Synthesis of a flame retardant substance based on liquid glass and silicagel

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Abstract: In this work, the synthesis, analysis, and application of a refractory substance obtained on the basis of cremnisol and liquid glass were studied in laboratory conditions. Also, the IR spectroscopic analysis of this substance and the fire resistance property of the sample treated with a solution of a refractory substance were studied. In addition, electron microscopic analyzes of the refractory material are emphasized.

Keywords: thermogravimetric analysis, fire-resistant, level of protection, flammability, burning speed, efficiency, decomposing temperature, fission process

INTRODUCTION

When the synthesis of the refractory substance was carried out in 2 different compositions, the substance synthesized by the 1st reaction was a transparent gel-like substance. The synthesized substance in the 2nd reaction turned out to be a dark yellow substance. In order to analyze the components of these substances, their IR-spectroscopic analysis were obtained and analyzed accordingly. From the analysis, it was found that the composition of the substance obtained through the 1st reaction is similar to the composition of the refractory substance that we want to obtain. Also, a number of laboratory analyzes were conducted.

RESEARCH METHODOLOGY

The dynamic thermogravimetric analysis curve (DTG) analysis of A-1 fire-resistant foaming coating obtained on the basis of local raw materials, silica gel and liquid glass, shows that the DTG curve is mainly carried out in the range of 2 intensively decomposing temperatures. The 1st decomposing interval corresponds to the temperature of 63-300 ℃, and the 2nd decomposing interval corresponds to the temperature of 300-790 ℃.

As a result of the analysis, it was found that in the second fission interval, an intensive fission process takes place, the main mass is lost, that is, 65% of the fission takes place.

A detailed analysis of dynamic thermogravimetric analysis curve and DSK curve is given in the table below.

Table 1

Analysis of the DTG and DSK curves of A-1 fire-resistant corrugated coating

№	temperature,°C	Mass lost,%	The rate of decomposition of the substance, mg/min	Amount of energy consumed (μV*s/mg))
1	100	2,087	0,465	2,88
2	200	4,12	0,453	2,01
3	300	20,86	1,557	3,02
4	400	62,31	3,488	6,93
5	500	72	1,459	4,15
6	600	79	2,473	5,75
7	700	83	1,787	4,47
8	800	84,75	2,018	2,86

As a result of these derivatographic studies, it appears that the main mass loss occurs in the range of 300-790 °C, where 7.8 mg of the main mass, i.e. 65% of the mass, is lost. No significant change is observed after 790 °C.

General appearance of reaction products A-1 and A-2

From this picture, we can see the substances that are intended to be used as a refractory obtained by reactions 1 and 2.

The mass remains unchanged. It was observed that 50% or 9 mg of the mass of the refractory foaming composite we obtained was lost when the temperature increased to 375 °C.

