

BENTONITE



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BENTONITE

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

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5 Bentonite

Bentonite is essentially a highly plastic clay containing not less than 85% clay mineral, montmorillonite. It gets its name from the place where its presence and usages were first discovered, Fort Benton, America. Bentonite's commercial importance is due to its inherent bleaching properties similar to that of fuller's earth, hence, it is also 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 & lubricity, high dry-bonding strength, high shear & compressive strength, low permeability and low compressibility make bentonite commercially viable. Bentonite is valued in applications, such as, foundry sand binding, drilling mud, iron ore pelletisation and as a waterproofing & 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 producing areas 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 both as unprocessed (crude) and processed (including activated) forms.

RESERVES/RESOURCES

The total reserves/resources of bentonite in the country as per NMI data based on UNFC system as on 1.4.2015 have been estimated at 583 million tonnes out of which 15 million tonnes are categorised as reserves. The bulk of the resources, i.e. 428 million tonnes (73%) are in Rajasthan, 144 million tonnes (25%) in Gujarat and the remaining in Tamil Nadu, Jharkhand and Jammu & Kashmir. Substantial quantity of 501 million tonnes (86%) of total resources are placed under Unclassified and Not-known categories; 60 million tonnes (10%) under Foundry grade, 19 million tonnes (3%) under Poor/Blendable grades. About 3 million tonnes resources are placed under Drilling Fluid grade. The reserves/resources of bentonite as per the UNFC system as on 1.4.2015 are furnished in Table - 1.

EXPLORATION & DEVELOPMENT

GSI carried out exploration for potash in glauconite bearing shale and sandstone around village Guneri of Kachchh district of Gujarat. During the investigation, occurrences of other minerals like bentonite as small vein/patches/pockets were observed. DGM, Rajasthan carried out exploration for bentonite at various places in Barmer district.

BENTONITE

In the FS 2014-15 DGM, Rajasthan further carried out exploration for minerals bentonite, siliceous earth, sandstone etc. near village Junejo Ki Dhani (1.5 to 2.2m thick orebody over 600m length), Pusad(8m thick, area about 200 ha.), Harwecha, Jasse ka Gaon, Rawar ka Gaon and Lalso ki Dhani in Sheo Tahsil, district Badmer by carrying out Detailed Geological Mapping on 1:2000 scale in 3 sq. km. area. Reserves/Resources were not estimated yet. Also in addition to this DGM carried out Detailed Geological Mapping on 1:2000 scale in 2.70 sq. km area near village Jharniya, tah. Pirawa, district Jhalawar. For Chemical analysis about 40 samples were collected. About 37,500 tonnes of bentonite reserves were estimated.

PRODUCTION

The value of bentonite produced in India in 2014-15 at ₹ 73 crore decreased by about 10% as compared to the previous year.

During the year under review Gujarat contributed 91% to the total value of production of bentonite while remaining 9% was accounted by Rajasthan (Table-2).

MINING & PROCESSING

Bentonite is exploited mainly by manual and at places by semi-mechanised methods by deploying shovels and dumpers for mining, haulage, etc. Generally, the bentonite deposits are very close to the

surface and mined to a depth of 25 metres. Most of the working mines are located in Kachchh & Bhavnagar districts of Gujarat and Badmer, Bikaner & Jhalawar districts in Rajasthan. 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. 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. 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 amount of chemicals like soda ash are added sometimes before grinding to control the properties of bentonite. 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 has extensive reserves of both types of Sodium & Calcium based bentonite in Kachchh, Gujarat, India. However, predominantly, most of its reserves are high quality, high montmorillonite based Sodium grades which gives Ashapura the opportunity to produce various quality bentonite products for diverse industry sectors.

**Table – 1 : Reserves/Resources of Bentonite as on 1.04.2015
(By Grades/States)**

(In tonnes)

State/Grade	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	
All India :Total	13926227	50000	609406	6838864	2721697	68632472	26519818	225744237	212115692	25730000	568302781	582888414
By Grades												
Drilling Fluid	69109	-	69109	-	-	-	-	-	3009437	-	3009437	3078546
Foundry	4705000	50000	4755000	-	592570	3565120	420000	-	50468524	-	55046214	59801214
Poor/blendable	-	-	-	-	-	-	-	-	18530969	-	18530969	18530969
Unclassified	9152118	-	609406	6838864	2129127	-	13583818	5302333	52583197	-	80437339	90198863
Not-known	-	-	-	-	-	65067352	12516000	220441904	87523565	25730000	411278821	411278821
By States												
Gujarat	9221227	-	9221227	6838864	-	12460170	2163813	1904	113259150	-	134723901	143945128
Jammu & Kashmir	-	-	-	-	-	-	-	-	147400	-	147400	147400
Jharkhand	-	609406	609406	-	3067	-	-	-	367527	-	370594	980000
Rajasthan	4705000	50000	4755000	-	2718630	56172302	24356005	222017000	92523096	25730000	423517033	428272033
Tamil Nadu	-	-	-	-	-	-	-	3725333	5818519	-	9543852	9543852

