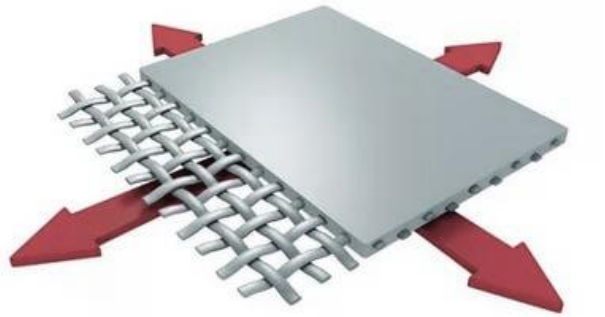
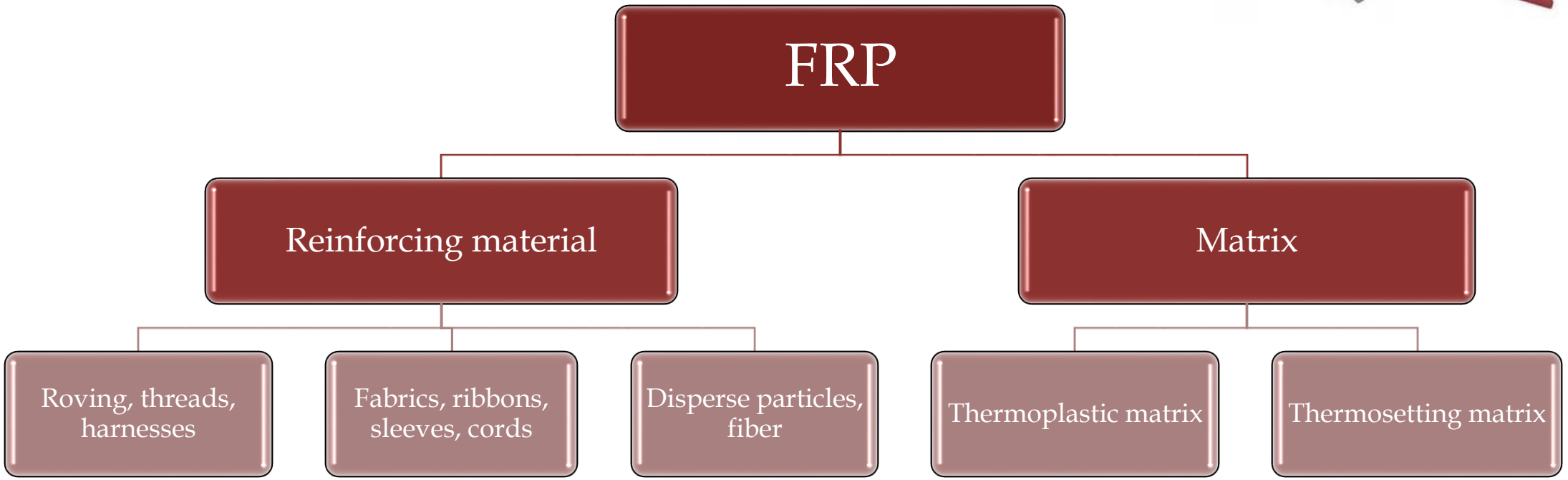
Non-traditional materials for constructions reinforcing

BASALT INDUSTRY DEVELOPMENT UNION
BASALTUNION

General information

Fiber reinforced plastic (FRB) - artificially created heterogeneous material, consisting of two or more components with a clear interface between them.



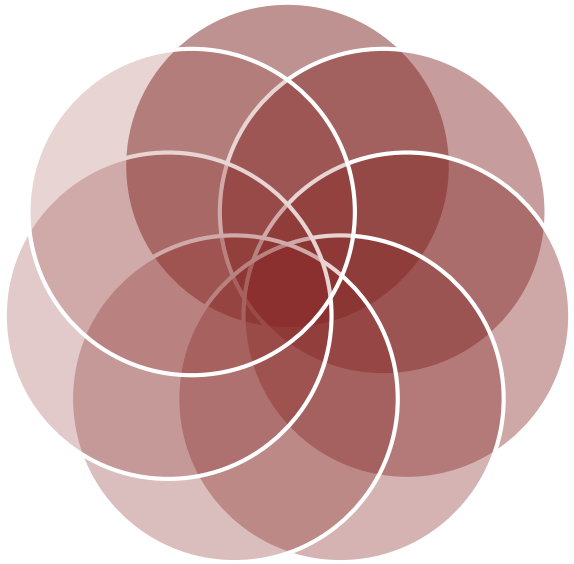


Advantages of FRP

High mechanical properties

Ecological compatibility

Low specific gravity



Resistance to aging, durability

Rigid conditions of operation

Heat resistance

Resistance to aggressive environment

- Reducing the cost of shipping to remote regions
- The possibility of creating radio-transparent structures
- Increased strength characteristics
- Resistance to chemical and biological corrosion
- Longer service life and overhaul period
- Easy transportation and assembling

