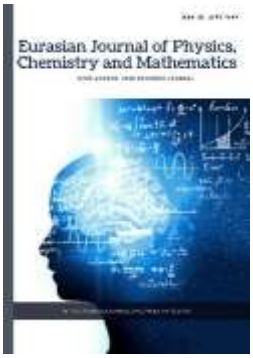

Obtaining a Fire-Resistant Coating Based on Acrylonitrile and Phosphoric Acid

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ABSTRACT

Increasing the fire resistance of wooden structures is an important task that must be solved for their long and safe operation. When a wooden structure catches fire, it can collapse and burn completely in 20-30 minutes. Fire retardants allow you to slow down the burning process by 2-3 times and prevent serious consequences. During this time, necessary measures can be taken, people can be taken out, valuables can be saved.

Keywords: Acrylonitrile, phosphoric acid, fire-resistant, IR-spectr, differential thermogravimetric analysis, solution polymerization.

Introduction.

During a fire, treated wooden structures can burn, but not burn completely. The fire resistance of wood can be increased by treating it with special fire retardant substances [1-3].

Depending on the purpose and field of application, fire retardants used for fire protection of wood and wood materials, according to the nature of the components: organic (consisting of organic components) and inorganic, foaming under the influence of heat, according to the method of application: damping, coating (up to 5 mm); are divided into types such as paints, varnishes (up to 1 mm) [4-7].

Wood is one of the widely used materials. Wooden constructions and decorative equipment made of it are widely used to this day. Wood is an environmentally friendly, inexpensive material with simple processing technology and ease of construction. One of the disadvantages of wood is its flammability. A number of methods have been developed to reduce the burning of wood. Often, to protect wood from the harmful effects of fire, the method of applying fire-resistant coatings to the surface of the structure is used [8-10].

Covering wood with fire retardant coatings is an effective method, in fire protection coatings form a thin film on the protected surface of wood, the coating has a decorative appearance, protects against burning, flame spread and moisture.

There are several requirements for wood fire protection coatings. The coating should have a high adhesion to the surface of the structures, should have a flawless appearance, be flexible, easy to apply to the surface, and not emit toxic substances under the influence of high temperatures.

Experimental Work.

As a result of our research, a fire-resistant coating based on phosphorus compounds and acrylonitrile was obtained for wooden structures.

Initially, polyacrylonitrile was obtained from acrylonitrile by solution polymerization [11]. Later, a fire-resistant complex compound based on polyacrylonitrile and phosphorus

compounds was obtained and neutralized with ammonia.

Result And Discussion

The fire resistance of pine wood samples prepared for the experiment was determined according to GOST 16363-98. Table 2 below shows the fire resistance properties of fire treated and untreated wood samples

Table 2

Determination of fire resistance of wooden materials treated with fire-resistant substances.

Sample number	Concentration of fire resistant coating	Sample mass , g			Dry weight gain	Mass loss		Average mass loss	
		Until it is processed again	Before burning	After burning	Total absorption , kg/m^3	g	%	g	%
0(сиг)	0	137,4	-	44,05	-	93,35	67,9		
1	APP-20	134,99	136,78	123,53	1,79	13,25	9,8	14,8	11,1
2		132,7	134,63	121,39	1,93	13,24	10,0		
3		130,32	132,01	117,37	2,69	14,64	11,2		
4		135,72	138,01	123,75	2,29	14,26	10,5		
5		137,41	140,33	125,27	2,91	15,06	11,0		
6		132,35	134,74	121,62	2,39	13,12	9,9		
7		137,36	139,95	123,32	2,59	16,63	12,1		
8		130,11	133,02	118,26	1,91	14,76	11,3		
9		132,76	135,01	119,48	2,25	15,53	11,7		
10		131,52	134,31	117	2,78	17,31	13,2		

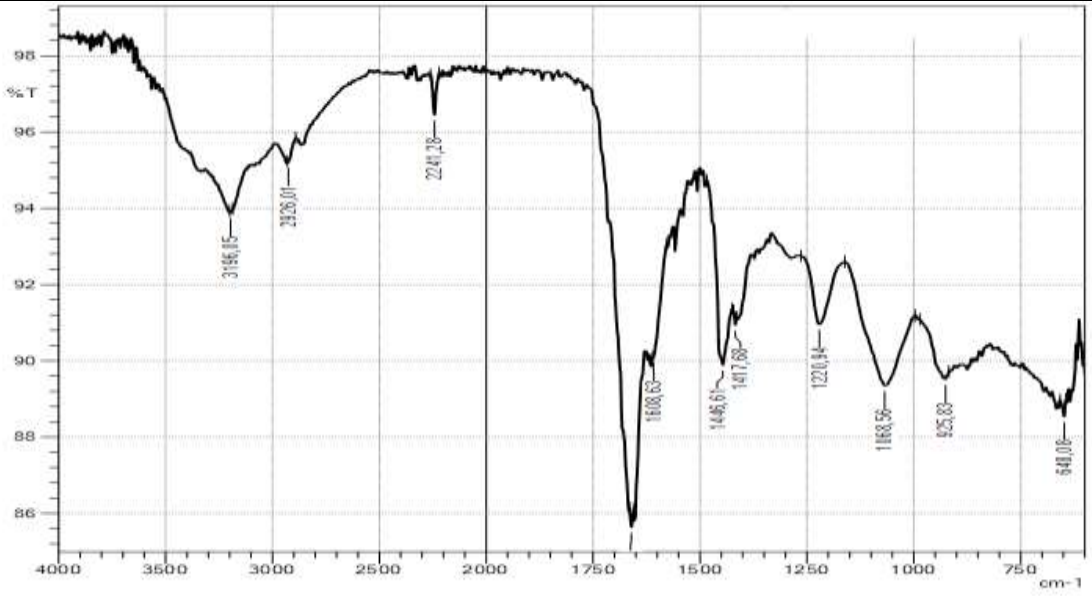
If the weight loss of the sample is not more than 9%, fire protection efficiency group I is established for wood protection products.

