REVIEW OF BASALT FIBERS

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Abstract: ***The page tosses a reviewabout the technology and perceptions of the basalt fibers and its various applications. These fibers are one of the new minerals for the study in the present times. The knowledge of basalt fibers is of great importance for the development of wide range industries. Basalt is the material produced from the carved out lava from the volcanoes at high temperature. Basalt is more of a non- metallic product. Basalt fiber offers more featuressuch as light weight, fire resistance and good tensile strength. Also it is very beneficial for construction industry. There are large numbers of applications of basalt fiber ineconomic, residential, industrial, highway and other constructions.[4] The further characteristics and properties are been discussed further. Various applications and the uses of the basalt fibers make the industries proceeding toward the development.***

Keywords: ***basalt fibers, strength, fire resistant, construction and development.***

1. Introducton

Industry is always fond of the new elements and materials for the better development and benefits to the industries. Among the vast research and development the element basalt is one of the highly interested topics to get on to for the beneficial approach to the industries.

Basalt fiber is a non-metallic fiber made from basalt rockat high temperature. Basalt rock can also make chopped basalt fiber, basalt fabrics and continuous filament wire.

Basalt fiber is originated from volcanic magma and volcanoes which are ahot fluid or semi fluid material under the earth's crust which is solidified in the open air. Basalt is a term commonly used for various types of volcanic rock.

Basalt has a fine-grained structure due to the molten rock cooling too quick for large mineral crystals to grow. It may contain larger crystals formed prior to the extrusion that brought the lava to the surface.

Figure 1: Basalt fibers [4]

2. Applications

Basalt fibers are appropriate for a range of applications such as automotive, aviation, construction, and electromagnetic shield, high temperature screen etc. the high tensile strength and great acid and alkali resistance make it preferable for various composites projects. The applications are listed below.

1. In automotive industriesthe basalt rovings' plays the main role. The rovings' and fabrics are used in production of various products like CNG cylinders, brake pads, head liners and other frictional materials. Also sporting goods like skies, snowboards, and bicycle are produced by basalt fabrics.
2. Basalt fabrics are used to make the UD tapes, these are used in producing the blades of various turbine. DUE to its high corrosive resistance coating of boats and ships are also done using basalt rovings.
3. In construction industry the basalt chopped fibers are majorly used as a ingredient in the concretes for better stability and durability. This makes the structure having prolonged life-span. The basalt mesh also reduces the chances of cracking and destruction of the structure. The high tensile strength and elasticity also make it preferable for building high load bearing applications like road , highways etc.
4. The high temperature resistance allows the basalt fibers for producing the high temperature bearing pipes, shields and other machinery parts which is required in large in mechanical industries.

The properties of basalt fibers are given below in table 1.

Table 1: Properties of basalt fibers

TYPE	PROPERTIES
MECHANICAL PROPERTIES	1. High tensile strength and good elastic features. 2. Great durability. 3.In comparison to glass fibers- Higher shear and compression strength. 4. Better recyclability and environment friendly. 5. Smooth texture and luster.
CHEMICAL PROPERSTIES	1. Better chemical resistance. 2. High temperature resistance. 3. Compared to glass and carbon – high oxidation and radiation resistance. 4. Non combustible 5. Great thermal protection. 6. Melting point is 1500-1700 Degree Celsius.
COST FACTOR	Higher than the glass fibers but cheaper than the carbon fibers.
PROCESSING	Easy methodology, no advanced technology required.

3. Literature Review

Basalt is usually grey or black in color, but rapidly changes to brown or rust-red because of oxidation of the metallic (iron-rich) minerals present in it to rust. Due to weathering or high amount of plagioclase, some basalt rocks are quite fade colored, especially resembling rhyolite to untrained eyes.[4] The basalt fibers do not contain many additives in a single producing procedure, which effectively reduces its cost making it more preferable. [4]

Chemical composition of basalt rock is given in the table 2.

Table 2: composition of basalt fibers [6]

elements	%
SiO2	52.8
Al2O3	17.5
Fe2O3	10.3
MgO	4.63
CaO	8.59
Na2O	3.34
K2O	1.46
TiO2	1.38
P2O5	0.28
MnO	0.16
Cr2O3	0.06

4. Processing Methodology

The Procedure of production of the continuous fiber of the basalt is as follows –

Firstly the basalt rock is finely crushed in the range of 5 to 20 mm of size. Then the crushed rock is to be heated at high temperature. This is done by loading all the crushed rock in the loader and then is transferred to the heater for further processing. The heater is called as the furnace where the rock is heated at range of temperature of 1400 to 1600 degrees.

After heating the mixture is cooled and then is passed through the set of holes from where the mixture gains the shape of continuous wires. The diameter of these wires is very small and ranges up to 9 to 15 microns.

Later after getting the wires they are lubricated using the lubricator for enhancing the texture and luster of the material. And finally they are reeled on the bobbins using motors on the roving spool.

