

ZIRCON



# Indian Minerals Yearbook 2012

(Part- III : Mineral Reviews)

**51<sup>st</sup> Edition**

**ZIRCON**

**(FINAL RELEASE)**

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

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# 50 Zircon

**Z**ircon ( $ZrSiO_4$ ) is found usually as a constituent in heavy mineral sand assemblages, which include ilmenite, rutile, leucoxene, monazite and garnet in varying proportions. Zirconium and hafnium are extracted (via their salts) from zircon sand and baddeleyite (an oxide- $ZrO_2$ ). Normally, all zirconium compounds contain between 1.4% and 3% hafnium. Zircon is very stable at high temperatures and has excellent thermal shock resistance, low thermal conductivity and chemical inertness. It finds use chiefly in industries like ceramic, refractory, abrasive, foundry, chemical and speciality alloys. Gem variety of zircon is used in jewellery & astrology.

## RESOURCES

Zircon occurs in close association with other heavy minerals, such as ilmenite, rutile and monazite, along the coastal tracts of the country. Its concentration in the deposits is about 0.6-18.7% of the total heavy minerals. Indian zircons analyse 63-66%  $ZrO_2$ . The AMD has carried out reconnaissance investigations in parts of Gujarat, Maharashtra, Andhra Pradesh, Tamil Nadu, Kerala, Odisha and West Bengal during 2008-12. The resources estimation in these areas is almost complete. The resources of zircon are placed at 32.28 million tonnes as per DAE. The statewise break-up of the resources is given in Table-1.

**Table – 1 : Resources of Zircon**

(In million tonnes)	
State	Resources*
<b>Total</b>	<b>32.28</b>
Andhra Pradesh	12.60
Bihar	0.08
Kerala	6.52
Maharashtra	0.07
Odisha	3.16
Tamil Nadu	9.46
West Bengal	0.39

*Source: Department of Atomic Energy, Mumbai.*

\* Inclusive of indicated, inferred and speculative categories.

As per the UNFC system as on 1.4.2010, compiled by the National Mineral Inventory (NMI) of IBM, the total resources of zircon are placed at 3.13 million tonnes.

## EXPLORATION & DEVELOPMENT

Exploratory agencies comprising GSI, Directorate of Geology, Odisha and AMD carried out exploration in the beach sands deposits which contain heavy minerals, such as ilmenite, rutile, monazite, rare earths, zircon and garnet. For details, the review on 'Ilmenite and Rutile' may be referred.

## PRODUCTION AND PRICES

The production of zircon decreased to 25,996 tonnes in 2011-12 from 33,209 tonnes in the preceding year. The statewise production of zircon is given in Table-2. Prices of zircon as furnished by IREL, KMML and V. V. Mineral are given in Table -3.

**Table – 2 : Production of Zircon  
2009-10 to 2011-12  
(By States)**

(In tonnes)			
State	2009-10	2010-11	2011-12
<b>India : Total*</b>	<b>28049</b>	<b>33209</b>	<b>25996#</b>
Kerala	10716	10338	-
Odisha	5906	5979	-
Tamil Nadu	11427*	16892	-

*Source: Respective Producers*

\* Besides, V.V. Mineral reported 7,900 tonnes production of zircon-sillimanite in 2009-10 and 8,200 tonnes in 2010-11 and 4,600 tonnes in 2011-12.

# : Indian total includes 14,583 tonnes, 5,213 tonnes and 6,200 tonnes production of zircon of IREL, KMML and V.V. Minerals respectively. Statewise break up is not available.

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**Table – 3 : Prices of Zircon, 2009-10 to 2011-12**

(Table-3 Concl.)

(₹ per tonne)

