IOSR Journal of Applied Physics (IOSR-JAP)
e-ISSN: 2278-4861.Volume 9, Issue 5 Ver. III (Sep. - Oct. 2017), PP 01-04
www.iosrjournals.org

Experimental Testing And Investigation Of Hybrid Fiber Reinforced Composite

Mir Ahmed Ali Mujahid [1], Dr. M. Manzoor Hussain [2]
Email address: ali.mirahmed@yahoo.com
[1](*Research Scholar, Department of Mechanical Engineering, PP.ME.0012, Rayalaseema University, A.P India.*
[2](*Department of Mechanical Engineering, JNTUH University Hyderabad, Telangana, India)*

Abstract: *Current industrial and research require new materials which are being introduced for various reasons in innovative product development to get low weight and high strength. Present research involved in introducing new material that needs experimental investigation of mechanical properties. This research work deals with glass and jute fiber reinforced composite laminates (Hybrid composite laminates) for experimental testing. In general glass fiber reinforced composite laminates are tested for tensile, bending and fatigue testing by many researchers and a large research effort is being spent on it today. Much work is done on glass, carbon reinforced composites. In this research work experimental study were carried out on glass and jute fiber reinforced hybrid laminates, as a new fiber reinforced material for engineering application.*

Keywords – *Fiber reinforced composite, Hybrid laminates, laminates, Tensile Test, Bending Test*

Date of Submission: 04-09-2017 Date of acceptance: 28-09-2017

I. Introduction

Increasingly complex design for engineering components and structures, the demand for superior performance, and the weight saving requirements propelled the scientists, engineers and designers into a continued search for new materials. Since 1960's when the first fiber reinforced plastics were developed, the extent and scope of their application is wide and has been continuously expanding [1].

In recent years composite materials have developed to use more rapidly than metals in structural engineering applications. They are used alternatively instead of metallic materials because of their low density, high strength and stiffness [2]. The fiber reinforced composites are quite different than the basic materials such as steel etc. these composite materials needed adequately well to know their mechanical properties[3]. The properties of composites depends on the type of material used [4]. .For this purpose the present work is focusing on tensile and bending test of fiber reinforced hybrid laminates (FRHL) and these fiber reinforced laminates can be used for retrofitting of structural beams [5,6].

II. Materials and test specimens

The main raw material used for the present work is woven glass fibers mat 242 grams and jute mat 40 grams by weight in a total weight of sample 300 grams and Epoxy weight 18 grams. Jute fiber is lighter than glass, aramid, carbon, Epoxy Lapox L-12 supplied by Allied Agencies is used as matrix. The composite specimen is manufactured by combining glass fibers mat and jute fibers mat as hybrid composite fibers with epoxy as matrix using hand layup method. For compressed laminates an eight metric ton flywheel press is used to compress mould while preparing laminates. Tensile testing utilizes the classical coupon test geometry as shown below and consists of two regions. A central region called the gauge length, within which failure is expected to occur, and B the two end regions which are clamped into a grip mechanism connected to a test machine. The thickness of test coupons were kept as 8mm thick for uncompressed laminates and thickness of 6mm for compressed coupons and central width of the coupons are 25mm for tensile testing and 38 mm wide for bending testing with a gauge length of 110 mm. The other dimension are shown below for these coupons.

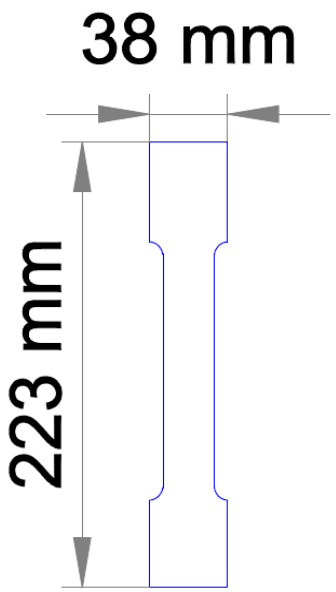

Fig 2.1 Test Coupon

III. Experimental Testing setup and Method

The Tensile Test and Bending Test were performed on Universal Testing Machine (UTM)

3.1 The Tensile testing of the laminates was done under the UTM of capacity about 1000kN. The two end regions were fixed and the central region was kept under loading as shown in Fig.3.1

