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## (Part- III : Mineral Reviews)

## 51st Edition

# CHROMITE

### (FINAL RELEASE)

**GOVERNMENT OF INDIA**
**MINISTRY OF MINES**
**INDIAN BUREAU OF MINES**

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# 9 Chromite

Chromite is an oxide of chromium and iron. The chemical composition of chromite is $FeO.Cr_2O_3$ or $Fe\ Cr_2O_4$. Chromite contains 68% $Cr_2O_3$ and 32% FeO with Cr : Fe ratio of about 1.8 : 1. Chromite is the only commercial source of chromium. It occurs as a primary mineral of ultrabasic igneous rocks and is normally associated with peridotite, pyroxenite, dunite and serpentinite. Worldwide, high-alumina chromite, largely from podiform deposits, is used in refractory applications while iron-rich ores, largely from stratiform deposits, are utilised in metallurgical and chemical applications.

## RESOURCES

As per UNFC system, total resources of chromite in the country as on 1.4.2010 are estimated at 203 million tonnes, comprising 54 million tonnes reserves (27%) and 149 million tonnes remaining resources (73%). More than 93% resources of chromite are located in Odisha, mostly in the Sukinda valley in Cuttack and Jajpur districts. Minor deposits are scattered over Manipur, Nagaland, Karnataka, Jharkhand, Maharashtra, Tamil Nadu and Andhra Pradesh. Gradewise, charge-chrome grade accounts for 36% resources followed by ferro-chrome grade (19%), beneficiable grade (17% ) and refractory grade 5%. Low, others, unclassified and not-known grades together account for 23% (Table-1).

## EXPLORATION & DEVELOPMENT

GSI completed reconnaissance stage investigation in area to the south of Raibola-Kanheipal in Dhenkanal district, Odisha. In the bedrock samples of serpentinite and gabbro, PGE values in six samples ranging from 64 ppb to 114 ppb were detected. Test drilling in Tangeria area intersected a 1.10 m thick chromite band associated with ultramafic rock at a depth range of 60.90 m to 62 m. Since the sub-surface probe did not yield any encouraging results, the scout drilling was discontinued.

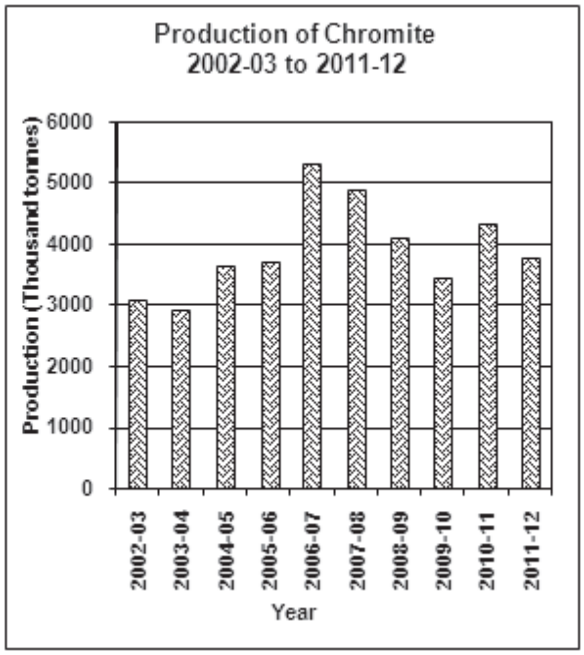
In Andhra Pradesh, reconnaissance stage investigation was taken up in the area between Kondapalli and Gangineni spread over in Krishna & Khammam districts. The rock types are pyroxene, granulite and charnockite in north of Koduru village, a mappable pyroxenite body was found to have chromite mineralisation. It occurs as lenses, bands, pockets & disseminations. These are small, discontinuos bands and have maximum length of 25 m and width of 17 m. Stringers of chromite occur in charnockite. This activity will be continued.

Directorate of Geology, Odisha conducted exploration for locating chromite mineralisation to the west of Sukinda Ultramafic Complex around Kankadahad-Kandhara area of Kamakhyanagar sub-division in Dhenkanal district. Presence of three ultramafic bands with $Cr_2O_3$ content ranging from 1.29 to 1.81% was indicated. Apart from drilling in Tailangi lease hold of IDCOL, a pilot project to examine the content of low grade chromite and nickel in overburden dumps in Sukinda valley was taken up by systematic sampling. Analysis of 15 samples indicated $Cr_2O_3$ content ranging from 6.5 to 15.25%, out of which 9 samples indicated an encouraging $Cr_2O_3$ content of 13.31 to 15.25%. The details are given in Table-2.

## PRODUCTION, STOCKS & PRICES

The production of chromite at 3764 thousand tonnes during 2011-12 decreased by 13% as compared to the previous year owing to less demand.

The number of reporting mines was 20 in 2011-12 as compared to 21 in the preceding year. Six principal producers operating 11 mines together accounted for 93% of the total production during the year. The contribution of 7 mines, each producing more than 100,000 tonnes per annum, was more than 88% of the total production.



## Table – 1 : Reserves/Resources of Chromite as on 1.4.2010
## (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** | **31652** | **7165** | **15153** | **53970** | **1371** | **1407** | **4431** | **31787** | **36525** | **52497** | **21359** | **149377** | **203347** |
| **By Grades** | | | | | | | | | | | | | |
| Refractory | 4074 | 923 | 704 | 5701 | 547 | - | - | 15 | 240 | 3262 | - | 4064 | 9765 |
| Charge-chrome | 10984 | 868 | 9565 | 21417 | 495 | 1107 | 1679 | 6332 | 29840 | 11508 | - | 50961 | 72378 |
| Low | 26 | 27 | - | 53 | - | - | - | - | - | 3713 | - | 3713 | 3766 |
| Beneficiable | 8245 | 2912 | 2668 | 13825 | 255 | 279 | 710 | 12457 | 1843 | 5610 | - | 21154 | 34979 |
| Ferro-chrome | 6304 | 1689 | 1353 | 9346 | 74 | 20 | 88 | 12805 | 2794 | 13280 | - | 29061 | 38407 |
| Others | 175 | 746 | - | 921 | - | - | - | 168 | 15 | - | - | 183 | 1104 |
| Unclassified | 1844 | - | 863 | 2707 | - | - | 1953 | 9 | 1778 | 14963 | 21359 | 40062 | 42769 |
| Not-known | - | - | - | - | - | 1 | 1 | - | 16 | 161 | - | 179 | 179 |
| **By States** | | | | | | | | | | | | | |
| Andhra Pradesh | - | - | - | - | - | - | - | - | 15 | 172 | - | 187 | 187 |
| Jharkhand | - | - | - | - | - | - | - | 15 | 98 | 623 | - | 736 | 736 |
| Karnataka | 333 | 395 | 17 | 745 | 250 | 218 | 96 | - | 20 | 303 | - | 887 | 1632 |
| Maharashtra | 53 | 23 | - | 76 | 5 | - | - | 43 | 67 | 441 | - | 556 | 632 |
| Manipur | 3 | 21 | 52 | 76 | - | - | - | - | 529 | 6052 | - | 6581 | 6657 |
| Nagaland | - | - | - | - | - | - | - | - | - | 3200 | - | 3200 | 3200 |
| Odisha | 31263 | 6725 | 15085 | 53073 | 1116 | 1189 | 4335 | 31722 | 35796 | 41431 | 21359 | 136948 | 190021 |
| Tamil Nadu | - | - | - | - | - | - | - | 7 | - | 276 | - | 283 | 283 |

