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ILMENITE AND RUTILE

(ADVANCE RELEASE)

GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

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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 village 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 3,800 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 2012-14 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 reserve (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.*

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
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.*
- Maharashtra (2300) tonnes.

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.

As per the UNFC system as on 1.4.2010 compiled by IBM, the total resources of titanium minerals is 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. Total 394 boreholes drilled and 2349 samples mineralogical analysis have 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.

GSI carried out exploration work for placer minerals in the terrritorial waters off north Bhuminipatnam, Andhra Pradesh for ilmenite, rutile, garnet, sillimanite and zircon. A total of 66 vibrocore seabed sediment samples varying in length from 0.46 m to 3.78 m with an average core length of 2.10 m were collected on grid of 1 km x 1 km within the water depth of 22.56 to 39.47 m. In territorial waters off Palur-Malud, Odisha sand samples show dominance of economic heavy minerals like ilmenite, rutile, garnet, monazite and sillimanite.

In Kerala, GSI took up assessment of heavy minerals in near shore area of Attipara, near Thiruvananthapuram. The preliminary study shows that ilmenite is the major heavy mineral occurring in the sediments. Other minerals include zircon, sillimanite, garnet and monazite.

The survey and exploration carried out by AMD during 2008-09, 2009-10, 2010-11, 2011-12, 2012-13 and 2013-14 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 2013-14 are furnished in Table-2.

PRODUCTION AND PRICES

Ilmenite

The production of ilmenite at 722 thousand tonnes in 2013-14 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 67% of the total production followed by Odisha 20% and Kerala 13 per cent.

Rutile

The production of rutile at 13 thousand tonnes in 2013-14 registered decrease by 19% 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 31% and Kerala 26 percent.

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

Table – 2 : Exploration Activities by AMD for Ilmenite, Rutile, Monazite, Zircon and other Heavy Minerals, 2013-14

Location	Activity		Remark
	Reconnaissance survey (sq km)	Detailed survey (sq km)	
Parts of Odisha, Andhra Pradesh, Karnataka and Tamil Nadu	302.62 (Coastal tracts) Inland areas	14.4	Reconnaissance survey was undertaken to delineate potential heavy mineral concentrations along the coastal and inland tracts: (a) Bajrakot-Brahmapur tract,Ganjam District, Odisha records THM ranging from 0.67 to 56.27%. (b) Four inland red sediment occurrences exposed between Patsonapuram-Agastinuagan, Ganjam District, Odisha record THM ranging from 2.01% to 57.31% (c) Swanamukhi River Confluence-Kothapatnam tract, SPSR, Nellore District records THM up to 1.55%. (d) Vaipar-vembar-Naripaiyur tract, Thoothukudi and Ramanathapuram District, Tamil Nadu records very low THM of 5-15%. In addition to reconnaissance surveys, detailed survey was carried out in (i) Malikipuram, East Godavari district, Andhra Pradesh and (ii) Chavara, Kerala.

***Source**: Department of Atomic Energy, Mumbai.*

Table – 3 : Production of Ilmenite and Rutile 2011-12 to 2013-14 (P) (By States)

(In tonnes)

State	2011-12	2012-13(R)	2013-14(P)
ILMENITE			
India : Total	**718612**	**738524**	**721959**
Kerala	86454	68555	95083
Odisha	188000	184570	146771
Tamil Nadu	444158	485399	480105
RUTILE			
India : Total	**20225**	**16527**	**13459**
Kerala	5664	3075	3468
Odisha	7874	7170	5759
Tamil Nadu	6717	6282	4232

Table – 4 : Prices of Rutile 2011-12 to 2013-14

(₹ per tonne)

Year	Grade	Price	Remarks
IREL			
2011-12			
2011-12	Q	68429	Ex-works, Bagged
2011-12	MK	68429	Ex-works, Bagged
2011-12	OR	68429	Ex-works, Bagged
2012-13			
2012-13	Q	112500	Ex-works, Bagged
2012-13	MK	112500	Ex-works, Bagged
2012-13	OR	112500	Ex-works, Bagged
2013-14			
2013-14	Q	80167	Ex-works, Bagged
2013-14	MK	80167	Ex-works, Bagged
2013-14	OR (SR/TiO_2)	80167	Ex-works, Bagged
KMML			
2011-12	-	87085	-
2012-13	-	110833	-
2013-14	-	67375	-
V.V. Mineral (Average)			
2011-12	Premium & Standard	70610	Average
2012-13	-do-	116158	Average
2013-14	NA	102340	Average

