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(Part-III : Mineral Reviews)



55th Edition

KAOLIN, BALL CLAY, OTHER CLAYS AND SHALE

(FINAL RELEASE)

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

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29 Kaolin, Ball Clay, Other Clays and Shale

1. Kaolin (China Clay)

The name kaolin is derived from the village of Gaoling in Jiangxi province, China, where the white clay was mined. Kaolin also known as china clay, is a white commercial clay consisting predominantly of the mineral kaolinite, a hydrated aluminosilicate formed by chemical weathering of aluminium silicate minerals like feldspars through a complex sequence of events. It is relatively pure clay predominantly consisting of kaolinite ($\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$), associated with other clay minerals like dickite, halloysite, nacrite and anauxite. Kaolinite and halloysite are the most commonly found members of the kaolin group whilst nacrite and dickite are considered rare but with the progress made in infrared spectroscopy techniques, nacrite and dickite are now found association with kaolinite in many deposits. The levels of these two minerals are used as a guide by the Oil Industry as an indication of depth of burial of sediments, the levels of the two minerals increases with the higher temperatures and pressures at depth.

Kaolin is commercially valued for its whiteness and fine particle size which distinguish it from other clays, such as, ball clay and fireclay. Other physical characteristics that influence commercial utility include brightness, glossiness, abrasiveness and viscosity. It often contains small amounts of impurities in the form of rock fragments, hydrous oxides and colloidal materials. Kaolin is produced and consumed in the country in crude & processed forms. The major use of crude china clay is in Cement Industry and of processed china clay in Ceramic Industry. The in situ clay deposits in India are often soft and easily extracted with no blasting required.

RESERVES/RESOURCES

China clay reserves/resources in the country as per NMI data based on UNFC system as on 1.4.2015 have been placed at 2,941.24 million tonnes. The reserves constitute only about 8% of the resources at 229.47 million tonnes. Out of the total reserves, 61% (about 140.46 million tonnes) reserves are under proved category whereas 39% (about 89 million tonnes) reserves fall under probable category.

The reserves/resources are spread over in a number of states of which Kerala holds about 23%, followed by Rajasthan (19%), West Bengal (14%), Odisha (10%) and Karnataka (9%).

Out of total reserves/ resources, about 26% or 771.42 million tonnes fall under ceramic/pottery grade, about 4% are classified under chemical, filler and cement grades and about 70% or 2,039 million tonnes resources fall under mixed grade, others, unclassified & not-known categories. The details of reserves/resources are furnished in Table- 1.

EXPLORATION & DEVELOPMENT

DMG, Kerala and Rajasthan carried out exploration for kaolin in the districts of Kannur and Kollam, Kerala state & Bikaner district of Rajasthan respectively. The details of exploration carried out during 2015-16 are furnished in Table-2.

PRODUCTION

As per GOI notification S.O.423(E) dated 10th February 2015, Kaolin, China Clay, Clay (Others) and Shale have been declared as 'Minor Mineral' hence the data on production beyond January 2015 is not available with Indian Bureau of Mines. A list of producers of Kaolin is furnished in Table-3.

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**Table –1 : Reserves/Resources of China Clay as on 1.4.2015
(By Grades/States)**

(In '000 tonnes)

Grade / State	Reserves						Remaining resources						Total resources (A+B)									
	Proved		Probable		Total (A)		Feasibility		Pre-feasibility		Measured			Indicated		Inferred		Reconnaissance		Total (B)		
	STD111	STD121	STD122	STD121	STD122	STD121	STD221	STD222	STD331	STD332	STD333	STD334		STD335	STD336	STD337	STD338	STD339	STD340	STD341	STD342	STD343
All India : Total	140456	36144	52869	107176	42220	98627	289723	415703	1685730	72599	2711777	2941247										
By Grades																						
Textile/Paper Coating	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Insecticide	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chemical	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ceramic/Pottery	77668	15765	30250	47145	26047	47784	103887	25753	362781	34340	647736	771419										
Rubber	-	136	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mixed Grade	356	200	80	7748	1846	4335	884	607	199355	18002	232778	233414										
Filler	9564	1118	3070	11606	1406	8144	621	684	32909	621	55990	69742										
Cement	4955	1230	2399	6749	1160	6070	25	423	2902	-	17330	25914										
Others	28168	17183	13174	13889	8206	17395	180397	1649	53406	6983	281925	340450										
Unclassified	12210	42	1940	15913	1342	6792	720	68626	31882	1421	126694	140886										
Not-known	7535	472	1954	4061	1533	8107	3189	317961	968311	11094	1314257	1324218										
By States																						
Andhra Pradesh	2494	953	1889	1508	989	2071	511	688	51427	362	57556	62893										
Assam	-	-	-	-	131	-	392	-	3520	-	4043	4043										
Bihar	-	-	-	-	-	-	104	39	1296	-	1438	1438										
Chhattisgarh	107	-	22	1272	765	1412	-	-	11422	-	14871	15001										
Delhi	-	-	-	-	-	-	857	630	3802	-	5289	5289										
Goa	-	-	-	-	-	16	-	-	-	-	16	16										
Gujarat	54111	3486	19671	25378	4790	28542	1663	4198	49337	4114	118021	195289										
Haryana	-	-	-	-	2367	3377	13	34	5485	-	12065	12065										
Jammu & Kashmir	-	-	-	-	-	-	-	2	28122	-	28124	28124										
Jharkhand	427	-	6412	9338	2093	4738	3962	7363	149892	18019	195405	202244										
Karnataka	330	472	-	1768	747	2683	220360	443	24803	6030	256834	257636										
Kerala	7097	200	725	4573	463	4112	43930	20439	571644	20200	665360	673383										
Madhya Pradesh	357	474	902	2882	406	3774	621	415	12017	-	20115	21848										
Maharashtra	-	-	-	418	81	831	184	184	5735	-	7248	7248										
Manipur	-	-	-	-	-	-	2520	-	-	-	2520	2520										
Meghalaya	-	-	-	-	-	-	1200	6266	76242	5167	88875	88875										
Odisha	-	-	-	3600	3503	5018	368	35770	236546	1354	286157	286157										
Puducherry	-	-	-	-	-	-	-	-	2940	-	2940	2940										
Rajasthan	73434	29510	22493	47554	26157	40542	1584	3221	294386	11428	424874	550311										
Tamil Nadu	-	-	-	-	-	-	-	327	56570	-	56897	56897										
Telangana	623	322	-	2902	1059	655	-	-	10602	132	15350	16295										
Uttar Pradesh	-	-	-	-	-	-	11600	3447	10018	-	25065	25065										
West Bengal	1476	727	754	3617	248	857	38	332236	79923	5793	422712	425669										

