Minerals that make up the montmorillonite group.

Abstract: Clays containing materials of regular structure are the most common inorganic sorbents for water purification in nature. Sorbents belonging to the type of expandable structural stratum minerals include montmorillonite and vermiculite, which form the basis of bentonite clays. Bentonites are clays which compose mainly of minerals belonging to the group of montmorillonite and sometimes called stonesoap. Navbahor alkaline bentonite deposit is located in Navbahr district of Navoi region of Uzbekistan Republic. The current proven reserves of the deposit are more than 7142.6 thousand tons. Montmorillonite is mainly the most effective adsorbent for various compounds and water purification. The surface area of montmorillonite is 450 m^2/g, and vermiculite is 450-500 m^2/g.[5]

Keywords: clay, montmorillonite, bentonite, gismondin, faujasite, pyrophyllite.

Introduction: Montmorillonite is a clay mineral belonging to the class of layered silicates (derived from the name of the French city of Montmorillon). The variability of the chemical composition of montmorillonite determines its colloidal chemical properties.

Montmorillonite is a phyllosilicate mineral with nanolayered structure. Its layered structure (ca. 1 nm in thickness) consists of stacked layers (100 nm × 100 nm, in width and length). Due to the isomorphous substitution, the layer is positively charged and then cations are existed in the interlayered space of Mt. Neighboring layers are held together primarily by van der Waals force and electrostatic force to form the primary particles of Mt. The particles then aggregate to form secondary micrometer-scale to millimeter-scale particles (Fig.1) [1,2].

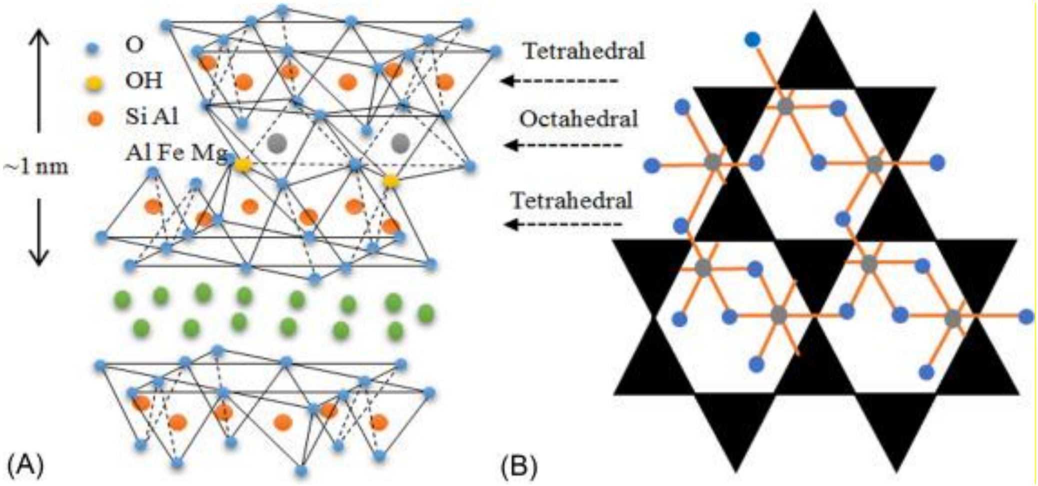


Fig.1. Schematic representation of the structure of Mt. (A) Side view: tetrahedrons units of Mt assembled through weak van der Waals and electrostatic forces to form the primary particles, (B) Top view of Mt, hexagonal structure of oxygen and hydroxyl ligands of the octahedral layer.[9]

The aim of the study is to increase the sorption capacity of bentonite several times through chemical and cation exchange mechanisms.

$$\mathbf{(Ca.Na)_{0.33}(Mg,Al,Fe)\ 2[(Si,Al)_4O_{10}(OH)_2\ nH_2O.}$$

According to the results of the analysis, the percentage is calculated as follows: Na_2O - 1,70 - 2,60; CaO - 0,76 - 4,05; MgO - 2,30 - 3,27; K_2O - 0,24 - 1,26; Fe_2O_3 - 4,04 - 6,31; SiO_2 - 57 - 63; Al_2O_3 – 13 – 15. Mineralogical composition (% by mass): montmorillonite - 75 - 90; mixed layered smectites: illite - 0 - 5; kristobalit - 3 - 6; calcite - 1 - 4; quartz - 0 - 5; plagioclase - 1 - 6; gypsum - 0 - 2; potassium mica - 0 - 8; geylandite 0 - 5. Fe2O3 - 5 and more. Studies have shown that this variable chemical composition determines its colloidal chemical properties.[5]

Polyunsaturated montmorillonite is called bedellite, magnesium is termed saponite and iron is called nontronite. It is mainly formed by the erosion of various rocks in alkaline environments, the transformation of hydraulics in the marine environment, and the decay of ash-like particles in lagoon basins and dry climatic soils. Montmorillonite bentonite is the main mineral of clays. High sorption, swells when moistened, increases in size, fills cracks and pores and is impermeable to water. Montmorillonite clays act as a good barrier for oil and gas deposits. Montmorillonite clay deposits are found in Bukhara, Samarkand, Fergana, Kashkadarya, Surkhandarya and Navoi regions of Uzbekistan. Montmorillonite clays are used in the oil, textile and cement industries. Clay mineral is an important material found in nature. Montmorillonite-based nanoclays are currently used to modify the performance of the polymer.