Figures rounded off

BENTONITE

BENTONITE

**Table – 2 : Value of Production of Bentonite
2012-13 to 2014-15
(By States)**

State	(Value in ₹'000)		
	2012-13	2013-14	2014-15 (P)
India	907770	817825	733700
Gujarat	728770	790800	666700
Rajasthan	179000	27025	67000

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 and is abundantly used in horizontal drilling for shale production. 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. Bentonite is also used to prepare sulphur bentonite fertilizer (90:10) which is useful to impart better productivity.

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.)

BENTONITE

Table - 3 (Concl.d.)

Sl. No.	Characteristic	Industry	
		Type 1 Chemical & Rubber	Type 2*
			High 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
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 2015-16 increased slightly to 83,600 tonnes from 79,500 tonnes in the previous year. Iron & Steel Industry

accounted for 38% of consumption followed by Oil-well Drilling 26%, Chemical Industry and Pelletisation (iron & steel) 9% each, Foundry 7% and Refractory (5%)(Table-5).

**Table - 5 : Consumption* of Bentonite
2013-14 to 2015-16
(By Industries)**

(In tonnes)			
Industry	2013-14	2014-15 (R)	2015-16 (P)
All Industries	79700	79500	83600
Alloy steel	900	900	900
Ceramic	700	700	700
Chemical	7500	7500	7500
Fertilizer	3300	3300	3300
Foundry ^(e)	6100	6200	6200
Iron & Steel	19800	22200	31400
Oil-well drilling	22000	22000	22000
Pelletisation (iron & steel)	15100	12300	7200
Refractory	4300	4400	4400
Others	++	++	++

(electrode, ferro-alloys,
paint, sugar, petroleum,
refining & textile)

Figures rounded off.

* Includes actual consumption and/or estimates made where ever required and paucity of data, hence coverage may not be complete.

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 with a capacity of 3,50,000 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 with a capacity of 1,00,000 tpy near Bhuj. It produces 90% minus 63-micron powder which is supplied to the Iron Ore Pelletisation Industry. Its main processing facility is close to Mundra port which is a deep water, all weather port, and can berth even up to cape sized vessels. It also has mining and mineral processing facilities in the States of Karnataka, Kerala, Andhra Pradesh and Odisha. Today Ashapura is the 3rd largest producer of bentonite in the world. It has extensive resources of both sodium and calcium bentonite which is mined and processed into several grades such as dried & crushed lumps, granules and powder to micronised powder as per the requirement of diverse needs of the clients. The Ashapura group possesses requisite ISO Certifications and its products are used by a wide range of industries such as Iron ore Pelletisation, Drilling, Metal casting (foundry), construction, cat litter etc. Its value added products are also extensively used in Paper Industry, Detergents, Pharmaceutical Industries, Animal Feeds etc.

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 produces bleaching clays from its plant in Bhuj in Kachchh district, Gujarat since 2001 with the installed capacity of 50,000 tpy. 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.

Following the success of the plant at Bhuj, Ashapura Group has set up another plant for manufacturing bleaching earth at Dharur, Andhra Pradesh, with installed capacity of 30,000 tpy. This plant not only has access to the primary raw mineral attapulgite but also has a logical edge for exports to the palm oil producing and refining countries in South-East Asia. The brand 'Clearflow' has within a short span established itself as a cost-effective brand in major oil refiners in India and overseas. Given the importance of Europe as a market, the Ashapura Minechem has set up a mineral processing complex at Antwerp, Belgium as a joint venture with AMCOL International Corp. with installed capacity of 20,000 tpy. The facility has the capability of processing bleaching earth which would be exported from India in a semi-processed form. The Antwerp facility today serve all the major oil refineries of Europe by making available cost-effective and quality product at their doorstep. All the Bleaching Earth grades from Ashapura are available at Antwerp facility. Malaysia being a strategic manufacturing hub in South-East Asia for edible oils, has prompted Ashapura to invest in Hudson MPA Snd. Bhd., a reputed Bleaching Earth manufacturer of Malaysia. The Selangor facility imports attapulgite and bleaching earth from Ashapura in India and processes it for marketing in Malaysia and neighbouring countries. The Selangor plant has an installed capacity of 20,000 tpy.

