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# Study of Physical and Chemical Properties of Polymer Composite Materials

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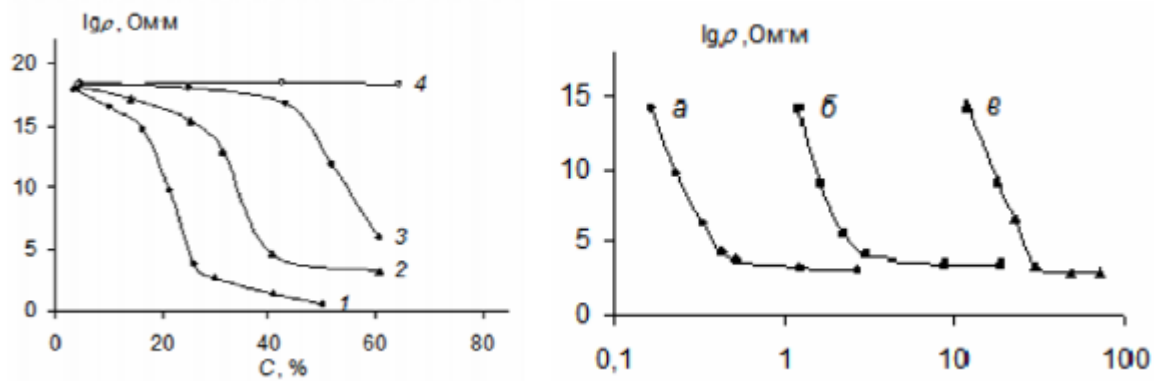
**Abstract:** Development and application contributes to the implementation of the topological optimization of the design with the distribution of rods by volume in accordance with the rational perception of the load. Obviously, the use of fibrous composites is the most promising direction in the development of core sandwich panels.

**Keywords:** polymethylacrylonitrile, polymer, degradation, hydrogen halides, thermal oxidizer, fiber fillers.

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Heat resistance is determined not only by the strength of the main chemical bonds of the polymer chain, but also by the strength of the weakest bonds, from the rupture of which destruction occurs, as well as the destruction mechanisms. The process of thermal degradation of polymers is complex and usually consists of a series of sequential and parallel elementary radical, ionic, and molecular reactions that can proceed via chain and non-chain mechanisms, depending on the polymer structure and degradation conditions. According to the nature of destructive transformations, polymers are divided into two groups. The first group includes polymers whose molecular chains completely decompose at high temperatures to volatile low molecular weight products or form a small amount of non-volatile residue. Of this group, for polymers of the vinyl series, the main processes that determine the composition of the resulting products can be depolymerization for PMMA, polymethylacrylonitrile, polytetrafluoroethylene, chain transfer reactions followed by P-bond cleavage for polyethylene, PMA. The second group includes polymers during the thermal decomposition of which low-molecular products are formed as a result of the elimination of atoms and groups framing the main chain of the macromolecule and intramolecular rearrangement, which is accompanied by the appearance of double bonds or cycles in the chain and cross-links between the chains until a non-volatile, spatially cross-linked carbonized residue is formed. These include unsaturated polymers of the vinyl series with hydroxyl, ester and halogen substituents during thermal degradation, water, aliphatic acids and hydrogen halides are released, respectively, polyacrylonitrile undergoing intramolecular cyclization, cellulose and a large number of polymers with aromatic and heterocyclic links in the chain. During the decomposition of polymers of the first group of thermoplastics, complete gasification occurs at high rates of release of volatile products, boiling of the polymer melt is observed. Polymers of the second class are structured with the formation of a carbonized non-volatile layer, which changes the conditions of mass and heat transfer at the interface between the gaseous and condensed phases. During the combustion of polymeric materials inside and on the surface of the condensed phase, complex physicochemical processes take place: phase transitions, thermal and thermal oxidative decomposition, and the formation of new phases. Breaking of the combustion cycle is possible at the interface between the condensed and gas phases as a result of changes in mass and heat transfer between these phases. This is achieved by preliminary application of a protective coating on