*Figures rounded off.*

## Table – 2 : Details of Exploration Activities for Chromite, 2011-12

| Agency/ State/ District | Location Area/ Block | Mapping | | Drilling | | Sampling (No.) | Remarks Reserves/Resources estimated |
|---|---|---|---|---|---|---|---|
| | | Scale | Area (sq km) | No. of boreholes | Meterage | | |
| **GSI** | Kondapalli | - | - | - | - | 24 | Reconnaissance Stage (G-4) investigation was taken up. $Cr_2O_3$ content was 20.82% to 43.04% from samples from Kondapalli area. On EPMA study, two samples revealed presence of PGE, rubidium & osmium as well as monazite grains high in cerium and low in lead content. |
| **Andhra Pradesh** | Gangineni | | | | | | |
| Krishna & Khammam | Koduru | | | | (Bed rock) | 191 | Analysis assayed 6.66% to 29.44% Cr. Seven samples indicated Pt 300 ppb, Pd 65 ppb, Ir 15 ppb and Rh 135 ppb. |
| **Odisha** | Raibola- | - | - | - | - | - | Reconnaissance Stage (G-4) |
| Dhenkanal | Kanheipal | | | | | | investigation was taken up. A few patches of intensely silicified serpentinite were noted in western part of areas under investigation. Chromite here occurs in weathered & silicified serpentinite as discrete grains, laminae & bands with width up to 70 cm. |
| **Directorate of Geology** | | | | | | | |
| **Odisha** | Kankadahad- | 1:2000 | 0.125 | - | - | 9 | Pitting was also done. Samples were |
| Dhenkanal | Kandhara | Geological Mapping | 104 | | | (rock) 64 (soil) | being analysed. Work will continue. |
| Jajpur | Tailangi mine of IDCOL | 1:1000 | 0.0054 | 1 | 42.5 | 86 | A chromite lode of 10.6 m thickness was encountered in a borehole in the eastern part of leasehold. Resource estimation was in progress. To assess low grade chromite(i.e. +10% $Cr_2O_3$) and nickel (0.6% Ni) associated with a dump of length 110 m and height varying from 5-11 m was subjected to pit sampling on a 20/20 m grid. Eleven pits of 1x1x2 m were dug and 170 samples were collected. Seven channels were cut on the eastern and southern part to study vertical profile and chromite incidence. |

The share of public sector in total production was 16% in 2011-12 as compared to that of 30% in the previous year. About 79% of the total production was reported from captive mines in the current year as compared to 68% in the previous year.

Odisha continued to be the major producing state of chromite, accounting for almost the entire production during 2011-12 and a nominal production was reported from Karnataka.

Gradewise analysis of production during 2011-12 reveals that 52% & above $Cr_2O_3$ fines accounted for 15%, 40%-52% $Cr_2O_3$ for 23% (lumps 4% and fines 19%), below 40% $Cr_2O_3$ for 42% (lumps 6% and fines 36%) and chromite concentrates 20% of the total production (Tables - 3 to 7).

Mine-head stocks of chromite at the end of 2011-12 decreased by 44% to 1,270 thousand tonnes as compared to 2,257 thousand tonnes at the beginning of the year. Out of the total stocks, about 99% were held at the mines in Odisha (Tables - 8A & 8B).

The average daily employment of labour in chromite mines during 2011-12 was 5,851 against 6,862 in the previous year. Domestic prices of chromite are furnished in the General Review on Prices.

**Table – 3 : Principal Producers of Chromite 2011-12**

| Name & address of producer | Location of mine | |
|---|---|---|
| | State | District |
| The Tata Steel Ltd, Bombay House, Fort, Homi Mody Street, Mumbai – 400 001, Maharashtra. | Odisha | Jajpur |
| The Orissa Mining Corporation Ltd, 'OMC House', Post Box No. 34, Bhubaneswar – 751 001, Odisha. | Odisha | Dhenkanal and Jajpur |
| Balasore Alloys Ltd, Balgopalpur, Balasore - 756 020, Odisha. | Odisha | Jajpur |
| Indian Metal & Ferro Alloys Ltd, Bomikhal, P.O. Rasulgarh, Bhubaneswar – 751 010, Odisha. | Odisha | Jajpur and Keonjhar |
| Ferro Alloys Corporation Ltd, D.P. Nagar, P.O. Randia - 756 135, Dist. Bhadrak, Odisha. | Odisha | Jajpur and Keonjhar |
| Misrilall Mines Pvt. Ltd. Chaibasa - 833 201, Dist. Singhbhum West, Jharkhand. | Odisha | Jajpur |

## Table – 4 : Production of Chromite, 2009-10 to 2011-12(P)
## (By States)

(Qty in tonnes; value in ₹ '000)

| State | 2009-10 | | 2010-11 | | 2011-12(P) | |
|---|---|---|---|---|---|---|
| | Qty | Value | Qty | Value | Qty | Value |
| **India** | **3425580** | **10453620** | **4325699** | **25964208** | **3764120** | **26523121** |
| Karnataka | 6483 | 30856 | 8540 | 33223 | 9827 | 40336 |
| Maharashtra | 66 | 489 | - | - | - | - |
| Odisha | 3419031 | 10422275 | 4317159 | 25930985 | 3754293 | 26482785 |

## Table – 5 : Gradewise Production of Chromite, 2010-11
## (By Sectors, States and 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 | Concentrates | Quantity | Value |
| **India** | **21** | **134338** | **1492416** | **136763** | **1029120** | **-** | **749289** | **783773** | **4325699** | **25964208** |
| Public sector | 8 | 8520 | 214901 | - | 447763 | - | 477280 | 131127 | 1279591 | 12726252 |
| Private sector | 13 | 125818 | 1277515 | 136763 | 581357 | _ | 272009 | 652646 | 3046108 | 13237956 |
| **Karnataka** | **3** | **8520** | **20** | **_** | **-** | **–** | **–** | **–** | **8540** | **33223** |
| Hassan | 3 | 8520 | 20 | _ | - | – | – | – | 8540 | 33223 |
| **Odisha** | **18** | **125818** | **1492396** | **136763** | **1029120** | **-** | **749289** | **783773** | **4317159** | **25930985** |
| Dhenkanal | 1 | 3789 | 200 | 15692 | 1616 | - | - | - | 21297 | 159499 |
| Jajpur | 13 | 58729 | 1492196 | 80548 | 989074 | - | 749289 | 783773 | 4153609 | 25219513 |
| Keonjhar | 4 | 63300 | _ | 40523 | 38430 | - | _ | _ | 142253 | 551973 |

## Table – 6 : Gradewise Production of Chromite, 2011-12 (P)
## (By Sectors, States and Districts)

(Qty in tonnes; value in ₹ '000)

| State/ District | No. of mines | Production by Grades : $Cr_2O_3$ Content | | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Below 40% | | 40% - 52% | | 52% & Above | | | | |
| | | Lumps | Fines | Lumps | Fines | Lumps | Fines | Concentrates | Quantity | Value |
| **India** | **20** | **208887** | **1358765** | **135719** | **735089** | **-** | **565883** | **759777** | **3764120** | **26523121** |
| Public sector | 7 | 9827 | 123281 | 414 | 126324 | - | 239896 | 111655 | 611397 | 7040006 |
| Private sector | 13 | 199060 | 1235484 | 135305 | 608765 | - | 325987 | 648122 | 3152723 | 19483115 |
| **Karnataka** | **2** | **9827** | **-** | **–** | **_** | **–** | **–** | **_** | **9827** | **40336** |
| Hassan | 2 | 9827 | - | – | _ | – | – | _ | 9827 | 40336 |
| **Odisha** | **18** | **199060** | **1358765** | **135719** | **735089** | **-** | **565883** | **759777** | **3754293** | **26482785** |
| Dhenkanal | 1 | 22501 | 1414 | - | - | – | – | – | 23915 | 157210 |
| Jajpur | 13 | 100909 | 1357351 | 98515 | 704196 | - | 565883 | 759777 | 3586631 | 25757526 |
| Keonjhar | 4 | 75650 | – | 37204 | 30893 | – | – | – | 143747 | 568049 |

