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Properties of Polymer Materials and Coatings

Turaev Shoyadbek Ahmadjonovich
Senior teacher at Andijan
Machine – building Institute

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 form of a scheme. 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.[11-12]
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.[20]

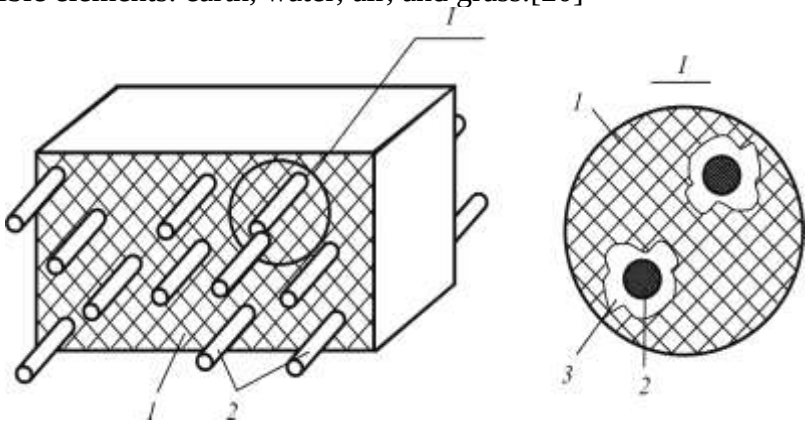

Figure 1.1. The structure of the composite material (scheme)
1 – matrix; 2 – reinforcing element; 3 - a transition layer at the boundary separating the elements

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 composite is subjected to a mechanical load, the stress is at its maximum at the yield point. 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.[15-16-17]
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

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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]

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.[7]

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.[3]

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]

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.

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 list of components is large 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.

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) change the mechanical parameters of the composites and give 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.

Reinforced composites contain such an element (reinforcement). It will be stronger than the matrix. These are usually long-dimension components that 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, and also provide the ability to absorb radio waves (electromagnetic waves in the radio range), anisotropy of mechanical and other properties, and create a different structure in 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.Kompozitlar tarkibiga bir vaqtning o’zida ham to’ldiruvchi, ham armaturalovchi elementlar kirishi mumkin.

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.[3]

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

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widespread use of polymers directly replaces expensive metal and wood materials. is the reason for obtaining, in many cases surpassing them.[20]

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.

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.[20]

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.

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