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Glass-basalt-plastic Pipes in Russia: Production, Market and Forecast

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Annotation

This review is the second edition of the study of the market of glass-basalt-plastic pipes in Russia.

The purpose of research is the analysis of the Russian market of glass-basalt-plastic pipes in Russia and forecast of its development until 2020.

The object of the study is composite pipes made of fiberglass and basalt fiber.

Chronological scope of the study is 2003-2015, a forecast – 2016-2020.

Geography of research is the Russian Federation.

This work is mainly *the desk study*. Information sources were the data of the Federal State Statistics Service of Russia (Rosstat) and the Federal Customs Service (FCS) of Russia. We also used data of the sectoral and regional press, annual and quarterly reports of companies, websites of producers of composite pipes.

Telephone interviews with the market representatives were also carried out when preparing the report.

The work includes 11 chapters, its volume is 139 pages. The text is illustrated with 23 figures and 50 tables.

The first chapter gives general information about glass-basalt-plastic pipes – their technical characteristics, types of construction of the pipe wall, the main types of binders used, and so forth.

The second chapter provides an overview of technologies for the production of plastic pipes, as well as the types of connections (joints) for this product.

The third chapter considers the main areas of application of composite pipes and discusses the main differences of these products from pipes made from conventional materials.

The fourth chapter analyzes the regulations in the field of technical production and the use of pipes from composite materials.

The fifth chapter is dedicated to the production of basalt glass pipes in Russia in 2003-2014. It presents data on the capacities of the main enterprises for the production of fiberglass pipes, on the range of products, volumes and dynamics of production of pipes.

The sixth chapter provides brief data about the producers of fiberglass pipes in the CIS.

The seventh chapter analyzes data on foreign trade operations with glass-basalt-plastic pipes in 2004-2015.

This chapter presents data on the dynamics and the geographical structure of export and import supplies of composite pipes, identifies major foreign suppliers and the main Russian consumers of these products.

The eighth chapter of the report presents data on the dynamics of average import prices of fiberglass pipes in 2004-2015, and also gives data on the actual prices for these products on the Russian market.

The ninth chapter analyses demand for fiberglass pipes in Russia in 2004-2015. It gives a supply-demand balance of composite pipes for different segments of the market, separately for pipes based on epoxy and polyester resins. The characteristics of the main potential areas of consumption of these products are presented.

The tenth chapter provides information on the domestic equipment for the production of glass-basalt-plastic pipes.

The eleventh chapter presents a forecast of development of the market of composite pipes for the period up to 2020.

The Appendix presents contact information on producers of fiberglass pipes and equipment for the manufacture of composite pipes.

1. General information about glass-basalt-plastic pipes

Composite materials are used for the manufacture of pipes for various purposes for over 60 years. The pioneers in this field were US companies, which began to produce fiberglass pipes in the late 40's of the twentieth century.

Composite materials have a high mechanical strength, resistance to corrosion, which enables the wide use of composite pipelines in various industries, in the public utilities and agriculture.

The use of composite pipes allowed solving the problem of corrosion - one of the greatest challenges in the field of the pipeline transportation, bringing huge losses in the operation of metal pipelines.

In the CIS, composite pipes are used since the late 80's of the last century, for this period more than 3,000 km of pipelines were installed in the energy, chemical, nuclear, oil industries, and public utilities.

Any continuous fiber can be used as the reinforcing fiber in the manufacture of pipes. In practice, mostly glass is used for these purposes, as the most accessible and cheap material. In much smaller quantities the basalt continuous filament (BCF) is used in the manufacture of composite pipes. It is superior by a number of characteristics to the fiberglass based on the aluminoborosilicate glass E, which is most often used in the production of fiberglass.

Basalt fibers demonstrate significant benefits as compared with fiberglass in terms of the heat resistance, chemical resistance and water resistance. Of particular importance is a higher elastic modulus of basalt fibers (approximately by 1.5 times higher than that of the aluminoborosilicate glass) for the manufacture of composite pipes. The modulus of elasticity, which determines rigidity of pipes from composite materials, particularly in the circumferential direction, is no less important than the mechanical strength.

Carbon and aramid (Kevlar) fibers are used for the most important parts in the aerospace industry, where a high specific strength and modulus of elasticity are required.

