PROPERTIES OF COMPOSITE POLYMER MATERIALS AND COATINGS USED IN AUTOMOBILES

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Annatatsiya: *Kompozit materiallarni tasniflashda materialshunoslikning bir nechta mezoni asos qilib olinadi. Bular–kelib chiqishi, vazifasi, matritsa materialining turi, unsur (komponent)lar tabiati, fazaviy qo'shilmalar o'lchami, strukturaning belgilari, olish usullari. Shularni bir-bir ko'rib chiqamiz.*

Kalit so`zlar: *Polimer qoplama materiallar, kukun metalurgiya, termoplast, termoreaktiv kompozit to'ldiruvchi, matritsa, polimer, kompozitsion material.*

Аннотация: *Классификация композиционных материалов основана на нескольких критериях материаловедения. Это происхождение, функция, тип матричного материала, природа элементов (компонентов), размеры фазовых включений, признаки строения, способы получения. Мы рассмотрим их один за другим.*

Ключевые слова: *Полимерные лакокрасочные материалы, порошковая металлургия, термопласт,термореактивный, композитный наполнитель, матрица, полимер, композитный материал.*

Abstract: *The classification of composite materials is based on several criteria of material science. These are origin, function, type of matrix material, nature of elements (components), size of phase inclusions, signs of structure, methods of production. We will consider them one by one.*

Keywords: *Polymer coating materials, powder metallurgy, thermoplastic, thermoreactive, composite filler, matrix, polymer, composite material.*

Composite (composite) materials are multi-phase systems consisting of two or more elements (components), which retain their originality (composition and structure). A composite is often formed as a result of combining chemically different phases in volume. The size of phase inclusions in a composite material is usually larger than the ability of an optical microscope (around 0.3 μm).

Figure 1 shows the structure of the composite material in the schematic view. The continuous component in the composite volume is called the matrix or binder (1). Other components, such as reinforcing or reinforcing components (2), are arranged in a certain order in the matrix. Transmissive surface layers (3) are located at the separation boundary of the matrix and other components. The properties of the substance of the transition layer (sometimes called the "third phase") are different from those of the main phases.

The idea of the expediency of accepting it as the third phase was mentioned by Plato. Through such an approach, it is intended to improve the interaction of

incompatible substances. The ancient Greek philosopher (428-348 BC) put forward such a concept to explain the idea that the universe may be composed of incompatible elements: earth, water, air, and grass.

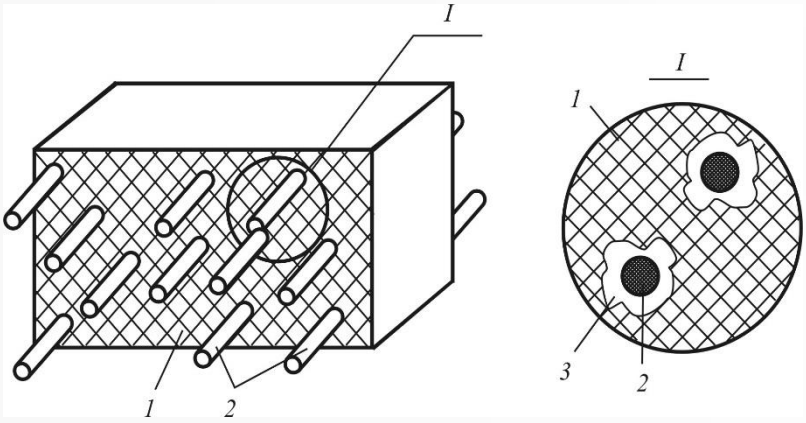

Figure 1. The structure of the composite material (scheme)

1–matrix; 2–reinforcing element; 3-a transition layer at the boundary separating the elements

The characteristics of the transition layer, first of all, the strength of the connection with the components (adhesion) largely determine the operational characteristics of the composite and their stability over time. When a mechanical load falls on the composite, the stress is maximum at this separation boundary. The main task of the transition layer is to reduce local stresses and distribute the load uniformly along the separation boundary. Therefore, the transition layer should not be damaged by the stresses and thermal stresses created by the deposition. The first of these stresses occurs as a result of the hardening of the matrix, and the second occurs during operation due to the fact that the coefficients of linear expansion of the matrix and components with temperature are different.[1-2]

