NANOSTRUCTURES RESEARCH OF FINELY-DISPERSED MINERAL GLAUCONITE

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Summary: We have researched the structure and surface properties of particulate mineral glauconite, which determine its application in the food and cosmetic industries. An explanation of glauconite high adsorption properties through its lattice structure and the natural properties of the external and internal structure.

Key words: glauconite, structure, surface properties.

Introduction

Recent years with a return to natural fashion cosmetic products widely used clay minerals of different origin. Their ability to cleanse the skin from harmful substances, improve metabolism and vitality of cells repeatedly proven in practice. But still not provided a reasonable explanation actually identified properties. In this work the clay mineral glauconite, which has such unique properties compared with other clay minerals:

- the dispersed particles have a spherical shape glauconite and virtually no swell in aqueous solutions;
- the active presence of potassium cations;
- high physical and chemical activity that characterized the exchange and adsorption capacity;
- the ability of unauthorized isothermal restore the structure in time, that is manifestation of self-organization;
- the ability to regenerate [1].

Glauconite (Eng. Glauconite) is natural disperse clay mineral structure from layered aluminosilicate radial circuits known since 1828 from the works of Kerfershteyn that and gave him the name [2]. The deposits of glauconite in Ukraine are very large, particularly in Western Volyn region, the Donbas. Glauconite widely distributed in rocks of different geological ages in the form of rounded grains ranging in size from 0.015 to 0.5 mm in cross-section with a crystalline structure with one or more centers of which "grow" mineral plate [3].

Materials and Methods

Research of particulate mineral glauconite was carried out using mass-spectrometric study of temperature-programmed desorption. Mass-spectrs of sample fragments in the range of molecular weights m/z 10 to 200 on the receiving device LKB-2091 (Sweden) with the standard procedure. With the gradual increase of sample temperature every 5^0C recorded mass-spectrs from temperature.

Results and discussions

The basis of the crystal structure of glauconite is a three-layer packet type tetrahedron-octahedron-tetrahedron with a strong connection between the package (Figure 1).

In tetrahedron ions Si^{4+} are situated between four atoms O placed at their peaks, providing a strong bond of ions between them. In octahedra cations Al^{3+} and Mg^{2+} surrounded by six anions O^{2-} or OH^{-}. Al^{3+} often replaced $Fe^{3+}$and Mg^{2+} – Fe^{2+}. Packets are interconnected by means of cations K^{+}, between packages are hydronium ions H_3O^{+}.

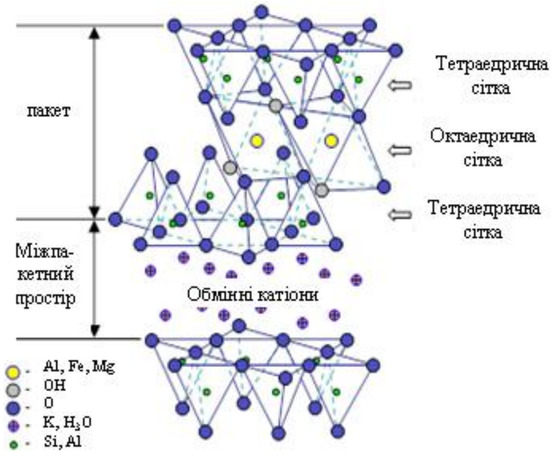

Fig. 1. Schematic representation of the glauconite structure

The role of potassium ions in the formation of glauconite is very high: glauconite is containing in its structure at least 4% K^{+}. He "fills" the niche in the space between the and provides a solid package packages without which this may give micaceous minerals [1-3].

The content of the main components fluctuates in limits (y %): K_2O – 4,0-9,5, Na_2O – 0-3,0, Al_2O_3 – 5,5-22,6, Fe_2O_3 – 6,1-27,9, FeO – 0,8-8,6, MgO – 2,4-4,5, SiO_2 – 47,6-52,9, H_2O – 4,9-13,5. Glauconite structural formula is the following: $K(Fe^{3+}Al^{3+}Fe^{2+}Mg^{2+})_2\ (OH)_2[Al^{3+}Si^{4+}O^{2-}{}_{10}]_n\ H_2O$ [1, 4].

Glauconite is green (from dark, almost black to olive). The hardness 2-3, the proportion of 2,2-2,8 g/cm^3. Glauconite is weakly magnetic, has significant absorbing properties in their physicochemical properties characterized by high exchange ("60 mg - equivalent/100 g) and adsorption (0,1 m^2 / g) capacity [4].

The existence of minerals on the surface of "carpet" with atoms of oxygen makes it effective adsorbent through the formation of hydrogen bonds with the adsorbed molecules [5].

For further in-depth research of surface properties of the mineral glauconite is used thermal-mass spectrometry. In mass spectrogram of glauconite (Figure 2) are observed peaks of different molecular fragments that are concentrated in the molecular mass m/z 10 to 100, corresponding to the decomposition of chemical compounds of low molecular weight.

