International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 11, November-2018

Mechanical Property Evaluation of Woven Glass/Basalt Fiber Reinforced Epoxy Resin Composites

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***Abstract*- In our contribution is to improve our mechanical properties in hybrid composite laminates. The composite laminates will be prepared by the combination of basalt/Glass woven fabric reinforced with epoxy resin composite with help of compression molding. The mechanical properties such as tensile, compressive, flexural, impact, hardness of these composites can be tested on the basis of ASTM standards. The results shows that the mechanical properties of these composites slightly higher than the E-glass fiber.**

Keywords: Glass and Basalt fibre,Epoxy Resin and E-glass , Mechanical properties.

1. INTRODUCTION

Composite materials play an important role in engineering. Fiber reinforced plastic materials are widely used in various engineering industries because of their superior performance and tailor made properties. Though Fibre Resin Plastics are widely used in various fields they are flammable. The Epoxy resins are the most commonly used thermoset plastic in polymer matrix composites have a good mechanical properties[1].The basalt fibre applications due to the potential low cost of this material together with its good mechanical performance, in particular at high temperature. They are two types in basal fiber chopped strand and the woven fabric. The chopped strands of basalt fiber have high in mechanical properties reinforced with polyurethane resin composites [2].Before the arrival of basalt the woven fabric the glass woven fabric plays an important role in various composites application because the glass fiber has moderate/high strength/weight ratio, GRP is used extensively in aviation and aerospace though it is not widely used for primary airframe construction.GRP is all around us, and its unique characteristics will ensure that it remains one of the most versatile and easy to use composites for many years[3] .The mechanical properties of natural fiber such as raffia palm /groundnut shell reinforced with epoxy resin composites have more impact on the mechanical properties of the composites[4].

In our work upon all of these papers we concluded that epoxy resin have high mechanical properties and the basalt /glass fiber have the same .so we choose woven type fibre for getting better properties.

2. MATERIALS & METHOD

2.1 Epoxy

Epoxy resin refers to a type of reactive prepolymer and polymer containing epoxide groups. These resins react either with themselves in the presence of catalysts, or with many co-reactants like amines, phenols, thiols, etc.

Epoxy resin has many industrial applications for a variety of purposes. It possesses higher mechanical properties and more thermal and chemical resistance than other types of resin. Therefore, it has exclusive use in making aircraft components.

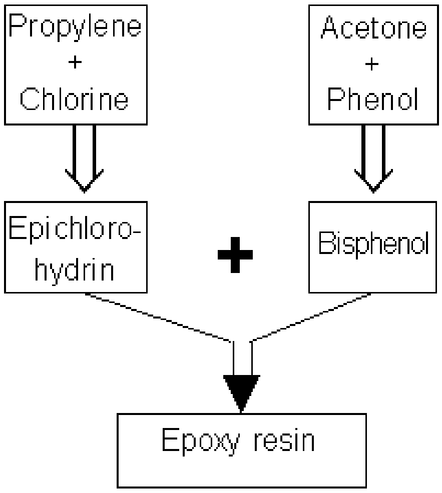

Figure 1: Epoxy Resin

The properties of epoxy resins are the most commonly used thermoset plastic in polymer matrix composites. They also have good adhesion to other materials. They have good chemical and environmental resistance, good chemical properties and good insulating properties the epoxy resins are generally manufactured by reacting epichlorohydrin with bisphenol

Tensile Strength	85 N/mm sq.
Tensile Modulus	10,500 N/mm sq.
Elongation at break	0.8%
Flexural Strength	112 N/mm sq.
Compressive Strength	190 N/mm sq.
Coefficient of linear thermal	3410
Density	1100 kg/m3

Table 1: Properties of Epoxy Resin

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2.2 Basalt Fiber

The process of producing fibers from basalt is based on selecting the richest chemical proprieties basalt rocks with the use of quality tests, crushing the rocks and melting to high temperatures. The melted basalt falls from a specific calculated hole where its temperature gradually decreased and forms a yarn which thickness reduces over the cooling process where it gets rolled in a roving.

