Indian Minerals Yearbook 2013

(Part- III : MINERAL REVIEW

52nd Edition

ILMENITE AND RUTILE

(FINAL RELEASE)

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

July, 2015

27 Ilmenite & Rutile

India is endowed with large resources of heavy minerals which occur mainly along coastal stretches of the country and also in inland placers. Heavy mineral sands comprise a group of seven minerals, viz, ilmenite, leucoxene (brown ilmenite), rutile, zircon, sillimanite, garnet and monazite. Ilmenite ($FeO.TiO_2$) and rutile (TiO_2) are the two chief minerals of titanium. Titanium dioxide occurs in polymorphic forms as rutile, anatase (octahedrite) and brookite. Though, brookite is not found on a large-scale in nature, it is an alteration product of other titanium minerals. Leucoxene is an alteration product of ilmenite and found associated with ilmenite.

RESOURCES

Ilmenite and rutile along with other heavy minerals are important constituents of beach sand deposits found right from Moti Daman-Umbrat coast (Gujarat) in the west to Odisha coast in the east. These minerals are concentrated in five well defined zones:

* Over a stretch of 22 km between Neendakara and Kayamkulam, Kollam district, Kerala (known as 'Chavara' deposit after the main mining centre).
* Over a stretch of 6 km from the mouth of Valliyar river to Colachal, Manavalakurichi and little beyond in Kanyakumari district, Tamil Nadu (known as MK deposit).
* On Chatrapur coast stretching for 18 km between Rushikulya river mouth and Gopalpur lighthouse with an average width of 1.4 km in Ganjam district, Odisha (known as 'OSCOM' deposit after IREL's Orissa Sands Complex).
* Brahmagiri deposit stretches for 30 km from Girala nala to Bhabunia villages with an average width of 1.91 km in Puri district, Odisha.
* Bhavanapadu coast between Nilarevu and Sandipeta with 25 km length and 700 m average width in Srikakulam district, Andhra Pradesh.

The AMD of the Department of Atomic Energy has been carrying out exploration of these mineral deposits. So far, about 3,799 km coastal tract and 160.72 sq km inland areas in Tamil Nadu and West Bengal have been investigated for over six decades by AMD. The ilmenite resources estimation for the areas explored up to 2012 has been completed and the resources are up from 520.38 million tonnes to 593.50 million tonnes (including leucoxene), inclusive of indicated, inferred and speculative categories. Resource estimation for the areas explored during 2012-13 is under progress. The most significant deposits which are readily available and attract attention of industry for large-scale operations are as follows:

State/Deposit	Ilmenite reserves (In million tonnes)
Andhra Pradesh	
1. Bhavanapadu Hukumpet	10.18
2. Kakinada (Phase I-VIII)	13.84
3. Kalingapatnam	5.80
4. Narasapur	2.92
5. Nizampatnam	19.26
6. Srikurman (South)	8.60
7. Visakhapatnam (Bhimunipatnam)	2.88
8. Amalapuram (Phase I-III)	3.10
9. Pandurangapuram-Voderevu (Bapatla-Chirala coast)	10.39
10. Vetapalem Coast (Chirala coast)	5.31
	82.28
Kerala	
1. Chavara Barrier beach	13.17
2. Chavara Eastern Extension (Phase-I)	17.02
3. Chavara Eastern Extension (Phase-II)	49.26
4. Trikkunnapuzha-Thotapally Beach & Eastern Extension	9.50
5. Alapuzha-Kochi	5.88
	94.83
Maharashtra	
Ratnagiri	3.68
Gujarat	
Moti Daman-Umbrat coast	2.77
Odisha	
1. Brahmagiri (Phase IV)	37.98
2. Chatrapur	26.72
3. Gopalpur (Phase I-IV)	6.39
	71.09
Tamil Nadu	
1. Kudiraimozhi	22.86
2. Ovari-Periyatalai-Manapadu (Teri)	24.01
3. Sattankulam Teris	41.26
4. Cuddalore-Pudupattuchavadi	4.67
5. Vayakallur (Block I-IV)	3.54
6. Manavalakurichi	2.04
7. Midalam	1.64
	100.02

Source: *Department of Atomic Energy, Mumbai.*

The average grade of total heavy minerals in these deposits is 10-25% of which 30-35% is ilmenite. The overall statewise reserves of ilmenite and rutile which occur together in beach sand deposits are given in Table-1.

Table – 1 : Resources of Ilmenite and Rutile

(In million tonnes)

State	Total in situ #
Ilmenite* : Total	**593.50**
Andhra Pradesh	163.05
Jharkhand/Bihar	0.73
Gujarat	2.77
Kerala	145.70
Maharashtra	3.74
Odisha	96.44
Tamil Nadu	179.02
West Bengal	2.05
Rutile : Total	**31.35**
Andhra Pradesh	10.25
Jharkhand/Bihar	0.01
Gujarat	0.02
Kerala	8.41
Maharashtra	(2300 tonnes)
Odisha	4.47
Tamil Nadu	8.00
West Bengal	0.19

Source: *Department of Atomic Energy, Mumbai.*
 # Inclusive of indicated, inferred and speculative categories.
** Including leucoxene.*

As per the UNFC system as on 1.4.2010 compiled by IBM, the total resources of titanium minerals are placed at 394 million tonnes comprising ilmenite (335.6 million tonnes), rutile (13.4 million tonnes), leucoxene (1.0 million tonnes), anatase (3.3 million tonnes) and titaniferous magnetite (40.6 million tonnes).

EXPLORATION & DEVELOPMENT

IREL carried out exploration work at Chatrapur sand deposit, district Ganjam, Odisha for the ilmenite & rutile, zircon, monazite, sillimanite and garnet. The area explored was 2464.054 hectares, work started by AMD, DAE in the year 1969. A total of 394 boreholes was drilled and 2349 samples for mineralogical analysis have been done during the year 2012-13 and future plan is to drill 942 boreholes in next three years. The deposit is beach placer deposit, length 18 km along the coast of Bay of Bengal between Rushikulya river and Gopalpur with an average width of 1.4 km.

The survey and exploration carried out by AMD during 2008-09, 2009-10, 2010-11, 2011-12 and 2012-13 included parts of West Bengal, Odisha, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Maharashtra and Gujarat. The details of exploration activities carried out by AMD during 2012-13 are furnished in Table-2.

Table – 2 : Exploration Activities by AMD for Ilmenite, Rutile, Monazite, Zircon and other Heavy Minerals, 2012-13

Location	Activity		Remarks
	Reconnaissance survey (sq km)	Detailed survey (sq km)	
Parts of Odisha, Andhra Pradesh, Karnataka and Tamil Nadu	256.80 (Coastal tracts) Inland areas	13.04	Reconnaissance survey was undertaken to delineate potential heavy mineral concentrations along the coastal and inland tracts: (a) Eastern extension of Brahmagiri deposit, District Puri, Odisha records THM ranging from 1.73 to 24.78% with an average of 5.76% upto the depth of 18 m. (b) Joydebkasba-Dhobimu-Lechanpur sector, District Balasore, Odisha records THM upto 18% with an average of 1.15%. (c) Tiruppulani block, District Ramanathapuram, Tamil Nadu records average THM of about 4%. (d) Pudumadam block, Ramnad basin, District Ramanathapuram, Tamil Nadu records THM upto 35.87% with an average of 2.53%. (e) Murudeshwar-Dhareshwar tract, District Uttar Kannada, Karnataka records THM of 2 to 12%. In addition to reconnaissance surveys, detailed survey was carried out in Malikipuram deposit, East Godavari district, Andhra Pradesh to upgrade the resources from inferred to indicated category. Further work is in progress.