FRP and traditional construction materials

Comparison of the composite with traditional construction materials (for example, profile):

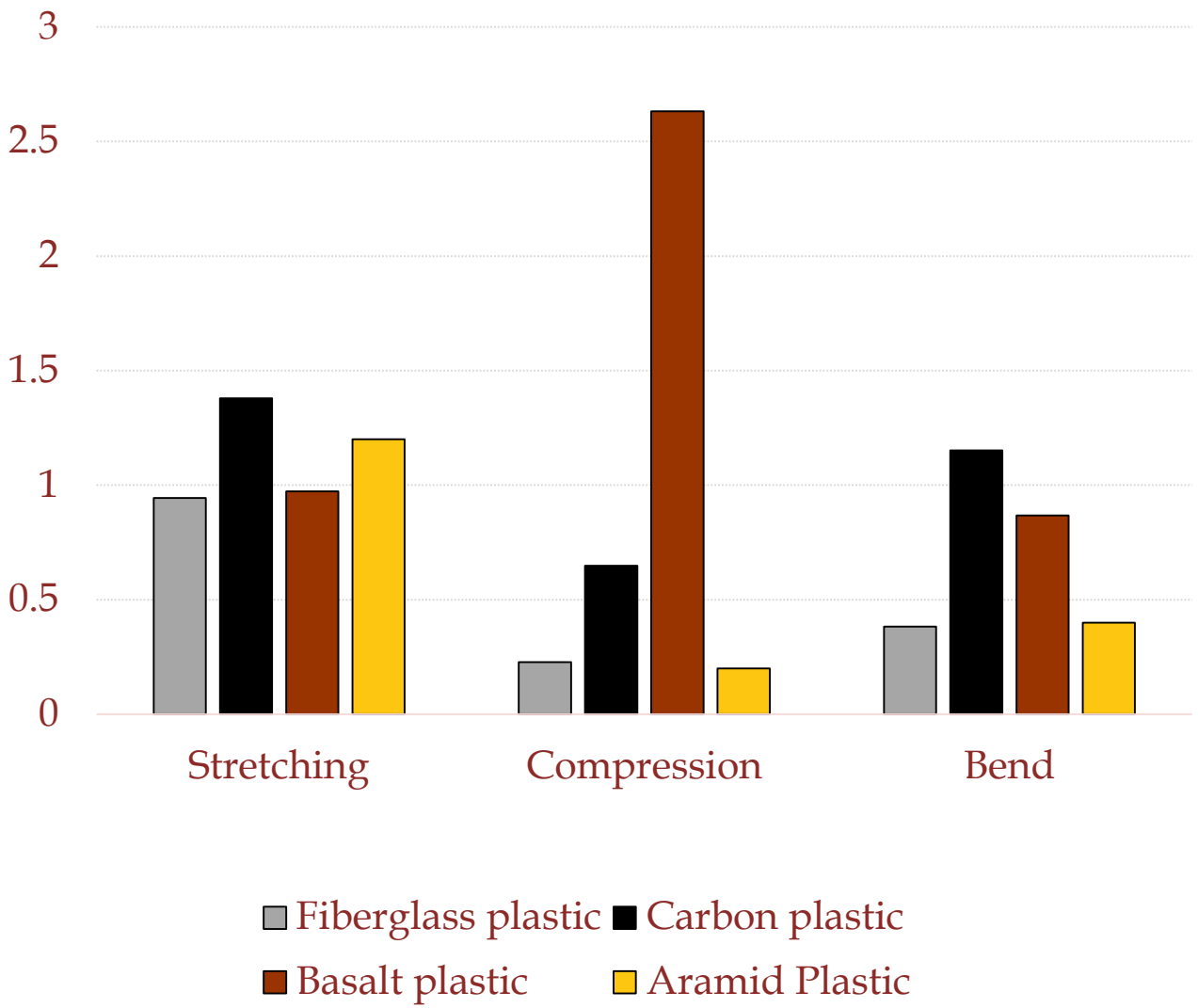
	Density, kg/m^3	**Elastic modulus, GPa**	**Ultimate tensile strength, MPa**	**CLTE*, 10^{-6}/K**	**Thermal conductivity, W / K · m**
Composite	**1,8 …2,4**	20 … 55	**221 … 1700**	**0,5 … 8**	**0,58**
Steel	7,7 … 7,9	**210**	240 … 450	11,9 … 15	17,5 … 58
Aluminium	2,7	70	360	19,6 … 26,9	201,3 … 221

