

A Comparison of Basalt Fibre with that of Basalt (Rock) for a Composite Application

^[1] R Ranjith Kumar, ^[2] Rajnish R Dubey, ^[3] Bharath Kumar, ^[4] Dr C Anil Kumar, ^[5] Vinod kumar Biradar
^{[1][2][3]} Scholars of Sri Sairam College of Engineering
^[4] Professor, ^[5] Asst. Professor Department of Mechanical Engg
Sri Sairam College of Engineering

Abstract:- In the present days, technological life the components with composite material is growing every year more than 10 % throughout the world. One of the basic reinforcing elements of composite materials is fibres because fibrous materials are widely applied in quality of thermal, sound-proof, strength and so on. Another basic reinforcing elements of composite materials are particulates in the form of flakes or short fibre, these material size and structures vary from Nano to micro depending upon the application. The present investigation is to have a comparison between the Basalt rock properties with that of Basalt fibres for several applications.

INTRODUCTION

In the present generation, the various types of fibers are developed and used in the different field of application like industries, constructions, engineering network, agriculture etc., The steel is mainly used in various applications and also carbon fibers, glass fibers, polythene fibers, polyamide fibers are also developed and used. In this list a new fiber is added that is known as basalt fibers.

Millions of years ago, eruptions from the Earth crust which expelled an enormous quantity of lava in the surface. In contact to atmosphere the lava has cooled creating the first continents in the planet, the Pangaea. Later on new eruptions and still unknown phenomenal had split the first continent in the today's structure.

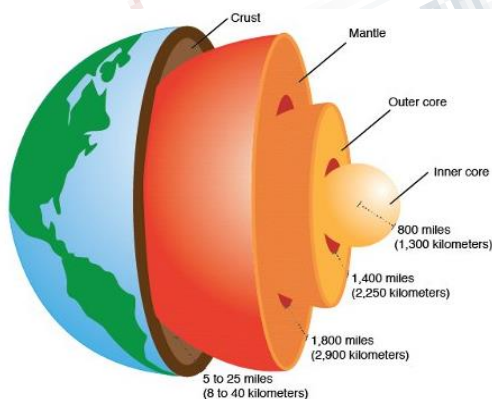


Fig1. Earth Crust

The Earth mantle has a thin layer called sphere, this thin lava when in contact with superficies will create the basalt Rock,

in many places in the earth is possible to find great canyons and natural sculptures made in basalt by the nature, as result of long years of earth center temperature and pressure stabilization.

Even though quality basalt can be found in abundance in the nature, volcano's keep throwing tons of lava in earth atmosphere which reinforced the concept of Advanced Basalt Fiber as a high technology and green composite.

In India Basalt rocks are found in Deccan Trap in Maharashtra in abundance. It is also found in Kutch, Saurashtra, Gujarat, Central India, Madhya Pradesh, Hyderabad region etc.



Fig 2. Basalt solid rock formed by lava



Fig 2a. Basalt porous rock formed by lava

Basalt rock is a type of igneous rock formed by the rapid cooling of lava at the surface of a planet.

It is the most common rock in the Earth's crust. Its characteristics vary from source of lava, cooling rate, & historical exposure to the element. But Basalt fiber is a material made from extremely fine fibers of basalt, which is composed of the minerals plagioclase, pyroxene, & olivine.

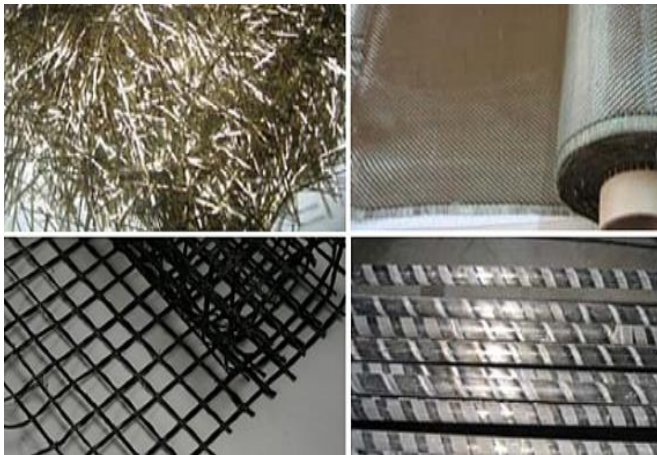


Fig 3. Fabricated Basalt fibers from Basalt Rock

It is similar to fiberglass, having better physic-mechanical properties greater than fiberglass, but being significantly cheaper than carbon fiber & basalt rock fibers have no toxic reaction with air or water, and non-combustible and explosion proof. One Kg of basalt reinforces is equal to 9.6 Kg of the steel. They have many field applications and can replace many costly and rare materials. Basalt fiber offers the potential to solve the largest problems in field of Construction and Engineering application like Defense which is having a potential application.