Period	Grade	Price	Remarks
<b>IREL</b>			
<b>2009-10</b>			
w.e.f. 1.4.2009	Q & MK	48000	Ex-works, bagged
	OR	45000	Ex-works, bagged
w.e.f. 12.10.2009	Q & MK	44500	Ex-works, bagged
	OR	40000	Ex-works, bagged
<b>2010-11</b>			
w.e.f. 1.4.2010	Q & MK	44500	Ex-works, bagged
	OR	40000	Ex-works, bagged
w.e.f. 1.5.2010	Q & MK	41000	Ex-works, bagged
	OR	38000	Ex-works, bagged
w.e.f. 30.7.2010	Q & MK	44000	Ex-works, bagged
	OR	41000	Ex-works, bagged
w.e.f. 27.9.2010	Q & MK	46000	Ex-works, bagged
	OR	43000	Ex-works, bagged
w.e.f. 16.11.2010	Q & MK	50000	Ex-works, bagged
	OR	47000	Ex-works, bagged
w.e.f. 31.12.2010	Q & MK	62000	Ex-works, bagged
	OR	57000	Ex-works, bagged
<b>2011-12</b>			
w.e.f. 1.4.2011	Q & MK	62000	Ex-works, bagged
	OR	57000	Ex-works, bagged
w.e.f. 6.4.2011	Q & MK	74000	Ex-works, bagged
	OR	67000	Ex-works, bagged
w.e.f. 2.6.2011	Q & MK	89000	Ex-works, bagged
	OR	82000	Ex-works, bagged
w.e.f. 5.7.2011	Q & MK	107000	Ex-works, bagged
	OR	98500	Ex-works, bagged
w.e.f. 3.10.2011	Q & MK	121500	Ex-works, bagged
	OR	112000	Ex-works, bagged
<b>KMML</b>			
2009-10	NA	44500	–
		to	
		50000	
2010-11	NA	45000	–
	Grade A	50000	–
		to	
		67000	
	Grade B	48000	–
		to	
		65500	
	Grade C	47000	–
		to	
		64000	

Period	Grade	Price	Remarks
2011-12	Grade A	75000	–
		to	
		123000	
	Grade B	73500	–
		to	
		121500	
	Grade C	72000	–
		to	
		120000	
	Zircon Gr.I	118000	–
	Zircon Gr.II	114000	–
<b>V. V. Mineral*</b>			
2009-10	66% min	39546	–
2010-11	NA	27425	–
2011-12	Premium	94546	–
	Standard		

*Source: Department of Atomic Energy, Mumbai.*

*Q: Quilon; MK: Manavalakurichi; OR: Odisha*

*\* Price of zircon-sillimanite is quoted by V. V. Mineral at ₹11,320 per tonne during 2009-10 and ₹11,500 per tonne during 2010-11 and ₹27,848 per tonne during 2011-12.*

## MINING AND PROCESSING

IREL, a Government of India Undertaking, KMML, a Kerala State Government Undertaking and V. V. Mineral, a private sector company are engaged actively in mining and processing of beach sands in India. Zircon is recovered by these companies as a co-product of mining/dredging of heavy mineral sands which include ilmenite, rutile, leucoxene, monazite, sillimanite and garnet. Beach sand deposits containing these minerals are worked from coastal tracts of Manavalakurichi in Tamil Nadu, Chavara in Kerala and Gopalpur in Odisha. As such, no deposit is being worked exclusively for zircon alone. For details regarding mining and processing etc., review on 'Ilmenite and Rutile' may be referred. A project for enhancement of zircon production capacity to 4,000 tpy is being implemented by KMML at Chavara. Plantwise capacity and production of zircon during 2009-10 to 2011-12 are given in Table-4.

(Contd.)

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### INDUSTRY

IREL has set up a dry grinding mill at Chavara, Kerala to produce zirflour for its application in the ceramic industry. A wet grinding mill was also set up at Chavara to produce micro-zir for its specialised application as opacifier. IREL, Chavara, produced 1,444 tonnes and 918 tonnes Zirflour during 2009-10 and 2010-11 respectively, against an installed capacity of 6,000 tpy. In addition, 1,627 tonnes microzir was produced by IREL, Chavara in 2010-11. Besides, IREL set up a small chemical plant at Manavalakurichi, Tamil Nadu to produce zircon frit, zirconium chloride, etc. primarily for making supply of zircon frit to Department of Atomic Energy's Nuclear Fuel Complex (NFC), Hyderabad. A pilot plant (3.5 tpy capacity) was set up at Orissa Sand Complex (OSCOM) to produce a whole range of zirconia stabilised with CaO, MgO and rare earths.

The NFC, Hyderabad has different production facilities which include the zirconium oxide plants for processing of zircon to pure zirconium oxide

and zirconium sponge plants for conversion of zirconium oxide to pure sponge metal at NFC, Hyderabad and Zirconium Complex (ZC) at Pazhayakayal, near Thoothukudi, Tamil Nadu. The latter was commissioned on 27.11.2009.

