Research on Low-Flammable Textile and Building Materials

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ABSTRACT

This article presents a study of fire retardant AC and ABS obtained on the basis of orthophosphoric acid and vermiculite in the form of a suspension. The proposed suspension increases the flammability and reduces smoke formation of building and textile materials.

Keywords: Fire safety, polymer material, textile materials, fire retardant, flammability, smoke generation.

Directed research is being conducted around the world to increase the growth of production of products based on polyolefins and cellulose with increased heat-resistant, heat-resistant properties, as well as to improve the quality and strength of the materials used to ensure fire safety of facility structures.

In this regard, fire retardants based on silicate compositions used as impregnating and casting compounds, in addition to the required level of physical, mechanical, thermophysical and electrical properties, must have reduced flammability [1]. Therefore, the selection of multifunctional modifiers aimed at regulating the properties of polymer materials, including low flammability, is of particular importance and relevance.

The general characteristics of silicate composite materials are given, the physical and mechanical properties and areas of application of polymer building materials based on cellulose are shown, the creation of heat-resistant and heat-resistant composite materials based on textile materials, calculations of flammability, ignition and smoke-generating ability of polymer building materials based on secondary polyolefins, modern trends in regulating the fire-safe functioning of objects using polymer materials, and also considered the problems of vermiculite localization.

The fire risk assessment system takes into account dangerous socio-economic consequences in residential buildings, fire prevention, problematic issues of analysis methods, information on damage from smoke and their consequences [2-3]. As a result of the study, data were discussed on the instability of products based on polyolefins and textile materials to heat and fire, rapid combustion and the formation of toxic gases as a result of fire, causing harm to the life and health of the population in residential buildings.

About 70% of all fires occur in the residential sector, and the main cause of death during fires is not injury from fire, but in 80% of cases death occurs from smoke poisoning. The main cause of poisoning of people during fires is the smoke emitted during the combustion of

polymer materials used in residential premises, that is, 70% of construction and finishing materials. Based on a critical analysis of these problems, the goals and objectives of the presented study were formed.

Research methods. Experimental studies used methods for preparing samples, determining the fire retardant properties of polymer materials, determining fire resistance to combustion, oxygen index and smoke generation coefficient, as well as methods for studying the kinetics of thermal destruction of polymers and their calculations. In order to determine the spread of flame along a horizontally fixed sample, a standard method (state standard 28157-89) was used to determine the combustion resistance [4].

The experimental part presents a study of the influence of fire retardants obtained on the basis of silicate composite compounds on the flammability, flame propagation and smoke formation of wood and textile materials modified with suspension fire retardants.

The subject of the study is wood and textile materials impregnated with fire retardants AC and ACB based on orthophosphate acid with a silicate composition in the form of a suspension emulsion. Combustion is usually characterized by the values of linear and mass burnout rates of textile materials. In laboratory studies, the self-combustion time of the material is determined. Based on this, in the studies conducted, the effectiveness of fire retardants was assessed by the duration of self-combustion of composites by the method of determining the burning rate. Combustion is usually characterized by the values of linear and mass burnout rates of textile materials. In laboratory studies, the self-combustion time of the material is determined. Based on this, in the studies conducted, the effectiveness of fire retardants was assessed by the duration of self-combustion of composites by the method of determining the burning rate. The method is intended for comparative assessment of the relative ability of plastics to ignite when exposed to an ignition source [5].

The catalytic activity of fluorine and silicates in the process of thermal destruction of the polymer makes it possible to shift the process towards a decrease in the thermal effect and, thereby, reduce the maximum rate of heat release.

It was revealed that, during combustion, coke is formed on the surface of the modified polymer material, since the adduct of urea and orthophosphoric acid forms a foaming layer, thereby helping to create a barrier of polyphosphoric acid, slowing down the interpenetration of oxygen from the air into the combustion zone, as well as stopping the exit from the outside floating destructive products.

As studies of the heat resistance of the resulting composites have shown, the oligomeric composition of textile material with flame retardants leads to a synergistic effect. Tables 1 and 2 show the results of the experiments performed to determine the spread of flame.

Table 1
Results of testing flame propagation on horizontally fixed samples of wood materials impregnated with a fire retardant composition

№	Sample	ample weight p to ombustion m_0, g		Sample weight after combustion m_0, g		peed istribution ame υ, mm/min		Burning time t, sec	
		veryone ample	erage agnitude	veryone ample	erage agnitude	veryone ample	erage agnitude	veryone ample	erage agnitude
1.	ontrol sample	6,501		4,250		83,5		104	

2.	AC-1	7,186	6,543	6,259	5,773	19,04	19,49	63	52,2
3.	AC-1.1	6,487		5,889		21,42		42	
4.	AC-1.2	5,969		5,372		14,63		41	
5.	AC-1.3	6,069		5,428		28,08		52	
6.	AC-1.4	7,007		5,918		14,28		63	

Based on the tests carried out in accordance with the provisions of state standard 28157-89, it can be concluded that wood samples impregnated with fire retardant № AC are not included in the class that spreads flames.

