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CHROMITE

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GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

Indira Bhavan, Civil Lines,
NAGPUR – 440 001

PHONE/FAX NO. (0712) 2565471
PBX: (0712) 2562649, 2560544, 2560648
E-MAIL: cme@ibm.gov.in
Website: www.ibm.gov.in

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6 Chromite

Chromite is the single commercially viable ore of chromium (Cr) which is chemically known as iron chromium oxide ($FeCr_2O_4$). The properties of chromium that make it most versatile and indispensable are its resistance to corrosion, oxidation, wear & galling and enhancement of hardenability. Chromium is an important alloying metal in ferrous metallurgy, perhaps next only to manganese. It is used in the manufacture of alloys along with other metals, such as nickel, cobalt, molybdenum, copper, titanium, zirconium, vanadium, columbium and selenium. Chromium is traded primarily as chromium ore or as an alloy of chromium and iron, namely, ferrochrome or charge chrome. The name of the element is derived from the Greek word '*chrôma'*, meaning colour, because many of its compounds are intensely coloured. It is a steely-grey, lustrous, hard and brittle metal which takes high polish, resists tarnishing and has a high melting point.

RESERVES/RESOURCES

As per NMI database based on UNFC system, the total reserves/resources of chromite in the country as on 1.4.2020 has been estimated at 332 million tonnes with 79 million tonnes as "Reserves" (24%) and 253 million tonnes as "Remaining Resources" (76%). More than 96% resources of chromite are located in Odisha, mostly in Jajpur, Kendujhar and Dhenkanal districts. Minor deposits are scattered over Manipur, Nagaland, Karnataka, Jharkhand, Maharashtra, Tamil Nadu, Telangana and Andhra Pradesh. Gradewise, Charge chrome grade accounts for 28% resources followed by Beneficiable grade (24%), Ferrochrome grade (17%), Refractory grade (16%) and Unclassified grade (10%). Low, Others, and Not-known grades together account for remaining 4% (Table- 1).

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on Exploration & Development under "General Reviews".

PRODUCTION AND STOCKS

The production of chromite was 2,864 thousand tonnes during 2020-21 which decreased by 27% as compared to 3,929 thousand tonnes in the previous year. The number of reporting mines were 23 in 2020-21 as compared to 22 in the preceding year. The share of Public Sector in total production was 39% in 2020-21 as compared to 21% in the previous year. About 23% of the total production was reported from captive mines in the current year as compared to 20% in the previous year.

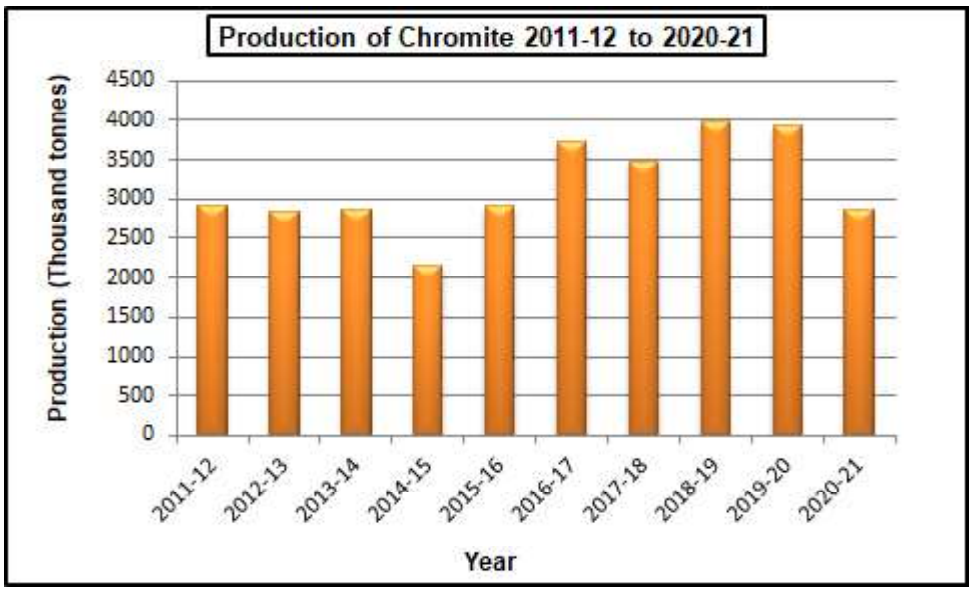

Table – 1 : Reserves/Resources of Chromite as on 1.4.2020 (P)
(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved STD111	Probable		Total (A)	Feasibility STD211	Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	
		STD121	STD122			STD221	STD222						
All India : Total	**40635**	**15229**	**22672**	**78535**	**52696**	**10545**	**44395**	**1630**	**53008**	**70440**	**20435**	**253150**	**331685**
By Grades													
Refractory	6830	8592	11241	26663	14981	2902	3053	70	430	4238	-	25675	52338
Charge chrome	21426	3130	7340	31896	20723	4651	5205	140	26395	4699	-	61815	93711
Low	4480	-	-	4480	2545	27	-	-	-	3713	-	6284	10764
Beneficiable	7515	3507	4091	15113	11365	2964	14885	1335	14059	20805	-	65413	80526
Ferrochrome	-	-	-	-	1519	-	21083	75	11801	22951	-	57429	57429
Others	-	-	-	-	-	-	-	-	15	-	-	15	15
Unclassified	385	-	-	384	1562	-	169	9	308	13856	19889	35793	36177
Not-known	-	-	-	-	1	1	1	-	-	177	546	725	725
By States													
Andhra Pradesh	-	-	-	-	-	-	-	-	-	-	-	-	-
Jharkhand	-	-	-	-	-	-	-	15	98	623	-	736	736
Karnataka	176	340	323	499	474	378	54	-	20	392	-	1317	1817
Maharashtra	5	48	23	5	5	-	5	43	67	418	-	533	538
Manipur	-	-	-	-	3	21	52	-	504	6077	-	6657	6657
Nagaland	-	-	-	-	-	-	-	-	-	3200	-	3200	3200
Odisha	40453	15229	22349	78031	52215	10146	44289	1565	52304	59284	20435	240237	318269
Tamil Nadu	-	-	-	-	-	-	-	7	-	276	-	282	282
Telangana	-	-	-	-	-	-	-	-	15	171	-	186	186

Figures rounded off

Odisha continued to be the sole producing State for chromite, accounting for the entire production during 2020-21 and nil production was reported from Karnataka and Maharashtra.