Due to the transition layers, composite materials have unusual properties. The term additivity is used in materials science. Its meaning is "joining", that is, some indicator of a complex object is equal to the sum of the same indicators of the parts that make up the object. Applying this term to material science, it can be said that the properties of the composite are not additive to the properties of the components. That is why composite materials are made, in other words, the properties of the composite are more than the sum of the properties of its constituents. This phenomenon is called synergism.[3-4]

The classification of composite materials is based on several criteria of material science. These are origin, function, type of matrix material, nature of elements (components), size of phase compounds, signs of structure, methods of production. We will consider them one by one.[5-6]

By origin, there are natural, artificial and synthetic composite materials. Natural composites are readily available on Earth or in space. Artificial and synthetic composites are the product of human activity.

According to the task, composites are divided into two large groups: composite materials intended for general technical works and special works. The first receives

and transmits mechanical loads, from which structural elements are made. The second (it can also be structural) performs special tasks in the product: reducing friction and corrosion of moving joints, protecting metal details from corrosion, sound and heat insulation, etc.[7-8]

According to the material of the matrix, there are the following composites:

- polymer composites (based on thermoplastics, reactoplasts, based on polymer mixtures);

-metal composites (including alloys made by the powder metallurgy method, consisting of macro-different phases);

-ceramic and other inorganic composites (based on inorganic polymers, in mineral, carbon, oxide and other inorganic matrices);

-combined (polymatrix) composites.[9-10]

The matrix gives the necessary shape and monolithicity to the product made of composite, ensures the transfer and distribution of the load in the volume of the material, protects the reinforcing elements from external influences. The type of matrix determines the following parameters related to the composite material and the product made from it: working temperature range, corrosion resistance, electrical properties, thermophysical characteristics, kinetic laws of wear, manufacturing technology, important operational characteristics.[11-12]

According to the nature of the components (included in the matrix), the composites are divided into groups corresponding to the sign of the modifying components. The component list is extensive and all applicable technical materials are included. Therefore, the classification of composites according to this sign will be hierarchically structured. The first step of the hierarchy is to divide composites into filled and reinforced types.[13-14]

In the matrix of filled composites there are fillers-dispersed, that is, small, crushed particles of inorganic and organic substances. They can be in any phase. Fillers in the composite perform the following tasks:

1) changing the mechanical parameters of composites and giving them special properties (electrical conductivity, chemical stability, sound absorption, etc.);

2) improves the technology of composites, i.e. makes them flexible for product preparation (for example, anti-friction components improve the pressability of powder mixtures; plasticizers increase the wetting of powder particles with a binder; active additives increase the adhesion of components, etc. .);

3) makes the product cheaper, because fillers (for example, gas additives, sand, kaolin, etc.) are cheaper than binders.[15-16]

Reinforced composites contain such an element (reinforcement). It will be stronger than the matrix. These are, as a rule, long-dimensional components, which absorb a large part of the mechanical load when the composite works. The strength of the matrix can be increased by 1.5-2.0 times with the help of a filler, and it can be increased ten times or more when reinforcing. In addition, reinforcing elements make the composite thermally and electrically conductive, as well as absorb radio

waves (electromagnetic waves in the radio range), provide anisotropy of mechanical and other properties, and create a different structure on the surface layer. The properties of reinforcing components (fibers, threads, fabric, sheet materials, fibrous bulk or porous elements, etc.) to composites are in many cases of decisive importance. Therefore, the chemical nature of the reinforcement is reflected in the name of the composites: graphite-plast, metal-ceramic, glass wool, etc.[17-18]

Composites can include both filler and reinforcing elements at the same time.

In order to strengthen the economic independence of our country, to fully satisfy the ever-increasing demands of our people, it is necessary to develop industry and agriculture with great strides. Improvement of production techniques requires more and more creation of new materials and creation of new technology of their production.