Figures rounded off.

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Table – 2 : Details of Exploration Activities for Kaolin/China clay and other Clays, 2015-16

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
DMG Kerala							
Kannur	Kannadipoyil area Taluka: Taliparamba	-	-	08	168	67	Objective of exploration was investigation for china clay by core drilling. The average thickness of aluminous laterite overburden was found to be about 3 m. The average thickness of china clay was found to be about 10 m. The tentative inferred resources of low grade china clay have been estimated at 9.6 million tonnes and aluminous laterite 3 millions tonnes respectively.
	Karinthadaom area Taluka: Taliparamba	-	-	18	397.5	149	Objective of exploration was investigation for china clay and aluminous laterite by core drilling. Thickness of overburden was found to be 6 m and it is followed by lateritic clay, greyish, yellowish, yellowishwhite variegated clay having thickness of about 11m. A total tentative reserves/resources of low grade china clay have been estimated at 21 million tonnes in this area.
Kollam	Kumbalam- Kottppuram area Taluka: Kollam	-	-	11	464	-	Objective of exploration was to identify new china clay resources in and around Kanjiracode area & to assess the resources for further developement of M/s Kerala Ceramics Pvt.Ltd. The average thickness of overburden was found to be about 15 m and that of dull white to greyish sandy clay 15 m. About 2.7 million tonnes of tentative resources of dull white to greyish sandy clay have been estimated.
DMG Rajasthan							
Bikaner	Motawatan, Kishnayat area Taluka: Kolayat	-	-	-	-	5	Objective of exploration was to locate and map clay, silica sand areas out side the leased out area. Geologically the large area of Bikaner district consists of Tertiary formations . In Kolayat large area is being excavated for production of ballclay. Exploration work includes regional mineral survey & regional geological mapping over an area of 270 sq km and 20 sq km respectively.

Table – 3 : Principal Producers of Kaolin, 2015-16

Name & address of producer	Location of mine	
	State	District
Shree Ram Minechem International, G.I.D.C Area, Madhapar, Bhuj, Distt. Kachchh-370 020 Gujarat	Gujarat	Kachchh
EICL Ltd, TC- 79/04, Veli, Thiruvananthapuram-695 021, Kerala.	Kerala	Thiruvananthapuram
Ashapura China Clay Company, D-409A, Shivalik Corporate Park ,D Mart building, Satellite, Ahmedabad Distt. Ahmedabad Gujarat.	Gujarat	Kachchh
The Kerala Ceramics Ltd , PB.No.2, P.O.Kundara, Distt.Kollam-691 501, Kerala	Kerala	Kollam
Devkrupa China Clay Company, Plot No.65,66,67, New Sanskarnagar, Bhuj, Distt. Bhuj -370 001, Gujarat.	Gujarat	Kachchh
Uma Mine Chem Industries, 113-114, Pooja Complex 'B', Station Road, P.O. Bhuj, Distt. Kachchh -370 001, Gujarat.	Gujarat	Kachchh
Mohd. Sher Khan, (Popular Minerals) Khawaja Bagh, P.O. Sawa, Distt. Chittorgarh-312 613, Rajasthan.	Rajasthan	Chittorgarh
WMA India B-33,RICCO HSG Complex Ajmer road, Beawar Distt.Beawar-305 901 Jharkhand.	Jharkhand	Sahebganj
R.B. Mining & Company, 25/531, Neelkanth Colony, Vill. Gudda, P.O. Mandal, Distt. Bhilwara-311 403, Rajasthan.	Rajasthan	Bhilwara

MINING, PROCESSING & MARKETING

China clay deposits worked in India are mostly of pocket-type. Opencast manual mining is followed in most kaolin mines. The most common practice is to dig trial pits for locating clay pockets or beds which are gradually enlarged into pits of various dimensions. China clay is often soft and easily extracted with no blasting required. Clay and overburden are quarried in benches. In few mines, bulldozers and excavators are used to remove the overburden which is then transported through trucks/tractors/trailers.

