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# Methods of Reducing the Flammability of Polymer Compositions

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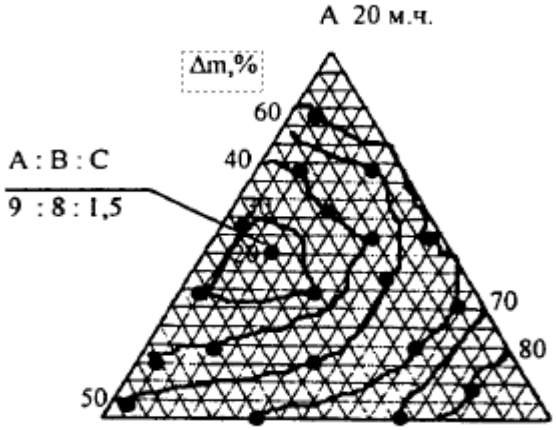
## Abstract

In the vast majority of cases, the effect of flame retardants on the combustion of polymeric materials is multiple. Flame retardant elements and groups that can affect the course of polymer pyrolysis and heterogeneous oxidation can simultaneously be present in the fire retardant structure. Various substances are used as flame retardants, the mechanism of action of which is very different.

Keywords: nitrogen-phosphorus-containing, polystyrene, modifiers, halogen-containing.

A complex method for optimizing the composition of mixed flame retardant systems for polymers has been developed. A number of additives that reduce the mythation of halogen-containing and nitrogen-phosphorus-containing flame retardants from plasticized PVC and polystyrene have been studied. The effect of PVC heat stabilizers on the combustibility of the product, in which they are contained, has been established. Impact strength modifiers for polystyrene compositions of reduced flammability have been selected. New polymer compositions of reduced flammability have been developed, the main characteristics of the substances used in the work are presented, and grades of polymers, the flammability of which has decreased, are given. The equipment and technologies for sample preparation are described. Test methods are given. In the course of the research, such indicators of fire hazard properties were determined as: ignition temperature, ignition time, self-burning time after the sample was taken out of the flame, the time to reach the maximum temperature of the exhaust gaseous combustion products, weight loss of the samples, flammability and combustibility group according to GOST 12.1.044-89 " Fire and Explosion Hazard of Substances and Materials” Flame propagation rate over the sample and fire resistance category according to GOST 28157-89 “Plastics. Methods for determining the resistance to burning.

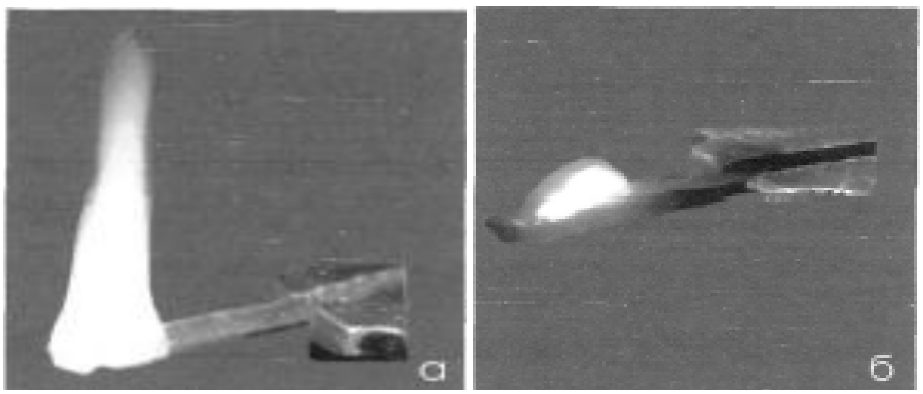
When studying the effect of flame retardants on the consumer properties of the product, the following indicators were determined: thermal stability according to "Congo-red". color fastness, whiteness, elongation, tensile strength, Charpy impact strength, melt flow rate, Martens heat resistance, corrosion properties. The studies were carried out according to the methods set out in the current GOSTs for testing plastics. A method for optimizing the composition of low-flammability polymer compositions is described in detail. To optimize three-component flame retardant mixtures (flame retardant-synergist-anti-migration additive), the method of composition-property diagrams (Fig.1) is proposed.




**Rice. I.** The composition-property diagram of the mass loss of the sample when tested on the OTM unit. As replicas A, B, C, the components of the mixture are used. Their concentration varies from 0 to 20 m.h., and as responses, the indicators of the fire hazardous properties of the samples determined as a result of tests. The points corresponding to certain concentrations of components for which the property indicators are the same (or close in value) are connected by lines of the same efficiency (or equipotential curves). These lines determine the optimal ratio of components. With the optimization carried out in this way, each property indicator can correspond to its optimal ratio of components [1]. The results of a study of the effect of the PTEBA additive on the resistance of the cured epoxy resin ED-22 to burning and the action of a hot wire are presented.

