PROPERTIES OF COMPOSITE POLYMER MATERIALS AND COATINGS.

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Annotation: Composite polymer materials and coatings are currently widely used in various industries due to their highly effective mechanical, chemical and physical properties. These materials are often a combination of polymers and other components, which allows achieving optimal performance characteristics such as high strength, corrosion resistance and wear resistance. Composite polymer materials have a number of advantages, including lightness, low production costs and the ability to create specialized coatings to protect against external influences.

Keywords: Composite polymer materials, polymer coatings, mechanical properties, corrosion resistance, high strength, protective coatings.

Introduction: Composite polymer materials and coatings are one of the fastest growing areas of science and technology that have received significant attention in recent years. Polymers are known for their lightness, workability, cost-effectiveness, and simplicity of preparation. In addition, their chemical and physical properties, such as high corrosion resistance, thermal and electrical insulation properties, provide a wide range of applications. Composite polymer materials are materials that are made up of a combination of two or more components. These materials are often made up of a mixture of polymers and reinforcing materials (glass fibers, carbon fibers, ceramics, etc.). As a result, they can have unique high mechanical and physicochemical properties, which makes them widely used in various fields - aerospace, automotive, chemical industry, construction, medicine, etc.

The properties, production processes, applications, and development trends of these composite polymer materials and coatings are discussed. The scientific aspects of the materials and new perspectives for their practical application are also analyzed. Research and innovative approaches carried out in this area can serve as the basis for the creation of new materials and technologies in the future[1].

Main part: Composite polymer materials and coatings are one of the most important and promising areas of modern materials science. They are distinguished from other traditional materials by their unique properties. The main parts provide detailed information about the composition, production processes and main properties of composite materials and coatings. Composite materials and their composition: Composite materials are created by combining two or more components. They consist of the following components: Matrix - The main part of composite materials and is mainly composed of polymers. Composite materials are created using various manufacturing processes, such as molding, pressing, working with thermoplastic or thermosetting polymers[2-3].

Properties of composite polymer materials: Composite polymer materials have high strength and durability, and are characterized by the following main properties: a). Lightness and high strength: Polymer composites are often light and have high strength. Therefore, they are widely used in the automotive, aviation and aerospace industries. b). Corrosion resistance: Polymer composites are usually resistant to water, chemicals, and other external influences. These properties allow them to be used in harsh conditions and aggressive environments. v). Thermal insulation: Polymers retain heat well, and composite materials can be produced using special polymers designed to work at high temperatures. c). Flexibility: Composite materials can be made into various shapes and sizes, which allows them to be used in many industrial sectors[4].

Methods: The molding method is one of the most common methods for producing composite materials. In this method, a polymer matrix and fillers (such as glass or

carbon fibers) are placed in a mold, heated, and then twisted or pressed under high pressure[5].

Pultrusion is a continuous process for the production of composite materials. In this method, fillers and a polymer matrix are combined and extruded into a tube or profile. When the materials are converted into composites, they are automatically processed, and the advantage of this method is that the production process is very efficient and economical. Pultrusion is mainly used in the production of tubes, profiles and other structural materials.

Vacuum infusion is a low-pressure method for producing composite materials, in which filler materials and a polymer matrix are combined under vacuum pressure. This method produces materials with a rigid and precise shape, high strength and good corrosion resistance. Vacuum infusion is a widely used and highly efficient method, especially in the production of large-scale devices, ships and aerospace equipment[6].

Manufacturing methods such as molding, prepreg technology, pultrusion, vacuum infusion, and 3D printing ensure high quality composite materials and coatings. Each method has its own advantages, allowing them to be used effectively and economically in various industrial sectors.

Composite polymer materials, especially plastic-based materials, have significant environmental impacts and environmental concerns. Polymer materials do not naturally degrade and can persist in the environment for a long time. Therefore, the development of composite material processing technologies and the creation of environmentally sustainable options are of great importance. Although composite material production methods, such as prepreg technology, vacuum infusion or pultrusion, are effective in obtaining high-quality materials, sometimes the production processes can be very complex and expensive. New technologies, especially automated and optimized production processes, need to be developed.Although composite polymer materials are designed to perform over a long period of time in many applications, in some cases the durability of the

materials may be limited. For example, they may be sensitive to certain chemicals or high temperatures. Therefore, it is necessary to better understand and modify the factors that affect the long-term performance of the materials. This, in turn, ensures production processes and the longevity of materials[7].

Results: The research and development of composite polymer materials and coatings has yielded many positive results. The following are the main results obtained in the application and production methods of these materials:

-Composite polymer materials, especially polymers mixed with reinforcing fibers, have high mechanical strength, elastic modulus and deformability. These materials are widely used, for example, in the production of car body parts or aircraft components. As a result, it is possible to obtain lightweight and high-strength materials. Also, the high durability of composite materials ensures long-term use[8].

Composite polymer materials and coatings are corrosion resistant and provide high protection against various environmental influences (chemicals, moisture, heat, etc.). This is especially important in the chemical industry, marine industry, automotive industry and many other industries. As a result of corrosion resistance, the service life of materials is extended and maintenance costs are reduced.

Composite polymer coatings, especially in the automotive and construction industries, provide high-quality protection and long-term service. The surface of these materials is easy to clean and maintain, which reduces maintenance costs. The coatings retain their unchanging quality for a long time, which is economically beneficial[9].

Discussion: Composite polymer materials and coatings are of great importance in modern materials science. Their many positive properties, including high mechanical strength, lightness, corrosion resistance, thermal and electrical insulation, environmental safety, and recyclability, ensure their widespread use in many industrial sectors. Polymer coatings also provide long-term performance of materials and reduce maintenance and repair costs. However, the use and

production processes of these materials may also encounter a number of problems and limitations. The production processes of composite polymer materials and coatings have their own complexities. For example, it is necessary to mix polymers and reinforcing materials in a correct and coordinated manner, and to produce them under the right temperature and pressure conditions. In addition, the production of composite materials, especially mixtures of high-quality fibers and polymers, can be expensive[10]. On the other hand, the complexity of the production process of high-quality materials can lead to an increase in price, which limits their widespread use in some industries. Depending on the economic situation of the industry in which these materials are produced, sometimes the high price may not be able to cover the costs of raw materials and production. In addition, the environmental and economic aspects of composite materials and coatings, as well as the issues of recyclability and sustainable production, will become more relevant in the future. The rapid production and widespread use of these materials, as well as their efficient and sustainable production, will affect the development of the industry[10].

Conclusion: Composite polymer materials and coatings have become an integral part of modern industry with their high mechanical, chemical, and physical properties. They are lightweight, durable, corrosion-resistant, and have high performance properties, and are widely used in automotive, aviation, construction, shipbuilding, and other industries. The processing and production of polymer materials using new technologies offers many useful opportunities. In the future, composite materials will have even higher quality and their use in various industrial sectors may expand. They play an important role in ensuring not only strength, but also environmental sustainability. Therefore, the development of the field of composite materials and coatings will help meet the new needs of the industry, and their importance is expected to increase further in the future**.**

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