Besides, the Zircaloy Fabrication Plant produces various zirconium alloy tubings and sheet, rod and wire products. The plant has facilities for reclamation of zircaloy mill-scrap. Zircon sand is processed through caustic fusion, dissolution, solvent extraction (to remove hafnium), precipitation and calcination to obtain zirconium oxide. The pure oxide is subjected to high temperature chlorination, reactive metal reduction and vacuum distillation to obtain homogeneous zirconium sponge. The sponge is briquetted with alloying ingredients and melted in vacuum arc to produce zircaloy ingots. The alloy ingots are extruded to convert into seamless tubes, sheets and bars. The total installed capacity and production of zirconium oxide and zirconium sponge plants at NFC and ZC are furnished in Table - 5.

**Table – 4 : Plantwise Capacity and Production of Zircon, 2009-10 to 2011-12**

(In tonnes)

Company	Location	Specification	Installed capacity (tpy)	Production		
				2009-10	2010-11	2011-12
<b>Total</b>			<b>51,480</b>	<b>28049</b>	<b>33209</b>	<b>25996<sup>#</sup></b>
Indian Rare Earths Ltd	Manavalakurichi, Kanyakumari dist., Tamil Nadu	65% ZrO <sub>2</sub> +HfO <sub>2</sub> (min)	10000	4527	3542	NA
	Chavara, Kollam dist., Kerala	65% ZrO <sub>2</sub> +HfO <sub>2</sub> (min)	12000	8124	7500	NA
	Orissa Sand Complex, Ganjam dist., Odisha	64.25% ZrO <sub>2</sub> (min)	5000	5906	5979	NA
Kerala Minerals & Metals Ltd	Chavara, Kollam dist., Kerala	Zircon Gr.I 64.0% (min) Zircon Gr.II 62% (min)	6480	2592	2838	5213
V. V. Minerals	Keeraikarantattu, Tirunelveli dist., Tamil Nadu	66% min (ZrO <sub>2</sub> +HfO <sub>2</sub> )	18,000 (654000 - Total Heavy Minerals)	6900*	13350*	6200*

**Source:** Respective Producers and Department of Atomic Energy, Mumbai.

<sup>#</sup> Total includes 14,583 tonnes of Zircon of IREL., Plantwise breakup is not available.

\* Besides, 7,900 tonnes production of zircon-sillimanite is reported in 2009-10, 8,200 tonnes in 2010-11 and 4600 tonnes in 2011-12.

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**Table – 5 : Production at Zirconium Oxide and Sponge Plants of DAE at NFC and ZC  
2009-10 to 2011-12**

(In tonnes)

Plant/Location	Installed capacity (tpy)	Production		
		2009-10	2010-11	2011-12
Zirconium Oxide Plant, NFC, Hyderabad	500	527.61	544.02	545.11
Zirconium Sponge Plant, NFC, Hyderabad	400	375.84	380.23	351.41
Zirconium Oxide Plant, ZC, Palayakayal	500	18.50	276.76	NA
Zirconium Sponge Plant, ZC, Palayakayal	250	0.73	80.27	NA

*Source: Department of Atomic Energy, Mumbai.*

Besides, Bhalla Chemical Works Pvt Ltd operates three plants; two of which are located at Gurgaon, Haryana to manufacture zirconium derivatives ( $ZrO_2$ ), based on imported zircon ore (capacity 10,000 tpy) and zirconium silicate opacifiers (capacity 5,000 tpy). One plant of the company in Rajasthan manufactures zirconium oxychloride crystals and special zirconias (capacity 10,000 tpy).

### USES & CONSUMPTION

Zircon's exceptional qualities of hardness and durability makes it a must-use for the manufacture of ceramics and refractory tiles and also for a range of other high-tech applications such as armour plating on military aircraft, heat shield in space shuttles and potentially as solid oxide fuel cells in hydrogen powered vehicles and in many industrial and chemical applications. Owing to its chemical inertness, very low heat conductivity, high specific gravity, low expansion, good resistance to abrasion, high melting point and no shrinkage on being heated up to  $1750^{\circ}C$ , zircon is found to be an outstanding refractory material.

