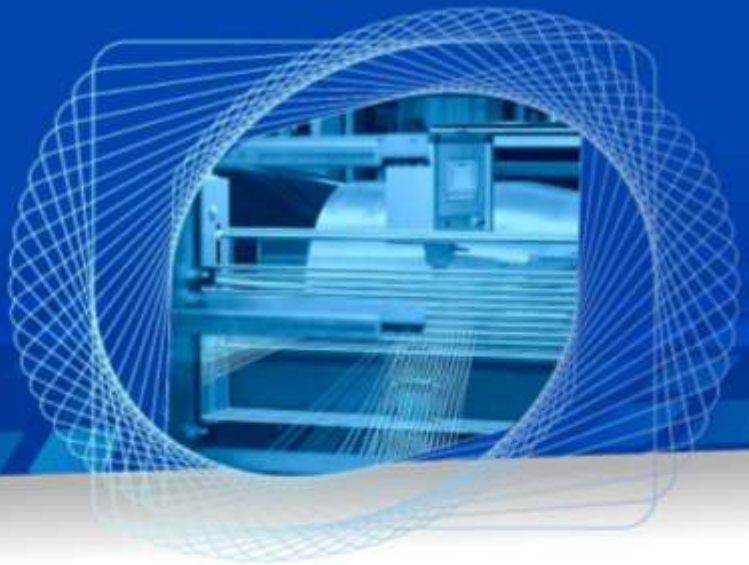

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Silica fibers based on 11-Glass

Silica fibers from 11-Glass (Overview)

Silica fibers are high content (94–96 % SiO_2) continuous fibers and different products consisted of them. Production of silica fibers based on selected dissolving (leaching) of separated ions from the glass by applying of acids to suitable glass fibers composition.

The first generation of Silica fibers were developed and in 1954 during by NPO Stekloplastic. Since then the manufacturing process were advanced and became unique technology both in terms of primer glass fiber composition and production process.

The presence of two oxides with a high melting point (SiO_2, Al_2O_3). in the glass fiber composition is the main difference between the silica fibers 11-Glass made by NPO Stekloplastic process and traditional E-glass fiber leaching technology.

Usage of Sulfur acid instead Hydrochloric acid improves ecological aspect both for the ion exchange process of silica fibers and for the final application. Absence of halogen ions provides risks of corrosion reduction

Silica materials are produced both in non-shrunk (non-heat-treated) and shrunk (heat-treated) form. Silica fiber products can be impregnated with various organic sizings or finishing to improve the performance properties or adhesion for polymers .

Silica materials are classified as non-combustible materials and proved by fire safety certificate. The production, application and sale of silica materials comply with the state sanitary rules. Unlike asbestos Silica products are non-cancerogenic.

Unique combination of thermophysical properties such as high temperature resistance, fire resistance, excellent dielectric characteristics and advanced resistance to various chemical medias environments allow to use silica fiber materials in various industries. They perform effectively as heat and electrical insulation, thermal protection, in aggressive environments and increased radiation, in vacuum and low temperatures. Silica fibers are an excellent environmentally friendly substitution for asbestos.

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Silica fiber from 11-Glass properties

Composition: SiO_2 — 95-96%, Al_2O_3— 3,5-4,0%

Continuous Fiber Diameter — 6-9 µm

Working temperatures — up to 1000ºC

Short term exposure temperature — up to 1400ºC

Melting point ≈ 1650ºC

Linear shrinkage at 1000ºC

for unshrunk fibers — 7%,

for shrunk fibers — not more than 1,5%

Strength – up to 900 MPa

Chemical properties — durable to H_2O, water steam, acid solution (except HF, H_3PO_3), weak alkali solutions, melted metals (except Mg, Na, Si) and alloys

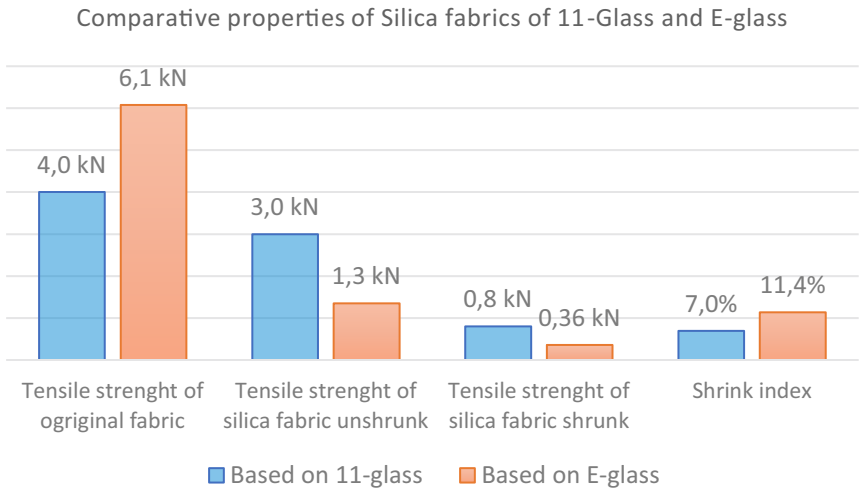
Thermal conductivity Coefficient at 1000ºC — 0,22 Watt/M·K

