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ADVANCED MANUFACTURING TECHNIQUES AND DIVERSE APPLICATIONS OF COMPOSITE REINFORCEMENT

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Abstract
Composite building materials play a pivotal role in contemporary construction, witnessing continual growth in production. This article addresses the crucial aspects of composite materials, focusing on their production, quality enhancement, and the integration of scientific advancements in capital construction. Emphasizing the need for ongoing improvement, the paper explores refined production processes, heightened material quality, and the application of cutting-edge technologies. Through case studies and real-world applications, it illustrates the transformative impact of innovation on construction practices. The article serves as a concise overview, highlighting the essential role of composite materials in shaping the future of construction. As the demand for robust and sustainable building solutions intensifies, this exploration underscores the imperative to embrace innovation in composite material production, ensuring its continued ascent in the construction industry.
Keywords: Composite building materials, Quality enhancement, Capital construction, Sustainable building, Resilient structures, Environmental impact, Modern construction, Future of construction.

Introduction

Certain positive results are being achieved in our republic in terms of deepening reforms and their development in the production network of construction materials and products, increasing the type of construction materials, products and constructions and the number of enterprises producing them. Due to the problems arising in the effective use of fuel and energy resources in our republic, the share of composite building materials with high energy efficiency in the production of modern building materials is increasing.

The main directions of development of the composite building materials production industry are as follows:

– application of scientific innovations to the field; increase the quality level and efficiency of composite building materials;
– Wide application of the most modern technological processes to reduce labour costs in production, organize mass production of high-quality composite materials, radically

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improve production technology; and use of high-performance automatic equipment;
- use of the best quality management and control system of raw materials in determining the properties of composite materials;
- extensive use of computer technology; application of waste-free and resource-saving technology;
- large-scale use of industrial waste and secondary products;
- extensive use of production reserves in order to increase efficiency of labor, energy and material resources.

Composite building materials are one of the main building materials, and their production is increasing day by day. One of the main issues in capital construction is to improve the production and use of building materials, to improve their quality, and to apply scientific and technical achievements in construction.

Materials and methods

Today, composite materials are in high demand, especially in the construction industry. The first fiberglass was created in the second half of the 30s of the 20th century. Since the 1950s, fiberglass shipbuilding has become widespread in the world, and a large number of yachts, work and rescue vessels, fishing vessels, landing ships, etc. have been built on its basis. Composite materials were first used in the aviation industry in 1967 in the production of carbon-fiber panels for the rear of the F-111A aircraft.

Currently, about 50% of the total mass of Boeing-787 or Airbus A350 aircraft is composite materials. Composite materials are also used in the automotive industry. Limited composite materials are used to manufacture machine parts and motors. However, until recently, companies have demonstrated that composites products are mainly produced manually, and the serial production of the product did not require deep automation of the processes.

Production technologies of products from composite materials

Recently, composite reinforcement has been used in the reinforcement of various constructions made of concrete. This material composite reinforcement is made using the latest advances in chemistry and material science because it has unique properties. Composite fittings do not deteriorate or rust under the influence of moisture. Its mass is 9 times lower compared to steel wire reinforcement of the same strength. Composite reinforcement is resistant to heat and cold and can maintain its properties well in the temperature range from -70 0C to 100 0C.

Production of fiberglass composite fittings

For the production of composite fittings, epoxy resin and glass fiber are used. The production of composite reinforcement consists of several stages. First, epoxy resin is applied to glass fibers. Strands of resin-soaked glass rovings are then polymerized by passing them through a funnel known as a filler, which is heated to a certain temperature.

This process of polymerization is called pultrusion in scientific language (from the English "pull" - pull and "through" - through).

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At the pultrusion stage, a smooth surface reinforcement of the desired diameter is formed. The surface of the reinforcement should have a ribbed surface for good engagement with concrete. Therefore, in order to create such a surface, at the last stage, the zagatovka is made by rolling through valets with ripple marks. In the method of forming a periodic profile on the surface of the fittings, a small-diameter glass rod impregnated with epoxy resin is spirally wound on the zagatovka, and polymerization is carried out as described above. Composite fittings are marked as follows: ASK - glass-composite (glass plastic) fittings based on glass fibers; ABK - basalt-composite (basalt plastic) fittings based on basalt fibers; AUK - composite reinforcement based on carbon fibers;
AAK - aramid composite reinforcement based on aramid fibers;
KK is a combined composite reinforcement based on the above-mentioned fibers.

Table 1. Comparison of "Rockbar" composite fittings with existing analogues

Technical properties		Rockbar basalt composite rebar	Rockbar glass-plastic	AV steel fittings	Glass-plastic fittings	Stainless steel fittings
1. Tensile strength	MPa	1200	2300	550	1000	550
2. Thermal		< 0.46	< 0.46	56	< 1.0	17
3. Density	g/cm3	2.10	1.6	7.85	2.10	7.85
4. Viscosity modulus	GPa	50-55	100-150	200	45	200
Safety indicators						
1. Electrical conductivity		Can be installed in a wide range	Conducts electricity	Conducts electricity	Does not conduct	Conducts electricity
2. Magnetic property		Does not	Does not	Magnetize	Does not	Magnetized
2. Fire resistance	°C	up to 300 (600*)	up to 300 (600*)	up to 600	up to 150 (300*)	up to 600
4. Reliability indicator (corrosion resistance)		Very high	Very high	Low	High	High

Table 1 provides information on the comparison of Rockbar composite reinforcement with existing analogues. "Rockbar" composite fittings have the following advantages:

1. The tensile strength is 3 times higher than that of AIII class steel reinforcement. The strength index of metal reinforcement is 390 MPa, and that of composite reinforcement is not less than 1000 MPa;
2. Composite fittings do not rust or corrode;
3. Acid resistant. Resistant to the effects of sea water;
4. Does not conduct electricity. Dielectric;
5. Composite reinforcement practically does not conduct heat;

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6. Does not resist radio waves;
7. It does not lose its strength properties at very low temperatures.