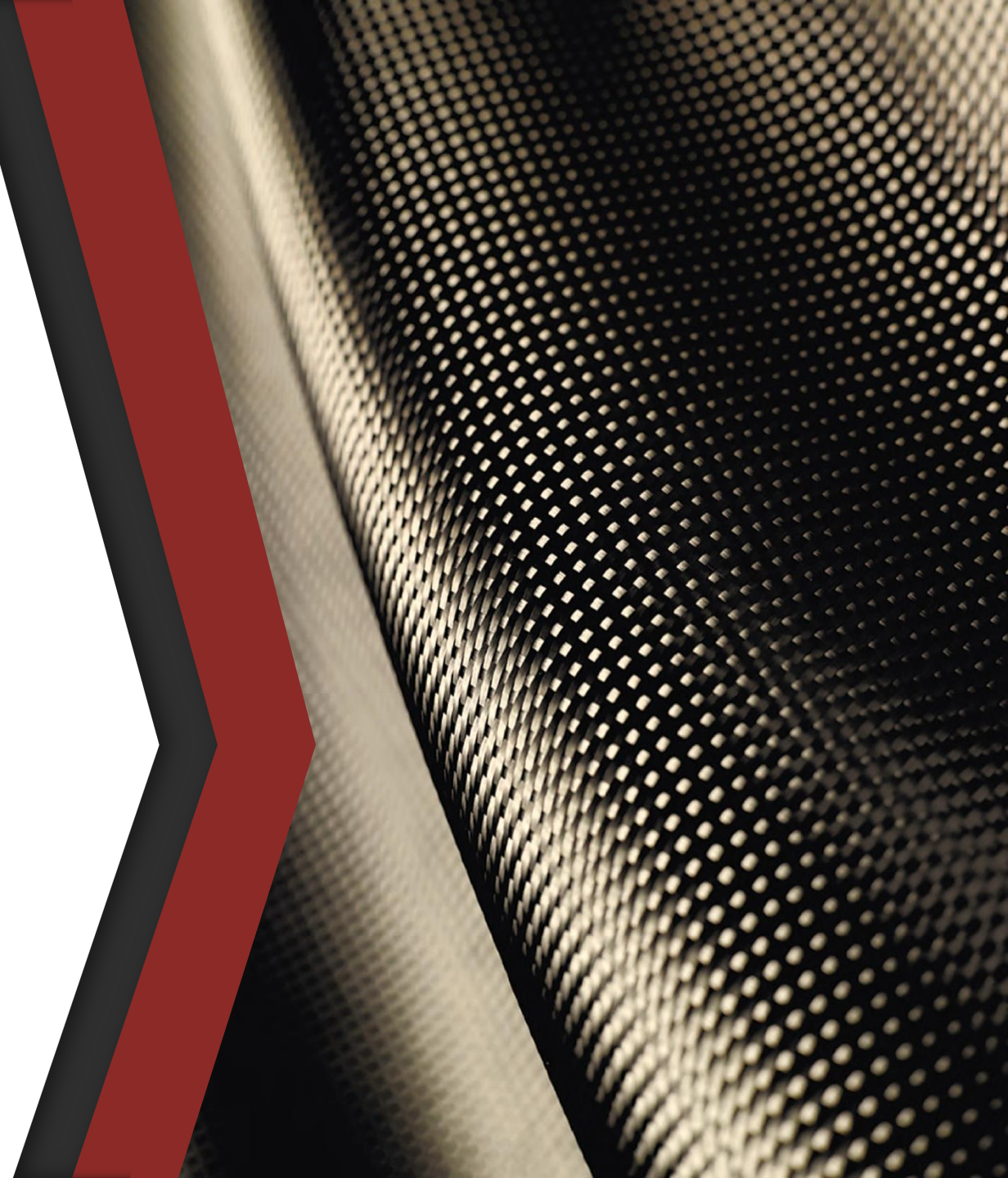
*CLTE – coefficient of linear thermal expansion

Characteristics of FRPs

		Fiberglass plastic	Carbon plastic	Basalt plastic	Aramid plastic
Density, kg / m^3		1800-2000	1450-1600	1900-2400	1250-1360
Modulus of elasticity, GPa		70-50	350	50	127-160
Ultimate strength, MPa	When stretching	1700	2000-3000	1650	1500-2500
	When compressing	410-1180	940-1290	5000	250-400
	When bending	690-1240	1670-2000	1650	500-800
Cost, € / kg		**≈5-10**	>50	**≈5-10**	≈30-60

Comparative diagram of the specific strength parameters of FRP

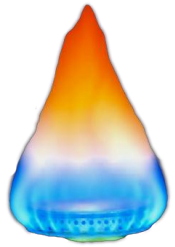




Continuous basalt fiber

Continuous basalt fiber (CBF) is a product obtained from single-stage pulling out of fiber from melted basalt rocks without using of any chemicals.