the surface or by the formation of a protective surface layer during the thermal decomposition of the polymer material. During thermal decomposition of polymers with an increased tendency to coke formation, as well as carbon-chain polymers with additives of phosphorus or boron-containing compounds, a vitreous layer or a layer in the form of a solid foam with closed pores is formed on the surface. This protective layer limits the release of combustible products of polymer thermal degradation into the gas phase and reduces the thermal effect on the polymer. Fire protection using flame resistant fire retardant coating materials. Introduction of fillers. The introduction of flame retardants or flame retardants. Modification of polymeric materials. Along with the first and second methods, polymeric materials are impregnated with fire-extinguishing compositions capable of forming a protective layer on the surface of the material. In some cases, these compositions are taken into account when formulating polymeric materials. Fire protection with flame-resistant materials means covering products made of combustible materials with tiles, sheets made of non-combustible or slow-burning materials. Flame retardant paints, varnishes, foam coatings can be used as fire retardant coatings. The advantages of fire-retardant coatings are ease of manufacture and relatively low cost. However, with increasing temperature, most coatings are characterized by flaking from the main combustible material[1]. The question of the method of obtaining PCM with a given set of properties should always be decided by the simultaneous selection of the necessary components and the appropriate technology - i.e. both technology and CM components are interconnected. In the case of using fiber fillers, as a rule, the process of obtaining a product is combined with the process of manufacturing CM. Carbon fiber fabric or mats laid out in a special shape are impregnated with a liquid binder. Further, at low pressures created in various ways, or without pressure at a certain temperature, the curing process takes place. The molding method is one of the main ones in the production of carbon fiber, it has a variety of technological design. Reinforced with continuous fibers or fabrics of linear thermoplastic polymers; is not yet widely used, since methods suitable for liquid binders cannot be used for thermoplastics that go into a viscous liquid state at relatively high temperatures. From this point of view, a non-impregnating method for obtaining thermoplastics reinforced with a fabric based on carbon fibers is of interest. It is based on the co-spinning of carbon and synthetic fibers. The resulting fabric contains a thermoplastic binder in the form of threads intertwined with carbon. The resulting fabric can be laid into shapes of any configuration. When heated at contact or slightly elevated pressure to a temperature above the melting point of the organic fiber, the latter loses its structure and goes into the state of a liquid binder. One of the promising new production methods is the polymerization filling method, in which a polymer is synthesized from a monomer in the presence of filler particles, on the surface of which a catalyst has been previously applied. In this case, the polymerization process starts directly on the surface of the filler particles. The CM obtained in this way is characterized by close contact between the matrix and the filler and a more uniform distribution of the filler in the matrix than when mixed in a melt or polymer solution. Another promising method is the filling of polymers with metals, in which filler particles are formed in the presence of a polymer. This method consists in the reduction of metals from their salts by countercurrent diffusion of salt and reducing agent directly in the polymer matrix. Either a water-swelling polymer (PVA, etc.) or a porous polymer, the porous structure of which is formed, for example, by the crazing mechanism, is taken as a matrix. By mixing in solution (option b), it is possible to achieve a uniform distribution of soot aggregates in the volume of the CM.



**Rice.** Dependence of the volume resistivity of PE-based composites on the concentration of electrically conductive fillers: 1-cetylene carbon black; 2-graphite; 3-aluminum powder; 4 - zinc dust. Rice. Fig. 8. Concentration dependence of the volume resistivity of Ketjenblack polystyrene-carbon black composites for various methods of preparing the composition.

The nature of the filler distribution in the polymer matrix is largely determined by the interaction at the boundary between the individual filler particle and the polymer medium. The thermodynamic models considered in the literature are based on the calculation of the most energetically favorable states of the polymer–filler system. In this case, the value of the percolation threshold, as a rule, does not coincide in magnitude with the value predicted by the percolation theory and the effective medium model. The models determine the total interfacial free energy  $g$  of the mixture of polymer and filler. It is shown that other parameters affecting the formation of chain structures are the viscosity of the polymer melt and the diameter of the filler particles [2].

The development and application of bar schemes contributes to the implementation of the topological optimization of the design with the distribution of bars by volume in accordance with the rational perception of the load. Obviously, the use of fibrous composites is the most promising direction in the development of core sandwich panels. When combining the direction of the reinforcing fibers with the axes of the rods, the maximum possible mechanical characteristics of the composite will be realized. An example of such an approach is the work, where a braid-shaped bundle impregnated with a binder is placed on a corrugated surface to form a pyramidal-type rod structure. Unfortunately, such a solution limits the possibility of constructing bar structures of various configurations, moreover, due to the small area of contact between the filler and the skin, the strength of their connection is low. This paper presents the results of a study of the possibilities of a new technological scheme for the manufacture of core fillers for multilayer panels. The proposed scheme is based on combining the technologies of folded structures, directional fiber placement and transfer molding [3].

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