Source: *Department of Atomic Energy, Mumbai.*

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

Table – 5: Prices of Ilmenite 2011-12 to 2013-14

(₹ per tonne)

Period	Grade	Price	Remarks
IREL			
2011-12			
2011-12	Q	6875	Ex-works, loose
2011-12	MK	6525	Ex-works, loose
2011-12	OR	5125	Ex-works, loose
2011-12	Q	17000	Ex-works, loose
2011-12	MK	16100	Ex-works, loose
2011-12	OR (Non SR/TiO_2)	10000	Ex-works, loose
2011-12	Q	12650	Ex-works, loose
2011-12	MK	12450	Ex-works, loose
2011-12	OR (SR/TiO_2)	12650	Ex-works, loose
2012-13			
2012-13	Q	20937	Ex-works, loose
2012-13	MK	19775	Ex-works, loose
2012-13	OR (Non SR/TiO_2)	17062	Ex-works, loose
2012-13	Q	15200	Ex-works, loose
2012-13	MK	14775	Ex-works, loose
2012-13	OR (SR/TiO_2)	13525	Ex-works, loose
2013-14			
2013-14	Q	13833	Ex-works, loose
2013-14	MK	19833	Ex-works, loose
2013-14	OR (Non SR/TiO2)	16833	Ex-works, loose
2013-14	OR (Non SR/TiO2)	14958	Ex-works, loose
2013-14	Q	12283	Ex-works, loose
2013-14	MK	35550	Ex-works, loose
2013-14	OR (SR/TiO2)	10567	Ex-works, loose
KMML			
2011-12	12650	59.88% TiO_2	
2012-13	17900	59.88% TiO_2	
2013-14	NA		
V.V. Mineral (Average)			
2011-12	NA	11174	
2012-13	NA	15269	
2013-14	NA	10562	
BMC			
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
2013-14	TiO_2 : 49-51%	9475 (US$150)	f.o.b.Thoothukudi
DCW Ltd			
2011-12	NA	7693	
2012-13	NA	20552	
2013-14	NA	17290	

Source: *Department of Atomic Energy, Mumbai.*

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

MINING & PROCESSING

Mining and processing of beach sand is 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 in 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, 2011-12 to 2013-14

(In tonnes)

Company/ Location	Mineral	Specification	Installed capacity (tpy)	Production		
				2011-12	2012-13	2013-14
Indian Rare Earths Ltd**						
Manavalakurichi,	Ilmenite	55% TiO_2 (min)	90000	35009	33260	
Distt. Kanyakumari,	Rutile	94% TiO_2 (min)	4000	1534	1381	
Tamil Nadu.	Zircon	65% ZrO_2+HfO_2 (min)	10000	3182	2688	
	Sillimanite	58% Al_2O_3	–	-	-	
	Monazite	96% pure	6000	-	-	
	Garnet	97% pure (min)	8500	11797	10240	
Chavara,	Ilmenite	58% TiO_2 (min)	200000	43051	23309	
Distt. Kollam,	Rutile	95% TiO_2 (min)	11400	2769	1224	
Kerala.	Zircon	65% ZrO_2+HfO_2 (min)	17500	5231	1992	
	Rare Earths	–	4500*	-	-	
	Sillimanite	58% Al_2O_3 (min)	24500	7667	4936	
	Leucoxene	–	–	529	105	
	Zirflour	-200 mesh	6000	1886	1161	
	(includes	-300 mesh	500	-	940	
	Microzir)					
Orissa Sands Complex,	Ilmenite	50.25% TiO_2 (min)	220000	188000	184570	
Distt. Ganjam,	Rutile	94.25% TiO_2 (min)	10000	7874	7170	
Odisha.	Zircon	64.25% ZrO_2+HfO_2 (min)	5000	6170	6235	
	Sillimanite	56.5% Al_2O_3 (min)	10000	17489	12314	
	Garnet	93.5% garnet (min)	24000	19889	23898	
Kerala Minerals & Metals Ltd						
Chavara,	Ilmenite	59.88% TiO_2	61600	43403	45240	62850
Distt. Kollam.	Rutile	93.20% TiO_2	4400	2600	1850	2330
Kerala.	Zircon	64.81% ZrO_2	6500	5213	3960	3635
	Sillimanite	NA	3600	339	1265	1270
V.V. Mineral						
Distt. Thoothukudi,	Ilmenite	51.0-52.5% TiO_2	450000	405700	447000	211662
Tamil Nadu.	Rutile	95% TiO_2 (min)	12000	1500	7000	3580
	Zircon@	66% ZrO_2+HfO_2 (min)	18000	6200	6250	
	Zircon-sillimanite	NA	24000	4600	11500	
	Garnet	NA	150000	_	-	
Beach Minerals Co. Pvt. Ltd						
Kuttam,	Ilmenite	KU grade 49-51% TiO_2	150000	36000	36500	49090
Distt. Tirunelveli,						
Tamil Nadu.						

