

FIRECLAY



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**FIRECLAY**

(FINAL RELEASE)

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

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# 20 Fireclay

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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 (>1,580°C) and good plasticity. Fireclay containing high alumina and low iron oxide, lime, magnesia & alkalis 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 alkalis 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).

## PRODUCTION, STOCKS & PRICES

The production of fireclay at 760 thousand tonnes in 2011-12 decreased by 11% as compared

to that in the previous year due to lack of demand, heavy rain and closure of some mine (environmental problem) in some state.

There were 65 reporting mines in 2011-12 as against 60 mines in the preceding year. Besides these primary mines, the production of fireclay was also reported as an associated mineral by 11 mines, which accounted for 10% of the total production during the year 2011-12. Nine principal producers contributed 65% of the total production. Twentyfour fireclay mines including 5 associated mines each producing more than 5000 tonnes annually accounted for about 88% of the total production. Private sector mines reported 99% output of fireclay.

Rajasthan continued to occupy the first position among states with contribution of 52% followed by Jharkhand 9%, Madhya Pradesh, Gujarat, Tamil Nadu, West Bengal 8% each, Andhra Pradesh 4% and rest 3 percent production was reported from Maharashtra and Karnataka (Tables -2 to 5).

Mine-head stocks of fire clay at the end of 2011-12 were 229 thousand tonnes as compared to 395 thousand tonnes at the beginning of the year. (Table-6).

The average daily employment of labour during 2011-12 was 655 as against 553 in the preceding year. Domestic prices of fireclay are furnished in the General Review on 'Prices'.

## MINING AND MARKETING

Practically, all the fireclay mines are worked manually. 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 Mahumilan and Tori 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.

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**Table – 1 : Reserves/Resources of Fireclay as on 1.4.2010  
(By Grades/Stages)**

(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						
<b>All India : Total</b>	<b>14,376</b>	<b>7,358</b>	<b>8,370</b>	<b>30,104</b>	<b>10,020</b>	<b>19,216</b>	<b>21,775</b>	<b>47,664</b>	<b>54,377</b>	<b>529,173</b>	<b>1,190</b>	<b>683,416</b>	<b>713,519</b>
<b>By Grades</b>													
Refractory-non-plastic/semi-plastic	2,914	390	1,337	4,642	3,959	11,953	1,743	807	1,180	86,235	-	105,876	110,518
Refractory-plastic	2,801	1,165	1,253	5,220	719	3,656	2,934	4,241	4,527	238,860	232	255,168	260,388
Refractory-unspecified	7,240	3,990	4,945	16,175	4,743	3,208	5,244	1,115	2,658	79,233	-	96,201	112,377
Others	580	1,664	542	2,786	579	204	1,920	7,236	4,137	45,096	125	59,297	62,084
Unclassified	704	17	293	1,013	-	-	5,097	59	30	5,679	-	10,865	11,878
Not- known	137	132	-	268	20	195	4,837	34,206	41,845	74,070	833	156,006	156,275
<b>By States</b>													
Andhra Pradesh	548	647	381	1,576	50	735	1,314	56	908	18,444	132	21,638	23,214
Assam	-	-	-	-	-	-	-	-	-	3,161	-	3,161	3,161
Bihar	-	-	-	-	-	-	-	-	-	44	-	44	44
Chhattisgarh	-	23	12	35	-	27	-	7,180	3,400	10,336	-	20,942	20,978
Delhi	-	-	-	-	-	-	-	6	13	45	-	64	64
Gujarat	276	29	132	437	1,175	635	923	638	962	53,526	-	57,859	58,295
Jharkhand	828	-	775	1,602	12	479	125	-	249	64,151	-	65,017	66,619
Karnataka	95	324	85	503	792	595	6,871	-	226	5,250	-	13,734	14,238
Kerala	-	-	-	-	-	-	-	8,200	51	9,929	-	18,181	18,181
Madhya Pradesh	2,167	2,026	269	4,462	829	3,747	5,690	1,582	2,823	101,081	100	115,852	120,314
Maharashtra	244	-	388	632	-	-	-	-	-	6,850	-	6,850	7,482
Meghalaya	-	-	-	-	-	-	-	-	-	10,999	-	10,999	10,999
Odisha	581	278	52	911	2,135	11,280	3,774	26,185	42,747	83,045	-	169,166	170,076
Rajasthan	8,543	659	5,000	14,202	195	1,071	583	2,256	2,580	45,536	-	52,221	66,423
Tamil Nadu	322	3,269	423	4,014	4,833	171	1,611	1,561	-	102,069	-	110,244	114,258
Tripura	-	-	-	-	-	-	-	1	-	369	-	370	370
Uttar Pradesh	-	-	-	-	-	-	-	-	-	3,221	-	3,221	3,221
West Bengal	771	104	854	1,729	-	476	883	-	419	11,115	958	13,852	15,581

Figures rounded off.