It can be used for the following purposes:

- various materials and products in the field of catalysis, food additives, antibacterials;
- application of polymers, sorbents and significant improvement in application;;
- as a food supplement for health and endurance, dental and antibacterial activity;
- decomposition of gum, use as a sorbent and catalyst for noionic, anionic and cationic dyes.

Bentonite is an important clay rock found in nature. It is an important source of montmorillonite in nature and is a rock composed of highly colloidal and plastic clays. In addition to montmorillonite, bentonite may contain a certain amount of crystalline quartz, cristobalite, and feldspar.

Bentonite, which is mainly composed of montmorillonite, was found in the United States around 1890, and the name “bentonite” is associated with the name of an American geologist. Montmorillonite derived from bentonite may contain sodium or calcium. Sodium montmorillonite is the main component of bentonite found in combination with 10-20% various minerals.

The textile and dyeing industries of India, Pakistan, and China have used dye bath water, which is a cationic dye. The adsorption system developed using montmorillonite is useful for water treatment in the dyeing industry. Using the adsorption properties of montmorillonite, it is possible to purify kaolinite to remove toxic metals such as As, Cd, Cr, Co, Cu, Fe, Pb, Mn, Ni from an aqueous solution. Montmorillonite and its modified forms significantly increased metal adsorption.

The formula of montmorillonite is as follows:

$$\mathbf{(Na,Ca)_{0.33}(Al,Mg)_2(Si_4O_{10})(OH)_2 \cdot nH_2O}$$

According to the degree of exposure to montmorillonite, the modifiers are divided into 3 groups in the scientific literature:

1. To the first group: solutions of dilute mineral and organic acids, which react with the exchange cations located between the layers of bentonite.

2. The second group: solutions of medium concentrations of mineral acids (2 - 4 n), which lead to structural changes in aluminosilicate. The specific surface area is increased to 330 m2 / g, the adsorption volume is increased to 0.5 cm3 / g.

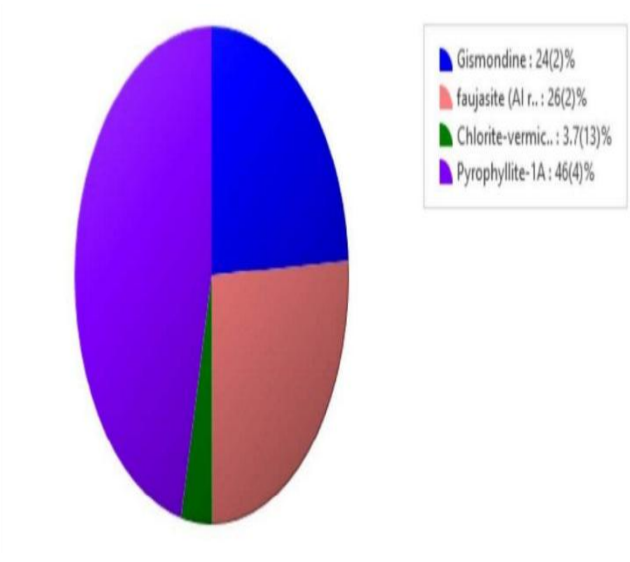
3. To the third group: concentrated mineral acids (greater than 4n), motnmorillonite is characterized by changes in crystal structure and complete leaching of exchangeable cations.[5]

Results and discussion: The composition of montmorlonite analyzed in X-ray apparatus consists of the following minerals (Fig.2). Let's take a brief look at the minerals gismondine, faujasite and pyrophyllite in montmorlonite.