## Table – 7 : Production of Chromite, 2010-11 and 2011-12(P)
## (By Frequency Groups)

(Qty in tonnes)

| Production group | No. of mines | | Production for the group | | Percentage in total production | | Cumulative percentage | |
|---|---|---|---|---|---|---|---|---|
| | 2010-11 | 2011-12 | 2010-11 | 2011-12 | 2010-11 | 2011-12 | 2010-11 | 2011-12 |
| **Total** | **21** | **20** | **4325699** | **3764120** | **100.00** | **100.00** | **-** | **-** |
| Up to 10000 | 8 | 6 | 17755 | 9827 | 0.41 | 0.26 | 0.41 | 0.26 |
| 10001 - 100000 | 4 | 7 | 234773 | 424398 | 5.43 | 11.27 | 5.84 | 11.53 |
| 100001 - 200000 | 4 | 3 | 456433 | 409695 | 10.55 | 10.88 | 16.39 | 22.41 |
| 200000- 300000 | 3 | 1 | 787636 | 234848 | 18.21 | 6.25 | 34.60 | 28.66 |
| 300000 and above | 2 | 3 | 2829102 | 2685352 | 65.40 | 71.34 | 100.00 | 100.00 |

## Table – 8 (A) : Mine–head Stocks of Chromite, 2011-12
## (At the beginning of the year)
## (By States/Grades)

(In tonnes)

| State | Stocks by Grades: $Cr_2O_3$ Content | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | Below 40% | | 40% -52% | | 52% and above | | | |
| | Lumps | Fines | Lumps | Fines | Lumps | Fines | Concentrates | |
| **India** | **60770** | **1857055** | **25776** | **155942** | **355** | **58843** | **98249** | **2256990** |
| Karnataka | 13674 | 303 | - | - | - | - | - | 13977 |
| Maharashtra | 125 | - | - | - | - | - | - | 125 |
| Odisha | 46971 | 1856752 | 25776 | 155942 | 355 | 58843 | 98249 | 2242888 |

**Table – 8 (B) : Mine – head Stocks of Chromite, 2011-12(P)**
**( At the end of the year)**
**(By States/Grades)**

(In tonnes)

| State | Stocks by Grades: $Cr_2O_3$ Content | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | Below 40% | | 40% -52 % | | 52% and above | | | |
| | Lumps | Fines | Lumps | Fines | Lumps | Fines | Concentrates | |
| **India** | **83635** | **734319** | **26090** | **148354** | **355** | **162514** | **114250** | **1269517** |
| Karnataka | 15761 | 303 | - | - | – | – | - | 16064 |
| Maharashtra | 125 | – | - | - | – | – | - | 125 |
| Odisha | 67749 | 734016 | 26090 | 148354 | 355 | 1625141 | 4250 | 1253328 |

**Table – 9 : Principal Producer of Chromium Metal, 2011-12**

| Name & address of producer | Location of plant | |
|---|---|---|
| | State | District |
| ACME Ferro Alloys Pvt. Ltd, 30, C.D.E. C-Sector Industrial Area, Ratlam-457 001, Madhya Pradesh. | Madhya Pradesh | Ratlam |

**Table – 10 : Production of Chromium Metal 2009-10 to 2011-12**

(In kg)

| Year | Quantity |
|---|---|
| 2009-10 | NA |
| 2010-11 | 1595 |
| 2011-12 | NA |

# MINING & TRANSPORT

Chromite is mined mostly by opencast method in the country. In OMC's opencast mines, the bench height is less than 6 m and the bench width is more than 10 m in mechanised quarry. The bench height and width is 1.5 m and 2 m, respectively, in the manual quarry. The mining machinery deployed in OMC mines include I.R. & wagon drills for drilling 100 mm dia holes, excavation by Poclain of 1.00 $m^3$ to 3.70 $m^3$ capacity, dozers of 15' blade, loader excavator of 1.70 $m^3$ and dumpers of 16-18 $m^3$ capacity. In some quarries, tippers and pay loaders are used in addition to manual means. The motive power is provided by electric generators of 75-160 KVA and portable diesel generators of 5 KVA capacity. In South Kaliapani (quarry D) mine of OMC, the 14 m wide main haulage road was proposed to align with a circular path. The haulage road for removing overburden from quarry face to dump was also to be partially aligned. The altered position will be permanent.

Underground mines are confined to Byrapur in Karnataka and Boula & Kathpal mines in Odisha. A proposal was under consideration to convert Nuasahi chromite mines of Indian Metals and Ferro Alloys Ltd (IMFA) into an underground mine. For this purpose, development of inclines from the existing quarry bottom was started. Tata Steel was also contemplating to convert a part of Sukinda chromite mine into an underground mine for which rock mechanics studies by South African consultant have been carried out. Chromite ore body extending to 300 m depth is mined by underground method since 1967 at Byrapur in Hassan district of Karnataka. Here cut-and-fill method of stoping is practised. In Sukinda valley, chromite has been mined to a maximum

depth of about 63 m by opencast method. The maximum overburden to ore ratio is 15:1. In the two underground mines in Odisha-one at Kathpal of M/s Ferro Alloys Corporation Ltd and other at Bangur of IMFA, sub-level stoping with parallel/ ring hole blasting with delayed firing is practised. Construction of cement concrete barrier has been planned to provide a base for the fill material at 30 m interval in the dip direction. In Sukinda area, deposits of chromite lying below 100 m depth may have to be exploited by highly specialised underground mining techniques.

OMC was also developing underground mine near Bangur in Baula-Nuasahi chromite belt close to IMFA mining operations. Though positive results were obtained from drilling, systematic exploration was yet to be taken up. OMC's chromite mines at Kaliapani, Sukrangi, Kalarangi, Kathpal and Bangur, all in Odisha, make it one of the leading chromite producers of the country. Chrome ore of very high grade (+58% $Cr_2O_3$) is produced here. The chrome ore beneficiation plant at Kaliapani with a total production capacity of 84,000 tonnes concentrates is designed to upgrade low-grade ore below 33% $Cr_2O_3$. Keeping in view the increasing demand for chrome concentrates, OMC is in the process of doubling the capacity of this plant.

Transportation of the ore from mines to railway sidings is done through trucks and from railway sidings to various consuming centres by railway wagons. In South Kaliapani mine of OMC, the width of haul road was more than 3 times the width of tipper/dumpers plying in the quarry, and in some places one way traffic was provided as and when needed. Important loading stations for chromite in the country are Jajpur-Keonjhar Road in Odisha and Tiptur in Karnataka. Export of chromite is through Paradip port. However, small quantities of lumpy chromite ore are imported to meet the needs of ferro-alloys industry in the country.

