Advanced basalt fibre in high-tech applications

More and more sectors are becoming interested in basalt fibres. The range of applications is diversifying, and includes some high-value-added ones. Russian company Kamenny Vek is one of the players in that market. In this article, it reviews the characteristics of basalt fibre and the innovative applications in which it is used.

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Basalt is an inert, naturally-occurring volcanic rock available worldwide. The first attempts to produce basalt filaments from the melt were made in the USA in 1923. During World War II and continuing into the 1950s, research in several countries advanced the science and technology of basalt fibre manufacture, but no commercial products were produced. In the past 30-40 years, most of the research and commercialization of basalt fibre products occurred in Russia and in the former Soviet Union republics.

Fig. 1: Raw materials for basalt fibers production.

The current technology for producing continuous basalt fibre is very similar to that used for E-glass manufacturing. The main difference is that E-glass is made from a complex batch of materials, whereas basalt fibre is made from melting basalt rock (Fig. 1) with no other additives. Basalt-based materials are environmentally friendly and non-hazardous.

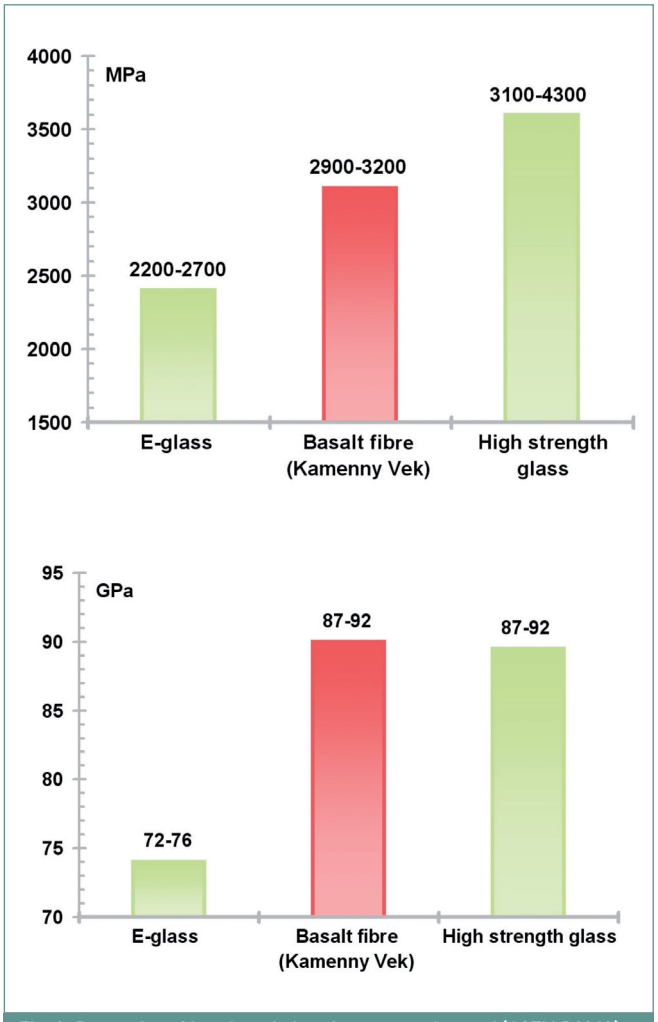

Fig. 2: Properties of basalt and glass impregnated strand (ASTM D2343) a: tensile strength; b: tensile modulus.

Advantages and possible applications of advanced basalt fibre

Basalt fibre is used as a replacement for regular E-glass, high-strength glass and other specialty glass types, due to its specific properties:

- 20-25% higher tensile strength than E-glass (Fig. 2a);
- 10-15 % higher tensile modulus than E-glass (Fig. 2b);
- better chemical resistance than regular E-glass;
- extended temperature range up to 580°C;
- environmental friendliness and easy recycling/disposal of basalt-fibre-reinforced plastics (BFRP) compared to GFRP.

Fig. 3: High-tech applications of basalt fibers.

As a result, basalt fibre ranks somewhere between E-glass and high-strength glass in terms of tensile strength, and about equal to high-strength glass or even slightly higher as regards tensile modulus. Its better environmental friendliness and recycling should definitely be taken into account.

Different types of rovings, chopped strands and twisted yarns are available. Various kinds of woven and non-woven materials, UD and multiaxial fabrics can also be supplied. All these products are compatible with different resin types, such as epoxy, phenolic, polyester and vinyl ester systems.

