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FIRECLAY

(FINAL RELEASE)

GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

Indira Bhavan, Civil Lines,
NAGPUR – 440 001

PHONE/FAX NO. (0712) 2565471
PBX : (0712) 2562649, 2560544, 2560648
E-MAIL : cme@ibm.gov.in
Website: www.ibm.gov.in

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20 Fireclay

The name fireclay is given to a group of refractory clays which can withstand temperatures above pyrometric cone equivalent (PCE) - 19. Refractoriness and plasticity are the two main properties needed in fireclay for its suitability in the manufacture of refractory bricks. A good fireclay should have a high fusion point (>1580^{o} C) and good plasticity. Fireclay containing high alumina and low iron oxide, lime, magnesia & alkalies is preferred by refractory manufacturers. The aluminous (kaolinitic) variety of fireclay is more refractory because of its hardness and density and absence of iron, giving it a white-burning colour. The absence of alkalies gives it a very high fusion temperature.

RESOURCES

India possesses substantial reserves of fireclay. The best deposits occur in association with the coal seams in the Lower Gondwana Coalfields of Andhra Pradesh, Jharkhand, West Bengal, Madhya Pradesh and Neyveli lignite fields in Tamil Nadu. Notable occurrences of fireclay, not associated with coal measures, are reported in Gujarat, Jabalpur region of Madhya Pradesh and Belpahar-Sundergarh areas of Odisha. The reserves of fireclay are substantial but reserves of high-grade (non-plastic) fireclay containing more than 37% alumina are limited.

Reserves and resources of fireclay as per UNFC system as on 1.4.2010 are estimated at 713.5 million tonnes. Out of these, 30.1 million tonnes are grouped under reserves category while the bulk, i.e., 683.4 million tonnes are classified under resources category. Out of 30.1 million tonnes reserves, 14.4 million tonnes are proved reserves and 15.7 million tonnes are probable reserves. Out of the total resources, Odisha accounts for 24% followed by Madhya Pradesh (17%), Tamil Nadu (16%), Jharkhand & Rajasthan (9% each) and Gujarat (8%). Gradewise, refractory-plastic grade accounts for 36% followed by refractory-unspecified (16%) and refractory-non-plastic/semi-plastic (15%). The remaining 33% are of others, unclassified and not-known grades (Table-1).

EXPLORATION & DEVELOPMENT

No exploration was carried out during the year 2014-15 by any Central/State govt. agencies.

PRODUCTION, STOCKS & PRICES

As per GOI notification S.O.423 (E) dated 10th February 2015, fireclay has been declared as 'minor mineral' ; hence, the production beyond January, 2015 is not available with IBM.

The production of fireclay at 713 thousand tonnes in 2014-15 (up to January 2015) decreased by 23% as compared to that in the previous full year due to lack of demand and closure of some mines for environment clearance. There were 51 reporting mines in 2014-15 as against 62 mines in the preceding year. Besides these principal mines, the production of fireclay was also reported as an associated mineral by 11 mines, which accounted for about 15 % of the total production during the year 2014-15.

Seven principal producers contributed 64% of the total production. Twenty three mines including 6 associated mines each producing more than 5000 tonnes annually accounted for about 92% of the total production. Private sector mines reported 99% output of fireclay.

Rajasthan continued to occupy the first position among states with contribution of 36% followed by Gujarat and Tamil Nadu (24% each),West Bengal (8%), Andhra Pradesh (4%), Madhya Pradesh (3%) and the remaining production was reported from Karnataka & Maharashtra (Tables- 2 to 5).

Mine-head closing stocks of fireclay in 2014-15 (up to January 2015) were 311 thousand tonnes as compared to 348 thousand tonnes in 2013-14 (Table- 6).

The average daily employment of labour during 2014-15 was 471 as against 664 in the preceding year. Domestic prices of fireclay are furnished in the General Review on 'Prices'.

MINING AND MARKETING

Fireclay mines are worked by manual method. Most of the mines are small and worked by opencast method by forming benches in overburden and fireclay. Most of the refractory manufacturing units have their own captive mines.

The important marketing centres of fireclay are Bikaner in Rajasthan, Mahuamilan and Balumath in Jharkhand, Than in Gujarat, Katni in Madhya Pradesh and Belpahar in Odisha. Water seepage beyond the depth of 6 m is the main problem commonly faced by most of the mine owners and as a result of which most of the mines are kept closed during rainy season.

