

## **PROSPECTS FOR CREATING BUILDING MATERIALS BASED ON REGOLYTH**

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In recent decades, space agencies have been actively exploring the possibility of building infrastructure on the Moon using existing terrestrial technologies. The use of lunar regolith (finely dispersed layer of crushed rock formed by meteorite bombardment) for space construction is seen as a promising way to ensure a long-term human presence on the Moon and beyond. The main idea is to use local resources, which allows minimizing the transportation of materials from Earth. Regolith can serve as the basis for creating durable building structures using 3D printing, melting, or sintering technologies. Such structures can effectively protect astronauts from temperature fluctuations, cosmic radiation, and micrometeorite impacts. However, when researching and developing such materials and the technological parameters for their production, the lunar environment, which includes low temperature, low gravity, and low atmospheric pressure, should be taken into account. In turn, the regolith contains oxygen suitable for human life support and fuel production, as well as metals (iron, aluminum, titanium) that can be used to make tools and build infrastructure, which is a pressing task for materials scientists.

According to NASA research The vast majority of the obtained lunar regolith samples contain significant concentrations of oxides CaO, FeO, Al<sub>2</sub>O<sub>3</sub> and SiO<sub>2</sub> (more than 10%). In addition, some samples recorded a high content of oxides MgO and TiO<sub>2</sub>. For consideration, SiO<sub>2</sub>-Al<sub>2</sub>O<sub>3</sub>-CaO and SiO<sub>2</sub>-Al<sub>2</sub>O<sub>3</sub>-FeO were selected as the main systems, as well as compositions based on them, which have great potential for obtaining composites, ceramic and glassy materials and have appropriate performance characteristics.

The coefficient of thermal expansion of the simulated regolith compositions varies from 6.38 to  $9.75 \times 10^{-6}$  1/°C in the temperature range of 30...915 °C (softening temperatures). The thermal conductivity and specific heat capacity of the simulators are close to those of conventional concrete. At room temperature, the compressive strength is about 60-80 MPa, and the flexural strength is 90-110 MPa, which significantly exceeds the characteristics of traditional cement on Earth.

One of the key factors for building in space is the selection of appropriate technologies, in particular 3D printing, which is distinguished by energy efficiency, automation, wide design capabilities and reduced production time. This technology is considered the optimal solution for creating lunar settlements, but it is necessary to improve the recycling processes of local resources and optimize 3D printing.

Further prospects for the development of research in this area include the study of relevant three- and four-component systems with identified oxides, the selection of compositions and technologies for their production based on the melting diagrams of selected systems, as well as the improvement of the technology of 3D printing of final materials and products based on modeled compositions.