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INTERNATIONAL JOURNAL
EIJMRMS
Next Scientists
European International Journal of Multidisciplinary Research and Management Studies
SJIF 5.954 2022

EUROPEAN INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH AND MANAGEMENT STUDIES
ISSN: 2750-8587
DOI: https://doi.org/10.55640/eijmrms-02-06-33
https://eipublication.com/index.php/eijmrms
Volume: 02 Issue: 06 June 2022
Published Date:- 30-06-2022

Page No.-170-173

RESEARCH OF POLYMER COMPOSITE MATERIALS BASED ON THERMOPLASTICS

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ABSTRACT: - The specific operating conditions of products made of thermoplastic materials necessitate targeted modification of polymer binders, which reduces the characteristic disadvantages of thermoplastics and enhances their advantages .The article examines some aspects of the use of composite materials based on thermoplastics. The most effective modifiers of polymer matrices, from the point of view of increasing their parameters of deformation-strength and tribotechnical characteristics, are components that prevent the development of thermo - oxidative destruction and tribocracking processes. In our opinion, the formed requirements for functional composite materials based on thermoplastics can be ensured by implementing the basic methodological principles, which consist in increasing the resistance to the effects of thermo oxidizing and operating environments and aging.

KEYWORDS: Thermoplastics, polymer composites, modifiers of polymer matrices, tribotechnical characteristics, polymer mixtures.

INTRODUCTION

The specific operating conditions of products made of thermoplastic materials necessitate targeted modification of polymer binders, which reduces the characteristic disadvantages of thermoplastics and enhances their advantages.

Methodological approaches to the creation of composite materials based on polymer matrices in the presence of general patterns are characterized by a number of specific features determined by the operating modes of the product, the requirements for manufacturability and economic parameters that affect their competitiveness when compared with analogues.

As a result of the successful development of chemistry and physics of high-molecular compounds, a number of new polymer and composite materials with a wide variety of mechanical, thermophysical and technological properties have been created. The physical and mechanical properties of composites depend significantly on the relative content of the components. The higher the fiber content, the higher the density, the higher (all other things being equal) the modulus of elasticity and strength of composites should be.

The main reasons for the destruction of polymer composite materials are swelling and cracking of coatings from the substrate. And the cause of swelling, cracking of coatings is insufficient adhesive and cohesive strength, coating continuity, large size of crystals, as well as changes in internal stresses in coatings. Fillers play an important role in the durability of polymer composite materials.

Fillers can be organic or mineral in the form of powders, rolls, sheets (soot, wood flour, calcium carbonate, asbestos, talc, cotton or flax fibers, fiberglass, etc.). Organic fillers increase strength, reduce brittleness, but worsen the thermal and water resistance of plastics. Mineral fillers increase the strength, water resistance, chemical resistance, thermal and electrical insulation properties of plastics, but often increase their fragility and density.

Strength and reliability are the most important characteristics of any material. When the material is stretched, simultaneously with elongation, its transverse dimensions are reduced, which is characterized by the Poisson's ratio, which establishes a relationship between deformations along the εx and across the εy of the sample: $\varepsilon x = \mu \varepsilon y$.

If the filler is as polar as the polymer, then it can have a strengthening effect on the strength characteristics of the polymer material at a certain degree of filling. The reinforcing effect of the filler is especially clearly manifested when the filler has an ordered structure, for example in laminated plastics. On the contrary, in the case of unequal polarity of the polymer and the filler, when the polymer "does not wet" the powdered filler, a decrease in the strength characteristics of the polymer is observed.

Thermoplastics macromolecules of any composition contain active centers due to the structure of the molecular chain or the peculiarities of synthesis. These centers can interact with various reagents, for example, with oxygen in the air. As a result, there is a significant decrease in the parameters of the service characteristics of products made of thermoplastics. Polymer compositions can be divided into two types that differ in their structure: microscopically homogeneous materials consisting only of a polymer substance, and microscopically heterogeneous materials consisting not only of a polymer substance, but also of dispersed or oriented foreign particles or filler layers in it.

The analysis of studies shows that the most effective modifiers of polymer binders are components that prevent the development of processes of thermal oxidative degradation. Of particular interest in this aspect are modifiers that actively affect the parameters of the characteristics of polymer composites under prolonged exposure to operational factors. In recent decades, there has been an intensive development of research related to the production of multicomponent polymer mixtures.

The main problem in the technology of mixed materials is the thermodynamic incompatibility of most polymers with each other due to the low entropy of their mixing and weak adhesive interaction in the interfacial region. As a result, the combined components in the composite material break up into separate phases having an adhesive interaction at the interface, which significantly affects the parameters of the characteristics of the products obtained from the compositions. Two-phase composites based on polymer mixtures can be divided into two types by structure: conventional dispersions and mixtures with two continuous phases (matrix structure).

Conventional dispersions are characterized by the formation of one of the components of the dispersion medium, and the second component is the dispersed phase. The matrix structure is characterized by the fact that both phases of the mixture are continuous and "intertwined". The continuity of both phases is characteristic only for high-molecular emulsions and is due to their high viscosity.

- The mixing of components similar in chemical composition and structure is accompanied by structural changes at the level of structural organization. The effects observed when mixing polymers of different molecular chain structure and chemical nature are due not to intraphase transformations, but at the interphase level. The nature of the changes is determined by the size and perfection of the structural elements, the interaction of phases at the interface, and for crystallizing polymers
- The phase correlation within the components.
- Improved compatibility in polymer mixtures can be achieved by several methods:
- selection of polymer pairs or modification of components to increase intermolecular interaction (for example, the formation of hydrogen bonds);
- carrying out chemical reactions between the components of the mixture, in the process of combining leading to the production of an interpolymer;
- Introduction of low-molecular or high-molecular compounds into the system that enhance the specific intermolecular interaction between the chains of matrix and alloying components.

A very effective technique for improving the compatibility of thermodynamically incompatible polymers is the modification of polymer mixtures using various active components. In our opinion, the formed requirements for functional composite materials based on thermoplastics can be provided with the implementation of the basic methodological principles, which consist in increasing resistance to the effects of thermo-oxidative and operational environments and aging. The proposed principles are based on modern approaches to managing the structural characteristics of composite materials using various technological solutions.

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