In foundry industry, zircon is used as facing for foundry moulds as it increases the resistance to metal penetration and affords a uniform finish to castings. Zircon sand is preferred to silica sand because of its uniform size, higher melting point, low thermal expansion and resistance to molten metal, acidic chemicals, slag, etc. Zircon containing 64%  $ZrO_2$  is used generally for foundry applications.

In ceramic industry, finely ground high-grade zircon and zirconium dioxide are used as opacifier in melts for vitreous enamelling and as pigment in ceramic glazes. Zirconium oxide is considered as a potential ceramic material for high temperature applications like engine components. Usually, zircon containing 65%  $ZrO_2$  is preferred in ceramics. The toughened zirconia finds its use in ceramic coatings in jet aircraft engines and in other applications where strength and high temperature oxidation resistance are important. Zirconia ceramics are also used in automobile sensors for the microprocessor control of engines.

In chemical industry, its property of high resistance to corrosion is used where dry chlorine, hydrochloric acid and caustic alkalis are involved. Abrasive and grinding wheels made from zircon sands are used for polishing optical glasses.

Zirconium and zirconium powders are used in ammunition, primers, detonation caps, flashlight mixtures, radio tubes and in various heating elements. Hafnium-free zirconium metal is used as cladding material in atomic reactors due to its low absorption cross section for thermal neutron. Green, blue, indigo, red, orange coloured zircon is used as a natural gemstone and also processed to produce cubic zirconia - a synthetic gemstone resembling diamond.

Consumption of zircon/zirflor decreased to 12,135 tonnes in 2011-12 from 21,818 tonnes in 2010-11. Consumption of zircon/zirflor during 2009-10 to 2011-12 is furnished in Table - 6.

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**Table – 6: Consumption of Zircon/Zirflor  
2009-10 to 2011-12  
(By Industries)**

Industry	(In tonnes)		
	2009-10	2010-11	2011-12
<b>All Industries</b>	<b>15556</b>	<b>21818</b>	<b>12135</b>
Ceramic	10184	15347	8947
Foundry	2855	3292	1972
Refractory	1125	1390	487
Chemical	698	854	323
TV face plates/glass	497	608	283
Others*	197	327	123

*Source: Department of Atomic Energy, Mumbai.*

*\* Including electrode, abrasive and other industries.*

*Note: Consumption relates to sales figures of IREL. In addition, sales by KMML is 2,601 tonnes, in 2009-10 for which industrywise break-up is not available. KMML's sales figures for 2010-11 and 2011-12 are not available. Domestic sales figures of M/s V.V. Mineral are also not available.*

## POLICY

Zircon was classified as a 'prescribed substance', as per notifications issued under Atomic Energy Act, 1962. From the revised list notified vide S. O. No. 61(E), dated 20.1.2006, zircon has been deleted, subject to the condition that the mineral shall remain a prescribed substance till the policy on exploration of beach sand minerals notified on 6.10.1998, is adopted/revised/modified by Ministry of Mines or till 1.1.2007, whichever occurs earlier and shall cease to be so thereafter.

As per the Foreign Trade Policy, 2009-2014 and the effective policy on export and import, zirconium ores and concentrates under HS Code 26151000 can be imported/exported freely.

## WORLD REVIEW

Identified world resources of zircon are estimated to exceed 60 million tonnes. World reserves of zirconium are placed at 48 million tonnes in terms of ZrO<sub>2</sub> and of hafnium are placed at 660 thousand tonnes. Australian mineral sand deposits hold the world's largest reserves of zirconium (44%), followed by South Africa (29%). The world production of zirconium minerals was estimated at 1.6 million tonnes in 2011. Australia, South Africa, Indonesia and USA are the principal producers of zirconium minerals. (Tables - 7 and 8). Zircon finds its application in ceramics, zirconia, chemicals, refractory and foundry & castings which accounts for zircon's total world estimated consumption of about 1.3 million tonnes.