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**Table – 2 : Principal Producers of Fireclay, 2011-12**

Name & address of producer	Location of mine	
	State	District
Sampat Lal Daga, Bagree Mohalla, Bikaner-334 005, Rajasthan.	Rajasthan	Bikaner
Shanta Sales Corporation, 2-Kha-23, Jawahar Nagar, Bikaner -334 001, Rajasthan.	Rajasthan	Bikaner
Bikaner Ceramics Private Ltd, Industrial Area, Rani Bazar, Bikaner -334 001, Rajasthan.	Rajasthan	Bikaner
Ved Prakash Sharma, Prakash Bhawan, Lake Road, Hindpiri-834 001, Ranchi, Jharkhand.	Jharkhand	Ranchi
Sunder Lal Daga, E-27,Khajanchi Market, Bikaner -334 001, Rajasthan.	Rajasthan	Bikaner

(Contd.)

Table - 2 (Concl.)

Name & address of producer	Location of mine	
	State	District
Motilal Bajaj, S/o Late Panna Lal Bajaj, Post:- Katni, Madhya Pradesh.	Madhya Pradesh	Katni
Mshabhai Ismailbhai Kalidia, Phulwadi, Thangadh Road, Surendranagar, Gujarat.	Gujarat	Surendranagar
Parijat Mining Industries, Opposite Shivaji Maidan Road, Post:- Daltonganj, Palamau, Jharkhand.	Jharkhand	Latehar
Smt. R. Ponambal, Thirumathi Panruti, (Via) Kadambuliyur, Keeliruppu - 671 030, Cuddalore, Tamil Nadu.	Tamil Nadu	Cuddalore

**Table – 3 : Production of Fireclay, 2009-10 to 2011-12  
(By States)**

(Qty in tonnes; value in ₹'000)

State	2009-10		2010-11		2011-12(P)	
	Quantity	Value	Quantity	Value	Quantity	Value
<b>India</b>	<b>548748</b>	<b>89680</b>	<b>856741</b>	<b>136668</b>	<b>759746</b>	<b>130654</b>
Andhra Pradesh	24540	5516	26423	5871	29754	5713
Gujarat	92868	9829	145961	12484	62295	5171
Jharkhand	16145	1912	24305	3156	69143	11329
Karnataka	5523	2949	15330	4431	7684	2256
Madhya Pradesh	34704	3193	44519	4199	64158	7303
Maharashtra	6744	641	3334	391	9512	1284
Odisha	51312	16015	-	-	-	-
Rajasthan	247473	40580	507381	91472	396490	80505
Tamil Nadu	23260	4431	52620	9948	61641	11716
West Bengal	46179	4614	36868	4716	59069	5377

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**Table – 4 : Production of Fireclay, 2010-11 and 2011-12  
(By Sectors/States/Districts)**

(Qty in tonnes; value in ₹ '000)