Source*: Department of Atomic Energy, Mumbai.*

PRODUCTION AND PRICES

Ilmenite

The production of ilmenite at 739 thousand tonnes in 2012-13 decreased by 2% as compared to that in the preceding year. Tamil Nadu was the leading producer of ilmenite during the year under review, contributing 66% of the total production followed by Odisha 25% and Kerala 9 per cent.

Rutile

The production of rutile at 17 thousand tonnes in 2012-13 registered nominal decrease as compared to that in the previous year. Odisha was the leading producer of rutile accounting for 43% of the total production followed by Tamil Nadu 38% and Kerala 19 per cent.

Production and prices of ilmenite and rutile are furnished in Tables - 3 to 5.

Table – 3: Production of Ilmenite and Rutile 2010-11 to 2012-13 (By States)

(In tonnes)

State	2010-11	2011-12(R)	2012-13(P)
ILMENITE			
India : Total	**663217**	**751163**	**738524**
Kerala	113240	86454	68555
Odisha	206139	188000	184570
Tamil Nadu	343838	476709	485399
RUTILE			
India : Total	**26593**	**16598**	**16527**
Kerala	5969	5664	3075
Odisha	8043	7874	7170
Tamil Nadu	12581	3060	6282

Table – 4 : Prices of Rutile 2010-11 to 2012-13

(₹ per tonne)

Year	Grade	Price	Remarks
IREL			
2010-11			
2010-11	Q	35749	Ex-works, Bagged
2010-11	MK	35478	Ex-works, Bagged
2010-11	OR	35748	Ex-works, Bagged
2011-12			
2011-12	Q	81187	Ex-works, Bagged
2011-12	MK	89241	Ex-works, Bagged
2011-12	OR	86466	Ex-works, Bagged
2012-13			
2012-13	Q	121578	Ex-works, Bagged
2012-13	MK	121767	Ex-works, Bagged
2012-13	OR	117048	Ex-works, Bagged
	SR (TiO_2)		
KMML			
2010-11	93.2% (TiO_2)	40,000	
2011-12	93.2% (TiO_2)	1.09,000	
2012-13	93.2% (TiO_2)	1,09,000	
V.V. Mineral (Average)			
2010-11	NA	37565	Average
2011-12	Premium & Standard	70610	Average
2012-13	-do-	116158	Average

Source: *Department of Atomic Energy, Mumbai.*
Note*: Q : Quilon; MK: Manavalakurichi; OR: Odisha*

Table – 5: Prices of Ilmenite 2010-11 to 2012-13

(₹ per tonne)

Period	Grade	Price	Remarks
IREL			
2010-11			
2010-11	Q	5366	Ex-works, loose
2010-11	MK	4989	Ex-works, loose
2010-11	OR	3916	Ex-works, loose
2011-12			
2011-12	Q	10337	Ex-works, loose
2011-12	MK	11084	Ex-works, loose
2011-12	OR	12298	Ex-works, loose
2012-13			
2012-13	Q	17420	Ex-works, loose
2012-13	MK	16693	Ex-works, loose
2012-13	OR (SR/TiO_2)	14765	Ex-works, loose
2012-13	OR (Non SR/TiO_2)	14958	Ex-works, loose
KMML			
2010-11	59.88% TiO_2	8050	
2011-12	59.88% TiO_2	12650	
2012-13	59.88% TiO_2	17900	

(Contd.)

Table - 5 (Concld.)

Period	Grade	Price	Remarks
V.V. Mineral (Average)			
2010-11	NA	5940	
2011-12	NA	11174	
2012-13	NA	15269	
BMC			
2010-11	TiO_2 : 48-50%	4500 (US$100)	f.o.b.Thoothukudi
2011-12	TiO_2 : 49-51%	6500 (US$130)	f.o.b.Thoothukudi
2012-13	TiO_2 : 49-51%	8500 (US$140)	f.o.b.Thoothukudi
DCW Ltd			
2010-11	NA	6375	
2011-12	NA	7693	
2012-13	NA	20552	

Source: *Department of Atomic Energy, Mumbai.*
Note*: Q: Quilon; MK: Manavalakurichi; OR: Odisha*

MINING & PROCESSING

Mining and processing of beach sand are carried out by the IREL, a Government of India Undertaking, KMML, a Kerala State Government Undertaking and two private sector producers; viz, M/s V. V. Mineral, Thoothukudi (Tamil Nadu) and M/s Beach Minerals Co. Pvt. Ltd, Kuttam (Tamil Nadu). IREL is exploiting beach sand deposits located at Chavara in Kerala, Gopalpur in Odisha and Manavalakurichi in Tamil Nadu.

At IREL, Chavara, Beach Sand was collected over a strech of 22 km between Neendakara and Kayamkulam in Kerala and was transported to plant site. The unit has adopted wet mining operations involving use of two Dredge and Wet Concentrator (DWC) of 100 tph capacity each to exploit the inland deposits away from the beaches. Chavara ilmenite is the richest in TiO_2 content (75.8% TiO_2) and has great demand in India and abroad for manufacture of pigments.

At Manavalakurichi, deposit is spread over 300 hectares at Thuthoor-Ezudesam villages, Vilavancode tehsil, district Kanyakumari, Tamil Nadu. All the raw sand required to operate the separation plant at its full capacity is collected from nearby beaches by the fishermen of surrounding villages and supplied to the unit at cost. Deposits are also exploited by DWC of 100 tph capacity. Manavalakurichi is next to Chavara in terms of TiO_2 content which is more than 55%.

The sand deposits of OSCOM at Chatrapur, district Ganjam extend along the coast of Bay of Bengal with an average width of 1.4 km and average depth of 7.5 m. Mining operations involve suction dredging to 6 m depth below water level on a much larger scale (500 tph) augmented by a smaller sized (100 tph) supplementary. The ilmenite from OSCOM is inferior in grade in terms of TiO_2 content (50%) in comparison to Chavara and Manavalakurichi. The Synthetic Rutile Plant of OSCOM is presently not working. As a result, the majority of OSCOM ilmenite produced today is finding its way in the international market as feed stock for production of both slag grade and anatase grade pigment.

In dry mining, beach washings laden with 40-70% Heavy Minerals (HM) are collected through front end loaders and bulldozers for further concentration to 90% HM at land-based concentrators. Dry mining is very simple and economic as well. However, it is facing opposition by local people on the ground that removal of sand causes sea erosion. Therefore, collection of beach washings has reduced significantly in recent past.