Source: *Department of Atomic Energy, Mumbai and IREL.*

** In terms of rare earths chloride.*

@ Besides, 4,600 tonnes, 11,500 tonnes and 6640 tonnes production of zircon-sillimanite is also reported during 2011-12, 2012-13 and 2013-14 respectively.

*** The plantwise production details in respect of 2013-14 is not available. However, total production during 2013-14 was ilmenite-2,08,054 tonnes, rutile-7,878 tonnes, zircon-8,778 tonnes, zirflour-598 tonnes, sillimanite-16,005 tonnes, garnet-26,010 tonnes and brown ilmenite-162 tonnes.*

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 an MoU with NALCO for this purpose. Depending upon feasibility, further value addition to TiO_2 pigment and Ti sponge shall be taken up, subsequently.

The 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 tonne 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 2011-12 to 2012-13 are given in Table-7 (data in respect of 2013-14 is not available).

Table –7 : Installed Capacity and Production of Synthetic Rutile/Titanium dioxide Pigment, 2011-12 to 2013-14

(In tonnes)

Plant	Location	Specification	Installed capacity (tpy)	Production		
				2011-12	2012-13	2013-14
Total			**243000** (Synthetic rutile)	**75331**	**59426**	–
			85600 (TiO_2 Pigment)	**54768**	**23459**	–
IREL	Orissa Sands Complex, Distt. Ganjam, Odisha.	90.5% TiO_2 (min)	100000 (Synthetic rutile)	–	–	–
KMML	Chavara, Distt. Kollam, Kerala.	92%-93% TiO_2	50000 (Synthetic rutile)			
			40000 (TiO_2 - Chloride Process)	29117	–	–
DCW Ltd	Sahupuram, Distt. Thoothukudi, Tamil Nadu.	95% TiO_2	48000 (Synthetic rutile)	47331	40696	–
CMRL	Edayar, Distt. Ernakulam, Kerala.	96.5% TiO_2	45000 (Synthetic rutile)	28000	18730	–
TTPL	Kochuveli, Distt. Thiruvananthapuram, Kerala.	97.5% TiO_2	17000 (TiO_2-Sulphate Process)	12701	11550	–
VVTi Pigments Pvt. Ltd* (formerly Kilburn Chemicals)	Thoothukudi, Tamil Nadu.	98% TiO_2 (min)	18000 (TiO_2-Sulphate Process)	12122	11909	12243
Kolmak Chemicals Ltd	Kalyani, Distt. Nadia, West Bengal.	NA	3600 (TiO_2-Sulphate Process)	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 188,600 tonnes in 2013-14. Bulk ilmenite was consumed for manufacturing synthetic rutile (99%), followed by welding electrode and ferro-alloys industry. The consumption of rutile in 2013-14 was 26,000 tonnes compared to 26,100 tonnes in 2012-13. Bulk consumption was in paint industry followed by electrode industry. In 2013-14, 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, 2011-12 to 2013-14 (P) (By Industries)

(In tonnes)

Industry	2011-12	2012-13(R)	2013-14(P)
ILMENITE			
All Industries	**190500**	**188800**	**188600**
Chemicals	189300(5)	187000(5)	187000(5)
Electrode	900(20)	1500(28)	1300(28)
Ferro-alloys	300(5)	300(5)	300(5)
Paint	++(2)	++(2)	++(2)
Refractories	++(1)	++(1)	++(1)
RUTILE			
All Industries	**24900**	**26100**	**26000**
Electrode	7600(42)	8800(50)	8800(50)
Paint	16700(12)	16600(12)	16600(12)
Paper	300(2)	300(2)	300(2)
Others (Cosmetic, electrical,ferro-alloys)	300(4)	400(5)	300(5)

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 720 million tonnes in terms of TiO_2 content. Major reserves are in China (28%), Australia (24%), India (12%), South Africa (9%), Brazil and Madagascar (6% each), Norway (5%) and Mozambique (2%). The world reserves of rutile are 47 million tonnes in terms of TiO_2 content. Major rutile reserves are located in Australia (60%), followed by South Africa (18%), India (16%) and Ukraine (5%).

