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Study of the Flammability of New Silicate-Based Heat-Insulating Materials

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ABSTRACT: The research work presents the results of studies of the flammability of the developed tile materials, including porous materials based on sodium water-soluble silicates, glue-like cellulose derivatives, silicone, sodium carbosimethyl cellulose, microcrystalline cellulose, highly dispersed wood chips, dolomite, aluminum oxide SiO2 and O2.

KEY WORDS: water-soluble silicates, cellulose derivatives, microcrystalline cellulose, silicone, sodium carbosimethyl cellulose, wood chips, dolomite, thermo-vermiculite, SiO2 and aluminum oxide, heat resistance, fire-resistant materials.

I.INTRODUCTION

As you know, ensuring fire safety in construction is carried out through the implementation of a complex of construction, installation and other works, as well as organizational and technical measures to ensure fire protection of buildings, structures and their complexes at the stages: design, construction, reconstruction, modernization, repair, technical re-equipment [one]. At the same time, fire protection is understood as a set of measures aimed at preventing the occurrence, limiting the development and ensuring extinguishing a fire, as well as protecting people and material assets from the effects of its dangerous factors.

Fire protection of buildings is achieved by using structural, space-planning and engineering solutions. These solutions can be divided into two blocks. The first constructive fire protection, within which the requirements for fire resistance and fire hazard of building structures and materials from which the building is made are established. The second is planning fire protection, within the framework of which, through space-planning solutions, the fulfillment of fire protection tasks is ensured. Thus, fire protection is achieved by using:

- Building structures and materials, including those used for facing structures, with standardized fire resistance indicators of fire hazard;
- Means and methods of fire protection;
- Devices to limit the spread of fire and hazardous factors of fire;
- Appropriate types of fire fighting equipment and fire extinguishing equipment; automatic fire extinguishing and fire alarm systems; technical means, including automatic ones, warning systems and evacuation control;
- Means of collective and individual protection of people from dangerous fire factors; smoke protection systems; other means of fire protection.

Thus, based on the foregoing, it can be argued that for the appropriate provision of fire protection of buildings, it is necessary to use building structures and materials, including those used for facing structures, with standardized fire resistance indicators of fire hazard.

Today, one of the most commonly used in the construction of modern buildings is thermal insulation building materials, which have different classifications. Thermal insulating materials are called building materials that have a density (average or bulk) in a dry state (ρ) of not more than 500 kg / m³ and a low thermal conductivity - not more than 0.175 W / (m · K) and are used to insulate building structures of buildings and structures, thermal and refrigeration plants and pipelines.

Thermal insulation materials and products, in accordance with GOST 16381 [2,3], are subdivided according to the following main features:

According to the type of the main raw materials, materials and products are subdivided into inorganic and organic. Products made from a mixture of organic and inorganic raw materials are classified as inorganic if the amount of the latter in the mixture exceeds 50% by weight. In terms of shape, materials and products are divided into loose

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(mineral and other types of wool, porous aggregates, etc.), flat (plates, mats, felt, etc.), shaped (cylinders, half-cylinders, segments, etc.) and cord. By structure, materials and products are divided into fibrous, cellular and granular (free-flowing). According to the content of the binder, materials and products are subdivided into those containing a binder and those not containing a binder. According to flammability (combustibility), materials and products are divided into non-combustible, hardly combustible and combustible.

The degree of fire hazard of materials in accordance with

ShNK 2.01.02-04 [4]. are determined by such properties as combustibility, flammability, ability to spread the flame over the surface, smoke-generating ability, toxicity of combustion products.

In this research work, the results of work on the study of the flammability of the obtained new tile materials are presented. Samples of tile materials mainly consist of the following components: standard sodium water glass, thermovermiculite, basalt fiber, silicone, cellulose derivatives (cellulose acetates, sodium carbosimethyl cellulose), technical microcrystalline cellulose - MCC, MK - microsilica, as well as porous and inert fillers.

The samples were investigated to determine the flammability according to GOST 30244 method I and II). Experiment condition: U≈160 V. Sample size: 50x45x45 mm. Atmospheric pressure 95.5 kPa. Room temperature17 - 18 0C, Air humidity 60%.

Table 1.

Composition based on soda water glass, dolomite and hydrochloric acid

Sample number	Initial furnace temperature, ° C	The difference between the internal and external temperatures of the sample, ° C	Time to reach maximum temperature min.	Sample weight, g		Weight loss,%
				before tried	after tried	
1	750 ±2 °C	30	30	50,3	40,7	19,08
2		31	30	51,4	41,9	18,48
3		29	30	50,0	40,9	18,24

Conclusion: The material is non-flammable. The average temperature difference is 30.0 ° C. Average weight loss is 18.58%.

Table 2.

Composition based on sodium water glass, dolomite, silica and hydrochloric acid

Sample number	Initial furnace temperature, ° C	The difference between the internal and external temperatures of the sample, ° C	Time to reach maximum temperature min.	Sample weight, g		Weight loss,%
				before tried	after tried	
1	750 ±5 °C	40	30	25,1	24,7	1,29
2		26	30	29,4	28,9	1,32
3		33	30	27,2	26,9	1,29

Conclusion: The material is non-flammable. The average temperature difference is 33.0 ° C. Average weight loss is 1.30%.

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Table 3.
Composition based on sodium water glass, silicone, thermovermiculite and fine wollastonite

Sample number	Initial furnace temperature, ° C	The difference between the internal and external temperatures of the sample ° C	Time to reach maximum temperature min.	Sample weight, g		Weight loss,%
				before tried	after tried	
1	750 ±5 °C	107	30	61,459	57,925	5,75
2		109	30	61,387	57,890	5,69
3		104	30	60,450	56,955	5,78

Conclusion: The material is flammable. The average temperature difference is 106.6 ° C. Average weight loss was 5.74%.

Table 4.
Composition based on sodium water glass, microcrystalline cellulose, thermovermiculite and fine wollastonite

Sample number	Initial furnace temperature, ° C	The difference between the internal and external temperatures of the sample ° C	Time to reach maximum temperature min.	Sample weight, g		Weight loss,%
				before tried	after tried	
1	750 ±5 °C	85	30	42,140	32,495	22,87
2		86	30	42,652	31,278	23,45
3		85	30	42,349	32,148	22,98

Conclusion: The material is flammable. The average temperature difference is 85.5 ° C. Average weight loss 23.10%.

From the data in Tables 1-4, it can be seen that the tested samples of the compositions (Table 1 and 2.) have low values of weight loss (less than 50%), the temperature rise in the furnace for both samples is less than 500C, and there is no flame combustion of the sample, respectively. these samples are non-flammable. The rest of the compositions with numbers (Tables 3 and 4), due to slightly higher rates of temperature rise, are combustible, which then, after testing according to method II, are assigned to group G1 (slightly combustible).

Thus, based on the results of the research carried out, it can be concluded that the materials obtained belong to the class of fireproof materials.

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