As an alternate approach, IREL has adopted wet mining involving dredging and wet concentration (DWC) from inland areas away from the beach lines. In this mode, an artificial pond is created, the sand bed is cut and the slurry is pumped to spiral concentrator for removal of quartz. Manavalakurichi was the first plant to install a DWC (100 tph) followed by one (500 tph) at OSCOM and two (each 100 tph) at Chavara. The concentrate (90% HM) of beach washing plant from DWC is further upgraded to 97% HM grade at a Concentrate Upgradation Plant (CUP) before sending it to Mineral Separation Plant (MSP).

KMML collects seasonal accretions of heavy mineral sand from the beach front. The pit so formed gets filled by fresh accretions of heavy mineral sand. The mineral sand is collected using bulldozers and wheel loaders and transported in tippers to Mineral Separation Plant.

The mineral separation plants use variety of equipment such as gravity concentrators, high tension electrostatic separators and magnetic separators. Making use of difference in physical properties like electrical conductivity, magnetic susceptibility and difference in specific gravity, etc., individual minerals like ilmenite, rutile, zircon, sillimanite and garnet are separated. The mined beach sands are pre-concentrated and dried after sieving (30-mesh) to separate the heavies from rejects. The heavy minerals are passed through electrostatic separators where conducting minerals – ilmenite and rutile – are separated from other non-conducting minerals. Ilmenite and rutile are further subjected to low-intensity magnetic separators where magnetic fraction - ilmenite is separated from rutile.

Similarly, non-conducting fractions are subjected to high-intensity magnetic separators where weak magnetic fraction (monazite and garnet) is separated from non-magnetic fraction (zircon and sillimanite). The fractions are further processed on wind tables to separate garnet from monazite and sillimanite from zircon.

IREL carried out trial runs of expansion of capacity of ilmenite to 200,000 tonnes at Chavara plant in Kerala and has commissioned it successfully. The company has plan to expand MSP capacity at OSCOM to produce 4.7 lakh tonnes of ilmenite and associated minerals by the end of 2014. Trimex Group is understood to be gearing up to begin its 200,000 tpy ilmenite, 6,000 tpy zircon, 60,000 tpy garnet and 50,000 tpy sillimanite, rutile project in Srikakulam district, Andhra Pradesh.

Installed capacity and production of ilmenite, rutile and other associated heavy minerals by various separation plants are furnished in Table-6.

Table – 6 : Installed Capacity & Production of Ilmenite, Rutile and Other Heavy Minerals, 2010-11 to 2012-13

(In tonnes)

Company/ Location	Mineral	Specification	Installed capacity (tpy)	Production		
				2010-11	2011-12	2012-13
Indian Rare Earths Ltd						
Manavalakurichi,	Ilmenite	55% TiO_2 (min)	90000	43222	35009	33260
Distt. Kanyakumari,	Rutile	94% TiO_2 (min)	4000	1628	1534	1381
Tamil Nadu.	Zircon	65% ZrO_2+HfO_2 (min)	10000	3542	3182	2688
	Sillimanite	58% Al_2O_3	–	150	-	-
	Monazite	96% pure	6000	-	-	-
	Garnet	97% pure (min)	8500	14909	11797	10240
Chavara,	Ilmenite	58% TiO_2 (min)	154000	74320	43051	23309
Distt. Kollam,	Rutile	95% TiO_2 (min)	10000	3556	2769	1224
Kerala.	Zircon	65% ZrO_2+HfO_2 (min)	12000	7500	5231	1992
	Rare Earths	–	4500*	NA	-	-
	Sillimanite	58% Al_2O_3 (min)	10000	8243	7667	4936
	Leucoxene	–	–	110	529	105
	Zirflor	-200 mesh	6000	2545	1886	1161
	(includes Microzir)	-300 mesh	500	-	-	940
Orissa Sands Complex,	Ilmenite	50.25% TiO_2 (min)	220000	206138	188000	184570
Distt. Ganjam,	Rutile	94.25% TiO_2 (min)	10000	8044	7874	7170
Odisha.	Zircon	64.25% ZrO_2+HfO_2 (min)	5000	5979	6170	6235
	Sillimanite	56.5% Al_2O_3 (min)	10000	17889	17489	12314
	Garnet	93.5% garnet (min)	24000	18474	19889	23898
Kerala Minerals & Metals Ltd						
Chavara,	Ilmenite	59.88% TiO_2	63000	38920	43403	45240
Distt. Kollam.	Rutile	93.20% TiO_2	4000	2413	2600	1850
Kerala.	Zircon	64.81% ZrO_2	6480	2838	5213	3960
	Sillimanite	NA	3600	-	339	1265
V.V. Mineral						
Distt. Thoothukudi,	Ilmenite	51.0-52.5% TiO_2	450000	372000	405700	447000
Tamil Nadu.	Rutile	95% TiO_2 (min)	12000	6750	1500	7000
	Zircon@	66% ZrO_2+HfO_2 (min)	18000	13350	6200	6250
	Zircon-sillimanite	NA	24000	8200	4600	11500
	Garnet	NA	150000	120000	_	-
Beach Minerals Co. Pvt. Ltd						
Kuttam, Distt. Tirunelveli, Tamil Nadu.	Ilmenite	KU grade 49-51% TiO_2	150000	34000	35150	61211

Source: *Department of Atomic Energy, Mumbai and IREL.*
** In terms of rare earths chloride.*
@ Besides, 8,200 tonnes, 4,600 tonnes and 11,500 tonnes production of zircon-sillimanite are also reported during 2010-11, 2011-12 and 2012-13 respectively.

INDUSTRY

For manufacture of titanium dioxide pigment, ilmenite is first treated chemically to obtain upgraded ilmenite, commonly called as synthetic rutile. There are two major pigment production processes namely chloride process and sulphate process depending on different operating characteristics and feedstock requirements. Plants employing chloride process consume high TiO_2 content feedstocks like synthetic rutile and chloride slag. On the other hand, plants employing the sulphate process use lower grade ilmenite and sulphate slags.

Ilmenite obtained from Mineral Separation Plant (MSP) is chemically treated to remove impurities such as iron to obtain synthetic rutile (90% TiO_2) in Synthetic Rutile Plant (SRP). Indian Synthetic Rutile Plants are based on reduction roasting followed by acid leaching with or without generation of hydrochloric acid. Plants of IREL (OSCOM) and KMML depend on acid regeneration from the leach liquor while those of Cochin Minerals & Rutile Ltd (CMRL) and DCW use fresh acid and recover ferric chloride from the leach liquor for its use in water purification.

At OSCOM plant of IREL, reduction-roasting of ilmenite with coal is followed by leaching with HCL to separate iron as soluble ferrous chloride. The leached ilmenite is calcined to yield synthetic rutile and the acidic leach liquor is treated in an acid regeneration plant to recover HCl for recycling with iron oxide as waste. The unit stopped production in 1997 as it was not viable economically. IREL intends to set up titanium slag plant based on OR ilmenite at Odisha and has signed MoU with NALCO for this purpose. Depending upon feasibility, further value addition to TiO_2 pigment and Ti sponge shall be taken up subsequently.

