

Experimental Investigation of Mechanical Properties of Glass Fiber, Sisal and Banana Fiber Reinforced Polymer Composite

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ABSTRACT: In this paper glass fiber as the major reinforcement and combination of sisal ,banana fiber as an additional fiber to improve the mechanical properties of polymer composite with resin epoxy LY556 as a base material prepared by hand layup process according to ASTM standards. Test specimens are prepared with different percentage improvement in mechanical properties of the hybrid composite material is observed. With the SEM analysis the conclusion of the project is made for compatibility of a sisal and banana fiber with resin epoxy556 Reinforcement is observed.

KEY WORDS: Glass, Sisal, Banana Fiber, Epoxy, Mechanical Properties.

I. INTRODUCTION

In most of the developing countries are very rich in agricultural and natural fibre. Except a few exceptions, a large part of agricultural waste is being used as a fuel. India alone produces more than 400 million tonnes of agricultural waste annually. It has got a very large percentage of the total world production of rice husk, jute, stalk, baggase and coconut fibre. All these natural fibres have excellent physical and mechanical properties and can be utilized more effectively in the development of composite materials for various building applications.

W. J. Cantwell, et al (2000) the influence of the ply stacking sequence on the impact resistance and subsequent 0-tension fatigue performance of carbon fiber laminates has been investigated. Drop-weight impact tests were conducted on a range of 16 ply carbon fiber laminates with either all non-woven plies or mixtures of woven and non-woven plies. Damaged coupons were tested in 0-tension fatigue for up to 106 cycles, scanned using an ultrasonic probe and then loaded in tension until failure. The impact resistance and subsequent fatigue performance have been found to be sensitive to the ply stacking sequence. The non-woven composites showed a marked sensitivity to impact loading, but increases in residual static strength were noted after cycling. The inclusion of a woven fabric served to improve the impact resistance of the laminates. Fatigue cycling resulted in considerably improved residual static strengths; by 106 cycles any effect of the impact damage had been removed.

Mehmet Aktas, et al (2008) in this study, the impact response of unidirectional glass/epoxy laminates has been investigated by considering energy profile diagrams and associated load-deflection curves. Damage modes and the damage process of laminates under varied impact energies are discussed. Two different stacking sequences, [0/90/0/90]s and [0/90/+45/_45]s, were chosen in tests for comparison. An alternative method, based on variation of the excessive energy (Ee) versus impact energy (Ei), is presented to determine penetration threshold (Pn). The penetration threshold for stacking sequence [0/90/+45/_45]s is found to be smaller than that of [0/90/0/90]s. The primary damage mode was found to be fiber fracture for higher impact energies; whereas, it was indentation resulting in delamination and matrix cracks for smaller impact energies.

The present study is taken up to understand the response of fiber reinforced plastic laminated plates under low energy, and low velocity impacts to simulate the case of a cover plate, in an automobile engine of wing of an aircraft subjected to impact loading.

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II .EXPERIMENTAL SETUP

Composite Laminate Preparation:

The laminate size is 200mm × 200mm x 4 mm .Laminate is a symmetric because the no of layer is 6. The stitching direction is perpendicular to the fiber direction of the 0° surface layers of the laminates. An ensuing volume fraction of stitch threads material of about 0.3%.



Fig 1: Fabrication of composite material

Resin Preparation:

Resin is to transfer stress between the reinforcement fibers, act as a glue to hold the fiber together. Commonly used resin are: Epoxy, polyester and vinyl ester. But now Epoxy LY556 is selected. Epoxy LY556 and it mixed with Hardener HY951. Ratio of mixing epoxy and hardener is 10:1

Moulding preparation:

Two rectangular mild steel plate having dimensions of 100mm × 100mm x 4 mm. Chromium plated to give a smooth finished as well as to protect from rusting. Four beading are used to cover compress the fiber after the epoxy is applied. Bolt and nuts are used to lock the plate.

Specimen preparation for glass fiber

- The mould should be well cleaned and dry.
- Release agent is applied.
- The epoxy mixture is uniformly applied.
- First woven mat is laid into the moulded.
- Apply the resin on mat by brush.
- Second mat is laid to first mat
- Repeated the process up to 6 layers Mould is closed.

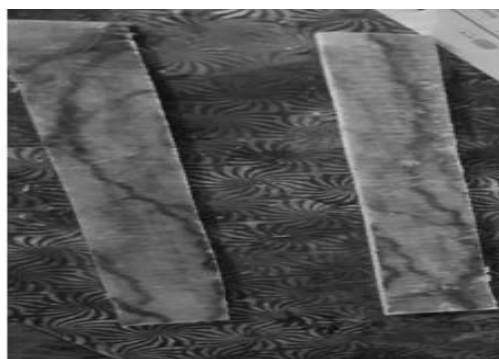


Fig. 2: Experimental Speciman

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III. EXPERIMENTAL RESULTS

In this experimental results were conducted by pure glass fiber and combination of glass, banana, and sisal fiber composite materials to find the results on tensile strength, compressive strength, impact strength at various specimens. Finally the results are compared by using the graphs.

