PROPERTIES AND APPLICABILITY OF SOME COMPOSITE MATERIALS

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ABSTRACT: Nowadays, the need for materials with improved properties led to new researches in the field of composites. Composites material have two main categories of constituent materials: matrix and reinforcement. With the help of these two, a new material is obtained which has superior properties. An important utility is that of strengthening and reinforcing some resistance elements such as: beams, walls, pillars, etc. This is done based on the materials that make up the composite. These materials have different properties and in turn contribute to the improvement of stress behavior of the resistance elements.

KEY WORDS: matrix, reinforcement, applicability, properties

1. INTRODUCTION

Composite materials have been used for a long time with applicability in people's daily lives (mixtures of building materials, plant fibers for fabrics, etc.). These materials consist of two components, namely: matrices and reinforcements element.

An important element from a composite material is the matrix. There are different types of matrices according specialized literature [1]:

-Polymer matrices which are realized from a polymeric resin (polyamides, epoxy, polyester);

-Ceramic matrices that can be: Silicon Carbide, Alumina, Silicon Nitride, etc.,

- Metal matrices with contain Mg alloy, Al alloys, Cu alloy, etc.

Another material which is content in the composites is the reinforcement. This reinforcement can be done from different types of elements like artificial and natural which do the composite to be used in different ways depending the field of use [2].

From this point of view the reinforcement is classified, according to the researchers, as: powders, whiskers, particles, and continuous or discontinuous fiber or yarn [3].

Regarding the fibers they can be: carbon, glass, basalt, aramid, etc., and they are embedded in the matrix giving improved properties to the new obtained material.

The types of these utilized fibers depend on the field of their use. These fields of utilization can be: energy, sports, aerospace, automotive, civil engineering, etc.

Regarding the types of fibers used for reinforcement these can be also long or short and can have different orientation often constituted in a laminated structure. Fibers used in a composite material contribute to weight minimizing and influence the tensile strength and stiffness. The fiber properties are giving by the coating chemistries used in the process and by the manufacturing process which they are obtain [4].

In the specialized literature the fiber are studied regarding the obtaining way, the influence of working parameters and their properties [5]. Depending the obtaining way fibers can be obtained continuous fiber and woven fibers being available in

many forms such as: uni-directional tapes of various widths, already containing the resin (matrix), dry, harness satins and plain weave, etc. The long fibers and the short fibers are employed in compression by operation of sheet moulding and moulding. These come in the form of chips, flakes, random mate [6].

The orientation of the fibers inside the composite material and their length determines the properties of the composite. A certain orientation of the fibers when making a composite results in obtaining much superior physical, mechanical and chemical properties, compared to the initial materials that make up the composite material. Thus, composite materials with very good strength, rigidity and an important strength-to-density ratio characteristics are obtained. In fig.1 it can be seen how the composite materials are done inside.

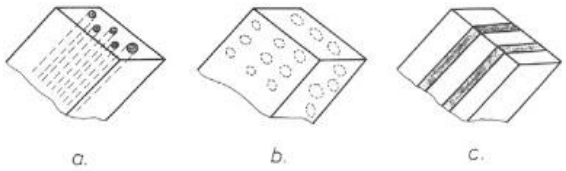

Fig.1. Composite materials:
a - Fiber reinforced
b - Disperse
c – Stratified [7]

The type of fibers influence the properties of the composite materials. For instance, there are composite materials with carbon fibers and glass fibers which have very good properties such as high stiffness, high strength and light weight. They can be used in civil engineering to consolidate different elements such as beams, walls, pillars, columns when their deterioration occurs.

To strengthen the resistance of these kind of elements are need to be used different types of composite materials. Among them are met carbon fiber or glass fiber plates or fabric.

Carbon fibers are twice as stiff and five-times stronger than steel. Because of these properties, carbon fiber is lighter than steel [8].

Glass fibers have good resistance to the actions of temperature variations, and also to the actions of different types of aggressive chemicals.

