

BENTONITE



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BENTONITE

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**GOVERNMENT OF INDIA
MINISTRY OF MINES
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Bentonite is essentially highly plastic clay containing not less than 85% clay mineral, montmorillonite. A great commercial importance is attached with Bentonite which possess inherent bleaching properties like fuller's earth. Hence, it is known as bleaching clay. There are two types of bentonites; namely, swelling-type or sodium bentonite and non-swelling-type or calcium bentonite. Sodium bentonite is usually referred to as bentonite, whereas calcium bentonite is called Fuller's earth. The commercial importance of bentonite depends more on its physico-chemical properties rather than its chemical composition. Excellent plasticity and lubricity, high dry-bonding strength, high shear and compressive strength, low permeability and low compressibility make bentonite commercially viable. Bentonite is valued in foundry sand binding, drilling mud, iron ore pelletisation and as waterproofing and sealing agent in civil engineering works. Processing is a prerequisite for bentonite marketing. Bhavnagar and Kachchh districts of Gujarat and Barmer district of Rajasthan are the major producers of bentonite. The sodium bentonite mined in Rajasthan tends to be of lower quality and is used as foundry sand. Both activated and granular bentonite are produced in the country. Bentonite is exported in unprocessed (crude) and processed (including activated) forms as well.

RESOURCES

The total resources of bentonite in the country as per UNFC system as on 1.4.2010 are about 568 million tonnes out of which 25 million tonnes are categorised as reserves. Bulk of the resources i.e., 424 million tonnes (76%) are in Rajasthan, 134 million tonnes (24%) in Gujarat and the remaining in Tamil Nadu, Jharkhand and Jammu & Kashmir. About 9 million tonnes resources are placed under drilling fluid grade, 55 million tonnes under foundry grade and 19 million tonnes resources are placed under poor/blendable grades, respectively. Substantial quantity (485 million tonnes or 85%) of total resources is placed under 'unclassified' and 'not-known' categories. The reserves/resources of bentonite as per the UNFC system as on 1.4.2010 are furnished in Table - 1.

EXPLORATION & DEVELOPMENT

During 2010-11, Directorate of Mines & Geology, Rajasthan carried out exploration near village Pusad, Barmer district where occurrences have been noticed. It is grey to off

white in colour. The deposit has a length of about 30 m, width 20 m and exposed thickness was found to be about 105 m, but bottom has not been exposed. Besides this, some ferruginous sandstone patches were also noticed to occur as overlain marker horizon of bentonite mineral. The bentonite appeared to be of foundry grade. Regional Mineral Survey over 210 sq km Regional Geological Mapping over 16 sq km and Detailed Geological Mapping over 2 sq km was carried out.

PRODUCTION

The value of bentonite produced in India in 2010-11 at ₹ 29 crore decreased about 46% as compared to the previous year.

During the year under review Gujarat was the leading state and accounted for 99% to the total value of production of bentonite while Rajasthan accounted for the remaining 1% share of the value (Table - 2).

MINING & PROCESSING

Bentonite is exploited mainly from manual mines. The bentonite deposit is very close to the surface and mined to a depth of 25 metres. A few mine owners in Kachchh and Bhavnagar districts of Gujarat deploy shovels and dumpers for mining, haulage, etc. Working of bentonite often involves selective mining, blending and processing to achieve the required grade.

The processing involves drying, grinding, sizing and at times use of additive for cation exchange. The mined material is first graded and sun-dried before pulverisation. Bentonite is processed generally by simple milling techniques that involve removal of water and volatile matter like carbon dioxide, if present, and grinding it to the appropriate sizes. Small amounts of chemicals like soda ash are added sometimes before grinding to control the properties of bentonite. Raw bentonite when delivered to the processing plant contains 25 to 40% moisture. It is, therefore, dried in dryers and the dried clay is ground in roll and hammer mills or other pulverisers and screened. Most of the bentonite is ground to approximately 90% finer than 200 mesh. For insecticide purpose, bentonite is made in the form of granules. Ashapura Minchem Ltd is one of the major processors which processed about 159,789 tonnes of bentonite lumps and produced 50,993 tonnes of granules during 2010-11.

