PRODUCTION OF HEAT-INSULATING MATERIAL BASED ON AGRICULTURAL WASTE

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Abstract. The article deals with the use of agricultural waste as a filler for gypsum thermal insulation materials, the compositions and properties of these materials are considered.

Keywords. gypsum, organic fillers, kenafa bonfires, cotton stalks, rice husk and wood chips, compositions, properties, building, thermal.

In Uzbekistan, among the most priority sectors is the construction materials industry, which has a powerful potential and is of great importance for the development of the construction complex. It is appropriate to note that the increase in the efficiency and quality of construction mainly depends on the cost of building materials, which is about 55-65% of the total cost of capital construction and their quality.

Construction as a branch of our republic occupies one of the first places in the use of material resources. The modern scale of construction also poses the task of solving the issues of economical and rational use of resources, first of all, the implementation of existing reserves, i.e. the creation of low-waste and energy-saving technologies using industrial waste. The implementation of these tasks leads, first of all, to the saving of expensive material resources, and secondly, the refusal to import them from other regions.

In modern conditions, it is urgent to find the possibility of using local resources to obtain binders and materials based on them that meet technical requirements and contribute to improving the environmental situation.

To fulfill these tasks, it is necessary to expand the range of building materials by using energy- and resource-saving building materials based on local raw materials and waste from various industries and advanced technologies for their production.

In recent years, a new term has appeared in domestic and foreign literature – energy-efficient (energy-efficient) buildings, that is, buildings, during the design, construction and operation of which all possible measures (energy-saving measures) aimed at saving thermal and electrical energy have been implemented.

Modern buildings have great opportunities to increase their thermal efficiency on the basis of the formation of thermal and air conditions, optimization of heat and mass flows both in rooms and enclosing structures[1].

The main weapon in the struggle for energy conservation and reduction of heat loss is a properly selected thermal insulation material. Thermal insulation material (TIM) is a material designed to reduce heat transfer, the thermal insulation properties of which depend on its chemical composition and physical structure. Thermal insulation materials have a thermal conductivity λ of no more than 0.175 W / (m * S), while 1 m^3 of effective TIM allows you to save 1.45 tons of conventional fuel. Highly efficient tims are capable of having a thermal conductivity coefficient λ = 0.06 or less.Thus, the use of thermal insulation materials in construction pays off on average within 5-15 years. For comparison, a hollow brick will pay off the energy for its production only after 50 years [2,3]. Gypsum slabs are widely used in construction as a thermal insulation material. They are used for plastering walls and ceilings of premises. Thanks to the gypsum solution, good sound and thermal insulation is provided. The use of gypsum in construction can be considered as an independent material and for the manufacture of various gypsum products. These include: drywall, gypsum fiber, gypsum chipboard, groove-ridge slabs. Gypsum is a part of plasters and putties, due to which smooth and smooth coatings are obtained [4]:

As you know, gypsum is widely used in construction. It is mainly used for the production of gypsum and gypsum concrete construction products used for the interior of buildings (thermal insulation boards, dry plaster, partition plates and panels, and a number of others), as well as for the manufacture of lime-gypsum plaster solutions for the interior walls of buildings.

In 2010, according to the USGS, 147 million tons of gypsum were produced in the world. The largest producers are China (47 million tons), Iran (13 million tons), Spain (11.5 million tons), the USA (8.8 million tons), Thailand (8.5 million tons) [5]. Construction gypsum is valued for its properties. The list of its advantages is voluminous [6]:

•The material is environmentally friendly, does not contain toxic substances, does not cause allergic reactions. Contributes to the creation of a favorable indoor climate.

• Buildings using gypsum withstand about 20 cycles of freezing and thawing without losing their strength. In the absence of a humid climate and sudden temperature changes, buildings look decent for a long period of time.

• Due to its low thermal conductivity, gypsum is used in construction as a room insulation.

• The material is not amenable to gorenje. When exposed to temperatures of about 600-700 degrees, moisture begins to be released, slowing down the process of spreading fire.

• Construction gypsum is light due to high strength and low density (1200-1500 kg/m3).

• Gypsum is considered the most affordable raw material. There are no problems with its extraction and processing. Complex and energy-intensive technologies are not used.

• Hygroscopicity of gypsum is able to provide a positive effect on the humidity of the room.

In production conditions, artificial porous fillers - perlite, vermiculite, agliporite, expanded polystyrene, etc. - are used as light fillers to reduce the consumption of gypsum. The use of agricultural waste instead of these fillers is effective both from an economic point of view (to reduce the cost of thermal insulation gypsum) and from an environmental point of view.