The Continuous Basalt Fiber is short for CBF, which is make use of the natural volcanic rock as the raw material and put them in the furnace under 1450P0P-1500P0P after being crushed into power and then which are produced by the platinum rhodium drawing filament laminate. Compared to the carbon fiber, Aramid fiber & (UHMWPE), which has many unique advantages. Such as the physical property, the high temperature resistance, continuous work from -269P0P to 700PP,good acid & alkali-resistance, the good UV resistance, the low hygroscopic property, the environmental resistance And sound insulation, high temperature filter-ability, radiation resistance and the excellent wave-adsorption and wave-penetration and so on. Many sorts of composites which are use of the basalt fiber as the reinforced material can be used many fields such as fire, environmental protection, aerospace, armament, automotive & vessels' manufacture, infrastructural material and so on. Crushed basalt rock is the only raw material required for manufacturing the fiber. It is a continuous fiber produced through igneous basalt rock melt drawing at about 2,700° F (1,500° C).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.

Figure: 2 Basalt Fiber

In which the basalt fibre include the properties such as tabulated below:

Tensile Strength	2.8-3.1 Gpa
Elastic Modulus	85-87 Gpa
Elongation at break	3.15%
Density	2.67 g/cm cube

Table 2: Properties and values of Basalt Fiber

2.3 Glass Fiber

Textile-grade glass fibers are made from silica (SiO_2) sand, which melts at 1720°C/3128°F. SiO_2 is also the basic element in quartz, a naturally occurring rock. Quartz, however, is crystalline (rigid, highly ordered atomic structure) and is 99 percent or more SiO_2. If SiO_2 is heated above 1200°C/2192°F then cooled ambient, it crystallizes and becomes quartz. Glass is produced by altering the temperature and cool down rates. If pure SiO_2 is heated to 1720°C/3128°F then cooled quickly, crystallization can be prevented and the process yields the amorphous or randomly ordered atomic structure we known as glass. The step by step process of glass fiber is batching, melting, fiberisation and coating.

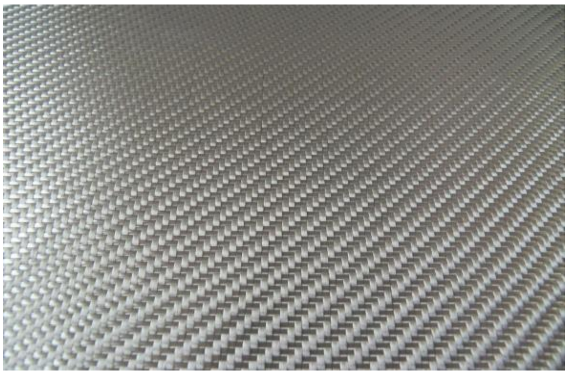

Figure: 3 Glass Fiber

In which the basalt fibre include the properties such as tabulated below:

Fibre type	Compression Strength	Tensile Strength	Density	Thermal Expansion	Softening T (.c)
Eglass	3445	1080	2.58	5.4	846
S2 glass	4890	4600	2.46	2.9	1056

Table 3: Properties and values of Glass Fiber

3. METHODOLOGY

The Sheet of Material has been Prepared by the hand lay-up process.

Step 1: In which a long one metre of Glass fibre has been cutted in pieces of 30 sq.cm and there has been cutted with the required for six pieces. Likewise the Basalt fibre of One metre has been cutted in which 30 sq.cm required in six pieces.

Step 2 :The glass fibre in which the weight of each of the pieces carried Sixteen grams and though the six pieces carried Ninety Six grams.Same as the Basalt fibre one of the pieces carried Twenty Four gram and the six pieces obtained the One Fourty Four gram.The both of the cutted pieces of glass and basalt fibre are kept in weight machine in that measured obtained weight of Two Sixty grams.

