sold in competition with some ferrochromes.

The second industrial development in South Africa is the expansion of its own ferrochromium industry which will export ferrochromium alloys rather than the metallurgical grade chromite ores or concentrates. The availability of electric power which is essential in the manufacture of ferrochromium products, as well as sufficient foreign funds, will make this project a reality. Although there are some advantages, the principal disadvantages to the buying nations are:

1) higher cost of imports and the resulting effect on balance of trade and balance of payments;
2) dependence on a few countries for essential material: local disruptions-political or natural-could adversely affect the consuming nations;

"The move by ore-producing countries to export ferrochrome rather than chromite will cause significant changes in the world ferrochrome industry. One result will be that there will probably be little or no increase in the amount of ore available for world trade between 1973 and 1980. The U.S.S.R's plan to construct a ferrochrome plant by 1980 will further aggravate the chromite supply difficulties of the industrialized nations if there is not a concomitant increase in ore production. In addition, there is a good possibility that Brazil will be involved in a ferrochrome project by 1980 that will further aggravate the chromite supply situation for traditional ferrochrome producers. Because of the limited sources of chromite, this situation will have to be accepted by the consuming nations." (10)

The price of chromite made two significant upturns during late 1974 and early 1975 as shown by the following graph.



Canadian chromite requirements

Although small amounts of chromite concentrate were produced from Canadian chromite deposits in the period from 1886 to 1949, no concentrates have been produced in recent years. All Canadian chromite requirements are imported with some subsequent exports of chromium products. The amount of chromite ores imported and the amount of ferrochromium consumed in Canada since 1969 are recorded in the following table:

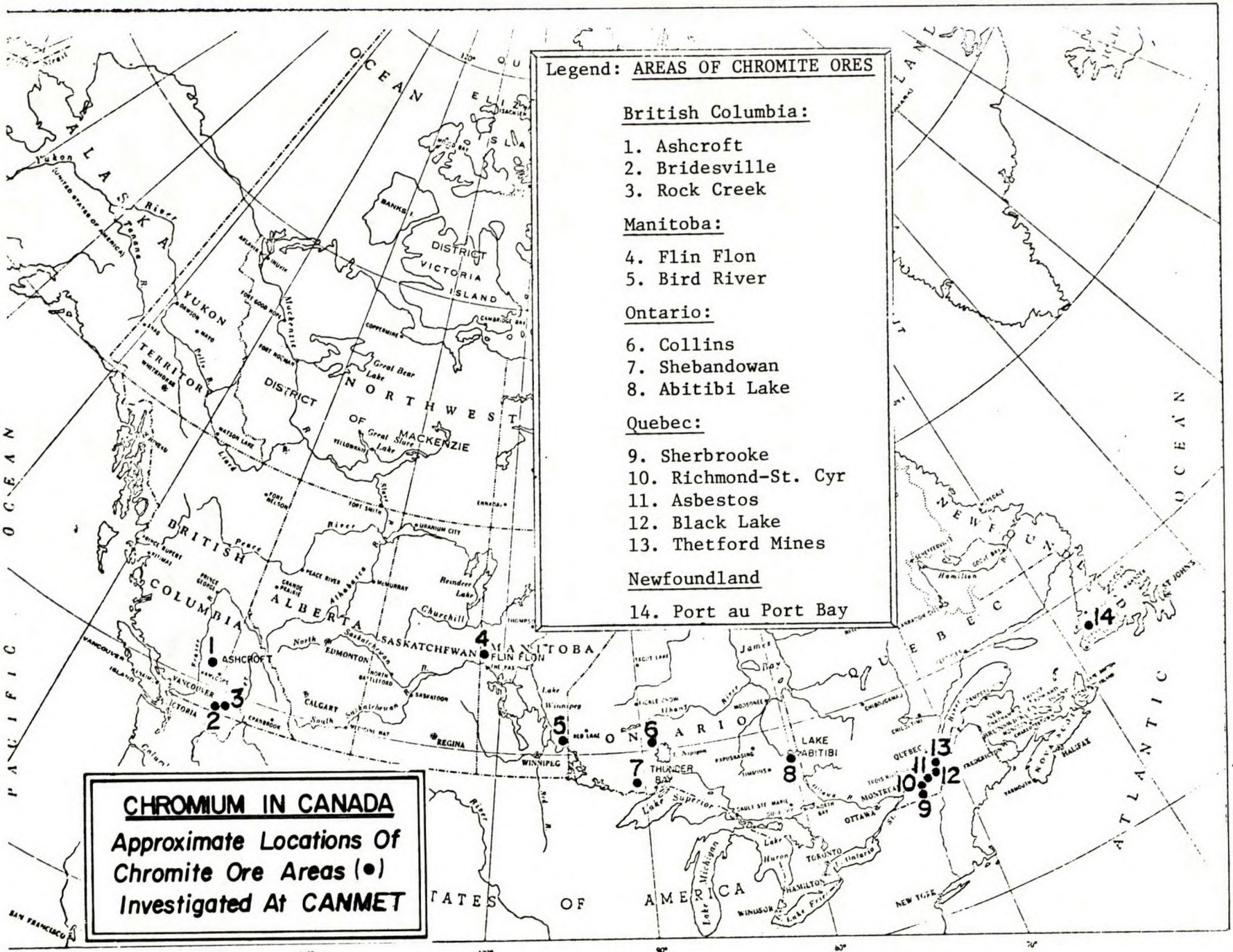
Canadian imports of chromite ores and ferrochromium consumption from 1969 to 1975

Year	Imports of Chromite Ores, short tons	Ferrochromium Consumption, short tons
1969	68,484	25,035
1970	61,963	31,257
1971	61,313	22,861
1972	62,712	24,975
1973	38,030	28,380
1974	66,658	23,223
1975	40,554	17,000*

* Estimated

Characteristics of Canadian chromite ores

In general, Canadian chromite deposits are composed of the impure chromite mineral - $(Fe, Mg)O(Cr,Al,Fe)_2O_3$-which usually occurs in a gangue matrix. Besides a relatively high iron content in impure chromite which lowers its chromium to iron ratio, this mineral also contains nuclei of gangue minerals in its crystal structure,[8] further lowering the chromium grade of the mineral and consequently lowering the chromium grade of the ore. In most


Legend: AREAS OF CHROMITE ORES
British Columbia:
1. Ashcroft
2. Bridesville
3. Rock Creek
Manitoba:
4. Flin Flon
5. Bird River
Ontario:
6. Collins
7. Shebandowan
8. Abitibi Lake
Quebec:
9. Sherbrooke
10. Richmond-St. Cyr
11. Asbestos
12. Black Lake
13. Thetford Mines
Newfoundland
14. Port au Port Bay
CHROMIUM IN CANADA
Approximate Locations Of Chromite Ore Areas (•) Investigated At CANMET
PACIFIC OCEAN
ATLANTIC OCEAN
ALASKA
YUKON TERRITORY
NORTHWEST TERRITORIES
DISTRICT OF MACKENZIE
VICTORIA ISLAND
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
NEWFOUNDLAND
ASHCROFT
FLIN FLON
THUNDER BAY
LAKE ABITIBI
PORT AU PORT BAY
VANCOUVER
EDMONTON
CALGARY
REGINA
WINNIPEG
TORONTO
OTTAWA
MONTREAL
HALIFAX
ST JOHN'S
UNITED STATES OF AMERICA

of these deposits, with the exception of some in Quebec, impure chromite is the only mineral of economic interest.

