PROPERTIES OF CHOPPED GLASS FIBRE AND BASALT FIBRE REINFORCED EPOXY COMPOSITES

M.Sikkandar Basha[1],V.Vetrivel[2],M.Viswanath[3],L.Arivalagan[4],C.Anand Chairman[5].

[1,2,3,4] *UG Students,Department of Mechanical Engineering,*
[5] *Professor,Department of Mechanical Engineering,*
K.RamakrishnanCollege of Engineering,Trichy-621112.

ABSTRACT

The technology of composite materials is based on the concept of fiber reinforcement to strengthen matrix materials. Material properties that can be improved in this way include mechanical strength, stiffness, weight, fatigue life, heat resistance, acoustical insulation and resistance to wear and corrosion. Composites are emerging as an advanced class of engineering materials due to its high strength to weight ratio, corrosion resistance and good specific mechanical properties.
Chopped basalt fiber and glass fiber reinforced wood sawdust panels were glued using epoxy resin. The tensile and bending strengths of the composites were tested, which indicated that the tensile and bending strengths of basalt composites is better than glass composites under all conditions.

KEYWORDS:*Fiber reinforcement,wood sawdust panel, corrosion resistance, composite strength.*

INTRODUCTION

Usage of fibre-reinforced composite structures has increased in such industries as automotive, marine transportation, civil engineering, sporting goods, medical equipment and prosthetic devices. With the increased use of composite materials, there is a need to develop methods to predict the material properties and behaviour of composite materials and of structures made of these materials, under a variety of loading and environmental conditions. The developments in composite material after meeting the challenges of aerospace sector have cascaded down for catering to domestic and marine, automotive, electronics and allied industries. Composites, the wonder material with light weight, the ease of fabrication and its stiffness properties have come a long way in replacing the conventional materials.

Thermosetting polymers are insoluble and infusible after cure because the chains are rigidly joined with strong covalent bonds. Typical examples of thermoset polymers include epoxies, polyesters, phenolics and polyamide. Epoxy is the most popular among the available thermosetting polymers due to its high strength and low viscosity

Newer manufacturing techniques were invented and introduced during the last few decades; some of them were increasingly popular due to their enhanced advantages and ease of manufacturing over the conventional processes. Polymer composite material such as glass, carbon and Kevlar fibre reinforced composite are popular in high performance and light weight applications such as aerospace and automobile fields. Carbon fibre reinforced polymer is an extremely strong and light fibre reinforced polymer which contains carbon fibres. For composite manufacturing a suitable resin either thermoplastic or thermosetting is needed to blend with. Thermoplastic and thermosetting resins have their unique properties but generally thermosetting resins are preferred to mix with glass, carbon and kevlar due to their higher strength and easily curing properties at room temperature. Thermosetting polymers are insoluble and infusible after cure because the chains are rigidly joined with strong covalent bonds. Typical examples of thermoset include epoxies, polyesters, phenolic and polyamide. Epoxy is the most popular among the available thermosetting polymers due to its high strength, low viscosity, low volatility and lower shrinkage rates over other thermosetting polymers.

PROPERTIES OF BASALT FIBRE

a) Physical Properties
Colour:- It is available in golden brown in colour.
Diameter:- It is available in different diameter like 5.8 micron.

Length:- Available in 6mm,8mm,12mm etc. Density:- density of basalt fibre is 2.75 g/cm3
Coefficient of friction:- The coefficient of friction may be between 0.42 to 0.50.

b) Chemical Properties
Basalts are more stable in strong alkalis.
Weight loss in boiling water, Alkali and acid is also significantly lower.
Possess resistance to UV- Light & biologic and fungal contamination.
Are compatible with phenolic resins. Absorption of humidity comes to less.

c) Thermal Properties
With a thermal range of –260 ◦C to 982 ◦C and melt point of 1450◦C as well as low thermal conductivity 0.031

PROPERTIES OF GLASS FIBRE

Glass fibres are available in continuous or chopped lengths. Glass fibres have large tensile strength and elastic modulus but have brittle
Stress-strain characteristics and low creep at room temperature. Glass fibres are usually are usually round and straight with diameters from 0.005 mm to 0.015 mm. They can be also bonded together to produce the bundle of glass fibres with diameter up to 1.3 mm.