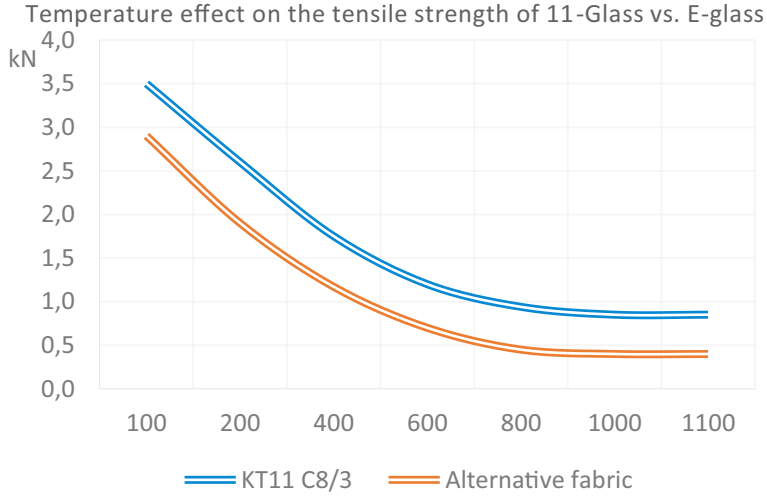
Specific electrical resistance — 10^{17} – 10^{18} Ohm·cm (20ºC)

Dielectric constant — 3,7

Silica fibers from 11-Glass vs. E-glass

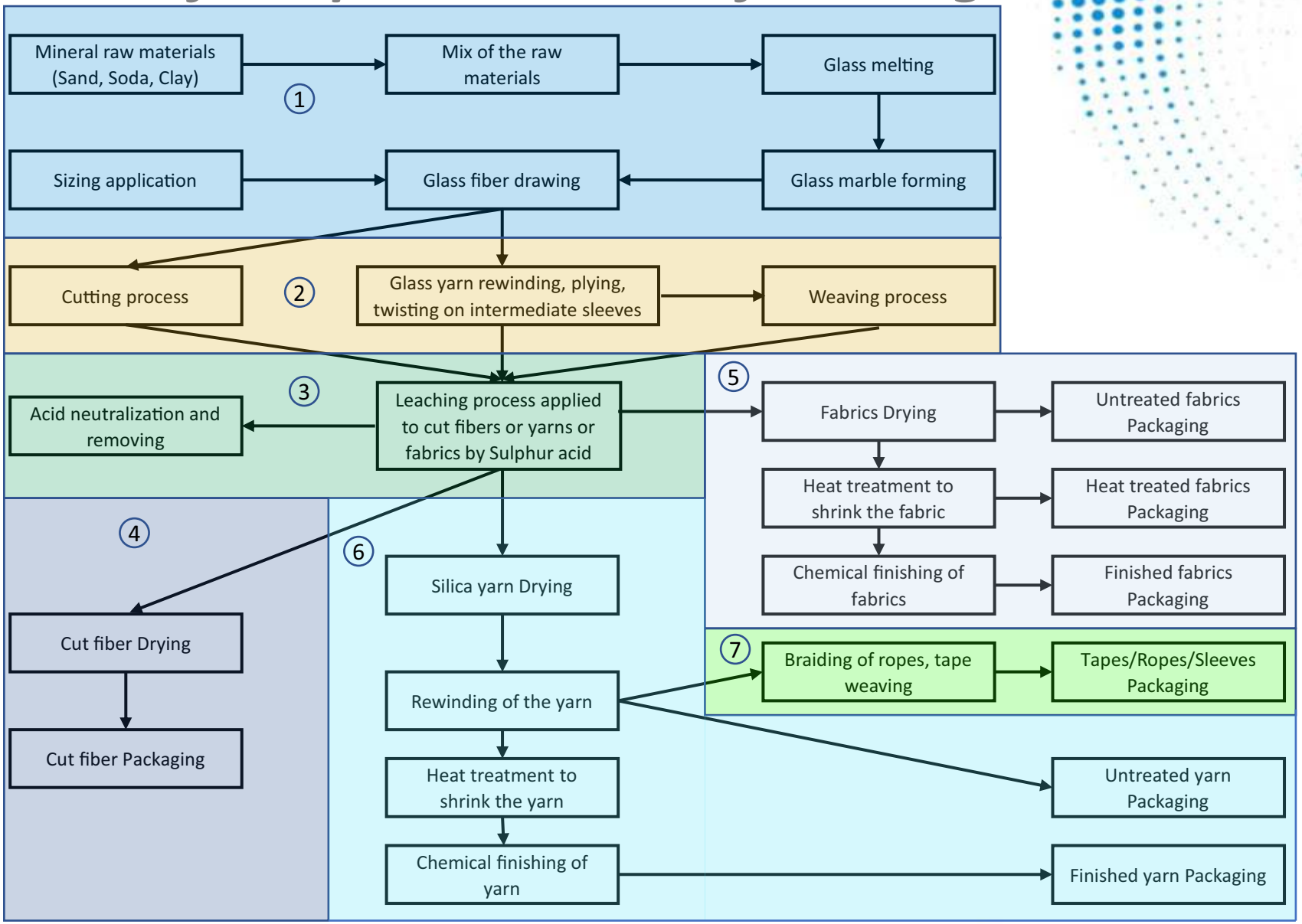
Silica fiber supplier	Glass fiber	Glass fiber composition, %					
		SiO_2	Al_2O_3	B_2O_3	CaO	MgO	Na_2O
NPO Stekloplastic	Original glass fiber 11-Glass	76 - 77	3 - 4	–	–	–	20
	Silica glass after leaching	94 - 96	3 - 4	–	–	–	–
Alternative glass supplier	Original glass fiber E-glass	52 - 56	12 - 16	5 - 10	16 - 26	1 - 6	0 - 1
	Silica glass after leaching	95 - 98	–	–	–	–	–