KMML is manufacturing rutile grade titanium dioxide pigment by chloride route at its Sankaramangalam plant near Chavara in Kerala. The project for the production of one lakh tonnes of TiO_2 in a phased manner is under implementation. The company also has plans to enhance pigment capacity to 60,000 tpy for which detailed project report is under preparation. In 2009, the company had developed Nano Titanium Dioxide particles on laboratory scale and in July 2011, India's first commercial plant for synthesis of nano-titanium dioxide was commissioned. KMML is setting up a plant for producing 500 tpa of Titanium sponge with technology from DMRL. Subsequently, the company plans to expand the capacity to 1,000 tpa. The production of titanium sponge during 2011-12 & 2012-13 was 15.184 tonnes & 88.296 tonnes, respectively.

The DCW Ltd procures ilmenite from Manavalakurichi which is then roasted with coke fines to convert Fe_2O_3 into FeO. The reduced ore is leached with concentrated hydrochloric acid to remove oxides of iron and other metals. The leached ore is washed and calcined to get upgraded ilmenite which contains more than 95% TiO_2. The upgraded ilmenite is micronised to 2 microns by using high-pressure steam. This is marketed as Titox. The liquor from ilmenite leaching process contains fine TiO_2 particles and chlorides. The TiO_2 recovered by filtration & washing in filter process is marketed as Utox. The company has plans to increase the capacity of plant to 48,000 tpy and also to install facilities for the manufacture of ferrite grade iron oxide from the effluent of the ilmenite plant.

Cochin Minerals and Rutile Ltd (CMRL), which began production at its 10,000 tpy synthetic rutile plant in Kerala in 1990 as a 100% EOU, has gradually raised the production capacity to around 45,000 tpy since 2008-09 for exports. It also has ferric chloride & ferrous chloride plants having capacities 24,000 tpy & 72,000 tpy, respectively.

The Travancore Titanium Products Ltd (TTPL), a Kerala State Govt. Undertaking, manufactures titanium dioxide pigment by sulphate process at its plant at Kochuveli, Thiruvananthapuram. Ilmenite is reacted with sulphuric acid in digesters and a porous cake is formed. The mass in the solid form is dissolved in dilute sulphuric acid to get titanium in solution as titanium oxysulphate along with other metallic ingredients in ilmenite as their sulphate. The liquor is reduced using scrap iron, when ferric iron gets completly reduced to the ferrous state. The liquor is clarified, concentrated and boiled to precipitate the titanium content as hydrated titania which is then filtered by vacuum filters and calcined. Sulphuric acid required for captive consumption is produced at site using elemental sulphur. Till recently TTPL was the only unit producing anatase grade titanium dioxide pigment in India. TTPL has capacity to produce 17,000 tpy of titanium dioxide modernise and diversify in stages to produce both anatase and rutile grades titanium dioxide pigment.

Tata Steel has proposed a project to produce 100,000 tonnes per year titanium dioxide from ilmenite mined from beach sands of Tirunelveli and Thoothukudi districts in southern Tamil Nadu.

The NMDC has signed an MoU with KSIDC and IREL for setting up a synthetic rutile plant in Kerala. The company has applied for prospecting licences in various areas in Odisha, Kerala and Tamil Nadu and sought Swedish technology for mineral separation plant. The Beach Minerals Co. Pvt. Ltd also has plans for production of synthetic rutile from ilmenite. Presently, it only has facility of pilot plant. M/s V. V. Mineral has plans to set up a 5 lakh tpy titanium pigment plant. The project is at approval stage.

Present domestic titanium metal production is negligible. KMML has set up a 500 tpy titanium sponge plant with Defence Metallurgical Research Laboratory (DMRL) technology and first batch of titanium was delivered in September 2011. The plant will be further expanded to 1,000 tpy. IREL is to set up a 10,000 tpy titanium sponge plant at OSCOM for which proposals have been invited on build, operate and own basis. IREL intends to set up titanium slag plant based on ilmenite from OSCOM, Odisha and has signed an MoU with NALCO for this purpose. Depending upon feasibility, further value addition to TiO_2 pigment and titanium sponge will be taken up subsequently. Titanium sponge is imported by Mishra Dhatu Nigam Ltd. Midhani for further processing in the country.

The available data on plantwise capacities & production of synthetic rutile and TiO_2 pigment from 2010-11 to 2012-13 are given in Table-7.

Table –7 : Installed Capacity and Production of Synthetic Rutile/Titanium dioxide Pigment, 2010-11 to 2012-13

(In tonnes)

Plant	Location	Specification	Installed capacity (tpy)	Production		
				2010-11	2011-12	2012-13
Total			**243000** (Synthetic rutile)	**80936**	**75331**	**59426**
			85600 (TiO_2 Pigment)	**64393**	**54768**	**23459**
IREL	Orissa Sands Complex, Dist. Ganjam, Odisha.	90.5% TiO_2 (min)	100000 (Synthetic rutile)	–	–	–
KMML	Chavara, Dist. Kollam, Kerala	92%-93% TiO_2	50000 (Synthetic rutile)			
			40000 (TiO_2 - Chloride Process)	36879	29117	–
DCW Ltd	Sahupuram, Dist. Thoothukudi Tamil Nadu.	95% TiO_2	48000 (Synthetic rutile)	44761	47331	40696
CMRL	Edayar, Dist. Ernakulam, Kerala.	96.5% TiO_2	45000 (Synthetic rutile)	36175	28000	18730
TTPL	Kochuveli, Dist. Thiruvananthapuram, Kerala.	97.5% TiO_2	17000 (TiO_2-Sulphate Process)	15749	12701	11550
VVTi Pigments Pvt. Ltd* (formerly Kilburn Chemicals)	Thoothukudi, Tamil Nadu.	98% TiO_2 (min)	25000 (TiO_2-Sulphate Process)	11441	12122	11909
Kolmak Chemicals Ltd	Kalyani, Dist. Nadia, West Bengal.	NA	3600 (TiO_2-Sulphate Process)	324	828	NA

Source: *Department of Atomic Energy, Mumbai and individual companies.*
Note: *KMML captively consumes synthetic rutile while CMRL and DCW export synthetic rutile.*
* *Including Kilburn Chemicals.*

USES

Ilmenite is used mainly for the manufacture of ferro-titanium and synthetic rutile i.e., titanium dioxide, a white pigment. Because of a unique combination of its superior properties of high refractive index, low specific gravity, high hiding power and opacity and non-toxicity, titanium dioxide finds application in the manufacture of all types of white and pastle shades of paints, white-walled tyres, glazed papers, plastics, printed fabrics, flooring materials like linoleum, pharmaceuticals, soaps, face powders and other cosmetic products, etc. Because of its non-toxic nature, it is used in cosmetics, pharmaceuticals, and even added to foodstuffs as well as in toothpastes to improve their brightness. Titanium dioxide is used in the manufacture of many sunscreen lotions and creams because of its non-toxicity and ultra violet absorption properties. Synthetic rutile is used for coating welding electrodes as flux component and for manufacture of titanium tetrachloride which in turn is used in making titanium sponge. Synthetic rutile is also used as ingredient of special abrasives. Titanium metal is a versatile material with exceptional characteristics. The lightness, strength and durability of the metal make it an essential metal for the aerospace industry. It is also used in desalination and power generation plants and corrosive chemical industries because of its inertness and resistance to corrosion and high thermal conductivity. Its non-reactive property makes titanium metal one of the few materials that can be used in the human body for orthopaedic use and in pacemakers.