Mechanical properties of basalt-plastic pipes are superior compared to those made of fiberglass. This is due to the fact that the adhesive interaction of basalt fibers, especially those based on epoxy resins, is higher than that of glass fibers because of the presence in their structure of units of iron oxide. The high strength of this interaction is shown as the level of residual stresses in the boundary layer of resin, and in increasing crack resistance of a plastic. Due to these factors, basalt plastics have confirmed in practice their superiority to fiberglass in terms of reliability and durability.

A higher adhesion of basalt continuous filament (BCF) to epoxy binders and a significant increase in the modulus of elasticity contribute to the increase of the carrying capacity of structures operating in complex stress-strain states. These structures include, for example, pipe joints made of composite materials. The results of long-term operations attest to the great reliability of connections of basalt-plastic pipes.

It is known that the potentials of the materials, which are related to its high strength, are often underutilized due to a loss of integrity. One of the major reserves to increase the pressure at which the depressurization occurs and to bring this pressure closer to the pressure of an irreversible destruction is to increase the elastic modulus to reduce the deformation of the pipe and decrease the formation of cracks and pores in the plastic.

According to various estimates, at the same depressurization pressure and all other conditions being equal, basalt-plastic pipes may have a thickness of about 15% lower than fiberglass pipes. This is an important reserve to reduce the cost, and therefore to increase the competitiveness of these products.

We should also note another important advantage of BCF. Basalt fiber is significantly less hygroscopic than the glass fiber (by about 10 times), which substantially reduces energy costs associated with the removal of moisture, and reduces labor costs for manufacturing products.

1.1. Main technical characteristics of the glass-basalt-plastic pipes

Physical and mechanical properties of the composite pipes vary over a wide range depending on a manufacturing technology, the type of the binder resin, the kind and ratio of the reinforcing components.

The principal characteristics, which are specified by manufacturers of pipes, are the inner diameter (DN), the stiffness (SN), the nominal pressure, and the maximum temperature of a transported medium.

The stiffness class (SN or G) of glass-basalt-plastic pipes is the transverse stiffness of the pipe, i.e. the ability of the pipe walls to withstand the stresses leading to a deformation or a compression of the tube in a plane perpendicular to the axis of the pipe.

The thicker the wall, the higher the stiffness and ability to resist corrosion. Stiffness characteristics, in different systems of standardization of pipes, are divided into the following classes (Table 1):

Table 1. Indicators of stiffness of pipes in various systems of standardization

Standardization system	Symbol	Unit of measurement	Stiffness class		
			SN2500	SN2500	SN10000
ISO	S_P	N/m^2 (Pa)	2500	5000	10000
DIN	S_R	N mm (MPa)	0,02	0,04	0,08
ASTM	F/Δy	psi	20	40	80

Source: data of "American Composites manufactures Association" (USA)

The pressure class PN means such an internal pressure, which can be maintained in the pipeline throughout the entire period of operation at a predetermined safety margin. The pressure class of the pipe is determined by the long-term strength (over 50 years), using the safety coefficient (a safety factor) equal to 1.8.

Technological processes for the production of fiberglass pipes can produce pipes with an inner covering layer, which is resistant to different environments (Table 2).

In Russia, fiberglass pipes and fittings, depending on the temperature, the content of solids, and the chemical composition of the transported material, are manufactured with various internal protective coatings. They are divided into the following types:

a – for fluids containing abrasive substances;
kh – for chemically aggressive environments;
p – for drinking cold water;
g – for a hot (up to 75°C) drinking water supply;
c – for other environments.

Table 2. Types of internal protective coatings of pipes and their effect on the technical characteristics

Designation of the internal coatings of pipes	Maximum operating temperature, °C	Limiting pH value at a maximum temperature
VA	35	1,0-9
DA	50	0,8-10
DS	75	0,5-13
HP	90	0,2-14

Source: data of the company Hobas

The thickness of the inner protective coating layer is from 0.5 to 3 mm, depending on the type of a coating and the transported medium.

The percentage of fibers in the pipe material may be in a range from 65% to 85%. Physico-mechanical properties of fiberglass pipes depend on the method of reinforcement (the laying direction of the fiber) and for each type of a pipe they differ along the axis and in the circumferential direction (Table 3). Depending on the orientation and the amount of fiberglass, pipes can be produced with different mechanical characteristics.