Crude china clay is normally processed. Almost, all the china clay user industries except cement, insecticide and refractory units consume processed china clay. The natural china clay is processed in the country mostly by conventional method of levigation/washing. In addition, hi-tech processes, such as, Mozeley hydrocyclone separator, high-intensity magnetic separator, bleaching (chemical decolourisation), spray drying and calcination are in practice. There is a need to use more sophisticated processing techniques like ultra froth-flotation, cryo-filter, etc.

The recovery percentage of processed china clay from raw china clay ranges from as low as 14% to as high as 56%, depending upon the quality of china clay available in different states. Large number of levigation plants are installed in the country mostly in Kerala, Gujarat, Jharkhand, West Bengal and Rajasthan. Kerala has become a hub for India's processed kaolin production. The important plants in the country are English Indian Clays Ltd (EICL) (300,000 tpy capacity), Veli, Thiruvananthapuram, Kerala; Kerala Ceramic Ltd,(18,000 tpy capacity) Payangadi, Kannur district, Kerala; 20 Microns Ltd, Mamura, Bhuj district Kachchh, Gujarat (80,500 tpy capacity; a new plant of 33,600 tpy is also installed); Devkrupa China Clay Company (18,000 tpy capacity), Mamura, Kachchh, Gujarat; Amrapali China Clay Washing Plant, Nadapa, Bhuj, district Kachchh, Gujarat; Hindalco's Beneficiation Plant at Bagru Plateau in Lohardaga district, Jharkhand. EICL has capacity to produce 240,000 tpy paper coating and filler grades of processed china clay (hydrous), besides 60,000 tpy of calcined clays. Popular Minerals has mines spread across 26 leases over 400 hectares. The company owns four clay washing and three grinding units powder plants at Sawa district Chittorgarh, Rajasthan. Ashapura

has modern china clay processing plant at Bhujodi taluka, district Bhuj, Gujarat. The new facility is the company's second facility after the one operational in Kerala, and make Ashapura one of the largest producer of kaolin in Asia. Ashapura has already acquired new mines having reserves of about 2.5 to 3.0 million tonnes in Kerala to meet high demand for kaolin. Satish Minerals is also a leading manufacturer and processor of china clay with 18,000 tpy capacity plant at Kachchh, Gujarat. Uma group of companies located in Gujarat is engaged in mining, processing & trading of china clay. It possess mining area in Dagara & Mamuara. Koat manufacturing company is engaged in processing of hydrous kaolin, calcined kaolin & metakaolin, having plant of capacity 1,000 mtpm at Kachchh, Gujarat.

Hydrous Kaolin, Levigated/Water Washed/Deaminated/spray dried kaolin products available from 75% to 84% (ISO) brightness. Particle size 2 Micron-49% to 93% (packing options available - 25 kg/50 kg/500 kg jumbo bags). China clay powder manufacture Shree Umia Sales Corpn. in GIDC Ahmedabad is engaged in export and supply of Indian china clay powder and ball clay.

Processed kaolin is presently marketed under various trade names mostly in levigated and spray dried forms. A small quantity of crude kaolin is also marketed. The various trade names under which the levigated kaolin is marketed are highest brightness calcined clays for coated paper, excellent partial replacement for TiO_2 . Zeta- balanced kaolin, highest brightness calcined clays for architectural decorative and industrial coatings/inks. High brightness finer hydrous clays for all kinds of aqueous paints, excellent functional clays for all paints formulations. Calcined lumps for refractory grade materials non-calcined lumps for refractories. Highly reactive pozzolan, Meta kaolin for RMC and cement application; kaolin for Agrochemicals, Rubber & Plastics, soaps & detergents, Fibre glass & ceramics. Improved processing techniques could increase further the prospects of Indian kaolin in the international markets.

USES AND SPECIFICATIONS

China clay (kaolin) is used in a number of industries in both crude and processed forms. The major use for crude china clay in India is in the Cement Industry, whereas Ceramic Industry accounts for consumption of a major

share of processed form of china clay. Besides ceramics, processed china clay finds use in other industries in the country, such as sealants, paper coatings, as extender in fibre glass, paint and as a filler for paper, rubber, plastic, cosmetics, pharmaceuticals and textiles. Crude china clay also finds use in Insecticide and Refractory Industries. Other uses of china clay are in ink, ultramarine, synthetic zeolite, catalyst, water filter candles, soaps & detergents and explosives & pyrotechnic industries. Some of the areas where use of china clay is gaining importance are in the manufacture of plastic film, video and audio tapes where clays are used as anti-blocking agents, and in the field of biotechnology, where ceramics are widely in use for its light weight & high strength properties. EICL has been producing Metakaolin which increases the durability of concrete by lime fixation and arresting of deterioration of concrete by weathering. Himacem has high chemical resistance which makes the product suitable for construction of high span bridges, underwater structures and chemical plants.