The major Canadian chromite deposits are located in British Columbia, Manitoba, Ontario, Quebec and Newfoundland (as shown on the map on page 9). Although not thoroughly explored, it is estimated that these deposits together would not exceed 50 million tons of various chromium grades containing up to 28% chromium (up to 41% Cr_2O_3) and up to 20% iron ore. These deposits, therefore, have a low chromium grade compared with foreign ores, and a relatively high iron content and thus a low chromium to iron ratio (Cr:Fe).

The largest Canadian chromite deposit is located in southeastern Manitoba in the Bird River area[5]. The estimated tonnage is about 16,000,000 tons with the chromium content ranging between 5 and 25% Cr_2O_3 and averaging about 11.5% Cr_2O_3. The highest grade deposit of the area is on the Page claims, averaging about 25% Cr_2O_3[8]. A geological survey of all chromite deposits in Manitoba is currently being conducted by the Manitoba government.

Deposits of medium-or concentrating-grade occur in isolated areas of Newfoundland. Although surveys have been made, little development with a view to exploitation has been carried out.

Upgrading of Canadian chromite ores

The success in upgrading chromite ores in general depends on their mineralogical characteristics, their chromium grade and the chromium and iron contents of the chromite mineral itself. Ores that have low grade because of a high amount of gangue minerals but

with their chromite mineral being high in chromium and low in iron, can be upgraded by physical methods, without much difficulty, usually by gravity concentration. On the other hand, if the chromite mineral has a low chromium and high iron content and the mineral itself thus has a low chromium to iron ratio, these ores cannot be upgraded by physical methods alone to produce the chromite concentrates of the present industrial specifications, particularly, not a metallurgical-grade concentrate. This is also the case with the ores in which chromite is finely intergrown with other components or contains gangue material in its crystal structure.

Although the concentrates produced usually have higher chromium grades than the original ores due to rejection of gangue, the chromium to iron ratio in general does not improve unless magnetic and/or other iron-bearing minerals which can be separated from chromite, are present in the ore.

Gravity concentration by tabling and in some cases jigging, was the main upgrading method used in most CANMET investigations on the Canadian deposits, but in some cases flotation was also applied. Where magnetite was present, the low-intensity magnetic separation method was also applied for rejection of magnetite.

From 1886 until 1949, Canada produced 278,326 tons of chromite concentrates of various grades-272,252 tons from Quebec, 5,278 tons from Ontario and 796 tons from British Columbia, but none from Newfoundland or Manitoba deposits.

Objective and outline of the report

The objective of this report is to summarize and evaluate each ore dressing investigation carried out at CANMET between 1918

and 1976 on chromium-bearing samples from Canadian deposits. Each summary contains the following points of investigation:

- Number and title of investigation.
- Mineralogy and analysis of ore sample tested.
- Purpose of investigation.
- Methods of concentration.
- Summary of results and conclusions.

The summaries of investigations are grouped by provinces.

Through information regarding mineralogy of the deposits and their amenability to beneficiation, this report will be of help in assessing various deposits for purposes of resource evaluation and will also indicate areas where new or improved methods of beneficiation would be required to help bring some of the more promising deposits into production.

SUMMARY OF MINERALOGY AND CONCENTRATION RESULTS

Mineralogy

The only chromium-bearing mineral of economic interest in Canadian chromite deposits is an impure mineral-$(Fe,Mg)O(Cr,Al,Fe)_2O_3$ - (the chemical formula of the pure chromite mineral is $FeO.Cr_2O_3$). Due to high iron and high magnesia and alumina contents in impure chromite as well as large amounts of gangues these Canadian deposits have a low chromium content ranging between 1% and 28% chromium (1.47% and 41% Cr_2O_3), relatively high iron content (up to 20% Fe) and thus a low chromium to iron (Cr:Fe) ratio. As foreign ores of high chromium grades, high Cr:Fe ratios and low

impurity content are readily available (Table, Page 5), the Canadian chromite ores have not been accepted by the industry in their natural form. These ores must therefore be upgraded by rejecting as much impurity as possible to produce acceptable concentrates.

Concentration results

As about 60% of chromium in ores is consumed by the steel industry in the form of ferrochromium alloys, most of the CANMET investigations have been directed toward preparing concentrates for this purpose.

A summary of the most promising results obtained from ore samples from various areas is given below:

1. Concentrates with chromium recoveries from 81 to 90% and chromium grades and chromium to iron ratios suitable for ferrochromium production were obtained from chromite deposits located in the areas of Port au Port Bay in Newfoundland, Sherbrooke and Richmond-St. Cyr in Quebec.

The chromium and iron assays and the chromium recoveries of these concentrates are recorded in the following table:

Deposit			Chromite Concentrate			
Location	Assay %		Assay %		Cr/Fe Ratio	Distn % Cr_2O_3
	Cr_2O_3	Fe	Cr_2O_3	Fe		
P. P. Bay, Nfld.	41.0	10.7	53.14	13.3	2.73:1	81.4
Sherbrooke, Que.	34.2	9.8	55.49	11.6	3.26:1	87.3
Richm.-St.Cyr, Que.	18.1	7.7	47.50	11.2	2.84:1	90.0

The type and amount of impurity (MgO, CaO, Al_2O_3, SiO_2 and others) in the concentrates were not determined.

It could not be determined if the concentrates, which were assayed only for chromium and iron, were acceptable to the steel industry as the impurities in the concentrates are important factors for ferrochromium production (Table on Page 4).

2. Chromite concentrates with the chromium recoveries from 75% to 93% and reasonable chromium grades, but with chromium to iron ratios lower than specified for the ferrochromium production (minimum 2.8), were obtained from other ore samples. These were from chromite deposits in the Ashcroft, Rock Creek and Bridesville areas in British Columbia, the Page claims in the Bird River area in Manitoba, Obonga Lake area in Ontario and Richmond-St.Cyr area in Quebec.

Results obtained from each area are recorded in the following table:

Deposit			Chromite Concentrate			
Location	Assay %		Assay %		Cr:Fe ratio	Distn % Cr_2O_3
	Cr_2O_3	Fe	Cr_2O_3	Fe		
Ashcroft and Rock Creek, B.C.	17.47	6.9	53.3	15.9	2.3:1	75
Bridesville,B.C.	n.a.	n.a.	48.3	15.7	2.1:1	84
Bird River, Man.	26.40	12.7	42.0	19.1	1.49:1	78
Obonga Lake,Ont.	16.40	9.8	42.0	n.a.	n.a.	92.8
Black Lake,Que.	10.7	n.a.	45.7	n.a.	n.a.	72.7

n.a. = not analysed.

With the exception of those from the Bridesville area, the impurities in other concentrates were not determined. Even iron assays were not obtained in some.

CONCLUSIONS

Ores from the Canadian chromite deposits have low chromium and relatively high iron grades and, therefore, low chromium to iron ratios. They cannot be utilized by industry in their natural state and, as a result, must be upgraded to produce chromite concentrates of acceptable industrial specifications. No chromite concentrates suitable for ferrochromium manufacture have been produced from Canadian chromite deposits since 1949.

