The Study on Tension and Shear Behavior Variation in different combination of Polymer Composites: A Review

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Abstract - The paper works describes the development of tensile and shear behavior of different type's material combinations of polymer composites with carbon fiber reinforcement, vinyl ester resin and different filler materials. The results shows that out all other type of reinforcement the vinyl ester resin with carbon fiber reinforcement and filler materials that's adds the strength and better mechanical properties in particularly tensile and shear characteristic.

Key Words: carbon fiber, vinyl ester resin, Tensile and shear behavior

1. Introduction

A composite material can be defined as a combination of two or more materials that results in better properties than those of the individual components used alone. The two constituents are reinforcement and a matrix. The main advantages of composite materials are their high strength and stiffness, combined with low density, when compared with bulk materials, allowing for a weight reduction in the finished part. The reinforcing phase provides the strength and stiffness. In most cases, the reinforcement is harder, stronger, and stiffer than the matrix. The reinforcement is usually a fiber or a particulate.

1.1 Specimen preparation

Most of the materials are prepared by hand layup technique which is the oldest method used to fabricate the laminated composites. The materials used are vinyl ester as the resin and the carbon fiber as the reinforcement with different filer material combination. The carbon fiber reinforcement are used in the form of unidirectional as it has higher strength than other form of carbon fiber. Different hardener is used according the requirement of the filer material.

1.2 Test Method:

1. Tensile Strength The tension test is generally performed on flat specimens. The most commonly used specimen geometries are dogbone specimen and straight-sided specimen. The tensile tests were conducted according to the ASTM D 3039-76 standard on a Computerized Universal Testing Machine INSTRON H10KS.

2. Interlaminar shear strength the short beam shear (SBS) tests are performed on the composite samples at room temperature to evaluate the value of inter-laminar shear strength (ILSS). It is a 3-point bend test, which generally promotes failure by interlaminar shear. The SBS test is conducted as per ASTM standard (D2344-84) using the same UTM.

1.3 Literature survey

R.Panneerdhassa[1] et.al
This paper describes the mechanical properties of the luffa fiber and ground nut with epoxy reinforced hybrid polymer composite. The luffa fiber and ground nut reinforced with epoxy polymer hybrid composite as been fabricated by using of hand layup technique, and composite plate are prepared different volume fraction of luffa fiber and ground nut are 10%,20%,30%,40% and 50% are used for fabrication of composites. Due to the volume variation of the fiber, mechanical properties are gets varied. And also optimum mechanical properties are obtained at 40% of fiber volume fraction of fiber treated composite.

Yuan Wang[2], et.al
They was selected material are carbon fiber, vinyl ester resin and filled with silicon carbide as a filler material, the composites were manufactured through chemical vapor infiltration (CVI) and this composite disc is used to study the microstructure of friction surface by using focused ion beam microscopy (FIB) and transmission electron microscopy (TEM) analysis and also friction test were conducted on a laboratory scale Dynamometer.

And he measured the coefficient of friction (COF) averaged from recorded data of four pairs of disc and pad, every single braking applied from the 1st to 49th, The highest CoF of 0.33±0.01was achieved at the last braking stop, which was raised from a starting level of 0.27±0.01 at the first one.

Andy Leatherbarrow[3] et.al

He was selected a carbon fiber- vinyl ester resin and silicon carbide composite manufactured through different routes are liquid silicon infiltration (LSI) and chemical vapour infiltration (CVI). and using different carbonaceous raw materials. He used two types fiber material PAN based carbon fiber and pyrolytic carbon . he tested for different properties like Young's modulus, hardness, fracture toughness and ductility.after tests are carried out . he obtained pyC and PAN carbon fibres, one might consider to estimate the upper and lower bounds of Young's modulus of these carbons using constitutive relations for any randomly distributed polycrystals, for hardness all carbon constituents in the composites exhibited a much lower ductile deformation.

