STUDY OF PHYSICAL AND MECHANICAL PROPERTIES OF EPOXY RESIN-BASED FLEXIBLE POLYMER COMPOSITE COATINGS

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Abstract. *Physico-mechanical properties and structure and fire resistance of epoxy resin-based intumescent polymer composite coatings used in the oil and gas industry to protect against fire, oxygen index increased from 18% to 45% were studied on the basis of experimental tests.*
Keywords: *intumescent fire retardant coating, epoxy resin, composition, oxygen index, modification.*

Introduction. A number of different compositions can be used to obtain flame retardant polymer composites. When these components are added in order to improve fire-resistant and bulging properties, they affect the structure of the polymer composite and lead to changes in its physical and mechanical properties [1, 2, 3].

As a result of the addition of polymer binders, flame retardants, foaming additives, PAV, stabilizers, fillers, and hardening chemical additives to the composition of fire-protective foamable polymer composites, the mechanical properties of polymer materials change [4, 5, 6, 7]. Mainly, as a result of adding flame retardants, plasticizing chemical additives and fillers to polymer materials, the mechanical properties of polymer composite deteriorate [8, 9]. Therefore, polymer composite materials have different standards according to the field of use, and effective methods of application are developed based on these requirements [10, 11].

The lacquer industry has its own standards that allow the use of polymer composites with mechanical properties compared with analogues. Based on this, the composition of the proposed fire-resistant intumescent polymer composite coatings includes several brands of fire-resistant intumescent polymer composite coatings consisting of polymer binders based on epoxy resin and polymer binders based on acrylic copolymers [12, 13].

As a result of the interaction of micro heterogeneous particles and polymer fillers in the composite phases of these polymer composite coatings, it is possible to create fire-resistant bulging polymer composites that exhibit new physical and mechanical properties [14, 15]. In the development of fire-resistant foaming coatings (organic solvents and aqueous emulsions), additives are used that change their composition and increase technological convenience, which improves the performance of the coatings [16].

Methods and materials. The scientific significance of the results of the research is that in the creation of new fire-protective foamable polymer composite coatings, the influence of polymer binders, foamable chemical additives, flame retardants and coke-forming chemical additives on their mutual proportions, influence on physico-chemical and mechanical properties, fire resistance and thermal-physical properties development of a mathematical model in the process of temperature change.

The practical significance of the research results is the development of the technology of obtaining fireproof, bulging coatings for metal structures used in the oil and gas industry, the development of the optimal amount of use of these polymer composites, and the development of

an effective mechanism for increasing fire resistance, as well as the bulging polymer coating, which serves as the main factor in the protection of metal structures in the event of fire. It is explained by the fact that the content has been put into practice.

Highly informative, modern physico-chemical, fire resistance and swelling, and thermal physical-mechanical properties in the identification of the obtained fire-protective intumescent polymer composite coatings are explained by the reciprocity of the results of theoretical and experimental research and the implementation of the development into practice.

Results and discussion. In table 1 below, IPC-1, IPC-2 and IPS-3 (intumescence polymer composite - IPC) compositions are obtained from mixtures of epoxy resin, hardener and compounds containing nitrogen, phosphorus, metal in mutual proportions. A certain ratio of components provides good fire resistance properties, opens up wider application possibilities and is environmentally friendly and economical.

Table-1

Physico-mechanical properties of fire-protective intumescent polymer composite coatings based on epoxy resin.

№	Indicators	Terma-S (analogue)	IPC-1	IPC-1	IPC-1
1	Appearance of the coating	Light gray	White gray	White gray	White gray
2	Adhesion	1	1	1	1
3	Grinding level, μm	65-75	50-60	50-60	50-60
4	Impact strength limit of polymer composite, cm	21	22	21	19

As can be seen from the tables, the technical result of the application of the invention consists in expanding the functional capabilities of the method of manufacturing an intumescent composition based on epoxy resin, increasing fire resistance, and expanding the temperature range of swelling. In researching the oxygen index of fire-protective foamable polymer composite coatings, test experiments were carried out to determine the oxygen index based on the results of calculating the amount of oxygen concentration in the mixture of oxygen and nitrogen by burning a specially prepared polymer composite.

Determination of oxygen index of polymer composites based on epoxy resins was carried out as follows. According to it, a polymer composite sample was prepared based on ГОСТ 12.1.044-2018 and ГОСТ 21793-76.

Table-2

Experimental results of the study of the effects of the chemical composition ratios of the fire-protective foamable polymer composites on the oxygen index.

Polymer composite name	Oxygen index, %
Composite based on epoxy resin	17-19,0
IPC-1	36
IPC-2	33
IPC-3	32
Analogue	34

According to the working mechanism of epoxy resin-based fire-protective foamable polymer coatings, the effects of polymer binders, flame retardants, foamable chemical additives that generate gas under the influence of temperatures of 220-350ºC, and fillers in the ratio of 5-40% on the oxygen index were studied. In addition, in this type of polymer coating, hardeners are used in the amount of 10% compared to the mass of the polymer binder. It consists of nitrogen-containing organic compounds as hardeners.

Thus, adding 10% to 30% of chemical additives with flame retardant and swelling properties to the fire resistance and swelling properties of epoxy resin-based fire retardant foamable polymer composites ensures a good result.

Conclusion

In conclusion, the study of physical and mechanical properties of epoxy resin-based flexible polymer composite coatings has provided valuable insights into the performance and potential applications of these materials.

The research demonstrated that the incorporation of flexible polymer additives into epoxy resin coatings can significantly enhance their flexibility and toughness without compromising their mechanical strength. This improvement in flexibility is crucial for applications where the coating needs to withstand deformation, such as in the automotive and aerospace industries.

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