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**PRODUCTION OF COMPOSITE GYPSUM MIXTURES FOR THE PRODUCTION OF HEAT-INSULATING MATERIALS USING ALUMINOSILICATE ASH MICROSPHERES****Talipov N.Kh.***Doctor of Engineering Sciences, Professor,  
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**Annotation:** The paper presents the results of selecting the composition of composite gypsum materials using inorganic fillers - ash microspheres, which are formed during the combustion of coal at thermal power plants. Based on the laboratory studies, composite compositions have been developed for obtaining heat-insulating building products with low bulk density. The rheological properties and physical and mechanical properties of mortar mixtures have been studied and the optimal compositions of composite gypsum mixtures for the production of heat-insulating materials using aluminosilicate ash microspheres have been determined.

**Key words:** mineral binders, filler, aluminosilicate microsphere, low bulk density, superplasticizer, composite composition, density, thermal insulation materials.

**Introduction.** Modern trends in the development of competitive production require the creation of new promising thermal insulation materials for various purposes, consisting of mineral binders, organic and inorganic porous mineral fillers with low bulk density. The use of inorganic and organic lightweight fillers in the production of thermal insulation materials based on gypsum binders allows you to adjust and improve the construction and technical and thermal insulation properties of mineral binders and materials based on it to specified quality criteria.

Currently, new thermal insulation materials using inorganic porous fillers with low bulk density are increasingly used in construction. All this requires the development of the most effective compositions of thermal insulation materials with a low thermal conductivity coefficient.

Currently, the use of non-traditional porous fillers in the production of heat-insulating materials with low bulk density is becoming widespread, for example, aluminosilicate ash microspheres with various mineral binders and water-soluble polymers [1], which also act as a binder. The use of ash microspheres as a component in cement or gypsum mixtures gives the material heat-insulating properties and has increased physical and mechanical characteristics [1,2].

Aluminosilicate ash microspheres are a unique material with a wide range of applications. These are hollow glass-crystalline aluminosilicate balls, which have a number of names: light fraction of fly ash, ash microspheres, microspheres. Aluminosilicate microspheres are formed during high-temperature flare combustion of coal at thermal power plants, as a result of granulation of

the melt of the mineral part of the coal by crushing it into individual small drops and swelling of the latter due to an increase in gas inclusions.

**Object and methods of research.** During laboratory research on the development of thermal insulation material compositions for partition purposes, composite gypsum binders were used as a binder and aluminosilicate ash microspheres were used as a lightweight filler. To reduce the water:solid ratio and increase the spreadability of solution mixtures, a water-reducing additive was used - superplasticizer Polyplast SP-1. Polyplast SP-1 is manufactured according to TU 5870-002-58042865-05 in the form of dry powder and aqueous solution at the production sites of Polyplast OJSC [3].

Composite gypsum compositions for the production of thermal insulation materials with low bulk density were prepared in laboratory conditions. The homogenization process of the original materials was carried out in a laboratory ball mill for 20 minutes [2,3]. The physical and mechanical properties of the developed compositions were studied according to GOST 23789-2018 in standard samples of beams measuring 4x4x16 cm molded from mortar mixtures of normal density, the thermal conductivity coefficient of the samples was determined according to GOST 17177-94, "Building thermal insulation materials and products. Test methods".

**The results obtained and their discussion.** Aluminosilicate microspheres obtained from ash and slag are a mineral expanded finely dispersed bulk product of light gray color, consisting of hollow spherical particles of regular shape with a diameter of 5 to 500 microns with solid non-porous walls with a thickness of 5 to 10% of the particle diameter, and in chemical composition corresponds to the main composition of impurities of burnt coals. The internal cavity of the particles is filled with nitrogen and carbon dioxide.

Laboratory studies have shown that aluminosilicate ash microspheres have the lowest density and are several times less than the density of water, which is the basis for effective gravitational separation of microspheres from fly ash in an aquatic environment. Tables 1 and 2 show the chemical composition and physical characteristics of aluminosilicate ash microspheres.

**Table 1**

**Chemical composition of aluminosilicate ash microspheres.**

Oxide content, mass. %							
SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	CaO	MgO	TiO <sub>2</sub>	R <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>
52,0-64,0	23,0 -29,0	1,5-6,0	0,1-5,8	0,5-2,0	0,6-1,0	1,0-2,3	0,2-1,0

**Table 2**

**Physical characteristics of aluminosilicate ash microspheres**

№	Characteristics	Indicators		
1	Particle size, mm	0,04-0,125	0,1-0,3	0,25-0,5
2	Bulk density, kg/m <sup>3</sup>	610	400	340
3	Average pressure indicator, kN	24	24	24
4	Thermal conductivity, W/mK	0,10	0,09	0,08

5	Moisture content, %	Less than 0.5	Less than 0,5	Less than 0,5
6	Fraction content, %	22,3	31,8	45,9

Based on the laboratory studies, composite compositions were developed to obtain heat-insulating building products with low bulk density. In the work, when selecting modifying additives, the entire range of requirements for heat-insulating composite materials was taken into account. The content of the modifier additive was established experimentally.

When selecting the optimal composition of composite materials, we first determined the rheological properties of mortar mixtures at different ratios of the initial components, then determined the effect of additives on the construction and technical properties and performance indicators of thermal insulation materials. During the laboratory studies, the mechanism of action of the superplasticizer on the properties of the developed compositions of composite thermal insulation mixtures and products based on them was investigated.

The results of the study showed that the spherical shape and a wide range of granulometric composition are ideal factors for a bulk filler, since the material in this form has increased fluidity and, due to the effective ratio of surface area to occupied volume, ensures the most compact packing, which allows to minimize the shrinkage deformation of finished products based on microspheres compared to fillers of other shapes [3,4].

Laboratory studies of the physical and mechanical properties of composite gypsum materials have shown that finely dispersed ash microspheres in the amount of 7.5-10% improve the rheological properties of mortar mixtures and increase the strength characteristics of the composition by 15-18%. The increase in the strength indicators of composite thermal insulation mixtures is explained by the fact that highly dispersed particles of ash microspheres fill the voids between coarser grains in the process of forming the structure of calcium sulfate dihydrate in hardened materials.

The study of the physical characteristics of samples made from normal density composite thermal insulation mixtures showed that depending on the amount of lightweight filler, it is possible to regulate the thermal and physical and mechanical properties of materials. The results showed that with the introduction of 7.5-10% ash microspheres into the composition of gypsum mixtures, it is possible to obtain building products with an average density of 475 - 700 kg / m<sup>3</sup>.

**Conclusion.** Based on the conducted laboratory studies, it was established that, depending on the amount of lightweight filler, it is possible to regulate the thermal and physical-mechanical properties of composite materials with low bulk density used in construction. The results showed that the thermal conductivity coefficient of the developed composite materials with an average density of 475 - 700 kg / m<sup>3</sup> with a content of aluminosilicate microspheres of 7.5 - 10.0% is equal to 0.170 - 0.190 W / m K [5].

Based on the conducted studies, it was established that for the production of thermal insulation materials with high strength and low thermal conductivity, the use of aluminosilicate microspheres in the compositions of composite gypsum binders is promising.

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