Table – 1 : Reserves/Resources of Fireclay as on 1.4.2010
(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	**14376**	**7358**	**8371**	**30104**	**10020**	**19216**	**21775**	**47664**	**54377**	**529173**	**1190**	**683415**	**713519**
By Grades													
Refractory-non-plastic/semi-plastic	2914	390	1337	4642	3959	11953	1743	807	1180	86235	-	105876	110518
Refractory-plastic	2801	1165	1253	5220	719	3656	2934	4241	4527	238860	232	255168	260388
Refractory-unspecified	7240	3990	4945	16175	4743	3208	5244	1115	2658	79233	-	96201	112377
Others	580	1664	542	2786	579	204	1920	7236	4137	45096	125	59297	62084
Unclassified	704	17	293	1013	-	-	5097	59	30	5679	-	10865	11878
Not-known	137	132	-	268	20	195	4837	34206	41845	74070	833	156006	156275
By States													
Andhra Pradesh	434	-	381	815	7	656	1259	56	-	9878	132	11988	12803
Assam	-	-	-	-	-	-	-	-	-	3161	-	3161	3161
Bihar	-	-	-	-	-	-	-	-	-	44	-	44	44
Chhattisgarh	-	23	12	35	-	27	-	7180	3400	10336	-	20942	20978
Delhi	-	-	-	-	-	-	-	6	13	45	-	64	64
Gujarat	276	29	132	437	1,175	635	923	638	962	53526	-	57859	58295
Jharkhand	828	-	775	1602	12	479	125	-	249	64151	-	65017	66619
Karnataka	95	324	85	503	792	595	6871	-	226	5250	-	13734	14238
Kerala	-	-	-	-	-	-	-	8200	51	9929	-	18181	18181
Madhya Pradesh	2167	2026	269	4462	829	3747	5690	1582	2823	101081	100	115852	120314
Maharashtra	244	-	388	632	-	-	-	-	-	6850	-	6850	7482
Meghalaya	-	-	-	-	-	-	-	-	-	10999	-	10999	10999
Odisha	581	278	52	911	2135	11280	3774	26185	42747	83045	-	169166	170076
Rajasthan	8543	659	5000	14202	195	1071	583	2256	2580	45536	-	52221	66423
Tamil Nadu	322	3269	423	4014	4833	171	1611	1561	-	102069	-	110244	114258
Telangana	114	647	-	760	42	79	55	-	908	8566	-	9650	10410
Tripura	-	-	-	-	-	-	-	1	-	369	-	370	370
Uttar Pradesh	-	-	-	-	-	-	-	-	-	3221	-	3221	3221
West Bengal	771	104	854	1729	-	476	883	-	419	11115	958	13852	15581

Figures rounded off.

Table – 2 : Principal Producers of Fireclay, 2014-15

Name & address of producer	Location of mine	
	State	District
Sampat Lal Daga, Labuji Ka Katla, 1st Floor, Bagree Mohalla, Bikaner- 334 001, Rajasthan.	Rajasthan	Bikaner
Maheshbhai Nanalal Bharad, Darbargadh Street, Thangadh, Chotila-363 530, Gujarat.	Gujarat	Rajkot
A. Abdullah, No.10/108, North Street, T. Pottakollai.Z.Thathanur, Udayarpalayam- 621 804, Distt. Ariyalur, Tamil Nadu.	Tamil Nadu	Ariyalur
Bikaner Ceramics (P) Ltd., Industrial Area, Rani Bazar- 334 001, Rajasthan.	Rajasthan	Bikaner

(Contd.)

Table - 2 (Concld.)

