

# 37 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 (>1580 °C) and good plasticity. Fireclay containing high alumina and low iron oxide, lime, magnesia and 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 Orissa. 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 1.4.2005 are estimated at 704.8 million tonnes. Out of these, 59.3 million tonnes are grouped under reserves category while bulk, i.e., 645.5 million tonnes are classified in resources category. Out of 59.3 million tonnes reserves, 26.9 million tonnes are proved reserves and 32.4 million tonnes are probable reserves. Out of the total resources, Orissa accounts for 25% followed by Tamil Nadu and Madhya Pradesh (16% each), Jharkhand (10%), Rajasthan (9%) 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 460 thousand tonnes in 2007-08 decreased by 7.4% as compared to that in the previous year due to closure of some mines in consequence of High Court orders and also on account of less demand from refractory industries.

There were 61 reporting mines in 2007-08 as against 80 in the preceding year. Besides these primary mines, the production of fireclay was also reported as an associated mineral by 6 mines, which accounted for 8% of the total production during the year under review. Eleven principal producers contributed 65% of the total production. Twenty-four fireclay mines and two associated mines, each producing more than 5000 tonnes annually together accounted for about 82% of the total production. Almost 100% output of fireclay was reported by private sector mines.

Rajasthan was once again the major producing state with contribution of 31%. Orissa occupied the second position with 17%, followed by West Bengal and Madhya Pradesh with 12 % each (Tables - 2 to 5).

Mine-head stocks of fireclay at the end of 2007-08 were 131 thousand tonnes as compared to 186 thousand tonnes at the beginning of the year (Table - 6).

The average daily employment of labour during 2007-08 was 836 as against 1,077 in the preceding year. Domestic prices of fireclay are furnished in Table - 7.

## 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 Orissa. 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.

FIRECLAY

**Table - 1 : Reserves/Resources of Fireclay as on 1.4.2005  
(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						
<b>All India : Total</b>	<b>26897</b>	<b>14456</b>	<b>17948</b>	<b>59301</b>	<b>19</b>	<b>9447</b>	<b>5595</b>	<b>49149</b>	<b>47758</b>	<b>532436</b>	<b>1058</b>	<b>645462</b>	<b>704763</b>
<b>By Grades</b>													
Refractory-non-plastic/semi-plastic	6534	8304	2260	17098	-	4130	628	390	915	85744	-	91821	108919
Refractory-plastic	3065	1899	3529	8493	14	3736	1001	3054	3656	234085	100	245637	254130
Refractory-unspecified	14715	1937	6320	22972	5	1564	3393	113	866	80606	-	86542	109514
Others	1697	2138	1406	5241	-	17	573	11304	434	45345	125	57798	63039
Unclassified	753	17	342	1112	-	-	-	59	30	10369	-	10458	11570
Not known	133	161	4091	4385	-	-	-	34229	41857	76287	833	153206	157591
<b>By States</b>													
Andhra Pradesh	1382	935	1444	3761	-	-	-	56	758	17928	-	18742	22503
Assam	-	-	-	-	-	-	-	44	-	3117	-	3161	3161
Bihar	-	-	-	-	-	-	-	-	-	44	-	44	44
Chhattisgarh	-	50	12	62	-	-	-	10580	-	10336	-	20916	20978
Delhi	-	-	-	-	-	-	-	6	13	45	-	64	64
Gujarat	1629	337	797	2763	-	265	418	270	909	53744	-	55606	58369
Jharkhand	979	634	743	2356	-	23	18	-	-	64405	-	64446	66802
Karnataka	119	242	728	1089	-	16	81	-	226	9928	-	10251	11340
Kerala	-	-	-	-	-	-	0	8200	51	9929	-	18180	18180
Madhya Pradesh	2128	1415	4462	8005	-	2898	1233	1438	791	100305	100	106784	114789
Maharashtra	272	-	392	664	-	-	-	-	-	6849	-	6849	7513
Meghalaya	-	-	-	-	-	-	-	-	-	10999	-	10999	10999
Orissa	2932	7196	1181	11309	-	4387	3399	26000	42418	87972	-	164177	175486
Rajasthan	9013	1438	4948	15399	-	126	-	2293	2592	40778	-	45789	61188
Tamil Nadu	7702	1813	2551	12066	-	1300	102	261	-	102133	-	103796	115862
Tripura	-	-	-	-	-	-	-	1	-	369	-	370	370
Uttar Pradesh	-	-	-	-	-	-	-	-	-	3221	-	3221	3221
West Bengal	741	396	690	1827	-	432	344	-	-	10333	958	12067	13894

Figures rounded off.