Basalt is used for CBF production. It is a unicomponent environmentally friendly raw material prepared by nature. Basalt reserves are endless and cheap, accounting for less than 5% of production cost.

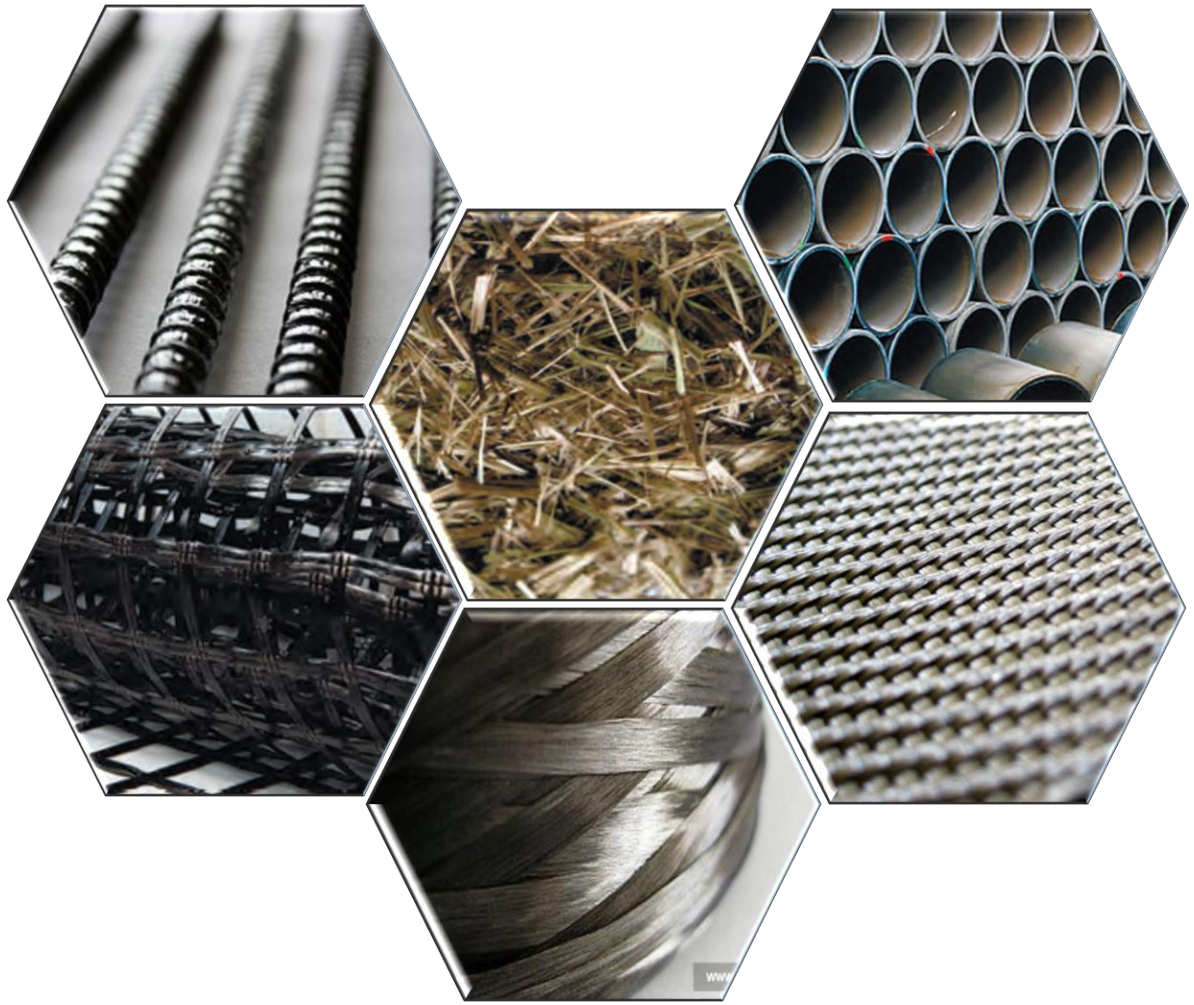
stone  +  **fire** =

Roving is a bundle of complex basalt thread consisting of filaments. It is used for production of composites, mesh, etc.

Twisted thread is obtained by twisting elementary basalt fiber. It is used for production of fabrics and composites

Basalt fiber is a chopped continuous basalt filament. It is used to give new properties to concrete, asphalt, etc.