High temperature resistant Al_2O_3 is glass forming oxide improving the thermal and mechanical properties in 11-Glass while in E-glass is modificator oxide which dissolving after the chemical treatment process.
During the leaching process of 11-glass fiber by by H_2SO_4 solution less than 20% of low melting temperature oxides transfer to the solution allowing to keep at least 50% of silica fiber's initial strength. It results in pores forming dimension less than 0,3 nm.
While the treatment of E-glass by HCl solution causes about 50% of the initial oxides dissolved and generation of 0,9 - 1,1 nm pore on the fiber's surface.
Higher level of porosity increase the shrink index at temperature treatment of Silica E-glass fiber.
After the chemical treatment of 11-Glass lose 25% of their initial strength while E-glass fibers lose 4-5 times of their initial strength.

Silica fiber products manufacturing



Silica fiber manufacturing processes

1. Glass fiber production.
   1.1. Mineral raw materials mix and batch preparation,
   1.2. Advanced glass formulation melting.
   1.3. Glass marbles forming
   1.4. Sizing preparation
   1.5. Glass fiber drawing and sizing

2. Conversion of primary fibers to intermediate glass fiber products.
   2.1. Glass fiber cutting
   2.2. Glass yarn plying and twisting.
   2.3. Glass fabrics beaming and weaving

3. Leaching of glass fiber products process by Sulphur acid to remove the metal ions form the glass.

4. Silica cut fibers drying and packaging

5. Silica fabrics drying and treatment and packaging
   5.1. Silica fabrics drying
   5.2. Heat treatment
   5.3. Chemical treatment and finishing

6. Silica yarn drying and treatment and packaging
   5.1. Silica yarn drying
   5.2. Heat treatment
   5.3. Chemical treatment and finishing

7. Silica yarn downstream conversion by braiding of ropes and sleeves or by tape weaving.

Silica fiber applications

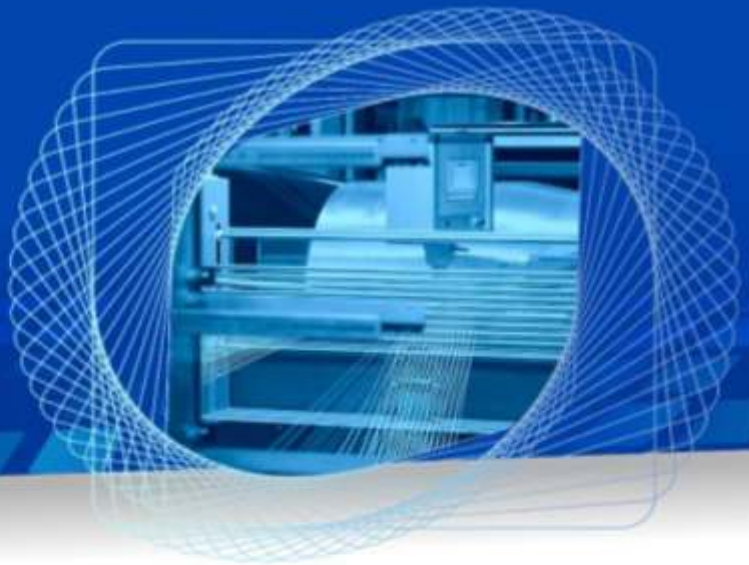
Cut Silica fiber

Silica yarn

Silica fabrics, tapes, ropes

Silica plied yarn

Superior temperature resistance (up to 1000 ℃), fire resistance, incombustibility, health safety



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Thank you for attention!

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