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STUDY OF THE FIRE RETARDANT PROPERTIES OF THE SYNTHESIZED SAMPLES

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ABSTRACT:

The article presents the results of new studies carried out in the direction of shaving methods of obtaining a fire retardant based on epichlorohydrin. Some results of practical research are given. Attention is paid to the most common and effective way to reduce the flammability of polymer materials. The results of scientific observations and practical studies of the properties of halogen-containing flame retardants are given.

The article is devoted in general to the current problems of science and technology in studying the properties of obtaining a fire retardant based on epichlorohydrin and modern methods of obtaining fire retardants.

INTRODUCTION:

To determine the thermal stability of composites based on PP and synthesized oligomers of epichlorohydrin with ammonium dihydrogen phosphate, their derivatographic analysis was carried out (Fig. 6-7). Figure 6 shows that the introduction of the synthesized oligomer catalyzes the thermal oxidation process and the peaks of the onset of thermal oxidation with an increase in the oligomer content (0.2; 0.4; 0.8; 1.2) somewhat decrease in size and are in the same temperature range. The same tendency is observed in the second oxidation peak, which has a value of 355 ° C, with the same composition of fire retardants.

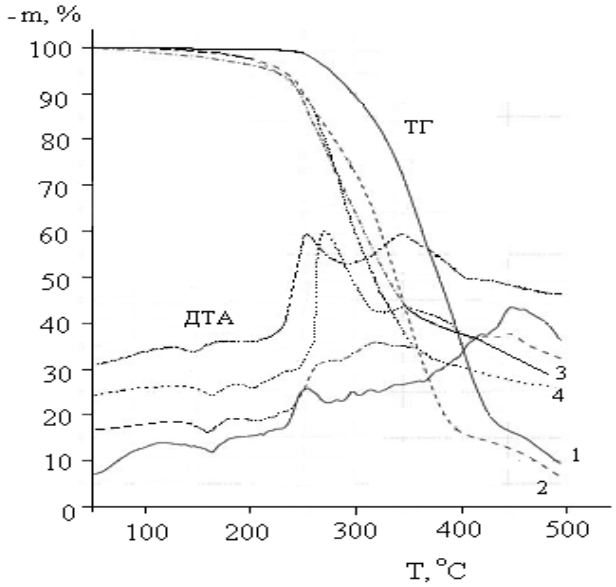

Figure: 6. Derivatogram of polypropylene samples with different content of fire retardants based on ECH with ammonium dihydrogen phosphate,%:
1-0,2; 2-0,4; 3-0,8; 4-1,2.

The obtained studies of the derivatogram show that the peaks of the onset of thermal oxidation (260 ° C) become more intense. The addition of an oligomer, which promotes the formation of intumescent coke on the polymer surface, reduces the intensity of oxidation and makes the polymer more stable to oxidation, as evidenced by the appearance of a second hump at the oxidation peak, which is shifted to higher temperatures.

The next stage of the work is the study of LDPE in the absence and presence of synthesized oligomers based on ECH with ammonium dihydrogen phosphate (1) and carbamide with orthophosphoric acid (2). Figure 8 shows thermograms of LDPE samples; LDPE + EHGADGF; KOFK.

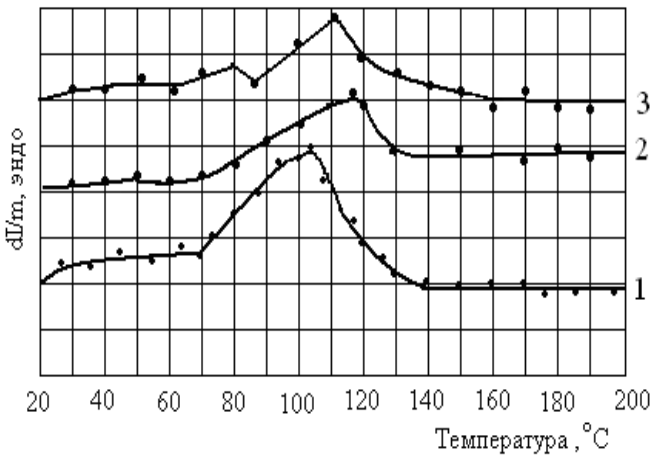

Figure: 8. Thermograms of 1-LDPE samples; 2-VEVD + oligomer based on ECH with ammonium dihydrogen phosphate; 3- LDPE + oligomer based on carbamide with orthophosphoric acid.

On curve 1 in Fig. 8, the endothermic peak corresponds to the melting process of polyethylene, and the melting point is lower than that of PE with the addition of synthesized fire retardants.

On curve 2, when a PE oligomer is added to the melt based on ECH with ammonium dihydrogen phosphate, an increase in the thermal effect of melting is observed, which indicates an increase in the degree of crystallinity, an increase in the melting temperature of PE to 120 ° C.

The thermograms of polyethylene with a fire retardant based on carbamide with phosphoric acid have a small second melting peak. Apparently, in this case, the process of copolymerization or crosslinking of the fire retardant with polyethylene occurs, a supramolecular structure with a melting point at 80 ° C is formed, which is confirmed by the obtained thermo grams.