Products from the CBF



- ✓ Ecological compatibility
- ✓ Manufacturability
- ✓ Thermal and frost resistance
- ✓ High physical and mechanical characteristics
- ✓ Low cost
- ✓ Chemical resistance
- ✓ Biological stability
- ✓ High sound absorption coefficient
- ✓ Low water absorption coefficient

Possible application of CBF products in construction

Reinforcement of paving and concrete	Infrastructural construction: roads, facilities, ports	Monolithic structures in aggressive environments	Dispersed reinforcement of light concretes
Basalt-composite flexible connections, «sandwich» type panels	Basalt-Composite Masonry Mesh	Dry building mixtures with the addition of basalt fiber	Production of basalt-fiber-reinforced concrete slabs and siding
Production of building profiles	Thermal and sound insulation with mats and soil separation	Filtering drainage systems	Production of decorative concrete for decoration of buildings

Road construction

Basalt plastic reinforcement for the construction of roads and structures

- The obstacle to the appearance of cracks at temperature differences due to the close to concrete CLTE
- 2-2.5 times increase between repair interval
- Reducing the cost of service by 15-20% (compared to steel reinforcement)

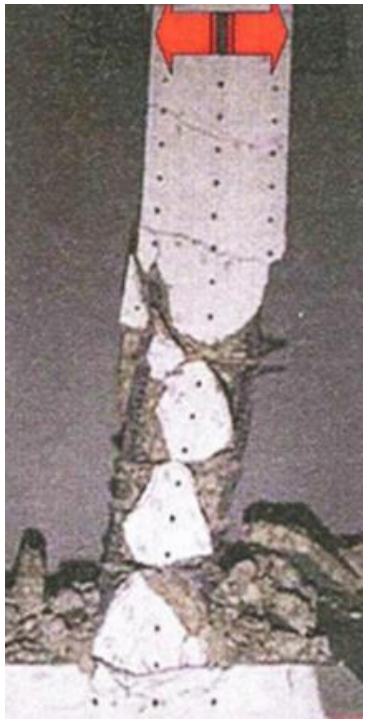
Basalt fiber for concrete reinforcement

- 60% increase of the resistance to abrasion of the concrete covering
- 8-10 times increase of impact resistance and splitting resistance
- 6.4 times increase of durability
- Increase of frost resistance of concrete up to 100 cycles

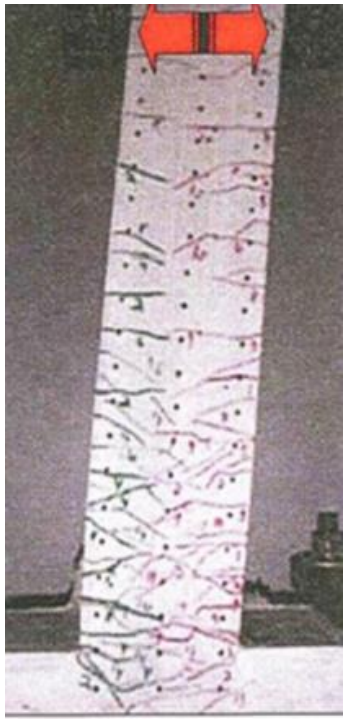
Basalt geogrid for paving reinforcing

- Increased of paving frost resistance
- 20% reduction of asphalt thickness without loss of strength
- 2-2.5 times decrease in the interval between repairs due to a more uniform load distribution