Gimpex Imerys India Pvt. Ltd has a processing plant with capacity of 60,000 tpy in Kachchh region of Gujarat producing sodium and calcium bentonite. It is reported that in addition to Gimpex Imerys India Pvt. Ltd, Jumbo Mining, Star Bentonite Group, Fonadwell Minechem and Gexmin Co. also produce processed bentonite.

WORLD REVIEW

The global production of bentonite in 2015 was around 18.4 million tonnes. USA was the largest producer with an estimated output of around 4.32 million tonnes (23%) followed by China with 3.5 million tonnes (19%) and Turkey with 3.1 million tonnes (17%). Other major producers were India, Greece, Mexico, Iran, Russia, Brazil, Japan and Germany (Table - 6).

BENTONITE

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

(In '000 tonnes)			
Country	2013	2014	2015
World: Total	16059	16610	18446
Argentina ^(c)	200	200	200
Brazil	403	405	400 ^(e)
China ^(e)	3600	3500	3500
Cyprus	158	140	127
Czech Republic	226	301	369
Germany	359	395	395 ^(e)
Greece	1000	1011	1150
India ^(e)	1305	1327	1466
Iran	502	403	430
Japan ^(e)	420	420	420
Mexico	827	474	470 ^(e)
Morocco	105	99	92
Russia ^(e)	460	460	460
Slovakia	184	205	205
South Africa	177	170	164
Spain	103	106	102
Thailand	150	150 ^(e)	150 ^(e)
Turkey	623	1088	3135
USA	4350	4800	4320 ^(e)
Ukraine ^(e)	219	219	219
Other countries	687	737	672

Source: World Mineral Production, 2011-2015.

FOREIGN TRADE

Exports of bentonite increased slightly to 1.57 million tonnes in 2015-16 from 1.30 million tonnes in the previous year. Major buyers were Ukraine (27%), Indonesia (16%), Malaysia (12%), and Oman (5%) (Table-7).

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

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1300083	3999734	1572469	4814345
Ukraine	216503	495331	430700	888775
Indonesia	259785	548507	254145	658578
Malaysia	259139	657564	189140	575284
Oman	80316	235003	83375	270387
Saudi Arabia	62559	228029	44139	206394
UAE	43240	156683	54244	186312
Korea, Rep. of	39010	136036	43223	175902
Kuwait	30975	83073	36802	140088
Netherlands	26600	59359	60608	134846
Singapore	14388	82271	22155	124463
Other countries	267568	1317878	353938	1453316

Similarly imports of bentonite also increased to 15,225 tonnes in 2015-16 from 11,002 tonnes in the previous year. Imports were mainly from Turkey (57%), USA (24%), China (9%) and Egypt & Italy (3% each) (Table-8).

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

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	11002	316055	15225	353710
Turkey	5711	102803	8670	137362
USA	1845	120448	3591	133152
China	1866	35016	1365	26491
Egypt	425	10562	498	19217
Italy	620	13190	502	11546
Canada	88	1982	232	5293
Poland	5	1209	203	4405
UK	186	15794	73	3312
Thailand	25	3929	18	3062
Chinese Taipei/ Taiwan	-	-	5	2959
Other countries	231	11122	68	6911

FUTURE OUTLOOK

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 market of bentonite and fuller's earth is likely to witness a healthy growth owing to strong demand expected in foundry and Iron Ore Pelletisation Industry. This is mainly due to strong growth in the automotive production (>100M vehicles) as well as increase in iron & steel production. Increase in civil construction activity in Asian countries and traditional edible oil refining in Asia will also boost bentonite consumption in near future. The slump in global crude oil prices since 2015, may result in lower demand of future exploration activity for oil and gas. Bentonite consumption in Drilling Mud Industry is also expected to remain on lower side till global oil market again picks up.

Global Bleaching clay market exceeds \$700 million in 2015. This product is widely used in processing and refining of edible oils as well as for decolorising mineral oils, waxes and lubricants. Asia Pacific Bleaching clay market may witness significant growth owing to increasing edible oil production in China, India, Malaysia and Indonesia.

BENTONITE

Ashapura Group of Companies, an Indian company features among the global key operators in the Bleaching Clay Industry which include BASF SE, Clariant International, AMCOL Speciality Minerals etc.

Bentonite is among the exportable mineral commodities in India. Since Indian resources of Bentonite are of high grades, India has excellent opportunity to cater to diverse industries worldwide. 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. More and more Indian companies are entering in joint ventures with multinationals in order to meet the challenge of the strong global competition.

