ON THE APPLICABILITY OF COMPOSITES MATERIALS

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ABSTRACT: *Composite materials have emerged from the need to create new materials with special properties and to replace or reduce the consumption of traditional and expensive materials, as well as to increase the safety and reliability of parts or tools. Due to their remarkable properties (durable, shock-resistant, low volume in relation to metals etc), composite materials are used in multiple fields (machine building, construction, electronics, medicine, chemistry, etc.)*

KEY WORDS: composites, reinforcing elements, fibers, matrix

1. Introduction

The evolution of society over time has determined its development on all levels: social, cultural, economic, technical, etc. Economic progress has been and it is in close contact with technical discoveries. Thus, the discovery of new materials, improvement of the properties of the existing ones, the development of new technologies and processes contributed to the development of humanity.

Composite materials also fall into the category of materials that have led to technical success, being the most advanced materials that man has produced in modern times and will evolve in the future and will lead to performances in science and technology.

Composite materials have always existed in nature. For example, we can assume that the plants are composite reinforced with cellulosic fibers, and the animals are composite reinforced with collagen fibers, elastin and keratin [1].

Bamboo can be considered a composite material because cellulose fibers are reinforced with silica, which gives it exceptional elasticity and resilience. Similarly, in plasma blood flow forms the matrix, and the red blood cells are dispersed. One of the first composite created by people is a materials used in antiquity, in Egypt, clay mixture with grain straw for the construction of shelters [1]. Examples of composite materials existing in nature from remote times can continue. [2].

1.1 The characterization of composite materials

In the modern era, due to the evolution of the technique, taking into account the concept of sustainable development, it was necessary to develop new materials and technologies that would satisfy the requirements of the market.

Thus, the term "composite material" has its own properties and represents the future in the technique.

Composite materials have emerged from the need to create new materials with special properties and to replace or reduce the consumption of traditional, expensive materials, as well as the need to increase the safety and reliability of parts or tools.

A composite material is an assembly of two or more homogeneous macroscopic materials with different structure and properties which, by combining the individual qualities of the components, form a heterogeneous material with improved overall performance. Therefore, a composite consists of at least two components, in which one with a matrix function, the other one embedded in the first, with different shapes and dimensions, acts as an armature with well-defined separation surfaces. The basic function of the matrix is to transmit the external

load onto the reinforced phase. For the matrix, a good bond strength with the reinforcing phase material (i.e. perfect wettability without chemical interaction at the interface of the matrix and reinforcement) is required.
The matrix of composite materials must be done from a material that can contain the dispersed component and which it does not destroy by dissolving, melting, chemical, or mechanical action.
The matrix make the connection between the reinforcement elements and the external load and represents the deformable part of the material, having a lower mechanical strength than the complementary material it includes and may be plastic, ceramic or metallic. The matrix also determines the composite's resistance to temperature and corrosion.
The reinforcement give to the composite material a high strength and represents the main load picking element. The matrix and reinforcement are chosen so as not to interact chemically or mechanically with each other during the process of composite material preparation or its use.
The choice of the matrix is made according to the purpose and methods of obtaining the composite[3].
Composite materials are artificially created by combining different components and presents properties that no separate components can have. Being artificially created, it is possible to control the working conditions by modifying the different parameters and thus obtaining composites with special properties.
For example (fig.1), varying the concentration of H_3PO_3 in the electrolysis bath for Ni-P/SiC composite electrodeposition layers results in different hardnesses when applying the same load[4].

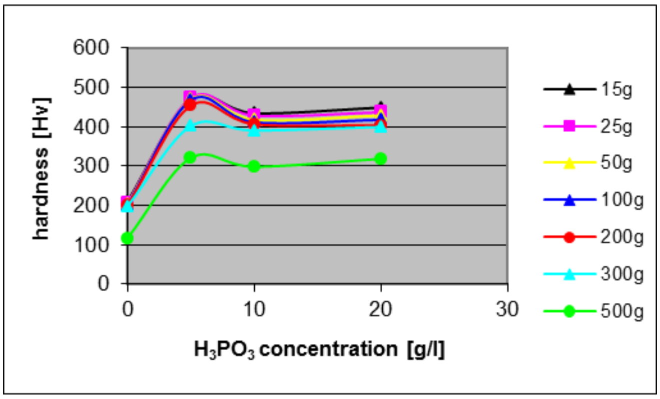

Figure 1: Variation of deposition hardness depending on phosphorus acid content in electrolyte