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

(In tonnes)

Grade/State	Reserves			Remaining resources					Total resources (A+B)	
	Probable		Total (A)	Pre-feasibility STD221	Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334		Total (B)
	STD121	STD122								
All India : Total	11415982	13644526	25060508	3067	26519818	225744237	265309715	25730000	543306837	568367345
By Grades										
Drilling fluid	-	-	-	-	-	-	9303460	-	9303460	9303460
Foundry	592570	3565120	4157690	-	420000	-	50468524	-	50888524	55046214
Poor/blendable	-	-	-	-	-	-	18530969	-	18530969	18530969
Unclassified	2126060	609406	2735466	3067	13583818	5302333	52583197	-	71472415	74207881
Not-known	8697352	9470000	18167352	-	12516000	220441904	134423565	25730000	393111469	411278821
By States										
Gujarat	-	12460170	12460170	-	2163813	1904	119553173	-	121718890	134179060
Jammu & Kashmir	-	-	-	-	-	-	147400	-	147400	147400
Jharkhand	-	609406	609406	3067	-	-	367527	-	370594	980000
Rajasthan	11415982	574950	11990932	-	24356005	222017000	139423096	25730000	411526101	423517033
Tamil Nadu	-	-	-	-	-	3725333	5818519	-	9543852	9543852

Figures rounded off.

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**Table – 2 : Value of Production of Bentonite
2008-09 to 2010-11
(By States)**

State	(Value in ₹'000)		
	2008-09	2009-10	2010-11(P)
India	191094	542125	291571
Gujarat	159479	257018	287424
Rajasthan	31615	285107	4147

Source: State Governments.

In case local supply of bentonite is not available, synthetic bentonite can be prepared from fuller's earth; i.e., calcium bentonite, by treating it with anhydrous soda ash.

USES & SPECIFICATIONS

Bentonite has high swelling properties along with good viscosity and liquid limit. These properties are highly valued in most of the industrial applications. Sodium bentonite is well suited as a binder in the preparation of pellets and in foundry and as oil well drilling mud. Bentonite also acts as a suspending agent in oil well drilling fluids. Bentonite exhibits good green strength along with high hot and dry strength which helps in preventing moulds from breaking or cracking during the pouring or cooling process in the foundry industry. Owing to high green strength

resulting from its property to absorb and then release moisture, bentonite is used in iron ore pelletisation. Sodium-based bentonite of 75 micron size finds suitability in iron ore pelletisation for bonding by user industries. Bentonite clay is also used in pyrotechnics, to make end plugs and rocket engine nozzles.

Bentonite has remarkable colloidal and waterproofing properties. Bentonite gels are used as a carrier for a number of cosmetic preparations, toothpastes, creams, etc. Bentonite is also used in chemical, rubber, insecticide & pesticide industries and in civil construction works. Bentonite in the form of fine powder free from dirt and other foreign matter and of least swelling property is used in ceramic industry. Bentonite which is the active mineral in clays with medicinal properties is also prescribed as a bulk laxative and it is also used as a base for many dermatological formulations.

The specifications of bentonite for chemical & rubber and oil-well drilling industries vide BIS Specification IS:6186-1986 (Second Revision Reaffirmed 2010) are given in Table-3. Specifications for ceramic industry vide IS:12621-1988 (Reaffirmed 2011) are given in Table-4. BIS has revised the specifications of bentonite for use in foundries; the new specifications are prescribed vide IS : 12446 - 2007 (first Revision, Reaffirmed 2012).

**Table – 3 : BIS Specifications of Bentonite in Chemical, Rubber and Oil - Well Drilling Industries
{IS:6186-1986 (Second Revision, Reaffirmed 2010)}**

Sl. No.	Characteristic	Industry		
		Type 1 Chemical & Rubber	Type 2* Oil-well drilling	
			High grade	Offshore grade
1.	Moisture, % by mass			
	a) Minimum	5.00	–	–
	b) Maximum	12.00	12.00	12.00
2.	pH	9.00 to 10.50	–	–
3.	Gel formation index	To pass test	To pass test	To pass test
4.	Swelling power	To pass test	–	–
5.	Fineness			
	a) Dry - To pass through 150 micron IS sieve, % by mass, minimum	–	98.00	98.00
	To pass through 75 micron IS sieve, % by mass, minimum	95.00	90.00	–
	b) Wet - Retained on 150 micron IS sieve, % by mass, maximum	0.01	–	–
	To pass through 45 micron IS sieve, % by mass, minimum	90.00	98.00	–

(Contd.)

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Table - 3 (Concl'd.)

Sl. No.	Characteristic	Industry		
		Type 1 Chemical & Rubber	Type 2* Oil-well drilling	
			High grade	Offshore grade
6.	Viscosity at 30° C, centipoise, min			
	a) Apparent	–	15.00	–
	b) Plastic	–	6.00	–
7.	Filtration loss, ml, maximum	–	15.00	15.00
For Rubber Industry Only				
8.	Sand content, % by mass, maximum	–	2.00	2.00
9.	Loss on ignition (other than loss on drying), % by mass, maximum	6.00	–	–
10.	Matter soluble in water, % by mass, maximum	4.00	–	–
11.	Copper (as CuO), % by mass, maximum	0.01	–	–
12.	Manganese (as MnO), % by mass, maximum	0.01	–	–

* This material shall also have a yield of 90 barrels, which shall be determined by the number of barrels (181-litre capacity) of mud of 15-centipoise viscosity obtained from 1,000 kg bentonite dispersed in water and aged for 24 hours.

