INVESTIGATION OF THE MAGNESIUM-SILICATE RAW MATERIALS OF URAL-SIBERIAN REGION FOR CERAMIC PROPPANTS OBTAINING

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The main problems in the preparation of magnesium-silicate proppants from the compositions of serpentinite, dunite and olivinites (their natural mixtures) are associated with difficulties of sintering process of granular material based on them This is due to the fact that the main crystalline phase, that is formed during the firing from such natural raw materials, represents a difficult sintering magnesium orthosilicate - forsterite. It affects the the relatively low strength of the ceramic material, especially in a granular state, and necessitates the firing temperature increasing, which leads to increased process energy requirements. The solving of these problems is impossible without comprehensive investigation of the chemical and mineralogical composition of the raw material and its structural-phase changes during thermal destruction.

The aim of this work is a comprehensive investigation of magnesium-silicate raw materials of Khakas areas.

Results of the rocks chemical composition investigation are shown in Table 1.

The high values of mass loss on ignition of Khakass magnesium-silicate rock, equal to 13.95%, indicates its mainly serpentinite composition. Also the high content of iron oxide is characteristic for this rock (10.4% in the calcined state). Magnesium-silicate module (MgO/SiO_2) of Khakass rock is equal to 0.78 (less than 1) and indicates a high content of silica in the rock.

Evaluation of the investigated rock mineralogical composition was carried out by X-ray method. Analysis of diffraction patterns of the initial (uncalcined) investigated sample (Figure 1a) shows that its main rock-forming mineral is serpentine, as evidenced by the characteristic reflections with interplanar distance of 0.734; 0.364; 0.254 nm, and olivine $(Mg,Fe)_2SiO_4$ (0.276; 0.243 nm).

X-ray method investigations of physical and

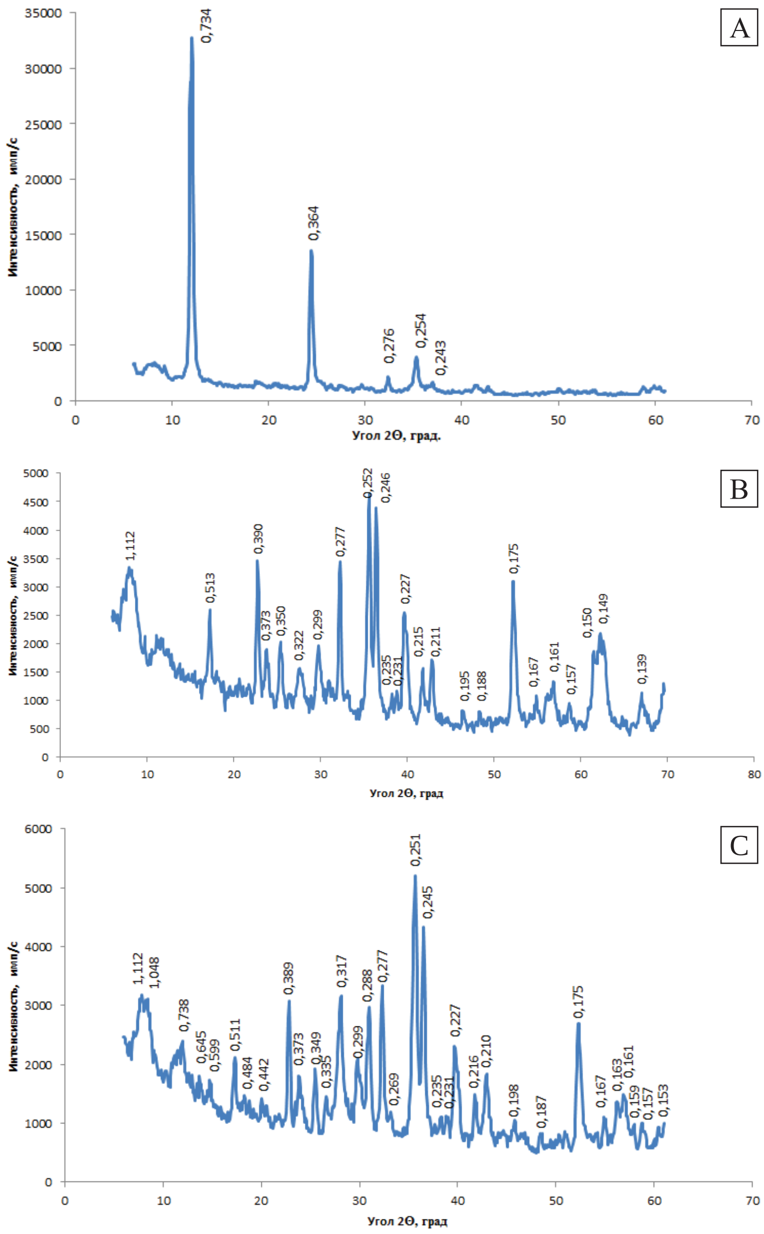

Fig. 1. *X-ray diffraction pattern of the initial serpentine (a) and calcined at 900 °C (b) and 1100 °C (c)*