FIRECLAY

**Table - 2 : Principal Producers of Fireclay, 2007-08**

Name & address of producer	Location of mine	
	State	District
Sampat Lal Daga, Bagree Mohalla, Bikaner-334 005, Rajasthan.	Rajasthan	Bikaner
Tata Refractories Ltd, At & P.O. Belpahar, Dist. Jharsuguda – 768 218, Orissa.	Orissa	Cuttack
Rama Devi Sharma, Dist. Bikaner, Rajasthan.	Rajasthan	Bikaner
*Patel Nagar Minerals & Ind. (P) Ltd, Patel Nagar, P.O. Mohammad Bazar, West Bengal.	West Bengal	Birbhum
Bikner Ceramics Private Ltd, Industrial Area, Rani Bazar, Bikaner – 334 001, Rajasthan.	Rajasthan	Bikaner

Table - 2 (Concl.)

Name & address of producer	Location of mine	
	State	District
B.C.Sahu, Sunakhani Fireclay Mine, Moni Sahu Chowk, Cuttack, Orissa.	Orissa	Cuttack
S. Veera Reddy, 5-33-2, Rawararam, Anaparty, Dist. Godavari East, Andhra Pradesh.	Andhra Pradesh	East Godavari
Shri Natraj Ceramic & Chem.Ind. Ltd, Dalmiyapuram, Therani F/C Mines, Post: Kallakudi-621 651 Tamil Nadu.	Tamil Nadu	Tiruchirapalli
Birbhum Kaolin & Allied (India) Pvt. Ltd, Post: Barasat – 743 201, Dist. 24,-Parganas North, West Bengal.	West Bengal	24 Paraganas North

(Contd.)

\* Producing fireclay as an associated mineral.

**Table - 3 : Production of Fireclay, 2005-06 to 2007-08  
(By States)**

(Qty in tonnes; value in Rs.'000)

State	2005-06		2006-07		2007-08 (p)	
	Quantity	Value	Quantity	Value	Quantity	Value
<b>India</b>	<b>535735</b>	<b>62448</b>	<b>497315</b>	<b>65868</b>	<b>460380</b>	<b>73069</b>
Andhra Pradesh	51900	6570	42678	8209	31356	8449
Gujarat	113269	6350	81190	5108	35451	2531
Jharkhand	19952	2560	25811	3511	19450	2919
Karnataka	10637	2147	1835	275	-	-
Madhya Pradesh	75048	6937	51495	4560	55782	5403
Maharashtra	8044	603	8700	767	7239	543
Orissa	70753	20022	70081	20315	79179	20647
Rajasthan	84260	5979	130526	13740	143579	20999
Tamil Nadu	30309	2955	22502	3032	31391	5766
West Bengal	71563	8325	62497	6351	56953	5812

FIRECLAY

**Table - 4 : Production of Fireclay, 2006-07 & 2007-08(p)**  
(By Frequency Groups)

(Qty in tonnes)

Production group	No. of mines		Production for the group		Percentage in total production		Cumulative percentage	
	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08
<b>All Groups</b>	<b>80(6)</b>	<b>61(7)</b>	<b>497315</b>	<b>460380</b>	<b>100.00</b>	<b>100.00</b>	-	-
Upto 1000	17(2)	11(2)	7971	5420	1.60	1.18	1.60	1.18
1001 to 5000	39(1)	26(3)	112896	75238	22.70	16.34	24.30	17.52
5001 to 10000	13(2)	15(1)	97558	116059	19.62	25.21	43.92	42.73
10001 & Above	11(1)	9(1)	278890	263663	56.08	57.27	100.00	100.00

Figures in parentheses indicate the number of associated mines.

**Table - 5 : Production of Fireclay, 2006-07 and 2007-08**  
(By Sectors/States/Districts)

(Qty in tonnes; value in Rs.'000)

State/District	2006-07			2007-08 (p)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
<b>India</b>	<b>80(6)</b>	<b>497315</b>	<b>65868</b>	<b>61(7)</b>	<b>460380</b>	<b>73069</b>
Public sector	1	35	7	1	112	23
Private Sector	79(6)	497280	65861	60(7)	460268	73046
<b>Andhra Pradesh</b>	<b>10(1)</b>	<b>42678</b>	<b>8209</b>	<b>7(1)</b>	<b>31356</b>	<b>8449</b>
Adilabad	1	12052	542	-	-	-
East Godavari	7(1)	22746	5833	5(1)	23126	6433
West Godavari	2	7880	1834	2	8230	2016
<b>Gujarat</b>	<b>18</b>	<b>81190</b>	<b>5108</b>	<b>11</b>	<b>35451</b>	<b>2531</b>
Kachchh	-	-	-	1	1200	120
Rajkot	2	24043	1033	1	7303	365
Surendranagar	16	57147	4075	9	26948	2046
<b>Jharkhand</b>	<b>10</b>	<b>25811</b>	<b>3511</b>	<b>8</b>	<b>19450</b>	<b>2919</b>
Dhanbad	4	3625	465	2	1686	219
Hazaribagh	1	1997	200	2	2184	214
Latehar	5	20189	2846	4	15580	2486
<b>Karnataka</b>	<b>1</b>	<b>1835</b>	<b>275</b>	-	-	-
Tumkur	1	1835	275	-	-	-