Gradewise analysis of production during 2020-21 reveals that about 47% of the total production of chromite accounted for 40% – 52% Cr_2O_3 (lumps & fines) followed by 30% accounted for below 40% Cr_2O_3 (lumps & fines) grade and 21% accounted for 52% & above Cr_2O_3 fines grade.

Mine-head closing stocks of chromite in 2020-21 were 2,799 thousand tonnes as compared to 2,411 thousand tonnes in 2019-20.

The average daily employment of labour in chromite mines during 2020-21 was 4,248 as against 5,845 in the previous year (Tables-2 to 8).

Table – 2 : Principal Producers of Chromite, 2020-21

Name & address of producer	Location of mine	
	State	District
Tata Steel Ltd, Bombay House, 24, Homi Mody Street, Fort, Mumbai – 400 001, Maharashtra.	Odisha	Jajpur
The Odisha Mining Corporation Ltd, 'OMC House', Unit 5, Post Box No. 34, Bhubaneswar – 751 001, Odisha.	Odisha	Jajpur Keonijhar
Indian Metals & Ferro Alloys Ltd, IMFA Building, Bomikhal, P.O.-Rasulgarh, Bhubaneswar – 751 010, Odisha.	Odisha	Jajpur,
Balasore Alloys Ltd, Balgopalpur, Dist. Balasore - 756 020, Odisha.	Odisha	Jajpur
Ferro Alloys Corporation Ltd., Charge Chrome Plant, D.P.Nagar, Randia, Bhadrak-756135 Odisha.	Odisha	Jajpur

Table – 3 : Production of Chromite, 2018-19 to 2020-21
(By States)

(Qty in tonnes; Value in ₹'000)

State	2018-19		2019-20		2020-21 (P)	
	Qty	Value	Qty	Value	Qty	Value
India	**3970691**	**36850747**	**3929260**	**32134395**	**2863869**	**22910242**
Maharashtra	++	++	-	-	-	-
Odisha	3970691	36850747	3929260	32134395	2863869	22910242

Table – 4 : Gradewise Production of Chromite, 2019-20 (By Sectors/States/Districts)

(Qty in tonnes; Value in ₹'000)

State/ District	No. of mines	Production by Grades : Cr_2O_3 Content								
		Below 40%		40—52%		52% & Above			Total	
		Lumps	Fines	Lumps	Fines	Lumps	Fines		Quantity	Value
India	**22**	**73044**	**830291**	**94838**	**1078617**	**-**	**1625150**	**227320**	**3929260**	**32134395**
Public sector	9	320	314465	238	255292	-	233999	5409	809723	5670300
Private sector	13	72724	515826	94600	823325	-	1391151	221911	3119537	26464095
Karnataka	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hassan	2*	-	-	-	-	-	-	-	-	-
Odisha	**20**	**73044**	**830291**	**94838**	**1078617**	**-**	**1625150**	**227320**	**3929260**	**32134395**
Dhenkanal	3*	-	-	-	-	-	-	-	-	-
Jajpur	14	72724	830199	94600	1078617	-	1625150	227320	3928610	32130371
Keonjhar	3	320	92	238	-	-	-	-	650	4024

* *Only labour reported*

Table – 5 : Gradewise Production of Chromite, 2020-21(P) (By Sectors/States/Districts)

(Qty in tonnes; Value in ₹'000)

State/ District	No. of mines	Production by Grades : Cr_2O_3 Content								
		Below 40%		40—52%		52% & Above		Concentrates	Total	
		Lumps	Fines	Lumps	Fines	Lumps	Fines		Quantity	Value
India	**23**	**81597**	**781935**	**131954**	**1219795**	**-**	**615393**	**33195**	**2863869**	**22910242**
Public sector	8	-	182082	-	732759	-	208901	-	1123742	11481303
Private sector	15	81597	599853	131954	487036	-	406492	33195	1740127	11428939
Karnataka	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Hassan	2*	-	-	-	-	-	-	-	-	-
Odisha	**21**	**81597**	**781935**	**131954**	**1219795**	**-**	**615393**	**33195**	**2863869**	**22910242**
Dhenkanal	3*	-	-	-	-	-	-	-	-	-
Jajpur	15	81597	781935	131954	1219795	-	615393	33195	2863869	22910242
Kendujhar	3*	-	-	-	-	-	-	-	-	-

* *Only labour reported.*

Table – 6 : Production of Chromite, 2019-20 and 2020-21 (By Frequency Groups)

(Qty in tonnes)

Production group	No. of mines		Production for the group		Percentage to total production		Cumulative percentage	
	2019-20	2020-21 (P)	2019-20	2020-21 (P)	2019-20	2020-21 (P)	2019-20	2020-21 (P)
Total	**22**	**23**	**3929260**	**2863869**	**100.00**	**100.00**	**-**	**-**
Up to 10000	12	13	5870	-	0.15	-	0.15	-
10001—100000	2	4	127064	266480	3.23	9.30	3.38	9.3
100001 — 200000	3	2	449445	307980	11.44	10.75	14.82	20.05
200001 — 300000	1	2	240907	521820	6.13	18.22	20.95	38.27
300001 and above	4	2	3105974	1767589	79.05	61.73	100.00	100

Table – 7 : Mine-head Closing Stocks of Chromite, 2019-20 (By States/Grades)

(In tonnes)

State	Stocks by Grades: Cr_2O_3 Content						Concentrates	Total Quantity
	Below 40%		40—52 %		52% and above			
	Lumps	Fines	Lumps	Fines	Lumps	Fines		
India	**18065**	**1711225**	**12132**	**143057**	**285**	**503141**	**22971**	**2410876**
Karnataka	834	-	-	303	-	-	-	1137
Odisha	17231	1711225	12132	142754	285	503141	22971	2409739

Table – 8 : Mine-head Closing Stocks of Chromite, 2020-21 (By States/Grades)

(In tonnes)

State	Stocks by Grades: Cr_2O_3 Content						Concentrates	Total Quantity
	Below 40%		40—52%		52% and above			
	Lumps	Fines	Lumps	Fines	Lumps	Fines		
India	**27130**	**1898469**	**11300**	**590351**	**285**	**244964**	**26814**	**2799313**
Karnataka	1038	-	-	303	-	-	-	1341
Odisha	26092	1898469	11300	590048	285	244964	26814	2797972

MINING & TRANSPORT

At present, mining operations for chromite are restricted in the Sukinda ultramafic belt, in the Baula Nausahi chromite belt in Odisha and in Hassan district of Karnataka. The method of exploitation of chromite in the areas includes both opencast and underground mining. Chromite outcrops generally are under overburden cover of 3 to 9 m. The overburden is generally soft, consists of aluminous laterite, murrum and laterite except in areas near the base of the Mahagiri Hill. The ore extracted from Kathpal mine and from all the mines in the Baula Nausahi belt is hard and massive. In all other mines, the ore occurs as friable and powdery.