Typically, all manufacturers of fiberglass pipes tend to ensure that the strength in the circumferential direction of the pipe is twice the strength along the axis. The value of the circumferential strength of fiberglass pipes at the total destruction of the material may be from 400 to 650 MPa. For comparison, the tensile strength of steel 20 is 410 MPa.

Table 3. Dependence of the physical and mechanical properties on the type of winding

Indicator	Pipes of coil winding with a winding angle 55^o	Continuous winding pipes, reinforcement 2:1
Tensile strength in the tangential direction, MPa, at least	240	180
Tensile strength in the axial direction, MPa, at least	120	80
Elastic modulus in the tangential direction, MPa, at least	25000	19000
Elastic modulus in the axial direction, MPa, at least	12000	8000
Coefficient of linear thermal expansion (axial) $1/^0C$, at most	1 $8x10^5$	2 1x10'
Density, kg/m^3	1800 – 1900	1600 – 1700
Weight ratio of glass filler/binder	65–72/35–28	50–55/50–40
Tangential tensile stress, MPa, at most	50	35
Axial tensile stress, MPa, at most	24	16
Tensile deformation, mm/m, at most	0,2	0,2

Source: the technical literature

Glass basalt-plastic pipes are divided into groups according to the following criteria:

- By the type of a binder (matrix): the epoxy or polyester;
- By the type of pipe connections: adhesive or mechanical;
- By design of the pipe wall: pure fiberglass (without lining), fiberglass with a film layer (lined pipes), and multi-layer structures.

1.2. Main types of a binder in the glass-basalt-plastic pipes

Operability of composite materials at different temperatures and in corrosive environments is determined mainly by a polymer matrix which can be made of thermosetting materials and of a thermoplastic.

The main materials for a matrix of composite pipes are thermosetting resins which upon curing by a heat and (or) a chemical reaction are irreversibly converted into a solid, infusible and insoluble material with a three-dimensional network structure.

Thermosetting polymers are unsaturated polyester, epoxy, vinylester, phenolic and other types of organic resins.

Curing of unsaturated *polyester resins* (orthophthalic, isophthalic, bisphenol, terephthalic) occurs either by heating or by use of peroxide catalysts and activators to form polyesters.

Epoxy resins are always used together with curing agents or catalysts, after curing the epoxy plastic is formed.

Upon curing the vinyl ester resin (this is a thermosetting resin made of an epoxy resin) the vinyl ester plastic is prepared.

Various kinds of resins have different physico-chemical characteristics, the specific form of the resin is selected depending on the application and conditions of use of pipes.

Mechanical properties of the composite materials to a significant extent depend on adhesive interactions of fibers with the polymer matrix. Epoxy resins have the highest adhesion, better strength and stiffness characteristics of the material and a better fracture toughness.

The chemical resistance and mechanical properties improve in the series orthophthalic - isophthalic - vinyl ester resins. Isophthalic and vinyl ester resins are also superior to the orthophthalic resin by adhesive properties.

Pipes made of ***polyester resins*** have the international designation of ***GRP*** (glass-reinforced plastics). Their disadvantage is the impossibility to use these pipes to transport a high temperature medium (as a rule, above 50^{o}C) and under pressures above 32 atm.

Specifications of the GRP pipes on a polyester binder define the scope of their application - they are widely used in the systems of cold water supply, stormwater and sewage, in irrigation and land reclamation systems, for industrial effluents with slightly aggressive media.

For use at high pressures, high temperatures and in contact with aggressive media composite pipes on an ***epoxy binder*** are employed, the international designation - ***GRE*** (glass-reinforced epoxy).

Composite pipes GRE at an epoxy binder are capable of withstanding pressures up to 270 bar, the maximum operating temperature is up to 130°C.

Depending on the type of an epoxy resin hardener, products of a different thermal stability can be prepared - the use of the anhydride hardener gives the thermal resistance up to +65°C, of aliphatic amines - to +95°C, of aromatic amines – to +110°C.

GRE pipes are suitable for transporting the chemically aggressive liquids. These pipes are suitable for the infrastructure of seaports, petrochemical, oil & gas and other industries, where a reliability and strength of the structure are of paramount importance.