Name & address of producer	Location of mine	
	State	District
Firoz Musabhai Kaladiya, C/o Musabhai Ismailbhai, Kaladia, PO.Chotila, Fulwadi, Thangadh Road, Surendranagar-363 530, Gujarat.	Gujarat	Surendranagar
Ramjibhai Chunilal Kanjaria, Near Vasuki Temple, Thangadh, Chotila- 363 530, Gujarat.	Gujarat	Surendranagar
Sunder Lal Daga, Bagree Mohalla, Bikaner- 334 001, Rajasthan.	Rajasthan	Bikaner

Table – 3 : Production of Fireclay, 2012-13 to 2014-15 (By States)

(Qty in tonnes; Value in ₹'000)

State	2012-13		2013-14		2014-15* (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**999925**	**182739**	**920809**	**185684**	**712792**	**131090**
Andhra Pradesh	49478	10512	32061	7366	27286	6788
Chhattisgarh	2570	643	-	-	-	-
Gujarat	86316	6602	154301	14316	173357	14765
Jharkhand	111594	17151	3655	329	-	-
Karnataka	16307	10000	13966	7813	2965	2535
Madhya Pradesh	71226	12671	74441	16203	22642	3593
Maharashtra	7547	1132	5076	761	3799	598
Rajasthan	410331	87771	359845	91440	253166	62845
Tamil Nadu	145468	19768	181362	28232	169458	28359
West Bengal	99088	16489	96102	19224	60119	11607

** Data up to January 2015*

Table – 4 : Production of Fireclay, 2013-14 and 2014-15*
(By Sectors/States/Districts)

(Qty in tonnes; Value in ``'000)

State/District	2013-14			2014-15* (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	**62(18)**	**920809**	**185684**	**51(11)**	**712792**	**131090**
Public Sector	1(1)	5917	3624	(1)	2965	2535
Private Sector	61(17)	914892	182060	51(10)	709827	128555
Andhra Pradesh	**11(1)**	**32061**	**7366**	**9**	**27286**	**6788**
East Godavari	8(1)	28111	5787	7	25266	5898
West Godavari	3	3950	1579	2	2020	890
Gujarat	**9**	**154301**	**14316**	**5**	**173357**	**14765**
Kachchh	2	650	111	-	-	-
Rajkot	1	76846	7685	1	96728	8415
Surendranagar	6	76805	6520	4	76629	6350
Jharkhand	**1**	**3655**	**329**	**-**	-	-
Latehar	1	3655	329	-	**-**	**-**
Karnataka	**1(1)**	**13966**	**7813**	**(1)**	**2965**	**2535**
Hassan	(1)	3936	3149	(1)	2965	2535
Tumakuru	1	10030	4664	-	-	-
Madhya Pradesh	**12(6)**	**74441**	**16203**	**8(1)**	**22642**	**3593**
Jabalpur	2(2)	22160	2943	1(1)	3577	874
Katni	7(3)	37400	7765	4	14865	2299
Satna	(1)	7564	4538	-	-	-
Umaria	3	7317	957	3	4200	420
Maharashtra	**1**	**5076**	**761**	**1**	**3799**	**598**
Amravati	1	5076	761	1	3799	598
Rajasthan	**13(2)**	**359845**	**91440**	**13(2)**	**253166**	**62845**
Bikaner	13(2)	359845	91440	13(2)	253166	62845
Tamil Nadu	**8(2)**	**181362**	**28232**	**10(2)**	**169458**	**28359**
Ariyalur	1	74900	9887	1	58131	8123
Cuddalore	3	4661	930	3	18223	3573
Perambalur	4	63961	12495	6	61544	12560
Tiruchirapalli	(2)	37840	4920	(2)	31560	4103
West Bengal	**6(6)**	**96102**	**19224**	**5(5)**	**60119**	**11607**
Bankura	4(1)	13139	3384	3	3558	569
Birbhum	2(5)	82963	15840	2(5)	56561	11038

** Data up to January 2015.*

Figures in parentheses indicate associated mines of ball clay, bauxite, clay (others), laterite and kaolin/china clay.

Table – 5 : Production of Fireclay, 2013-14 and 2014-15

(By Frequency Groups)

(Qty in tonnes)

Production group	No. of mines		Production for the group		Percentage in total production		Cumulative percentage	
	2013-14	2014-15*(P)	2013-14	2014-15*(P)	2013-14	2014-15*(P)	2013-14	2014-15*(P)
All Groups	**62(18)**	**51(11)**	**920809**	**712792**	**100.00**	**100.00**	**-**	**-**
Up to 1000	18(1)	18	4010	4851	0.44	0.68	0.44	0.68
1001-5000	21(7)	16(5)	73740	54549	8.00	7.65	8.44	8.33
5001-10000	5(6)	1(1)	75309	11680	8.18	1.64	16.62	9.97
10001 & Above	18(4)	16(5)	767750	641712	83.38	90.03	100.00	100.00

Figures in parentheses indicate the number of associated mines with ball clay, bauxite, clay (others), kaolin, china clay and laterite.