The excavation of overburden in opencast mines is done by digging with shovels. The overburden generated is then loaded and transported by trucks & dumpers of 10 & 35 tonnes capacity, respectively. In the case of hard overburden of hard murrum or laterite or serpentinised quartzite etc. drilling and blasting procedures are commonly utilised. Drilling, done with jack hammer, and blasting (with appropriate quantity of explosives) loosen the hard formations which enable removal of overburden. The ores are subsequently excavated, sorted and stacked. In manual mines, ore is extracted manually by using pick axe.

South Kaliapani is the main chrome ore mine of Odisha Mining Corp. Ltd. In South Kaliapani mine, nominal blasting is done to loosen the ore which is then transported to stack yard and sorted manually. The ores for dissemination are transported and stacked separately.

Underground mining is practised in four chromite mines viz. , Kathpal mine of M/s FACOR, Nausahi mine of M/s IMFA, Bangur chrome ore mine of Odisha Mining Corp. Ltd and Baula mine of M/s FACOR. The Kathpal chromite mine of M/s FACOR and Mahagiri mine of M/s IMFA are both underground and opencast. Maheswari lode is mined by underground method of mining, whereas Balaji lode is mined by opencast method.

ENVIRONMENT

The major problems associated with chromite mining are the pollution and degradation caused to the environment. The hexavalent chromium, especially in friable ore is the major cause of concern as it is carcinogenic in nature. The hexavalent chromium contamination of water bodies is a major issue that requires concerted attention. Viable treatment methods of pumping water, especially with ferrous sulphate solution, before it being discharged must be rigorously implemented as remedial measure. Ferrous sulphate solution converts the hexavalent into trivalent form which is non-carcinogenic. Incidentally, Mining Research Cell, Indian Bureau of Mines, during 2008-09 undertook a study for attenuation of hexavalent chromium in Sukinda chromite belt by bio-remediation technology which is apparently environment-friendly. This study was a S & T Project undertaken in association with the Utkal University. Air pollution by dumping is another major factor that leads to environmental degradation particularly during dry season.

Chromium contamination of air also comes from emissions of coal-based power plants and industrial chimneys of iron & steel and ferrochrome industries, from spray paintings, chrome baths, refractory industries and mining of chromite & magnesite. In rural areas, chromium in atmosphere rarely exceeds 1mg/cu.m of air, but in towns with major Iron & Steel Industries the levels may be 1,000 times more.

The inhalation of chromium compounds has been associated with the development of cancer among workers in the Chromite Industry. The relative risk for developing lung cancer has been calculated to be as much as 30 times. There is also evidence for an increased risk of developing nasal, pharyngeal, and gastrointestinal carcinomas. Quantitative epidemiological data were obtained by Mancuso and Hueper (1951), who observed increased occurrence of deaths (18.2%; $p<0.01$) from respiratory cancer among chromite workers as compared with 1.2% deaths where controls

were at place. In a follow-up study conducted when more than 50% of the cohort died, the observed incidence for lung cancer deaths had increased to approximately 60%.

Protection of environment has become a major issue presently. The major environmental impacts of mining are (i) deforestation (ii) land damage (iii) water pollution and hydrological damage (iv) air pollution (v) noise pollution (vi) ground vibration and fly rock problem (vii) visual impacts, etc.

Deforestation takes place at actual site of an opencast mines and also where mineral and over-burden dumps are created or where service buildings and roads are built. Land damage takes place in opencast mining while exposing the mineral and in underground mining due to surface subsidence. In addition, land damage also takes place due to siting of surface dump of mineral, overburden refuse tips and formation of tailing dams.

After enforcement of MCDR,1988 there was afforestation in metalliferous mines in order to stabilise and reduce the impact of mining. IBM did play a major role in the restoration of mine environment. Plantation trees and other afforestation efforts to improve the environment were carried out regularly since 1989-90 and are still in practice.

CONSUMPTION

The consumption of chromite decreased by about 2% to 2.72 million tonnes in 2019-20 from 2.77 million tonnes in 2018-19. The most consuming industry was Ferroalloys/Charge chrome Industry (96%). In addition to above, chromite in substantial quantities is also consumed by small-scale ferrochrome units, information for which is scarce. Besides, nominal consumption is reported by Refractory Industry and a negligible amount by others. Data on consumption of chromite from 2017-18 to 2019-20 is furnished in Table- 9.

Table – 9 : Estimated Consumption* of Chromite 2017-18 to 2019-20 (By Industries)

(In tonnes)

Industry	2017-18	2018-19 (R)	2019-20 (P)
All Industries	**2575200(45)**	**2774800(42)**	**2718900(41)**
Chemical	5000	5100	5300
Concentrates (Chrome ore/ chromite)	60700	112100	99900
Ferroalloys (including Charge chrome)	2499200	2639800	2597500
Refractory (including iron & steel)	9300	16700	15800
Others (foundry, calcination)	1000	1100	400

Figures rounded off

** Includes actual reported consumption and/or estimates made wherever required. Owing to Paucity of data, the coverage may not be complete.*

(): Number of plant reported/estimated.

USES

In metallurgy, chromite is mainly used in the manufacture of ferrochrome, silicochrome, charge chrome and chromium metal. Chromium imparts additional strength, hardness and toughness to its alloys. It also shows resistance to corrosion & prevents steel abrasion, reduces oxidation and flow of electricity. Stainless steel, high-speed tool steel and corrosion & heat-resistant steel are some of the important varieties of chromium steel.

