

FELSPAR



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**FELSPAR**

**(FINAL RELEASE)**

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

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# 19 Felspar

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Felspars are one of the most abundant rock-forming minerals in the earth's crust, comprising a complex series of aluminosilicates with varying amounts of potassium, sodium, calcium and though rarely barium. Common amongst these are the potash felspars called orthoclase and microcline ( $K_2O \cdot Al_2O_3 \cdot 6SiO_2$ ), sodium felspar called albite ( $Na_2O \cdot Al_2O_3 \cdot 6SiO_2$ ) and calcium felspar called anorthite ( $CaO \cdot Al_2O_3 \cdot 2SiO_2$ ). The sodium and calcium felspars form a continuous series of solid solutions and are together termed plagioclase felspars. Though felspars occur in a variety of colours, pink, brown and grey felspars are known to be common.

The several varieties of felspar minerals are used as gemstones. Three of them, moonstone, sunstone and labradorite are known for their unique optical phenomena. The phenomenal properties of moonstone, sunstone and labradorite are almost always cut as dome-shaped cabochons. Their phenomenal properties are dependent upon light striking microscopic structures within a polished stone at just the right angle. To make that happen, skilled craftsmen who understand the optical phenomena of these gems must study the rough and cut the stone so that the planes where the optical phenomena are produced are parallel to the bottom of the cut gemstone.

## RESERVES/RESOURCES

As per NMI database, based on UNFC system, the total reserves/resources of felspar as on 1.4.2015 have been placed at 634 million tonnes of which 320 million tonnes (50.47%) constitute as "Reserves" and 314 million tonnes (49.53%) as "Remaining Resources". In terms of grades, Unclassified grade accounts for 57%, Pottery/Ceramic grade 18%, Glass grade 13% and Not-known & Others grades (6% each) of the total resources. By States, Rajasthan alone accounts for about 90% of the total reserves/resources followed by Telangana (4%), Andhra Pradesh and Tamil Nadu (2% each) (Table - 1).

## EXPLORATION & DEVELOPMENT

During the year 2015-16, no exploration was reported for felspar by Geological Survey of India, State Government Departments and Public Sectors Undertaking.

## PRODUCTION & STOCKS

As per Govt. of India Notification S.O. 423(E) dated 10<sup>th</sup> February 2015, felspar has been declared as 'Minor Mineral', hence the production beyond January, 2015 is not available with IBM. List of principal producers of felspar are furnished in Table-2.

## MINING & MARKETING

Felspar is won chiefly from pegmatites. Mining is carried out, generally, by opencast method. Significant output of felspar is obtained as an associated mineral during mining of quartz, mica and to some extent beryl. Ajmer, Bhilwara and Sikar districts in Rajasthan, Sri Potti Sriramulu Nellore district in Andhra Pradesh and Karur district of Tamil Nadu are the important mining areas in the country.

The pegmatite bodies are exposed after the removal of top soil and overburden. It is then broken either manually or by drilling and blasting.

The broken materials are then sorted out and sized. Crushed felspar is separated mechanically by suitable screens to meet market requirements. The general demand is for 30/80 mesh, 100 mesh, 150 mesh, 180 mesh, 200 mesh and 250 mesh material. Washing is sometimes done to upgrade the product by removing clay, etc. The processed felspar is bagged and despatched to different consignees.

The processing of felspar usually involves flotation or magnetic separation to remove accessory minerals like mica, garnet, ilmenite and quartz. Silica in the form of quartz in pegmatites and silica sand in felspathic sand deposits are obtained as co-products of mining. Though in some applications, presence of silica is advantageous, most users require extremely