State/District	2010-11			2011-12 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
<b>India</b>	<b>60(6)</b>	<b>856741</b>	<b>136668</b>	<b>65(11)</b>	<b>759746</b>	<b>130654</b>
Public sector	(1)	5125	2942	1(1)	5908	2187
Private Sector	60(5)	851616	133726	64(10)	753838	128467
<b>Andhra Pradesh</b>	<b>9(1)</b>	<b>26423</b>	<b>5871</b>	<b>9(1)</b>	<b>29754</b>	<b>5713</b>
East Godavari	7(1)	20943	4475	7(1)	24044	4121
West Godavari	2	5480	1396	2	5710	1592
<b>Gujarat</b>	<b>10</b>	<b>145961</b>	<b>12484</b>	<b>6</b>	<b>62295</b>	<b>5171</b>
Kachchh	1	1020	112	-	-	-
Surendranagar	9	144941	12372	6	62295	5171
<b>Jharkhand</b>	<b>7</b>	<b>24305</b>	<b>3156</b>	<b>7</b>	<b>69143</b>	<b>11329</b>
Dhanbad	2	1557	275	1	1165	140
Hazaribagh	1	1775	311	-	-	-
Latehar	4	20973	2570	5	36713	6499
Palamau	-	-	-	1	31265	4690
<b>Karnataka</b>	<b>2(1)</b>	<b>15330</b>	<b>4431</b>	<b>1(1)</b>	<b>7684</b>	<b>2256</b>
Hassan	(1)	5125	2943	(1)	4734	2049
Bengaluru	1	7005	490	1	2950	207
Tumkur	1	3200	998	-	-	-
<b>Madhya Pradesh</b>	<b>11(2)</b>	<b>44519</b>	<b>4199</b>	<b>11(3)</b>	<b>64158</b>	<b>7303</b>
Jabalpur	-	-	-	2	1000	140
Katni	6	30199	2367	5(2)	50783	5861
Satna	(1)	1460	278	(1)	1625	203
Sidhi	(1)	50	4	-	-	-
Umaria	5	12810	1550	4	10750	1099
<b>Maharashtra</b>	<b>2</b>	<b>3334</b>	<b>391</b>	<b>2</b>	<b>9512</b>	<b>1284</b>
Amravati	2	3334	391	2	9512	1284
<b>Rajasthan</b>	<b>12</b>	<b>507381</b>	<b>91472</b>	<b>11(2)</b>	<b>396490</b>	<b>80505</b>
Bikaner	12	507381	91472	11(2)	396490	80505
<b>Tamil Nadu</b>	<b>4</b>	<b>52620</b>	<b>9948</b>	<b>12</b>	<b>61641</b>	<b>11716</b>
Ariyalur	-	-	-	1	3524	254
Cuddalore	1	33050	4428	5	31467	4840
Perambalur	3	19570	5520	6	26650	6622
<b>West Bengal</b>	<b>3(2)</b>	<b>36868</b>	<b>4716</b>	<b>6(4)</b>	<b>59069</b>	<b>5377</b>
Bankura	2	4634	560	4	15496	1264
Birbhum	1(2)	32234	4156	2(4)	43573	4113

*Figures in parentheses indicate associated mines of bauxite, laterite and kaoline.*

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**Table – 5 : Production of Fireclay, 2010-11 and 2011-12(P)**  
**(By Frequency Groups)**

(Qty in tonnes)

Production group	No. of mines		Production for the group		Percentage in total production		Cumulative percentage	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
	<b>All Groups</b>	<b>60(6)</b>	<b>65(11)</b>	<b>856741</b>	<b>759746</b>	<b>100.00</b>	<b>100.00</b>	–
Up to 1000	10(1)	17(1)	2662	5771	00.31	00.76	00.31	00.76
1001 to 5000	25(3)	24(5)	72465	86223	8.46	11.35	8.77	12.11
5001 to 10000	10(2)	7(2)	87662	67668	10.23	08.91	19.00	21.02
10001 & Above	15	17(3)	693952	600084	81.00	78.98	100.00	100.00

*Figures in parentheses indicate the number of associated mines.*

**Table – 6 : Mine-head Stocks of Fireclay, 2011-12 (P)**  
**(By States)**

(In tonnes)

State	At the beginning of the year	At the end of the year
<b>India</b>	<b>395068</b>	<b>229224</b>
Andhra Pradesh	5370	1875
Gujarat	1814	1607
Jharkhand	3575	8764
Karnataka	16786	6393
Madhya Pradesh	18552	22019
Maharashtra	-	35
Odisha	1298	3719
Rajasthan	340825	150633
Tamil Nadu	2962	15447
West Bengal	3886	18732

## USES AND SPECIFICATIONS

Fireclays are used in the manufacture of bricks, blocks, retorts, crucibles, mortars, masses, 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 1650 °C (PCE 30), high duty fireclay up to 1700 °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 <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	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 <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	PCE (orton)
<b>i) Non-plastic/Semi-plastic Fireclay</b>			
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
<b>ii) Plastic Fireclay</b>			
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 reported consumption of fireclay decreased slightly from 534,600 tonnes in 2010-11 to 523,200 tonnes in 2011-12. Cement industry was a major consumer of crude fireclay accounting for 53% consumption in 2011-12, followed by refractory (32%), ceramic (8%) and iron & steel(6%) industries. The remaining 1% was consumed in other industries, i.e. pesticide, alloy steel, graphite products, foundry, sugar, etc. (Table - 8).