B.R. Raju[4] et.al

Has investigated the tensile behavior of the glass fabric epoxy with adding the filler material of silicon carbide of sizing 5-10 micro, adding with the epoxy of the different weight percentage of 5%, 7.5%, and 10% of whole weight of epoxy and composite specimens are fabricated by hand layup followed by the compression molding technique. Specimens are tested according to the ASTM standards; finally they got the results of tensile strength gradually increasing as the silicon carbide increases.

Moe Moe thwe[5], et.al

This paper describes comparing the mechanical properties of short bamboo fiber reinforced polypropylene composite and the short bamboo-glass fiber polypropylene hybrid composite were fabricated through a compression molding technique. After fabricated composite plates are cuts according to the ASTM standards for testing purpose, and after test results are observed that small bamboo fiber enhanced good properties when hybridization with small amount of glass fibers.

R. Satheesh Raja[6], et.al

This paper describes mechanical behaviour of the flyash impregnated glass fiber reinforced composite. The composite is prepared by using of chopped strand of E-glass fiber, unsaturated polyester resin and also filler material fly ash size ranging from 10-50 micron, by using all these constituents fabricate a composite plate by hand layup technique and specimens are prepared according to the ASTM standards for the mechanical testing. The testing results shows the fly ash impregnated composite specimens are exhibits better mechanical properties are compared to the without filler loaded specimens.

C.Elanchezhian[7] et.al

Has investigated that Mechanical behaviour of glass and carbon fibre reinforced composites at varying strain rates and temperatures. This paper deals with the fabrication and investigation of fibre composites and compares it with GFRP and CFRP used separately. Mechanical behaviour of the composite is obtained by testing the composite laminates for tensile (at varying strain rates and temperatures), flexural (at varying strain rates) and impact testing. The composite is manufactured by hand layup process. It is found that the CFRP composite has better properties than the GFRP in tensile and flexural. The internal structure of the composite is observed under scanning electron microscope (SEM) and the fractures, voids and fibre delaminating are analysed.

Vicente Sánchez-Gálveza[8]

Has investigated that the Analytical simulation of high-speed impact onto hybrid glass/carbon epoxy composites targets for different impact speeds ranging between about 200 and 600 m/s. speeds ranging between about 200 and 600 m/s. Analytical results of both ballistic limit (maximum speed for no perforation) and residual velocity of penetrator after full perforation .

R. Murugana[9] et.at

Has investigated that the Investigation on Static and Dynamic Mechanical Properties of Epoxy Based Woven Fabric Glass/Carbon Hybrid Composite Laminates. The influence of stacking sequence of composite laminates on static and dynamic mechanical properties was discussed in detail. The modulus curves of dedicated and hybrid composite laminates in a Cole-Cole plot show an imperfect semi-circular curve indicating the heterogeneity of the laminates and relatively good fibre/matrix bonding. They arrive with a conclusion as to the superiority of one of the hybrid constructions for structural applications could also be reached.

2 Test Method:

1 Tensile Strength The tension test is generally performed on flat specimens. The most commonly used specimen geometries are dogbone specimen and straight-sided specimen. The tensile tests were conducted according to the

ASTM D 3039-76 standard on a Computerized Universal Testing Machine INSTRON H10KS.

2. Interlaminar shear strength the short beam shear (SBS) tests are performed on the composite samples at room temperature to evaluate the value of inter-laminar shear strength (ILSS). It is a 3-point bend test, which generally promotes failure by interlaminar shear. The SBS test is conducted as per ASTM standard (D2344-84) using the same UTM. When comparing the results of tension and shear of the different material combination of following data has been collected. To comparing all the data we obtained carbon fiber with vinyl ester, this combination of composite material will gives the maximum tensile strength and shear strength as compared to all other combination of material shown in table 1 bellow.