The fields of applications of basalt fibre products are extremely broad, depending on the specific properties of the fibre, including automotive, sporting goods, boat building, wind turbine blades, and civil engineering (Fig. 3).
In the automotive industry, high-quality basalt rovings, fabrics and chopped strands are used in the production of CNG cylinders, brake pads, mufflers, headliners and other parts for interior applications. The industry's main requirements are high mechanical properties and easy fibre recycling.

Due to their high mechanical properties, basalt rovings are highly suitable for the production of different sporting goods, including skis, snowboards, and bicycles.

In wind-turbine-blade and boat-building applications, basalt rovings are used to produce woven, UD and multiaxial fabrics. Here, the high corrosion resistance and high mechanical properties of basalt play the main role.
A wide range of products are also available for concrete reinforcement, including high-strength rovings for pultruded load-bearing parts and concrete-reinforcing bars, basalt woven fabrics for heat, sound insulation and fire protection, geogrids

More information ...

Kamenny Vek, located in Dubna, Russia, is a global leader for the production of high-quality basalt fibre and has been producing continuous basalt fibre since 2002.

The company is ISO 9001:2000 certified and manufactures basalt fibre using only state-of-the-art equipment and technology. The company is committed to the secured supply of high-performance, high-quality basalt fibre and continually invests in technology, equipment, and intellectual resources to do so (photo).
In 2007, Kamenny Vek's production capacity was 1,000 metric tons/year. In June 2008, the capacity increased significantly – up to 2,000 metric tons/year – and the company is expecting a further increase in the next year or so.

for road and land reinforcement, and stucco nets for wall reinforcing and renovation. High mechanical properties, corrosion resistance, extended temperature range and very good insulation properties are very important in this sector.

While a great variety of products are already available, new products and solutions are developed every year. For instance, in 2008 a new product, basalt needle-punched mat, was added to the existing range, and a new project is in progress to produce basalt UD tapes for wind turbine blades.

Fig. 4: Basalt needle-punched mats.

Basalt needle-punched mats

The production of basalt needle-punched mats started in June 2008.

A canvas of basalt fibre is mechanically formed and compressed slightly by a needle-punching machine to produce the mats. Then, the fibres in the mats are bound by the same basalt yarns that are pulled through the mat by special needles. The resulting mats do not contain any binding resins.

The diameter of the basalt fibre is over 9-10 microns, creating no breathing hazards. The diameter of mineral- and glass-wool monofilaments, which are widely used in construction, is under 9 microns, so they can be used in any buildings with only some lining to keep the filaments from release into the environment.

Needle-punched basalt mats use fibres with non-hazardous monofilament diameter and do not contain carcinogenic asbestos filaments or hazardous phenolic binders. As a result, they can be classified as heat and sound insulation materials meeting very high hygienic and fire resistance requirements. Basalt has a wider operating temperature range and better chemical resistance than E-glass, making basalt needle-punched mat a very valuable material.
The manufacture of fire protection products with this material has already started.

Basalt UD tapes for wind turbine blades

The energy sector is booming all over the world, and wind energy contributes significantly to the growth of renewable energy.

At the moment, wind energy is by far the most widely used form of renewable energy and it has gained a certain momentum. New wind-turbine production units are built every year, and increasingly longer blades are developed and launched into production to increase the amount of energy generated by the turbines.

Wind turbine blade producers are currently using E-glass in their production. To increase the energy output of existing turbines, the wind industry is constantly seeking cheap, easily available materials with higher mechanical properties. High-quality basalt fibre shows 15-20% higher tensile strength and modulus, thus approaching and sometime outperforming high-strength glass and other special fibres, but beating them pricewise.

Compared to standard E-glass, the superior mechanical characteristics of basalt fibre make it possible to produce longer blades with the same amount of fibre, i.e. to increase energy output.

Several companies are actively testing basalt fibre for the production of wind turbine blades. A new project for the production of special basalt UD tapes for wind turbine blades is currently under development.

It is sometimes difficult to transfer the high mechanical characteristics of the fibre to a final product (UD tape, multiaxial fabric), so the conversion process parameters need to be carefully selected. Basalt fibre has a higher elastic modulus and is stiffer than E-glass, and these characteristics need to be taken into account while processing.

Fig. 5: Biaxial machine, used for basalt UD-tape production.

Research is currently in process to optimize the parameters for processing basalt rovings into UD tape, with a view to creating products that ideally suit the requirements of blade producers and developing optimized UD production technology.

Conclusion

Combining state-of-the-art production technology with modern business practices and a world-class distribution network has enabled basalt producers to produce high-quality basalt fibre products and to efficiently operate and expand their business. ■

More information: www.basfiber.com