**Table – 4 : BIS Specifications of Bentonite for Ceramic Industry
{IS:12621-1988 (Second amendment, Reaffirmed 2011)}**

Sl. No.	Characteristic	Requirement
1.	Free moisture content at 105 ± 2°C, % by mass, max	6.0
2.	Residue on 106 micron IS sieve, % by mass, max	Nil
3.	Grit content on 45 micron IS sieve, % by mass, max	1.0
4.	Loss on ignition, % by mass	8 to 12
5.	Silica (as SiO ₂), % by mass	48 to 55
6.	Alumina (as Al ₂ O ₃), % by mass	18 to 28
7.	Iron oxides (as Fe ₂ O ₃), % by mass, max	4
8.	Titanium oxide (as TiO ₂), % by mass, max	3
9.	Oxides of iron (as Fe ₂ O ₃) and titanium (as TiO ₂) together, % by mass, min	6
10.	Water of plasticity, % by mass	45 to 60
11.	Swelling power after 24 hours	15 to 20
12.	Calcium oxide (as CaO), % by mass, max	3
13.	Magnesium oxide (as MgO), % by mass, max	3
14.	Oxides of calcium (as CaO) and magnesium (as MgO), together, % by mass, max	5
15.	Viscosity at 30°C, centipoise, min	4.5

Note: All tests except for Sl. No. 1 shall be carried out on dry basis.

CONSUMPTION

The consumption of bentonite in 2011-12 decreased slightly to 124,600 tonnes from 125,800 tonnes in the previous year. Foundry industry accounted for 44% consumption, followed by, oil well drilling 19%, pelletisation 12% and chemical industry 6% (Table-5).

Table - 5 : Reported Consumption of Bentonite 2008-09 to 2010-11 (By Industries)

Industry	2008-09	2009-10(R)	2010-11(p)
All Industries	108300	105800	112400
Alloy steel	900 (2)	900 (2)	900 (2)
Ceramic	700 (7)	700 (7)	700 (7)
Chemical	1500 (2)	7500 (3)	7500 (3)
Fertilizer	3300 (1)	3300 (1)	3300 (1)
Foundry ^(e)	52500 (22)	54300 (23)	54300 (23)
Iron & Steel	3900 (2)	3100 (2)	2500 (2)
Oil -well drilling	17400 (2)	24400 (2)	22400 (2)
Pelletisation (iron & steel)	10900 (2)	7000 (2)	16200 (2)
Pesticide	4600 (1)	-	-
Refractory	4600 (11)	4600 (12)	4600 (12)
Others (electrode, ferro-alloys, paint, sugar & textile)	++ (13)	++ (13)	++ (13)

Figures rounded off.

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

*(*Includes actual consumption and/or estimates made wherever required).*

In addition, substantial quantity has also been consumed in civil construction of which data is not available.

INDUSTRY

There were about 30 pulverising units in Gujarat and 27 in Rajasthan. The processing plants of bentonite owned by Neelkanth Chemical Work at Akli, Barmer and Jodhpur in Rajasthan produce about 25,000 tpy sodium bentonite.

The Ashapura Minechem Pvt. Ltd, Kachchh, Gujarat has a bentonite pulverising plant having a capacity of 60,000 tpy near Bhuj, Kachchh district. The plant can produce 90% 200-mesh powder. The company also has a new Pellet Strength Test (PST) grade bentonite plant having a capacity of 100,000 tpy near Bhuj. It produces 90% minus 63-micron powder which is supplied to the iron ore pelletisation industry. It also has mining and mineral processing facilities in the states of Karnataka, Kerala, Andhra Pradesh and Odisha. The company produced 10,606 tonnes bentonite granules, 117,471 tonnes bentonite

powder, 263,546 tonnes bentonite processed lumps, 11,060 tonnes bentonite unactivated lumps and 13,597 tonnes attapulgitic lumps in 2010-11. Production during 2009-10 was 16,579 tonnes granules, 50,993 tonnes powder, 159,789 tonnes processed lumps, 96,312 tonnes unactivated lumps and 5,912 tonnes attapulgitic lumps. The plant had an installed capacity over 7 million tpy of processed industrial mineral of standard product specification, against which the production of processed minerals was 0.94 million tonnes and 1.31 million tonnes in 2009-10 and 2010-11, respectively.

