



FLEXURAL STRENGTH ENHANCEMENT OF GLASS FIBRE REINFORCED POLYMER COMPOSITE

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ABSTRACT

The present work describes the mechanical properties and development of a new set of synthetic fibres based polymer composites consisting of coir as reinforcement and liquid epoxy resin. Experiments are carried out to study the effect of fibre length on flexural behavior of these epoxy based polymer composites. In the present work, coir composites are developed and their flexural behavior is evaluated. Also, a step forwarded to use the agricultural waste technically and enhance the properties of several existing material which can be more useful and can have advanced properties than the existing form. The flexural behavior of specimen is tested on Universal Testing Machine. The results emphasized the flexure modulus or flexure strength of material. The main objective is to be finding out the flexural behavior of prepared composites from S-2 glass fibre.

Key words: Glass Fibre, Polymer Composite, Reinforced, Chemical treatment.

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1. INTRODUCTION

Reinforced-composites are popularly being used in many industrial applications because of their inherent high specific strength and stiffness. Due to their excellent structural performance, the composites are gaining potential also in tribological applications. Fibre reinforced composites materials consists of fibre of high strength and modulus in or bonded to a matrix with distinct interfaces (boundary) between them. In this form both fibres and matrix retain their physical and chemical identities. Yet they produce a combination of properties that cannot be achieved with either of the constituents acting alone. In general, fibres are the principal load carrying candidates, while the surrounding matrix keeps them in the desired location and orientation. A Fibrous composite can be classified into two broad groups: continuous (long) fibre composite and discontinuous (short) fibre composite. Mishra, S et.al.,[1] investigated that addition of quite small amount of glass fibre to the pineapple leaf fibre and sisal fibre-reinforced polyester matrix improves the mechanical properties of the resulting composites. The study also reported that the water absorption tendency of composites decreased because of hybridization and treatment of biofibres. Venkateshwaran, N et.al.,[2] reported that the incorporation of sisal fibre in banana/epoxy composites of up to 50% by weight results in enhanced mechanical properties and decreased moisture absorption property. Zhang, Y. et.al.,[3] informed that the surface micro fibrillation of sisal fibre improves the compression strength, stability, tensile strength, internal bonding strength and wear resistance of the sisal/ aramid fibre hybrid composites. Gowda, T. M et.al.,[4] found a considerable increase in the tensile, flexural, impact and compressive properties of Roystonearegia/glass fibre hybrid composites with the increase in glass fibre loading. However, the dielectric constant and electrical conductivity values decreased with increase in glass fibre loading in the hybrid composites at all frequencies. Anandjiwala, R. D., et.al.,[5] Composite materials reinforced with natural fibres, such as flax, hemp, kenaf and jute, are gaining increasing importance in automotive, aerospace, packaging and other industrial applications due to their lighter weight, competitive specific strength and stiffness, improved energy recovery, carbon dioxide sequestration, ease and flexibility of manufacturing and environmental friendliness. Sanjay, M. R et.al.,[6] reviewed that Glass Fibre Reinforced Polymers are mixing with natural fibres to increase Engineering and Technology applications. Brostow, W., et.al.,[7] discussed the importance of tribology for polymer-based materials (PBMs). Traditional tribology developed originally for metals cannot be applied to PBMs for at least two reasons. Chand, N., et.al.,[8] investigated the abrasive wear behaviour of jute fibre-reinforced polypropylene composites. Gujjala, R et.al.,[9] investigated a new hybrid composite with epoxy as a resin and reinforcing both biowaste (jute) and traditional fiber (glass) as continues layered mat composites and also study experimentally the effect of the stacking sequence on tensile, flexural, and interlaminar shear properties. Jayaramudu, J., et.al.,[10] examined the effect of alkali treatment on the mechanical, morphological, and thermal properties of the fabric .