Fig.3.1 Laminate before Tensile Test

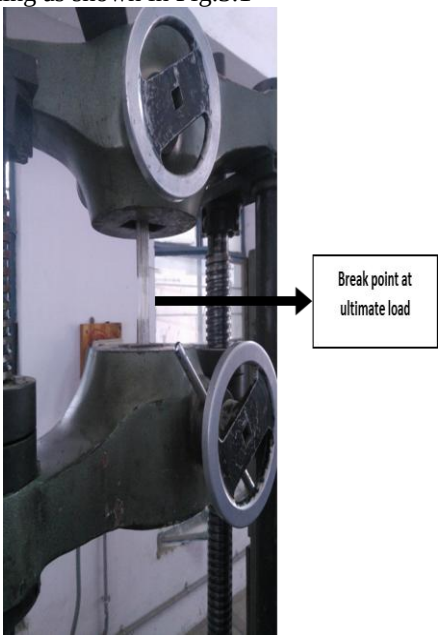

Fig.3.2 Laminate during Tensile Test

3.2 The Bending test of the laminates was done under the UTM of capacity about 1000kN in 3 point loading. The two end regions were simply supported and the central region was kept under point loading as shown in Fig. 3.3

Fig.3.3 Laminate before Bending Test

Fig.3.4 Laminate after Bending Test

IV. Tables

Table 4.1 Glass – Jute Hybrid Laminate Tensile Test Values for uncompressed laminates

Shape	Thickness (mm)	Width (mm)	Gauge length(mm)	Maximum Load(KN)	Maximum Stress(MPa)
Coupon Element-1	8.0	25	110	107.29	536.45
Coupon Element-2	7.9	25	110	106.61	539.78
Coupon Element-3	7.9	25	110	107.43	543.97
Coupon Element-4	8.0	25	110	107.24	536.20
Coupon Element-5	8.0	25	110	108.66	543.30

Table 4.2 Glass – Jute Hybrid Laminate Tensile Test Values for compressed laminates

Shape	Thickness (mm)	Width (mm)	Gauge length(mm)	Maximum Load(KN)	Maximum Stress(MPa)
Coupon Element-1	6.0	25	110	89.68	597.87
Coupon Element-2	6.0	25	110	90.80	605.33
Coupon Element-3	6.0	25	110	91.48	609.87
Coupon Element-4	6.0	25	110	90.30	602.00
Coupon Element-5	6.0	25	110	90.55	603.67

Table 4.3 Glass – Jute Hybrid Laminate Bending Test Values for uncompressed laminates

Shape	Thickness(mm)	Width(mm)	Gauge length(mm)	Bending Strength(N)
Plate Element-1	8.0	38	110	1529.05
Plate Element-2	7.9	38	110	1525.61
Plate Element-3	7.9	38	110	1523.77
Plate Element-4	8.0	38	110	1522.13
Plate Element-5	8.0	38	110	1531.12

Table 4.4 Glass – Jute Hybrid Laminate Bending Test Values for compressed laminates

Shape	Thickness(mm)	Width(mm)	Gauge length(mm)	Bending Strength(N)
Plate Element-1	6.0	38	110	1590.85
Plate Element-2	6.0	38	110	1589.11
Plate Element-3	6.0	38	110	1592.37
Plate Element-4	6.0	38	110	1591.13
Plate Element-5	6.0	38	110	1591.52

V. Conclusion

- The tensile test results of these glass and jute hybrid (FRHL) uncompressed laminates shows that the tensile strength of these laminates are more than ordinary steel rebar Fe 415 used in structural reinforced members.
- The compressed laminates are even stronger than the uncompressed laminates in terms of tensile strength.
- The tensile test results of these hybrid (FRHL) compressed laminates shows that the compressed laminates are capable of taking more tensile stress than uncompressed laminates.
- Also the test of bending of these hybrid (FRHL)compressed laminates clearly showing these compressed laminates are capable of carrying more bending stress than uncompressed laminates
- Since these glass fibers and jute fibers are locally and economically available and having high tensile strength, laminates made of glass and jute fibers can be used for retrofitting of structural applications.

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IOSR Journal of Applied Physics (IOSR-JAP) is UGC approved Journal with Sl. No. 5010, Journal no. 49054.

Mir Ahmed Ali Mujahid . "Experimental Testing And Investigation Of Hybrid Fiber Reinforced Composite ." IOSR Journal of Applied Physics (IOSR-JAP), vol. 9, no. 5, 2017, pp. 01–04.