It would appear that chromite concentrates suitable for ferrochromium manufacturing [7,8,9,10,11] can be produced from most Canadian chromite deposits by applying fine grinding and present ore dressing methods. This would be particularly true if methods for pelletizing and treating chromite fines recently developed in South Africa, would be applicable for Canadian chromite ores.

RECOMMENDATIONS

Based on the results obtained and present technology for producing ferrochromium alloys, it is recommended that the following steps be taken:

(1) establish true reserves, chromium and iron grades of the deposits and determine their potentials;

(2) conduct concentration investigations on representative ore samples from each deposit and establish the chromium grade, recovery and industrial suitability of the concentrates produced;

(3) conduct pyrometallurgical and/or hydrometallurgical treatment [7,8,9,10,11] of some concentrates to remove as much iron and gangue as possible and thus produce a new high-grade concentrate grading 70-90% Cr_2O_3 and with a low iron content, i.e., the new concentrate would have a high Cr:Fe ratio of 40-50:1.

By adding a calculated amount of the new chromite concentrate to the untreated, original low-grade concentrate ("sweetening" the original concentrate), the resulting mixed chromite concentrate would have the required specifications for the production of ferro-chromium alloys;

(4) up-date estimates of mining cost as well as costs of (2) and (3) and establish feasibility of preparing metallurgical-grade chromite concentrates by comparing their costs with those of imported foreign chromite ores.

APPENDIX

SUMMARIES OF ORE DRESSING INVESTIGATIONS ON CHROMITE DEPOSITS OF BRITISH COLUMBIA

Ore Dressing Investigation No. 35, 1934

CONCENTRATION TESTS ON CHROMITE ORES
FROM ASHCROFT, B. C.
by
R. K. CARNOCHAN

Ore sample tested: About 172 lb of ore were investigated.

Mineralogy: Not reported.

Analysis: 39.42% Cr_2O_3. Other components were not determined.

Purpose of investigation: To investigate what grade of concentrate could be obtained from this ore sample.

Methods of concentration: Tabling, flotation, roasting and magnetic separation of sized fractions of a 20-mesh crushed ore.

Summary of results and conclusions: The grade of concentrates obtained varied from 42.23% to 46.11% Cr_2O_3. Chromium recovery was not recorded. Although the iron and gangue components were not determined, it was concluded that the results were not satisfactory for ferrochromium production.

Ore Dressing Investigation No. 1343, January 15, 1943

CONCENTRATION TESTS ON CHROMITE ORES
FROM FERGUSON AND SCOTTY CREEKS,
ASHCROFT MINING DIVISION,
BRITISH COLUMBIA
by
H. L. BEER

Ore samples tested: Four different ore samples, two from Ferguson Creek and two from Scotty Creek with a total weight of about 2,400 lb were investigated.

Mineralogy:

Sample: Ferguson Creek West

The character of this material differed from that of the

east workings. The chromite was disseminated as coarse-sized grains some of which contained inclusions of gangue. Most of the magnetite occurred as scattered grains in the gangue, though a minor portion was present as thin films and minute grains at the borders of the chrome grains and as small veinlets cutting them. Pyrite rarely occurred in the gangue.

Sample: Ferguson Creek East

Sections from this sample indicated that the chromite was largely disseminated as medium-sized grains and was locally quite abundant. The chrome grains contained gangue inclusions varying from rare inclusion-free grains to those which contained as much as 50% by volume of gangue. Some grains had been almost completely replaced by gangue. The magnetite occurred largely in close association with the chromite as narrow veinlets in chrome grains, as irregular films and discontinuous coatings on the chromite grains, and rarely as particles accompanying the gangue inclusions.

Sample: Scotty Creek North

The material from the north workings was evenly distributed and consisted of comparatively coarse chromite grains which showed some grouping into irregular sinuous bands. The chromite was relatively free from gangue inclusions and there appeared to be little associated magnetite. The latter mineral was present, however, as very thin shells around the chrome grains and as tiny veinlets within them.

Sample: Scotty Creek South

The chromite occurred variably, from scattered disseminated grains to fairly massive chromite. In some areas there were coarse irregular networks of stringers of granular chromite.

Analysis: The following components were determined:

	Per cent	
	Cr_2O_3	Fe
Ferguson Creek West -	17.47	6.92
Ferguson Creek East -	20.37	8.92
Scotty Creek North -	20.09	7.45
Scotty Creek South -	18.85	8.39

Purpose of investigation: To produce chromite concentrates of satisfactory grade and chromium-iron ratio.

Methods of concentration: Jigging, tabling and low-intensity magnetic separation.

Summary of results and conclusions:

Ferguson Creek West

At a grind of 100% minus 35 mesh, a table concentrate assaying 53.36% Cr_2O_3 and 15.92% Fe was obtained, with a chrome: iron ratio of 2.29:1. The recovery was about 75% of the chromium in the ore.

Ferguson Creek East and Scotty Creek

On both samples it was not possible to secure Wilfley table concentrates better than 44% Cr_2O_3 and 14% Fe, at a grind of minus 48 mesh. A chrome:iron ratio of only about 2:1 was obtained.

Ore Dressing Investigation No. 1399, May 4, 1943

CONCENTRATION OF CHROMITE ORE FROM ROCK CREEK, BRITISH COLUMBIA

by
W. S. JENKINS

Ore samples tested: Six samples with total weight of about 500 lb from the above claims were tested.

Mineralogy: The gangue was composed of a very soft grey material which formed the ground mass for the metallic mineralization and consisted of greenish grey talcose rock.

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

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

Analysis: The samples, analyzed separately, assayed between 30.69% Cr_2O_3 and 35.28% Cr_2O_3, with 10.12% Fe to 10.59% Fe, i.e, with a Cr:Fe ratio of between 2.03:1 and 2.35:1.

Purpose of investigation: To analyze each sample separately and determine the Cr_2O_3 grade and Cr:Fe ratio of chromite concentrates that could be obtained from the combined ore samples.

Methods of concentration: Six samples were combined as one composite sample. Tabling and low-intensity magnetic separation were applied on size fractions of samples ground to minus 48 mesh, minus 100 mesh and minus 200 mesh.

Summary of results and conclusions: Grinding to minus 48 mesh gave a concentrate of 44% Cr_2O_3. Grinding to minus 100 mesh increased it to 50.25%. Grinding to minus 200 mesh gave a concentrate assaving 52.8% Cr_2O_3 and 17.6% iron.

In none of these tests was the ratio of Cr:Fe raised above 2.1:1. The chromium recovery ranged between 68 and 72%.

Letter Report* of August 21, 1973.

AN INVESTIGATION ON A CHROMITE ORE
FROM BRIDESVILLE AREA, BRITISH COLUMBIA
by
R. P. BAILEY

Ore sample tested: Not recorded.

Mineralogy: Not recorded.

Analysis: Not recorded.

Purpose of investigation: To obtain a commercial grade chromite concentrate.

Methods of concentration: Very fine grinding (ore to minus 325 mesh, middlings to minus 500 mesh) followed by low-and high-intensity wet magnetic separations.