These kind of composite are utilized in automotive industry (for structure and components), aviation industry, marine (flooring, structural panels) and architecture, sport (different types of elements from the sport equipment).

Another example of composite produced and marketed nowadays is carbon fabric and glass fabric which consist of woven or stitched, unidirectional, carbon and glass fiber fabrics and impregnating resins [9]. They are used for applications such as: confinement, shear, strengthening of weak concrete, masonry, natural stone and timber structures [9]. Strengthening of the damaged elements is achieved by applying the carbon fabric or glass fabric to the damaged element, together with an epoxy matrix.

Regarding the carbon fibers there are many producers in the world that are doing this type of reinforcement. Depending on the field of use, composite materials are made in several types: with unidirectional, bidirectional or multi-directional fabrics. Here are few examples of composite materials which are currently used on the market: high strength unidirectional, carbon fiber fabric with very high modulus very high modulus and high elasticity is used for static consolidation of the damaged structures, where is necessary to increase the tensile strength of the section and also for improve the ductility and load capacity of the damaged structures [10].

There are also high-strength, bi-directional carbon fiber fabrics which are recommended for repair and improvement of bending strength and shear force of the reinforced concrete elements. Another type

of fabrics are cuadriaxial glass fiber fabrics which are recommended for repair and compliance static of the structures of masonry and concrete degraded by the environment and also are recommended for repair of two-dimensional structures such as floors, tiles, small arches, etc [10].
Another possibility for reinforcement is also basalt fiber mesh which is resistant to alkali. This kind of composite is used for strengthening concrete and masonry structures to increase their strength and ductility [10].

2. EXPERIMENTAL STUDY

This paper present a general view on some composite materials which have carbon and glass fibers as reinforcement. Because carbon fiber and glass fiber composite materials provide high mechanical properties, high reliability, low weight, they can be used to strength elements such as: beams, walls, and pillar.
For example, the wood beam, which is presented in this paper, generally, can withstand a relatively small concentrated bending force because the maximum bending strength that can handle the material is also small. If in the area of the beam where a bending force is applied is added composite with greater strength than wood (fig.2) then the wood beam can withstand a bigger force
because of the composite action. When the beam without reinforcement is subjected to bending then the wood rupture appear more easily. As a conclusion, we can observe that the wood beams reinforced with composite materials has a much better behavior than the unreinforced beams.
One of the principal objectives of this paper was the possibility of reinforcement of the wood beam with composite material and to observe the deformation under the bending force applied on the beams.

Fig. 2. Reinforcement application: two sheets of glass fiber fabric

Testing the beams system from fig.2 we observe that it resists at a maximum applied force of 21,5kN when the beams get a maximum displacement of 22mm. The reinforcement is made of two wood beams with rectangular section 50x25x500 mm, one of ash and other of beech, reinforced with two glass fiber fabrics glued with epoxy resin. It is important also to take into account the influence of working parameters during the tests [11]. As it is known from specialized literature wood has certain properties and depend of the environment condition.
In fig. 3 there are four beech beams reinforced with two carbon fiber fabrics glued with epoxy resin.
The beams have the following dimensions: two of them are 25x10x500 mm and the other two have 25x5x500mm.
Testing the beams system we observe that it resists at a maximum applied force of

15,8kN when the beams get a maximum displacement of 28mm.
We can see that the type of the reinforcement determine the behavior of beams system. Because the beach beam and the ash beam have different stiffness and different strengths and also composites material in both cases have another properties, the two reinforced systems have different behavior under the load force.

Fig. 3. Reinforcement application: two sheets of carbon fiber

3. CONCLUSION

The method of reinforcement with carbon fiber fabric and glass fiber fabric composite materials offers improved mechanical properties such as: increased resistance of the consolidated elements (in this case the wood beams), small weight, stiffness, high strength, etc. Also the composite materials are flexible and easy to apply. Adding composite materials on the wood beams increased the resistance of the beams under the bending force and improved the actual behavior of the systems.

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