**Table – 7: World Reserves of Zirconium  
(By Principal Countries)**

Country	Reserves
(In '000 tonnes)	
<b>World : Total (rounded)</b>	<b>48000</b>
<b>Zirconium</b>	<b>47800</b>
<b>Australia</b>	
Zirconium	21000
<b>China</b>	
Zirconium	500
<b>India</b>	
Zirconium	3400
<b>Mozambique</b>	
Zirconium	1200
<b>South Africa</b>	
Zirconium	14000
<b>USA</b>	
Zirconium	500
<b>Other countries</b>	
Zirconium	7200

*Source: Mineral Commodity Summaries, 2013.*

*\* As per Department of Atomic Energy, Mumbai, the total resources of zircon are estimated at 32.28 million tonnes.*

**Table – 8 : World Production of  
Zirconium Minerals  
(By Principal Countries)**

Country	(In '000 tonnes)		
	2009	2010	2011
<b>World : Total</b>	<b>1175</b>	<b>1310</b>	<b>1612</b>
Australia	431	549	762
Brazil #	34	23	25 <sup>(e)</sup>
China <sup>(e)</sup>	32	34	34 <sup>(e)</sup>
India* <sup>(e)</sup>	28	33	33 <sup>(e)</sup>
Indonesia <sup>(e)</sup>	63	50	127
Mozambique	21	37	44
South Africa	392	381	383
Ukraine <sup>(e)</sup>	35	35	35
USA	100	110	115
Vietnam <sup>(e)</sup>	19	24	24
Other countries	20	34	30

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

*# Including caldasite rock containing zircon and baddeleyite.*

*\* As per Department of Atomic Energy, Mumbai, India's production of zircon in 2009-10, 2010-11 and 2011-12 was 28,049 tonnes, 33,209 tonnes and 25,996 tonnes respectively.*

## Australia

Improved market conditions led Iluka Resources to significantly increase its zircon production. The increase was mainly due to start of its operations in Eucla Basin, South Australia and its operations in the Murray Basin, Victoria. Development of Dubbo Zirconia project of Alkane Resources Ltd was continuing in New South Wales. In 2010, the company operated a demonstration pilot plant to confirm process flow sheet. In 2011, the company completed a definitive feasibility study of an operation with 400,000 tpy of ore throughout for an initial 20 years period. The company also began a preliminary assessment of a one million tonne per year operation.

The mine & plant designs of Astron Ltd's Donald mining project in Victoria were completed and continued work on feasibility study. The deposit is estimated to contain 305 million tonnes reserves with 6.2% heavy minerals comprising 19% zircon. The Western Australian project is estimated to contain 850,000 tonnes zircon reserves and with 40,000 tpy rate of production, it may have a mine life of 17 years.

Iluka planned to expand operations at Twin Hills and Depot Hill North near Eneabba and planned to produce 25,000 metric tonnes per year of zircon.

Matilda Zircon Ltd continued the development of the Keysbrook deposit, 70 kilometers south of Perth. Matilda planned to begin mine construction in 2012 and to begin mining in 2013. The Keysbrook project had a resource of 66 Mt of ore containing 12 weight-percent zircon. A project on the Tiwi Islands, the Kilimirka project, was expected to begin production in 2013, subject to economic assessment.

## Canada

Titanium Corp. continued its research in recovery of bitumen, volatile organic compounds and heavy minerals, including zircon from mined oil sand tailings. Titanium Corp. completed a demonstration pilot and recovered 95% of the heavy minerals as concentrate. Titanium Corp. was continuing with a pre-commercialization phase.

## China

Inner Mongolia Western Zirconium Co. Ltd planned to build a 100,000 tpy zirconium oxychloride plant, which would bring the total zirconium oxychloride capacity in China to 400,000 tpy.

## Mozambique

Pathfinder Minerals Plc acquired IM Minerals Ltd and its Mosebase and Naburi titanium-zircon sands deposits. Pathfinder had expected to begin mine construction in 2013 and to begin production in 2014. Expected annual production included 65,000 tonnes of zircon.

## Russia

Lukoyanovskoye heavy mineral sands deposit of ARZM Uranium Holding Co. was under development. In 2012 the company planned to launch a pilot development program by hydraulic bore-hole mining. The mine would have 1.5 million tpy ore sands processing plant by 2014, including up to 35,000 tpy of zircon.

## Senegal

After completion of feasibility study, construction of mine and separation plants were to begin in 2011 at the Mineral Deposits Ltd's Grande Cote heavy minerals deposit. Initial production is slated to start in 2013. After full commissioning, the mine is expected to produce 85,000 tpy of zircon besides other heavy minerals totalling 575,000 tpy. Mineral Deposits Ltd continued with development and construction of the mine and separation plants at Grande Cote heavy-minerals deposit, and initial production was scheduled for 2013. Once the Grande Cote mine and separation plants are fully commissioned, TiZirish is expected to produce an average of 575,000 tonnes per year of ilmenite, 85,000 tonnes per year of zircon and small amounts of rutile and lucoxene during a mine life of 20 years.