# ENVIRONMENTAL PROBLEMS

Management of waste dump in Sukinda valley is the major environmental concern. These overburden dumps alter the land topography, affect the drainage system, prevent natural succession of plant growth resulting in acute problems of soil erosion and environmental pollution.

Normally, waste dumps are maintained up to a height of 20-30 m with 30 m terrace width and slope angle of 25 to 35°. Toe-wall, garland drain, terracing and plantation along the slope are some of the common measures that are being adopted for waste dump management. Neem, Chakunda, Accacia, Mahul, Sal, Mango, Cashew, Arjuna, Babul, Amla, Bahada, Jamun, etc. are the species used in afforestation over dead dump slopes, dump terrace, along the haul roads and safety zones in the mines.

The major source of environmental pollution in Odisha is the hexavalent chromium generation, especially in case of friable ore. The hexavalent chromium contamination of the local water bodies is a major concern because of its carcinogenic properties. The pumped out water from the mine needs to be doused with ferrous sulphate solution before being discharged. The water is then neutralised with addition of lime. The Mining Research Cell, Indian Bureau of Mines, during 2008-09 had carried out a study for the attenuation of hexavalent chromium in Sukinda chrome belt by bio-remediation technology which is apparently environment-friendly. This study was a S & T Project in association with the Utkal University.

Environmental problems related to chromium processing are limited. Chromium, in its trivalent ($Cr^{3+}$) oxidation state as found in chromite and other natural minerals is an essential nutrient. Its principal function is to maintain normal glucose metabolism. Chromium deficiencies can lead to

problems in insulin circulation as well as possible risk of cardiovascular disease. Hexavalent form of chromium ($Cr^{6+}$) which is used widely in chemical compounds has been implicated in skin rashes and lung cancer.

# CONSUMPTION

The reported consumption of chromite in the organised sector decreased by about 10% from 2,661,400 tonnes in 2010-11 to 2,389,900 tonnes in 2011-12. Almost entire consumption (98.6%) was in ferro-alloys/charge-chrome industry. In addition to above, chromite in substantial quantities is also consumed in small-scale ferro-chrome units for which information is lacking. Besides, nominal consumption is reported by refractory industry and a negligible amount by others. Data on consumption of chromite, ferro-chrome & ferro-chrome-silicon from 2009-10 to 2011-12 are given in Tables -11 to 13.

**Table – 11: Reported Consumption of Chromite 2009-10 to 2011-12 (By Industries)**

(In tonnes)

| Industry | 2009-10 | 2010-11(R) | 2011-12(P) |
|---|---|---|---|
| **All Industries** | **2159500** | **2661400** | **2389900** |
| Chemical | 4800(2) | 6500(2) | 6500(2) |
| Ferro-alloys (including charge-chrome) | 2130000[e] | 2609400[e] | 2357000[e] |
| Refractory (including iron & steel) | 23900(23) | 44600(24) | 25800(24) |
| Others (foundry, ceramic, glass) | 800 | 900 | 600 |

*Figures rounded off.*
*Figures in parentheses denote the number of units in the organised sector reporting* consumption.*
*(*Includes actual reported consumption and/or estimates made wherever required).*
*Small scale sector is also producing ferro-chrome for which data is not available.*

**Table – 12 : Reported Consumption of Ferro-chrome, 2009-10 to 2011-12 (By Industries)**

(In tonnes)

| Industry | 2009-10 | 2010-11(R) | 2011-12(P) |
|---|---|---|---|
| **All Industries** | **272700** | **263400** | **287300** |
| Alloy Steel | 37800(12) | 27500(12) | 27500(12) |
| Electrode | ++(1) | 500(2) | 200(3) |
| Foundry | 400(9) | 400(8) | 400(8) |
| Iron & Steel | 234500(13) | 235000(13) | 259200(14) |

*Figures rounded off.*
*Figures in parentheses denote the number of units in the organised sector reporting* consumption.*
*(*Includes actual reported consumption and/or estimates made wherever required).*

**Table – 13 : Reported Consumption of Ferro-chrome-silicon, 2009-10 to 2011-12 (By Industries)**

(In tonnes)

| Industry | 2009-10 | 2010-11(R) | 2011-12(P) |
|---|---|---|---|
| **All Industries** | **460** | **460** | **460** |
| Alloy Steel | 460(1) | 460(1) | 460(1) |

*Figures rounded off.*
*Figures in parentheses denote the number of units in the organised sector reporting* consumption.*
*(*Includes actual reported consumption and/or estimates made wherever required).*

# USES

In metallurgy, chromite is used in the manufacture of chromium metal and various alloys with iron, nickel, cobalt, tungsten, molybdenum, etc. Chromium imparts additional strength, hardness and toughness to its alloys. It also shows resistance to corrosion to steel abrasion, reduces oxidation and flow of electricity. Stainless steel, high-speed tool steel, corrosion and heat-resistant steel are some of the important varieties of chromium steel. Ferro-chrome 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 and in aircraft and high-speed trains, respectively. Chromium (17%) with iron (83%) is also used as ferritic stainless steel to manufacture coins.

Chromite is used in refractory industry because of its resistance to corrosion, high temperature and ability to withstand sudden temperature changes and its chemically neutral character. The ore is used in the form of lumps, bricks or cement in linings, specially of steel furnaces.

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 of chromium tends to be deterred by cost performance or the customer appeal of the chromium. There are no substitutes in the stainless steel or super-alloys. Boron, manganese, nickel and molybdenum can be substituted in alloy steels and cast irons. Base metal alloys can sometimes be used in place of stainless steel. 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 IS specifications for metallurgical, refractory, chemical and foundry industries are given in Tables -14 to 17.

**Table – 14 : IS Specifications of Chromite for Metallurgical Industry (IS : 10818-1984) (Reaffirmed in 2008)**

| Sl. No. | Characteristic (on dry basis) | Grade (%) | | | |
|---|---|---|---|---|---|
| | | Low carbon ferro-chrome | High carbon ferro-chrome | Silico-chrome | Charge-chrome |
| 1. | $Cr_2O_3$ percent, min | 48 | 48 | 48 | 44 |
| 2. | Total iron percent, max. (as FeO) | 15 | 16 | 15 | 18 |
| 3. | $Al_2O_3$ percent | 13 | 13 | 13 | 10 |
| 4. | $SiO_2$ percent, max | 5 | 8 | 10 | 12 |
| 5. | CaO percent, max | 5 | 5 | 5 | 5 |
| 6. | MgO percent, max | 14 | 16 | 14 | 12 |
| 7. | Sulphur* (as $SO_3$) percent, max | 0.1 | 0.1 | 0.1 | 0.14 |
| 8. | Phosphorus* (as $P_2O_5$) percent, max | 0.005 | 0.02 | 0.02 | 0.2 |
| 9. | Cr:Fe, min | 3:1 | 2.8:1 | 3:1 | 1.6:1 |
| 10. | MgO : $Al_2O_3$ | – | 1:4 | – | – |

**Sulphur* (as $SO_3$) *and phosphorus* (as $P_2O_5$) *may be determined as agreed upon by the supplier and the purchaser.*

**Table – 15 : IS Specifications of Chromite for Refractory Industry**
**(IS : 10819-1999)**
**(First Revision Reaffirmed, 2010)**

**a) Chemical**

| Sl. No. | Characteristic (on dry basis) | Grade - I (percent by mass) | Grade - II (percent by mass) | Grade - III (percent by mass) |
|---|---|---|---|---|
| 1. | Loss on ignition | 1.5 max | 1.5 max | 1.5 max |
| 2. | $Cr_2O_3$ | 52 min | 50 min | 48 min |
| 3. | Total iron (as FeO) | 16 max | 18 max | 18 max |
| 4. | $SiO_2$ | 3 max | 7 max | 9 max |
| 5. | MgO | 15 max | 15 max | 15 max |

**b) Physical**

All the refractory grades of chromite are hard, massive, fine-grained, serpentine-free lumpy ores and in the size range -50 mm to + 50 mm.