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**Table – 8 : Reported Consumption of Fireclay  
2009-10 to 2011-12  
(By Industries)**

Industry	(In tonnes)		
	2009-10(R)	2010-11	2011-12 (P)
<b>All Industries</b>	<b>523900</b>	<b>534600</b>	<b>523200</b>
Alloy steel	800(10)	800(10)	800(10)
Cement	244500(2)	286200(4)	275800(4)
Ceramic	77200(55)	43400(13)	43700(13)
Foundry	200(23)	200(23)	200(16)
Graphite products	900(18)	1000(18)	1100(18)
Iron & steel	34600(6)	29100(6)	29100(5)
Pesticides	2900(2)	2900(2)	2900(2)
Refractory	162500(37)	170700(40)	169300(39)
Sugar	100(24)	100(24)	100(24)
Others (abrasive, glass, paper, textile, and vanaspati)	200 (21)	200(21)	200(21)

*Figures rounded off. Data collected on non-statutory basis.*

*Figures in parentheses denote the number of units in organised sector reporting\* consumption.*

*(\* includes actual reported consumption and/or estimates made wherever required).*

## FOREIGN TRADE

### Exports

The exports of fireclay increased slightly to 9,622 tonnes in 2011-12 from 8,624 tonnes in 2010-11. Exports were mainly to Kuwait, Bangladesh, Nepal, Brunei and Saudi Arabia. Exports of refractory bricks decreased to 404 thousand tonnes in 2011-12 from 455 thousand tonnes in 2010-11. Exports were mainly to Turkey, Iran, Morocco, Nigeria, Indonesia, Brazil Malaysia, etc (Tables - 9 & 10).

### Imports

Imports of fireclay in 2011-12 were 269 tonnes against 689 tonnes in the previous year, mainly from U S A, France and China. Imports of refractory bricks increased to 663 thousand tonnes in 2011-12 from 366 thousand tonnes in the previous year. Imports were mainly from China (44%), Netherland (43%) and Germany (3%) (Tables - 11 & 12).

**Table – 9 : Exports of Fireclay  
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
<b>All Countries</b>	<b>8624</b>	<b>22563</b>	<b>9622</b>	<b>30881</b>
Bangladesh	5690	8557	4735	7753
Kuwait	-	-	897	3881
Nepal	357	1459	944	3335
\Brunei	-	-	470	2409
Sudan	-	-	100	1991
Singapore	7	42	401	1984
Pakistan	101	408	337	1417
Djibouti	5	32	305	1074
Saudi Arabia	385	1625	210	845
Australia	20	266	148	749
Other countries	2059	10174	1075	5443

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

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
<b>All Countries</b>	<b>454721</b>	<b>5211193</b>	<b>403835</b>	<b>5715939</b>
Turkey	6726	206831	8463	636828
Iran	8821	124390	11969	390195
New Caledonia	-	-	1324	287823
U Arab Emts	62407	92800	9689	220659
Indonesia	5145	160482	8933	208944
Nigeria	57681	136630	15208	194883
Malaysia	15985	294118	5408	188775
Saudi Arab	31686	129570	180926	172831
Brazil	3600	108539	4073	162000
Russia	23355	67749	3028	161606
Other countries	239315	3890084	154814	3091395



**Table – 11 : Imports of Fireclay  
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
<b>All Countries</b>	<b>689</b>	<b>10920</b>	<b>269</b>	<b>5177</b>
USA	-	-	158	2321
Korea Rep. of	-	-	10	1331
China	241	6208	13	690
France	96	1481	24	390
Germany	++	61	40	239
Ukraine	-	-	24	195
Singapore	-	-	++	11
Other countries	352	3170	-	-

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

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
<b>All Countries</b>	<b>366310</b>	<b>10726152</b>	<b>662726</b>	<b>15082560</b>
China	278857	7347766	292998	9862626
France	7393	643664	12524	1220444
Germany	21342	1150560	18227	1219025
Austria	10155	542336	10927	625034
Netherland	615	26455	282570	514296
Korea Rep. of	777	33158	2711	235134
Japan	1438	83526	3892	229354
Italy	1757	73662	3230	166387
USA	4331	160235	1991	141955
Thailand	336	14415	7385	86754
Other countries	39309	650375	26271	781551

## 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 and steel industry. India has huge reserves of this mineral and there does not seem to be any problem of supply to the refractory industry in the future. However, a serious dearth is being felt in the refractory industry with respect to the availability of high grade fireclay analysing 37% and above  $Al_2O_3$  and having  $Fe_2O_3$  and fluxing impurities less than 2%. In view of this, deposits of high grade fireclay may be explored and delineated. Detailed exploration for deposits of high grade fireclay is necessary to meet the increasing demand from refractory industry.

Since fireclay is low-value high bulk mineral, there does not appear much prospect for increasing the exports. Use of fireclay in fireclay bricks as an export commodity should be encouraged.

The apparent domestic demand of fireclay is estimated at 480 thousand tonnes by 2011-12 and at 739 thousand tonnes by 2016-17 at 9% growth rate as per the Sub Group Report on 12th Plan, Planning Commission of India.