CONSUMPTION

The ilmenite consumption is placed at 190,900 tonnes in 2012-13. Bulk ilmenite was consumed for manufacturing synthetic rutile (99%), followed by welding electrode and ferro-alloys industry. The consumption of rutile in 2012-13 was 25,700 tonnes compared to 24,900 tonnes in 2011-12. Bulk consumption was in paint industry followed by electrode industry. In 2012-13, the consumption of ferro-titanium was 1,234 tonnes. About 84% consumption was in iron and steel industry and 15% in alloy steel and foundry industries (Table - 8).

Table – 8 : Consumption of Ilmenite, Rutile and Ferro-titanium, 2010-11 to 2012-13 (By Industries)

(In tonnes)

Industry	2010-11	2011-12(R)	2012-13(P)
ILMENITE			
All Industries	**189900**	**190500**	**190900**
Electrode	300(6)	900(20)	1300(26)
Ferro-alloys	300(5)	300(5)	400(5)
Synthetic rutile (Chemical)	189300(5)	189300(5)	189200(5)
Other (Iron & Steel, Paint, Refractory)	++(4)	++(4)	++(4)
RUTILE			
All Industries	**22800**	**24900**	**25700**
Electrode	5500(29)	7600(42)	8500(48)
Paint	16700(12)	16700(12)	16600(12)
Paper	300(2)	300(2)	300(2)
Others (Cosmetic, electrical, rubber)	300(4)	300(4)	300(6)
FERRO-TITANIUM			
All Industries	**1215**	**1232**	**1234**
Alloy steel	191(6)	191(6)	191(6)
Iron & steel	1020(9)	1037(9)	1037(9)
Foundry	4(1)	4(1)	4(1)
Electrode	++	++	2(1)

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

POLICY

The Government of India had notified in October 1998 a policy on exploitation of beach sand minerals in the country, which inter alia allows participation of private sector with or without foreign companies subject to conditions stipulated. This will encourage further exploitation of mineral deposits through a judicious mix of public & private sector participation including foreign collaboration. The ceiling on FDI on mining of titanium minerals has been raised to 100 percent.

Joint ventures with foreign participation were being pursued by IREL for production of value-added products, keeping in view the Beach Sand Mineral Policy of the Government.

The minerals ilmenite and rutile were grouped as 'prescribed substances' as per notifications issued under the Atomic Energy Act, 1962. However, as per the revised list of Prescribed Substances, Prescribed Equipment and Technology notified by Department of Atomic Energy vide S.O.No.61(E), dated 20.1.2006, the titanium ore minerals like ilmenite, rutile and leucoxene have been delisted as prescribed substances by the Department of Atomic Energy subject to the note as below:

"These minerals shall remain prescribed substances only till such time the policy on Exploration of Beach Sand Minerals notified vide Resolution No.8/1(1)/97-PSU/1422, dated 6.10.1998, is adopted/revised/modified by the 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 policy on exports and imports, titanium ores and concentrates under heading 2614 (comprising ilmenite unprocessed and upgraded, i.e., beneficiated ilmenite including ground ilmenite) and rutile sand can be imported/exported freely.

SUBSTITUTES

There are no cost-effective substitutes for titanium dioxide pigments. Synthetic rutile made from ilmenite can be substituted for natural rutile. Nickel steels, stainless steels and some non-ferrous metal alloys can sometimes replace titanium alloys in industrial uses although at the expense of performance or economics. Tungsten carbide competes with titanium carbide for surface cutting machine tools. Titanium slag competes with ilmenite and rutile.

Environmental awareness indicates that titanium dioxide plants are likely to use chloride technology in future as it produces much less quantity of waste products. Synthetic rutile or slag (made from ilmenite) is likely to be used as feed in increasing amount. There is also a strong pressure to reduce the radioactive content of feed stocks because it affects the marketability of beach sand ilmenite. Titanium alloys may be replaced in aerospace applications by lithium-aluminium alloys or carbon-epoxy composites.

WORLD REVIEW

World resources of anatase, ilmenite and rutile are more than 2 billion tonnes. World reserves of ilmenite are estimated at 700 million tonnes in terms of TiO_2 content. Major reserves are in China (29%), Australia (23%), India (13%), South Africa (9%), Brazil and Madagascar (6% each), Norway (5%) and Mozambique (2%). The world reserves of rutile are 48 million tonnes in terms of TiO_2 content. Major rutile reserves are located in Australia (50%), followed by South Africa (17%), India (15%), Sierra Leone (8%) and Ukraine (5%).

World production of ilmenite and rutile concentrates was 11.40 million and 0.84 million tonnes, respectively, in 2012. Canada contributed 23% of ilmenite production, followed by South Africa and Australia (12% each). Australia produced 52% of world rutile output, followed by South Africa with 15% and Ukraine 12%. World reserves and production of titanium minerals, viz, ilmenite and rutile, are furnished in Tables - 9 to 11, respectively.

Table – 9 : World Reserves of Ilmenite and Rutile (By Principal Countries)

(In '000 tonnes of contained TiO_2)

Country	Reserves	
	Ilmenite	Rutile
World: Total (Ilmenite+Rutile) : 748000		
World: Total (Rounded)	**700000**	**48000**
Australia	160000	24000
Brazil	43000	1200
Canada	31000	–
China	200000	–
India*	85000	7400
Madagascar	40000	–
Mozambique	14000	510
Sierra Leone	–	3800
Norway	37000	–
South Africa	63000	8300
Ukraine	5900	2500
USA	2000	–
Vietnam	1600	–
Other countries	26000	400

***Source**: Mineral Commodity Summaries, 2014.*

** As per NMI, the total resources of titanium minerals in India are estimated at about 549.49 million tonnes.*

Table – 10 : World Production of Ilmenite (By Principal Countries)

(In '000 tonnes)

Country	2010	2011	2012
World: Total (wt. of concs)	**10400**	**10900**	**11400**
Australia	1339	1277	1344
Canada[(e)@]	2400	2500	2700
China[(e)]	1000	1100	1100
India*	663	700[e]	700[e]
Mozambique	678	637	574
Madagascar	273[e]	490	530
Norway	864	870	831
South Africa[e]	1200	1369	1400[e]
USA[e]	200	300	300
Vietnam[e]	881	870	1164
Ukraine[(e)]	600	600	600
Other countries	294	184	158

***Source**: World Mineral Production, 2008-2012.*
****** Figures rounded off*
***Note**: Some ilmenite is converted to synthetic rutile in Australia, India, Japan, Taiwan and USA.*
@ Canada produces some ilmenite which is sold as such and not processed into slag, but tonnages are small.
** India's production of ilmenite in 2010-11, 2011-12 and 2012-13 was 663,217 tonnes, 751,163 tonnes and 738,524 tonnes, respectively.*

Table – 11 : World Production of Rutile (By Principal Countries)

(In '000 tonnes)

Country	2010	2011	2012
World: Total (wt. of concs)	**800**	**840**	**840**
Australia	438	474	439
India	27	27[e]	27[e]
South Africa	135	129	130
Sierra Leone	68	68	94
Ukraine[(e)]	100	100	100
Other countries	32	42	50

***Source:** World Mineral Production, 2008-2012.*
India's production of rutile in 2010-11, 2011-12 and 2012-13 was 26,593 tonnes, 16,598 tonnes and 16,527 tonnes respectively.