Pipes based on the polyester resin (GRP), as a rule, have a larger diameter than pipes on the epoxy binder (GRE). The diameter of GRP pipes is 30 to 4500 mm. The diameter of GRE pipes is from 5 to 600 mm (may be more).

1.3. Types of construction of pipe walls

Glass-basalt-plastic pipes from different manufacturers can vary in the wall construction.

Single-layer pipes are made of a high quality glass-basalt-plastic produced by the "wet" winding. In order to increase the chemical resistance and reduce the coefficient of drag, the liner is made on the inner surface of the pipe.

The liner is a two component composite of a low density glass material ,impregnated with an epoxy binder, the content of which is 60-70% by weight. The thickness of the liner may vary in a range from 0.2 to 0.8 mm. The main pipe layer (the structural layer) is composed of glass fibers (rovings) impregnated with an epoxy binder. The structural layer provides a predetermined ratio of physico-mechanical characteristics along the axis and in the circumferential direction of the pipe.

A single-layer glass-basalt-plastic pipe is made without the lining. In carrying out construction works with such pipes one needs to pay special attention to the preparation of the trench: the trench should be larger, it is necessary to have a sandy base line, etc. The cost of single-layer tubes can be somewhat less than the cost of pipes lined with film materials and multilayer pipes, but the cost of construction works is much higher. Moreover, pipelines made of single-layer pipes are less reliable in operation. These circumstances significantly reduce the technical and economic effect of single-layer pipes.

Single-layer pipes are used in pipelines of the water supply and sewage systems, including the drinking water supply; for the transport of production of oil wells and oil products; in pipelines for the transfer or disposal of process water and a salt water; in the pipes of crude oil tank farms and in the systems of the fire protection.

Double-layer pipes represent a two-layer structure consisting of a protective and a structural layers.

The protective layer (of the thickness of 1 mm to 3 mm) is made of high-pressure polyethylene - a material which is considered the most chemically stable in environments of field pipelines. The adhesion of polyethylene to fiberglass is provided through the use of special grades of polyethylene, cross-linked during the curing of pipes, the epoxy binder formulations and the heat treatment of pipes. The process of the heat treatment provided a simultaneous cross-linking of polyethylene and curing of the epoxy binder. As a result, it is practically impossible to peel away the inner polyethylene layer of the pipe from the plastic without destroying the latter.

Table 4. Characteristics of single- and double-layer pipes

Parameters	Values	
	Single-layer	Double-layer
Operating parameters		
Range of produced diameters, mm	110 ÷ 450	
Design pressure, MPa	up to 6,4 MPa	
Operating temperature, ºC	up to 120	up to 90
Seals type:	two ring rubber seals	
Connection type:	using mechanical fixing ropes or flanges	
Hydrostatic properties		
Fogging stresses of a pipe in the circumferential direction under biaxial stress state, MPa	at least 110	at least 580
Allowable stresses in the circumferential direction under biaxial stress state, MPa (for a period of 20 years in nominal conditions)	55	120

Source: the technical literature

The protective layer is intended to improve the chemical resistance of the pipe and maintain its integrity under the action of significant external forces. The structural layer is made of the high quality glass-basalt-plastic produced by the "wet" winding of glass fibers (rovings), impregnated with an epoxy binder.

Pipes of the double-layer construction, internally coated with film materials, are less susceptible to a loss of tightness in pipelines laying in unstable soils.

However, during the operation of two-layer pipes in oil-pipelines, a number of serious deficiencies requiring a change in design and technology of the pipe has been identified:

- An insufficient adhesion between the lining and the glass fiber layers, which does not allow for the monolithic wall of the pipe;
- A violation of the elasticity of the lining material at low ambient temperatures;
- A detachment of the lining from the fiberglass layer of pipes during the transport of gas-containing media through pipes (the caisson effect).

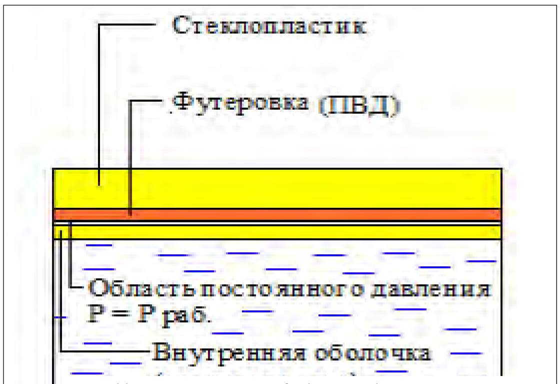
Glass-basalt-plastic double-layer pipes are suitable for the use in pipelines transporting degassed media: in pipelines for pumping the waste and reservoir water, water (except drinking water pipelines), sewage, etc.