Step 3: After Cutting the fibres and then process in which a 100 square centimeter of two granite stone the wax will be pasted and in which kept in constant period of time. Since Wax has the diverse classof organic compounds that are lipophilic, malleable solids near ambient temperatures. They include higher alkanes and lipids, typically with low viscosity liquids. waxes are insoluble in water but soluble in organic, nonpolar solvents.In which the pasted of waxes in stone the

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cut pieces of fibre are in applied in preparation in process of sheet in reinforcement of resins.

Step 4: The preparation of sheet in which the fibres and the resin of the ratio of 50:50. The weight of both fibre is Two Sixty grams in which that Epoxy resin also added as Two Sixty gram of for reinforcement. Also adding with the Hardner of the Epoxy resin.Both resin and Hardner are titrated with a paint brush of a small cup.

Step 5 : In that granite stone the first glass fibre is fixed and then resin will painted on full of that fibre after than basalt fibre will applied, likewise every pieces are kept in every each of glass and basalt fibre are in reinforced with the epoxy resin and the hardner.At last the wax painted on other granite stone has been Compressed on that stone.And theh the limited amout of weight of small material such as bricks are kept on the stone for the fibres of glass and basalt would get compressed.It will kept Constant for 24 hours as in which the sheet would required with the cortect form of material.

Step 6: After 24 hrs the separation of both wax painted on granite stone the slide of sheet has been prepared as shown in figure 16.The Sheet is prepared in the compression as in which without correct form of square shaped sheet.Thus in which slide of sheet is cutted with the wire-cut and last required the correct form of square in shape.Finally the sheet has been required for testing method.

Fig : 4 Cut Pieces of Glass and Basalt Fibre

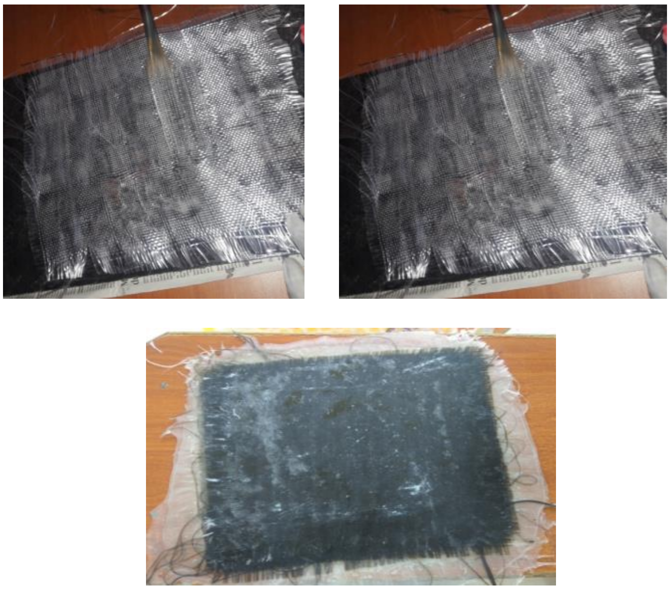

Fig : 5 Applying Epoxy resin of Glass and Basalt fibre

4. RESULTS & DISCUSSION:

4.1. Compressive Testing:

Compression testing is a very common testing method that is used to establish the compressive force or crush resistance of a material and the ability of the material to recover after a specified compressive force is applied and even held over a defined period of time. In which sheet of glass and basalt fibre is cutted for compression.