Ashapura Volclay is a joint venture between Ashapura Group, India's leading bentonite exporter, and Illinois-based Amcol International Corp., one of the USA's top bentonite producers. The company is producing bleaching clays from its plant in Bhuj in Kachchh district, Gujarat since 2001. This plant has 30,000 tpy capacity to produce attapulgitic-bentonite product. The blended clay is in demand particularly in the domestic market for bleaching of light-coloured vegetable oils, such as sunflower, groundnut and cotton seed oils. The company is in the process of expanding its production capacity of acid activated bleaching clay. Ashapura is on way to become world's third largest bleaching clay producer in terms of capacity.

Gimpex Ltd has a processing plant with capacity of 45,000 tpy in Kachchh region of Gujarat producing sodium and calcium bentonite. It is reported that in addition to Gimpex Ltd, Jumbo Mining, Star Bentonite Group, Fonadwell Minechem and Gexmin Co. also produce processed bentonite.

WORLD REVIEW

The global production of bentonite in 2011 was around 15.5 million tonnes. The USA was the largest producer with an estimated output of around 5 million tonnes followed by China with 3.4 million tonnes. Other major producers were Greece, Mexico, Russia, Japan, Turkey, Brazil, Germany and India (Table - 6).

FOREIGN TRADE

Exports of bentonite increased considerably to 1,033,552 tonnes in 2011-12 from 637,692 tonnes in the previous year. Major buyers were Malaysia (24%), Ukraine (15%), Indonesia (14%) and Oman (5%) (Table-7).

Imports of bentonite increased slightly to 3,956 tonnes in 2011-12 from 2,301 tonnes in the previous year. Imports were mainly from Australia (21%), USA (18%) and China (17%) (Table-8).

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**Table – 6 : World Production of Bentonite
(By Principal Countries)**

(In '000 tonnes)

Country	(In '000 tonnes)		
	2009	2010	2011
World: Total	14200	14900	15500
Argentina	148	204	200 ^(e)
Brazil	218	326	330 ^(e)
China ^(e)	3400	3400	3400
Cyprus	153	163	161
Czech Republic	177	183	160
Germany	326	363	375
Greece	1500	845	1250
India ^(e)	561	739	996
Iran	387	350	350 ^(e)
Italy	115	111	103
Japan ^(e)	432	430	430
Mexico	511	591	564
Russia ^(e)	460	460	460
Spain	147	157	111
Turkey	753	718	380
Ukraine	195	185	211
USA	3650	4630	4950
Other countries	1067	1045	1069

Source: World Mineral Production, 2007-2011.

**Table – 7 : Exports of Bentonite
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	637692	1801785	1033552	2699338
Malaysia	73298	173754	253803	448657
Indonesia	76932	150859	148804	266039
Ukraine	78465	241341	154000	249028
Oman	20992	31854	56643	199782
Saudi Arabia	33424	96275	41596	179690
Brazil	86158	226852	34879	121670
UAE	35529	94843	31061	103050
Korea Republic	12032	34877	28515	82902
Australia	23592	89861	11709	78261
Italy	16712	40712	37012	76901
Other countries	180558	620557	235530	893358

**Table – 8 : Imports of Bentonite
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹ '000)	Qty (t)	Value (₹ '000)
All Countries	2301	74759	3956	122538
USA	934	33745	700	33749
Brazil	40	3143	249	22482
China	662	16549	691	19755
Australia	-	-	816	6964
UK	44	4422	149	6398
Italy	138	2184	281	5174
Indonesia	140	2255	169	4111
Bulgaria	-	-	28	3931
Korea Rep.	-	-	360	3094
France	27	4304	44	2371
Other countries	316	8157	469	14509

FUTURE OUTLOOK

The Indian bentonite industry is expected to perform better in the coming years because of emerging demand for oil clarification and cat litter. The biggest market for bentonite in both North America and European countries are foundry, cat litter, iron ore pelletising and drilling. Civil engineering and environmental applications, such as land fills require bentonite for use as a sealant and lubricant. The global bleaching clay market is estimated at 860,000 tpy of which 700,000 tpy is used for bleaching edible oils, 150,000 tpy for petroleum and the remaining 10,000 tpy for clarifying beverages, such as wines and fruit juices.

Bentonite is among the exportable mineral commodities in India. Bentonite is exported both in unprocessed (crude) and processed (including activated) forms. Though, export of crude bentonite account for a higher quantity, the exports of processed bentonite fetch higher value than the crude bentonite. There is a pressing need to develop different processing techniques that suit our available resources, in order to make our products match the international standards. There is scope to establish bentonite processing granulation and paint-grade processed bentonite units in the country to meet the indigenous demand as well as demand in the international market.