Three-layer pipes are a three-layer structure consisting of an inner fiberglass shell, a protective layer and a structural layer. Structurally, the inner shell is independent of the cross-linked protective and structural layers.

The thickness of the inner shell can range from 3 to 6 mm depending on the internal diameter of the pipe. The inner shell does not bear loads along the axis of the pipe and its design is optimized to provide a greater strength in the circumferential direction. The inner shell is intended for smoothing the cyclically changing internal pressure in the pipe, which occurs when dissolving or degassing the gas contained in the transported product.

The protective layer is made of high-pressure polyethylene. The thickness of the protective layer may be from 1 to 3 mm. The protective layer is intended to improve the chemical resistance of the pipe and maintain its integrity under the action of significant external forces.

The transported medium penetrates the region between the inner shell and the film layer, thereby creating a region of a constant pressure near the liner, which is equal to the operating pressure in the pipeline. Due to the fact that the pressure near the film layer does not change, the conditions for the gas penetration through it are absent and no caisson effect occurs. At the same time the inner layer further increases the stiffness of the pipe and reduces the thermal influence of the environment on the supporting glass-basalt-plastic, which also increases the durability of its use.



Wall structure of three-layer pipes

2. Technologies of production and the types of connections of composite pipes

2.1. Technologies of production

In practice, the global production of pipes based on composite materials uses various manufacturing techniques, including the winding, rotational molding, pultrusion, etc.

The method of winding is one of the most common methods of obtaining products from reinforced materials of different types and purposes. In addition to the cylindrical thin- and thick wall pipes and fittings, the method of winding is used to produce closed profiles of the rectangular, triangular, and elliptical cross-sections, conical shells, closed containers (cylinders) for the storage of gaseous and liquid media under high pressure and so forth.

The winding method is based on the formation of composite products made of continuous filament of the fibers, which is impregnated with a binder (a thermosetting resin) and wound onto a forming surface of a circular cross-section - the mandrel.

On a rotating metal mandrel at a certain angle continuous filament rovings, which are reinforcing materials for a future product, are fed. Roving threads are impregnated with a prepared binder.

Depending on the method of winding, the resin may be applied directly in the process of forming a product (a "wet" winding), or in advance, soaking the roving filaments in the special spinneret (a "dry winding).

If necessary, fillers such as quartz, chopped roving, alumina and so forth may be administered to the wall of a pipe or a tank.

Special mechanisms, which move at a speed synchronized with the rotation of the mandrel, control the winding angle and the location of the reinforcing material. Successive layers are applied at the same or at different angles of winding until the desired thickness is achieved. The angle of winding can vary from a very small - the longitudinal to a large - the circumferencial, i.e. about 90° relative to the axis of the mandrel, including any angles of helix in this interval.

Usually the curing is carried out at elevated temperature without the overpressure. After curing, the finished product is removed from the mandrel and subjected to machining operations: grinding ends, grinding chamfers, etc.

Characteristics of the final product - the chemical resistance, abrasion resistance, electrical and thermal conductivity, mechanical properties - depend on the choice of a binder, fillers and a reinforcing material.

The winding process has many options, which differ widely in the type of winding, the design features, a combination of materials and the type of equipment.

Thus, by cyclicality of production the *continuous* and *periodic types* of winding are allocated, by the method of winding - the cross and straight types of winding.

Equipment is developed for the production of large tanks (the diameter of 24 m) by the winding method at the installation site.

Continuous winding

The method of continuous winding is the world's most common method of production of composite pipes. The first equipment for the production of pipes by the method of continuous winding was developed in the late 60's of the XX century.

When continuous manufacturing methods are used, then all of the major technological transitions, including the winding (or other technology of the application of the reinforcing layer), the impregnation with the binder, the polymerizing and cutting the pipe, are carried out at a continuous motion along the axis of the pipe, accompanying its escapement from the forming mandrel.