World production of ilmenite and rutile concentrates was 11.10 million and 0.80 million tonnes, respectively, in 2013. Canada contributed 25% of ilmenite production, followed by Australia (14%) ,South Africa and China (about 10% each). Australia produced 54% of world rutile output, followed by South Africa with 16%, Sierra Leone (15%) and Ukraine about 13%. 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) : 767000		
World: Total (Rounded)	**720000**	**47000**
Australia	170000	28000
Brazil	43000	-
Canada	31000	–
China	200000	–
India*	85000	7400
Madagascar	40000	–
Mozambique	14000	-
Sierra Leone	–	NA
Norway	37000	–
South Africa	63000	8300
Ukraine	5900	2500
USA	2000	–
Vietnam	1600	–
Other countries	26000	400

***Source**: Mineral Commodity Summaries, 2015.*

** As per NMI, the total resources of titanium minerals in India are estimated at about 349.49 million tonnes.*

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

(In '000 tonnes)

Country	2011	2012	2013
World: Total (wt. of conc.)	**11100**	**11400**	**11100**
Australia Ilmenite	1277	1344	1340(e)
Leucoxene	225	228	230(e)
Canada(e)@	2500	2700	2800
China(e)	1100	1100	1100
India**	751	750e	750e
Mozambique	637	574	720
Madagascar	511	562	562
Norway	870	831	826
South Africae	1369	1210	1120
USAe	300	300	300
Vietname	870	1164	606
Ukraine(e)	600	600	600
Other countries	90	37	146

***Source**: World Mineral Production, 2009-2013.*

** 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	2011	2012	2013
World: Total (wt. of conc.)	**800**	**800**	**800**
Australia	474	425	430e
India	17	16e	16e
South Africa	133	124e	130e
Sierra Leone	68	94	120
Ukraine(e)	100	100	100
Other countries	8	41	4

***Source:** World Mineral Production, 2009-2013.*

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 7.35 million tonnes in 2013, reported a decrease of 4% compared with that of 2011. The leading sources of world imports of titanium mineral concentrates were Australia, South Africa, China and Canada.

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

Iluka Resources Ltd produced 127,000 tonnes of rutile and 3,95,000 tonnes of ilmenite from its operations in Australia, a decrease of 42% and 14%, respectively, compared with that of 2012. Only one of Iluka's four synthetic rutile kilns was in operation during 2013 and it was idled in June, resulting in a 76% decrease in production to 59,000 tonnes of synthetic rutile .

Image Resources undertaken a feasibility study at its Atlas and Boonanarring deposits in Perth Basin, Western Australia for a facility to produce 35,000 tonnes per year of zircon and 91,000 tonnes per year of ilmenite over 10 years.

Canada

Argex Titanium Inc. announced plants to construct a TiO_2 pigment plant in Salaberry-de-Valley field, Quebec. The plant was expected to use a new production technology that could use run of mine material as feed stock. The plant was expected to begin production in mid 2015 with a capacity of 50,000 tonnes per year.

China

The pigment production in China was dominated by sulphate-route technologies, the capacity of chloride -route production at the end of 2013 was 180,000 tonnes per year. A potential 1.4 million tonnes per year of chloride capacity may be placed by 2018.

Japan

Japan produced 42,200 tonnes of titanium sponge in 2013, a decrease of 33% from that of 2012. Exports of titanium sponge were about 18,000 tonnes in 2013, a decrease of 41% from those of 2012. Lower sponge production and subsequent lower exports in 2013 were attributed to a decline in water desalination plant projects and nuclear power markets, competition with Chinese producers who had surplus capacity and lower demand for titanium sponge due to increased use of scrap. Shipments of titanium mill products were 12,400 tonnes, a decrease of 41% from those of 2012.

