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Paper Authors: **Qurbonov Jakhongir Komiljon ogli**

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COMPOSITE POLYMER MATERIAL USED IN THE REINFORCEMENT OF REINFORCED CONCRETE STRUCTURES

Qurbonov Jakhongir Komiljon ogli
Jizzakh Polytechnic Institute, Faculty of Architecture and Construction
Student of the II stage of "Construction of buildings and structures"

ABSTRACT: The article analyzes carbon fiber composite polymer materials used in the reinforcement of reinforced concrete structures. Features of the use of carbon fiber. Technical characteristics and advantages of its use in construction are given.

Keywords: reinforced concrete structures, polymeric materials, carbon fiber.

INTRODUCTION

How carbon is formed. Carbon was discovered in 1880 by T. Edison during the study of incandescent lamp filaments. Thanks to foreign manufacturers and industrialists, carbon fiber began to be actively used in various fields, including construction. Recent projects using carbon fiber in the territory of our country were developed during the Soviet era, so they are being actively restored by engineers.

Features of carbon use. Carbon fiber is an artificial product that belongs to a polymer with a composite structure. It is made up of thin filaments (3 to 15 microns in diameter) and filaments, in turn, of carbon atoms attached to a crystal lattice. Due to the physical properties of the carbon atom, the crystals in the network are parallel to each other. This flexibility is a key factor in helping to increase the tensile strength of the fiber.

The widespread use of carbon fiber in the aerospace and defense industries, as well as in building construction, is justified by the fact that the material is much harder than metal. In construction, carbon fiber began to be used in the 1980s to reinforce buildings located in a seismically active zone in California. In home construction, the material is used, as a rule, in repair work, but its popularity and scope of application is gradually growing.

Specifications and advantages of construction:

- excellent adhesion to surfaces of different textures.
- high resistance to corrosive processes.
- lightness and strength. Because carbon fiber is surprisingly lightweight, it is used in reinforcement systems, which reduces the load on the foundation of the building.
- moisture insulation.

The surface of the carbon fiber is shiny, which prevents it from reacting with water.

- high fire resistance and impact resistance.
- When used for fittings, the material can be applied in several layers.
- Any repairs that may use carbon fiber can be carried out without interrupting the operation of the building itself.
- it is completely toxic and environmentally friendly.

Soft, parallel skin, very strong and very stretchy. Elasticity is 70%. Resistant to heat and cold. It does not change shape or properties. Made of 10 times stronger steel.

Highly versatile. It can be used to reinforce structures of almost any configuration: on edged surfaces, from round and angular

elements, in light segments of frame structures, and so on.

Manufacture of polymeric materials. The production of polymeric materials requires a great deal of experience. Achieving accepted quality standards requires not only qualified personnel, but also defined technology for product production. For these reasons, everything in the catalog is of high quality, guarantees the achievement of its goals, and has regular positive reviews.

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Why is the price of carbon fiber so high? High energy costs are the main reason for the high cost of carbon fiber.

Carbon fiber production technology requires a lot of energy. Because the production process is semi-continuous, the production time of a single batch can be up to several weeks.

The starting material for the production of carbon fiber is the flagellum of a PAN precursor specially designed for this purpose.

To obtain the optimal orientation of the molecular structures, the PAN precursor is pulled and held under voltage.

Real-time monitoring of the PAN precursor manufacturing process ensures its uninterrupted operation and high efficiency

The precursor is exposed to hot air, becoming oxidized

The carbonization of the oxidized PAN fiber and its conversion to carbon fiber takes place in a nitrogen atmosphere at a constant furnace temperature. To achieve the required strength, hardness and other defined properties, the carbon fiber undergoes final carbonization at temperatures above 1000-1500 ° C.

An additional graphitization step is performed at a temperature of

2000-3000 ° C to obtain high modulus types of carbon fiber.

To improve the adhesive properties, the surface of the carbon fiber undergoes a special treatment or cutting. Subsequent application of a polymer lubricating layer increases the resistance of the carbon fiber to damage during textile processing, increasing wetting and adhesion to the binder. Continuous strands (bundles) of carbon fiber are wound on coils. Carbon fiber can also be fed in crushed or crushed form.