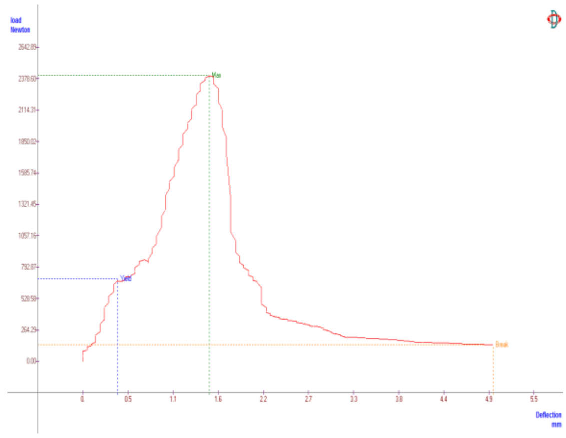

Fig: 6.Graph of Compression test

S.No	**Maximum force of Compresssion**	**Maximum deflection of Compression**
1	2406.55 N	1.53mm

Table: 4 Compression Test

4.2. Hardness Testing:

The hardness test method as used to determine Brinell hardness is defined in ASTM E10. The testing often use a very high test load (3000 kgf) and a 10mm diameter indenter so that the resulting indentation averages out most surface and sub-surface inconsistencies. The sheet cutted for hardness test.

S.No	**Composite Material**	**Observed values of Hardness number (1)**	**Observed values of Hardness number (2)**	**Ambient temp ° (c)**	**Avg Hardness number**
1	Glass & Basalt Fibre	79	78	25.0	77

Table: 5 Hardness Test

4.3. Flexural Test:

Flexural testing is used to determine the flex or bending properties of a material. Sometimes referred to as a transverse beam test, it involves placing a sample between two points or supports and initiating a load using a third point or with two points which are respectively call 3-Point Bend and 4-Point Bend testing.The sheet cutted for hardnes test.

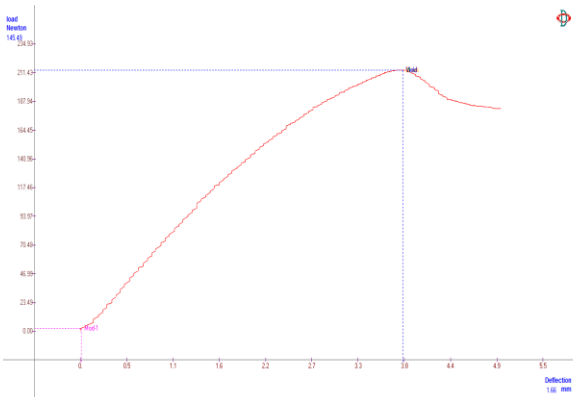

Fig :7 Graph of flexural test

S.No	Force at 1%	Deflection at 1%	Flexural modulus at 1%	Maximum force	M(SLOPE)	Flexural strength
1	2.56 N	0.01mm	255.95 N/mm	213.57 N	255.95 N/mm	98.57 N/mm2

Table: 6 Flexural Test

4.4. Impact test:

The Charpy impact test, also known as the Charpy V-notch test, is a standardized high strain-rate test which determines the amount of energy absorbed by a material during fracture. This absorbed energy is a measure of a given material's notch toughness and acts as a tool to study temperature-dependent ductile-brittle.The sheet cutted for Charpy impact test.

S.no	Sample Identification	Specimen temp °c	L*b*h(mm)	Charpy Impact of energy joules	Capacity [J]
1	Glass and Basalt fibre	Room temp°c [25.3]	65*13*4	4	300

Table:7 Impact Test

5. CONCLUSION:

From the Characterisation study of glass and basalt fibre with epoxy resin component it has been that specific mechanical property as its own strength.The result confirmed that sheet formed by glass and basalt fibre are reinforced with epoxy resin is basically superior to find out the values of each test.

- In Impact test has found that the composite of glass and basalt fibre of composite material of sheet obtained value 4 joules.
- In flexural test has found that the composite of glass and basalt fibre composite material of sheet obtained value of strength as 98.57 N/mm^2
- In Compressive test has found that the composite of glass and basalt fibre composite material of sheet obtained value of Maximum force of Compresssion as 2406.55 N and Maximum deflection of Compression as 1.53mm
- In Hardness test has found that the composite of glass and basalt fibre of composite material of sheet obtained value Average Hardness Number as 77.

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