Kenya

Base Resources Ltd began producing heavy mineral concentrates at its Kwale prospects and began shipments of ilmenite in February, 2014. During the first 6 years of operation, production at Kwale was expected to be 360,000 tonnes per year of ilmenite and 80,000 tonnes per year of rutile.

Madagascar

World Titanium Resources Ltd (WTR) estimated ore reserves at its Ranobe deposit in the Toliara Sands Project in southwest Madagascar to be 161 Mt with 8.2% heavy minerals. WTR expected to produce 407,000 tonnes per year of ilmenite and 44,000 tonnes per year of zircon/rutile concentrate over a mine life of 21 years. Production was scheduled to begin in the third quarter of 2015.

Mozambique

Kenmare Resources plc's produced 720,100 tonnes ilmenite and 4,000 tonnes of rutile at its Moma Mine in 2013. Although, in 2013 ilmenite production increased by 25% from that of 2012 following completion of plant expansions, rutile production decreased by 22% over the same period due to startup problems with the rutile and zircon circuit expansions.

Norway

TiZir Ltd's Tyssedal ilmenite upgrading facility to produce 190,000 tonnes titanium slag in 2013 an increase of 5% that of 2012.

Russia

IRC Ltd. produced 150,485 tonnes of ilmenite at its Kurankh deposit, an increase of 20% from that of 2012. The Kurankh deposit is located in the Amur region in the Russian Far East was expected to produce 160,000 tonnes per year of ilmenite over a remaining mine life of more than 15 years. Most of IRC's ilmenite production was expected to China.

VSMPO-Avima signed an agreement with the Boeing Co. to build a new plant in the Sverdlovsk region to expand its plant's capability to produce titanium stampings. The agreement also extended Boeing's supply contract of titanium mill products, set to expire in 2018 for additional 10 years.

Saudi Arabia

Cristal Global announced that the first two ilmenite smelting furnaces at its ilmenite smelting plant in Jazwan were to be commissioned in mid 2014. The plant was to have an initial capacity of 500,000 tonnes per year of titanium slag with 235,000 tonnes per year of pig iron. The production of this plant was to be used at its pigment plant in Yanbu.

Senegal

Costruction at Mineral Deposit Ltd's Grand Cote Mine was completed by year end. The production was expected to begin in March 2014 and expected to produce as average of 575,000 tonnes per year of ilmenite and 85,000 tonnes per year of zircon with small amounts of rutile and leucoxene, over a mine life of at least 20 years.

Sierra Leone

Sierra Rutile Ltd (SRL) produced 120,350 tonnes of rutile in 2013, a 27% increase from 2012. SRL planned to increase capacity of its mineral separation plant from 165,000 tonnes per year to 225,000 tonnes per year.

Singapore

Ishihara Sangyo Kaisha Ltd (ISK) announced that it will close its chloride route pigment plant in Singapore due to sluggish demand, increased feedstock prices and higher infrastructure cost. ISK was to consolidate the production of TiO_2 pigment at its existing plant in Yokkaichi, Japan. the capacity of the plant in Singapore was 54,000 tonnes per year.

South Africa

South African Council for Scientific and Industrial Research and Boeing Co. signed an MoU to develop a process for producing titanium metal powder from $TiCl_4$ in a continuous process using the reduction of $TiCl_4$ in a molten solution. A pilot plant was launched in Pretoria, with the initial stage of the project planned to last up to 24 months. The Fairbreez Mine part of the Kwazulu-Natal (KZN) sands which was expected to be completed in the second part of 2015 was to replace the Hillendale Mine, which ceased operation in December 2013. Over a 12 year life. KZN Sands operations were expected to produce 30,000 tonnes per year of rutile and 220,000 tonnes per year of titanium slag. Mineral commodities Ltd commenced beach mining and processing at its Tormin project and produced 1,730 tonnes of non-magnetics zircon and rutile with more than 60,000 tonnes of heavy mineral concentrates stockpiled for further processing. The Tormin operation was expected to produce 45,000 to 50,000 tpy of zircon/rutile concentrate.

FOREIGN TRADE

Exports

As per the data from DGCI & S, Kolkata exports of titanium ores & conc. decreased to 0.68 million tonnes in 2013-14 as compared to 0.80 million tonnes in the preceding year. Exports in 2013-14 comprised ilmenite (686,264 tonnes), rutile (1,619 tonnes) and other titanium ores (40 tonnes) were also exported. Main destinations were China (45%), Netherlands (24%) and Japan (11%).