The Bureau of Indian Standards (BIS) has prescribed specifications for china clay to be used in different industries. They are IS:505-1995 (Third Revision, Reaffirmed 2011) for paper coating and filler for paper, rubber, textile industries, IS:1463-1983 (Third Revision, Reaffirmed 2000) for cosmetics and IS:7589-1974 (Reaffirmed 2011) for Explosive & Pyrotechnic Industry. BIS has revised the specifications for china clay for Ceramic Industry to IS:2840-2002 (Second Revision, Reaffirmed 2008) and for paint industry to IS:68-2006. The whiteness, particle size, plasticity, contents of alumina, iron and titanium are some important factors which control the specifications of china clay for different end-uses. China clay for ceramic and refractory applications is analysed for grit, brightness, green and dry strength, fixed colour, iron and alumina contents. For filler and extender applications, it must meet very rigid specifications, such as, particle size, colour, brightness and viscosity. The replacement of kaolin as a filler with precipitated calcium carbonate (PCC) and ground calcium carbonate (GCC), results in lowering consumption of kaolin in Paper Industry. Now they are using GCC due to a switch over by paper makers from an acid-based processing route to an alkali-based route for production. (Table - 4).

CONSUMPTION

The main consuming industry for raw china clay is the china clay processing/refining plants. The china clay processed by these plants in turn is consumed by various industries except cement, refractory and pesticide industries. The data on raw china clay consumption by various china clay processing plants are not readily available. However, the consumption of china clay by various industries is given in Table-5.

Consumption of china clay increased to 1,584 thousand tonnes in 2015-16, from 1,281 thousand tonnes in 2014-15. Cement Industry accounted for 66% consumption followed by ceramic (14%), the major consumer of raw china clay. Pesticide, paint, refractory, paper, cosmetic, rubber, abrasive, asbestos products, chemical, dry cell batteries, textile, electrical, electrode and glass industries together accounted for the remaining 20%.

Table – 4: Specifications of China Clay Required in Different Industries

Sl. No.	Characteristics	Paper coating Grade I	Filler in paper, rubber, textile Grade II	Cosmetics	Explosives
1.	Bureau of Indian Standard Specification No.	505 (1995) reaffirmed 2011	505 (1995) reaffirmed 2011	1463 (1983) reaffirmed 2011	7589 (1974) reaffirmed 2011
2.	Fineness (by weight % material retained on:)				
	45 microns sieve	–	–	2.0	–
	53 microns sieve	0.8	1.0	–	–
	63 microns sieve	–	–	–	1.0
	90 microns sieve	–	–	0.1	–
3.	Larger than 10 microns in diameter (% by mass, max)	5.0	15.0	–	–
4.	Smaller than 10 microns in diameter (% by mass, min)	75.0	60.0	–	–
5.	Grit (% by mass, max)	–	–	–	0.001
6.	Loss on Drying (% max)	2.0	2.0	1.5	1.5
7.	Loss on Ignition (% max)	14-15.5	14-15.5	15	14.0
8.	Water Plasticity (%)	14.0	–	–	–
9.	Shrinkage linear				
	a) Dry shrinking	–	–	–	–
	b) Fired shrinking	–	–	–	–
10.	Relative/Bulk density	2.5-2.9	2.5-2.9	*	0.65-0.90(BD)
11.	Colour reflectance to blue light (%)	80-85	*	–	–
12.	Chemical (% by mass, max)	–	–	@	–
	Fe ₂ O ₃	0.6	0.75	0.5	–
	Matter soluble in HCl	0.5-1	1.5-2.5	2.0	1.5
	CuO	–	0.007	–	–
	MnO	–	0.013	–	–
	Heavy metals (as Pb)	–	–	5 ppm	–
	As ₂ O ₃	–	10 ppm	2 ppm	–
	pH value of aqueous extract	4.5-7.5	4.5-7.5	7.5	6.0-7.5
13.	Oil absorption (ml/100 g)	–	50 (min)	–	35-45
14.	Water soluble matter (% , max)	–	0.5	–	0.5

* As agreed.

@ To pass test for iron and carbonate as well.

