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 • SiO_2) and enstatite (MgO • 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

L.P. Govorova, A.P. Potapova
Scientific Superviser – DSc, Professor, T.V. Vakalova
Linguistic Advisor – PhD, Associate Professor, A.E. Abakumov

National Research Tomsk Polytechnic University
634050, Russia, Tomsk, 30 Lenin Avenue, lgovorovatpu@yandex.ru

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).

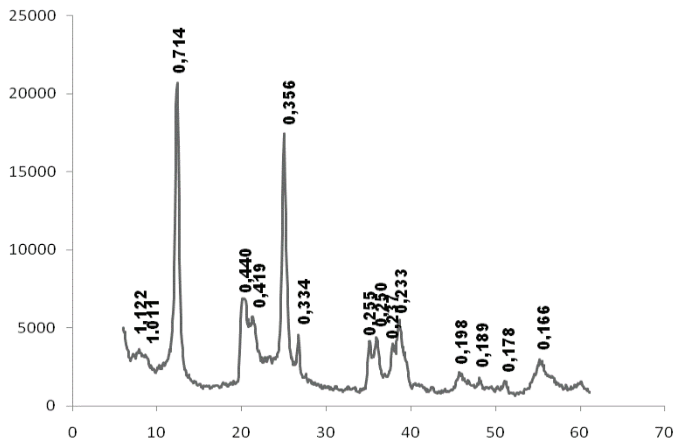

Fig. 1. *X-ray diffraction pattern of Borovichy kaolin*

Table 1. The chemical composition of the investigation kaolin

The content of oxides, wt. %									
SiO_2	Al_2O_3	TiO_2	Fe_2O_3	MnO	CaO	MgO	K_2O	Na_2O	Δm
42.61	38.80	2.26	0.75	–	0.17	0.70	0.22	0.13	14.36

The main reason of low strength of kaolin after burning up to full sintering is the formation of cristobalite in large amounts. It is negative for using kaolin as the main raw material in the technology of high-strength aluminosilicate proppants. One of ways to improve the strength characteristics of the product (including granular material) is the addition of alumina. It neutralize process of cristobalite formation by binding silica, released from kaolinite structure, in the secondary mullite.

Another reason of low strength of proppants based Borovichy kaolin should be associated with their natural rusks. Appropriate to consider changes in the tecnological production of proppant. Kaolin fed to wet grinding with next drying in a tower. This provide the powder of raw materials with a stable composition, structure and properties for using in a aluminosilicate proppants technology.

OPTIMIZATION OF SULPHATE LIGNIN RECYCLING IN AIR PLASMA

A.G. Karengin, K.G. Piunova
Scientific supervisor – Associate Professor, A.G. Karengin

National Research Tomsk Polytechnic University
Lenina Avenue, 30, Tomsk, 634050, Russia, karengin@tpu.ru

Lignin is a wood component which is hard to utilize. It produces during wood chemical conversion at paper and paperboard plants [1].

On the other hand it is a potential raw material resource for many countries. According to the International Lignin Institute annually in the world 70 million tons of technical lignin are produced, but only 2% are used for industrial, agricultural and other purposes. The rest is burned in power plants or disposed as sludge lignin (SL) [2]. Nowadays there are not effective technologies to utilize SL, although literature review last time shows increasing interest of scientist to this problem.

Sulpate lignin (SL) produces at paper and paperboard plants during chemical digestion of wood. SL equals to 30–35% of the feedstock and has permanent formulation [3]: ash 1.0–2.5%; acids (most sulphuric) 0.1–0.3%; water-dilutable compounds 9–11%; resiny compounds 0.3–0.4%; Klason's lignin 85% (sulfur content 2.0–2.5% including unconsolidated 0.4– 0.9%).

Often SL is used as boiler fuel. Caloric value of dry lignin is 5500– 6500 kcal/kg, 18–25% humidity – 4400–4800 kcal/kg, 65% humidity – 1500–1650 kcal/kg [3].

Effective and environment-friendly utilization of waste based on lignin could be reached in plasma. SL is induced by utilization in form of water-organic composition (WOC) having optimal formulation and adiabatic combustion temperature of 1200 °C.

Figure 1 shows influence of SL content on adiabatic combustion temperature of optimal WOC.

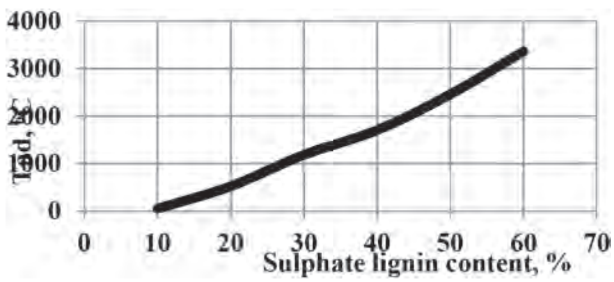

Fig. 1. *Influence of SL content on adiabatic combustion temperature of optimal WOC*

Based on the calculation findings optimal WOC was determined with maximus SL content (70% water: 30% SL). It has $T_{ad} \approx 1200$ °C net calorific value 6.34 MJ/kg. Plasma recycling of 1 ton/h of such WOC lets to get 1.76 MW-h additional heat energy.

To determine optimal modes of research process equilibrium formulations of gaseous and condensed products were calculated for case SL plasma utilization. Program «TERRA» was used for this purposes. Initial parameters of calculations were pressure (0.1 MPa), temperature range (300–4000 K) and heat transfer agent (air) mass fraction (0.1–0.95).