7 things you need to know about carbon fiber. 20 years ago, when carbon frames first appeared on the market, many experts compared what should be the ideal material for frames - aluminum, steel, titanium or carbon? Then carbon took the last place along with steel. But over time, the situation changed dramatically and carbon fiber became the material for high-end bikes. Carbon frames can cost up to $ 2,000, and that price can be justified depending on the quality of the material. But surprisingly, carbon fiber is starting to dominate not only as a material for frames, but also as a material for other parts of the bike.

Carbon is a complex material that can be used to create lightweight, complex frames with a combination of different shapes needed for bicycles. Carbon fiber is capable of taking almost any, even the most complex shape. This allows you to create any detail.

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What is carbon fiber? Carbon fiber is a long-stranded material made of carbon atoms. These thousands of yarns are combined to form a special yarn, which is then combined with resin to form layers of carbon.

Creating a carbon frame or other parts for a bike is done by applying carbon plates to a special shape. As a rule, special aluminum molds act as molds, which are preheated to make the carbon plates more flexible.

In this case, the frame is divided into several elements created separately (wagon assembly, fork cup, upper and lower pipes, etc.) and assembly into one structure is carried out before cooking. And the deposition is, in fact, the layers that are applied after all is assembled

Where are carbon frames and components manufactured?

Durable! Carbon can do a lot of damage before it becomes unusable, and it can even be much easier to recover than other materials. Due to their properties, carbon frames can be glued without the need for complex equipment. However, once the frame is restored, its overall strength is almost non-existent.

As for the loads that carbon products can withstand, they are very high. Thus, carbon fiber is superior to steel in terms of tensile strength.

Use of carbon. Carbon fiber was originally developed for the sports car industry and space technology, but due to its excellent performance properties such as low weight and high power, it has spread to other areas:

- in the aircraft industry
- for sports equipment: clubs, helmets, bicycles.
- hooks,
- medical technology, etc.

The flexibility of the carbon fabric allows it to be easily cut and trimmed and then impregnated with epoxy resin to independently form carbon products of any shape and size. The resulting blanks can be sanded, polished, dyed and flexo printed.

How carbon fiber is formed. Fibers composed of the best carbon filaments are obtained by heat treatment in air, i.e. by oxidation of polymer or organic fibers (polyacrylonitrile, phenol, lignin, viscose) for 24 hours at 250 ° C, i.e., by their combustion in practice. This is what the carbon filament looks like under a microscope after burning.

After oxidation, carbonization occurs - heating the fiber in nitrogen or argon at a temperature of 800 to 1500 ° C to build structures similar to graphite molecules.

Then graphitization (carbon saturation) is in the same environment

It is carried out at a temperature of 1300-3000 ° C. This process can be repeated several times, removing nitrogen from the graphite fiber, increasing the carbon concentration, and making it stronger. The higher the temperature, the stronger the fibers. This treatment increases the carbon concentration in the fiber to 99%.

Types of carbon fibers. The fibers may be short, cut, they are called “staples,” or the coils may have continuous threads. These can be woven, yarn, roving, they are then used to make woven and non-woven fabrics and ribbons. Sometimes the fibers are deposited in the polymer matrix without mixing (UD).

Fibers work well in tension, but because they are bad in bending and compression, the ideal use for carbon fiber is to use it as a carbon fabric.

Scientific novelty and benefits. Now about the money. For example, there is a bridge. The building is 15 meters long, 50 years old. It is collapsing. There are two options: one repair with a metal profile or carbon fabric will cost 40% less. No complicated equipment, no special specialists required, the carbon fabric is glued like wallpaper.

In our time, the construction industry is actively developing through the introduction of new

materials, as well as the use of innovative technologies.

The most pressing issues are the installation of structures that are resistant to dynamic loads and aggressive environmental conditions. Thus, to strengthen concrete structures, they began to use carbon fiber, which was previously only used in aircraft and rockets.

Where can I get carbon fiber? Taiwan, China, Russia. But in Russia, it refers to “high-strength structural fabrics based on carbon fiber”. If you find your way to the enterprise, then you are very lucky. Many companies offer ready-made carbon fiber DIY kits for cars and motorcycles, including carbon fiber parts and resins.

70% of the global carbon fabric market is produced by major brands in Taiwan and Japan: Mitsubishi, TORAY, TOHO, CYTEC, Zoltec and others.

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