TECHNOLOGY OF OBTAINING "SMART" MATERIALS BY ADDING FIBER FILLERS BASED ON THERMOPLASTIC POLYMERS

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ANNOTATION
This article provides information about fiber fillers, methods of obtaining composite materials, properties, targiibi, properties, use, innovations of "smart" materials. The results of the studies on the changes in the polymer composition of fiber and other fillers are given.

Keywords. Polymer, composite material, filler, embossing, "smart" materials, optical fibers, thermoplastic, thermoreactive polymer, polymer composites in aircraft construction.

INTRODUCTION

Polymer composite materials (PCM) are becoming increasingly common and developing, in which the polymer performs the function of a pure form or polymer-bonding Matrix. The polymer-based composition is understood by the addition of various additives, such as plasticizers, stabilizers, solvents, etc. Such a structure of PKM is explained by the characteristics of different types of polymers and the supply of composite materials obtained from them, as well as the relatively simple processing technology and good bonding ability. [1]
Flammability is characterized by a number of properties, such as the ability to burn, the speed of combustion, the composition of combustion products, the heat intensity and, finally, the composition of the atmosphere in which combustion is possible. It is customary to divide polymer materials into non-combustible, hard-combustible, hard-liquid and easily combustible components. The coefficient of flammability (K) in such materials is appropriate <0,1; 0,1-0,5; 0,5-2,1; >2,1. The higher the flammability coefficient, the more flammable and dangerous the polymer substance will be. The coefficient of flammability is determined by the amount of heat delivered to it from the source of combustion by the amount of heat released during the combustion of a given mass sample[1].
"Intelligent" materials are able to adequately change their characteristics and shape to new loads and independently adjust the degree of their reaction to new conditions in accordance with the level of their change. As a result of the creation of "intelligent" materials, the concepts of "learnability" of materials and their "feeling" of extreme situations appeared in materials science. For "intelligent" behavior, the material must have non-linearly changing properties. The "intelligence" of the materials is based on the implementation of the following points:[2]
- Control of the main functions;
- Optimization of properties by training;

- The presence of sensors in them that monitor changes in environmental factors;
- The ability of materials to analyze the situation that has arisen as a result of environmental changes;
- The ability to respond to the results of their own analysis of the environment.

MATERIAL AND MATERIALS

The "intelligent" abilities of composite materials are provided by the components with shape memory, alloys with magnetic properties, fiber-optic sensors, piezoelectric sensors, electrorheological fluids and other elements with several non-linearly varying characteristics.

Technologies for the production of "intelligent" materials are based on the embedding of the components listed above into a polymer matrix. The most developed technology is the creation of "intelligent" materials by embedding fiber-optic sensors in their structure. Such sensors allow you to monitor the processes occurring during the molding of products made of "intelligent" materials, as well as monitor their condition during operation and adequately respond to changes occurring in them due to environmental influences[3].

The presence of fiber-optic sensors allows you to receive real-time information about the behavior of a product made of "intelligent" material and detect changes in its structure long before irreversible deformations appear at the initial stage.

However, the embedding of such sensors does not pass without a trace for the structure and properties of the composite material, since the diameter of the optical fibers exceeds the diameter of the main reinforcing fibers in the material by an order of magnitude or more, which leads to the occurrence of internal stresses in it. Polymer materials reinforced with fiber-optic sensors belong to the "intelligent" materials of the first generation.

They are able to respond to the effects of the external environment by generating a signal. The decision based on the results of the analysis of this signal is made by a person using a computer, i.e. their own "intelligence" of the first generation materials is still not enough to adequately respond to environmental challenges.

DISCUSSION

Modern "intelligent" materials are not only able to analyze the level of environmental impact, but also adapt to its changes. When creating such materials, not only sensors are embedded in their structure, but also actuators that make changes to the structure of the material based on signals received from sensors. This behavior of "intelligent" materials is achieved, for example, by using metal fibers or tapes with shape memory in their composition, capable of reversible changes in the original shape and size due to thermoelastic martensitic transformation.

The reaction of such alloys to a change in temperature is a change in shape when heated: the curved fiber can be straightened, and when cooled, it can take its original shape again. Being embedded in the structure of a polymer composite, it "forces" it to take the appropriate shape and size. Huge stresses, reaching more than 100 MPa, arise inside metals "with memory" of the shape when it changes [4].

In addition to metals with shape memory, polymers are also used that are able to "remember" their configuration and change the volume when the stress state changes. Another way to create "intelligent" materials is to embed capsules about 1 micron in size with magneto- and electro-rheological liquid containing ferroelectric and electret particles into their structure. The use of ceramic fibers with piezoelectric properties in the structure of the "intelligent" material makes it possible to create materials with vibration-damping properties.

CONCLUSION

Polymers that change their volume under the influence of electrical voltage, as well as materials capable of converting electrical energy into mechanical energy and vice versa are also used as activators.

The creation of "intelligent materials" based on polymers opens up fundamentally new possibilities for the development of modern technology.

Their use makes it possible to operate this technique under critical loads in conditions when no other methods of monitoring the condition of the material and corrective action on it can be used for constructive or technological reasons [5].

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Currently, "intelligent" reinforced polymer composites are used mainly in the designs of aircraft and other equipment, the viability of which depends on the ability to perform strategic tasks. Thus, the use of the skin of SU-27M, SU-47, SU-35 combat aircraft, made of "intelligent" polymer composites, makes them less vulnerable, because it reduces the level of radar detection by the enemy. The use of "intelligent" materials makes it possible to create aircraft with aeroactive wings capable of changing their shape according to flight conditions. The first samples of such aircraft already exist.

PCMs are widely used in Electrical Engineering and electronic devices. Such properties, the value of which must be regulated, include electrical conductivity, electrical strength, dielectric conductivity, etc. Electrical conductivity is the inverse value of electrical resistance, which depends on the size and surface of the polymer sample. The electrical conductivity of polymers is closely related to their chemical purity. Tiradi significantly change this indicator in mixtures. For example, in terms of mass, polyamide humidity in the amount of 0,1-1,0% increases electrical conductivity in 1000 times. Similarly, plasticizers with high mobility of ions are also affected [2].

Fillers can affect electrical conductivity in different ways, depending on their nature. The high content of electrical conductive fillers (metal powders, graphite) significantly increases the electrical conductivity of the polymer material. Based on such compositions, for example, electric heaters of a complex geometrical shape are obtained.

When creating electroplating polymer materials, there are no restrictions on the use of polymers as binders. These solid thermoses and reagoplasts can be rubber-like materials, which have a constant shape of the product or a variable shape in loading, that is, materials with high return deformation.

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