Table1: Tensile Test on glass fiber

Test Parameters	Specimen 1	Specimen 2
Gauge Thickness(mm)	3.32	3.68
Gauge Width(mm)	25.95	25.56
Original Cross Section area(mm ²)	86.15	94.06
Ultimate Tensile load(KN)	1.73	2.35
Ultimate Tensile Strength (N/mm ²)	200.34	249.41

Table2: Tensile Test on glass fiber with natural fiber

Test Parameters	Specimen 1	Specimen 2
Gauge Thickness(mm)	3.08	3
Gauge Width(mm)	27.11	25.82
Original Cross Section area(mm ²)	83.50	83.92
Ultimate Tensile load(KN)	2.68	2.67
Ultimate Tensile Strength (N/mm ²)	321.44	318.42

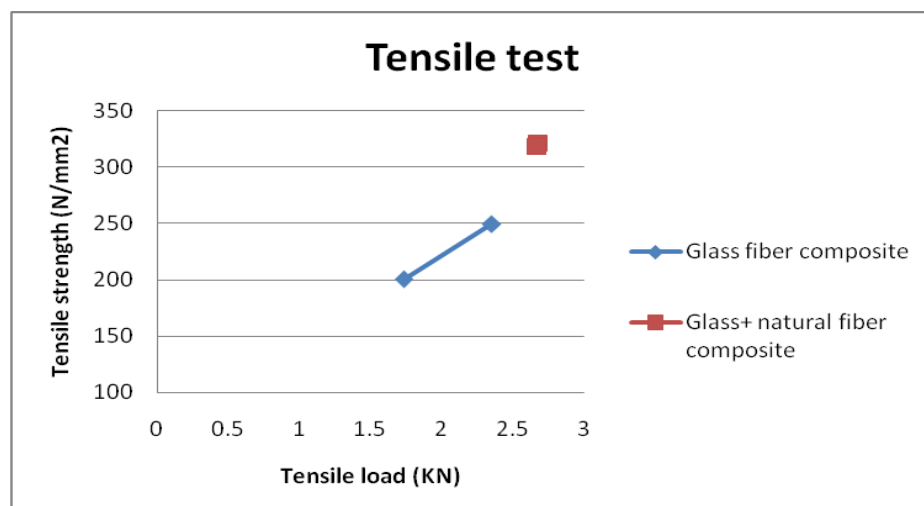


Fig3: Result comparison on tensile test

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Table3: Compressive Test on Glass fiber

Test Parameters	Specimen 1	Specimen 2
Gauge Thickness(mm)	4.03	3.94
Gauge Width(mm)	26.61	25.32
Original Cross Section area(mm ²)	107.24	99.76
Compressive load(KN)	1.09	0.795
Compressive Strength (N/mm ²)	10.16	7.97

Table4: Compression Test on Glass Fiber With Natural Fiber

Test Parameters	Specimen 1	Specimen 2
Gauge Thickness(mm)	3.45	3
Gauge Width(mm)	26.47	26.12
Original Cross Section area(mm ²)	91.32	88.81
Compressive load(KN)	1.08	0.770
Compressive Strength (N/mm ²)	11.77	8.67

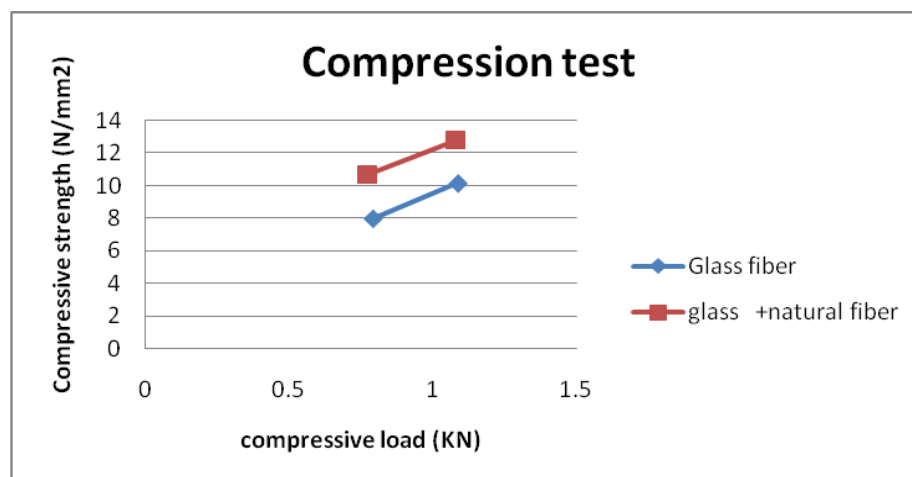


Fig4: Result comparison on compression test

Table5: Charpy Impact Test On Glass fiber

Test Parameters	Specimen 1	Specimen 2	Specimen 3	Average
Absorbed energy-joules	10	12	10	11.33

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Table6: Charpy Impact Test on Glass Fiber With Natural Fiber

Test Parameters	Specimen 1	Specimen 2	Specimen 3	Average
Absorbed energy-joules	12	14	12	12.67

IV.CONCLUSION

In these experimental results by using data acquisition system it was found that when glass, banana and sisal fibers reinforced with epoxy matrix that gives higher tensile ,compressive and impact strength compared to normal glass fiber composite material.

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