With a weight loss of more than 9%, but not more than 25%, fire protection efficiency group II is established for wood protection products.

With a weight loss of more than 25%, it is considered that this agent does not provide fire protection for wood.

From the analysis of the results of Table 2 above, it is known that the fire protection coating belongs to the II-group.

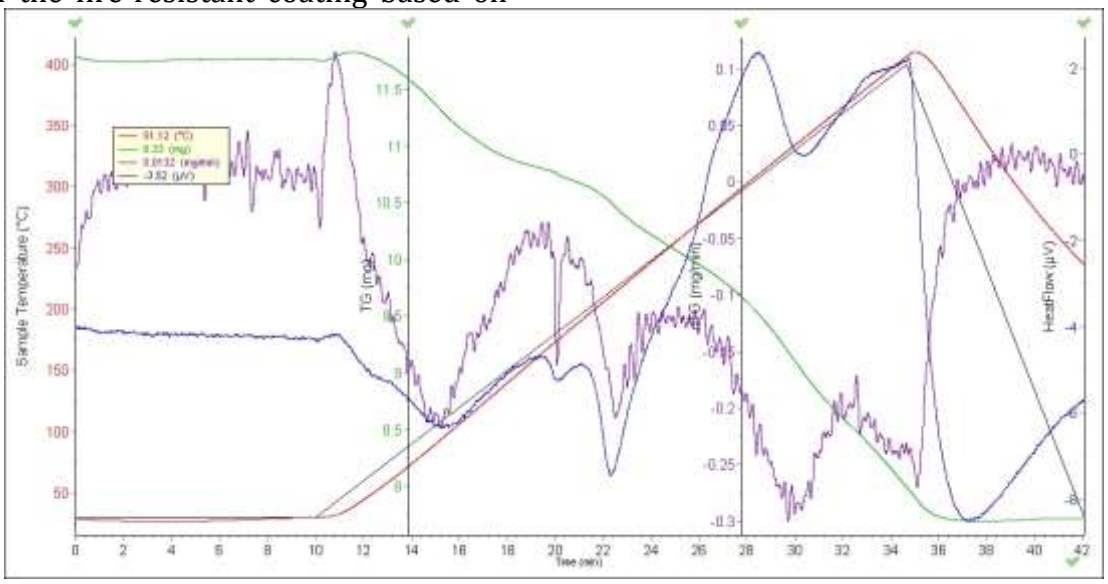
The yield and IR-spectroscopic analysis of the resulting coating were analyzed.



1 - picture. IR spectrum of fire resistant coating.

The analysis of the IR spectrum of the fire protection coating revealed the presence of the nitrile group –S≡N bond in acrylonitrile in the absorption area of 2241 cm^{-1}, the C – O bond in the absorption area of 1662 cm^{-1}, and the P – O – C bond in the absorption area of 1068 cm^{-1} showed. This shows that the complex obtained on the basis of polyacrylonitrile and phosphorus compounds was created due to the P–O–C bond.

The differential thermogravimetric analysis of the fire-resistant coating based on polyacrylonitrile and phosphoric acid is presented in Figure 2 below, which consists of 4 curves. Analysis of the differential thermogravimetric analysis (DTGA) curve (Curve 2) shows that the DTGA curve mainly occurs in the 2 intensive decomposition temperature ranges. The 1st decomposition interval corresponds to the temperature of 70-225 ^{0}C, and the 2nd decomposition interval corresponds to the temperature of 260-395 ^{0}C.



2- picture. Derivatogram of fire resistant coating

1-Temperature curve; 2- differential thermogravimetric analysis curve (DTGA); 3-derivative of differential thermogravimetric analysis curve (DTGP); 4-DSK curve.

The analysis shows that the intensive decomposition process takes place in the 1st decay interval. The amount of decomposition in this interval is 22.65% of the decomposition, i.e. 2.32 mg.

A detailed analysis of the differential thermogravimetric analysis curve and DSK curve is given in Table 1 below.

Table 1
Analysis of DTGA and DSK curve results of refractory coating

№	Temperature, °C	Lost mass, mg (12)	Lost mass, %	The amount of energy consumed (μV*s/mg)
1	50	11,903	0,285	1,45
2	100	10,309	7,93	2,91
3	200	9,209	17,87	4,09
4	300	8,406	20.65	5,08
5	400	7,896	22.65	6,93

As a result of this derivatograph research, it can be seen that the main mass loss takes place in the 1st decomposition in the range of 100-350 ^{0}C, in which 22.65% of the main mass, i.e. 3.32 mg of the mass, is lost. After 390 ^{0}C, no change is observed. The mass remains unchanged.

Conclusion. The fire retardant coating obtained on the basis of local raw materials was obtained with the highest yield of 94% at 120-140 ^{0}C in a ratio of 1:2. When applied to wood, the coating gives a decorative look and provides effective fire protection.

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