At the Namangan Institute of Civil Engineering at the Department of "Production of Building materials, products and structures", research was conducted to study the use of agricultural waste to improve the thermal insulation properties of gypsum.

Special additives - organic fillers - have been added to the composition of gypsum (G-5 grade) in the solution: kenaf bonfires, cotton stalks, rice husks and wood shavings.

Kenaf is an annual herbaceous plant. Dry stems contain up to 21% of the fiber used for the manufacture of technical fabrics, and seeds contain up to 20% of technical oil. Kenafa bonfire is a waste of the primary processing of kenafa stems. The stems of the kenaf, before processing to separate the bast fiber from the wood, are subjected to special treatment. A necessary stage of such preparation is soaking kenaf for 20-30 days in natural reservoirs or pits filled with water, or in special pools with hot water. In the process of such processing, water-soluble sugary substances, organic acids and mineral salts are leached from the bonfire.

Cotton belongs to the Malvaceae family. Stems consist mainly of lignified cells of elongated shape. The bast contains the longest and strongest bundles of fibers, but they are closely related to the bark When the stems are crushed, a large amount of dust and small things (up to 6%) is formed. The average fiber length of cotton stems is 1.0 mm, width is 25 mk. The ratio of length to width is 40. This ratio for spruce and pine with an average fiber length of 3.0 mm is 65 and 55, respectively, for aspen -35 with a fiber length of 1 mm. Thus, the fibers of cotton stems are, on average, close in size to aspen fiber and are significantly inferior to coniferous wood.

It is known that cotton stems are more flexible and plastic than wood, but less durable. This is due to the fact that cotton is an annual shrub, a significant part of the bast fibers of which do not have time to stiffen. Up to 40% of the stems are bast fibers and bark. This structure of cotton stems leads to difficulties in crushing due to the formation of a large number of individual long fibers that clog knives. Rice husk - waste from the rice processing industry – is ellipsoid scales from light yellow to yellow in length 6-8 mm, width 3-4 mm and thickness 0.3-0.5 mm. The main components of rice husk as a plant material are cellulose, polysaccharides, hexosanes. Rice husks brought from the Srednechirchik district of the Tashkent region were used for research.

Wood in the Central Asian region is a scarce material for the production of arbolite-like materials. Wood is imported to Uzbekistan mainly from Russia and Kazakhstan. Wood waste in Uzbekistan is generated at woodworking enterprises and workshops for the manufacture of furniture, joinery, construction parts and various blanks. These wastes come in the form of individual pieces of solid wood, as well as machine shavings and sawdust [7]. To determine the thermophysical characteristics of gypsum with crushed organic fillers - kenafa bonfire, cotton stalks, rice husk and wood chips, the method of thermal pulse with a linear heat source was chosen. Gypsum tiles with various fillers (with the same filler content) with a size of 160x160x40 are made. Three samples were prepared for each test. The tests were carried out on dried samples to a constant mass. Prior to that, the samples were solidified under natural conditions. The test results are shown in Table-1.

Table-1. Thermophysical characteristics of gypsum with fillers

№ samples	Name of fillers	Density kg/m^3	Coefficient of thermal conductivity-news, W/mK	Specific heat, kJ/kg K
1	Kenafa Bonfire	435	0.068	0.59
2	Cotton stems	450	0.078	0.71
3	Rice husk	460	0.086	0.82
4	Wood shavings	490	0.095	0.86

As can be seen from Table-1, the lowest thermal conductivity is at the kenaf campfire. Based on the data obtained, it should be noted that the thermal conductivity of the material depends on the density of fillers. In addition, the thermophysical properties of gypsum depend on the filler content in the material. With an increase in the content of organic filler in gypsum, the thermal conductivity of the latter decreases. Studies to determine the biostability of samples have shown that the developed gypsum material belongs to the group of biostable materials and is not biodegradable.

Fire resistance tests of thermal insulation gypsum with organic fillers were carried out on samples with a rib size of 150x60x10mm. The flammability was assessed by the loss of mass of samples over a five-minute fire action. The results showed that the developed thermal insulation gypsum based on agricultural waste belongs to the group of hard-to-burn materials.

Conclusions. The results of the conducted studies have shown that the use of agricultural waste fillers (organic fillers) instead of artificial porous fillers (perlite, vermiculite, agliporite, expanded polystyrene, etc.): kenafa bonfire, cotton stalks, rice husk and wood chips) made it possible to obtain a thermal insulation material with sufficiently low thermal conductivity and heat capacity, bio-resistant and difficult to burn. The use of agricultural waste is effective both economically (to reduce the cost of thermal insulation gypsum) and from an environmental point of view. This material is recommended to be used in the form of slabs for finishing the interior walls of buildings, in order to provide thermal insulation indoors.

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