Exports of titanium and alloys (including waste & scrap) were 118 tonnes in 2013-14 as compared to 195 tonnes in the previous year. Exports were mainly to Malaysia and USA. Exports of titanium oxide and dioxide (total) increased to 38,206 tonnes in 2013-14 from 38,011 tonnes in 2012-13. Out of total exports in 2013-14, those of titanium dioxide were 9,054 tonnes and other than titanium dioxides were 29,152 tonnes (Tables-12 to 19).

Imports

As per the data from DGCI&S, imports of titanium ores & conc. rose to 91,775 tonnes in 2013-14 as compared to 77,819 tonnes in the preceding year. Out of total imports of titanium ores & conc. in 2013-14, those of ilmenite were 79,276 tonnes, rutile 10,078 tonnes and other titanium ores were 2,421 tonnes. Main suppliers were Mozambique, Australia and Sri Lanka.

Imports of titanium and alloys (including waste & scrap) were 1,536 tonnes in 2013-14 as compared to 1,273 tonnes in the previous year. Imports were mainly from Italy, China and USA. Imports of titanium oxide and dioxide (total) were 17,445 tonnes in 2013-14 as compared to 18,802 tonnes in the preceding year. Bulk of these imports were of titanium dioxide (16,875 tonnes) and those of other oxides were 570 tonnes in 2013-14. Imports were mainly from China (31%), Germany (13%) and Korea, Rep. of (16%) (Tables - 20 to 27).

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**791735**	**14158888**	**686264**	**8731824**
China	423751	6882540	311065	3814153
Japan	100440	3396923	78632	1793452
Netherlands	166480	2380516	169190	1756606
Malaysia	39400	449184	89280	995616
Korea, Rep. of	50000	743475	21800	206454
Belgium	-	-	4004	52738
Iran	-	-	224	3890
Chinese Taipei/ Taiwan	44	1018	152	2904
Tanzania	-	-	84	1141
Unspecified	-	-	11800	103895
Other countries	11620	305232	33	975

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	**800730**	**14571902**	**687923**	**10412481**
China	430996	7130962	311065	3814153
Japan	101081	3419034	78634	1794080
Netherlands	166734	2420782	169296	1764731
Iran	33	4050	1448	1658204
Malaysia	39631	477269	89320	998296
Korea, Rep. of	50020	746858	21800	206454
Belgium	-	-	4056	56227
Philippines	132	13637	66	4590
Chinese Taipei/ Taiwan	44	1018	152	2904
Unspecified	-	-	11800	103895
Other countries	12059	358292	286	8947

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2322**	**253625**	**1619**	**1678038**
Iran	33	4050	1224	1654314
Netherlands	254	40266	106	8126
Philippines	132	13637	66	4590
Belgium	-	-	52	3489
Malaysia	231	28084	40	2680
Slovenia	-	-	28	2130
Hong Kong	-	-	20	1558
Japan	141	14750	2	628
UAE	-	-	78	299
Indonesia	-	-	1	126
Other countries	1531	152838	2	98

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**6673**	**159389**	**40**	**2619**
Bangladesh	132	12213	10	1286
Kenya	-	-	10	1200
Nepal	-	-	20	132
Iraq	-	-	++	1
Other countries	6541	147176	-	-

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**195**	**268751**	**118**	**163435**
Malaysia	9	37724	2	44040
USA	68	34659	41	21528
Ukraine	-	-	5	16661
Saudi Arabia	4	29321	8	14867
Philippines	1	9040	1	13099
UAE	8	28565	1	8958
UK	31	19791	41	7886
Norway	7	21122	++	7033
Egypt	++	191	1	6439
Singapore	6	3727	1	5037
Other countries	61	84611	17	17887

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**38011**	**4519600**	**38206**	**3447972**
Japan	27738	3192277	25596	1920812
USA	2057	272234	3277	427959
Italy	1366	212115	2168	325981
China	500	40761	2716	163827
Iran	274	51568	984	160162
Singapore	3000	359003	1000	91248
Turkey	271	37219	467	65753
Nigeria	475	61082	283	41276
Thailand	846	110507	300	37633
UAE	329	40064	170	30016
Other countries	1155	142770	1245	183305

