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CONCRETES WITH ADDITION OF HIGHLY DISPERSED CHALK FOR RECONSTRUCTION, RENOVATION AND MAINTENANCE OF URBAN OBJECTS

In the theses, the possibility of using finely dispersed chalk as a mineral additive for concrete is considered. The composition of chalk and its influence on the phase composition of new formations, as well as physical-mechanical and operational characteristics of concrete are considered. The use of concretes with the addition of highly dispersed chalk will allow solving environmental, energy and resource-saving problems.

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EVALUATION OF THE POSSIBILITY OF FIRE PROTECTION OF WOODEN BUILDING STRUCTURES WITH A XEROGEL COMPOSITION

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The operational characteristics of a fire retardant coating based on a xerogel are considered. Samples of fire retardant coatings were investigated at different degrees of heat exposure. The following characteristics have been studied: average density, thermal conductivity, adhesion to the protected material, impact strength. The results obtained showed that the physical and mechanical properties of this coating correspond to those for protective coatings used in construction.

Currently, one of the most common building materials is traditionally wood and wood products. This material is distinguished by its environmental friendliness and does not present the problem of utilization, which is important today. However, along with the advantages that distinguish it favorably from other building materials, wood also has disadvantages, the main ones of which are flammability and combustibility. One of the main tasks of every democratic state is to ensure the security of society. Thus, the prevention of fires in buildings and structures, minimization of their consequences when using wood in construction is an urgent scientific problem.

In the study of fire protection, different methods are used, described in the works [1—4]. One of the methods of fire protection is a method of applying a coating layer to the surface of the protected material, the effectiveness of which is determined by the physicochemical properties and adhesion to the given surface [5]. Under local exposure to a short-term ignition source, fire retardant coatings impede the combustion of wooden structures, facilitate extinguishing a fire, and in some cases exclude the possibility of its occurrence. In works xerogel is considered as a fire retardant agent. Its advantage lies in its inorganic nature, as a result of which the material is incapable of combustion and does not pose a problem for its utilization, in contrast to organic substances.

The coating is a xerogel composition with fibrous and coarsely dispersed fillers. It is used for fire protection of wood used indoors.

Standard methods are used to test the performance of coatings. Tests for hygroscopicity, adhesion and impact strength were carried out according to the developed methods, in accordance with the requirements for such tests. It should be noted that the hygroscopicity of the control sample with a fire retardant coating should not exceed the hygroscopicity of the control sample. For fire protection means, operated in dry rooms, it is allowed to exceed the hygroscopicity of the controlled sample while maintaining the integrity of the coating and its functional properties.

The aim of the work is to analyze the possibility of using a xerogel-based fire retardant for building structures made of wood. To achieve this goal, it is necessary to solve the following tasks: The aim of the work is to analyze the possibility of using a xerogel-based fire retardant for building structures made of wood. To achieve this goal, it is necessary to solve the following tasks:

- to experimentally determine the thermal conductivity of the material at different stages of thermal exposure, compare the indicators with existing thermal insulation materials;
- determine the adhesion strength of the fire retardant coating, compare with existing coatings;
- determine the impact strength, compare it with existing coatings.

Proving the possibility of using a xerogel coating, it is necessary to determine the main performance characteristics of this coating and compare them either with the corresponding parameters specified in the standards for this type of coating, or with the characteristics of coatings that have been used for a long time in construction.

To determine the average density [3], 6 types of samples of fire-resistant coatings were made, held at different temperatures. The mass of the samples was found by weighing in an air-dry state, and the volume of the material — by the volume of the displaced liquid, by immersion in a liquid inert with respect to the material.

Samples preliminarily weighed in air on a thin thread were completely dipped for a short period of time into a vessel with molten paraffin to make the surface hydrophobic. After cooling, the samples were re-weighed, and then their volume was determined by volume meters. In this case, the value of the volumetric body mass:

$$\rho_0 = \frac{m}{V - \frac{m_p - m}{\rho_p}}, \text{ g cm}^{-3} \quad (1)$$

where m — test body weight, g; V — volume of the sample covered with paraffin, cm^3; m_p — weight of paraffin, g; $\rho_p = 0.93$ g cm^{-3} — paraffin density.

Determination of the adhesion strength of the fire-resistant coating was carried out by the method of normal pull-off. The coating was applied to a wood plate, then held for the time required for the coating to cure. A metal fungus was glued to the coating (epoxy resin ED-20 with a plasticizer and a hardener was used as an adhesive composition, while the strength of the adhesive bond was 2.5 MPa). The samples were kept for 3 days, after which, using a dynamometer, the coating was detached from the substrate by applying the force of the dynamometer to the fungus.

The adhesion strength of the xerogel fire retardant coating can be compared with the adhesion of known polymer paints and plaster compositions [4]. For example, for plaster compositions, the adhesion strength with the base should be at least 0.3 0.5 MPa, while our adhesion strength, that is, the adhesion strength with the base was 1.3-1.6 MPa according to the test results, which 3 times the required sufficient.

The method for determining the strength of a fire-resistant coating upon impact is based on determining the maximum height from which a load of a certain mass does not cause visible mechanical damage on the surface of the coated plate. A device of the U-1 type 'Figure 2' was used for testing. The coating was applied to planed pine specimens with a thickness of 1.0–1.2 mm and a size of 90×100 mm^2.

As a result of the tests carried out, it was determined that the impact strength of the fire retardant coating corresponded to 70 cm.

In parallel, tests for coatings based on water dispersion paint were carried out. When the load fell from a height of 50 cm, cracks and even chips were visible on the paint samples.

Thus, it can be concluded that this fire retardant coating has an impact strength index 25% higher than that of a coating based on water-dispersion paint used in construction for painting wooden surfaces.

The determination of the coefficient of thermal conductivity of a fire-resistant coating was carried out on an ITSM-1 installation (measuring the thermal conductivity of building materials).

To determine the thermal conductivity of the materials under study, samples of 6 types were made, with an area of 10×10 cm^2 and a height of 5 mm. Samples were prepared similarly to samples for density measurements.

After the preparatory operations were carried out, the thermal conductivity coefficients of all coating materials obtained before and after heating at different temperatures were determined.

As you can see from the, with an increase in the heating temperature of the samples of the fire retardant coating, the density of the coating material decreases and, accordingly, the coefficient of thermal conductivity of the protective coating decreases, which is a positive factor. The obtained values of density, 194 $kg \cdot m^{-3}$ and thermal conductivity of 0.058 $W \cdot m^{-1} \cdot K$, correspond to the values of known heat-insulating materials such as foam plastic, glass wool, expanded perlite, expanded vermiculite, aerated concrete, etc.

The results of testing the operational characteristics of the fire retardant coating showed that this coating has higher adhesion strength and impact strength than coatings based on water-dispersion paints and plaster solutions.

In terms of average density and thermal conductivity (after swelling during heating), this coating can be attributed to low-thermal insulation materials.

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ОЦІНКА МОЖЛИВОСТІ ВОГНЕЗАХИСТУ ДЕРЕВ'ЯНИХ БУДІВЕЛЬНИХ КОНСТРУКЦІЙ КСЕРОГЕЛЕВОЮ КОМПОЗИЦІЄЮ

Розглянуто експлуатаційні характеристики вогнезахисного покриття на основі ксерогелю. Досліджувалися зразки вогнезахисного покриття при різному ступені теплового впливу. Вивчено такі характеристика як: середня щільність, теплопровідність, адгезія, ударна міцність. Отримані результати показали, що фізико-механічні властивості даного покриття відповідають аналогічним показникам для захисних покриттів що застосовуються в будівництві