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MINOR MINERALS

30.13 KAOLIN, BALL CLAY, OTHER CLAY AND SHALE

(FINAL RELEASE)

GOVERNMENT OF INDIA
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30-13 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 felspars through a complex sequence of events. It is relatively pure clay predominantly consisting of kaolinite ($Al_2Si_2O_5(OH)_4$), 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 in association with kaolinite in many deposits. As the levels of nacrite and dickite increase with the higher temperatures and pressures at depth, these two minerals are used as a guide by the Oil Industry as an indicator of depth of sediments burial.

Kaolin is commercially valued for its whiteness and fine particle size which distinguishes 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 by the country in crude & processed forms. The major use of crude china clay is in Cement Industry and is of processed china clay that is in Ceramic Industry. The in situ clay deposits in India are often soft and can be easily extracted without blasting.

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% is 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

The exploration & development details, if any, are given in the review on "Exploration & Development" in "General Reviews".

PRODUCTION

As per Govt. of India Notification S.O.423(E) dated 10th February 2015, 'Kaolin, China Clay, Clay (Others) and Shale' have been declared as 'Minor Minerals' hence the production data is not available with IBM.

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 STD111	Probable		Total (A)	Feasibility STD211	Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	
		STD121	STD122			STD221	STD222						
All India : Total	**140456**	**36144**	**52869**	**229469**	**107176**	**42220**	**98627**	**289723**	**415703**	**1685730**	**72599**	**2711777**	**2941247**
By Grades													
Textile/Paper Coating	-	-	-	-	65	-	-	-	-	-	-	65	65
Insecticide	-	-	-	-	-	-	-	-	-	113	-	113	113
Chemical	-	-	-	-	-	600	-	-	-	33945	-	34545	34545
Ceramic/Pottery	77668	15765	30250	123683	47145	26047	47784	103887	25753	362781	34340	647736	771419
Rubber	-	136	-	136	-	81	-	-	-	125	138	345	481
Mixed Grade	356	200	80	636	7748	1846	4335	884	607	199355	18002	232778	233414
Filler	9564	1118	3070	13752	11606	1406	8144	621	684	32909	621	55990	69742
Cement	4955	1230	2399	8584	6749	1160	6070	25	423	2902	-	17330	25914
Others	28168	17183	13174	58525	13889	8206	17395	180397	1649	53406	6983	281925	340450
Unclassified	12210	42	1940	14192	15913	1342	6792	720	68626	31882	1421	126694	140886
Not-known	7535	472	1954	9961	4061	1533	8107	3189	317961	968311	11094	1314257	1324218
By States													
Andhra Pradesh	2494	953	1889	5337	1508	989	2071	511	688	51427	362	57556	62893
Assam	-	-	-	-	-	131	-	392	-	3520	-	4043	4043
Bihar	-	-	-	-	-	-	-	104	39	1296	-	1438	1438
Chhattisgarh	107	-	22	130	1272	765	1412	-	-	11422	-	14871	15001
Delhi	-	-	-	-	-	-	-	857	630	3802	-	5289	5289
Goa	-	-	-	-	-	-	16	-	-	-	-	16	16
Gujarat	54111	3486	19671	77268	25378	4790	28542	1663	4198	49337	4114	118021	195289
Haryana	-	-	-	-	2367	789	3377	13	34	5485	-	12065	12065
Jammu & Kashmir	-	-	-	-	-	-	-	-	2	28122	-	28124	28124
Jharkhand	427	-	6412	6838	9338	2093	4738	3962	7363	149892	18019	195405	202244
Karnataka	330	472	-	802	1768	747	2683	220360	443	24803	6030	256834	257636
Kerala	7097	200	725	8022	4573	463	4112	43930	20439	571644	20200	665360	673383
Madhya Pradesh	357	474	902	1733	2882	406	3774	621	415	12017	-	20115	21848
Maharashtra	-	-	-	-	418	81	831	-	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	125437	47554	26157	40542	1584	3221	294386	11428	424874	550311
Tamil Nadu	-	-	-	-	-	-	-	-	327	56570	-	56897	56897
Telangana	623	322	-	945	2902	1059	655	-	-	10602	132	15350	16295
Uttar Pradesh	-	-	-	-	-	-	-	11600	3447	10018	-	25065	25065
West Bengal	1476	727	754	2957	3617	248	857	38	332236	79923	5793	422712	425669

Figures rounded off.

MINING, PROCESSING & MARKETING

China clay deposits worked in India are mostly of pocket-type. Opencast manual mining is followed in most kaolin mines.

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.

Processed kaolin is presently marketed under various trade names mostly in levigated and spray dried forms. 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.

CONSUMPTION

The main consumption of raw china clay is in the china clay process/refining plants industry. The china clay processed by these plants in turn is consumed by various industries except cement, refractory and pesticide industries. 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.

TRADE POLICY

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

WORLD SCENARIO

World production of Kaoline is increasing steadily. Two third of the world production comes from USA,China, Turkey, Ukraine, Brazil, Iran and Germany.

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.

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- 2.

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 is not available with Indian Bureau of Mines.

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

About 95% consumption was accounted for by the Ceramic Industry. The remaining consumption (5%) was reported by the Refractory and Abrasive Industries.

3. Clay (others)

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

PRODUCTION & STOCKS

As per Govt. of India Notification S.O.423(E) dated 10th February 2015, 'Clay (others)' has been declared as 'Minor Mineral' hence the production data is not available with IBM.

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.

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-3).

PRODUCTION & STOCKS

As per Govt. of India Notification S.O.423(E) dated 10th February 2015, 'Shale' has been declared as 'Minor Mineral' hence the production data is not available with IBM.

Table – 2 : Reserves/Resources of Ball Clay as on 1.4.2015
(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining resources							Total Resources (A+B)
	Proved STD111	Probable		Total (A)	Feasibilty STD211	Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333	Total (B)	
		STD121	STD122			STD221	STD222					
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

Table – 3: 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		Total (A)	Feasibility STD211	Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	
		STD121	STD122			STD221	STD222						
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.