(Contd.)

FIRECLAY

Table - 5 (Concl'd.)

State/District	2006-07			2007-08 (p)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
<b>Madhya Pradesh</b>	<b>13(1)</b>	<b>51495</b>	<b>4560</b>	<b>11(4)</b>	<b>55782</b>	<b>5403</b>
Jabalpur	1(1)	9508	672	(1)	60	8
Katni	8	32937	3175	7	41184	3618
Satna	-	-	-	(2)	4258	724
Sidhi	-	-	-	(1)	1010	181
Umaria	4	9050	713	4	9270	872
<b>Maharashtra</b>	<b>2(1)</b>	<b>8700</b>	<b>767</b>	<b>2</b>	<b>7239</b>	<b>543</b>
Amravati	2	6145	460	2	7239	543
Ratnagiri	(1)	2555	307	-	-	-
<b>Orissa</b>	<b>5</b>	<b>70081</b>	<b>20315</b>	<b>5</b>	<b>79179</b>	<b>20647</b>
Cuttack	4	68965	19846	4	77702	20027
Jharsuguda	1	1116	469	1	1477	620
<b>Rajasthan</b>	<b>6</b>	<b>130526</b>	<b>13740</b>	<b>6</b>	<b>143579</b>	<b>20999</b>
Bikaner	6	130526	13740	6	143579	20999
<b>Tamil Nadu</b>	<b>7</b>	<b>22502</b>	<b>3032</b>	<b>6</b>	<b>31391</b>	<b>5766</b>
Cuddalore	4	11108	633	3	8200	472
Perambalur	3	11394	2399	3	23191	5294
<b>West Bengal</b>	<b>8(3)</b>	<b>62497</b>	<b>6351</b>	<b>5(2)</b>	<b>56953</b>	<b>5812</b>
Bankura	4	11998	1380	3	8447	1050
Birbhum	2(3)	48222	4664	1(2)	48394	4739
Purulia	2	2277	307	1	112	23

Figures in parentheses indicate the number of associated mines.

**Table - 6 : Mine-head Stocks of Fireclay, 2007-08 (p)**  
(By States)

(In tonnes)

State	At the beginning of the year	At the end of the year
<b>India</b>	<b>185636</b>	<b>130849</b>
Andhra Pradesh	2482	2472
Gujarat	851	1081
Jharkhand	1309	1192
Karnataka	3730	882
Madhya Pradesh	12537	19748
Maharashtra	1365	1365
Orissa	6726	15447
Rajasthan	135387	76389
Tamil Nadu	4313	2270
West Bengal	16936	10003

FIRECLAY

**Table - 7 : Prices of Fireclay, 2005-06 to 2007-08  
(Domestic Markets)**

(In Rs. per tonne)

Grade	Market	2005-06	2006-07	2007-08(p)
Plastic Fireclay Lump Loose	Ex-mine Suri (West Bengal)	100	100	100
Super	f.o.r. Bikaner (Rajasthan)	450	550	550
A' Grade <sup>e</sup>	f.o.r. Bikaner (Rajasthan)	240	290	290
C' Grade <sup>e</sup>	f.o.r. Bikaner (Rajasthan)	65	90	90
I	Ex-mine Indo-ka-bala (Rajasthan)	200	200	200
II	Ex-mine Indo-ka-bala (Rajasthan)	130	130	130
III	Ex-mine Indo-ka-bala (Rajasthan)	80	80	80
IV	Ex-mine Indo-ka-bala (Rajasthan)	50	50	50
'B' Grade	Ex-mine Guda Radhera (Rajasthan)	195-205	195-205	195-205
'C' Grade	Ex-mine Guda Radhera (Rajasthan)	70-90	70-90	70-90

## 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-8.

## FIRECLAY

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 - 8 : 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 consumption of fireclay decreased by about 3.1% from 550,700 tonnes in 2006-07 to 533,600 tonnes in 2007-08. Cement industry has emerged as a major consumer of fireclay accounting for 46% consumption in 2007-08, followed by refractory (34%) and ceramic (15%) industries. The remaining 5% was consumed in industries, i.e., iron & steel, pesticide, alloy steel, graphite products, foundry, sugar, etc. (Table - 9).