Summary of results and conclusions: The concentrate assayed 48.3% Cr_2O_3, 22.9% Fe_2O_3 (Cr:Fe ratio = 2.1:1), 14.9% MgO, 10.1% Al_2O_3, 3.7% SiO_2. Recovery of chromium in the ore was 84.1%.

Other investigations conducted: British Columbia Mines Report of 1958.

---

* Mines Branch Investigation Report was not written.

SUMMARIES OF ORE DRESSING INVESTIGATIONS ON CHROMITE DEPOSITS OF MANITOBA

Ore Dressing Investigation No. 1327, November 20, 1942

INTERIM REPORT OF CONCENTRATION TESTS ON A CHROME ORE FROM THE PAGE CLAIMS, BIRD RIVER, MANITOBA

by

H. L. BEER

Ore sample tested: About 1,180 pounds of chromite ore from Page claims.

Mineralogy: The microscopic examination of the polished sections showed that the average size of the chromite grains was about 160 microns (minus 65 plus 100 mesh) and that these grains contained numerous small inclusions of gangue material, the majority of which were too small to be economically eliminated by grinding. The polished sections also revealed that if magnetite were present it was in very small amounts.

Analysis: The ore sample assayed:

26.80% Cr_2O_3

12.34% Fe

10.30% SiO_2

Purpose of investigation: A preliminary concentration of chromite by various methods.

Method of concentration: Gravity concentration, desliming, flotation and low-intensity magnetic separation.

Summary of results and conclusions: At grinds ranging between 35 and minus 48 mesh, the applied methods produced chromite concentrates of grades ranging from 40.6 to 42.4% Cr_2O_3 with 78.9 and 66.0% chromium recovery respectively.

Ore Dressing Investigation No. 1329, November 26, 1942

SINK-AND-FLOAT TESTS ON SAMPLES OF CHROMITE ORE FROM BIRD RIVER, MANITOBA

by
J D. JOHNSTON

Ore samples tested: Three ore samples- 660 lb, 5820 lb and 460 lb - were received for this investigation.

Mineralogy: The ore was composed of gangue minerals, mainly serpentines, and the impure chromite mineral of irregular and rounded octahedral crystals lying in a matrix of gangue minerals. Besides chromium and iron, this chromite mineral also contained nuclei of gangue minerals in its crystal structure.

Chromite in this ore was the only mineral of economic interest.

Analysis:

Samples were cut from each of the shipments, assayed and reported as follows:

	Cr_2O_3, %	Iron %	Al_2O_3, %	MgO %	SiO_2, %
Shipment No. 1 -	20.88	11.62	10.56	16.42	14.74
Shipment No. 2 -	21.27	12.38	6.59	20.60	16.82
Shipment No. 3 -	0.28	7.63	28.51	32.29	23.32

Purpose of investigation: To obtain a chromite concentrate with the highest chromium grade and chromium:iron ratio.

Method of concentration: Sink-and-Float.

Summary of results and conclusions: On the basis of the samples submitted it was possible to recover 95% of the chromium in a product assaying 22.5% Cr_2O_3, or slightly better from ore crushed to 1.5 in.

Ore Dressing Investigation No. 1360, February 24, 1943

SMALL-SCALE CONCENTRATION TESTS ON A CHROMITE ORE FROM THE PAGE CLAIMS, BIRD RIVER, MANITOBA

by

H. L. BEER

Ore sample tested, Mineralogy and Analysis are the same as in Investigation No. 1327.

Purpose of investigation: To produce a chromite concentrate of highest chromium grade and highest chromium to iron ratio.

Methods of concentration: Tabling and flotation with and without desliming; low-intensity magnetic separation.

Summary of results and conclusions: Tabling of minus 35 mesh ground ore gave the best results. The highest grade of the concentrate obtained was 44.28% Cr_2O_3 and 20.7% Fe, i.e., a Cr:Fe ratio of 1.46:1.

The recovery was about 85% of the chromium in the ore.

Ore Dressing Investigation No. 1361, February 27, 1943

PILOT PLANT TEST ON CHROMITE ORE FROM THE PAGE CLAIMS, BIRD RIVER, MANITOBA

BY

K. N. STEWART

Ore sample tested: 85 tons of ore from Page claims were obtained for this investigation.

Mineralogy: Same as in Investigations No. 1327 and 1329.

Analysis: The sample assayed 26.40% Cr_2O_3 and 12.70% Fe, i.e., a Cr:Fe ratio of 1.42:1.

Purpose of investigation: To produce sufficient chromite concentrate for treatment at Chromium Mining and Smelting Company Limited in Sault Ste. Marie, Ontario. (Investigation No. 1492).

Methods of concentration: Crushing, tabling, grinding of middlings and desliming.

Summary of results and conclusions: The concentrate produced by this pilot plant operation contained about 78% of the chromium in the ore and assayed about 42% Cr_2O_3 and 19.1% Fe, i.e., a Cr:Fe ratio of 1.49.

Other investigations conducted on this deposit: Ore Dressing Investigation No. 1492, September 4, 1943.

Ore Dressing Investigation No. 1391, April 24, 1943

CONCENTRATION OF CHROMITE ORE FROM EMBURY LAKE*, MANITOBA

by

W. S. JENKINS

Ore sample tested: About 1½ lb of chromite ore.

Mineralogy: Not reported.

Analysis: 23.72% Cr_2O_3 (16.2% Cr) and 17.60% Fe, i.e., Cr:Fe = 0.92:1.

Purpose of investigation: To investigate whether the material had the quality of a commercial chromium ore .

Methods of concentration: Gravity and low-intensity magnetic separation.

Summary of results and conclusions: A concentrate of 53.64% Cr_2O_3 (36.7% Cr) and 23.4.6% Fe with 29.5% chromium recovery and a Cr:Fe ratio of 1.66:1 was produced from this ore. Due to a low Cr:Fe ratio and low chromium recovery, the ore was placed in the non-commercial class of chrome ores .

*Flin Flon area.

SUMMARIES OF ORE DRESSING INVESTIGATIONS ON CHROMITE ORES OF NEWFOUNDLAND

Ore Dressing Investigation No. 940, December 31, 1940

CONCENTRATION OF CHROMITE ORE FROM THE PORT AU PORT BAY DISTRICT NEWFOUNDLAND

by

O. STAPLES

Ore samples tested: Two samples of chromite ore, one low-grade and one high-grade, with a combined weight of 30 lb, were tested.

Mineralogy: Low-grade Sample

Gangue formed the bulk of this ore. It consisted of soft, dark, clouded, greenish brown and light greenish yellow serpentine. Some olivene and carbonates were also present. The main metallic mineral was chromite but some magnetite, limonite and ilmenite also occurred in the ore.

High-grade Sample

The gangue was essentially the same in this sample as in the low-grade sample but was lesser in quantity. Metallic mineralization was much heavier in this sample and was represented solely by chromite occurring largely as coarse disseminated grains varying in size from several millimetres down to a fraction of a millimetre. Nearly all of the grains were fractured and cut by veinlets of gangue, some of which showed replacement of the chromite while others showed none. Also, nearly all grains contained numerous small inclusions of gangue which were probably due to replacement of the chromite by gangue; in some places this replacement had proceeded to such an extent that all that remained of the chromite were numerous, tiny, ragged remnants in gangue.

