



Bentonite



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Bentonite clay is an aluminum phyllosilicate, which consists mostly of the mineral montmorillonite. It has the incredible ability to increase as much as 14 times its original volume.

Formation of Bentonite

Bentonite is a material derived from the alteration, over geological time periods, of glassy material emitted from volcanoes (tuff or ash), or from the alteration of silica bearing rocks such as granite and basalt. Bentonite only forms in the presence of water. Depending on the nature of formation, Bentonite can have a variety of accessory minerals in addition to its constituent mineral Montmorillonite. These minerals may include attapulgite, kaolin, mica, and illite as well as minerals like quartz, feldspar, calcite and gypsum. The presence of these minerals may affect the value of a deposit.

Types of Bentonite

Two types of Bentonite are recognized, and the uses of each depend on specific physical properties.

Type 1 Sodium Bentonite

Sodium Bentonite is the type of swelling clay. It has single water layer particles which contain Na^+ as the exchangeable ion.

Type 2 Calcium Bentonite

Calcium Bentonite is the non-swelling clay. It has a double water layer with Ca^{2+} as the exchangeable ion.

Uses of Bentonite

Bentonite has very ample and attractive properties which gives it a wide and diverse range of uses, these are:

Foundry: Bentonite is used as a bonding material in the preparation of molding sand for the production of iron, steel and non-ferrous casting. The unique properties of Bentonite yield green sand moulds with good flow ability, compact ability and thermal stability for the production of high quality castings.

Cat Litter: Bentonite is used for cat litter, due to its advantage of absorbing refuse by forming clumps (which can be easily removed) leaving the remaining product intact for further use.

Pelletizing: Bentonite is used as a binding agent in the production of iron ore pellets. Through this process, iron ore fines are converted into spherical pellets, suitable as feed material in blast furnaces for pig iron production, or in the production of direct reduction iron (DRI).

Construction and Civil Engineering: Bentonite in civil engineering applications is used traditionally as a thixotropic, support and lubricant agent in diaphragm walls and foundations, in tunneling, in horizontal directional drilling and pipe jacking. Bentonite, due to its viscosity and plasticity, also is used in Portland cement and mortars.

Environmental Markets: Bentonite's adsorption/absorption properties are very useful for wastewater purification. Common environmental directives recommend low permeability soils, which naturally should contain Bentonite, as a sealing material in the construction and rehabilitation of landfills to ensure the protection of groundwater from the pollutants. Bentonite is the active protective layer of geosynthetic clay liners.

Drilling: Another conventional use of Bentonite is as a mud constituent for oil and water well drilling. Its roles are mainly to seal the borehole walls, to remove drill cuttings and to lubricate the cutting head.

Oils/Food Markets: Bentonite is utilized in the removal of impurities in oils where its adsorptive properties are crucial in the processing of edible oils and fats (Soya/palm/canola oil). In drinks such as mineral water, and in products like sugar or honey, Bentonite is used as a clarification agent.

Agriculture: Bentonite is used as an animal feed supplement, as a pelletizing aid in the production of animal feed pellets, as well as a flowability aid for unconsolidated feed ingredients such as soy meal. It also is used as an ion exchange for improvement and conditioning of the soil. When thermally treated, it can be used as a porous ceramic carrier for various herbicides and pesticides.

Pharmaceuticals: Cosmetics and Medical Markets: Bentonite is used as filler in pharmaceuticals, and due to its absorption/adsorption functions, it allows paste formation. Such applications include industrial protective creams, calamine

lotion, wet compresses, and ant irritants for eczema. In medicine, Bentonite is used as an antidote in heavy metal poisoning. Personal care products such as mud packs, sunburn paint, baby and face powders, and face creams may all contain Bentonite.

Detergents: Laundry detergents and liquid hand cleansers/soaps rely on the inclusion of Bentonite, in order to remove the impurities in solvents and to soften the fabrics.

Paints: Dyes and Polishes: Due to its thixotropic properties, Bentonite and oreoano clays function as a thickening and/or suspension agent in varnishes, and in water and solvent paints. Its adsorption properties are appreciated for the finishing of indigo dying cloth, and in dyes (lacquers for paints & wallpapers).

Paper: Bentonite is crucial to paper making, where it is used in pitch control, i.e. absorption of wood resins that tend to obstruct the machines and to improve the efficiency of conversion of pulp into paper as well as to improve the quality of the paper. Bentonite also offers useful de-inking properties for paper recycling. In addition, acid-activated Bentonite is used as the active component in the manufacture of carbonless copy paper.



Bentonite in Jordan

Bentonite is a commercial term for a special type of clay composed essentially of crystalline smectite minerals commonly dominated by montmorillonite. It is formed from alteration of glassy igneous material either tuff or volcanic ash and deposited in shallow water lakes in the Plio-Pleistocene time. Chemically, it is a hydrous aluminum silicates with magnesium and iron that partially substitute (Al) in the structure. Alkalis or alkaline earth elements are also present as essential constituents.



Location

Bentonite deposit occurs in two separate areas; Q'a Al Azraq and Ein Al Bayda that are approximately 120 km northeast of Amman. Q'a Al Azraq represents a closed basin and covers about 150 km². Both areas have low relief about 510m above sea level. Smectite, mixed layer illite/smectite and kaolinite forming the major constituents of clay minerals, whereas quartz, feldspar and calcite are present as impurities.

Reserves

Ein al Bayda area: 105 million ton.

Q'a Al Azraq: not determined

Chemical Properties

Chemical comparison between Jordanian Bentonite and Wyoming Bentonite.

Sample/Location	Na ₂ O %	MgO %	Al ₂ O ₃ %	SiO ₂ %	K ₂ O %	CaO %	TiO ₂ %	Fe ₂ O ₃ %
Bentonite/Azraq	0.13	3.47	20.08	55.67	2.45	2.15	2.54	13.47
Bentonite (Wyoming)/ USA	ND	1.92	22.84	66.11	0.56	1.32	0.55	6.51

Physical Properties	
Specific gravity	2.49-2.72
Specific surface area M ² /g	370-487
CEC Meq/100g	53-83
Oil absorption% by wt	73-87
Water absorption% by wt	115-207
Attrition resistance%	80-95
Adsorption of water vapor %	11-17
Bleaching capacity of edible oil%	81-99

Particle Size Distribution	
Grain size (µm)	Wt %
+ 1000	0.13 - 0.41
1000 - 63 <input type="checkbox"/>	2.71 - 4.93
63 - 2 <input type="checkbox"/>	42.14 - 44.77
- 2 <input type="checkbox"/>	49.89 - 55.02

Investment Opportunities

Based on the physical and chemical properties the Bentonite can be used in the following industries:

- Bleaching of edible oil.
- Oil absorption.
- Odour and liquid absorbent (Cat litter).
- Waste water treatment.
- Cast iron industry.
- Pelletizing.
- Filtering and clarification.

Note: For More Information and inquiry can be contacted at the following address:

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