Were investigated a method of producing fire retardants based on morpholine and epichlorohydrin. The results of the studies showed that as a result of the interaction of epichlorohydrin with morpholine at a ratio of the initial reagents of 1: 1, the product EM-1 is formed. Possible schemes of their interaction are presented below: Figure: 8. Thermograms of 1-LDPE samples; 2-VEVD + oligomer based on ECH with ammonium dihydrogen phosphate; 3- LDPE + oligomer based on carbamide with orthophosphoric acid.

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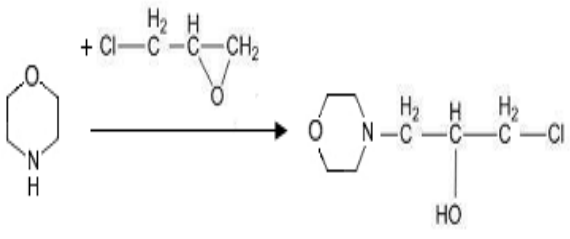
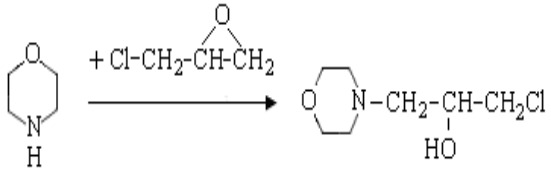
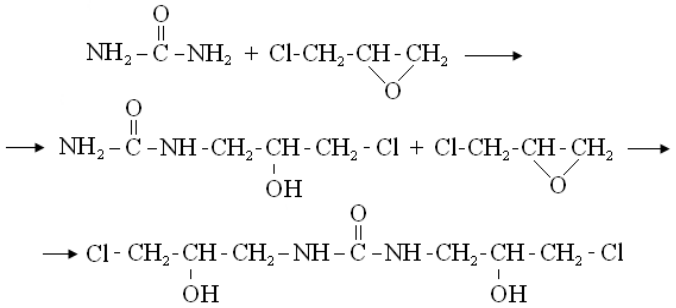




The reaction of interaction of urea with epichlorohydrin was also studied. Studies have shown that when the ratio of the initial reagents is 1: 1, the product EK-1 is formed, and when the ratio is 1: 2 - EK-2.



The physical properties of the obtained fire retardants are presented in Table 1.

Table 1. Properties of the obtained fire retardants

Flame retardant type	Density, g / cm ^{3}
ЭК-1	1,12-1,14
ЭК-2	1,15-1,18

The optimal conditions for the reaction were determined (t=25˚C, reaction time 24 hours). The structure of the compounds was confirmed by IR spectral studies.

Tests of the compositions were carried out in a "fire tube" installation (Fig. 9

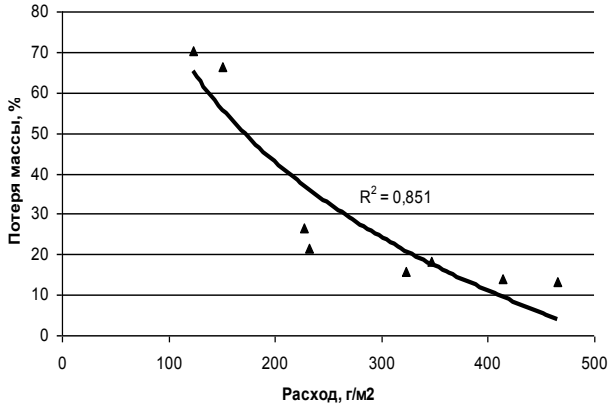


Figure 9 Dependence of weight loss on EK-2 consumption, g / m ^{2}

As can be seen from the figure, this composition has flame retardant properties. At a consumption of EK-2 over 320 g / m2, the loss of wood mass is less than 20%, which makes it a difficult-to-combustible material.

The search for materials that can reduce the flammability of polymers, reduce the formation of harmful products and smoke during combustion continues. As a rule, the main methods of inhibiting the combustion of polymers are based on the use of chlorine- and bromine-containing flame retardants, as well as on the modification of polymers with chlorine- or bromine-containing compounds. But, as it was found, these substances, entering the atmosphere, contribute to the destruction of the ozone layer of the Earth, and are also dangerous to humans. Therefore, one of the main tasks of modern polymer materials science is the development of halogen-free methods for reducing flammability. However, no additives can completely prevent the combustion of polymers. But it is possible to significantly reduce the speed of combustion and flame propagation and get a self-extinguishing material.

Analysis of literature sources allowed us to conclude that, as in a number of other cases, the introduction of phosphorus into the structure of organic compounds can be successfully used to solve this problem.

The method of introducing a flame retardant into a polymer during molding is not widely used, since flame retardants must meet a number of requirements. The fire retardant must maintain thermal stability up to 300 ° C, be easy to dose, melt during processing, have a high dispersion, be as effective as possible with a minimum amount introduced.

Initially, halogen-containing organic flame retardants were used; they had good thermal stability and little smoke emission.

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