Based on this, today it is difficult to imagine modern production without polymer materials. The use of these materials, in addition to compacting the structures of technical equipment, reducing their mass, increasing the reliability of operation, opens a great way to reduce the cost of production and labor costs, and the widespread use of polymers directly replaces expensive metal and wood materials. is the reason for obtaining, in many cases surpassing them [1-2].

The fact that polymers can replace many expensive and rare ferrous and non-ferrous metals, and sometimes surpass them, has led to their widespread use. Their use is also economically beneficial, for example, costs for materials, labor costs for the preparation of parts are reduced, parts are much lighter, capital expenditure and operating costs (lubrication, maintenance) are reduced, etc.

If the parts are made from metal by casting, thermal and mechanical processing, then they are obtained from polymer by only one operation-casting or pressing under pressure. Material waste in the production of polymer products does not exceed 5-10%, and in the production of metals, the waste is much more (60-70%). Polymer products are two to three times cheaper than metal products.

Polymers have a complex composition. The main part of them is binders consisting of natural or artificial resins (polymers). Polymer molecules are substances consisting of chemically connected links that are reduced several times. Plasticity, i.e. taking the desired shape and keeping it, is a unique property of polymers. Long chains of polymer molecules have different shapes and can be arranged in different ways. If the molecules are in the form of a straight thread, the substance obtained from them will have the properties of a flexible body. If the molecule is in the form of a coil, due to their alignment, the material can stretch five to seven times (stretches much more than steel, steel does not stretch more than 10-20%) . Adjacent groups of atoms from some polymer compounds are connected in the form of a single framework. Such materials are not soluble.

In addition to the binder, the polymer also includes:

* fillers (wood flour, soot, glass, fluff, paper, asbestos, gas, metal powder, etc.). Fillers are designed to reduce the consumption of the expensive main binder, as well as to increase the strength of the product and reduce its penetration. Asbestos-like fillers increase the heat resistance of materials, while metal powders or graphite give it electrical and heat-conducting properties;

* plasticizers (derivatives of oils, phosphoric and phthalic acids); they make polymers plastic and easy to process;

* antioxidants substances that increase the resistance of polymers to the influence of oxygen in the air and sunlight;

* paints, oils, pore formers and some other substances.

The properties of polymers depend on the composition and amount of substances added to them. By changing the amount of these substances, it is possible to obtain compounds with different, even predetermined properties. The most important positive properties of many polymers are their resistance to water, many aggressive substances and petroleum products. Advances in chemistry allow us to obtain plastics that can work at both low and high temperatures. Since many polymers are good electrical insulators (dielectrics), they can be used in the production of electrical equipment for tractors. The disadvantage of the polymer is that it is not very resistant to heat, as well as changes its properties over time, that is, it tends to wear out. But materials free of these defects are being created more and more.

Polymers are divided into two main large groups: thermoplastic and thermoset polymers. Thermoplastic polymers are polymers that soften when heated and become very plastic, easily deformed, and when cooled, harden and soften again. Such materials can be transferred many times from one state to another. They are soluble in various solvents. Parts made of these polymers can work at a low temperature (up to 60-70o C), and some can withstand up to 160-200o C.

Polymers that first soften and partially liquefy when heated, and then become non-liquefiable and insoluble are called thermosetting polymers. They are insoluble or slightly swollen in solvents.

Recycling of thermosetting plastics is an irreversible process.

According to their function, polymers are classified as follows:

* structural polymers with high, medium and low strength, heat-resistant, cold-resistant, decorative-processable;

* electronic and radiotechnical polymers-electrically insulating, electrically conductive;

* amortization, sound and heat insulation;

* frictional and antifrictional;

resistant to anti-corrosion and aggressive environment (atmosphere, acid, alkali, oil products, solvents, etc.).

Many polymers have complex properties that can be used in several fields. For example, polypropylene is used in the development of complex-shaped details, gear wheels, lubrication and cooling system filters, plugs, electrical equipment.