Analysis: The following analyses were carried out:

Ore	Cr_2O_3 - %	FeO - %
Low-grade ore sample:	1.31	10.76
High-grade ore sample:	41.01 (28% Cr)	13.82 (10.75% Fe)

Purpose of investigation: To produce commercial grade chromite concentrates.

Methods of concentration: Grinding the ore to minus 35 mesh followed by jigging and/or tabling.

Summary of results and conclusions: Jigging and tabling combined, or tabling alone of the high-grade ore produced the following chromite concentrates:

Results from high-grade ore

Concentrates produced from high-grade chromite ore	Assay - %			Cr/Fe ratio	Distn - %	
	Cr_2O_3	Cr	Fe		Cr	Fe
Chromite conc from jigging and tabling	53.40	36.42	13.18	2.77:1	79.3	66.5
Chromite conc from tabling alone	53.14	36.36	13.30	2.73:1	81.4	75.8

The chromite concentrates obtained from the high-grade ore had satisfactory chromium grades and an acceptable Cr:Fe ratio for ferrochromium production. The other components, such as SiO_2, Al_2O_3, MgO, etc. which are also essential characteristics of the metallurgical grade concentrate, were not assayed.

Results from low-grade ore: As the chromium grade of the low-grade ore was very low (1.31% Cr_2O_3) and well below expectation, the results of one test showed that a commercial grade chromite concentrate cannot be produced from the low-grade ore sample.

SUMMARY OF ORE DRESSING INVESTIGATIONS ON CHROMITE DEPOSITS OF ONTARIO

Ore Dressing Investigation No. 425, September 3, 1931

THE CONCENTRATION OF CHROMITE ORE FROM OBONGA LAKE*, ONTARIO

by

A. K. ANDERSON

Ore samples tested: Two samples, Lot 1 and Lot 2, were tested.

Mineralogy: Lot No. 1, vein material, consisted of a chlorite schist carrying some magnetite crystals and black grains scattered through the rock which could not be ascertained by microscopic methods but did not look like typical chromite. Part of Lot No. 1 and 2, consisted of extremely altered pyroxenite or peridotite rock almost completelv transformed into talcose rock. Through this, grains of magnetite or chromite were scattered in limited amounts. Their average size was not much above 1/6 mm.

Analysis: Lot 1 assayed 4.44% Cr_2O_3 and Lot 2 1.89% Cr_2O_3.

Purpose of investigation: To produce a chromite concentrate of 40%-48 Cr_2O_3.

Methods of concentration: Tabling and flotation.

Summary of results and conclusions: As the chromium content in this sample was very low, the concentrates of the requested grades could not be produced.

Ore Dressing Report No. 426, 1932

THE CONCENTRATION OF CHROMITE FROM LAKE SHEBANDOWAN, ONTARIO

AUTHOR NOT RECORDED.

*Collins area.

Ore sample tested: About 120 lb of chrome-bearing rock was received on November 3, 1931.

Mineralogy: The ore was greenish grey intermediate or basic schist containing minute crystals of chromite and possibly magnetite.

Analysis: Sample contained 16.85% Cr_2O_3. Other components were not determined.

Purpose of investigation: To make a commercial grade chromite concentrate.

Method of concentration: Tabling of ground and sized ore.

Summary of results and conclusions: The concentrate obtained from a minus 100-mesh grind assayed 30% Cr_2O_3 with about 67% chromium recovery. The Cr:Fe ratio was about 1:1. It was concluded that a higher grade concentrate could not be expected and that thus no commercial grade concentrate could be obtained from this ore sample.

Ore Dressing Investigation No. 712, November 9, 1937

"CHROMITE ORE FROM THE CHROMIUM MINING AND SMELTING CORPORATION LIMITED, OBONGA LAKE, ONTARIO"
by
A. K. ANDERSON

Ore samples tested: Four ore samples were investigated.

1. Ore of Type A - 200 lb
2. Ore of Type B - 200 lb
3. Combined 1 and 2
4. Ore of Type B Coarse

Mineralogy: Type A ore consists of gangue, chromite, and a very small quantity of sparsely disseminated hematite. If magnetite was present, it was not possible to differentiate it from the chromite.

The chromite was coarse grained. It has been somewhat coarsely shattered and appeared as large angular fragments in the gangue. The chromite itself contained varying quantities of minute inclusions of gangue material, possibly ferromagnesian minerals. The sizes of these inclusions ranged from a maximum of about 25 microns down to the most minute size visible under high powers of magnification, the average size being somewhere in the neighbourhood of 1600 mesh (9 microns). As it cannot be hoped to free these inclusions from the chromite, measurements were carried out to determine the size of the composite chrome grains, i.e., chromite with inclusions.

Type B ore was quite different in character from Type A. The constituents were gangue and chromite. Any magnetite present was undifferentiated, and pyrite was extremely rare.

The chrome grains were largely equidimensional and showed rough crystal outlines, which have apparently been somewhat rounded and in places have been indented and slightly replaced by gangue. All of the larger grains exhibited a border zone, slightly lighter in shade than the central cores. This zone was consistently about 25 microns in width and thus, grains that were less than about 50 microns in diameter did not show the darker cores. This zone was probably due to slightly different composition of the chromite and was regarded as representing a type of reaction shell.

In some places, gangue inclusions like those so prominent in Type A, were common, but in general this chromite was notably free from them.

The mineralogy of ore Type B Coarse, was the same as that of Type A.

Analysis: A and B type ores assayed:

	Type A, %	Type B, %
Cr_2O_3	16.40	14.48
Fe	9.79	11.27
CaO	3.35	1.55
MgO	24.27	23.34
S	0.16	0.06
SiO_2	22.08	25.80

Purpose of investigation: To obtain a chromite concentrate of highest chromium grade with maximum chromium recovery.

Methods of concentration: Tabling (on laboratory and pilot plant scale) of sized feed and rejection of gangue minerals by flotation.

Summary of results and conclusions: A chromite concentrate of about 42% C_2O_3 grade with about 70% Cr_2O_3 recovery was obtained by the laboratory testwork.

The chromite concentrate from the pilot plant operation had the same grade with a recovery of about 78% of the chromium in the ore.

Ore Dressing Investigation No. 733, June 1938

CHROMITE FROM THE CHROMIUM MINING AND SMELTING CORPORATION LIMITED, COLLINS, ONTARIO

AUTHOR NOT RECORDED

Ore sample tested: A large pilot plant-size sample was investigated.

Mineralogy: Not reported.

Analysis: The average assays were:

8.87% Cr_2O_3

12.94% Fe

Purpose of investigation: To continue a pilot plant investigation similar to that of Investigation No. 712 and also to provide information for design of a concentrator.

Methods of concentration: Jigging and tabling.

Summary of results and conclusions: An average grade concentrate assaying 28% Cr_2O_3 was produced with 83.4% Cr_2O_3 recovery. Sufficient data for a mill design was obtained.

Ore Dressing Investigation of November 15, 1937

CONCENTRATION OF CHROMITE FROM COLLINS, ONTARIO

by

A. K. ANDERSON

Ore samples tested: Sample A (52 lb) and Sample G (73 lb) were tested in this preliminary laboratory investigation.

Mineralogy: Not reported.