CHOPPED FIBRE
Main determinant of economic efficiency of modern projects is time of their accomplishment. In this case, the traditional steel system is quite slow process and does not allow to create light, spatial elements. So the weight of steel elements and slow and time consuming process of their creation has negative effect on economic characteristics of the process.

Chopped fiber reinforcement is the most effective way to improve negative characteristics of plain elements in modern methodology that was actively accomplished in the world, especially during the last decade. Chopper fiber reinforced concretes have sharply improving parameters of strength, stability, impact resistance, freeze resistance and waterproofing.

EPOXY RESIN
Epoxy is either any of the basic components or the cured end products of epoxy resins, as well as a colloquial name for epoxidefunctional group. Epoxy resins, also known as polyepoxides,reactive prepolymers and polymers which contain epoxide groups. Epoxy resins may be reacted (cross-linked) either with themselves through catalytic homopolymerisation, or with a wide range of co-reactants including polyfunctional amines, acids (and acid anhydrides), phenols, alcohols and thiols.

METHODOLOGY AND SETUP

MATERIAL SELECTION

BASE MATERIALS

- Chopped glass fibre - PX35

  Size:4-5mm

Diameter :0.22mm

- Chopped basalt fibre

  Size:3-4mm

  Diameter :0.40mm

RESIN

- Epoxy - LY556
- Hardener - HY556

TESTING

Hardness test

The Rockwell test is generally easier to perform, and more accurate than other types of hardness testing methods. The Rockwell test method is used on all metals, except in condition where the test metal structure or surface conditions would introduce too much variations; where the indentations would be too large for the application; or where the sample size or sample shape prohibits its use.

The Rockwell method measures the permanent depth of indentation produced by a force/load on an indenter. First, a preliminary test force (commonly referred to as preload or minor load) is applied to a sample using a diamond or ball indenter. This preload breaks through the surface to reduce the effects of surface finish. After holding the preliminary test force for a specified dwell time, the baseline depth of indentation is measured

Tensile test

The most common testing machines are universal testers, which test materials in tension, compression, or bending. Their primary function is to create the stress- strain curve described in the following section in this chapter. Testing machines are either electromechanical or hydraulic. The principal difference is the method by which the load is applied.

Electromechanical machines are based on a variable-speed electric motor; a gear reduction system; and one, two, or four screws that move the crosshead up or down. This motion loads the specimen in tension or compression. Crosshead speeds can be changed by changing the speed of the motor. A microprocessor-based closed-loop servo system can be implemented to accurately control the speed of the crosshead.

HAND LAYUP METHOD

Cleaning

The tile surface should be cleaned by using white grease and water to remove the pours and dust materials.

Mixing

First of all the mixture of 250g of chopped glass fibre with 200ml of epoxy resin and 200ml of hardener is done.

Preparing

Then the mixture of chopped glass fibre is poured on the tile. The overflow of mixture is controlled by using some blocks on the sides of the tile.

Setting

Then the mixture is setted by using roller, then the epoxy resin and hardener is poured over the mixture for smoothening of the surface and also for easy detachment of material. Then the material is compressed using another tile over the top and it should be left for 2 days.

Drying

The material was dried for 2 days in atmospheric air, and away from any disturbance.

Fig.1 Chopped glass fibre plate

Fig.2 Chopped basalt fibre plate

TESTING REPORT

Tensile Test

The composite materials were given to strength of materials laboratory for tensile strength testing purpose, we have taken 2 plates with different combination for testing.