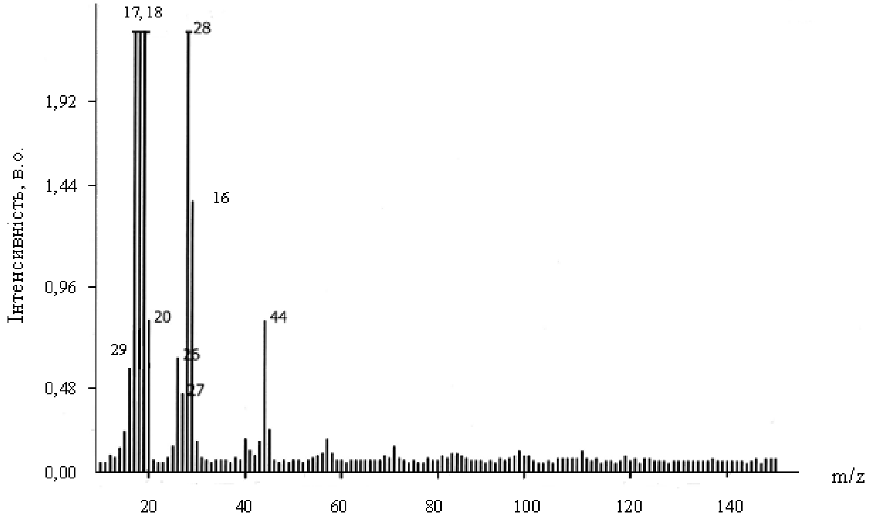

Fig. 2. Mass spectrums of glauconite temperature-programmed desorption obtained at 105^0C

Thermo mass spectrums of glauconite (Figure 3) consist of a large number of individual bands of molecular fragments that differ in intensity by several orders. From the literature [6] well known that the charged molecular fragments with m\z = 17 and 18 relate to hydroxyl groups and water molecules. The source of these fragments is desorbed molecules from the surface of glauconite water and surface OH groups. In the temperature range 40-100^0C weakest bound water is removed, referring to the capillary-osmotic [7].

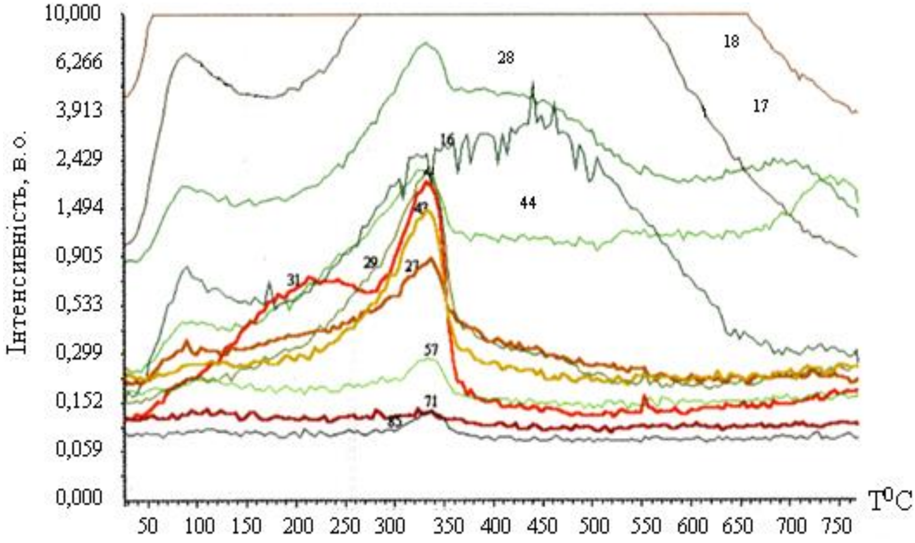

Fig. 3. Thermo mass spectrum of magnetically separated natural glauconite

More tightly bound water is removed from the surface of the mineral in the temperature 100-160^{0}C. According to [5-7], the mineral water is held through the formation of hydrogen bonding with surface hydroxyl groups hydration and exchange cations.

The band of m\z = 16, refers to the positively charged atom of oxygen, which appears due to ionization of water molecules and OH groups tanning electrons. The molecular fragments with m\z = 28 and 44 relating to the charged fragments of molecules of CO and CO_2, the first may be due to decomposition of $CO_2 \rightarrow CO + O$ under electron irradiation in the chamber of mass spectrometer, and the oxidation of organic substances contained in the mineral.

Strips m\z = 27, 29, 31. 43, 57, 71, 85 belong to the fragments of organic molecules of humic and fulvic acids in particular that seep into the macropores of the mineral from the environment. Peaks organic acids desorbed phase minerals are observed mainly at low temperatures: 85-110^{0}C and they coincide with peaks remove weakly bound molecules of water and carbon dioxide. Removal of such molecules leads to the formation of the dehydroxylated surface, thereby increasing the adsorption capacity of the mineral.

In the temperature range 270-370^{0}C likely to removed carbonates or bicarbonates alkaline earth metal impurity minerals that are present in the glauconite [5].

Due to the strictly defined internal pore size planes, glauconite has molecular sieve properties and is a good adsorbent for many organic and inorganic substances. It can adsorb radionuclides, heavy metals, and shows detoxification properties to nitrates, nitrites and mycotoxins.

Conclusions

Setting the surface properties of the mineral glauconite to create a matrix based on glauconite medicines, dietary supplements and cosmetics prolonged action. This preparation/medicine will have a complex effect sorption, detoxification, ion-exchange and metabolic functions of both the glauconite and entered active substance. Immobilization ensures long-term preservation of the active principles and improves its bioavailability, allowing much lower doses input and load organs deposit.

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