2. METHODOLOGY

2.1. Function of Fibre and Matrix

Fibres are the reinforcement and the main source of strength while the matrix glues all the fibres together in shape and transfers stresses between the reinforcing fibres. The primary function of the fibres is to carry the loads along their longitudinal directions while the matrix binds the fibres together, protects them from environment, shields from damage due to handling and distributes load onto fibres. Although matrices by themselves generally have low mechanical properties as compared to fibres, they influence many mechanical properties

of the composite. These properties include transverse modulus of strength, compressive strength, inter laminar shear strength, thermal expansion coefficient, thermal resistance and fatigue strength.

2.2. Glass Fibre

Glass fiber (or glass fibre) is a material consisting of numerous extremely fine fibers of glass. Glassmakers throughout history have experimented with glass fibers, but mass manufacture of glass fiber was only made possible with the invention of finer machine tooling. In 1893, Edward Drummond Libbey exhibited a dress at the World's Columbian Exposition incorporating glass fibers with the diameter and texture of silk fibers. This was first worn by the popular stage actress of the time Georgia Cayvan. Glass fibers can also occur naturally, as Pele's hair. Glass wool, which is one product called "fiberglass" today, was invented in 1932–1933 by Russell Games Slayter of Owens-Corning, as a material to be used as thermal building insulation. It is marketed under the trade name Fiberglas, which has become a genericized trademark. Glass fiber when used as a thermal insulating material, is specially manufactured with a bonding agent to trap many small air cells, resulting in the characteristically air filled low density "glass wool" family of products. Glass fiber has roughly comparable mechanical properties to other fibers such as polymers and carbon fiber. Although not as strong or as rigid as carbon fiber, it is much cheaper and significantly less brittle when used in composites. Glass fibers are therefore used as a reinforcing agent for many polymer products; to form a very strong and relatively lightweight fiber reinforced polymer (FRP) composite material called glass reinforced plastic (GRP), also popularly known as "fiberglass". This structural material product contains little or no air or gas, is denser, and is a much poorer thermal insulator than is glass wool.

3. PREPARATION OF COMPOSITES

The resin and hardener are taken in the ratio of 10:1, the resin and hardener should be stirred well. The fibres are placed by layers on the mould and resin poured in the mould cavity. Then the fibres are fabricated in order and the resin should be poured in between each fibre. It is allowed to cure for 24 hours and heat treated in the sun for 24 hours. The composite prepared by hand lay-up technique which is shown in figure 1.

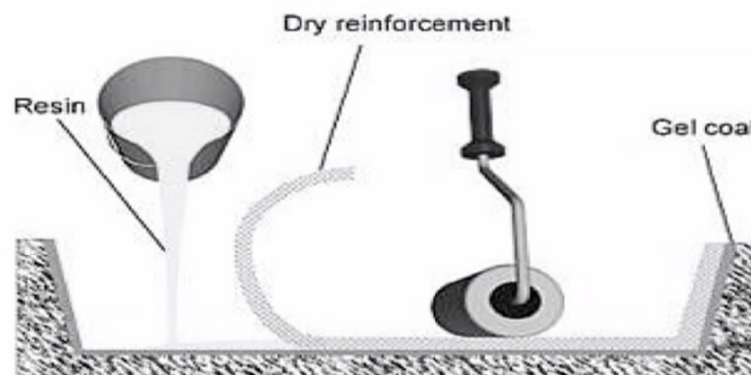


Figure 1 Hand lay-up technique

4. RESULTS AND DISCUSSION

4.1. Flexural (Bending) Test

Flexural tests are generally used for determining the flexure modulus or flexure strength of materials. Flexure test is more affordable than tensile test.

Many types of flexural testing are possible, but the most common is the 3-point flexure test, in which a sample is set upon two supports, and a force is applied directly between the two supports. Since the forces exerted on a material are different from a tensile test, the calculations necessary to find strength and ductility are also different which is shown in figure 2.