Ferrochrome is of two types: (i) high-carbon (containing 4–8% carbon) and (ii) low-carbon (containing up to 2% carbon). The amount of chromium used in steel varies with the purpose. Low chromium steels (less than 5% chromium and small amount of nickel) are used in rails, automobiles, armour plates, armour piercing projectiles, etc. Intermediate chromium steels (3–12% Cr and small amounts of W, Mo or Si) are used in high-speed tools, valves for engines and other equipment requiring resistance to abrasion, corrosion and oxidation. Chromium steels include stainless steel (12–18% Cr) and super-stainless steel (12–30% Cr and 7–10% Ni) which are used for cutlery and cooking utensils, in aircraft & high-speed trains, respectively. Chromium (17%) along with iron (83%) is also used as ferritic stainless steel to manufacture coins.

Chromite is used in Refractory Industry because of its high chemical stability, its high temperature resistance and corrosion resistant properties. Further, its high melting point, ability to withstand sudden temperature changes, its chemically neutral character, moderate thermal expansion and mechanical strength besides abundant availability and reasonable price are added advantages for use in Refractory Industry.

Chromite is used for manufacturing important chromium compounds like chromates and bichromates of sodium and potassium, chromium pigments like chromic oxide green and chromic acid, which in turn, are used in chromium-plating solution.

Chromium is an essential trace element for human health. However, some of its compounds are highly toxic and carcinogenic. Environment concerns have reduced the use of chromite refractories and chromium chemicals.

SUBSTITUTES

Development of substitutes for chromium tends to be deterred by cost performance or the customer appeal for chromium. There are no substitutes for chromium in stainless steel or superalloys. Boron, manganese, nickel and molybdenum can be substituted in alloy steels and cast irons. Chromium containing scrap can substitute for ferrochromium in some metallurgical uses. Dolomite is an alternative for some refractory bricks. Cadmium yellow is one of the several alternative pigments. However, it is not environmentally acceptable and nickel and zinc are possible substitutes for the protection of decorative coatings.

SPECIFICATIONS

The specifications of chromite vary for different end-use industries. The Cr.Fe ratio is one of the important factors to be considered before deciding the end-use of the mineral. The BIS has specified IS:10818-1984 specifications of chromite for Metallurgical Industries Reaffirmed March 2019. IS: 10819-1999 (First Revision, Reaffirmed in January 2017) for specifications of chromite for Refractory Industry, IS: 4737-1982 (First Revision, Reaffirmed January 2021) for specification of chromite for Chemical Industry and IS : 6788: 1973 (Re-affirmed Feb.2019) for specification of chromite sand for Foundry Industry.

INDUSTRY

Chromite is mainly used in Metallurgical Industry for manufacture of ferroalloys, e.g., ferrochrome, charge chrome and silicochrome which are used as additives in making stainless steel and special alloy steel. Ferroalloys are the essential ingredients for the production of high quality special alloy steel as well as mild steel. The demand for ferroalloys is associated with the production of alloy steel.

Production of ferrochrome/charge chrome was mainly reported by Ferro Alloys Corp. Ltd, Shri Vasavi Industries Ltd, Balasore Industries Ltd, Tata Steel Ltd, Indian Metals & ferro-Alloys Ltd and Indian Charge-chrome Ltd (merged with Indian Metals & Ferro alloys Ltd in 2006) were amongst the major producers of charge chrome in India. Charge chrome contains 50 to 60% chromium and 6 to 8% carbon. Hard lumpy chromite is used for high-carbon ferrochrome while friable ores and fine briquettes are used for low-carbon ferrochrome. Briquette fines along with lumpy ores were also consumed in charge chrome plants.

The production has been at 1.0 to 1.1 million tonnes over the past 4-5 years. India consumes 15-30% of its production and exports the rest to countries like China, South Korea and Japan. The domestic consumption of ferrochrome has not grown for two main reasons a) except for the top three ferrochrome players IMFA, Tata Steel and Balasore Alloys others are in financial difficulties; b) Domestic Stainless Steel production which is largely accounted for by the Jindal Stainless Group of late is under severe duress. The Indian Ferrochrome Industry is likely to get consolidated as capacities owned by Rohit Ferro Alloys and FACOR Alloys are to be auctioned through the

National Company Law Tribunal (NCLT) shortly. Recently, NCLT released the results of bidding for FACOR's assets.

The important plants which produce chromite based refractories are Tata Steel Ltd (formerly OMC Alloys), Orissa Industries Ltd, Bhilai Refractories Ltd, Burn Standard Co. Ltd, Joglekar Refractories and Ceramics (P) Ltd and Associated Ceramics Ltd.

Ferrochrome when added to steel imparts hardness, strength and augments its stainless characteristics. Carbon content classifies the ferrochrome alloy into high-carbon (6–8%), medium-carbon (3–4%) and low-carbon (1.5–3%), although chromium content in all the three grades is around 60–70 per cent. Around 2.5 tonnes chrome ore with an estimated power consumption of about 4,500 kWh is required to produce one tonne of ferrochrome.

Ferro Alloys Corpn. Ltd, Garividi, Andhra Pradesh; GMR Technologies & Industries Ltd, Srikakulam, Andhra Pradesh; Jindal Steel & Power Ltd, Raigarh, Chhattisgarh; Standard Chrome Ltd, Raigarh, Chhattisgarh; SAL Steel, Kachchh-Bhuj, Gujarat; Balasore Alloys Ltd, Balasore, Odisha; IDCOL Ferro Chrome Plant, Jajpur Road, Odisha; Indian Metals & Ferro Alloys Ltd, Theruballi, Odisha; Jindal Stainless Ltd, Duburi, Odisha; Nava Bharat Ferro Alloys Ltd, Dhenkanal, Odisha; Rawat Ferro Alloys, Cuttack, Odisha; Rohit Ferro Tech. P. Ltd, Bishnupur, West Bengal; and Sri Vasavi Ind. Ltd, Bishnupur, West Bengal are the major ferrochrome producers in the country. A sizeable quantity of ferrochrome is also produced by units in the Small-scale Sector.