** Data up to January, 2015.*

Table – 6 : Mine-head Closing Stocks of Fireclay, 2013-14 & 2014-15

(By States)

(In tonnes)

State	2013-14	2014-15* (P)
India	**348164**	**311346**
Andhra Pradesh	2156	1610
Chhattisgarh	24256	24256
Gujarat	8635	14730
Jharkhand	80212	77576
Karnataka	10153	11623
Madhya Pradesh	38656	19606
Maharashtra	35	35
Odisha	4	4
Rajasthan	123555	130396
Tamil Nadu	26108	18063
West Bengal	34394	13447

** Data up to January 2015.*

USES AND SPECIFICATIONS

Fireclays are used in the manufacture of bricks, blocks, retorts, crucibles, mortars, masses, pottery, floor tiles, etc. Low-grade material is used for manufacturing heavy sanitaryware, such as, pipes and bath tubs. Firebricks are used where heat generation is involved. Firebricks are used extensively in furnaces, kilns and ovens. Firebricks are required chiefly by metallurgical industries.

The fireclays are graded into: i) low duty ii) intermediate duty iii) high duty and iv) super duty, depending upon their capacity to withstand high temperature before melting. The low duty fireclay can withstand temperatures between 1,515 and 1,615°C (PCE 19-28); intermediate duty fireclay up to 1,650°C (PCE 30), high duty fireclay up to 1,700°C (PCE 32) and super duty beyond 1,775°C (PCE 35).

BIS has not standardised any specifications for fireclay. However, the erstwhile Director General of Technical Development Sub-committee on Refractory Raw Materials had recommended specifications as given in Table-7.

The Expert Group on Classification of Minerals with regard to their Possible Optimum Industrial Use had recommended the following end-use classification of fireclay for Refractory Industry:

Type	Constituent		
	Al_2O_3	Fe_2O_3	PCE (orton)
Non-plastic/ semi-plastic	30% (min)	2% (max)	30 (min)
Plastic	18% (min)	3% (max)	18 (min)

Table – 7 : Specifications of Plastic and Non-plastic Fireclays

Grade	Constituent		
	Al_2O_3	Fe_2O_3	PCE (orton)
i) Non-plastic/Semi-plastic Fireclay			
Grade-I	35-40%	1.0% max	33 min
Grade-II	32-35%	1.0-1.5% max	32 min
Grade-III	30-32%	1.5-2.0% max	30 min
ii) Plastic Fireclay			
Grade-I	30-32%	1.0-1.5%	30 min
Grade-II	28-30%	2.0-3.0%	28 min
Grade-III	22-28%	1.0-2.0%	26 min
Grade-IV	18-20%	1.5-2.0%	18-21 min

Crude fireclay and other clays including kaolin (china clay) are also used in a few cement manufacturing plants to increase the alumina content in the raw meal and its plasticity.

CONSUMPTION

The total consumption of fireclay decreased from 529,700 tonnes in 2013-14 to 512,100 tonnes in 2014-15. Cement Industry was a major consumer of crude fireclay accounting for about 55% consumption in 2014-15, followed by refractory (34%), ceramic (9%) and iron & steel (2%) industries. The negligible amount was consumed in other industries, i.e. pesticide, alloy steel, graphite products, foundry, sugar, etc. (Table- 8).

Table- 8: Consumption* of Fireclay 2012-13 to 2014-15 (By Industries)

(In tonnes)

Industry	2012-13	2013-14 (R)	2014-15 (P)
All Industries	**493600**	**529700**	**512100**
Alloy steel	500(9)	500(9)	500(9)
Cement	252800(4)	293500(4)	280600(4)
Ceramic	44200(13)	44200(13)	44200(13)
Foundry	200(23)	200(23)	200(23)
Graphite products	1200(18)	1300(18)	1300(18)
Iron & steel	10500(6)	10500(6)	10500(6)
Pesticides	2900(2)	2900(2)	2900(2)
Refractory	181100(44)	176400(43)	171700(43)
Sugar	100(27)	100(27)	100(27)
Others (abrasive, alloy steel, foundry glass, paper, textile, sugar and vanaspati)	100 (21)	100(21)	100(21)