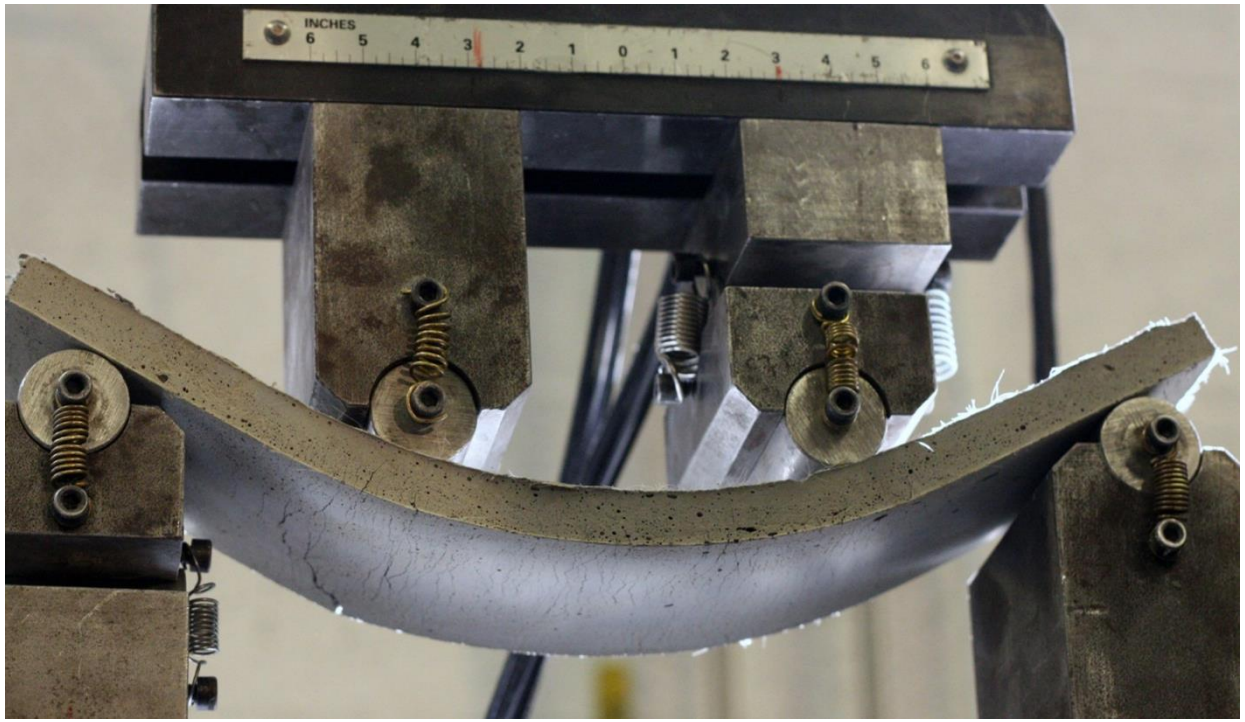
Concrete reinforced with basalt fiber tests



Steel Reinforced Concrete



FRP Reinforced Concrete



FRP Reinforced Concrete

World experience in bridge construction

The use of composites instead of steel reinforcement in the reconstruction and restoration prolongs the life of the structure, reduces repair time and causes minimal destruction to the original constructions.

Bridge construction (Canada)

Bridge Barrier (Canada)

World experience in bridge construction

The main problem of suspension bridges is their great mobility. Because of this, ordinary concrete, reinforced with hard metal, sooner or later gives cracks. Hybrid composite material in combination with plastic epoxy allows avoiding similar problems in concrete coverings.

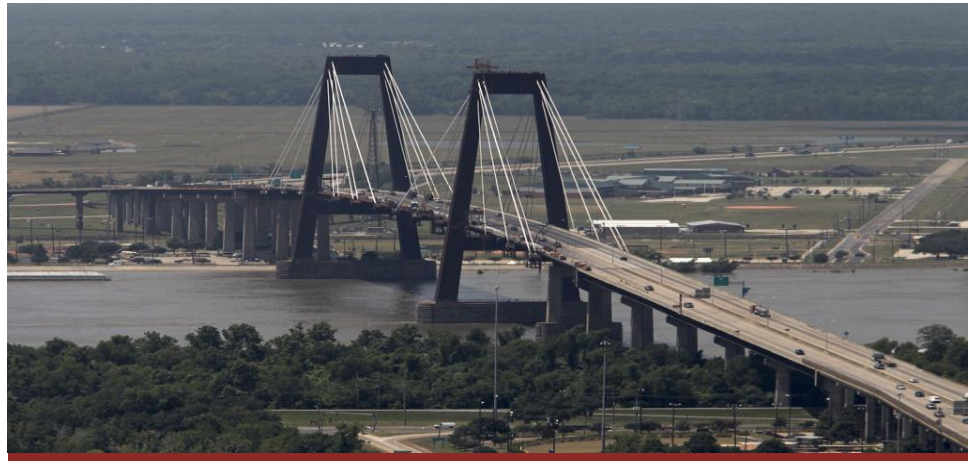
Repair of Hale Boggs Memorial Bridge (Canada)

A new one-span bridge on a two-lane road of class A in Co. Fermanagh, Northern Ireland

World experience in bridge construction

A new basalt composite material, developed by a team of graduate students, led by the University of Windsor professor Sreekanta Das (Canada), has been used in the rehabilitation of the Merrick Creek Bridge over the Detroit River.
The County of Essex and MEDA Engineering and Technical Services participated in developing the bridge rehabilitation project.

Merrick Creek Bridge Repair
(USA)



Merrick Creek Bridge Repair
(USA)

World experience in bridge building and bridge repair

Civil and environmental engineering professor Sreekanta Das believes it will take five years to definitively prove whether a revolutionary construction material can provide a cheaper and greener solution to future concrete and steel rehabilitation projects.
In the lab, basalt composite worked perfect, the developers emphasize.

Repair of the Warren Farm Bridge in the village of Wellsburg, Chaemoon county, New York (USA)

Repair of the Warren Farm Bridge in the village of Wellsburg, Chaemoon county, New York (USA)

Standards

GOST 31938-2012 Composite polymer reinforcement for the reinforcement of concrete structures.