Table 1

Sl no	Material combination	Tensile strength Mpa	Shear strength at ± 45^0
1	E Glass fiber with epoxy	100	18.2
2	E glass fiber with polyester	1080	20
3	Carbon fiber with epoxy	600	33
4	Jute with epoxy	53.34	05
5	Jute ,glass with epoxy (hybrid)	40.04	04
6	Glass, carbon with vinyl ester (hybrid)	512.5	44.7
7	Carbon fiber with vinyl ester	1940	44
8	Glass fiber with epoxy and 10% of silicon carbide	255	75
9	Mild steel	325	190
10	Boron with epoxy	1380	62

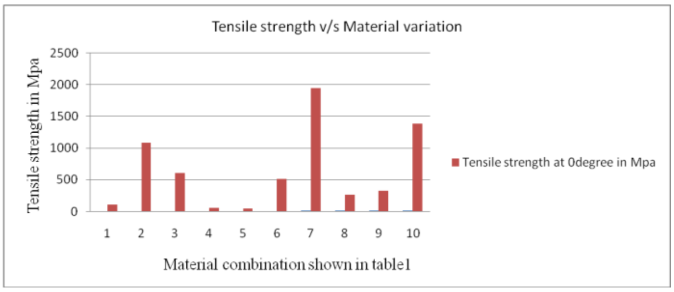

Chart -1: Tensile strength v/s material variation

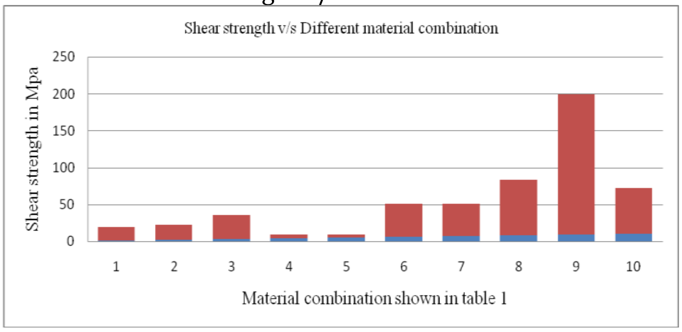

Chart-2: Shear strength v/s different material combination

E glass fiber with epoxy resin

These composites show the moderate tensile strength when compared to all other combination of composites materials in consideration. In this combination the type of fiber used is in the form of strands and is unidirectional hence it has less tensile strength for the artificial fibers.

E glass with polyester resin

These combinations of composites show almost 10 times higher strength than unidirectional glass epoxy composites. The woven glass fabric has higher strength when compared to the unidirectional fibers and bonding of woven fabric with the polyester resin is appreciable.

Carbon fiber with epoxy resin

The following composite material combination shows higher strength than unidirectional composites. These composites are not preferred for tensile strength because of their higher cost.

Epoxy resin with natural fiber

Any natural fiber in consideration will have less tensile strength when compared to all other artificial fiber irrespective of the matrix material because of their poor bonding with matrix material

Epoxy resin with natural hybrid fibers

Hybrid composites with natural fiber in it have less strength than the material with woven fabric buts has the increased strength than the individual natural fibers.

Carbon fiber with vinyl ester

Out of all the combination of material s available carbon fiber reinforcement with vinyl ester as the matrix material has the highest tensile strength which is almost 20 times than the unidirectional glass epoxy composite.

3. CONCLUSIONS

In the present study the tensile behavior of the different composite materials has been analyzed. It doesn't confine its results to only particular material. All different combination of composites is analyzed.

- Of all the materials under consideration carbon fiber with vinyl ester shows higher tensile strength
- The composites which show higher strength can be used for any further increase in strength by incorporating filler material or any other hybrid combination the purpose.
- This composites products can replace any other mild steel application products has its tensile strength is higher than mild steel.
- These composites can be used for the applications such as car bumpers, insulating stands, and outer casing for many storage equipments
- The main drawback of using these composites is its higher cost which makes it very difficult to use in domestic applications.

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BIOGRAPHIES

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