Continuous methods are characterized by a significantly higher performance and a lower cost than the positional manufacturing methods. Furthermore, they allow to broaden the technological capabilities, for example, to produce pipes of the indefinite length or tubes of a small diameter (about 20 mm).

The method of the continuous winding is characterized by a high productivity: an average production capacity is 170 km/year of pipes with a nominal diameter of 800 mm.

Advantages of the method:

- High productivity;
- High quality products; the possibility of obtaining a broad nomenclature of finished products;
- A reduced effect of the human factor in the production.

Drawbacks of the method:

- A high cost of equipment;
- The need for a larger production space to accommodate the line of winding.

Periodic winding

This method is a cyclical process. The premixed resin and the catalyst are fed to the spinneret. The glass roving, passing through the spinneret, is impregnated with a necessary amount of a resin and wound onto a rotating metal mandrel. The mandrel diameter can vary from tens of centimeters to several meters.

Depending on the desired mechanical conditions, the angle of winding can vary from a very small - longitudinal, to a large - circumferential. After reaching the desired wall thickness of the product, the winding stops. Further, depending on the binder used, the pipe is sent into a curing oven for curing the final product or remains at the shop for curing. After curing, the pipe is removed from the mandrel and is sent to the machining. Then the cycle repeats.

Advantages of the method:

- A relatively low cost of equipment;

- Production facilities do not require large areas;
- A high quality of the final product; an ability to change the hardware configuration under the required properties of the product.

Drawbacks of the method:

- Low productivity; for the efficient production it is necessary to have multiple machines or changing mandrels;
- Restrictions on the length of the finished product; production of large-diameter cylinders is difficult due to a high metal content.

Method of centrifugal forming (molding)

A characteristic feature of this technology is the formation of the pipe by centrifugation in molds. Raw materials (fiberglass, polyester resin, inert fillers (generally silica sand)) are fed into a rotating mold, the formation of the product occurs in the direction from the outer to the inner surface to obtain a particular thickness.

The required amount of raw materials is fed into the mold by a dispenser. For this, a polymer is used, which composition eliminates the polymerization during the pouring process. The distribution and arrangement of fibers within the layers is performed so as to ensure the strength of the pipe axially and circumferentially.

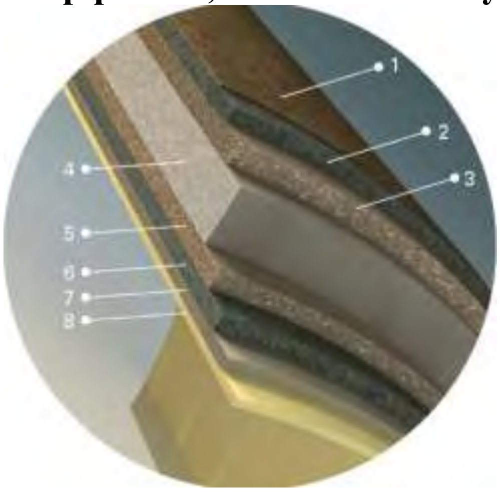
Initially, the mold is rotated at a relatively low speed. After completion of the supply of raw material, the rotation speed increases, which provides a full compression of the raw materials and the transition into the solid state.

The required wall thickness is achieved by linear movements of the dispenser inside the mold back and forth. The mechanical properties of pipes are regulated by changing the amount ratios of raw materials in the layers of pipes.

Each layer of the pipe wall has a different purpose (Fig. 1). The inner layer is made of a flexible polymer which provides good hydraulic properties of the pipe and a high abrasion resistance. This layer together with the corrosion-resistant barrier layer, saturated with a resin, gives the additional protection to the body of the pipe.

The outer layer protects the pipe from bumps and scratches during transportation, and also protects the wall tubes from the UV radiation. Structural layers of the tube (between the inner and outer layers) provide the physical and mechanical properties of the pipe, the construction of the structural layers depends on the pressure rating of the pipe and its strength class.

Figure 1. The structure of the pipe wall, manufactured by centrifugal forming



1– the outer protective layer; 2 - the outer reinforced layer (glass fiber, polymer); 3 - the intermediate layer (glass, resin, sand); 4 - the reinforcing layer (sand, polymer, glass); 5 - the transition layer; 6 - the reinforced inner layer; 7 - the barrier layer; 8 - the inner polymer layer

The modern equipment for the pipe production by the method of centrifugal molding is fully automatic - after selecting the required class and diameter of the pipe the computer carries out the management and control of the flow and distribution of raw materials, the speed of rotation of the mold, and the temperature inside the mold.