**Table - 16: IS Specifications of Chromite for Chemical Industry**
**(IS : 4737-1982) ( First Revision, Reaffirmed 2011)**

| Sl. No. | Characteristic (on dry basis) | Requirement ( %) |
|---|---|---|
| 1. | Chromic oxide (as $Cr_2O_3$), percent by mass, min | 44.0 |
| 2. | Total iron (as FeO), percent by mass, max | 20.0 |
| 3. | Alumina (as $Al_2O_3$), percent by mass, max | 14.0 |
| 4. | Silica (as $SiO_2$), percent by mass, max | 7.0 |
| 5. | Lime (as CaO), percent by mass, max | 3.0 |
| 6. | Magnesia (MgO), percent by mass, max | 14.0 |

**Table – 17 : IS Specifications of Chromite Sand for Foundries**
**(IS : 6788-1973) ( Reaffirmed 2008)**

**a) Chemical**

| Sl. No. | Constituent (on dry basis) | Requirement (%) |
|---|---|---|
| 1. | $Cr_2O_3$ | 44 min |
| 2. | $Fe_2O_3$ | 26 max |
| 3. | $SiO_2$ | 4 max |
| 4. | CaO | 0.5 max |
| 5. | MgO | As agreed |
| 6. | Clay | 0.75 max |
| 7. | LOI | 1.0 max |
| 8. | Moisture | 0.5 max |
| 9. | pH value | Between 7.0 and 9.0 |

**b) Physical**

The material shall be of two grades, namely, fine and coarse. The shape of grains should be mostly sub-angular and the fusion point should not be below 1800°C. The fineness of the two grades of chromite sand shall conform to the following requirement:

| I.S. Sieve | Fraction Retained on | |
|---|---|---|
| | Fine Grade (F) (%) | Coarse Grade (C) (%) |
| 710 micron | – | 5 max |
| 500 micron | – | 10 max |
| 355 micron | – | 10-25 |
| 250 micron | 3 max | 10-25 |
| 212 micron | 18 max | 10-20 |
| 150 micron | 70 min | 10-20 |
| 106 micron | | 7-20 |
| 75 micron | | 12 max |
| Pan | 12 max | 6 max |

# INDUSTRY

Chromite is mainly used in metallurgical industry for manufacture of ferro-alloys; e.g., ferro-chrome, charge-chrome and silico-chrome which are used as additives in making stainless steel and special alloy steel. Ferro-alloys are the essential ingredients for the production of high quality special alloy steel as well as mild steel. The demand for ferro-alloys is associated with the production of alloy steel.

Production of ferro-chrome/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. As per the Indian Ferro Alloys Producers' Association, 1,003,598 tonnes and 906,556 tonnes of ferro-chrome/charge-chrome were produced in 2010-11 and 2011-12, respectively. The production of low carbon ferro-chrome was 3,716 tonnes in 2011-12 as compared to 2,016 tonnes in 2010-11. Tata Steel Ltd, Ferro Alloys Corporation Ltd, and Indian Charge-chrome Ltd were amongst the major producers of charge-chrome in India. The charge-chrome contains 50 to 60% chromium and 6 to 8% carbon. Hard lumpy chromite is used for high-carbon ferro-chrome while friable ores and fine briquettes are used for low-carbon ferro-chrome. Briquette fines along with lumpy ores were also consumed in charge-chrome plants.

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

Ferro-chrome when added to steel imparts hardness, strength and augments its stainless characteristics. Carbon content classifies the ferro-chrome 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 percent. Around 2.5 tonnes chrome ore with an estimated power consumption of 4,500 kWh is required to produce one tonne of ferro-chrome.

Ferro Alloys Corpn. Ltd, Garividi, Andhra Pradesh; GMR Technologies & Ind. 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;Utkal Manufacturing Services Ltd, Choudhwar, 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 ferro-chrome producers.

A sizeable quantity of ferrochrome is also produced by units in the small-scale sector Tata Steel Ltd, FACOR and Indian Charge Chrome Ltd, the three major producers of charge-chrome in the country are 100% export-oriented, having a total capacity of 182,500 tpy. Tata Steel with its charge-chrome plant at Bamnipal, Odisha, has a capacity of 55,000 tpy. FACOR has a capacity of 65,000 tpy at its Randia Plant, Bhadrak district, Odisha. Indian Charge Chrome Ltd (merged with Indian Metals & Ferro Alloys Limited), Cuttack district, Odisha has an installed capacity of 62,500 tpy.

Vishnu Chemicals Ltd has plants at Medak, Visakhapatnam (Andhra Pradesh) and Bhilai (Chhattisgarh) to produce chromium chemicals. Sodium dichromate capacity at its plants is reported to be 70,000 tpy. 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.

Plantwise specifications of chromite in respect of major user industries are given in Table - 18.

## Table – 18 : User's Specifications of Chromite in Major Consuming Industries

| Industry/Name and location of plant | Specifications of ore consumed |
|---|---|
| **FERRO-CHROME/CHARGE-CHROME** | |
| **Andhra Pradesh** | |
| Andhra Ferro Alloys Ltd, Kothavalasa, Distt. Vizianagram. | NA |
| Cronimet Alloys India Ltd, Ravivalasa Distt. Srikakulam | Lumps : $Cr_2O_3$ 40% to 50%<br>Fines : $Cr_2O_3$ 40% to 52%<br>Concentrates : $Cr_2O_3$-40% |
| Ferro-Alloys Corp. Ltd, Shreeram Nagar, Distt. Vizianagram. | Lumps : $Cr_2O_3$ 38% to 40%<br>Fines : $Cr_2O_3$ 38% to 40%<br>Friable : $Cr_2O_3$ 48% to 50%<br>Concentrates : $Cr_2O_3$ 48% to 50% |
| JSL Ltd, (formerly Jindal Stainless Steel Ltd,) Jindal Nagar, Distt. Vizianagram. | Lumps : $Cr_2O_3$ 38%<br>Cr:Fe : 2.9 |
| Nav Bharat Ventures Ltd, Paloncha, Distt. Khammam. | Lumps : $Cr_2O_3$ 28-42%<br>Fines : $Cr_2O_3$ 48-50%, 52-54% |
| GMR Technologies & Industries Ltd, Ravivalasa, Distt. Srikakulam. | Lumps $Cr_2O_3$- 38-45%<br>Fines $Cr_2O_3$- 45-55 % |
| VBC Ferro Alloys Ltd, Rudragram, Distt. Medak. | Lumps : $Cr_2O_3$ 36-52% |
| **Chhattisgarh** | |
| Jindal Steel & Power Ltd, Raigarh. | Lumps : $Cr_2O_3$+38%<br>Cr:Fe : 2.9<br>Fines : $Cr_2O_3$+52%, Cr:Fe : 2.6 |
| Deepak Ferro Alloys Ltd, Urla, Distt. Raipur. | Lumps : $Cr_2O_3$ 36-40%<br>Fines : $Cr_2O_3$ 48-52% |
| **Jammu & Kashmir** | |
| Shree Sitaram Industries Pvt. Ltd. Distt. Samba, Jammu | Lumps : $Cr_2O_3$40% to 52%<br>Fines : $Cr_2O_3$40% to +52%, |
| Tawi Chemicals Industries Distt. Samba, Jammu | NA |
| **Odisha** | |
| Balasore Alloys Ltd, (formerly Ispat Alloys Ltd,) Balgopalpur, Distt. Balasore. | Lumps : $Cr_2O_3$ -40%<br>Fines : $Cr_2O_3$ -40 to +52% |
| Ferro Alloys Corp. Ltd, Charge Chrome Division, Randia, Distt. Bhadrak. | Lumps : $Cr_2O_3$ 36% ;<br>Friable : $Cr_2O_3$ 40% ;<br>Concentrates : N.A. |
| IDCOL Ferro Chrome & Alloys Ltd, Jajpur Road.Distt.Cuttak. | $Cr_2O_3$ : 42-52%<br>Cr:Fe : 3.0, $SiO_2$ 6% max |
| Indian Metals & Ferro Alloys Ltd, (Formerly, Indian Charge Chrome Ltd) Choudwar, Distt. Cuttack. | $Cr_2O_3$ : 40-48%<br>$SiO_2$ : 15% max |