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**Table - 5: Consumption of Kaolin (China clay)*, 2013-14 to 2015-16
(By Industries)**

(In tonnes)

Industry	2013-14	2014-15 (R)	2015-16 (P)
All Industries	1429400	1280600	1583800
Cement	662900	773800	1051600
Ceramic	561500	223700	222900
Cosmetic	2300	2300	2300
Glass	700	2100	21300
Paint	111100	111100	111300
Paper	27700	21700	21700
Pesticide	24800	24800	24800
Refractory	33800	51000	57700
Rubber	2400	2400	2400
Others (abrasives, asbestos-products, chemical, dry cell battery, electrical, electrode and textile).	2200	67700	67800

Figures rounded off hence total may not tally

Includes actual reported consumption and/or estimates made wherever required. Paucity of data hence coverage may not be completed.

TRADE POLICY

As per the Foreign Trade Policy (FTP) 2015-2020, there are no restrictions on exports and imports of china clay (kaolin).

WORLD REVIEW

The world production of kaolin at 24.27 million tonnes in 2015 increased by 5% as compared to 23.21 million tonnes in the previous year. Seven countries, namely, USA, China, Turkey, Ukraine, Brazil, Iran and Germany accounted for about 70% world production. Out of this the share of USA in total world production was about 23%, followed by China (14%), Turkey (8%), Ukraine & Brazil (7% each), Iran (6%) and Germany (5%) (Table-6).

USA

BASF has closed the previously announced transaction to divest its global paper hydrous kaolin (PHK) business to Imerys, a producer of mineral-based specialty solutions for industry, based in Paris, France. Under a tolling agreement of limited duration, BASF will continue to manufacture and supply PHK products to manufacture and supply PHK products to Imerys to enable a smooth transition for customers. Included in the transaction is a kaolin milling facility in Wilkinson County, Georgia referred to as the "Gibraltar mill".

BASF will continue to own and operate its other assets in Georgia, USA including kaolin reserves, mining and production facilities as well as a slurry facility in Ghent, Belgium.

IMERYS S.A. and Omya AG are pleased to announce they have entered into exclusive negotiations to form a 50:50 technology Joint Venture to promote the research and development of Micro Fibrillated Cellulose (MFC) concerning a variety of applications and industries. The venture will combine the FiberLean™ and Omya's MFC technology platforms developed by each company into one entity, henceforth to be known as FiberLean™ Technologies. The first commercial product available, allows paper & packaging producers to improve quality and/or increase the mineral filler loading to achieve productivity gains and reduced costs.

FOREIGN TRADE

Exports

Exports of kaolin increased to 304,702 tonnes in 2015-16 from 258,330 tonnes in 2014-15. UAE (62%), Nepal (10%) and Sri Lanka (9%) were the major importing countries in 2015-16 (Table- 7).

Imports

Imports of kaolin increased to 118,524 tonnes in 2015-16 from 93,322 tonnes in 2014-15. Major suppliers were USA (50%) Ukraine (16%), China (6%) and Czech Republic (5%) (Table- 8).

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**Table – 6 : World Production of Kaolin
(By Principal Countries)**

(In '000 tonnes)

Country	2013	2014	2015
World: Total	22789	23211	24269
Belgium ^(e)	300	300	300
Brazil	2139	2055	1700
China ^(e)	3300	3300	3300
Czech Republic	609	617	648
Egypt ^(e)	300	300	300
France	300	311	310 ^(e)
Germany	1100 ^(e)	1100	1100
Iran	1000 ^(e)	1880	1500 ^(e)
Korea, Rep. of	847	683	588
Malaysia	293	220	295
Mexico	670	546	500 ^(e)
Portugal	248	269	247
Spain	411	344	350
Turkey	1027	734	2032
USA	6140	6310	6160 ^(e)
Ukraine	1179	1426	1815
Vietnam ^(e)	650	650	650
Other countries	2276	2166	2474

Source: World Mineral Production, 2011-2015.

**Table – 7 : Exports of Kaolin
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
All Countries	258330	941752	304702	1105589
UAE	198089	262280	187836	318243
Iran	5799	89052	7036	118410
Bangladesh	25392	135305	14773	97036
Germany	3174	55302	3830	78188
Sri Lanka	2448	38613	28452	48425
Indonesia	1518	35763	1510	38810
Oman	415	7511	11952	34208
Egypt	670	15655	1079	28302
Malaysia	1013	20958	1143	24026
Nepal	1235	13764	29239	21897
Other countries	18577	267549	17852	298044

**Table – 8 : Imports of Kaolin
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
All Countries	93322	1662634	118524	1996778
USA	56759	1135291	58807	1211966
Ukraine	10818	117987	18515	202538
China	6136	92907	6975	85512
Czech Republic	2215	27946	6310	81350
UK	3409	52895	3139	69496
France	3332	62199	4141	66686
Thailand	850	11022	3899	52157
Germany	2154	36618	2383	42075
Iran	2330	18303	5391	39767
Bulgaria	1870	17033	3124	26865
Other countries	3449	90433	5840	118366

FUTURE OUTLOOK

India has abundant resources of kaolin which can easily meet both the internal and the external demands. The processing of kaolin in the country is done mostly by conventional methods like levigation and washing. New capacities for High-tech processing have to be established and existing capacities in the country have to be augmented to meet the demand of processed kaolin in the future.