Chromite mine at Sukinda became the first unit to obtain Integrated Management System (IMS) certification (ISO 9001:2015, ISO 14001:2015 and OHSAS 18001:2007). Tata Steel Ltd, FACOR and Indian Metals & Ferro Alloys Ltd (IMFA), the three major producers of charge chrome in the country have a total capacity of about 1,82,500 tpy. Tata Steel with its charge chrome plant at Bamnipal, Odisha, has a capacity of 55,000 tpy, while FACOR has a capacity of 65,000 tpy charge chrome at its Randia Plant, Bhadrak district, Odisha. Indian Metals & Ferro Alloys Ltd (IMFA), Cuttack district, Odisha, has an installed capacity of 62,500 tonnes per year.

Vishnu Chemicals Ltd has plants at Medak, Visakhapatnam (Andhra Pradesh) and Bhilai (Chhattisgarh) which produces chromium products, such as, sodium dichromate (70,000 tonnes per year), basic chromium sulphate, chromic acid (1,000 tonnes per year) and potassium dichromate (1,000 tonnes). There were two producers of chromium chemicals in small quantities in the organised sector, namely, Tamil Nadu Chromates and Chemicals Ltd and Krebs & Cie (India) Pvt. Ltd, Kolkata.

Commercially, chrome ore can be divided into three categories: (i) high-grade, containing >48% chromite, (ii) medium-grade with > 40% chromite and (iii) low-grade containing less than 40% chromite.

Chromium metal and the alloy ferrochromium are commercially produced from chromite by silicothermic or aluminothermic reactions, or by roasting and leaching processes. Chromium metal assumes high value due to its properties, such as, high corrosion resistance and imparting of hardness.

The discovery that steel could be made highly resistant to corrosion and discolouration by adding metallic chromium to form stainless steel led to major developments in the Steel Sector. This application, along with chrome plating (electroplating with chromium) are currently the major commercial use for the element. The element also finds application in the production of chromium compounds, albeit to a minor extent.

The strengthening effect of forming stable metal carbides at the grain boundaries and the strong increase in corrosion resistance has made chromium an important alloying material for steel. The high-speed tool steels contain between 3 and 5% chromium. Stainless steel, the main corrosion-proof metal alloy is formed when chromium is added to iron in sufficient concentrations usually above 11%. User's specifications of chromite in major consuming industries are furnished in Table-10.

Table – 10 : User's Specifications of Chromite in Major Consuming Industries

Industry/Name and location of plant	Specifications of ore consumed
FERROCHROME/CHARGE CHROME	
Andhra Pradesh/Telangana	
Cronimet Alloys India Ltd, Ravivalasa, Distt Srikakulam	Lumps : Cr_2O_3 40% to 50% Fines : Cr_2O_3 40% to 52% Concentrates : Cr_2O_3 40%
Ferro-Alloys Corp. Ltd, Shreeram Nagar, Distt Vizianagaram	Lumps : Cr_2O_3 38% to 40% Fines : Cr_2O_3 38% to 40% Friable : Cr_2O_3 48% to 50% Concentrates : Cr_2O_3 48% to 50%
JSL Ltd, (formerly Jindal Stainless Steel Ltd) Jindal Nagar, Distt Vizianagaram	Lumps : Cr_2O_3 38% Cr:Fe : 2 : 9
Nav Bharat Ventures Ltd, Paloncha, Distt Khammam	Lumps: Cr_2O_3 28-42% Fines: Cr_2O_3 48-50%, 52-54%
GMR Technologies & Industries Ltd, Ravivalasa, Distt Srikakulam	Lumps: Cr_2O_3 38-45% Fines: Cr_2O_3 45-55 %
VBC Ferro Alloys Ltd, Rudragram, Distt Medak, Telangana	Lumps: Cr_2O_3 36-52%
Chhattisgarh	
Jindal Steel & Power Ltd, Raigarh	Lumps : Cr_2O_3+38% Cr:Fe : 2 : 9 Fines : Cr_2O_3+52%, Cr:Fe : 2:6
Deepak Ferro Alloys Ltd, Urla, Distt Raipur	Lumps : Cr_2O_3 36-40% Fines : Cr_2O_3 48-52%
Jammu & Kashmir	
Shree Sitaram Industries Pvt. Ltd, Distt Samba	Lumps : Cr_2O_3 40% to 52% Fines : Cr_2O_3 40% to +52%,
Odisha	
Balasore Alloys Ltd, (formerly Ispat Alloys Ltd) Balgopalpur, Distt Balasore	Lumps : Cr_2O_3 - 40% Fines : Cr_2O_3 - 40 to +52%
Ferro Alloys Corp. Ltd, Charge Chrome Division, Randia, Distt Bhadrak	Lumps : Cr_2O_3 N.A.; Friable : Cr_2O_3 40% & above; Concentrates : N.A.
IDCOL Ferro Chrome & Alloys Ltd, Jajpur Road, Distt Cuttack	Cr_2O_3 : 42-52% SiO_2 : 6% max.
Indian Metals & Ferro Alloys Ltd, (Formerly, Indian Charge Chrome Ltd) Choudwar, Distt Cuttack	Lumps: Cr_2O_3 : 40 to >52% SiO_2 : 15% max. Fines: 40 to 50% & above
Indian Metals & Ferro Alloys Ltd, Therubali, Distt Raygada	Lumps: Cr_2O_3 : 40 to 52% Fines: Cr_2O_3 : 40 to >52% Concentrates: N.A.
Rohit Ferro Tech. Ltd, (Unit 2) Duburi, Distt Jajpur	Lumps, fines & concentrates

(contd)

Table-10 (Concld)