(Contd.)

Table - 18 (Concld.)

| Industry/Name and location of plant | Specifications of ore consumed |
|---|---|
| Indian Metals & Ferro Alloys Ltd, Therubali, Distt. Raygada, | Lumps & fines |
| Rohit Ferro Tech. Ltd., (Unit 2) Duburi, Distt. Jajpur. | Lumps, fines & concentrates |
| Tata Steel Ltd, (Formerly OMC Alloys Ltd) Bamnipal, Distt. Keonjhar. | $Cr_2O_3$ : 47% min<br>Size : 0-40 mm |
| **West Bengal** | |
| Rohit Ferro Tech Ltd, (Unit 1) Bishnupur, Distt. Bankura. | Lumps, fines & concentrates |
| Shri Vasavi Industries Ltd, Distt. Bankura. | NA |
| **REFRACTORY** | |
| **Chhattisgarh** | |
| SAIL Refratories Unit, Marauda Distt. Durg. | Friable lumps :<br>$Cr_2O_3$ : 52-54% min, $SiO_2$ : 5% max |
| Vishva Vishal Engineering Ltd, Bhilai, Durg. | $Cr_2O_3$ : 50%<br>$SiO_2$ : 4.5% max<br>$Fe_2O_3$ : 8% |
| **Maharashtra** | |
| Joglekar Refractories & Ceramics (P) Ltd, Rabale, Distt. Thane. | Lumps $Cr_2O_3$ 44% min, CaO < 2%, $Fe_2O_3$ < 21%<br>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. Sundergarh. | $Cr_2O_3$ : 52-54%<br>$Fe_2O_3$ : 15-18% max<br>$SiO_2$ : 3-5% |
| IFGL Refractories Ltd, Kalunga, Distt. Sundergarh. | $Cr_2O_3$ : 55% min, -16 to +22 mesh |
| Maruti Monolithics (Pvt) Ltd, Choudwar, Distt. Cuttack | N.A. |
| TRL Krosaki Refractories Ltd, Belpahar. | $Cr_2O_3$ : 48-50% min |
| Shree Chem Industries (Pvt) Ltd., Mandiyakudar, Distt. Sundergarh | $Cr_2O_3$ : 54%<br>$SiO_2$ : 5-9% min |
| **Tamil Nadu** | |
| Burn Standard Co. Ltd, Salem. | $Cr_2O_3$ : 52-54% min<br>$SiO_2$ : 3-5% max<br>$Fe_2O_3$ : 15-18% max |
| C. Nataraj Ceramics & Chem. Industry Dalmiapuram, Distt. Tiruchirappalli | Lumps, $Cr_2O_3$ + 44%. $Fe_2O_3$ -25% |
| **CHEMICALS** | |
| **Odisha** | |
| Krebs & Cei (India) Ltd, Kalma, Distt. Mayurbhanj. | $Cr_2O_3$ : 48-55% |

## TRADE POLICY

The Ministry of Commerce and Industries, Department of Commerce had come out with the new Foreign Trade Policy (FTP) for the period 2009-2014. As per the present Export-Import Policy as amended and effective from 5.6.2012, the imports of chromium ore lumps, friable ores and concentrates are freely allowed. The export policy on chromite is as follows:

| Tariff Item HS Code | Item | Export Policy | Nature of Restriction |
|---|---|---|---|
| 26100000 | (a) Chrome ore other than (i) beneficiated chrome ore fines/concentrates (maximum feed grade to be less than 42% $Cr_2O_3$); and (ii) those categories of chrome ores mentioned as permitted through STEs (State Trading Enterprises) | Restricted | Exports permitted under licence other than categories given below |
| 26100030 26100040 | (b) Beneficiated chrome ore fines/concentrates (maximum feed grade to be less than 42% $Cr_2O_3$) | STE | Export through MMTC Ltd |
| 26100030 | (c) Chrome ore lumps with $Cr_2O_3$ not exceeding 40% | STE | Export through MMTC Ltd |
| 26100090 | (d) Low silica friable/fine ore with $Cr_2O_3$ not exceeding 52% and silica exceeding 4% | STE | Export through MMTC Ltd |
| 26100090 | (e) Low silica friable/fine chromite ore with $Cr_2O_3$ in the range from 52 to 54% and silica exceeding 4% | STE | Export through MMTC Ltd |

## WORLD REVIEW

World resources of shipping-grade chromite are more than 12 billion tonnes, sufficient to meet conceivable demand for centuries. US chromium resources are mostly in Stillwater Complex in Montana. Other countries which possess sizeable quantities of resources are Finland, India, Russia, Turkey, Brazil and Albania. About 89% of world's 460 million chromium reserves are concentrated in Kazakhstan (46%) and South Africa (43%). The available data on world reserves of chromite are shown in Table - 19.

The world production of chromite decreased from 27.5 million tonnes in 2010 to 26.3 million tonnes in 2011. South Africa was the leading producer, contributing about 41% to the total world production, followed by Kazakhstan (19%) and India (14%). Other significant producers were Turkey, Brazil, Finland and Zimbabwe (Table - 20).

Similarly, upgradation of technological and beneficiation processes such as agglomeration of ore, pre-heating and pre-reduction of furnace feed, closed-furnace technology and recovery of chromium from slags are being followed worldwide.