The use of composite materials in many areas is due to the special advantages they impose:
- are durable;
- are resistant to shock;
- have high traction resistance;
- they have a very low expansion coefficient compared to the metals
- have a low bulk density relative to metals (eg, epoxy resins composite with silicon, boron and carbon fibers have a bulk density below 2 kg/dm^3);

- have a high vibration damping capacity;
- have low energy consumption and less expensive installations in the production process than metals;
- have high operational safety;
- are corrosion-resistant; have high resistance to high temperatures, etc.

Composite materials also have some disadvantages:
- are not ductile;
- are more expensive than traditional materials
- composite materials behave elastically until breakage, etc.

With remarkable properties, the field of use of composite materials is vast, being found in many areas [4]:

a) Construction of machinery
aircraft (helicopters, helicopters)
shipbuilding (boats, submarines)
vehicles
lifting machines
rolling material

b) constructions (recreational buildings, carpentry, roofs, cooling towers, profiles, mobile bridges, tanks, etc.)

c) electronics (computers)

d) energy (wind)

e) Optics (telescope)

f) chemistry (chemical machines, live containers)

g) medicine (orthopedics, dentistry)

1.2. Classification of composite materials

a. *Composite materials with organic matrix*

Organic matrix are made of thermoplastic materials (polystyrene, polyester, polyethylene, etc.) or thermosetting materials (polyester resins, phenolic resins, polyamide resins, etc.) and are most used in composite materials due to the characteristics they have: corrosion resistant, lightweight, thermal and electric insulator, etc. However, they have little mechanical strength at temperature rise and mechanical shock, low thermal conductivity and a high coefficient of thermal expansion. The organic matrix may be thermosetting matrix and thermoplastic matrix. Polymer composites have a wide range of uses due to their easy way of obtaining and the convenient price.

b) Composite materials with ceramic matrix

The use of technical ceramics for the production of composite materials has the advantage of obtaining composites with remarkable properties: mechanical strength and high hardness at temperature rise; a wider range of application temperatures, high resistance to chemical attack, very high breaking strength, high elasticity, etc.

Composite materials with ceramic matrix consist of inorganic substances (oxides, carbides, silicas, borides, etc.) reinforced in an assembly with reinforcing elements in the form of fibers, granules or aggregates.

The ceramic matrix has a high brittleness, which is a disadvantage of composite materials, but their wide range of uses makes them widely used.

c. Composite materials with metallic matrixes

Composite materials that are used at relatively high temperatures are based on a metal matrix.

They have good mechanical properties, are used successfully at high temperatures, have good chemical resistance, have high electrical and thermal conductivity, are processed well, etc.
The impediments are: the occurrence at the interface between matrix and fibers of fragile intermetallic compounds that cause stresses and microcircuits, the mass volume higher than the polymeric matrix, the elaboration methods are more complicated and more expensive. Their use is made taking into account the mechanical, thermal, electrical, metallurgical properties and specific gravity.
The quality of composite parts is appreciated according to the following criteria [5]:
- the reproducibility of the volumetric ratio between the polymer matrix and the reinforcing agent;
- the homogeneity of the polymer material appreciated by the lack of gaseous inclusions;
- state of the surface;
- stability and dimensional precision;
- mechanical strength of the material;

Due to the fact that these composite materials are used in different fields of activity, their quality and durability need to be very high. Thus, the quality of composites products depends both on the process and the manufacturing technology and quality control, as well as on the phenomena at the interface between the matrix and the reinforcement element. Also, quality management techniques and tools can be used in quality control and improvement processes in many areas [6,7], including composite materials manufacturing.

2. CONCLUSIONS

A composite material is an assembly of two or more homogeneous macroscopic materials with different structure and properties which, by combining the individual qualities of the components, form a heterogeneous material with improved overall performance.
The matrix make the connection between the reinforcement elements and the external load and represents the deformable part of the material.
The reinforcement give to the composite material a high strength and represents the main load picking element. The matrix and reinforcement are chosen so as not to interact chemically or mechanically with each other during the process of composite material preparation or its use.

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