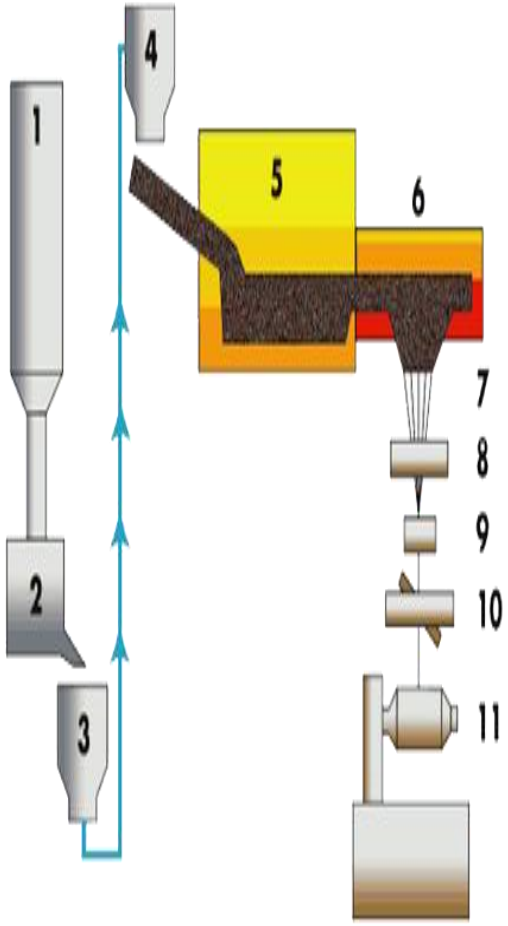


Figure 2: producing procedure of basalt fibers from rock [6]

Table 3: Properties of basalt compared to other [2]

PROPERTIES	BASALT FIBERS	GLASS FIBER	CARBON FIBERS
Tensile Strength (MPa)	**3000 – 4840**	**3100 – 3800**	3500 – 4400
Elastic Modulus (GPa)	**93 – 110**	**72.5 – 75.5**	230 - 800
Melting temperature (C)	**1450**	**1120**	NM
Extensibility (%)	**3.1 – 6**	**4.7**	1.3
Max Temp. range (C)	**~650**	**~380**	~400

Figure 3: fibers after the production process [6]

5. Production of Composites of Fibers

The composites applications of the basalt fibers are made by the process called pressing. In this technique firstly the fires are smashed into small pieces of 60mm. Later this batched fiber along with the glass fibers are passed through the carding machine. The carding machine used in this process is multi cylinder carding machine. The carding materials are the needle punched which are the made more consistent. The material is then made to form composite sheets by passing it through the hot pressing at temperature of 200 degrees & pressure of 20 bar. The process is shown in the figure 4a and 4b below.

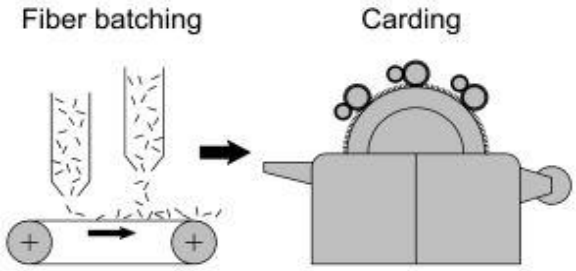


Figure 4(a): manufacturing of composites.

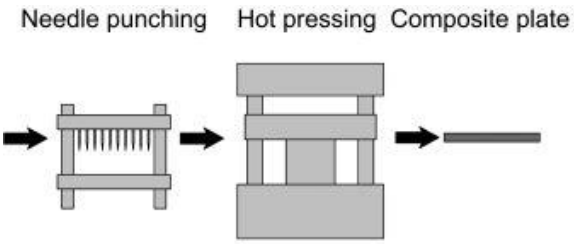


Figure 4(b): manufacturing of composites [6]

6. Comparison of Fibers

As basalt has very great features for the applications, the reasons due to which the basalt for getting the edge on the other elements is been discussed briefly. The properties of basalt fibers on comparing are given in table 3. According to the comparison the tensile strength of basalt ranges more than the glass fibers while the elastic modulus is less than the carbon fibers. As given the melting temperature of basalt is high therefore can be used high temperature

bearing applications an can be used at temperature at the range of 650 degree Celsius.

The temperature ranging of the basalt fibers compared to glass fibers is given in the graph 1.