In the Indian kaolin market, good growth is expected both for hydrous and calcined clay particularly in paint, cables, plastics, rubber and ceramics. The apparent demand of china clay is estimated at 4.61 million tonnes by 2016-17 and that of ball clay at 1.82 million tonnes by 2016-17 at 9% growth rate by the Planning Commission of India.

2. Ball Clay

Ball clay commonly consists of 20-80% kaolinite, 10-25% mica & 6-65% quartz. Ball clay and china clay differ only in the degree of plasticity. China clay is less plastic than ball clay. Ball clay is a highly plastic variety of kaolin having high binding power, tensile strength and shrinkage. It is utilised generally after mixing with non-plastic clay to impart the desired plasticity in pottery, porcelain and refractory materials. It also helps in the preparation of glaze, enamels and for imparting a dense vitrified body.

RESERVES/RESOURCES

Deposits of ball clays are relatively scarce due to the combination of geological factors needed for their formation. The total resources of ball clay as per NMI data based on UNFC system, as on 1.4.2015 in the country are placed at 134.74 million tonnes. Out of these resources, the reserves are about 49.49 million tonnes and the remaining resources are 85.25 million tonnes. About more than 57% resources are in Rajasthan followed by Andhra Pradesh with 42%. Resources in Gujarat are nominal. Out of the total reserves/resources, ceramic/pottery grade constitutes 58%. All India reserves/resources of ball clay are furnished in Table- 9.

PRODUCTION AND STOCKS

As per GOI notification S.O.423(E) dated 10th February 2015, Ball Clay has been declared as

'Minor Mineral' hence the data on production beyond January 2015 is not available with Indian Bureau of Mines. A list of producers of Ball Clay is furnished in Table - 10.

SPECIFICATIONS

The specifications for plastic clay and washed plastic clay for use in Ceramic Industry are prescribed vide IS:4589-2002 (Third Revision, reaffirmed 2008).

CONSUMPTION

Consumption of ball clay increased from 566,100 tonnes in 2014-15 to 586,100 tonnes in 2015-16. About 95% consumption was accounted for by the Ceramic Industry. The remaining consumption (5%) was reported by the Refractory and Abrasive Industries (Table- 11).

FOREIGN TRADE

Exports

Exports of ball clay increased substantially to 61,536 tonnes in 2015-16 from 57,557 tonnes in the previous year. Exports were mainly to UAE (58%), Saudi Arabia (27%) and Bangladesh (13%) (Table- 12).

Imports

Imports of ball clay increased by 34% to 167,856 tonnes in 2015-16 as compared to 125,384 tonnes in the previous year. Imports were mainly from Ukraine (54%), Malaysia (20%), UK (12%) and China (10%) (Table- 13).

Table – 9 : Reserves/Resources of Ball Clay as on 1.4.2015 (P)
(By Grades/States)

Grade/State	(In tonnes)											
	Reserves					Remaining resources					Total resources (A+B)	
	Proved STD111	Probable STD121	Probable STD122	Total (A)	Feasibility STD211	Pre-feasibility STD221	Measured STD331	Indicated STD332	Inferred STD333	Total (B)		
All India : Total	33526297	11182801	4784522	49493621	11045214	4286560	13437994	624977	2497880	53357091	85249716	134743337
By Grades												
Ceramic/Pottery	12164675	1733326	3894361	17792361	4582521	4223342	11445891	470986	2279330	37898024	60900094	78692455
Refractory	1411104	202950	54	1614108	3363353	-	763135	-	-	512760	4639248	6253356
Others	17857250	8534551	890108	27281909	342169	46134	67320	153991	-	9457635	10067249	37349158
Unclassified	2093268	711975	-	2805243	2757171	17084	1161648	-	218550	5488672	9643125	12448368
By States												
Andhra Pradesh	6700417	202950	1049025	7952392	5622514	2842702	10275648	-	2279330	28044529	49064723	57017115
Gujarat	20900	-	-	20900	342169	-	-	403801	-	49670	795640	816540
Rajasthan	26804980	10979851	3735497	41520329	5080531	1443858	3162346	221176	218550	25262892	35389353	76909682

Figures rounded off.

KAOLIN, BALL CLAY, OTHER CLAYS AND SHALE

Table – 10 : Principal Producers of Ball Clay

Name & address of producer	Location of mine	
	State	District
* Shanta Sales Corporation, H/o Mohanlal Mathur, Behind Rajasthan Pan Bhandar, Rani Bazar, Bikaner-334 001, Rajasthan.	Rajasthan	Bikaner
Jaichand Lal Daga, 1 st Floor, Labhuji Ka Katla, Kotegate, Bikaner - 334 001, Rajasthan.	Rajasthan	Bikaner
Anirudh Mines & Minerals, Near Ramdev Park, Outside Nathusar Gate, Bikaner – 334 004, Rajasthan.	Rajasthan	Bikaner
Sunder Lal Daga, Bagree Mohalla, Bikaner-334 001, Rajasthan.	Rajasthan	Bikaner
* Sampat Lal Daga, 1 st Floor, Labhu Ji Ka Katla, Bikaner-334 001, Rajasthan.	Rajasthan	Bikaner

(Contd.)