World production of TiO_2 contained in titanium mineral concentrates was 8.31 million tonnes in 2012, reported decrease of 4% compared with that of 2011. The leading sources of world imports of titanium mineral concentrates were Australia, China, South Africa and Vietnam.

Metal

Commercial production of titanium metal involves the chlorination of titanium-containing mineral concentrates to produce titanium tetrachloride ($TiCl_4$), which is reduced with magnesium (Kroll process) or sodium (Hunter process) to form a commercially pure form of titanium metal. As the metal is formed, it has a porous appearance and is referred as sponge. Titanium ingot and slab are produced by melting titanium sponge or scrap or a combination of both, usually with various other alloying elements.

Pigment

Global TiO_2 pigment production capacity was estimated to be 5.7 million tonnes per year. TiO_2 pigment produced by either process is categorised by crystal form as either anatase or rutile. Rutile pigment is less reactive with the binders in paint when exposed to sunlight than the anatase pigment and is preferred substance in outdoor paints. Anatase pigment has a bluer tone than rutile, is somewhat softer, and is used mainly in indoor paints and in paper manufacturing. Depending on the manner in which it is produced and subsequently finished, TiO_2 pigment can exhibit a wide range of functional properties, including dispersion, durability, opacity, and tinting.

Australia

In Australia, production of rutile decreased by 7% and production of ilmenite increased by 5% from that of 2011, as pigment producers switched to lower grade ilmenite feedstocks owing to the sharp increase in rutile prices.

In 2012, Iluka Resources Ltd. produced 220,000 t of rutile and 2,48,000 t of synthetic rutile from its operations in the Eucla Basin, Perth Basin and Murray Basin in Australia; reported decrease of 22% and 13%, respectively from the year 2011. Iluka's production of ilmenite from these basins was 459,000 t in 2012, reported an increase of 23% from 2011.

Gunson Resources Ltd. established the reserves at its Coburn heavy mineral sands project to 49,500 tpy of zircon, 109,000 tpy of ilmenite, and 23,500 tpy of higher titanium dioxide mineral products (rutile and leucoxene combined into a 90% TiO_2 product). The anticipated mine life was reduced to 19 years from 23 years.

Murray Zircon Pty. Ltd. restarted mining operations at its Mindarie Mineral Sands project in South Australia in October. The mixed heavy mineral concentrates, containing ilmenite, leucoxene, rutile are further shipped to China for further processing. The Mindarie Mineral Sands was expected to produce 120,000 tpy of mixed heavy mineral concentrate over a period of 15 years.

Tronox completed the acquisition of Exxaro Resources Ltd.'s mineral sand operations in Western Australia and South Africa. The acquisition also included Exxaro's Tiwest Joint Venture in Western Australia that was jointly owned with Tronox. The combined capacity of these three operations is 723,000 tpy of titanium feedstock and 265,000 tpy of zircon production.

Matilda Zircon Ltd. continued the development of the Keysbrook deposit, 70 kilometers south of Perth. Matilda planned to begin construction of mine in 2013 and mining in early 2014. The Keysbrook project was expected to operate for at least 7 years with a potential expansion to 15 years with additional approvals. Average annual production was expected to be 62,200 tpy of leucoxene and 28,700 tpy of zircon.

China

The exports of sponge and mill products were 4,500 t and 12,300 t, respectively in the year 2012. The 14 leading manufacturers produced 81,000 t of sponge in 2012, reported an increase of 25% from that of 2011, and 52,000 t of titanium mill products, a slight increase from that in 2011. China produced 1.9 million tonnes of TiO_2 pigment in 2012, an increase of 8% from that of 2011, with a utilization rate of 48% of an estimated 4.0 million tpy of capacity.

Henan Billions Chemicals Co., Ltd. signed an agreement with PPG Industries under which PPG was to provide chloride-based titanium dioxide technologies for use at Henan Billions' TiO_2 production facilities in China. Subsequent to the agreement, Henan Billions signed an agreement with Ti-Cons to build and operate a 100,000 tpy chloride-based TiO_2 production facility. Production is expected to begin in 2015.

Japan

The Export of titanium sponge was about 30,700 t in 2012, reported an increase of 22% from that of 2011, which accounted 62% exports of total to the United States, reported an increase of 18% compared with 2011 owing to aerospace industry demand.

Kenya

Base Resources Ltd was to begin mining operations at its Kwale prospects in July, 2013. A production of 3,30,000 tpy of ilmenite, 79,000 tpy of rutile, and 30,000 tpy of zircon will be envisaged during the first 7 years of operation.

Mozambique

The Jinan Yuxaio Group of China was granted a mining license for a heavy-mineral sands deposit in the Zambeze province along the Quelmaine coast.

Kenmare Resources plc produced 772,000 tonnes concentrate of heavy-mineral at its Moma operation, which is 10% less from that of 2011. The production of ilmenite at 574,500 tonne showed a decrease of 10% from that of 2011. Kenmare plans to increase its capacity from 800,000 tpy to 1.2 million tpy which was Scheduled for completion by 2013.

Norway

TiZir Ltd.'s Tyssedal ilmenite enhancing facility in southwest Norway produced 181,100 t of titanium slag in 2012, reported a slight increase from that of 2011. Ilmenite for the Tyssedal operation was mostly sourced from the production of Titania AS's nearby Tellnes Mine in Norway.

Russia

IRC Ltd. produced 125,000 t of ilmenite at its Kurankh deposit, an increase of 97% from that of 2011. The Kurankh deposit is located in the Amur region in the Russian Far East (IRC Ltd., 2013).

Saudi Arabia

Cristal Global announced that the titanium slag plant originally scheduled to be built in Yanbu had been

relocated to Jazan Economic City. The plant was to have an initial capacity of 500,000 tpy of 85% titanium slag with 235,000 tpy of pig iron as a co product and was scheduled to comence its operation in 2014.

Senegal

Astron Ltd. updated its ore reserve estimate for the Niafarang mineral sands project, south of Dakar. The Probable ore reserves were 4.7 million tonnes containing 11% heavy minerals. The heavy mineral suite included 75% ilmenite, 14% zircon, and 2.3% rutile.