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

(In 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)	
<b>All India : Total</b>	<b>173383004</b>	<b>103054634</b>	<b>319841612</b>	<b>45903221</b>	<b>42467697</b>	<b>40160373</b>	<b>13882441</b>	<b>17928113</b>	<b>150012330</b>	<b>3371567</b>	<b>313725742</b>	<b>633567354</b>
<b>By Grades</b>												
Glass	31101917	18964826	51183718	8069246	4155007	4088590	238133	181140	15735742	318842	32786700	83970418
Pottery/Ceramic	25598581	11659828	46306435	17946394	7997021	13703037	2462573	2417929	25265494	1238089	71030537	117336972
Others	9078676	888220	11519689	2480626	10933380	4250318	342147	100474	6621536	33048	24761530	36281219
Unclassified	106501350	71098791	31198970	16935671	19338463	17924472	634831	3195686	91436219	1762983	151228326	360027436
Not-known	1102480	442970	487210	471284	43825	193956	10204757	12032883	10953339	18605	33918649	35951309
<b>By States</b>												
Andhra Pradesh	2295253	150795	556263	4427537	50911	2379650	361444	1819937	1571271	442950	11053700	14056011
Bihar	-	-	-	-	-	35147	-	4195	4871499	-	4910841	4910841
Haryana	-	-	-	-	-	-	-	-	72164	-	72164	72164
Jharkhand	68789	15402	191913	276104	40766	348792	32510	120388	836061	-	1378517	1654621
Karnataka	-	-	-	103675	73613	107055	25000	135133	177300	3900	625676	625676
Madhya Pradesh	-	-	-	10330	-	6610	-	-	339851	-	356791	356791
Maharashtra	-	-	-	651835	-	323337	-	-	253731	-	1228903	1228903
Meghalaya	-	-	-	-	-	-	-	-	37449	-	37449	37449
Rajasthan	161965311	102283772	41417085	305666168	35514780	40938272	33919764	12410200	8488066	132329070	2866777	266466928
Tamil Nadu	738656	23386	7134	1896213	620530	1101842	18870	69822	5465465	-	9172741	9941916
Telangana	8244089	526905	1231579	10002573	3163212	1938177	134417	3890572	3657219	57940	13385142	23387715
Uttar Pradesh	-	-	-	-	-	-	-	-	200000	-	200000	200000
West Bengal	70906	54375	-	135639	200000	900000	340000	201250	-	-	4836889	4962170

Figures rounded off.

pure and finely-ground grades of felspar. Glass grade felspar is usually the most coarse material. The filler application demands finely-ground material. A modern processing plant located at Kodthal in Mahabubnagar district of Telangana and 12 processing plants in Rajasthan cater to Ceramics and Glass industries.

**Table – 2 : Principal Producers of Felspar**

Name and address of producer	Location of mine	
	State	District
Madhu Devi, 108, Himmatnagar, Gopalpura Mode, Tonk Road, Jaipur-302 018, Rajasthan.	Rajasthan	Sikar
K. K. Mines & Minerals, 9, Press Gallery, Chhawani Road, Beawar, Ajmer-305 901, Rajasthan.	Rajasthan	Ajmer
*P. Jaya Lakshmi, 6-3-609/101, Flat 402, Seetharama Enclave, Anandnagar Colony, Khairatabad, Hyderabad- 500 004.	Telangana	Mahabub- nagar
*Pankaj Kumar Tak, Sheetal Bhavan, Post. Kharwa, Masuda, Ajmer- 305 202. Dist. Ajmer, Rajasthan.	Rajasthan	Ajmer
*Avulaa Srinivas, Door No. 14-6-344, Chudi Bazar, Hyderabad- 500 001, Telangana.	Telangana	Mahabub- nagar
Laxmi Marble & Granite (P) Ltd, Opposite Rly Station, Neem ka Thana, Sikar-332 713, Rajasthan.	Rajasthan	Sikar
Sibelco India Minerals (P) Ltd, D. No. 8-2-293/K/311-312, Sriman Chambers, Kamalpur Colony, Phase-3, Hyderabad-500 073.	Telangana	Mahabub- nagar *Nalgonda *Rangareddy
Palle Sridhar Reddy, Plot No. 32, House No. 4-9-602, Vinayak Nagar, Hayat Nagar, Hyderabad-500 074.	Telangana	Mahabub- nagar

\* Associated mines of felspar with quartz.

## USES

Potassium felspar obtained from pegmatites is used traditionally as a source of alumina and alkali in ceramic and glass industries which account for more than 90% consumption. It also finds use as functional filler in paint, plastic, rubber and adhesive; as a binding agent in abrasives; and in the manufacture of artificial teeth, fertilizer and white cement. Certain varieties of felspar (like moonstone, sunstone and labradorite) are used as semi-precious stones.

In Ceramic Industry, felspar is used as fluxing agent which facilitates softening, melting and wetting of batch constituents. The flux controls the degree of vitrification of the ceramic body during firing. Potash felspar has technical advantages over sodium felspar. After clay, felspar is the biggest ingredient in the raw material batch for ceramic bodies. Typical felspar contents are < 25% in earthenware, 25-35% in sanitaryware, 15-30% in whiteware, 10-55% in floor and wall tiles and 30-55% in electrical porcelain. For Glass Industry, the alkali content in felspar acts as a flux, which not only facilitates lowering the glass batch melting temperature but also cuts production cost. The mineral is primarily added for alumina content which varies in its application from 0.05% for flat glass, 8% for container glass, 11% for some speciality glasses and up to 18% for insulation fibre glass.