Figure 2 Flexural test on Glass Composite

Table 1 Raw Specimen Data of Flexural test of Glass Composite

S.No.	Time(sec)	Extension (mm)	Load (N)
1	0	-0.00071	1.01216
2	1	-0.01595	-13.6494
3	2	-0.03499	-38.133
4	3	-0.03496	-35.5678
5	4	-0.03667	-41.0807
6	5	-0.03694	-47.0421
7	6	-0.038	-51.1341
8	7	-0.03973	-54.799
9	8	-0.03572	-58.7784

4.2. Glass Fibre Flexural Test

Table 2

General: Number of specimens	25
Number Inputs: Humidity (%)	50.00
Number Inputs: Temperature (C)	18.00
Text Inputs: Company	GITAM UNIVERSITY
Text Inputs: Laboratory Name	MECHANICAL LAB

The below figure 3 is plotted because to understand pictorially whether there is increment or decrement in the values on the specimen. Graphs are plotted between Flexural stress (N/mm^2) (Y-axis) and Flexural strain (X-axis) as follows

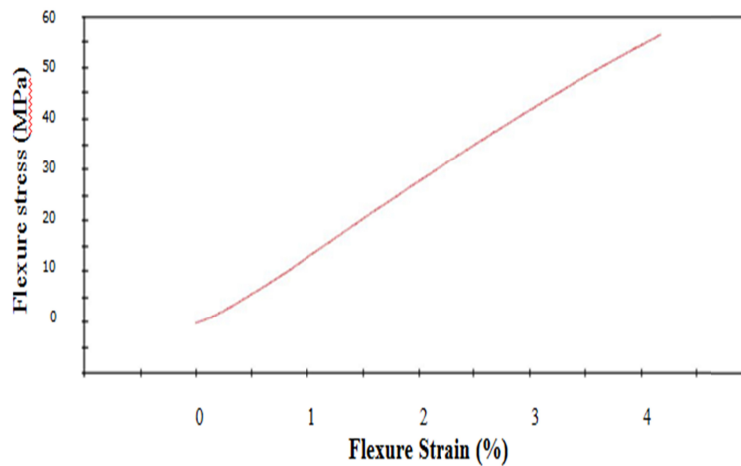


Figure 3 Flexural stress Vs flexural strain

The values of flexural stress and flexural strain are 56.48 MPa and 4.16317 % respectively.

Table 3 Flexural Test on the Glass Specimen

S.No	Glass Specimen	Maximum Flexure Load (KN)	Maximum Stress (MPa)	Load at maximum Flexure Load (KN)	Flexure Load at Maximum Flexure Stress(KN)	Flexure strain at Maximum Flexure load (%)	Flexure Modulus (MPa)
1.	Mean	3.71191	56.48	-3.71191	3.71191	4.16317	1508.46
2.	Standard Deviation	0.000	0.000	0.000	0.000	0.000	0.000
3.	Minimum	3.71191	56.48	-3.71191	3.71191	4.16317	1508.46
4.	Maximum	3.71191	56.48	-3.71191	3.71191	4.16317	1508.46

In flexural test the specimen undergoes both tension and compression. The lower surface of the specimen undergoes tension and the lower surface undergoes compression. The initial tensile extension of the specimen is 0.00018mm is occurred at the load of 3.16156N. After 0.05 sec the specimen undergoes compression. The extension of specimen is -0.00124mm at initial compressive load of 2.95509N. The extension of specimen is -1.9271mm at final compressive load of 3709.99N at the time 115.45sec.

The values of Stress, Strain and young's modulus of Flexural test are as follows

Flexural (Bending) Test

Flexural Stress: 56.48 MPa,

Flexure Strain: 4.16317%,

Flexure Modulus: 1508.46 MPa

5. CONCLUSIONS

The effect of chemical treatment of glass epoxy composite in altering the mechanical properties such as Flexural has been studied. In present work, an efficient and standard methodology has been established to increase the flexural strength of composite. The values of flexural stress and flexural strain are 56.48 Mpa and 4.16317 % respectively. The process of these experiments increases the mechanical properties of material. Results of this experiments shows one new method of neutralization of material before preparation of composite.

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