GOST 32486-2015 Composite polymer reinforcement for the reinforcement of concrete structures. Methods for determining the structural and thermomechanical characteristics

GOST 32487-2015 Composite polymer reinforcement for the reinforcement of concrete structures. Methods for determining the characteristics of resistance to aggressive environment

GOST 32492-2015 Composite polymer reinforcement for the reinforcement of concrete structures. Methods for determining the physico-mechanical characteristics

TU 2296-001-30604955-2012 TU for composite polymer reinforcement.

TU 2296-001-30604955-2012 Non-metallic rods of glass, basalt, carbon or aramid fibers impregnated with a thermosetting or thermoplastic polymer binder and cured

Body of Rules Project **63.13330.2012** «Construction of concrete with composite non-metallic reinforcement. Design rules»

Body of Rules «Fibreconcrete constructions and products. Design rules»

Body of Rules 297.1325800.2017 «Fibreconcrete constructions with nonmetallic fiber. Design rules»

Body of Rules 164.1325800.2014 «Strengthening of reinforced concrete structures with composite materials. Design rules»

Body of Rules 295.1325800.2017 «Concrete structures reinforced with polymer composite reinforcement. Design rules»

Composite polymer reinforcement is included in **Body of Rules 28.13330.2017** «Protection of building structures against corrosion. Updated version» **SNiP 2.03.11-85** and included in the change **№ 1 to Body of Rules 63.13330.2012** «Basic Provisions»

ACI 440.1R-06 (2006) «Guide for the Design and Construction of Structural Concrete Reinforced with FRP Bars».

ISO 9001: Basalt rebar has been tested by several methods and approved by ISO 9001.

Advantages of fiber-reinforced concrete

2-3 times increasing the service life of structures

30-50% reducing of the thickness of covering

Reducing the cost of covering repair

Easy installation without welding equipment

Reducing the weight of concrete (from 50 to 150 kg per cubic meter of concrete, depending on the purpose of the product)

Providing of three-dimensional reinforcement

Strengthening of concrete constructions:

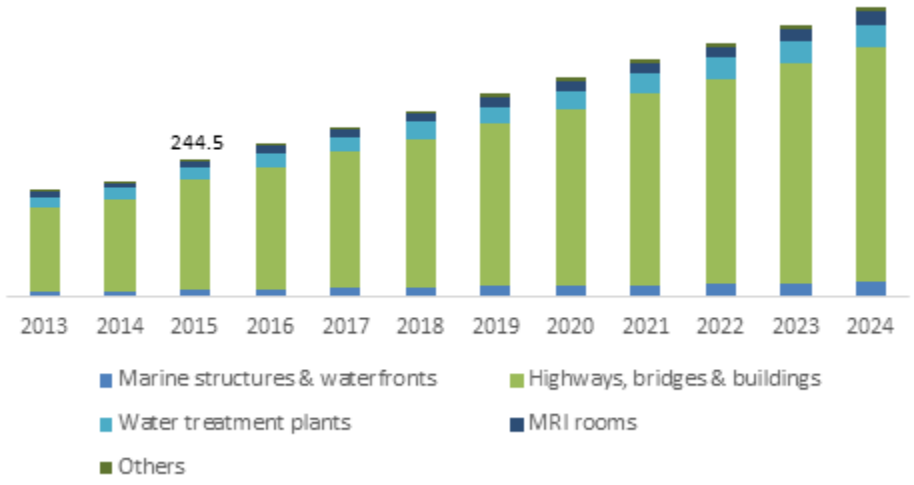
60 % increase of resistance to abrasion of the concrete covering

15-50% increase of compressive strength

100% increase of strength of concrete structure for bending and axial tension

8-10 times increase of impact strength and splitting resistance.

The forecast of the market of fiber-reinforced composite reinforcement up to 2024.