Analysis: Sample A contained 11.20% Cr_2O_3 and Sample G 3.43% Cr_2O_3.

Purpose of investigation: The company was considering the direct smelting of the ore. This investigation was undertaken to determine if a portion of the ore or gangue, low in chromium could be discarded prior to smelting.

Methods of concentration: Crushing to minus 14 mesh, sizing and tabling of size fractions.

Summary of results and conclusions:

Products	Sample A Cr_2O_3 - %		Sample G Cr_2O_3 - %	
	Assay	Distn	Assay	Distn
Comb concentrates	21.66	89.1	6.65	87.0
Comb tailings	2.26	10.9	0.81	13.0

It was decided to conduct a larger scale test.

Ore Dressing Report of August 30, 1939

CHROMITE SAMPLES FROM CLAIMS ON LAKE ABITIBI, SUBMITTED BY L. W. COON, HAILEYBURY, ONTARIO

AUTHOR NOT RECORDED

Ore samples tested: Four samples weighing 2 to 3 pounds each were tested.

Mineralogy: Not reported.

Analysis: The four samples contained: 4.30% , 1.41% 0.21% and 0.17% Cr, respectively. Iron was determined on Sample No.1 only and assayed 9.38% Fe.

Purpose of investigation: Not stated in the report but, based on the product obtained, it appears that the concentration of chromium was the prime concern.

Methods of concentration: Tabling and jigging of 35-mesh ground ore.

Summary of results and conclusions: The highest grade concentrate obtained by the methods applied assayed 20.3% Cr and 23.73% Fe with 21.2% Cr and 13.1% Fe recovery.

SUMMARIES OF ORE DRESSING INVESTIGATIONS ON CHROMITE DEPOSITS OF QUEBEC

Ore Dressing Test Report No. 70, 1918

CONCENTRATION OF CHROMITE ORE SUBMITTED BY DOMINION MINES AND QUARRIES LTD., BLACK LAKE, QUEBEC

AUTHOR NOT RECORDED

Ore sample tested: 236.5 lb of chromite ore was investigated.

Mineralogy: Not reported.

Analysis: This sample assayed 13.16% Cr_2O_3.

Purpose of investigation: To determine the grade of concentrates that could be expected and the possible recovery of the chromite values.

Method of concentration: Tabling (Overstrom table).

Summary of results and conclusions: The concentrate produced assayed 42.53% Cr_2O_3 with 59.5% recovery. The middlings assayed 24.61% Cr_2O_3 and contained 17.0% of the Cr_2O_3 in the ore.

It was concluded from these results that a chromium concentrate of 42.5% Cr_2O_3 with 70% recovery could be expected from this ore by tabling after the ore is crushed to minus 35 mesh.

Ore Dressing Test Report No. 71, 1918

CONCENTRATION OF CHROMITE ORE SUBMITTED BY MUTUAL CHEMICAL CO., BLACK LAKE, QUEBEC

AUTHOR NOT RECORDED

Ore sample tested: 158.5 lb sample of chrome ore.

Mineralogy: Not reported.

Analysis: 20.55% Cr_2O_3.

Purpose of investigation: To determine the grade of concentrates that could be obtained and the recovery of chromite values that could be expected.

Method of concentration: Tabling (Overstrom table).

Summary of results and conclusions: The concentrate produced assayed 47.18% Cr_2O_3 with 61.5% recovery. The middlings assayed 30.52% Cr_2O_3 and contained 18.73% of the chromium in the ore.

It was concluded that a concentrate of 47 to 48% Cr_2O_3 grade with 75 to 80% chromium recovery can be expected from this ore. At a 42% Cr_2O_3 grade the recovery would range between 80 and 85% of the Cr_2O_3 in the ore.

Ore Dressing Report No. 72, 1918

SMALL SCALE CONCENTRATION TESTS ON CHROME ORE FROM QUEBEC ASBESTOS AND CHROME COMPANY, ST. CYR, QUEBEC

AUTHOR NOT RECORDED

Ore samples tested: Three samples (A, B and C) were investigated.

Mineralogy: Not reported.

Analysis: Sample A - 19.7% Cr_2O_3. Sample B - 18% Cr_2O_3 Sample C - 26.28% Cr_2O_3.

Purpose of investigation: To produce chromite concentrates with a grade of about 50% Cr_2O_3.

Method of concentration: Tabling of crushed ore.

Summary of results and conclusions: At 30 mesh the following table concentrates and middlings were obtained.

Ore Sample	Concentrate		Middlings		Comb Conc and Midds	
	Cr_2O_3 - %		Cr_2O_3 - %		Cr_2O_3 - %	
	Assay	Distn	Assay	Distn	Assay	Distn
A	48.61	54.6	33.30	38.6	40.80	93.2
B	47.87	40.0	30.60	47.1	36.6	87.1
C	51.70	58.7	37.40	34.1	45.1	92.8

Other components were not reported.

Ore Dressing Report No. 73, 1918

LARGE SCALE CONCENTRATION TESTS ON CHROME ORE FROM QUEBEC ASBESTOS AND CHROME COMPANY, ST. CYR, QUEBEC

AUTHOR NOT RECORDED

Ore sample tested: 66,769 lb (dry) of chromium-asbestos ore was split into two lots.

Mineralogy: Not reported.

Analysis: 31.38% Cr_2O_3 (total sample).

Purpose of investigation: To make 46% to 48% Cr_2O_3 concentrate from one lot and 50% Cr_2O_3 concentrate from the other.

Methods of concentration: Both lots were ground to minus 24 mesh and separated into sand and slime fractions. Sands were tabled on an Overstrom sand table and slimes on a Deister slime table.

Summary of results and conclusion of pilot plant investigation:

At 24-mesh grind the following concentrates were produced:

Lot No	Sand Conc % Cr_2O_3		Slime Conc % Cr_2O_3	
	Assay	Distn	Assay	Distn
1	48.74	66.0	46.73	12.4
2	50.53	42.9	47.56	9.5

Ore Dressing Test Report No. 110, March 3, 1919

CONCENTRATION OF CHROMITE ORE* SUBMITTED BY DR. FERIER OF CANADIAN MUNITION RESOURCES COMMISSION

AUTHOR NOT RECORDED

Ore sample tested: 420 lb of chrome ore.

Mineralogy: Chromite was found to be finely cyrstalline. The gangue consisted of serpentine; iron-pyrites were also present in the ore.

* From Black Lake area.

Analysis: The ore sample assayed 10.7% Cr_2O_3. Other components were not determined.

Purpose of investigation: To produce chromite concentrate of 45 to 50% Cr_2O_3 grade.

Method of concentration: Tabling at various grinds.

Summary of results and conclusions: At 50, mesh tabling produced a chromite concentrate of 45.7% Cr_2O_3 grade with 72.7% Cr_2O_3 recovery. Unusually high sulphur content (1.8%) was present in the chromite concentrate.

Ore Dressing Report of July 20, 1938

TABLE CONCENTRATION TESTS ON A SAMPLE OF MILL TAILING FROM THE PROPERTY OF THE ASBESTOS CORPORATION AT THETFORD, QUEBEC
by
J. D. JOHNSTON

Ore sample tested: Sample of about 100 lb of mill tailing (minus ½ inch) was investigated.

Mineralogy: Not reported.