Industry/Name and location of plant	Specifications of ore consumed
Tata Steel Ltd, (Formerly OMC Alloys Ltd) Bamnipal, Distt Keonjhar	Cr_2O_3 : 47% min. Size : 0 to 40 mm
West Bengal	
Rohit Ferro Tech Ltd, (Unit 1) Bishnupur, Distt Bankura	Lumps, fines & concentrates
REFRACTORY	
Chhattisgarh	
SAIL Refractories Unit, Marauda, Distt Durg	Friable lumps : Cr_2O_3 : 52 to 54% min. SiO_2 : 5% max.
Vishva Vishal Engineering Ltd, Bhilai, Durg	Cr_2O_3 : 50%, SiO_2 : 4.5% max. Fe_2O_3 : 8%
Maharashtra	
Joglekar Refractories & Ceramics (P) Ltd, Rabale, Distt Thane	Lumps Cr_2O_3 44% min. CaO < 2%, Fe_2O_3 < 21% Imported sand - 30 to +85 mesh, Cr_2O_3 45% min. SiO_2 < 1%, Fe_2O_3 < 27%
Odisha	
Orissa Industries Ltd, Lathikata Works, Distt Sundargarh	Cr_2O_3 : 52 to 54% Fe_2O_3 : 15 to 18% max. SiO_2 : 3 to 5%
IFGL Refractories Ltd, Kalunga, Distt Sundargarh	Cr_2O_3 : 55% min. -16 to +22 mesh
TRL Krosaki Refractories Ltd, Belpahar, Distt Jharsududa	Cr_2O_3 : 48 to 50% min.
Shree Chem Industries (Pvt.) Ltd, Mandiyakudar, Distt Sundargarh	Cr_2O_3 : 54% SiO_2 : 5 to 9% min.
Kalinga Ferro Ispat Pvt Ltd, Mandia, Distt Jajpur	Fines Cr_2O_3 : 40-52% & above,
Khemka Refractories Pvt. Ltd, Kamakhyanagar - 759 018, Distt Dhenkanal	Fines Cr_2O_3 : 52% min.
Tamil Nadu	
Burn Standard Co. Ltd, Salem	Cr_2O_3 : 52 to 54% min., SiO_2 : 3 to 5% max. Fe_2O_3 : 15 to 18% max.
C. Nataraj Ceramics & Chem. Industry Dalmiapuram, Distt Tiruchirapalli	Lumps, Cr_2O_3 + 44%. Fe_2O_3 -25%
West Bengal	
National Refractories, P.O. Salampur - 713 357, Distt Burdwan	Cr_2O_3 : 52% min., above fines
CHEMICALS	
Odisha	
Krebs & Cei (India) Ltd, Kalma, Distt Mayurbhanj	Cr_2O_3 : 48 to 55%

TRADE POLICY

The Ministry of Commerce and Industry, Department of Commerce had come out with the Foreign Trade Policy (FTP) for the period 2015-2020. As per the present Export-Import Policy, ITC(HS), 2017 Schedule-2 " Export Policy" the imports of chromium ore lumps, friable ores and concentrates are freely allowed. The export policy on chromite is stated as follows: Chapter 2601 " Iron ores and concentrates, including roasted iron pyrites.

Tariff Item HS Code	Item	Export Policy
26100000	(a) Chrome ore lump containing (i) 47% Cr_2O_3 and above	-
26100020	(b) Chrome ore lumps containing 40% or more but less than 47% Cr_2O_3	-
26100030	(c) Chrome ore lumps with Cr_2O_3 below 40%	-
26100040	(d) Chrome ore friable and conc. fixes containing 47% Cr_2O_3 and above	-
26100090	(e) Other	

WORLD REVIEW

World reserves of Shipping-grade chromite are about 570 million tonnes in terms of chromite ore. Countries that possess sizeable quantities of reserves are Kazakhstan (40%) and South Africa (35%). These two countries together hold about 75% of world's chromite reserves. India possesses 18% while Turkey accounts for 5% of the world reserves of chromite. The available data on world reserves of chromite (Shipping-grade) is furnished in Table-11.

Table – 11 : World Reserves of Chromite (Shipping Grade) (By Principal Countries)**

(In '000 tonnes of chromium content)

Country	Reserves
World: Total (rounded off)	**570000**
Finland	13000
India*	100000
Kazakhstan	230000
South Africa	200000
Turkey	26000
USA	620
Other countries	NA

Source: *USGS, Mineral Commodity Summaries, 2022*
***Shipping grade - Reserves unit are thousand tonnes of Shipping-grade chromite ore which is Deposit quantity and grade normalised to 45% Cr_2O_3 except for United States where grade is normalised to 7% Cr_2O_3 and finland where grade is normalised to 26% Cr_2O_3 .*

*NA-Not available. *: Reserves/resources of chromite in the country as on 1.4.2020 as per NMI database based on UNFC system have been placed at 331.69 million tonnes.*

The world mine production of chromite ores & concentrates decreased by 20% to 31.05 million tonnes in 2020 from 38.6 million tonnes recorded in the previous year. South Africa was the leading producer contributing about 43% to the total world production followed by Kazakhstan (20%), Turkey (10%), India (9%), Zimbabwe & Finland (4% each) and Russia & Albania (2% each) (Table-12).

Table – 12 : World Mine Production of Chromium Ores and Concentrates (By Principal Countries)

(In '000 tonnes)

Country	2018	2019	2020
World: Total (rounded off)	**37500**	**38600**	**31049**
South Africa	17829	17664	13243
Kazakhstan	6889	7019	6327
India[(e)**]	3971	3837	2863
Turkey	2897	3364	3100
Zimbabwe	895	1550	1272
Albania	1143	1200*	627
Finland[(f)]	1099	1184	1131
Russia	469	698	689
Oman	885	608	382
Other countries	1386	1226	1414

Source: *BGS World Mineral Production, 2016-20*
**: Estimate, e: Years ends 31 March following that stated, f: Concentrates.*
***: production of chromite n india 2018-19, 2019-20 and 2020-21 was 3.97 million tonnes, 3.84 million tonnes and 2.86 million tonnes respectively.*

Upgradation of technology and advancement in beneficiation processes, such as, agglomeration of ore, pre-heating and pre-reduction of furnace feed, closed-furnace technology and recovery of chromium from slags have brought about significant changes and are now followed worldwide. For generalised view of the development in various countries, the countrywise description sourced from the latest available publication of USGS 'Mineral Yearbook 2018' chromium (Advance Release) is furnished below:

Albania

Albania produced an estimated 9,60,000 tonnes of chromite ore in 2018 as against 9,50,181 tonnes in 2017. Ferrochromium production was estimated at 60,000 tonnes in 2018 as against 49,000 tonnes in 2017. Chromite ore and ferrochromium production increased in the past several years owing to increased investment in AlbChrome (Tirana), the leading chromite ore and ferrochromium producer in Albania.