Figures rounded off.
Figures in parentheses denote the number of units in organised sector.
*(*paucity of data, hence consumption may not be complete).*

FOREIGN TRADE

Exports

The exports of fireclay increased to 2,503 tonnes in 2014-15 from 2,100 tonnes in 2013-14. Exports were mainly to Bangladesh (38%), UAE (13%), Nepal (10%) and Malaysia & Senegal (5% each). Exports of refractory bricks increased to 234 thousand tonnes in 2014-15 from 213 thousand tonnes in 2013-14. Exports were mainly to Saudi Arabia (5%), UK (4%), USA (3%) and Iran (2%) (Tables- 9 & 10).

Imports

Imports of fireclay in 2014-15 decreased drastically to 4 tonnes from 146 tonnes in the previous year. Imports were solely from China (100%). Imports of refractory bricks increased marginally to 287 thousand tonnes in 2014-15 from 272 thousand tonnes in the previous year. The share of imports from China was 86% which was followed by Germany (6%), USA & Austria (2% each) (Tables- 11 & 12).

Table- 9: Exports of Fireclay (By Countries)

Country	2013-14		2014-15 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2100**	**16879**	**2503**	**16318**
UAE	60	780	326	4898
Bangladesh	426	1060	945	2808
Nepal	309	2776	250	1145
Malaysia	1	41	128	1032
Kenya	91	928	43	657
Myanmar	5	91	26	603
Rwanda	157	962	62	583
Ethiopia	120	4702	104	543
Angola	36	151	115	497
Senegal	205	500	125	449
Other countries	690	4888	379	3103

Table – 10 : Exports of Refractory Bricks (By Countries)

Country	2013-14		2014-15(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**213394**	**6212776**	**234488**	**7377431**
USA	2996	349541	8130	591593
Turkey	31073	296599	3538	455647
Germany	1217	102576	2293	367947
Iran	4287	192797	5750	336717
Saudi Arabia	10388	222817	11823	325565
UK	7501	246796	9666	291727
Italy	3088	359553	2792	287768
France	1050	73723	2026	280093
China	1197	59267	3485	255912
Brazil	1560	78138	3417	234519
Other countries	149037	4230969	181568	3949943

Table- 11: Imports of Fireclay (By Countries)

Country	2013-14		2014-15(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**146**	**4473**	**4**	**137**
China	110	3370	4	83
USA	4	69	++	49
Thailand	-	-	++	5
Other countries	32	1034	-	-

Table – 12 : Imports of Refractory Bricks (By Countries)

Country	2013-14		2014-15(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**272306**	**15304944**	**286989**	**18671318**
China	224782	11377919	246238	13451819
Germany	17092	1592072	16665	1638616
USA	690	63212	5809	1535457
Austria	10142	850732	5579	516795
Belgium	771	72023	1189	464917
Italy	1732	160298	2529	296560
France	4866	418078	921	140681
Japan	2852	162071	536	83296
Turkey	2067	140805	1059	81513
Netherlands	212	43141	957	73529
Other countries	7100	424593	5507	388135

FUTURE OUTLOOK

Fireclay is one of the most important minerals used in the Refractory Industry. Almost the entire production in the country is consumed in the manufacture of refractories and about 80% of these refractories are used by the Iron & Steel Industry. India has huge reserves of fireclay and it does not seem to be any problem in respect of supplies to the Refractory Industry in the near future. However, a serious dearth is being felt in the availability of high-grade fireclay analysing 37% and above Al_2O_3 with Fe_2O_3 and fluxing impurities less than 2% for supply to the refractories. To fulfil the increasing demand of the Refractory Industry, it is imperative that deposits of high-grade fireclay be explored and delineated.

The export prospect of fireclay is relatively less as it is considered as low-value high bulk mineral. However, fireclay bricks as a commodity could have high export potential and therefore must be encouraged.

As per the Sub-Group-II Report for 12th five year plan, the apparent domestic demand of fireclay was estimated at 739 thousand tonnes by 2016-17 at 9% growth rate.