Analysis: The sample contained 0.42% Cr_2O_3 and 0.22% Ni.

Purpose of investigation: To produce a chromite concentrate suitable for production of ferrochrome with at least 2:1 chromium to iron ratio.

Methods of concentration: Tabling and low-intensity magnetic separation.

Summary of results and conclusions: The following products were obtained:

	Cr_2O_3 - %	Ni - %	Fe - %	Cr:Fe
Magnetic conc	4.53	0.42	45.36	
Non-mag. conc	13.37	0.19	9.53	1:1
Gravity tailing	1.09	0.18		

Results of the investigations were unsatisfactory.

Ore Dressing Report of January 10, 1939

THE MAGNETIC CONCENTRATION OF CHROMITE-NICKEL-MAGNETITE IN ASBESTOS TAILING FROM THE CANADIAN JOHNS-MANVILLE COMPANY LIMITED, ASBESTOS, QUEBEC

by
W. R. McCELLAND

Ore sample tested: Six hundred bags of the company's asbestos mill tailings were used for this investigation.

Mineralogy: Not reported.

Analysis: The composite sample contained: 0.33 Cr, 7.5% Fe and 0.23% Ni.

Purpose of investigation: To produce a bulk chromium, iron and nickel concentrate with maximum recoveries.

Methods of concentration: Low-intensity magnetic separation and tabling.

Summary of results and conclusions: The best concentrate obtained assayed 0.95% Cr, 60.07% Fe and 0.69% Ni with 13.1, 29.6 and 15.7% recoveries respectively.

Ore Dressing Investigation No. 1068, July 15, 1940

CONCENTRATION OF CHROMITE FROM THE BELANGER CHROME MINE, THETFORD MINES, QUEBEC

by
J. F. KOSTASH

Ore samples tested: Five ore samples totalling 2,529 pounds were investigated.

Mineralogy: The gangue was the same in all samples and was composed of soft, dull dark greenish grey material which probably represented a serpentine rock.

Chromite was the only abundant metallic mineral. It occurred in gangue as granular masses and disseminated grains,

coarse to fine in size but with the coarser sizes predominating. Although some grains were comparatively dense and homogeneous, most grains were fractured and veined with gangue and almost always contained numerous minute inclusions of gangue. Replacement of chromite by gangue was quite prominent, and, in some places had proceeded to such an extent that all that remained of the chromite were numerous tiny, raggy remnants in gangue. The numerous inclusions of gangue in chromite mentioned above were probably chiefly due to such replacement.

Magnetite and pyrite were present in two or three samples in almost negligible amounts. The former occurred as narrow veinlets and margins in and around the grains of chromite; the latter as rare, small, irregular grains in gangue.

Analysis: The constituents determined in samples were as follows:

Sample No.	Weight of sample, pounds	Cr_2O_3 %	Fe %
1	710	11.43	6.37
2	1,296	8.42	6.31
3	120	50.97	12.76
4	320	14.13	6.31
5	81	43.70	10.13

Purpose of investigation: To produce a commercial grade chromite concentrate.

Methods of concentration: Tabling, jigging and low-intensity magnetic separation. Testwork was carried out on samples No. 1 2 and 4 combined. Tests were not carried out on sample No. 3 or No. 5.

Summary of results and conclusions: After grinding the combined ore samples No. 1, 2 and 4 to minus 28 mesh, the table concentrate produced assayed 49.20% Cr_2O_3 with 51.0% recovery. About 34% of chromium in the ore was left in middlings which would require a much finer grind to increase the chromium recovery.

Ore Dressing Investigation No. 895, September 5, 1940

CHEMICAL ANALYSIS AND GRAVITY SEPARATION TESTS ON SAMPLES OF CHROMITE ORE*, QUEBEC

by

M. H. HAYCOCK

Ore samples tested: Three ore samples, designated as No. 86, No. 90, and No. 93, were investigated.

Mineralogy: Not reported.

Analysis: The following constituents were determined:

Sample	Percent			
	Cr_2O_3	Fe	SiO_2	Al_2O_3
Sample No. 86/40	48.40	10.63	8.17	9.63
Sample No. 90/40	43.03	9.58	11.23	6.15
Sample No. 93/40	27.07	8.40	21.60	N.A.

Purpose of investigation: To analyze the samples and to separate as pure a chromite mineral as possible from Sample No. 93/40 and then to analyze the product.

Methods of concentration: Grinding to minus 48 mesh, heavy liquid separation and low-intensity magnetic separation of the size fractions.

Summary of results and conclusions: Sample of practically pure chromite assayed: 52.58% Cr_2O_3 (36.0% Cr), 9.57% Al_2O_3, 12.98% MgO, 0.40% CaO, 18.16% Fe. The Cr:Fe ratio, therefore,

*From Sherbrooke area.

was approximately 2:1. It was concluded that a satisfactory product and good recovery could be made at minus 48 mesh.

Ore Dressing Investigation No. 865, January 18, 1941

CONCENTRATION OF CHROMITE FROM THE STERRETT PROPERTY, RICHMOND, QUEBEC
by
A. K. ANDERSON

Ore sample tested: About 300 lb sample from the Sterrett property.

Mineralogy:

Gangue: The gangue consisted of two constituents, serpentine and carbonate. The former predominates in quantity and is largely the irregular granular type. Both minerals vein the chromite.

Chromite: Chromite was the only abundant metallic mineral. It occurred as small to large disseminated grains and as coarsely granular masses of considerable size. The disseminated grains varied in size from a fraction of a millimetre to several millimetres, and contained inclusions of gangue. In some cases these inclusions were concentrated around their outer borders only while in others they occurred well within the grains. The massive chromite showed considerable fracturing and contained veinlets of dolomite and serpentine. In some cases replacement of the chromite by gangue was prominent and locally this had proceeded to such an extent that all that remained of the chromite were numerous small remnants in the gangue.

Magnetite: The quantity of magnetite was very small. Rare grains of sizes similar to that of the chromite occurred

with the latter mineral, and numerous minute grains of magnetite occurred throughout the serpentine.

Pyrite: Rare small grains of pyrite occurred in the gangue.

Analysis: The sample analyzed 31.22% Cr_2O_3 (21.36% Cr), 11.67% FeO (9.07% Fe).

Purpose of investigation: To determine the grade of concentrate and its suitability for various industrial applications.

Methods of concentration: Jigging of ¼-in. crushed ore and tabling of sized jig tailings.

Summary of results and conclusions: Combined concentrates from jigging and tabling contained 63% of the chromium in the ore with a combined grade of 45.58% Cr_2O_3 (31.2% Cr) and 10.9% Fe with a Cr:Fe ratio of 2.87;1. As about 27% of the chromium in the ore remained in the table middlings, it was estimated that, when the middlings are circulated on an operating scale, a recovery of about 80% of the chromium from the ore should be obtained.

Ore Dressing Investigation No. 948, January 18, 1941

SINK-AND-FLOAT TESTS ON A SAMPLE OF CHROMITE ORE FROM THE STERRETT MINE AT ST. CYR, RICHMOND COUNTY, QUEBEC

by

J. D. JOHNSTON

Ore sample tested: About 600 lb of chromite ore.

Mineralogy: Same as in Investigation No. 865.