Table 1. The chemical composition of the investigated magnesium-silicate rock

The content of oxides by weight. %										Module
SiO_2	MgO	Fe_2O_3	Al_2O_3	TiO_2	CaO	MnO	K_2O	Na_2O	$m_{прк}$	MgO/SiO_2
41.06	31.24	8.93	0.02	0.05	0.68	0.25	0.03	3.79	13.95	–
47.71	36.31	10.38	0.02	0.06	0.79	0.34	0.03	4.41	–	0.78

chemical processes that take place during firing of Khakass magnesium-silicate rock are shown (Figure 1b, 1c), that at the 900 and 1000 °C thermal destruction of the rock-forming minerals olivine and serpentine causes synthesis of the main crystalline phases – forsterite ($2MgO \cdot SiO_2$) and enstatite ($MgO \cdot SiO_2$). The emergence of hematite reflexes (0.277, 0.252;. 0.232 nm, etc.) on the X-ray diffraction patterns of the fired samples in the temperature range 800–1000 °C, caused to the processes of decomposition of olivine with the release of hematite (of Fe_2O_3).

Thus, Khakassia magnesium-silicate rock is a form of dunite rock with a high degree of serpentinization, that determines its prospects in the ceramic proppants forsterite-enstatite composition technology.

INVESTIGATION OF THE KAOLIN SUCH AS A RAW MATERIAL FOR THE TECHNOLOGY OF PROPPANTS

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The main difficulties of technology of ceramic proppants are necessity of high compressive strength and low bulk density combination. One of the main way to improve the compressive strength of the aluminosilicate proppants is the activation process of sintering the granular materials.

The aim of this work is a comprehensive investigation of kaolin from the Borovichy-Lyubytino deposit (Novgorod region). Kaolin is the main raw material for the aluminosilicate proppants. Kaolin is characterize the aggregation of clay particles due to cementing effect of alumino-siliceous colloids of complex composition, which complicates the process of sintering of the clay.

The investigations of chemical-mineralogical and grain composition of Borovichy kaolin shows next results. Granulometric composition of kaolin is highly disperse clay materials with content of fraction less than 1 micron more than 60%. The chemical composition (chart 1) in accordance with State standart 9169-81 show that kaolin represent a Al_2O_3 (calcined 45.7 wt.%) with an average content of coloring oxides $Fe_2O_3+TiO_2$ (less than 3.5%).

Mineralogical composition show that the kaolin is a monomineral raw material with an impurity. In the clay part is hydromica (illite), in non-plastic parts is quartz (Picture 1). The technological properties of kaolin are determine by the chemical-mineralogical composition and grain characteristics. Low- and moderate plasticity, low sensitivity to drying, enough high connectedness are technological properties.

Borovichy-Lyubytino kaolin belong to the raw material non- sintering up to the temperature of 1400 °C. High content of cristobalite in samples of kaolin (calcined at 1400 °C) is the main cause of the low compressive strength of the plastic molding samples (no more than 40 MPa).

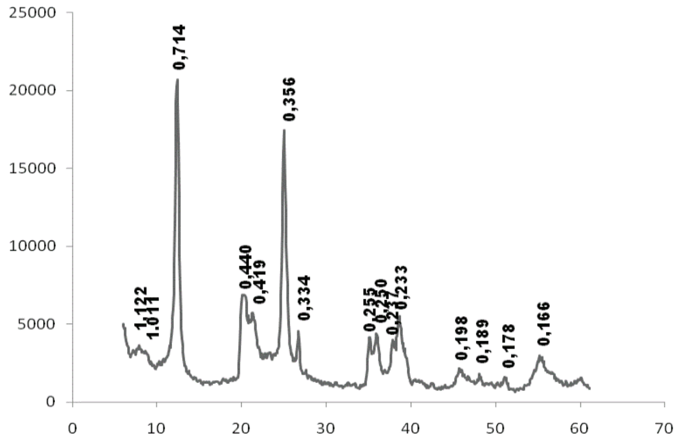

Fig. 1. *X-ray diffraction pattern of Borovichy kaolin*