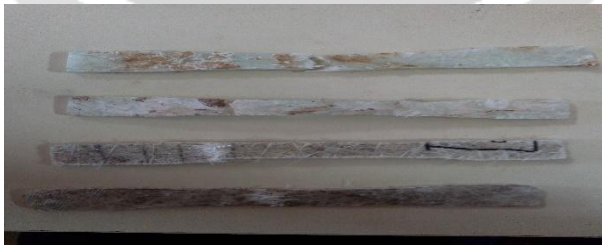

Fig.3 Tensile test specimen

All joints are tested up to failure of joints. The force applied to break them and the area of cross section are measured and the final tensile strength calculated for different joints.

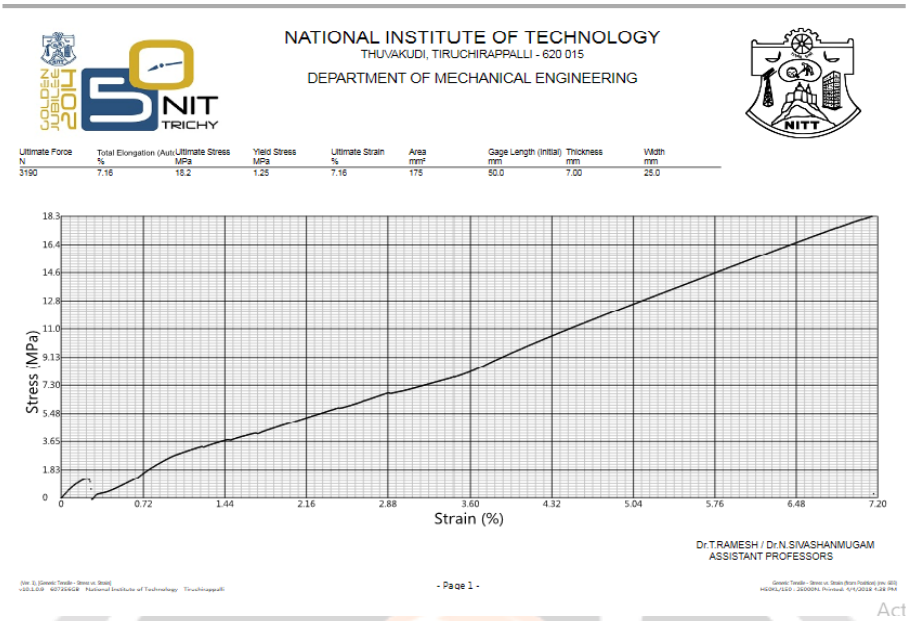

Fig.4 Tensile test basalt fibre

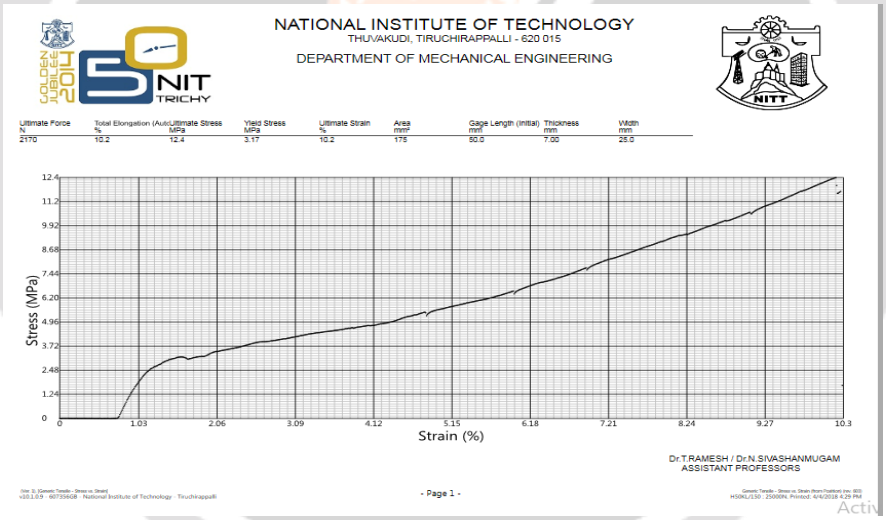

Fig.5 Tensile test glass fibre

Ultimate tensile strength of chopped = 18.2 MPa

Basalt fibre

Ultimate tensile strength of chopped = 13.3 MPa

Glass fibre

Hardness Test

The hardness test for welded plates carried out in our college by using Rockwell hardness with load of 100kgf.