Table 2
Test results of flame propagation on horizontally fixed samples of cotton textile materials impregnated with a flame retardant composition

№	Sample	ample weight p to ombustion m_0, g		Sample weight after combustion m_0, g		peed istribution ame υ, mm/min		Burning time t, sec	
		veryone ample	verage agnitude	veryone ample	verage agnitude	veryone ample	verage agnitude	veryone mple	verage agnitude
1.	Control sample	0,214		0,002		500		15	
2.	ACB-1	1,184	1,211	1,059	1,119	0	0	30	30
3.	ACB-1.1	1,189		1,076		0		30	
4.	ACB-1.2	1,295		1,28		0		30	
5.	ACB-1.3	1,195		1,090		0		30	
6.	ACB-1.4	1,194		1,094		0		30	

In accordance with the provisions of state standard 28157-89, it can be concluded that samples of cotton textile materials impregnated with fire retardant No. ABC are not included in the class that spreads flames. Table 3 shows the results of experiments conducted to determine the group of difficult-to-combustible and combustible solids and materials.

Table 3
Results of tests to determine the group of difficult to combustible and combustible solids of wood samples treated with a fire retardant composition.

№	Sample number	Sample weight, g			Consumption working staff		Mass loss sample		Average weight loss of sample	
		efore rocessing	efore burning	after combustion	oating, kg/m²	impregnating composition, kg/m²	g	%	g	%

1.	Control sample	92,7	-	52,3	-	-	40,4	37,4	-	-
2.	AC-1	92,5	93,1	77,9	0,001	15,2	15,2	14,1	15,6	14 ,5
3.	AC-1.1	93,4	93,9	78,6	0,001	15,3	15,3	14,6		
4.	AC-1.2	94,2	94,9	79,3	0,001	15,6	15,6	14,8		

In accordance with the provisions of GOST 12.1.044-2018, it can be concluded that samples of cotton textile materials impregnated with fire retardant №AC are classified as highly flammable materials.

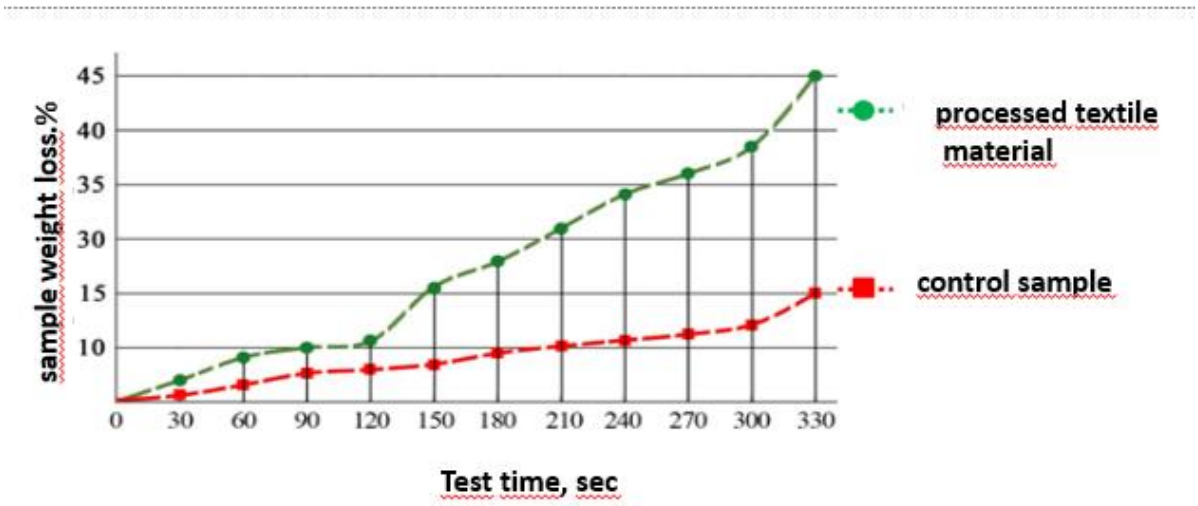

Fig.1. Average weight loss rates of wood samples

From Figure 1 it can be seen that the weight loss of the control wood sample at 300 seconds of combustion is 37.4%, and the treated sample at after 300 seconds of combustion, it loses 14.5% of its mass, which proves the effectiveness of its use.

In addition, compositions of a new type based on local raw materials vermiculite, orthophosphoric acid and silicate compositions belong to the group of low-flammability materials, as well as silicate-structured heat-resistant paints and varnishes impart heat resistance, heat resistance and thermal insulation ability to building structures (wood, metal, concrete), and thus thereby providing the opportunity to increase production capacity.

In conclusion, based on the results of the study, the following conclusions can be drawn that the new effective fire-retardant, heat-insulating paints and varnishes and fire retardants made it possible to transfer building materials from the flammability group (FL4) to the low-flammability group (FL1), and an increase in the critical smoldering time of wood materials has also been scientifically proven from 14 minutes to 18-19 minutes, that is, an improvement of at least 1.1 times.

The use of the results of the proposed work in a new composition of effective fire-retardant, heat-insulating paints and varnishes and fire retardants makes it possible to increase the strength of wood materials by 1.1%, heat resistance by 1.1-1.15%, and the possibility of reducing the smoke generation coefficient to 1 has also been scientifically proven. 2% and reduction in flame propagation speed by 1.2 times [5].

The identified methods make it possible to increase the fire safety of polymer materials in order to obtain fire-resistant building and textile materials modified with new types of fire retardants based on local raw materials, through the study of various methods for determining the fire resistance and flammability of various polyolefin materials [6].

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