Fig 4. Basalt rock formation from Volcanic lava

2. BASALT ROCK TO BASALT FIBER

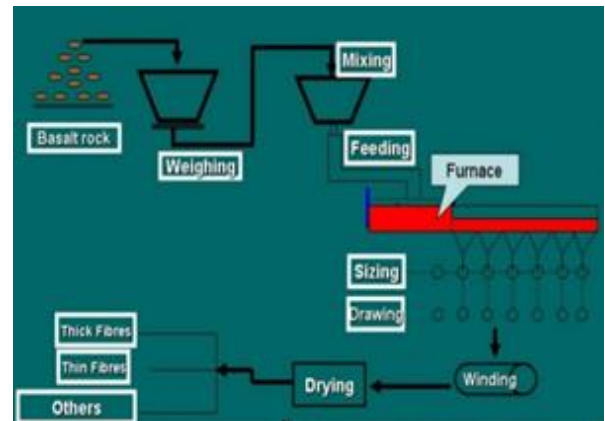


Fig 5. Basalt fiber from basalt rock

A Basalt fiber is made from a single material, crushed basalt, from a carefully chosen quarry source. Basalt of high acidity (over 46% silica content) and low iron content is considered desirable for fiber production. Unlike other materials, such as glass fiber, essentially no materials are added. The basalt is simply washed and moved in to the melting baths in gas-heated furnaces and started to melt. The manufacture of basalt fiber requires the melting of the quarried basalt rock at about 1400-1500°C. The molten rock is then extruded through small nozzles to produce continuous filaments of basalt fiber. Though the temperature required to produce fibers from basalt is higher than glass, it is reported by some researchers that production of fibers made from basalt requires less energy by due to the uniformity of its heating. There are three main manufacturing techniques, which are Centrifugal-blowing, Centrifugal-multi-roll and Die-blowing. The fiber typically has a filament diameter of between 9 to 13µm which is far enough above the respiratory limit of 5µm to make basalt fiber a suitable replacement for asbestos.

3. PROPERTIES OF BASALT ROCK:

Physical Properties of Basalt

- Hardness 6
- Grain Size Fine Grained
- Fracture Conchoidal
- Streak White to Grey
- Porosity Less Porous
- Luster Not Available
- Compressive Strength 37.40 N/mm²
- Cleavage Not Available
- Toughness 2.3
- Specific Gravity 2.8-3

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Vol 2, Issue 11, November 2017

- Transparency Opaque
- Density 2.9-3.1 g/cm³

Thermal Properties of Basalt

- Specific Heat Capacity 0.84 kJ/Kg K
- Resistance Heat Resistant, Pressure Resistant, Wear Resistant

Chemical Composition of Basalt Rock

- Silicon dioxide (SiO₂) 52.8%
- Aluminium oxide (Al₂O₃) 17.5%
- Iron oxide (Fe₂O₃) 10.3%
- Magnesium oxide (MgO) 4.63%
- Calcium oxide (CaO) 8.59 %
- Sodium oxide (Na₂O) 3.34%
- Potassium oxide (K₂O) 1.46 %
- Titanium (TiO₂) 1.38%
- Phosphorus pentoxide (P₂O₅) 0.28%
- Manganese oxide (MnO) 0.16%
- Chromium oxide (Cr₂O₃) 0.06 5 %

4. PROPERTIES OF BASALT FIBER:

- It has excellent thermal properties to that of glass fibers.
- It has tensile strength of 4.84 Gpa.
- It has high elastic modulus.
- It has elongation at break is 3.15%.
- It is safe and abundant.
- It has better corrosion resistance.
- It is extremely hard & has hardness values between 5 to 9 on Mohr's scale, which results in better abrasion property.
- Completely inert with no environmental risks.
- Good sound absorbing properties.
- Good moisture regaining capacity.

Basalt fiber	Density (g/cm ³)			
	Tensile Strength (GPa)	Specific strength	Elastic modulus (GPa)	Specific Modulus
110	2.65	4.15–4.80	1.57–1.81	100–37.7–41.5

5. Applications of basalt rock and basalt fiber:

As Basalt particulates and Basalt Fiber are having so many applications some of the applications are listed below

- It is used in port construction and sea platforms because of better chemical and salt resistance property and also for environment safety.
- Heat protection.
- High pressure vessels (e.g. tanks and gas cylinders).
- Windmill blades.
- Ship hulls.
- Car bodies.
- Concrete reinforcement (e.g. for bridges and buildings).
- Absorbent for oil spills.

CONCLUSION:

- Basalt rocks can be used for manufacturing fine, superfine, ultrafine fibers as Basalt Fibers.
- Basalt rock is an alternative raw material for fiber forming because of its relatively homogeneous chemical structure, its large scale availability throughout the world, its freedom from impurities and of course its ability to form fibers in the molten state.
- Basalt base composites can replace steel and known reinforced plastics (1Kg of steel is equals 9.6 Kg of steel). Basalt can replace almost all applications of asbestos and has three times its heat insulating property.
- Basalt is well known as a rock found in virtually every country round the world. Basalt is more in India (especially in Maharashtra). The cost of basalt is 10 times lower than that of raw material for fiberglass. Basalt is more available than any other raw material.
- Basalt fiber which are manufactured from the basalt rock also have same properties as that of Basalt rock.
- Basalt are non toxic reaction with air or water, are non-combustible and explosion proof.
- The Basalt particulate in the reinforced composites will have the same properties as that of Basalt rocks or Basalt Fibers because of its Multi dimensional properties and also as it consists of so many oxides with different properties.
- When in contact with other chemicals they produce no chemical reactions because of fibers are a compound of oxides that may not damage health or the environment.

**International Journal of Engineering Research in Mechanical and Civil Engineering
(IJERMCE)****Vol 2, Issue 11, November 2017**

Hence it is Chemically Inert and can also have a major application in the field of Construction and Engineering applications.

- Basalt rock Particulate Composite or Basalt Fiber Composites will possess same most of Properties because of the material used in Fabrication of fiber is the same which is available in environment

REFERENCE:

1. <http://www.ijraset.com>
2. <http://basaltm.com/en/tehnologii/basalt-continuous-fiber-bcf-production-techniques.html>
3. <http://geology.com/rocks/basalt.shtml>
4. <https://www.britannica.com/science/basalt>
5. Basalt Continuous Fiber - Information and Characteristics Information from the Basalt Fiber & Composite Materials Technology Development
6. <https://www.sokanu.com/careers/geologist>
7. <https://www.siliconrepublic.com/advice/geologist-career-how-to>
8. <http://www.kids-fun-science.com/basalt-rocks.html>