(Table - 10 Concld.)

Name & address of producer	Location of mine	
	State	District
Sandeep Chandna, Ramnath Sadan, Near Arya Samaj Mandir, Rathkhana Colony, Bikaner-334 001, Rajasthan.	Rajasthan	Bikaner
* Narendra Kumar Devra, Ward No. 51, Near Ratan Sagar Well, Bikaner-334 001, Rajasthan.	Rajasthan	Bikaner
* Smt Rama Devi Sharma, 99-100, Industrial Area, Road No.-9, Rani Bazar, Bikaner-334 001, Rajasthan.	Rajasthan	Bikaner
Vijayabharti Corporation, Door No. 22 D-3-30/1, Ramalayam Street, Ramkrishnapuram, Eluru, West Godawari-534 002, Andhra Pradesh.	Andhra- Pradesh	West- Godawari
Surendra Singh Baid, 1-B-10, Pawanpuri, Bikaner-334 001, Rajasthan.	Rajasthan	Bikaner

* Associated mines of ball clay with clay (others) and fire clay.

**Table – 11 : Consumption* of Ball clay
2013-14 to 2015-16
(By Industries)**

Industry	(In tonnes)		
	2013-14	2014-15 (R)	2015-16 (P)
All Industries	582500	566100	586100
Ceramic ^(e)	565200	544400	558900
Refractory	17200	21600	27100
Others (Abrasive)	100	100	100

Figures rounded off.

* Includes actual reported consumption and/or estimates made wherever required. Paucity of data hence coverage may not be completed..

**Table – 12 : Exports of Ball Clay
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
All Countries	57557	194269	61536	148435
UAE	7097	18138	35976	66084
Bangladesh	26620	110583	8253	47025
Saudi Arabia	8875	17977	16557	28983
Oman	12150	29976	320	3439
Sri Lanka	57	465	170	1464
Kenya	264	1408	132	721
Philippines	11	33	44	233
Iran	749	5461	24	151
Chinese				
Taipei/Taiwan	1	15	25	124
UK	-	-	10	102
Other countries	1733	10213	25	109

KAOLIN, BALL CLAY, OTHER CLAYS AND SHALE

**Table – 13 : Imports of Ball Clay
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	125384	957636	167856	1298485
Ukraine	61021	453872	90389	724544
UK	21224	242144	20068	237521
China	14223	110337	16768	128501
Malaysia	22853	65585	33924	99960
USA	983	22178	1006	24643
France	446	5412	1715	19089
Japan	180	5325	580	17653
Portugal	1300	13719	1404	14189
Bangladesh	-	-	3	11346
Thailand	2130	22125	719	7903
Other countries	1024	16939	1280	13136

3. Clay (others)

Clay under this category includes aluminous, ferruginous and tile & brick making clays.

PRODUCTION, STOCKS & PRICES

As per GOI notification S.O.423(E) dated 10th February 2015, Clay (others) has been declared as 'Minor Mineral' hence the data on production beyond January 2015 is not available with Indian Bureau of Mines. A list of producers of Clay (others) is furnished in Table-14.

**Table – 14 : Principal Producers of
Clay (Others), 2014-15**

Name and address of producer	Location of mine	
	State	District
Bhupendra Reva Sankar Gor, 66, Devkrupa, Limbda Street, Bhuj, Kachchh - 370 001, Gujarat.	Gujarat	Kachchh
* ACC Ltd , 'Cement House', 121, Maharshi Karve Road, Mumbai – 400 020, Maharashtra.	Madhya- Pradesh	Katni
English India Clays Ltd , TC-79/04, Veli, Thiruvananthapuram–695 021, Kerala.	Kerala	Thiruvanan- thapuram
Ishvarlal Nanjibhai Bhavani, 113-114, Pooja-B, Behind ICICI Bank, Station Road, Bhuj - 370 001, Distt. Kachchh, Gujarat.	Gujarat	Kachchh
Kissan Minerals, Shop No. 4, Mate Buiding, Salari Naka Road, Rapar-370 165, Distt. Kachchh, Gujarat.	Gujarat	Kachchh
Ratanbhai Dalabhai Gohil, Goyalvas, Bhimasar (Bhuj), Rapar-370 160, Distt. Kachchh, Gujarat.	Gujarat	Kachchh
*Shankarlal Gangaram Thakkar, DBZ South-157, Zanda Chowk, Gandhidham-370 201, Distt. Kachchh, Gujarat.	Gujarat	Patan
Satyam Minerals, Survey No.947, Paiki, Hamirpar Moti, Rapar–370 165, Distt. Kachchh, Gujarat.	Gujarat	Kachchh

* Producing clay (others) as an associated mineral.

FOREIGN TRADE**Exports**

Exports of clay (others) decreased to 23,341 tonnes in 2015-16 from 25,515 tonnes in 2014-15. Exports were mainly to Bangladesh (22%), Kenya and Nepal (16% each) (Table- 15).