## South Africa

The Fairbreez Mine at the KZN operation was in the process of obtaining regulatory and environmental approvals, and operations at Fairbreeze were expected to start in 2014, with a life expectancy of 15 years.

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**USA**

The US producers of zircon were Du Pont and Iluka Resources. They produced zircon from their heavy mineral sands operations near Starke, Florida and Stony Creek, Virginia, respectively. Industrial Minerals Corp. Ltd (IMC) continued development of Coos Bay heavy minerals project.

**FOREIGN TRADE**

**Exports**

Exports of zirconium ores and concentrates rose sharply to 43,532 tonnes in 2011-12 from 19,535 tonnes in the previous year. Exports were mostly to China. Exports of zirconium and scrap were sharply increased 645 tonnes in 2011-12 as against 26 tonnes in 2010-11 (Tables - 9 and 10).

**Imports**

Imports of zirconium ores and concentrates decreased considerably to 44,400 tonnes in 2011-12 from 54,312 tonnes in the previous year. Main suppliers were Australia and South Africa. Imports of zirconium and scrap were 7 tonnes in 2011-12 against 12 tonnes in the previous year. Imports were mainly from Italy and Germany (Tables - 11 and 12).

**Table – 9 : Exports of Zirconium Ores & Conc. (By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
<b>All Countries</b>	<b>19535</b>	<b>408265</b>	<b>43532</b>	<b>1772097</b>
China	16470	245673	38235	1213512
UAE	711	32640	878	106875
Germany	-	-	812	87847
Japan	40	2851	667	76537
Saudi Arabia	181	9823	500	72336
Chinese Taipei/ Taiwan	514	35218	677	64510
Iran	300	15858	250	31301
British Virgin Islands	-	-	365	31273
USA	-	-	286	24706
Netherlands	382	22138	239	22442
Other countries	937	44064	623	40758

Source: DGCI&S, Kolkata.

**Table – 10 : Exports of Zirconium & Scrap (By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
<b>All Countries</b>	<b>26</b>	<b>6798</b>	<b>645</b>	<b>112251</b>
Saudi Arabia	-	-	315	45386
USA	++	466	123	27107
Iran	-	-	200	23408
Japan	++	3731	1	14928
Bangladesh	-	-	5	813
Jordan	-	-	++	439
Sri Lanka	-	-	1	162
Botswana	-	-	++	8
Other countries	26	2601	-	-

Source: DGCI&S, Kolkata.



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**Table – 11 : Imports of Zirconium Ores & Conc.  
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
<b>All Countries</b>	<b>54312</b>	<b>2665929</b>	<b>44400</b>	<b>4320340</b>
Australia	44250	2215562	34789	3452568
South Africa	4848	212102	3124	240975
China	1406	58500	1558	179428
Belgium	-	-	521	66220
Ukraine	1379	61459	560	58257
UAE	216	11032	428	51557
Uzbekistan	-	-	365	43491
Vietnam	100	5204	300	31428
Japan	-	-	192	29436
Nigeria	69	1996	1020	27185
Other countries	2044	100074	1543	139795

Source: DGCI&S, Kolkata.

**Table – 12 : Imports of Zirconium & Scrap  
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
<b>All Countries</b>	<b>12</b>	<b>24349</b>	<b>7</b>	<b>15090</b>
Italy	6	4941	4	4484
USA	1	2983	++	2249
Germany	++	186	2	1993
Sweden	3	8860	++	1933
Japan	++	128	++	1414
China	1	3069	1	860
Hong Kong	++	110	++	739
Singapore	-	-	++	580
France	1	975	++	439
UK	++	275	++	389
Other countries	++	2822	++	10

Source: DGCI&S, Kolkata.

## FUTURE OUTLOOK

The Working Group on Mineral Exploration & Development (other than coal & lignite) for the 12th Five Year Plan (2012-17) has estimated the projected demand for next five years

between 86,000 and 90,000 tpy at the GDP growth rate of 8%, 9% and 10%. The projected production is expected to remain at the level of 30,000-35,000 tpy with the balance to be met by way of imports.