In the abrasive industry, plagioclase felspar is used as a mild abrasive material in scouring powders because of its semi-conchoidal fracture and its hardness which is 6 on Mohs' scale. In Refractory Industry, felspar is used as one of the batch constituents in the manufacture of acid-proof refractories. In Welding Electrode Industry, felspar is used as a flux which acts as an arc stabiliser and helps to protect the molten metal from aerial oxidation.

Physical properties like good dispersability, chemical inertness, stable pH, low free silica content and brightness of 89-95% improve the filler properties of finely-ground felspar materials.

## SPECIFICATIONS

The BIS specifications of potash felspar and soda felspar for use in Glass and Ceramic industries are as per IS: 9749-2007 (Re-affirmed in March 2012). The producers prefer the following specifications for various ceramic products:

### Sanitaryware

K<sub>2</sub>O 11-14%, Na<sub>2</sub>O 2-7%, SiO<sub>2</sub> 62-68%, Al<sub>2</sub>O<sub>3</sub> 16-20%, Fe<sub>2</sub>O<sub>3</sub> 0.25% (max.). The deleterious constituents are TiO<sub>2</sub> and MgO.

### Insulators

K<sub>2</sub>O 11-12.5%, Na<sub>2</sub>O 2-3% (4% max.), SiO<sub>2</sub> 64.5-68%, Al<sub>2</sub>O<sub>3</sub> 17-21%, Fe<sub>2</sub>O<sub>3</sub> 0.48% (max.) (but Fe<sub>2</sub>O<sub>3</sub> less than 0.1% is accepted).

### Ceramic Tiles

K<sub>2</sub>O 9%, Na<sub>2</sub>O 4%, Al<sub>2</sub>O<sub>3</sub> 18% (min.), Fe<sub>2</sub>O<sub>3</sub> 1% (max.), K<sub>2</sub>O+Na<sub>2</sub>O 14% (max.). Both sodium and potassium felspars are used.

### Crockeryware

K<sub>2</sub>O 12-15%, Na<sub>2</sub>O 3.69%, SiO<sub>2</sub> 63.05%, Al<sub>2</sub>O<sub>3</sub> 19.56% and Fe<sub>2</sub>O<sub>3</sub> 0.10%.

### Glass

The physical requirements specified are that of the material in powder form prepared from natural felspar which should be free from foreign matter; moisture shall not exceed 2% by mass; specific gravity should be between 2.5 and 2.7; PCE should be 8 to 10 orton (1,225 -1,260 °C); and fired-colour shall be glassy-white and free from specks.

However, the producers accept felspar analysing 10% K<sub>2</sub>O+Na<sub>2</sub>O, 64-68% SiO<sub>2</sub>, 15-19% Al<sub>2</sub>O<sub>3</sub> and 0.15% Fe<sub>2</sub>O<sub>3</sub>.

### Refractory

There is no BIS specification for felspar for use in refractory industry. The Industry prefers potash felspar analysing 11 to 12% Na<sub>2</sub>O<sub>3</sub>+K<sub>2</sub>O, 60 to 70% SiO<sub>2</sub>, 20 to 24% Al<sub>2</sub>O<sub>3</sub>, 1.5% Fe<sub>2</sub>O<sub>3</sub>, 0.8% LOI, 4 to 6 orton PCE and 2.5 to 10 cm material.

### Abrasive

Felspar in both powder and lump forms is used and white or pink mineral is preferred. As per the users

in the Organised Sector, felspar that analyses SiO<sub>2</sub> 65%, Al<sub>2</sub>O<sub>3</sub> 18%, Na<sub>2</sub>O+K<sub>2</sub>O 10% (max.), Fe<sub>2</sub>O<sub>3</sub> 0.45%, MgO 0.5%, CaO 0.6% and LOI 2% (max.) is generally consumed.

### Electrode

Potash felspar, analysing 12 to 14% K<sub>2</sub>O, 1 to 3% Na<sub>2</sub>O, 63 to 67% SiO<sub>2</sub>, 17 to 20% Al<sub>2</sub>O<sub>3</sub> and below 0.3% Fe<sub>2</sub>O<sub>3</sub>, is preferred.

## INDUSTRY

Ceramic Industry in India is about a century old and has formed a sizeable industrial base. The products generally comprises ceramic tiles, sanitaryware and crockery items. The Industry has its base both in large and small-scale sectors with wide variance in type, size, quality and standard. Manufacturing units are spread all-over India. The state-of-the-art ceramic goods are manufactured in the country. The domestic technology is at par with international standard. During the last two decades, there has been a phenomenal growth in the field of high end technical ceramics to meet specific demands of industries like high alumina ceramic, cutting tools and other structural ceramics.