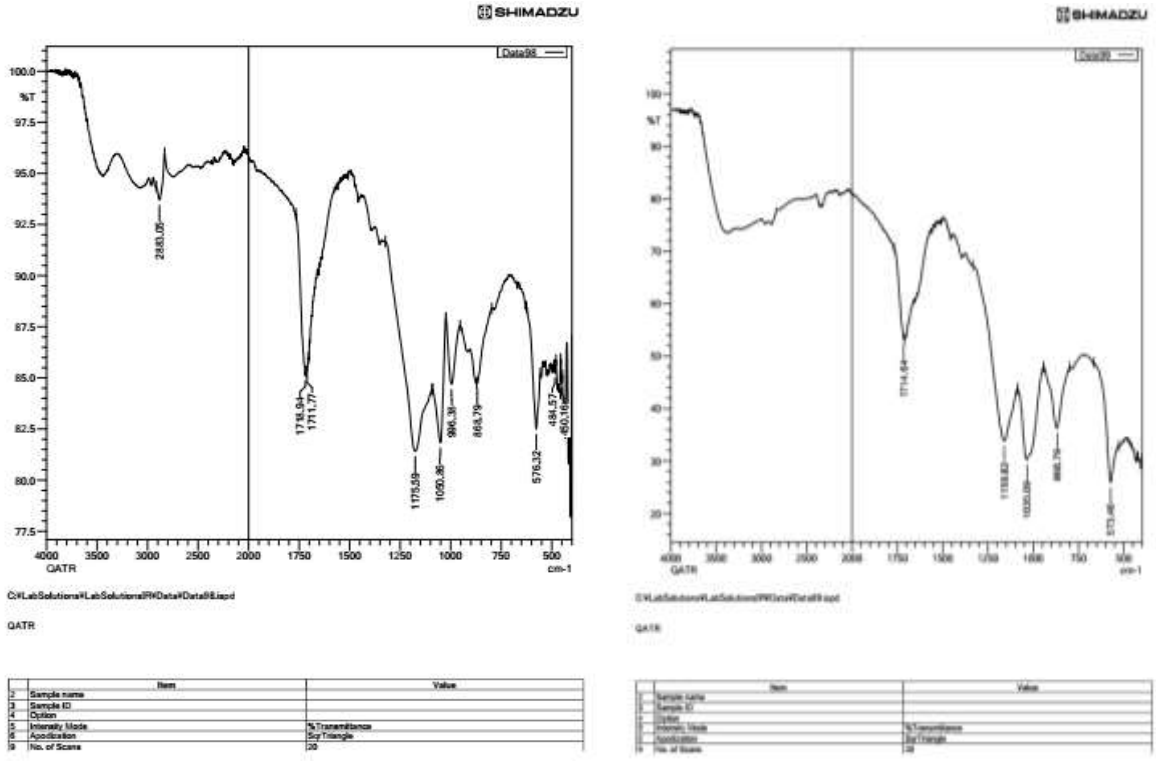

Figure 1. IR-spectroscopic analysis of obtained A-1 and A-2 fire-resistant materials

When analyzing the IR-spectrum analysis of A-1 fireproof substance, the carbonyl group in the absorption region of 1718.94 cm-1, the C-C-O group in the asymmetric valence absorption region of 1175.59 cm-1, Si in the absorption region of 1050.86 - 996.8.79- 868-79 cm-1 Si-O group, showed the presence.

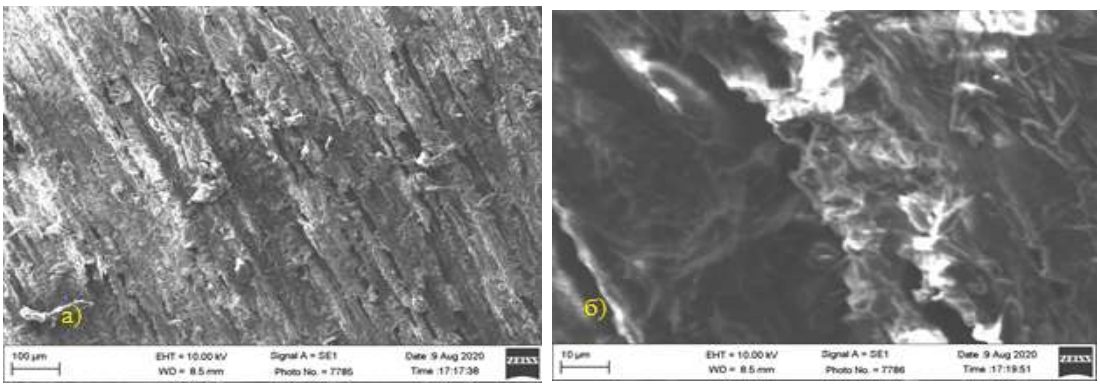

Figure 2 .A scanning electron microscope view of a wood sample treated with fire-resistant A-1 brand substance

In addition, it was found that when wood and fabric were treated with an aqueous solution of A-1 fire-resistant substance, they retained their properties and the property of fire resistance.

Scanning electron microscope (SEM) and elemental analyzes of the sample treated with A-1 refractory material were studied. When analyzed by SEM, it can be seen that it is evenly distributed on the surface of the sample, which increases the heat resistance of our sample. As a result, the sample treated with an aqueous solution of substance A-1 can create a more thermally stable barrier to reduce the intensity of combustion, thereby actively improving the safety of the wood sample.

Table 2

The results of determination of the hard-burning group of a sample of wood (pine) treated with a 20% solution of our A-1 fire-resistant substance

№	Time, p			Mass., g		Mass loss	
	Ignition temperature, oC	Independent ignition	Smoke formation	Before expirement	After expirement	gm	%
1	120	26	12	84,5	81,6	2,9	3,4
2	120	24	10	86,3	83,0	3,3	3,8
3	120	25	11	84,6	81,5	3,0	3,6
Average mass loss of samples %							3,6

It was found that the proposed fire-resistant wood materials have a lower temperature of 55-60 ℃ compared to wood materials not treated with A-1 fire-resistant material.

Further experimental processes were studied that it is possible to bring the fire resistance of wood to GOST requirements by applying two layers with a brush and spraying with a pulverizer. Due to the fact that the fire resistance indicators of brush application and pulverizer spraying are close to each other, pulverizer wood treatment processes, which are effective mainly for treating large areas, and their results are presented. It was proposed that this method can prevent unexpected fires by preparing a 15-20% solution of A-1 brand fire-resistant substance in ordinary home conditions and spraying it on wooden materials.

SUMMARY

In conclusion, as a result of research, the mass loss of a wood sample that was not treated with a thermostable substance after burning was 67.3%. The mass loss of wood samples treated with a 20% aqueous solution of our substance based on silica gel and liquid glass was 1.31%. Experiment conducted according to GOST 16363-98. All this represents the effectiveness of our substance. This thermostable substance can easily replace imported goods.

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