Table.1 Hardness Test Result

Materials	**A HVI**	**B HVI**	**C HVI**	**Average HVI**
Chopped Basalt fibre	78	77	68	74.33
Chopped Glass fibre	81	61	65	71

RESULT AND DISCUSSION

After this experimentation, various points are come out from the operation of hand lay-up method and testing of composite materials.
The composition of the materials is one more important parameter to be selected for the process. It is selected as per the thickness of the plates and diameter of the fibre. Also suitable reinforced resin helps to generate higher strength which is important requirement for the hand lay-up process.
The test results shows that chopped basalt fibre shows more tensile strength and hardness value when compared to chopped glass fibre.
The basalt fibre have more bonding efficiency when reinforced with epoxy composite than glass fibre. Due to the perfect composition for the resin and accurate specimen preparation method, chopped basalt fibre have more tensile value and hardness value than chopped glass fibre.

CONCLUSION

After the study of experimentation of reinforced composite materials some of the good points were came out. There are also some other points that also taken in to consideration for the extra work to be done. The some of concluded points regarding this study are:

- The process cost gets minimized automatically as the experimentation is done within the available tools and machines.
- The health hazards are taken care during the manufacturing process has many health hazards affected on operator due to direct exposure to the hot fibre.
- Use of backing plate to specimen gives the support and useful to avoid the movement of the fibre during the process. Since it avoids unnecessary air gap in the specimen.
- The composite materials test showed that there is good strength for basalt composite. The behaviour of basalt composite is better than glass composite under all testing conditions.

REFERENCE

[1]. G. Agarwal, A. Patnaik, R.K. Sharma, J. Eng. Sci. Technol. 9, 590 (2014).
[2]. G.C. Jacob, J.M. Starbuck, J.F. Fellers, S. Simunovic, Polym. Composite 26, 293 (2005).
[3]. W. Dong, H.C. Liu, S.J. Park, F.L. Jin, J. Ind. Eng. Chem. 20, 1220 (2014).
[4]. ASTM D638M-96, Standard test method for tensile properties of plastics (metric), American Society for Testing and Material, 1996.
[5]. ASTM D790-10, Standard test methods for flexural properties of unreinforced and reinforced plastics and electrical insulating materials, American Society for Testing and Material, 2010.

[6]. ASTM D4812-11, Standard test method for unnotched cantilever beam impact resistance of plastics, American Society for Testing and Material, 2011.

[7]. ASTM D-2583, Standard test method for indentation hardness of rigid plastics by means of a Barcol impressor, American Society for Testing and Material, 2013. Soboyejo, W. (2003). Mechanical properties of engineered materials, MarcelDekker Inc., New York.

[8]. Nielsen, L.E.; and Landel, R.F. (2004). Mechanical properties of polymers and composites, Marcel Dekker Inc., New York.

[9]. Friedrich, K. (1985). Micro structural efficiency and fracture toughness of short fiber/thermo plastic matrix composites. Composite Science andTechnology, 22, 43-74.

[10]. Sharma, M.; Bijwe, J.; and Mitschang, P. (2011). Abrasive wear studies on composites of PEEK and PES with modified surface of carbon fabric.
Tribology International, 44, 81-91.

[11]. Yunus, R.; Zahari, N.H.; Salleh, M.A.M.; and Ibrahim N.A. (2011). Mechanical properties of carbon fiber reinforced polypropylene composites,
Composite Science and Technology, 471-472, 652-657.

[12]. Katogi, H.; Takemura, K.; and Shimmer, Y. (2011). Mechanical properties of carbon fiber reinforced plastics under hot-wet environment, Fracture andStrength of Solids VII, 462-463, 207-212.