**Table – 19 : World Reserves of Chromite (Shipping Grade) (By Principal Countries)**

(In '000 tonnes)

| Country | Reserves |
|---|---|
| **World: Total (rounded)** | **460000** |
| India* | 54000 |
| Kazakhstan | 210000 |
| South Africa | 200000 |
| USA | 620 |
| Other countries | NA |

***Source:*** *Mineral Commodity Summaries, 2013.*

* *India's total resources of chromite as per National Mineral Inventory as on 1.4.2010 are 203 million tonnes of which 54 million tonnes are under reserves category.*

**Table – 20 : World Production of Chromium Ores and Concentrates (By Principal Countries)**

(In '000 tonnes)

| Country | 2009 | 2010 | 2011 |
|---|---|---|---|
| **World : Total** | **20100** | **27500** | **26300** |
| Brazil | 365[(e)] | 520 | 567 |
| China[(e)] | 200 | 200 | 200 |
| Finland | 247 | 598 | 693 |
| India* | 3426 | 4262 | 3735 |
| Iran | 274 | 350 | 330 |
| Kazakhstan | 4678 | 5092 | 5059 |
| Oman | 636 | 865 | 617 |
| Pakistan | 300 | 540 | 450 |
| Russia | 416 | 400 | 400 |
| South Africa | 6865 | 10871 | 10721 |
| Turkey | 1770 | 2461 | 2282 |
| Zimbabwe | 194 | 517 | 599 |
| Other countries | 729 | 824 | 647 |

***Source:*** *World Mineral Production, 2007-2011.*

* *Production of chromite in India in 2009-10, 2010-11 and 2011-12 was 3.4 million tonnes, 4.33 million tonnes and 3.76 million tonnes, respectively.*

## Albania

Empire Mining Corp (Canada) explored in Bulqiza Chromite Mining district near Bulqiza town by starting a drilling programme, but involved in litigation over new restriction on its mining licence imposed by the Government. Illyria Mining Industry (IMI) had a contract with the Government to explore and exploit Kalimash and Vlahne zone chromite deposits in northern part of the country to produce 80,000 tpy of lumpy ore and 90,000 tpy of concentrates from 300,000 tpy of r.o.m for exporting to China. The IMI also planned to have a high carbon ferro-chrome plant nearby.

## Canada

Cliffs Natural Resources Inc (USA) reported an inferred mineral resource of 69.5 million tonnes grading 31.9% $Cr_2O_3$ at its Black Thor, Black Label and Big Daddy properties in Ontario. A prefeasibility study for opencast and underground mining, ore processing and shipping facilities and a brownfield ferro-chrome smelter at Greater Sudbury was also conducted.

Azimut Exploration Inc explored for Chormite in James Bay region of Quebec. KWG Resources Inc. explored Big Daddy chromite deposit leading to an indicated resource of 26.4 million tonnes of 39.37% $Cr_2O_3$, an inferred resource of 20.5 million tonnes of 37.47% $Cr_2O_3$ at a cut-off grade of 15% $Cr_2O_3$. Noront Resources Ltd., explored at its Black bird and Eagle Two properties. A combined resource was 5.187 million tonnes of measured category at 34.43% $Cr_2O_3$, 3.678 million tonnes of indicated category at 35.14% $Cr_2O_3$ and 6.124 million tonnes of inferred resource at 25.87% $Cr_2O_3$. Resources Minie'res Pro-Or Inc. explored for chromite at its Menarik property. It also patented a method to increase the Cr:Fe ratio of chromite via carbo-clorination process that selectively removes iron. Diamond Discoveries International Corp. explored its Caribou property near Thetford Mines in Quebec to prove resources and feasibility studies by 2014.

## Finland

Outokumpu planned to increase its ferro-chrome production capacity to 530,000 tpy by 2015. Ruukki Group has chromite mines in South Africa, Turkey, Germany and Zimbabwe. It was developing Mecklenburg mine in South Africa, Waylox mine in Zimbabwe and also expanded Stellite Mine & Mogale Ferro Chrome Alloys facility.

## Kazakhstan

Eurasian Natural Resources Corporation plc (ENRC)'s subsidiary TNC Kazchrome JSC planned to increase its production from 4.4 million tonnes of r.o.m to 4.9 million tonnes in 2013. It also continued construction of 4 DC furnaces for a combined capacity of 440,000 tpy ferro-chrome costing $ 750 million.

## Oman

After South Africa and India, Oman was the third major exporter of chromite to China. Oman Chromite Company and Gulf Mining Group (GMM) were the leading producers of 30% to 42% $Cr_2O_3$ having Cr:Fe ratio as 1.9 to 2.6. GMM had 300,000 tpy capacity in the country's total estimated capacity of 1million tpy. A subsidiary of Muscat Overseas Group formed a joint venture with Indsil Group to build a ferro-chrome plant of 75,000 tpy capacity in Freezone Sohar by 2013. Another facility of 165,000 tpy of ferro-chrome will be built nearby by Metkore Alloys and Industries Ltd. in 2014.

## South Africa

As the leading producer of chromite and ferro-chrome in the world, South Africa had 13 companies producing from 27 mines and 7 companies producing ferro-chrome from 14 plants. Merico Chrome Corpn. has a mine working from lower group seams of Bushveld complex, where ore has upto 49% $Cr_2O_3$, lower i.e. less than 1% silica and high Cr:Fe ratio of 2:1 and lower magnetite content. Thus its production of 40,000 tpy was of metallurgical and refractory grades.

## Zimbabwe

The Ministry of Mines banned export of chrome ore, concentrates, fines and alluvial chrome concentrates from July, 2011. Zimbabwe Alloys Corporation Pvt. Ltd., restarted its chromite mine in 2011. It had stopped its ferro-chrome plant in 2008 due to paucity of funds. Zimasco had plans to enhance chromite production from 0.6 to 1.1 million tonnes per annum by 2015 from underground mines based on stratified deposits in the Great Dyke. Country's ferro-chrome production was affected due to power shortages.

# FOREIGN TRADE

## Exports

Exports of chromite increased to 0.23 million tonnes in 2011-12 from 0.17 million tonnes in the previous year. Out of total chromite exported in 2011-12, bulk share of about 48% was of chromite concentrate while chromite lumps and other chromite together accounted for 52%. Exports were mainly to China (97%) and Japan (2%). In 2011-12, about 10 tonnes of chromium & alloys and scrap was exported mainly to Indonesia and USA (Tables - 21 to 25). The exports of ferro-chrome are covered in 'Ferro-alloys' review.

## Imports

Imports of chromite increased to 136 thousand tonnes in 2011-12 from 86 thousand tonnes in the previous year. Out of total quantity of chromite imported in 2011-12, lumpy chromite accounted for 66% while concentrate and other forms accounted for remaining 34%. Imports were mainly from South Africa (37%), Turkey (30%) and Oman (29%). Imports of chromium & alloys in 2011-12 were 746 tonnes compared to 706 tonnes in the previous year. Imports were mainly from Russia (49%) and UK (17%) (Tables - 26 to 30). The imports of ferro-chrome are covered in 'Ferro-alloys' review.

**Table – 21 : Exports of Chromite : Total (By Countries)**

| Country | 2010-11 | | 2011-12 | |
|---|---|---|---|---|
| | Qty (t) | Value (₹'000) | Qty (t) | Value (₹'000) |
| **All Countries** | **172658** | **2857484** | **225084** | **4888205** |
| China | 149908 | 2468087 | 217536 | 4755062 |
| Japan | 22750 | 389397 | 5500 | 88422 |
| Nepal | - | - | ++ | 70 |
| Spain | - | - | 340 | 10182 |
| Yemen Republic | - | - | 8 | 585 |
| Unspecified | - | - | 1700 | 33884 |

**Table – 22 : Exports of Chrome Ore Lumps (By Countries)**

| Country | 2010-11 | | 2011-12 | |
|---|---|---|---|---|
| | Qty (t) | Value (₹'000) | Qty (t) | Value (₹'000) |
| **All Countries** | **55711** | **855744** | **70853** | **2479648** |
| China | 55711 | 855744 | 70853 | 2479578 |
| Nepal | - | - | ++ | 70 |