Widely known are pipes Hobas (Germany) made by the company's patented technology of centrifugal forming.

For reference:

The world's largest manufacturers of fiberglass pipes are using different manufacturing methods.

The most well-known manufacturing methods, depending on the production technology, are as follows:

– FLOWTITE CFW GRP (continuous filament winding glass-reinforced thermosetting plastics) – pipes fabricated by a continuous winding method on the basis of the polyester resin reinforced with fiberglass;

– C-Tech CC GRP (centrifugal casting glass-reinforced thermosetting plastics) – pipes produced by the method of centrifugal forming (molding) from polyester resins reinforced with glass fibers;

– Amipox GRE (glass-reinforced epoxy) – pipes of epoxy resins reinforced with the cross helical continuous winding of the glass fiber;

– Sarplast CFW GRP (continuous filament winding glass-reinforced thermosetting plastics) – pipes made of polyester resins reinforced with the cross helical continuous winding of the glass fiber.

The company ***Fiber Glass Systems L.P.*** (USA) (http://www.nov.com) is part of a group of enterprises National Oilwell Varco (NOV), specializing in the supply of products for the oil industry. Fiber Glass Systems LP is among the world leaders in the production of fiberglass pipes. In 2012, the company's sales exceeded $500 million.

The first batch of fiberglass pipes was sold in 1948. For a number of years the company has strengthened its market position through the acquisition of several companies (Smith, Koch, Fibercast, Fiberglass Resources) and the introduction of innovative production technologies.

Divisions of the company supply products of the brands *Star, Red Thread, Fiberspar, Centron, Dualoy, Centricast, Z-Core, Bondstrand, Ceram-Core, etc.*

In October 2011, National Oilwell Varco (NOV) has acquired 100% stake in *Ameron International Corporation (USA)* - a multinational manufacturer of high-tech products and materials for the chemical and petrochemical industry, industry, energy, transport and utilities. Ameron also occupies a leading position among the manufacturers of fiberglass pipes GRE for the oil and gas and chemical industries.

Capacities of Ameron are located in various regions of the world (North and South America, Europe, Asia, Middle East), the company has 25 plants. The company offers a wide range of pipes and fittings of brands *Bondstrand, Centron and SSL*.

Divisions of the company Fiber Glass Systems LP use different technologies for production of fiberglass pipes.

In the Russian market LLC "Faber Glas Rus" (Moscow) represents the interests of the company Fiber Glass Systems.

Concern ***Amiantit*** (http://www.amiantit.com) was founded in 1968 in Saudi Arabia. At present, the group has more than 40 manufacturing plants around the world.

Divisions of the concern produces pipes of different kinds of material (ductile iron, PE, PVC, concrete, polymer concrete).

30 companies of the group in 19 countries are engaged in production of pipes.

Nevertheless, the company is best known in the world as a manufacturer of GRP pipes made of a resin reinforced with glass fiber (GRP and GRE). Companies of the concern produce GRP pipes using practically all existing methods of production. Some companies produce and supply GRP pipes for over 40 years.

Group of Companies ***Hobas AG*** (http://www.hobas.com/) is one of the world's manufacturers of fiberglass pipes GRP. The warranty service life of the pipes is up to 75 years. Products are used for sewage, pressure pipelines, as hill-type pipes, dockside and offshore pipelines, overhead pipelines, household and drinking water pipes and railing pipes.

The Group includes 16 plants: Hobas Rohre GmBH (Germany), Hobas Benelux (Belgium), Hobas CZ Spol. (Czech Republic), Hobas Pipe Systems (Romania), Hobas Rohre GmBH (Austria), Hobas Pipe USA (USA), Eastern Hobas Pipes Com. (Thailand), Ozdemir Hobas (Turkey), Hobas Tapo (Uzbekistan), as well as plants in China, Egypt, Japan, Kazakhstan, Spain and the United Arab Emirates.

Hobas Group companies, as well as other major world producers, use different technologies of production of pipes, but the most widely used is the method of rotational forming (molding).

On the Russian market the company Hobas supplies products through its representative LLC "Hobas Pipes" (St. Petersburg).