Mineral Deposits continued with development and construction of the mine and separation plants at its Grande Cote heavy-minerals deposit. Mineral Deposits entered into a joint-venture agreement with ERAMET SA (Paris, France), whereby Mineral Deposits 90% stake in the Grande Cote deposit was combined with ERAMET's 100% stake in the Tyssedal ilmenite upgrading plant in Norway to form a new entity, TiZir Ltd. After the Grande Cote Mine and separation plants are operational, TiZir is expected to produce an average of 575,000 tpy of ilmenite, 85,000 tpy of zircon, and small amounts of rutile and leucoxene over a mine life of 20 years.

Sierra Leone

Sierra Rutile Ltd. (SRL) produced 94,490 t of rutile in 2012, reported a 39% increase from 2011. SRL announced the development of its Gangama dry mining project, which was projected to produce on an average 83,400 tpy of rutile, 46,000 tpy of ilmenite and 9,500 tpy of zircon and other concentrates for 6 years.

Ukraine

Volnogorsk AG announced expansion of its rutile and ilmenite capacity from its deposits in the Dnepropetrovsk region. By 2015, Volnogorsk expected to increase its capacity to produce 90,000 tpy of rutile and 950,000 tpy of ilmenite from the current levels of 60,000 tpy and 720,000 tpy, respectively.

Vietnam

VSMPO-Avisma of Verkhnyaya Salda, Russia, signed a memorandum of understanding with the Vietnam National Coal-Mineral Industries Holding Corp. (Vinacomin). The two companies planned to create a joint venture to process titanium minerals after Vinacomin secured licenses to develop mineral resources in the Binh Thuan province.

FOREIGN TRADE

Exports

As per the data from DGCI & S, Kolkata exports of titanium ores & conc. decreased to 0.80 million tonnes in 2012-13 as compared to 0.91 million tonnes in the preceding year. Exports in 2012-13 comprised ilmenite (791,735 tonnes), rutile (2,322 tonnes) and other titanium ores (6,750 tonnes). Main destinations were China (54%), Netherlands (21%) and Japan (13%).

Exports of titanium and alloys (including waste & scrap) were 202 tonnes in 2012-13 as compared to 399 tonnes in the previous year. Exports were mainly to USA, UK and France. Exports of titinum oxide and dioxide (total) decreased to 38,011 tonnes in 2012-13 from 50,194 tonnes in 2011-12. Out of total exports in 2012-13, those of titanium dioxide were 3,470 tonnes and other titanium oxides were 34,541 tonnes. Exports were mainly to Japan (79%), Singapore (9%) and USA (5%) (Tables-12 to 19).

Imports

As per the data from DGCI&S, Kolkata, imports of titanium ores & conc. rose to 77,819 tonnes in 2012-13 as compared to 68,501 tonnes in the preceding year. Out of total imports of titanium ores & conc. in 2012-13, those of ilmenite were 65,876 tonnes, rutile 9,826 tonnes and other titanium ores were 2,117 tonnes. Main suppliers were Mozambique (77%), Australia (8%) and Sri lanka (7%).

Imports of titanium and alloys (including waste & scrap) were 1,310 tonnes in 2012-13 as compared to 1,504 tonnes in the previous year. Imports were mainly from USA, Russia and China. Imports of titanium oxide and dioxide (total) were 18,803 tonnes in 2012-13 as compared to 23,110 tonnes in the preceding year. Bulk of these imports was of titanium dioxide (17,825 tonnes) and those of other oxides were 978 tonnes in 2012-13. Imports were mainly from China (27%), Germany (12%), Rep. of Korea (13%) and Czech Republic (12%) (Tables - 20 to 27).

Table – 12 : Exports of Titanium Ores & Conc. : Total (By Countries)

Country	2011-12		2012-13	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**912979**	**12442284**	**800807**	**14571902**
China	472383	5966675	431073	7130962
Japan	90044	2494763	101081	3419034
Netherlands	166026	1869760	166734	2420782
Korea, Rep. of	56180	676672	50020	746858
Malaysia	40221	282076	39631	477269
Singapore	2680	202144	1500	184868
Korea, Dem. Rep. of	20	917	10000	119240
Bangladesh	601	31683	361	32823
Ukraine	729	57298	100	15374
Philippines	396	38473	132	13637
Other countries	83699	821823	175	11055

Source: *DGCI & S, Kolkata.*

Table – 13 : Exports of Titanium Ores & Conc. (Ilmenite) (By Countries)

Country	2011-12		2012-13	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**879522**	**11499101**	**791735**	**14158888**
China	446953	5525027	423751	6882540
Japan	87048	2368140	100440	3396923
Netherlands	164196	1735036	166480	2380516
Korea, Rep. of	56000	658665	50000	743475
Malaysia	40000	262912	39400	449184
Singapore	2680	202144	1500	184868
Korea, Dem. Rep. of	-	-	10000	119240
Chinese Taipei/Taiwan	96	1471	44	1018
Bangladesh	58	2509	90	773
UAE	-	-	10	204
Other countries	82491	743197	20	147

Source: *DGCI & S, Kolkata.*

Table – 14 : Exports of Titanium Ores & Conc. (Rutile)
(By Countries)

Country	2011-12		2012-13	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**6699**	**507305**	**2322**	**253625**
China	717	43805	1224	108704
Netherlands	1830	134724	254	40266
Malaysia	221	19164	231	28084
Bangladesh	522	28347	139	19837
Ukraine	729	57298	100	15374
Japan	996	90201	141	14750
Philippines	396	38467	132	13637
Kenya	40	3196	47	5513
Iran	587	28295	33	4050
Korea, Rep. of	180	18007	20	3383
Other countries	481	45801	1	27

Source: *DGCI & S, Kolkata.*

Table – 15 : Exports of Titanium Ores & Conc. (Others)
(By Countries)

Country	2011-12		2012-13	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**26758**	**435878**	**6750**	**159389**
China	24713	397843	6098	139717
Bangladesh	21	827	132	12213
Japan	2000	36423	500	7360
UAE	-	-	20	98
Other countries	24	785	++	1

Source: *DGCI & S, Kolkata.*

Table – 16 : Exports of Titanium & Alloys (Incl. Waste & Scrap)
(By Countries)

Country	2011-12		2012-13	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**399**	**338371**	**202**	**268751**
France	10	17246	20	41605
Malaysia	6	6080	9	37724
USA	169	57496	68	34659
Saudi Arabia	7	33977	4	29321
UAE	3	119928	8	28565
Norway	1	16535	7	21122
UK	21	8459	31	19791
Kuwait	++	629	1	12273
Philippines	2	8101	1	9040
Germany	118	24024	12	4019
Other countries	62	45896	41	30632

Source: *DGCI & S, Kolkata.*

Table – 17 : Exports of Titanium oxide & Dioxide : Total (By Countries)

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**50194**	**3138303**	**38011**	**4519600**
Japan	30085	1612813	27738	3192277
Singapore	8016	318131	3000	359003
USA	955	121378	2057	272234
Italy	1033	171963	1366	212115
Thailand	582	77397	846	110507
Nigeria	476	31860	475	61082
Iran	44	7172	274	51568
China	3600	184572	500	40761
UAE	548	55803	329	40064
Turkey	1198	159353	271	37219
Other countries	3657	397861	1155	142770