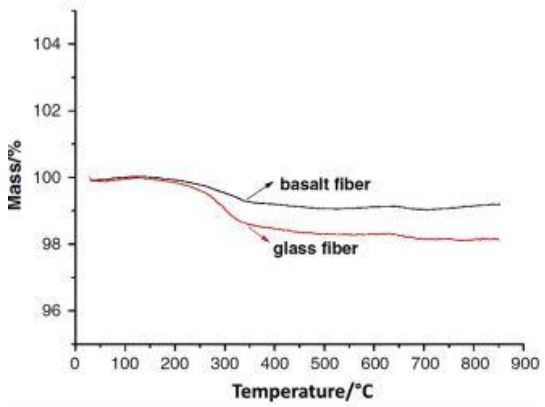
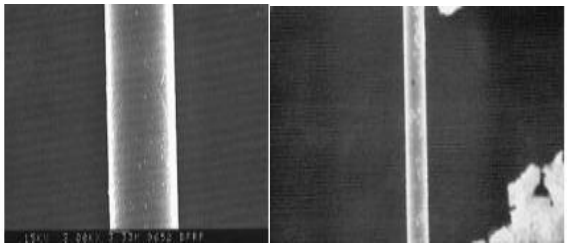


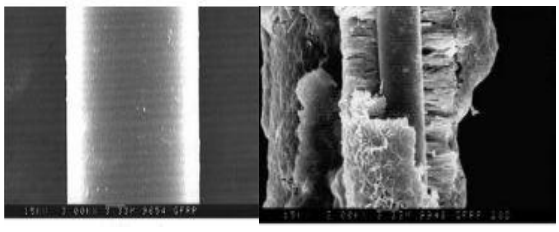
Figure 5: Graph 1 of temperature comparison [5]

This comparison had proved that the basalt fibers are capable of high temperature applications in various industries such as shield and pipes etc. as discussed above. The chemical resistance of the fibers is tested by keeping them in NaOH solution for a couple of days and has been kept noticing the changes in mass of the fibers accordingly and thus the conclusion and drawn was basalt fibers are less reactive to alkali and acid and had loss of mass of approx. 5.0% and retained their properties by around 92% while the glass fibers have gone under a severe destruction of the material in the same period of time. Thus basalt fibers are chemically more stable than glass fibers. The figure 5(a)and 5(b) show the condition of basalt and glass fibers in NaOH solution after 28 days respectively.



Normal after 28 days

Figure 5(a): Basalt fibers



Normal after 28 days

Figure 5(b): Glass fibers [6]

COMPARISON OF COMPOSITES OF FIBERS

Thanking to the various features and properties of the fibers of basalt, the composites and applications of the basalt fibers had thus proven to be more preferable than other products. The various properties of composites of basalt and glass fibers are compared below.

1. The shear strength of laminated composites of basalt on compared to glass is given in the graph2.

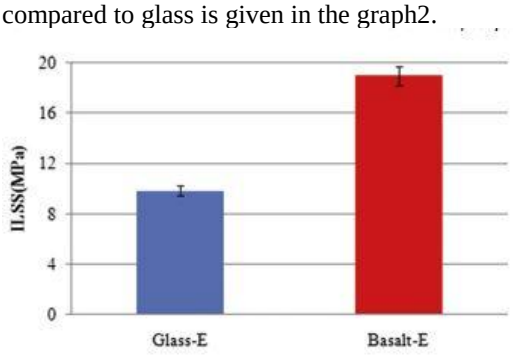


Figure 6: Graph 2: shear strength comparison [5]

2. The comparison of mechanical properties like tensile strength, flexural, compressive young's modulus capability are compared in graph3 below.

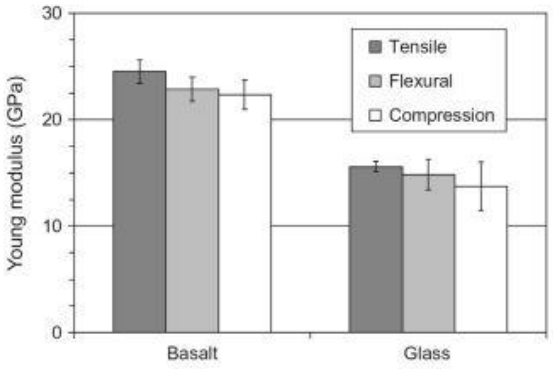


Figure 7: Graph 3 comparison of tensile strength, flexural and compression strength [5]

These properties made the basalt fibers to appropriate for various civil and industrial applications as discussed above.

3. The absorption energy and the maximum impact of external force capability is discussed in the graph 4.

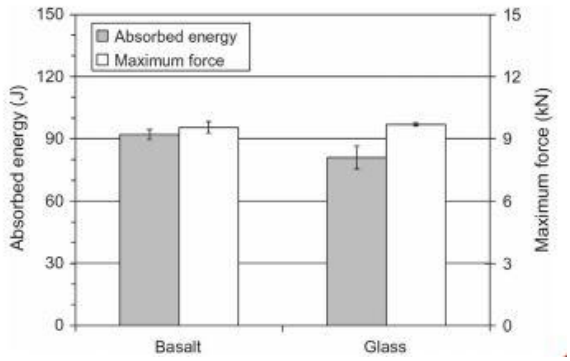


Figure 8: Graph 4 absorption energy and maximum impact comparison.

7. Conclusion

The elastic and extensibility feature of basalt fibers is comparatively low then glass and carbon fibers so this results in a better stiffness in the material and hence preferred on a wide range of applications. The basalt

fibers have properties much similar to the E glass but due to high resistances it has a more applications. The temperature range and melting is higher than other compared fibers thus it also preferred in high temperature applications.

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