Imports

Imports of clay (others) increased to 19,485 tonnes in 2015-16 from 14,347 tonnes in 2014-15. Turkey(40%) Ukraine (39%) and USA (12%) were the main suppliers (Table- 16).

4. Shale

Shale is a fine grained, plastic sedimentary rock comprised of mud that is a mixture of flakes of clay minerals and tiny fragments of minerals like quartz and calcite. The ratio of clay to other minerals is variable.

Shale which occurs with limestones as parting is rich in alumina content. Hitherto, shale was considered as implacable substance that reduced the quality of limestone due to presence of clay minerals. Now, with advancements and better knowledge, it is utilised as a source of alumina in cement making.

**Table – 15: Exports of Clay (Others)
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
All Countries	25515	217300	23341	312553
Kenya	1215	13825	3814	84632
Bangladesh	5731	36171	5085	56630
Nepal	4022	23306	3759	25633
Spain	465	6639	1460	16477
UAE	989	8642	1024	12445
Nigeria	732	9378	886	11598
Sri Lanka	1102	8725	1346	11433
Saudi Arabia	1414	12658	739	9388
Thailand	276	4438	651	9177
Tanzania	41	709	353	6945
Other Countries	9528	92809	4224	68195

KAOLIN, BALL CLAY, OTHER CLAYS AND SHALE

**Table – 16: Imports of Clay (Others)
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty	Value	Qty	Value
	(t)	(` '000)	(t)	(` '000)
All Countries	14347	231877	19485	266435
USA	2574	99384	2363	112420
Ukraine	9655	72009	7625	57300
Turkey	75	343	7779	41053
Spain	739	21893	379	11544
UK	456	7373	490	8629
Germany	44	3095	243	8382
Netherlands	184	13914	130	8196
Japan	34	1893	29	4401
Singapore	++	30	40	3183
China	374	7349	163	3162
Other countries	212	4594	244	8165

RESERVES/RESOURCES

The reserves/resources of shale were placed at 19.25 million tonnes as per NMI data, based on UNFC system, as on 1.4.2015, comprising 15.47 million tonnes reserves and 3.78 million tonnes remaining resources. About 72% resources are located in Telangana followed by Andhra Pradesh (18%) and Madhya Pradesh (10%) (Table- 17).

PRODUCTION & STOCKS

As per GOI notification S.O.423(E) dated 10th February 2015, Shale has been declared as 'Minor Mineral' hence the data on production beyond January 2015 is not available with Indian Bureau of Mines. A list of producers of Shale is furnished in Table-18.

KAOLIN, BALL CLAY, OTHER CLAYS AND SHALE

**Table – 17: Reserves/Resources of Shale as on 1.4.2015
(By Grades/States)**

(In '000 tonnes)

Grade / State	Reserves				Remaining resources						Total resources (A+B)
	Proved STD111	Probable STD121 STD122	Total (A)	Feasibility STD211	Pre-feasibility STD221 STD222	Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	
All India : Total	15027	171 274	15472	495	- 2022	-	-	1175	90	3781	19253
By Grade											
Unclassified	15027	171 274	15472	495	- 2022	-	-	1175	90	3781	19253
By State											
Andhra Pradesh	1120	162 272	1554	199	- 563	-	-	1142	90	1994	3548
Madhya Pradesh	55	9 2	66	295	- 1459	-	-	33	-	1787	1853
Telangana	13852	- -	13852	-	- -	-	-	-	-	-	13852

Figures rounded off.

KAOLIN, BALL CLAY, OTHER CLAYS AND SHALE

Table – 18 : Principal Producers of Shale

Name and address of producer	Location of mine	
	State	District
* ACC Ltd , Cement House, 121, Maharshi Karve Road, Churchgate, Mumbai – 400 020.	Karnataka Himachal Pradesh Maharashtra	Gulbarga Bilaspur Yavatmal
*Jaiprakash Associates Ltd, Sector-128, Noida-201 304, Uttar Pradesh.	Himachal Pradesh Madhya Pradesh	Solan Rewa
*Ambuja Cements Ltd, Elegant Business Park, MIDC Cross Road B Off Andheri Kurla Road, Andheri East, Mumbai- 400 059	Himachal Pradesh	Solan
Cement Corp. of India Ltd, Core – 5, Scope Complex , 7, Lodhi Road, New Delhi -110 003.	Telangana	Rangareddy
*Ultratech Cement Ltd, 'B' Wing, 2 nd Floor, Ahura Centre, Mahakali Caves Road, Andheri (E), Mumbai-400 093	Maharashtra	Chandrapur
Rain Cements Limited, No.34, Rain Centre, Srinagar Colony, Hyderabad, Andhra Pradesh -500 073	Telangana	Nalgonda
*T.Krishna Murthy, H-No:10-118-20, Gandhinagar, Kothepeeta, Andhra Pradesh -518 222	Andhra Pradesh	Kurnool

* Producing as an associated mineral with limestone.