Kazakhstan

Kazakhstan produced 66,88,700 tonnes of chromite ore in 2018 as against 63,13,300 tonnes (revised) in 2017 and an estimated 16,00,000 tonnes of ferrochromium in 2018 as compared with 16,40,300 tonnes (revised) in 2017. Kazakhstan was the third-leading producer of chromite ore and ferrochromium in the world.

Finland

Finland's production increased in 2018. The values for production in 2014 through 2017 have been revised and are now about twice as much as previously reported

South Africa

South Africa was the world's leading producer of chromite ore in 2018. South Africa produced 1,76,17,099 tonnes of chromite ore in 2018 compared with 1,65,47,717 tonnes (revised) in 2017 and an estimated 39,00,000 tonnes of ferrochromium in 2018 compared with an estimated 36,00,000 tonnes in 2017. Afarak Group Plc (Finland) announced a transformer failure of a submerged arc furnace that produces ferrochromium in August at its Mogale Alloys processing plant. As a result, Mogale shut down the furnace, and repairs were expected to take up to 14 weeks to complete. Mogale anticipated a 7,000-tonnes/year reduction in ferrochromium capacity and production.

Zimbabwe

Zimbabwe produced 8,94,661 tonnes of chromite ore in 2018 as against 6,88,838 tonnes (revised) in 2017 and an estimated 1,80,000 tonnes of ferrochromium in 2018 compared with 1,42,800 tonnes in 2017.

Balasore Alloys Ltd. (India) agreed to acquire a 70% stake in Zimbabwe Alloys Ltd (ZimAlloys) (Gweru) in January to increase domestic and overseas production capacity. The arrangement was sanctioned by the High Court of Zimbabwe. The investment also settled ZimAlloys' debt of $50 million to creditors. With the debt cleared, ZimAlloys planned to refurbish and restart its blast furnaces within 18 months.

Brazil

Brazil produced an estimated 5,50,000 tonnes of chromite ore in 2018, unchanged from the 2017 revised estimate. Ferrochromium production was 1,75,061 tonnes in 2018 compared with 1,71,531 tonnes in 2017. Companhia de Ferro Ligas da Bahia owned more than 95% of chromite deposits operated in Brazil. Ferbasa invested $2.1 million in its "Hard Lump" project to improve treatment and mining processes in chromite ore production. An investment of $6.1 million was also allocated to machinery and equipment. Ferbasa decided to decrease its sales volume in 2018 compared to sales in 2017 owing to the decrease in the global prices of chromite ore (Companhia de Ferro Ligas da Bahia, 2019).

China

China produced an estimated 30,000 tonnes of chromite ore in 2018, unchanged from the 2017 estimate, and an estimated 52,50,000 tonnes of ferrochromium compared with a revised estimate of 49,40,000 tonnes in 2017. China was the leading producer of ferrochromium in 2018.

In response to requests from the stainless-steel billet and hot-rolled sheet and Coil Industry in China, the Ministry of Commerce of the People's Republic of China announced an investigation into imports of

stainless-steel billets and stainless steel hot-rolled coil from the European Union, Indonesia, Japan and the Republic of Korea. The investigation was set to begin on July 23, 2018, and would run for 1 year but could extend into 2020 depending on special circumstances.

FOREIGN TRADE

Exports

Exports of chromite (total) decreased substantially by 91% to 2.87 thousand tonnes in 2020-21 from 33.90 thousand tonnes in the previous year. Out of total chromite exported in 2020-21, the share of chromite concentrate was only 7%, while chromite ore (others) accounted for 93%. Exports of chrome ore concentrate were almost fully to China in 2020-21. Export of chrome Ore (other) decreased substantially by 22% to 2,668 tonnes in 2020-21 from 3,433 tonnes in the preceding year.

In 2020-21, 168 tonnes of chromium & alloys were exported to various countries. Exports of chromium & alloys were mainly to USA (81%), Brazil (7%) and Nepal (6%). The exports of chromium & scrap was negligible. Exports of chromium unwrought (powder) was more or less unchanged to 158 tonnes in 2020-21 from 157 tonnes in the preceding year (Tables-13 to 19). The details of exports of ferrochrome are furnished in the Review entitled, 'Ferroalloys'.

Table – 13 : Exports of Chromite : Total (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**33898**	**867910**	**2872**	**71979**
China	32069	795604	2716	65714
Spain	1500	63405	100	4602
U A E	-	-	54	1579
Nepal	37	30	2	84
South Africa	292	8871	-	-

Figures rounded off

Table – 14 : Exports of Chrome Ore Concentrates (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**30465**	**735433**	**204**	**3104**
China	30377	732910	204	3104
South Africa	88	2523	-	

Figures rounded off

Table – 15 : Exports of Chrome Ore (Others) (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**3433**	**132477**	**2668**	**68875**
China	1692	62694	2512	62610
Spain	1500	63405	100	4602
U A E	-	-	54	1579
Nepal	37	30	2	84
South Africa	204	6348	-	-

Figures rounded off

Table – 16 : Exports of Chromium & Alloys (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**157**	**112533**	**168**	**119457**
USA	133	87667	136	83691
Nepal	-	-	10	21000
Brazil	2	2619	12	8138
U A E	3	1768	3	1902
Indonesia	++	174	1	1298
UK	1	1055	2	1038
Philippines	++	253	1	850
Egypt	++	282	1	573
Kenya	1	657	1	395
Qater	++	51	++	315
Other countries	17	18007	1	257

Figures rounded off

Table – 17 : Exports of Chromium Articles, Nes (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	**8**	**10**	**21035**
Nepal	-	-	**10**	21000
Italy	-	-	++	34
Australia	-	-	++	1
Bhutan	++	**4**	-	-
Nigeria	++	4	-	-
South Africa	++	++	-	-

Figures rounded off

Table – 18 : Exports of Chromium & Scrap (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	**30**	++	**32**
Kenya	-	-	++	19
Qater	-	-	++	11
UAE	-	-	++	2
Nepal	++	30	-	-
Korea	++	++	-	-