**Table – 23 : Exports of Chrome Ore Concentrates (By Countries)**

| Country | 2010-11 | | 2011-12 | |
|---|---|---|---|---|
| | Qty (t) | Value (₹'000) | Qty (t) | Value (₹'000) |
| **All Countries** | **102870** | **1760961** | **107001** | **1725168** |
| China | 79924 | 1368572 | 106807 | 1719515 |
| Spain | - | - | 186 | 5068 |
| Yemen Republic | - | - | 8 | 585 |
| Other countries | 22946 | 392389 | - | - |

**Table – 24 : Exports of Chrome Ore (Others) (By Countries)**

| Country | 2010-11 | | 2011-12 | |
|---|---|---|---|---|
| | Qty (t) | Value (₹'000) | Qty (t) | Value (₹'000) |
| **All Countries** | **14283** | **243861** | **47230** | **683389** |
| China | 14273 | 243771 | 39876 | 555970 |
| Japan | - | - | 5500 | 88422 |
| Spain | - | - | 154 | 5113 |
| Unspecified | | - | 1700 | 33884 |
| Other countries | 10 | 90 | - | - |

**Table – 25 : Exports of Chromium & Alloys and Scrap (By Countries)**

| Country | 2010-11 | | 2011-12 | |
|---|---|---|---|---|
| | Qty (t) | Value (₹'000) | Qty (t) | Value (₹'000) |
| **All Countries** | **18** | **12041** | **10** | **9236** |
| USA | - | - | 4 | 3529 |
| Indonesia | 6 | 3763 | 3 | 2694 |
| Saudi Arabia | 2 | 1229 | 1 | 896 |
| UK | 2 | 1512 | 1 | 411 |
| Kenya | 1 | 332 | ++ | 338 |
| Brazil | - | - | ++ | 304 |
| Philippines | ++ | 251 | ++ | 293 |
| Italy | ++ | 171 | ++ | 213 |
| Nepal | - | - | ++ | 163 |
| Bangladesh | - | - | ++ | 139 |
| Other countries | 7 | 4783 | 1 | 256 |

**Table – 26 : Imports of Chromite : Total (By Countries)**

| Country | 2010-11 | | 2011-12 | |
|---|---|---|---|---|
| | Qty (t) | Value (₹'000) | Qty (t) | Value (₹'000) |
| **All Countries** | **86456** | **904750** | **136204** | **2019641** |
| South Africa | 12074 | 214249 | 50523 | 877089 |
| Turkey | 6953 | 74532 | 41339 | 665921 |
| Oman | 56076 | 475726 | 39082 | 387705 |
| China | 359 | 9441 | 2958 | 37602 |
| USA | 542 | 5874 | 436 | 10747 |
| UAE | 9622 | 112381 | 423 | 8252 |
| Germany | 32 | 855 | 210 | 6586 |
| UK | 48 | 1034 | 216 | 6396 |
| Italy | - | - | 425 | 4432 |
| Thailand | - | - | 174 | 4057 |
| Other countries | 750 | 10658 | 418 | 10854 |

## Table – 27 : Imports of Chrome Ore Lumps (By Countries)

| Country | 2010-11 | | 2011-12 | |
|---|---|---|---|---|
| | Qty (t) | Value (₹'000) | Qty (t) | Value (₹'000) |
| **All Countries** | **80573** | **782223** | **90169** | **1166880** |
| South Africa | 6830 | 107435 | 27989 | 415374 |
| Turkey | 6872 | 72734 | 24659 | 371164 |
| Oman | 56076 | 475726 | 34315 | 343445 |
| China | 96 | 1557 | 2568 | 27406 |
| Italy | - | - | 425 | 4432 |
| USA | 542 | 5874 | 108 | 2659 |
| Thailand | - | - | 54 | 1320 |
| Germany | - | - | 48 | 1051 |
| Albania | - | - | 3 | 29 |
| Other countries | 10157 | 118897 | - | - |

## Table – 28 : Imports of Chrome Ore Concentrates (By Countries)

| Country | 2010-11 | | 2011-12 | |
|---|---|---|---|---|
| | Qty (t) | Value (₹'000) | Qty (t) | Value (₹'000) |
| **All Countries** | **13** | **2866** | **14612** | **256449** |
| Turkey | - | - | 14608 | 255205 |
| Germany | - | - | 4 | 1244 |
| Other countries | 13 | 2866 | - | - |

## Table – 29 : Imports of Chrome Ore (Others) (By Countries)

| Country | 2010-11 | | 2011-12 | |
|---|---|---|---|---|
| | Qty (t) | Value (₹'000) | Qty (t) | Value (₹'000) |
| **All Countries** | **5870** | **119661** | **31423** | **596312** |
| South Africa | 5244 | 106814 | 22534 | 461714 |
| Oman | - | - | 4767 | 44260 |
| Turkey | 81 | 1799 | 2072 | 39553 |
| China | 250 | 5018 | 390 | 10196 |
| UAE | - | - | 423 | 8252 |
| USA | - | - | 328 | 8088 |
| UK | 48 | 1034 | 216 | 6396 |
| Germany | 32 | 855 | 158 | 4290 |
| Thailand | - | - | 120 | 2737 |
| Indonesia | - | - | 60 | 1582 |
| Other countries | 215 | 4141 | 355 | 9244 |

**Table – 30 : Imports of Chromium & Alloys (By Countries)**

| Country | 2010-11 | | 2011-12 | |
|---|---|---|---|---|
| | Qty (t) | Value (₹'000) | Qty (t) | Value (₹'000) |
| **All Countries** | **706** | **404055** | **746** | **500440** |
| Russia | 566 | 302627 | 362 | 233554 |
| UK | 57 | 36109 | 125 | 87481 |
| Netherlands | 8 | 3638 | 77 | 50373 |
| China | 23 | 10017 | 57 | 35761 |
| Germany | 2 | 4598 | 21 | 30048 |
| Austria | ++ | 61 | 46 | 15442 |
| USA | 26 | 25976 | 8 | 14290 |
| France | 1 | 415 | 20 | 13128 |
| Japan | 12 | 14220 | 9 | 7924 |
| Thailand | - | - | 5 | 3476 |
| Other countries | 11 | 6394 | 16 | 8963 |

# FUTURE OUTLOOK

An Expert Committee constituted by the Ministry of Steel, Government of India had recommended the need for detailed exploration in all the potential areas in Odisha, Karnataka and ophiolite belt of North-Eastern region with a view to prognosticate resources to a depth of 500 m in Sukinda belt and estimation of resources in all other potential areas. Ferro-chromium production being electrical energy intensive, the location of such plant will reflect a cost balance between raw materials and electrical energy supply. The Report of the Working Group for 12$^{th}$ Plan Period, Planning Commission, has estimated chromite production at about 7.37 million tonnes by 2016-17 at 8% growth rate. The apparent consumption is estimated at 4.35 million tonnes by 2016-17 at 8% growth rate. The Working Group has also made following recommendations:- (i) Chromite resources are located to the tune of 90% in Odisha, predominantly in Sukinda Valley. The mines are going deeper and ore is becoming friable at lower levels. Exploration of deep seated ore bodies needs to be carried out on urgent basis. (ii) Exploration efforts also need intensification to identify more deposits of chromite in the country. Underground mining technology needs to be promoted. (iii) Development of suitable technology needs to be developed for beneficiation of low grade, friable chromite ore (30% $Cr_2O_3$) fines which are available in sizeable quantity in India. (iv) Further restrictions on exports of chromite ore/concentrates are desirable in view of the limited resources in India and increasing demand for steel industry.