Gismondine is recorded from the third basalts of the North Atlantic region, Antrim and a total of about 40 sites in Iceland, the empirical formula is as follows

$$\mathbf{[Ca_4(H_2O)_{18}]\ [Al_8Si_8O_{32}]}$$

Gismondine is named in honor of Carlo Giuseppe Gismondi (1762-1824), a teacher of mineralogy in Rome. Its crystals are in the form of stellar or radiative aggregates, and the glass is a bright, colorless to gray mineral. In terms of chemical composition, gismondin has Ca-dominant compositions. Gismondine, also known as Gismondine, is a rare mineral in the zeolite family. Many



specimens have been found in basalt lavas in Ireland and Iceland, as well as in other zeolites such as chabazite, thomsonite, and phillipsite. The zeolite gismondine crystals, $Ca_4Al_8Si_8O_{32} \cdot 16H_2O$, were completely ion exchangeable and their crystal structures were determined. Ag- and Cs, Na-gismondines maintained the spatial group symmetry of the original natural crystals. No monocrystals other than Na-gismondine were obtained.[1]

Faujasite is a group of minerals belonging to the zeolite family of silicate minerals. The group consists of faujasite-Na, faujasite-Mg and faujasite-Ca. They all have the same basic formula:

$$\mathbf{(Na_2,Ca,Mg)3,5[Al_7Si_{17}O_{48}]\cdot 32(H_2O)}$$

It is found as a rare mineral in many parts of the world and is also synthesized in industry. Faujasite first appeared in 1842 in the Limberg quarries, Sasbach, Kaiserstuhl, Baden-Württemberg, Germany. Sodium modifier faujacit-Na was added in the 1990s after the discovery of magnesium and calcium rich phases. It is named in honor of the French geologist and volcanologist Barthelemy Faujas de Saint-Fond (1741–1819).

Faujasite, like other zeolites, is synthesized from alumina sources such as sodium aluminate and silica sources such as sodium silicate. Other aluminosilicates such as kaolin are also used. The ingredients are dissolved in a basic medium containing an aqueous solution of sodium hydroxide and crystallized at 70 to 300°C (usually at 100°C)[7]. After crystallization, the faucet is in the form of sodium and must be ion exchange with ammonium to improve stability. The ammonium ion is then released by calcination, which makes the zeolite in acid form. Depending on the silicon-aluminum oxide ratio of their frame, synthetic fauxite zeolites are divided into X and Y zeolites. In X zeolites this ratio is 2 to 3, and in Y zeolites it is 3 and higher. The negative charges of the frame are balanced by the positive charges of the cations in the non-frame positions. Such zeolites have ion exchange, catalytic and adsorption properties. The stability of the zeolite increases with the silicon-aluminum oxide ratio of the frame. The type and amount of cations located in the non-frame positions are also affected. For catalytic cracking, Y zeolite is often used in the form of rare earth-hydrogen exchange.

Faujasite is used as a catalyst in liquid catalytic cracking to convert high-boiling fractions of crude oil into more expensive gasoline, diesel, and other products. It is also used in hydrocracking devices as a platinum / palladium base to increase the aromatic content of the refined oil.[2]

Faujasite has the following chemical compositions:

Faujasite-Na - $\mathbf{|(Na,Ca_{0,5},Mg0_{,5,}K)x(H_2O)16|[Al_xSi_{12}\text{-}xO_{24}]}$ x = 3,2 – 4,3

Faujasite-Ca - $\mathbf{|(Ca_{0,5,}Na,Mg_{0,5,}K)x(H_2O)16|[\ Al_xSi_{12}\text{-}x\ O_{24}}]$ x = 3,3 – 3,9

Faujasite-Mg - $\mathbf{|(Mg_{0,5,}Ca_{0,5},Na,\ K)3,5(H_2O)16|[Al_{3,5}Si_{8,5}\text{-}O_{24}}]$ [6]

Pyrophyllite is a phyllosilicate mineral composed of aluminum silicate hydroxide:

$$\mathbf{Al_2Si_4O_{10}(OH)_2}$$

Pyrophyllite occurs in fillite and schistose rocks, often associated with cyanide, which is a product of change. It is usually composed of bound minerals: cyanide, andalusite, topaz, mica and quartz[8]. The mineral has large deposits in Russia, Switzerland, Sweden, Belgium, Brazil, Japan, California, Arizona, North Carolina and other regions of the United States. The main deposits of pyrophyllite in South Africa are located in the Ottosdal region, where it is mined to produce a variety of products and sold as a “miracle stone” for sculpture.[3]

A compact variety of pyrophyllite is used for slate pens and sewing wolves. In Chinese carving, it was used to create small images and various ornaments. Pyrophyllite is easy to process and has excellent thermal stability, so it is added to sludge to reduce thermal expansion during combustion, but when used in combination with other compounds, it is used for many industrial purposes, such as insecticides and brick production.[4]

Conclusion: Montmorillonite is a type of clay mineral, and our main goal is to increase its efficiency and shelf life. The experiments were carried out mainly in Navbahor bentonites, and scientific research is being carried out to suggest methods of modification and regeneration of its composition with minerals. The amount of gismondine, faujasite and pyrophyllite used in bentonite enrichment was determined as a percentage by research methods. Montmorillonite adsorbents as a result of modification of Navbohor alkaline bentonite by activation by various methods and their composition, structure and physicochemical properties were studied.

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