Figures rounded off

Table – 19 : Exports of Chromium Unwrought : Powder (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**157**	**112525**	**158**	**98422**
USA	133	87667	136	83691
Brazil	2	2619	12	8138
U A E	3	1768	3	1902
Indonesia	++	174	1	1298
U K	1	1055	2	1038
Philippines	++	253	1	850
Egypt	++	282	1	573
Kenya	1	657	1	395
Qatar	++	51	++	315
France	-	-	++	91
Other countries	17	17999	1	131

Figures rounded off

Imports

Imports of chromite (total) increased by 20% to 156.21 thousand tonnes in 2020-21 from 124.69 thousand tonnes in the previous year. Imports were mainly from South Africa (71%), Mozambique (19%) and Switzerland (4%). Out of total quantity of chromite imported in 2020-21, chrome ore lump accounted for 50%, while concentrate and Other forms accounted for the remaining 50%. Imports of chrome ore lump were mainly from South Africa (43%), Mozambique (38%) and Switzerland (8%). 93% of the imports of chrome ore concentrate were from South Africa and the rest from Zimbabwe. Imports of chromium & alloys in 2020-21 were at 1,329 tonnes as compared to 1,514 tonnes in the previous year. Imports of chromium & alloys were mainly from Russia (49%), Netherlands (22%) and UK (19%). Imports of chromium & scrap were negligible in 2020-21 as compared to one tonne in 2019-20 (Tables- 20 to 27).

The import details of ferrochrome are furnished in the Review entitled 'Ferroalloys'.

Table – 20 : Imports of Chromite : Total (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**124693**	**2065047**	**156211**	**2257733**
South Africa	99301	1757431	110250	1654869
Mozambique	-	-	30109	384902
Switzerland	2546	31249	6070	87789
Turkey	-	-	4450	56880
Oman	13855	141143	4319	47871
U A E	324	7951	561	12416
Netherlands	73	3302	150	7458
Zimbabwe	1819	27451	287	4275
Brazil	-	-	8	485
U S A	++	++	1	319
Other countries	6775	96520	6	469

Figures rounded off

Table – 21 : Imports of Chrome Ore Lump (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**80819**	**1300165**	**78845**	**1148209**
South Africa	55907	1007319	33897	570767
Mozambique	-	-	30109	384902
Switzerland	2546	31249	6070	87789
Turkey	-	-	4450	56880
Oman	13855	141143	4319	47871
Singapore	3844	51314	-	-
Madagascar	2794	40226	-	-
Zimbabwe	1819	27451	-	-
Saudi Arabia	54	1463	-	-

Figures rounded off

Table – 22 : Imports of Chrome Ore Concentrate (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**891**	**24896**	**4013**	**93937**
South Africa	891	24896	3726	89662
Zimbabwe	-	-	287	4275

Figures rounded off

Table – 23 : Imports of Chrome Ore Others (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**42983**	**739986**	**73353**	**1015587**
South Africa	42503	725216	72627	994440
UAE	324	7951	561	12416
Netherlands	73	3302	150	7458
Brazil	-	-	8	485
U S A	++	++	1	319
China	23	953	4	247
Germany	6	554	2	222
Hong Kong	54	2009	-	-
Spain	++	1	-	-

Figures rounded off

Table – 24 : Imports of Chromium & Alloys (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1513**	**922166**	**1329**	**785783**
Russia	411	231277	653	309704
U S A	32	48594	38	138568
UK	375	205893	247	133905
Netherlands	337	184070	293	126282
Germany	4	18754	3	29498
Belgium	21	14425	60	27753
China	76	39722	29	12956
UAE	24	12942	2	2729
Japan	2	3615	1	1896
Sri Lanka	-	-	3	1299
Other countries	231	162874	++	1193

Figures rounded off

Table – 25 : Imports of Chromium Unwrought : Powders (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1417**	**819169**	**1163**	**650313**
Russia	411	231277	593	282628
U S A	32	37001	31	123694
Netherlands	337	184070	282	123540
U K	335	171329	182	82481
Belgium	1	425	60	27753
China	54	26794	9	4062
U A E	24	12942	2	2729
Japan	2	3302	1	1590
Sri Lanka	-	-	3	1299
Germany	-	-	++	457
Other countries	221	152029	++	80

Figures rounded off

Table – 26 : Imports of Chromium Articles, Nes (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**96**	**102997**	**166**	**135470**
UK	40	34564	65	51424
Germany	4	18754	3	29041
Russia	-	-	60	27076
USA	++	11593	7	14874
China	22	12928	20	8894
Netherlands	-	-	11	2742
Taiwan	-	-	++	528
Sweden	-	-	++	349
Japan	++	313	++	306
Korea	++	734	++	235
Other countries	30	24111	++	1

Figures rounded off

Table – 27: Imports of Chromium & Scrap (By Countries)

Country Name	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1**	**1791**	++	**972**
Austria	++	799	++	800
Germany	++	230	++	149
U S A	-	-	++	21
Singapore	-	-	++	2
U K	1	420	-	-
U A E	++	342	-	-

Figures rounded off

FUTURE OUTLOOK

The current status of chromite production and consumption is on anticipated lines, but the consumption could increase enormously in the coming years and the country may have to depend on imports even for the domestic needs of chromite. Depletion of reserves is bound to create a serious problem for the future of the Chromite Industry in the country. An Expert Committee constituted by the Ministry of Steel, Government of India, in its recommendations put forth the need for detailed exploration of chromite in all the potential areas in Odisha, Karnataka and in the ophiolite belt of North-Eastern region with a view to prognosticate resources to a depth of 500 m in Sukinda belt and estimate resources in all other potential areas. Addressing concerns in ferrochrome production which is energy intensive segment is also essential. Setting up of such plant must strike a cost balance between raw materials and electrical energy supply. There are other imminent issues like consistent supply of chrome ore at the right cost, steady power supply and other input materials like low phosporous met coke and good market conditions that need redressal in respect of the continuous and unscrupulous exploitation of chromite.

Adherence to stringent pollution control norms, innovations in the process technology and plant equipment design would become inevitable for the future of the industry.

As per the latest available data, supply of chrome ore is expected to increase at a compound annual growth rate (CAGR) of 2.4 per cent over the 2018 to 2022 period. Demand is expected to increase at a CAGR of 2.9 per cent. This is in comparision with the previous five years, where supply grew at a CAGR of 2.8 per cent and demand at 3.0 per cent modest reflection.