Reinforced concrete structures are also new to the field of production
innovative technologies are entering. In most European countries, instead of steel reinforcement in reinforced concrete, composite reinforcement is being used. The reason for this is that metal fittings cannot be used in aggressive environments (bridge supports). Today, the technology of manufacturing fittings from composite materials has improved and become cheaper, so the pace of transition to non-metallic fittings has also accelerated.
The following types of composite fittings are distinguished:

1. Glass-plastic fittings (removable on the basis of glass fiber and resin) (Fig. 1).
2. Basalt-plastic reinforcement (based on basalt fiber and resin) (Fig. 2).
3. Glass-reinforced polyethylene terephthalate reinforcement (based on fiberglass and thermoplastic polymer).
4. Carbon-plastic fittings (from carbon fibers) (Fig. 3).

The first two types of composite reinforcement are used more in practice.

a **b** **c**

Figure 1. Composite fittings: a - Glass-plastic fittings; b - Basalt-plastic reinforcement; 3 - Ugleplastlkll fittings.

One of the main directions of the development of the production of composite materials was the production of efficient materials and products that enable the construction to be carried out in a short period of time, reduce the weight of devices, increase the quality of construction and reduce the cost. As an example, it is possible to compare the thickness of the wall made of different building materials and the mass of 1m2 surface.
In this place, the use of concrete and prefabricated reinforced concrete products is also of great importance. The efficiency of reinforced concrete products and devices provides an opportunity to increase labor productivity and shorten the construction period. Therefore, the production of reinforced concrete products, including prestressed devices, is developing.
The use of light metal constructions is a big step in the path of technical progress. It is possible to reduce construction time by 15-20%, increase labor productivity by 20-25%, and significantly reduce transportation costs. In particular, devices made of aluminum are widely

used in industrial and civil constructions. The use of glued wooden structures and asbestos-cement products in construction is also of great benefit. It is possible to reduce the mass of such a building by 4-5 times, labor costs by 40-45%. In the composite building materials industry, more and more importance is attached to low energy consumption technologies. For example, the production of portland cement by dry method is developing, because this method consumes 1.5-2 times less electricity than other methods.

In order to protect the environment and save fuel energy, the production of construction materials based on waste is widely introduced. Industrial waste: metallurgical slag, ash, waste from thermal power plants, phosphorus slag, waste from stone processing enterprises such as marble, granite, etc. are a large raw material base in the production of building materials. They are used in obtaining binding materials, as lightweight fillers for concrete, thermal insulation, as additives to raw materials for ceramic products.

Thermal insulation materials are widely used in buildings and devices in order to reduce heat energy consumption. The production of polymer building materials and products is developing rapidly. Also, polymer materials for light constructions, floors and sanitary-technical equipment, plastic pipes, thermal insulation materials, varnish and other long-lasting polymer materials are effective in construction.

Our country has large reserves of raw materials for the development of the production of composite building materials. Abundance of mineral resources and raw materials opens wide opportunities for development of construction.

At the same time, one of the main tasks is the wide use of industrial waste in the production of composite building materials. For example, various dense, porous and fibrous materials are obtained from slag, which is a waste of the metallurgical industry, in the building materials industry. The use of industrial wastes expands the raw material base for construction materials, and the release of large amounts of land occupied by wastes also provides an opportunity to clean up the environment.

One of the main tasks in the development of the production of composite building materials is to use more local raw materials and improve the quality of the products obtained from them. For example, the production of silicate concrete based on local raw materials such as lime and sand, and various ceramics based on local clay soils, gives great economic benefits.

There are many opportunities to reduce the consumption of raw materials in the production of composite building materials: these are the integrated use of light products and structures, raw materials and industrial waste, the consumption of raw materials, heat and electricity in production, the reduction of transport costs, etc.

Conclusions

The dynamic evolution of composite building materials reflects their crucial role in shaping the modern construction landscape. As production continues to grow, it becomes imperative to recognize the pressing need for advancements in production processes, quality enhancement, and the integration of scientific achievements within the realm of capital construction.

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In addressing these challenges, it is evident that refining production processes holds the key to meeting the escalating demand for robust and sustainable building solutions. Quality enhancement remains paramount, ensuring that composite materials exhibit durability, resilience, and compliance with rigorous construction standards.

Moreover, the integration of scientific and technical advances emerges as a transformative force. By embracing innovation, composite building materials contribute to the development of more efficient, sustainable, and resilient structures. Real-world applications and case studies highlight the tangible benefits of such advancements, showcasing the potential for continued innovation in the construction industry.

In conclusion, this exploration underscores the multifaceted nature of composite building materials. The journey involves not only meeting current construction demands but also shaping the future of the industry through continuous improvement, innovation, and a commitment to sustainability. As composite materials rise in prominence, they become integral components in the construction sector's journey towards a more resilient, efficient, and sustainable future.

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