When conducting experiments on combining PTEBA with an epoxy composition, an important observation was the reduction in the cooling time of modified samples relative to unmodified ones, which is a qualitative indicator of the thermal conductivity of the material. This observation is important, since changing the heat balance of the flame by increasing heat loss is one of the effective ways to reduce combustibility.

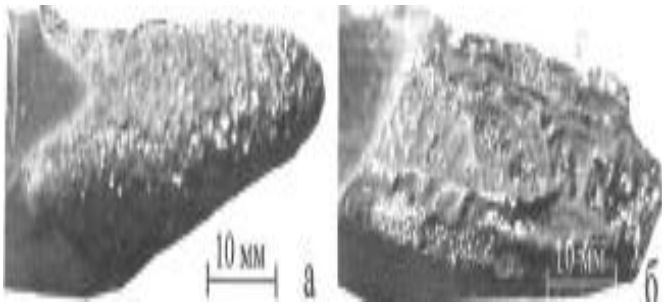
The test method for flammability (GOST 21207-81) is intended for a comparative assessment of the relative ability of plastics to ignite under the influence of an ignition source. In the flame of an unmodified polymer (Figure 2), three zones can be clearly distinguished, while in the flame of a polymer containing PTEBA, a bright low-temperature zone is most clearly expressed. A decrease in the height and intensity of the flame glow, an increase in the formation of soot and soot for polymers with a modifier content of more than 5% (mass) indicates that non-combustible components diffuse from the surface of the samples during combustion.



**Drawing 2** - Combustion, where a) sample without PTEBA;

b) a sample with the addition of PTEBA 1 O % (mass.)

Figure 7 shows the change in the geometry of the flame front. When the content of the modifier is 10% (wt.), the thermal energy released in the combustion zone as a result of redox reactions is distributed more evenly due to the increased thermal conductivity of the material.




**Drawing 3 - Type of charred samples, where a) a sample with the addition of PTEBA**

5% (mass); b) a sample with the addition of PTEBA 10% (mass.) A decrease in the burning rate of the polymer material indicates a change in the kinetic parameters of combustion and a decrease in the intensity of heat release in the combustion zone (Figure 3). Several factors contribute to the flammability reduction effect. The presence of PTEBA in the composition leads to a change in the kinetics and mechanism of chemical reactions of polymer decomposition. Increase in physical heat sinks from the combustion zone to the environment. The formation of soot during combustion also contributes to an increase in heat loss. The crust formed during combustion of samples with a content of more than 5% (wt.) Serves as a physical barrier between the polymer and the oxidizing environment, leads to a decrease in the release of combustible products into the gas phase, screens the material from the heat flux [2].

In the vast majority of cases, the effect of flame retardants on the combustion of polymeric materials is multiple. Flame retardant elements and groups that can affect the course of polymer pyrolysis and heterogeneous oxidation can simultaneously be present in the fire retardant structure. Various substances are used as flame retardants, the mechanism of action of which is very different. Halogen-containing flame retardants can significantly reduce the flammability of various polymeric materials, however, during the destruction of polymer composites based on such additives, toxic gases are released, which, in turn, does not contribute to reducing the fire hazard, even with a decrease in flammability. For this reason, halogen-containing flame retardants are less and less used in the production of [3].

**Listofreferences**

1. Yu.F. Mukhin., Development of polymeric compositions of reduced flammability based on plasticized polyvinyl chloride and polystyrene. Abstract Moscow, 1999 г.
2. Chipizubova Marina Sergeevna Reducing the combustibility of composite materials for structural purposes based on an epoxy binder with the addition of polymethylene-n-triphenyl ether of boric acid Abstract of Barnaul-2008 г.
3. VE Vaganov Research and development of technological methods for reducing the flammability of polymer fibers made of polyethylene terephthalate for building materials. Bulletin of PDABA No. 12 December 2013 г.
4. Polymeric materials with reduced flammability / Ed. A.N. Righteous. Moscow: Chemistry, 1986. - 224 p.

5. Gladyshev G.P., Ershov Yu.A., Shustova O.A. Stabilization of heat-resistant polymers. Moscow: Chemistry, 1989. - 272 p.
6. Cullis C.E., Hirchler M M. // Polymer. 1983. - v. 24. - №7. - P.834-840.