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**3470**	**527927**	**9054**	**1285335**
USA	387	63681	3128	415952
Italy	1312	200852	2060	301398
Iran	233	37247	984	160162
Japan	414	67791	516	71241
Turkey	180	25373	443	64271
Nigeria	41	8943	283	41276
Thailand	17	2242	300	37633
Spain	80	9966	200	26400
Indonesia	18	3077	200	24526
UAE	310	37226	154	20333
Other countries	478	71429	786	122143

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**34541**	**3991773**	**29152**	**2162637**
Japan	27324	3124486	25080	1849571
China	500	40759	2700	161297
Singapore	3000	359003	1000	91240
Italy	54	11263	108	24584
USA	1670	208553	149	12007
UAE	19	2839	16	9684
Chile	-	-	18	4115
Mexico	14	3608	18	3973
Saudi Arabia	85	2113	10	2074
Turkey	91	11846	24	1482
Other countries	1784	227303	29	2610

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**77819**	**2842107**	**91775**	**1933433**
Mozambique	59573	1222768	76188	1043133
Australia	7301	876295	9914	663692
Sri Lanka	5534	283442	4000	118020
South Africa	1340	164780	920	62379
Ukraine	429	57600	364	25988
Sierra Leone	397	10270	100	6853
Vietnam	939	72377	104	6399
China	479	72289	52	3080
Germany	48	4851	45	2281
UAE	52	8000	56	845
Other countries	1727	69435	32	763

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**65876**	**1403236**	**79276**	**1091737**
Mozambique	59573	1222768	76188	1043132
Sri Lanka	4535	99308	3000	46616
UAE	-	-	56	845
Germany	15	1596	5	659
UK	2	273	27	416
Norway	-	-	++	69
Other countries	1751	79291	-	.-

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**9826**	**1254835**	**10078**	**682300**
Australia	5711	707001	8011	539990
Sri Lanka	999	184134	900	64006
South Africa	1162	145626	634	42843
Ukraine	429	57600	252	18116
Sierra Leone	-	-	100	6853
Vietnam	739	54926	104	6399
China	479	72289	52	3080
Germany	29	3119	20	734
UK	-	-	5	263
Thailand	-	-	++	16
Other countries	278	30140	-	.-

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2117**	**184036**	**2421**	**159396**
Australia	964	110483	1903	123702
South Africa	178	19154	286	19536
Ukraine	-	-	112	7872
Sri Lanka	-	-	100	7398
Germany	4	136	20	888
Other countries	971	54263	-	-

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1273**	**2381849**	**1536**	**3161133**
Italy	63	152391	300	804155
China	212	330116	330	554576
USA	299	607277	137	476428
Russia	309	457430	309	364480
UK	109	344312	87	334533
Germany	50	120481	123	176320
Kazakhstan	60	44374	134	128376
France	15	73797	15	83072
Japan	49	29986	54	82207
Canada	6	32920	13	54178
Other countries	101	188765	34	102808

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**18802**	**3300512**	**17445**	**2999969**
China	5185	742498	5442	753112
Germany	2344	496701	2408	577139
Korea, Rep. of	2720	496951	2898	500900
USA	2018	404380	1308	251320
Japan	895	196821	876	221435
Ukraine	1200	176582	1600	203913
Czech Republic	2395	376530	1318	199809
Italy	396	65714	502	91124
Chinese Taipei/Taiwan	357	76471	225	41824
Finland	84	17893	163	31561
Other countries	1208	249971	705	127832

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**17824**	**3178780**	**16875**	**2919648**
China	4612	699367	4968	706132
Germany	2295	484635	2385	569811
Korea, Rep. of	2500	457171	2898	500900
USA	2015	403293	1298	248396
Japan	890	195307	864	211105
Ukraine	1200	176582	1600	203913
Czech Republic	2395	376530	1318	199809
Italy	332	58720	482	86578
Chinese Taipei/Taiwan	297	63056	225	41824
Finland	84	17893	163	31561
Other countries	1204	246226	674	119619

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**978**	**121732**	**570**	**80321**
China	573	43131	474	46980
Japan	5	1514	12	10331
Germany	49	12066	23	7328
Italy	64	6994	20	4546
Saudi Arabia	-	-	20	3794
USA	3	1087	10	2925
Singapore	-	-	11	2482
France	3	2563	++	1167
Poland	++	61	++	277
Switzerland	++	62	++	254
Other countries	281	54254	++	237

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.

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