## CONSUMPTION

Felspar is used mainly in ceramic, glass and cement industries. Minor quantities of felspar are consumed by refractory, abrasive and electrode industries. The total consumption of felspar in 2015-16 was 6,01,600 tonnes in the organised sector. Of the total consumption, the ceramic industry accounted for 78%, glass Industry 13%, cement industry about 9% and the negligible quantity by refractory, abrasive, electrode, coal washery and cosmetics industries (Table- 3).

## WORLD REVIEW

World resources of felspar are large and adequate enough to meet the anticipated world demand. Hence, quantitative data on resources of felspar in granites, pegmatites and felspathic sands have not been compiled. The world production of felspar was estimated at 26.15 million tonnes in 2015. Major producers were Turkey (30%), Italy (18%), China (10%) and Thailand & India (5% each) (Table-4).

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**Table- 3 : Consumption\* of Felspar  
2013-14 to 2015-16  
(By Industries)**

Industry	(In tonnes)		
	2013-14	2014-15 (R)	2015-16 (P)
<b>All Industries</b>	<b>504800</b>	<b>560700</b>	<b>601600</b>
Abrasive	600	600	600
Cement	79800	26900	52800
Ceramic	350000	455900	467000
Chemical	100	100	100
Coal washery	++	++	++
Cosmetics	++	200	++
Electrode	600	700	800
Glass	72900	75500	79500
Refractory	800	800	800

Figures rounded off.

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

## FOREIGN TRADE

### Exports

Exports of felspar (natural) decreased sharply to 426 thousand tonnes in 2015-16 from 590 thousand tonnes in the previous year. Exports were mainly to Bangladesh (22%), Vietnam (16%) and Indonesia (13%). Exports value of felspar (cut & uncut) increased sharply to ` 4.12 crore in 2015-16 from ` 2.65 crore in 2014-15. Exports of felspar (cut & uncut) were mainly to USA (62%), Germany (14%) and UK (4%) (Tables- 5 to 8).

### Imports

Imports of felspar (natural) decreased sharply by 61% to 25,716 tonnes in 2015-16 from 66,749 tonnes in 2014-15. Imports were mainly from Thailand (71%), Turkey (15%) and China (14%). In 2015-16, import values of felspar (cut & uncut) increased sharply to ` 212.68 lakh from ` 96.39 lakh in the previous year. In 2015-16, imports value of uncut felspar was ` 148.27 lakh and that of cut felspar was ` 64.41 lakh only. Imports of felspar (cut) were from Italy (64%) followed by Sri Lanka (36%). Imports of felspar (uncut) were solely from Hong Kong and negligible amount from Tanzania (Table-9 to 12).

**Table - 4 : World Production of Felspar  
(By Principal Countries)**

Country	(In '000 tonnes)		
	2013	2014	2015
<b>World: Total</b>	<b>24807</b>	<b>25729</b>	<b>26151</b>
Algeria	259	230	230 <sup>e</sup>
Argentina <sup>e</sup>	230	200	200
Brazil	294	718	700 <sup>e</sup>
China <sup>(e)</sup>	2500	2500	2500
Czech Republic	411	422	433
Ecuador	210	183	247
Egypt <sup>(e)</sup>	400	200	300
France <sup>(e)</sup>	550	550	550
Germany	350 <sup>e</sup>	320	317
India	1513	1343	1300 <sup>e</sup>
Iran	1045	1055	1000 <sup>e</sup>
Italy <sup>(e)</sup>	4700	4700	4700
Japan <sup>(e)</sup> @	100	100	100
Korea, Rep. of	343	529	601
Malaysia	314	377	443
Mexico	164	151	154
Poland	483	520	540
Portugal	139	136	179
Russia <sup>e</sup>	160	160	160
Saudi Arabia	160	168	176
South Africa	191	103	127
Spain	593	533	550 <sup>e</sup>
Thailand	1073	1413	1330
Turkey	7091	7610	7961
USA	550	530	510 <sup>e</sup>
Vietnam <sup>e</sup>	200	200	200
Other countries	784	778	643

Source: World Mineral Production, 2011-15.

@ Including weathered granite felspar.