A more promising and useful method of widespread use of polymer materials is their use in a metal-polymer system mixed with metals, that is, thin-layer polymers on metal. Such a combination allows to obtain polymer coatings on metal or non-metallic products with high capacity and quality. [3-4]

Polymeric materials that are placed on metal surfaces in the form of a thin film can withstand high voltages and conduct heat well. Thus, in bearings with a thin polyamide coating (0.1–0.5 mm), resizing for hygroscopicity and thermal expansion can be almost negligible, for example, there is no need for a hole between the shaft and the bearing.

In recent years, there has been an increasing interest in the use of thin-layer polymer coatings of metals in machine-building, tool-making, chemical, food, electrotechnical industry, construction and other sectors of the national economy. In our country and other countries (USA, England, France, Germany, Japan), 30-35% of the polymer materials produced in general are used for coatings. This is due to the fact that the coating provides a combination of excellent properties of metals and polymer materials. This is because the coating provides a beneficial combination of polymer material properties. Thin layer coatings allow to create new products of machine building and structures. In addition, they protect chemical devices, machine parts, fittings, pipes from corrosion, iron structures from moisture and mechanical damage, increase the wear resistance and antifriction properties of parts made of wear-resistant products and unsuitable units; ensures that the processed details do not stick to the upper part of the device, provides electrical insulation, etc.

Application of polymer coating materials in products, parts of machines and mechanisms: together with the saving of expensive and scarce stainless steel and aluminum iron, bronze, lead, nickel, babbitt, etc., it is possible to replace them with other materials in coating production. will give. [4] according to the work data, it can be seen that the price of a 2m3 container made of steel, made of polyvinyl chloride, is five times cheaper than the price of a similar container made of stainless steel of the IX18N9T brand. In this case, 650 kg of iron products are saved. The cost of sliding bearing with length 120 mm, diameter 120 mm made of cast iron or iron with 0.5 mm thickness polyamide coating is 2-3 times cheaper than the cost of bearing with the same specification but made of bronze material, and its durability [5] will be more than It should be noted that the production of products with a polymer coating is simpler than the production of celogite products from polymer products. In addition, the use of thin polymer films allows the economy of scarce and expensive polymers.[6]

Polymer coatings have advantages over painting, electroplating and silicification in terms of production technology and usage properties. Paintable

coatings cannot always meet the ever-growing demands of the industry. In addition, the presence of organic solvents in kraskas causes inconvenience in fire fighting and sanitary relations. When obtaining galvanic coatings, there is a large consumption of scarce and expensive metals. Most of them do not provide protection against corrosion. Silicate coatings require a lot of work and energy. In addition, they are brittle and inelastic.

When obtaining polymer products, the technological process is simplified, economic efficiency increases, they are obtained in a quality and long-term condition. Unlike paint and galvanic coatings, this process reduces the use of expensive, scarce, toxic and flammable organic compounds, and does not use non-ferrous and other precious metals.

One of the important features of polymer coating materials compared to lacquer, silicate and galvanic coatings is the ability to easily change their properties by adding appropriate stabilizers, fillers, plasticizers, etc.

For another way to compare polymer coated materials with galvanic coatings in terms of economy of use, here's an example: a polyvinyl butyral or high-density coated meat hanger at a meat plant is cheaper than a tin-coated hook. Its longevity increases 2-3 times.

It should be mentioned that a promising use of polymer-coated metal is metalloplast, a varnished material containing black or non-ferrous metals, covered with polymer on one or both sides. The usefulness of metalloplast is the possibility of using them in various types of mechanical processing, i.e. forming, stamping, welding, etc.

A very promising way of using polymer coating materials is to use them instead of obsolete parts in machines and mechanisms. The ease of restoration and repair of polymer coating materials and their relative cheapness are of great importance.

One of the most important features of polymer coating materials compared to others is their versatility. According to their designation, they can be used for decorative protection, anti-friction wear, corrosion resistance, vibration absorption, sound absorption, technological insulation, electrical insulation.

Thus, thinly coated polymer and composite coatings on the iron surface make it possible to use the useful properties of polymer and metal, to significantly increase the durability and longevity of metal products, machine and mechanism details, and to save on the use of expensive and scarce materials in large quantities. These properties of composite polymer coating materials are considered important for the national economy.[18-19]

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