Analysis: The following constituents were determined: 11.60% Cr_2O_3 and 9.22% FeO.

Purpose of investigation: To find out whether or not a substantial proportion of the ore could be rejected as low-grade material leaving a high-grade concentrate, or "sink", for further treatment.

Method of concentration: Preconcentration was done by the Huntington-Heberdein Sink-and-Float process by testing the ore in pails.

Summary of results and conclusions: About 60% of the waste float from the ore was rejected, assaying only 0.42% Cr_2O_3. This waste contained 2.1% of the chromium in the ore. The concentrate (sink) comprising about 40% of the ore by weight, contained 97.86% of the chromium in the ore and assayed 28.11% Cr_2O_3.

Ore Dressing Investigation No. 1051, July 15, 1941

CONCENTRATION OF CHROMITE FROM THE STERRETT PROPERTY, ST. CYR, RICHMOND COUNTY, QUEBEC

by

A. K. ANDERSON

Ore sample tested: 20 tons of chromite ore from Sterrett property.

Mineralogy: This ore was somewhat more disseminated than that investigated and reported in Investigation No. 865, July 15th, 1940. No large porportion of barren gangue was noticed as was evident in the former shipment.

Analysis: The average assays from daily runs were: 18.13% Cr_2O_3 and 7.7% Fe.

Purpose of investigation: To obtain data regarding the grade of the concentrate and chromium recovery, and also to determine a suitable flowsheet for erection of a concentrator.

Methods of concentration: Grinding to minus 14 mesh, sizing into sands and fines, jigging of sands and tabling of fine fractions.

Summary of results and conclusions: A combined concentrate with about 48% Cr_2O_3 grade and about 90% chromium recovery was produced by this pilot plant operation. The iron content and other constituents of the concentrate were not analyzed.

Ore Dressing Investigation No. 1090, September 11, 1941

CONCENTRATION OF CHANNEL SAMPLES REPRESENTING
THE ORE BODIES OF CHROMITE LIMITED
AT ST. CYR, QUEBEC
by
A. K. ANDERSON

Ore samples tested: Eighty samples, weighing approximately 1,162 lb were taken from all parts of the property and mixed in one composite sample.

Mineralogy: Not reported.

Analysis: The composite sample assayed: 29.23% Cr_2O_3, 8.40% Fe.

Purpose of investigation: To establish the chrome to iron ratio of the concentrates obtainable from a representative sample.

Methods of concentration: Grinding of the ore to minus 14 mesh, sizing and tabling of sized fractions.

Summary of results and conclusions: The combined chromite concentrate obtained assayed 48.54% Cr_2O_3, 15.09% Fe (11.70% Fe), 15.06% Al_2O_3, 3.31% SiO_2, Trace CaO, 14.94% MgO, 0.03% S, Trace P, 0.26% MnO, 0.20% NiO, 2.66% H_2O.

The chrome to iron ratio was 2.84:1. The middlings

produced, with average assays of about 29% Cr_2O_3, were not included in the chromite concentrate.

Ore Dressing Investigation No. 1155, February 3, 1942

GRAVITY CONCENTRATION OF CHROMITE ORE
FROM H. BRUCE FLETCHER, SHERBROOKE, QUEBEC
by
A. K. ANDERSON

Ore sample tested: About 2,730 lb of chromite ore from Orford Township.

Mineralogy: Not reported.

Analysis: Composite sample assayed: 34.17% Cr_2O_3 (23.2% Cr) 9.78% Fe, Cr:Fe = 2.38:1.

Purpose of investigation: To determine if this sample was suitable for the mill flowsheet of Chromite Limited at St. Cyr.

Method of concentration: Tabling of 14-mesh sized ore.

Summary of results and conclusions: The following combined chromite concentrate was produced:

Chromite Concentrate

Assay %			Distn %	
Cr_2O_3	or Cr	Fe	Cr_2O_3	Cr:Fe ratio
55.49	37.7	11.64	87.3	3.26:1

This ore, therefore, produced a high-grade chromite concentrate with a favourable chromium to iron ratio.

Ore Dressing Investigation No. 1301, September 18, 1942

RECOVERY OF CHROME-NICKEL-IRON CONCENTRATE
FROM ASBESTOS TAILING SUPPLIED BY THE
CANADIAN JOHNS-MANVILLE COMPANY,
ASBESTOS, QUEBEC
by
J. D. JOHNSTON

Ore samples tested: Three carloads of tailings, 73 tons, 35 tons and 33 tons, were used for this investigation.

Mineralogy: The material received was all minus 16 mesh. It consisted chiefly of serpentine, both crystalline and fibrous. It also carried about 6 to 7 % of iron in the form of magnetite, as well as small amounts of nickel and chromium.

Analysis: Samples taken from the feeder during daily runs assayed between 6.36 and 6.91% Fe, 0.20 and 0.22% Ni and about 0.53% Cr_2O_3.

Purpose of investigation: To produce an iron-nickel concentrate with maximum Fe-Ni recovery and a minimum chrome content.

Methods of concentration: Low-intensity magnetic concentration and tabling of the original and deslimed tailings.

Summary of results and conclusions: The iron-nickel concentrates obtained assayed: 50.29 to 59.7% Fe, 0.46 to 0.62% Ni and 0.80 to 1.73% Cr_2O_3. The recoveries in the concentrates were: 25.0% to 36.69% Fe, 7.39 to 13.15% Ni and 4.66 to 15.70% Cr_2O_3.

REFERENCES

1. Sully, A.H., Chromium; 1954.

2. Fisher, L.W., Chromite, its mineral and chemical composition; Amer. Min., v. 14; 1929.

3. Stevens, R.E., Composition of some chromite of the western hemisphere; Amer. Min. v. 29; 1944.

4. Canadian Minerals Year Books 1970, 1972, 1973 and 1974, Mineral Resources Branch, Dept. of Energy, Mines and Resources, Ottawa.

5. Davies, L.F., Chromite deposits of southeastern Manitoba; Can. Min. J.; April, 1958.

6. Garfield, V.R., Chrome ore sources and availability with emphasis on metallurgical use - Part I and Part II; I&SM; October, 1975 and November, 1975, respectively.

7. Downes, K.W. and Morgan, D.W., The utilization of low grade domestic chromite; research report no. MD79, Mines Branch, Ottawa; October 15, 1950.

8. Raicevic, D., Evaluation of processes for recovery of chromium from Bird River chromite deposit; report MRP/MSL (CF) 75-8 (IR), Mineral Sciences Laboratories, CANMET, Department of Energy, Mines and Resources, Ottawa, Canada; July, 1975.

9. Qayyum, M.A. and Reeve, D.E., Reduction of chromites to sponge ferrochromium in methane-hydrogen mixtures, report MRP/ERL 75-56 (J) Energy Research Laboratories, CANMET; May 1975.

10. Johnson, R.F., Chromium, Mineral Development Sector, Minerals and Metals Division, Department of Energy, Mines and Resources, Ottawa; May 7, 1975.

11. Pickles C.A., Wang, S.S., MacLean A. and Sergsworth, R.S., An investigation of a new technique for the production of ferro-chromium alloys; paper presented at the 15th annual conference of Metallurgists in Ottawa; August 22-26, 1976.

12. MD and IR investigations recorded in "Contents".