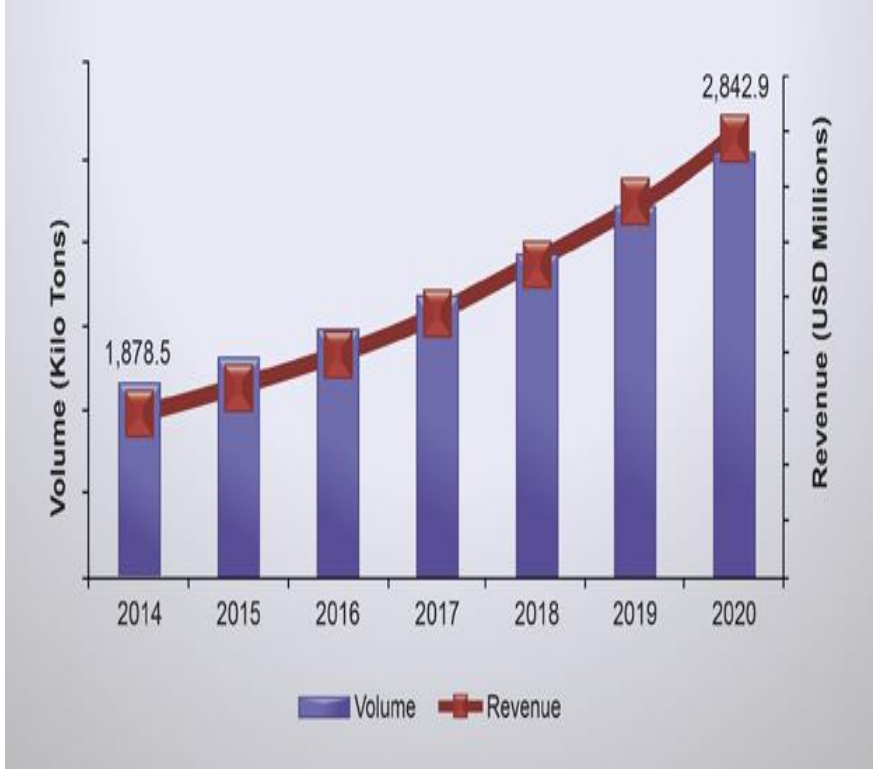


Fiber Reinforced Polymer Rebar Market size is posed to surpass $1.25bn in the nearest seven years, say the researchers from Global Market Insights, Inc. Potential outlook in highways, bridges & buildings along with water treatment plants will propel the FRP rebar market growth.

Technological advancement in product design, and material are the factors enhancing product penetration. Growth in construction of decks & railings, floor slabs, columns, parking garages, and walls will propel industry demand.

Increasing renovation projects on functionally deficient structures has encouraged the product demand in the market. Shift in trend towards non-corrosive, lightweight, durable reinforcements coupled with thermal & electric insulation are some of the significant factors fueling the industry growth. Increasing infrastructure spending mainly in emerging economies including India, China, and Japan, will fuel the FRP rebar demand.

Forecast of development of concrete fibers market



The concrete fiber market to reach $2,84 billion by 2020. According to the analysts, a compound annual growth rate is expected to reach 7.26% between 2015 and 2020. Basalt fiber is listed among the popular mineral fibers for concrete reinforcement.

Essential **factors to stimulate the development of the concrete fiber market** in the regions include a growing demand for concrete fibers in China and India, as well as growing population of concrete fibers.

Japan and South Korea are demonstrating a steady growing demand for this kind of products. However, high operating cost and capital-intensive R&D may pose challenge to the market growth in the near future.

As for Europe, reinforcing fibers are demanded in Germany, France and the UK.

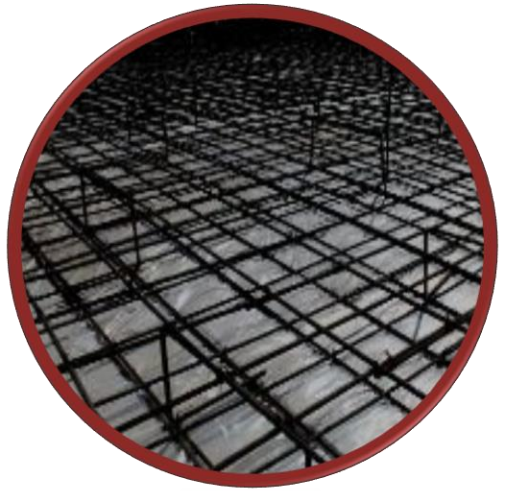
The prospect of using basalt fiber for reinforcing structures

Due to their resistance to corrosion, polymeric composite materials (PCM) are used as the main reinforcing material in reinforced and prestressed concrete constructions that are exposed to adverse environmental conditions, for example for decking and handrails of bridges, garages and offshore constructions.

The improvement of production technologies has led to the emergence of new generations of composite reinforcement (FRP) and has provided a step forward to the use of different types of fibers, such as basalt fiber, and not just those that have been used previously.

It is unlikely possible that in the nearest future concrete will be replaced by other material because of its ease of manufacturing, the ability to endless changes, uniformity, durability and the ability to save by using basalt fiber in high-strength concrete.

The above described set of characteristics, which distinguishes basalt fiber from other artificial fibers, coupled with the property of high adhesion to concrete, suggests a further growth in demand for this fiber in the world.



Thank you for attention!

Contacts:
Basalt Industry Development Union «BasaltUnion»
www.soyuzbasalt.ru
+7 495 241 32 73
contact@soyuzbasalt.ru