Source: *DGCI & S, Kolkata.*

Table – 18 : Exports of Titanium dioxide (By Countries)

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**5011**	**781078**	**3470**	**527827**
Italy	925	155995	1312	200852
Japan	360	57885	414	67791
USA	161	22305	387	63681
Iran	44	7138	233	37247
UAE	324	54029	310	37226
Turkey	1040	150453	180	25373
Nepal	47	8634	54	10225
Spain	720	106764	80	9966
Kuwait	-	-	48	9503
Nigeria	21	3236	41	8943
Other countries	1369	214639	411	57020

Source: *DGCI & S, Kolkata.*

Table – 19 : Exports of Titanium oxide (Other than Titanium Dioxide) (By Countries)

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**45183**	**2357225**	**34541**	**3991773**
Japan	29725	1554927	27324	3124486
Singapore	8016	318131	3000	359003
USA	794	99073	1670	208553
Thailand	465	62219	829	108264
Nigeria	455	28624	434	52138
China	3600	184572	500	40759
Malaysia	717	42104	116	16000
Iran	++	34	41	14321
Turkey	158	8900	91	11846
Italy	108	15968	54	11263
Other countries	1145	42673	482	45140

Source: *DGCI & S, Kolkata.*

Table – 20 : Imports of Titanium Ores & Conc. : Total (By Countries)

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**68501**	**1731291**	**77819**	**2842107**
Mozambique	43406	320241	59573	1222768
Australia	10904	813202	6573	769953
Sri Lanka	6519	156245	5534	283442
South Africa	1180	85997	1214	149638
China	605	41295	741	109105
Vietnam	200	13821	889	65955
Malaysia	1472	47053	1390	64870
Ukraine	1774	105694	429	57600
Brazil	-	-	260	38600
Italy	104	6508	212	22911
Other countries	2337	141235	1004	57265

Source: *DGCI & S, Kolkata.*

Table – 21 : Imports of Titanium Ores & Conc. (Ilmenite) (By Countries)

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**48150**	**389054**	**65876**	**1403236**
Mozambique	43406	320241	59573	1222768
Sri Lanka	3490	46910	4535	99308
Australia	313	9795	626	58811
Malaysia	908	10774	875	17487
Thailand	23	599	250	2992
Germany	10	735	9	994
Mexico	-	-	5	500
UK	-	-	2	273
China	-	-	1	103

Source: *DGCI & S, Kolkata.*

Table – 22 : Imports of Titanium Ores & Conc. (Rutile) (By Countries)

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**14647**	**1065112**	**9826**	**1254835**
Australia	8695	670087	5139	624251
Sri Lanka	1348	79992	999	184134
South Africa	920	69374	1088	136189
China	418	32491	740	109002
Ukraine	766	54711	429	57600
Vietnam	125	8375	739	54926
Brazil	-	-	260	38600
Malaysia	428	30688	202	19779
UAE	-	-	52	8000
USA	260	11558	52	7708
Other countries	1687	107836	126	14646

Source: *DGCI & S, .Kolkata.*

Table – 23 : Imports of Titanium Ores & Conc. (Others) (By Countries)

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**5704**	**277125**	**2117**	**184036**
Australia	1896	133320	808	86891
Malaysia	136	5591	313	27603
Italy	-	-	212	22911
South Africa	260	16623	126	13449
Vietnam	75	5446	150	11029
Sierra Leone	-	-	397	10270
Iran	-	-	52	5932
Chinese Taipei/Taiwan	56	2109	52	5704
Germany	52	2089	4	136
Singapore	-	-	3	110
Other countries	3229	111947	++	1

Source: *DGCI & S, Kolkata.*

Table – 24 : Imports of Titanium & Alloys (Incl. Waste & Scrap) (By Countries)

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1504**	**2149522**	**1310**	**2455456**
USA	471	571037	309	589685
Russia	64	89236	308	455008
China	191	243696	208	358803
UK	52	121507	104	327384
Italy	184	267345	61	152217
Germany	57	86497	52	122842
Korea Rep. of	34	51880	47	95674
France	93	159201	15	76223
Japan	198	310154	62	47270
Kazakhstan	-	-	60	44374
Other countries	160	248969	84	185976

Source: *DGCI & S, Kolkata.*

Table – 25 : Imports of Titanium oxide & Dioxide : Total (By Countries)

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**23110**	**3545107**	**18803**	**3300512**
China	7268	1018172	5006	747778
Germany	2794	440848	2219	455173
Korea, Rep. of	2292	354553	2357	432019
USA	2777	471130	1986	385375
Czech Republic	1170	180613	2303	359151
Japan	1065	203897	933	201436
Ukraine	1405	189968	1200	176582
Malaysia	201	33717	508	99887
Italy	209	25282	426	73831
Australia	620	107914	345	70382
Other countries	3309	519013	1520	298898

Source: *DGCI & S, Kolkata.*

Table – 26 : Imports of Titanium dioxide (By Countries)

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**22635**	**3490219**	**17825**	**3178780**
China	6940	983819	4593	714673
Germany	2793	440212	2090	438366
Korea, Rep. of	2280	352616	2137	392238
USA	2766	467628	1903	378977
Czech Republic	1170	180613	2303	359151
Japan	1058	201477	928	199977
Ukraine	1405	189968	1200	176582
Malaysia	201	33717	508	99886
Australia	620	107914	345	70382
Italy	138	21162	382	68867
Other countries	3264	511093	1436	279681

Source: *DGCI & S, Kolkata.*

Table – 27 : Imports of Titanium oxides (Other than Titanium Dioxides) (By Countries)

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**475**	**54888**	**978**	**121732**
Korea Rep. of	12	1937	220	39781
China	328	34353	413	33105
Germany	1	636	129	16807
Chinese Taipei/Taiwan	-	-	60	13415
USA	11	3503	83	6398
Italy	71	4120	44	4963
France	1	514	3	2368
Indonesia	-	-	20	2085
Japan	7	2420	5	1459
UK	1	180	1	1057
Other countries	43	7225	++	294

Source: *DGCI & S, Kolkata.*

FUTURE OUTLOOK

The major chunk of consumption of ilmenite is for the manufacture of synthetic rutile. The future demand of ilmenite during the 12th Plan period at the GDP growth rate of 8%, 9% and 10% is estimated at 3.19 lakh, 3.27 lakh and 3.35 lakh tonnes, respectively, as per the Report of Working Group on Mineral Exploration and Development (other than coal & lignite) for the 12th Five Year Plan (2012-17), Planning Commission of India.

Demand for rutile for next five years is projected at 44,000 tpy to 45,000 tpy as per the GDP growth rate of 8%, 9% and 10%. The production projected is 30,000 tpy as per the Working Group.

The Working Group has observed that no substantial progress in exploration activities for Beach Minerals was witnessed during the 11th Plan and has stressed on the need to take substantive steps to develop beach sand reserves of the country to its full potential by adopting suitable exploration strategy with modern techniques.

Global demand growth for TiO_2 expected to trend with economic growth and the production of paint, paper and plastics.

Acrospace, defence and industrial uses were expected to strongly influence consumption of titanium metal for the foreseeble future.