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**Table – 5 : Exports of Felspar (Natural)  
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
<b>All Countries</b>	<b>589820</b>	<b>2876166</b>	<b>426172</b>	<b>2232789</b>
Vietnam	61318	388393	67536	456172
Indonesia	78315	425564	53439	322236
Bangladesh	124092	422972	92531	305187
Iran	18585	111907	23948	199968
China	69230	360221	30131	168239
Thailand	97559	544638	29833	162582
Malaysia	21539	106267	26882	136809
UAE	33746	106524	41718	128867
Chinese Taipei/ Taiwan	16912	102152	13553	95055
Turkey	36991	109031	22349	79157
Other countries	31533	198497	24252	178517

**Table – 6 : Exports Value of Felspar  
(Cut & Uncut)  
(By Countries)**

(Value in ` '000)

Country	2014-15	2015-16 (P)
<b>All Countries</b>	<b>26488</b>	<b>41184</b>
USA	8940	25388
Germany	386	5566
UK	7698	1608
France	228	1412
Hong Kong	6636	1376
China	34	1209
Italy	259	1035
Canada	188	741
Australia	459	566
Netherlands	374	392
Other countries	1286	1891

Quantity not given due to partial coverage, value figures however, have full coverage.

**Table – 7 : Exports of Felspar (Cut)  
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (`000 carat)	Value (` '000)	Qty (`000 carat)	Value (` '000)
<b>All Countries</b>	<b>4031</b>	<b>25647</b>	<b>143270</b>	<b>39907</b>
USA	1622	8429	9263	25382
Germany	38	386	1326	5566
UK	1599	7375	3108	1608
France	189	228	142	1412
Italy	2	259	47	1035
Canada	146	188	334	741
Hong Kong	113	6636	558	739
China	1	34	125004	581
Australia	135	459	683	566
Netherlands	2	374	248	392
Other countries	184	1279	2557	1885

**Table – 8 : Exports of Felspar (Uncut)  
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (tonnes)	Value (` '000)	Qty (tonnes)	Value (` '000)
<b>All Countries</b>	<b>++</b>	<b>841</b>	<b>38</b>	<b>1277</b>
Hong Kong	-	-	20	637
China	-	-	18	628
Switzerland	-	-	++	7
USA	++	511	++	5
UK	++	323	-	-
UAE	++	6	-	-
Other countries	++	1	-	-

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**Table – 9 : Imports of Felspar (Natural)  
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (tonnes)	Value (` '000)	Qty (tonnes)	Value (` '000)
<b>All Countries</b>	<b>66749</b>	<b>242645</b>	<b>25716</b>	<b>177877</b>
Thailand	58980	167020	18150	96291
Turkey	2336	23954	3806	38724
China	5412	51404	3610	21054
Bangladesh	-	-	5	20547
Netherlands	-	-	1	178
Germany	-	-	4	145
USA	-	-	1	86
Australia	-	-	1	28
Sweden	-	-	++	2

**Table – 10 : Imports Value of Felspar  
(Cut & Uncut)  
(By Countries)**

Country	(Value in ` '000)	
	2014-15	2015-16 (P)
<b>All Countries</b>	<b>9639</b>	<b>21268</b>
Hong Kong	8	12017
Italy	-	5384
Tanzania	2952	2865
Sri Lanka	1779	950
Thailand	699	52
Germany	3865	-
Turkey	246	-
Canada	83	-
USA	4	-
Poland	3	-

*Quantity not given due to partial coverage, value figures however, have full coverage.*



**Table – 11 : Imports of Felspar (Cut)  
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (‘000 carat)	Value (` ‘000)	Qty (‘000 carat)	Value (` ‘000)
<b>All Countries</b>	<b>77</b>	<b>2351</b>	<b>399</b>	<b>6441</b>
Italy	-	-	256	5385
Sri Lanka	72	1640	142	950
Hong Kong	++	8	1	54
Thailand	5	699	++	52
USA	++	4	-	-

**Table – 12 : Imports of Felspar (Uncut)  
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (tonnes)	Value (` ‘000)	Qty (tonnes)	Value (` ‘000)
<b>All Countries</b>	<b>25</b>	<b>7288</b>	<b>1</b>	<b>14827</b>
Hong Kong	-	-	1	11962
Tanzania	7	2953	++	2865
Germany	18	3865	-	-
Turkey	++	246	-	-
Sri Lanka	++	138	-	-
Canada	++	83	-	-
Poland	++	3	-	-

## FUTURE OUTLOOK

India is the third largest tiles market in the world. While the global tiles production grew at an annualised rate of 6.3% for the period 2006-2013, tiles production

in India grew at almost double the rate at 12% during the same period. Ceramic tiles that accounts for close to 60% of the total tiles demand in India is expected to grow at a CAGR of 8.7% for the period 2014-2019.