**Table - 9 : Reported Consumption of Fireclay 2005-06 to 2007-08 (By Industries)**

Industry	(In tonnes)		
	2005-06	2006-07 (R)	2007-08(p)
<b>All Industries</b>	<b>555800</b>	<b>550700</b>	<b>533600</b>
Alloy steel	800 (10)	800 (10)	800 (10)
Cement	261800(3)	267400(3)	246500(3)
Ceramic	82100(e)	79500(e)	79500(e)
Foundry	400(21)	300(22)	300(22)
Graphite products	800(17)	800(17)	800(17)
Iron & steel	18600(4)	20100(4)	21200(4)
Pesticides	2900(2)	2900(2)	2900(2)
Refractory	188200(41)	178700(41)	181400(41)
Sugar	100(22)	100(22)	100(21)
Others (abrasive, glass, paper, textile, tin and vanaspati,)	100 (20)	100 (21)	100 (21)

*Figures rounded off. Data collected on non-statutory basis. Figures in parentheses denote the number of units in organised sector reporting consumption.*

## FOREIGN TRADE

The exports of fireclay increased to 8,354 tonnes in 2007-08 from 3,511 tonnes in 2006-07. Exports were mainly to Bangladesh, Norway, Nepal, Djibouti, UAE, Kenya, Ethiopia and USA . Exports of refractory bricks decreased to 118,964 tonnes in 2007-08 from 172,877 tonnes in 2006-07. Exports were mainly to Kenya, Nigeria, Malaysia, UAE, USA, Saudi Arabia and U.K.

In 2006-07 and 2007-08 meagre quantities of fireclay were imported. Imports of refractory bricks increased to 398,342 tonnes in 2007-08 from 264,177 tonnes in the previous year. Imports were mainly from China (84%), Germany (7%) and Austria (4%) (Tables - 10 to 13).

FIRECLAY

**Table - 10 : Exports of Fireclay  
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs. '000)	Qty (t)	Value (Rs. '000)
<b>All Countries</b>	<b>3511</b>	<b>12956</b>	<b>8354</b>	<b>18560</b>
Bangladesh	1584	2229	5827	9473
Norway	40	131	345	1411
USA	227	1864	171	1052
Nepal	323	1108	247	784
Ethiopia			196	740
Djibouti	5	10	243	703
UAE	86	400	229	700
Kenya	324	1145	219	691
Saudi Arabia	432	3744	162	563
Egypt	97	523	164	141
Other countries	393	1802	551	2302

**Table - 11 : Exports of Refractory Bricks  
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs. '000)	Qty (t)	Value (Rs. '000)
<b>All Countries</b>	<b>172877</b>	<b>1444285</b>	<b>118964</b>	<b>2065883</b>
Malaysia	3823	88592	6421	251555
Kenya	54098	38156	9601	136662
Nigeria	2972	48330	7152	134230
Turkey	3589	102957	3059	117945
USA	3564	84030	4344	110460
UAE	4481	71655	5993	98677
Saudi Arabia	5174	83026	4310	62709
Egypt	1574	51658	2718	50807
UK	5850	58894	3997	39405
Kuwait	3849	141685	1653	21469
Other countries	83903	675302	69716	1041964

**Table - 12 : Imports of Fireclay  
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs. '000)	Qty (t)	Value (Rs. '000)
<b>All Countries</b>	<b>9</b>	<b>1658</b>	<b>1</b>	<b>75</b>
Germany	-	-	1	43
USA	-	-	++	17
UK	-	-	++	15
Chinese Taipei/ Taiwan	++	25	-	-
France	9	1633	-	-

**Table - 13 : Imports of Refractory Bricks  
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs. '000)	Qty (t)	Value (Rs. '000)
<b>All Countries</b>	<b>264177</b>	<b>5675419</b>	<b>398342</b>	<b>6768131</b>
China	225569	3676444	334300	4020847
Germany	17767	830253	26341	1083390
Austria	6918	338078	14303	660552
Japan	588	33186	3531	208300
France	1698	127215	3175	202874
Italy	1265	60371	2909	111479
USA	2726	114767	1981	81336
UK	381	30174	1374	69702
Chinese Taipei/ Taiwan	1456	80562	602	44428
Netherlands	2031	224545	2175	41626
Other countries	3778	159824	7651	243597