Effect of Flyash Filler Material on Tensile Property for Jute/Glass Hybrid Laminate Composites with Dry and Wet Conditions

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Abstract - In this paper, an attempt has been made to estimate the tensile property for Jute/Glass hybrid composite by considering the different percentage of flyash as filler material. The Jute/Glass hybrid laminate composites with various flyash weight percentages (3%, 6%, 9% and 12%) were manufactured using hand lay-up technique with reinforcement and matrix weight ratio of 40:60. During fabrication process the reinforcement laminate (Jute and Glass) fiber are fixed and there by varying the matrix weight percentage in accordance with weight percentages of flyash filler material. The tensile specimens are prepared according to ASTM-D-638 standard were machined from square fabricated Glass/Jute laminated sheet along with various flyash weight percentages. The tensile test carried out for the specimens with dry and wet conditions. The wet conditions for the tensile specimen were done according to ASTM D5229. It was observed that 6 wt% of flyash filler material with Jute/Glass hybrid laminate composite gives the better results in both dry and wet conditions. Also it is found that the strength of 6 wt% of flyash filler material with Jute/Glass hybrid laminate composite is 2.6 to 2.8 times more than that of pure Jute laminate composite.

Keywords - Flyash, Glass fiber, Hybrid composite, jute fiber, Laminated, Tensile, Wet condition.

1. INTRODUCTION

Composites materials are more attractive materials because of their properties like stiffness, high strength which leads to possible application in the area of aerospace, automobile engineering *etc*. A composite laminate is a physical plate consisting of multiple layers of fiber reinforced in cured resin and hardner. The number of layers, the type of fiber (jute, glass), the fabric configuration (bi-directional), the type of resin, and other factors can be varied to design a structural element that is suitable for a particular application. Raw materials (fiber, resin, and some filler) in themselves are not useful as a structural member, Single natural fiber reinforced polymer composites have lower mechanical strength than synthetic fiber reinforced polymer composite due to its limitations[1],[3], Hybridization process can improve the mechanical strength of natural fiber reinforced polymer composite by reducing its limitations. Addition of another type of fibers having higher elongation into single natural fiber reinforced polymer composite is hybridization [4],[7], But when combined together, the product takes a new form with different properties that make them desired for use in structures. Epoxy resins are widely used as the high-rated family of composite resins and have grown to claim aerospace composites and other application areas, such as motor racing and racing yachts. The reinforcement fibers are the major load-carrying element of the composite thus, the selection of an appropriate type and form of reinforcement is crutial in obtaining a material with the desired engineering properties [8],[11], Glass fiber reinforcements are the most common synthetic reinforcing fiber available in modern day's composite industry. The success of glass fibers has been experienced to a number of factors, including cost, availability. A Glass fiber offers an excellent combination of high strength and stiffness, and low weight. The investigation of the novel properties of hybrid composites has been of deep interest to the researchers for many years as supported by [12],[13], Single natural fiber reinforced composites have lower mechanical strength than synthetic fiber reinforced composite due to its disadvantages. The Hybrid action can improve the mechanical strength of natural fiber reinforced composite by reducing its limitations. Addition of another type of fiber into single natural fiber reinforced composite is known as hybridization. Various researchers [14],[15],have stated that hybrid composites in which the glass fiber is reinforced with different type of natural fiber gives better results due to its brilliant properties such as light weight and high strength.

2 COMPOSITE PREPARATION

2.1 MATERIALS REQUIRED FOR COMPOSITE

In present work jute fiber mat of 0.8mm thick and E-Glass fiber mat of 0.2mm thick which are avilable in the market are used to fabricate the composite laminate. Epoxy resin L-12 and hardner K-6 are taken as matrix to bind the reinforcement. Fly ash is used as filler material. Hardner and resin mixture of 1:10 ratio is used to obtain optimum matrix composition composite.

2.2 FABRICATION OF COMPOSITE SPECIMENS

The composite laminate used for the present work was fabricated using hand layup technique. Different configurations of laminates are prepared in the investigation which with and without flyash.composite contains of five jute fiber mat layers, six glass fiber mat layers of thickness 5mm.Hardner and epoxy resin used as matrix. The arrangement of layers arranged in alternate sequence of glass and jute layers.first and last layers are of glass, First set of composite is fabricated with jute fiber and glass fiber without flyash. Similarly, for the second set of composite 3%, 6%,9%,12% flyash is used. laminate includes alternate glass and jute fiber mat layers with matrix. In this work, initially the

mixture of resin and hardener was stirred by stirrer to increase the bonding between resin and hardener. Next, the first layer of glass fiber laminate is wetted with epoxy resin and using roller make the resin to wick up the fiber cloth. Subsequently, another laminate is added and special care must be taken to remove air bubbles using roller. This process is repeated to obtain the desired thickness. After the fabrication processes the laminated sheets are cured under a load of 100N for 24 hours at room temperature. After this process the laminated sheets are kept at room temperature without load for 24 hours. Then, the laminated cured sheets are machined according to the required ASTM D-638 standard dimension using a cutter. Maximum care has been taken to maintain uniformity and resemblance of the composite specimen.

3 TENSILE TEST

After fabrication, the ASTM standard for tensile test specimens were subjected to computerized Universal Testing Machine (UTM) of one Ton capacity to evaluate tensile properties for both dry and wet conditions. For wet conditions, the test specimens were immersed in distilled water for 48 hours according to ASTM D5229 standard. The tensile test was carried in computerized UTM with the cross head speed of 5 mm/ min. In each case, six specimens were tested to obtain the average value. Tensile test specimens of hybrid and different percentages of flyash laminated composites are shown in Fig.1 to Fig.6 for dry conditions.

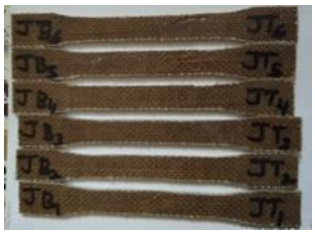

Fig.1: Jute natural composite

Fig.2: Jute & E-glass composite

Fig.3: Hybrid 3% flyash composite

Fig.4: Hybrid 6% flyash composite

Fig.5: Hybrid 9% flyash composite

Fig.6: Hybrid 12% flyash composite

Tensile test specimens of jute/E- glass hybrid without flyash and with flyash of different compositions for with and without water are machined according to ASTM standards. The specimens with water are as shown in Fig.6. The prepared composite specimens are immersed in water in an air tight container for two days separately. After completion of time they are taken out from water and weighed separately. Then tested for tensile test using computerized U.T.M. corresponding graphs were taken and comparisons are made on the basis of results. The processes will be similar to the earlier work of [11].

4 RESULTS AND DISCUSSION

4.1 DRY SPECIMENS

A series of experimental work carried out on jute/glass hybrid laminate composite without and with different percentages of fly ash composition for dry condition. Fig 7 depicts load vs. displacement graph for jute/glass hybrid without and with flyash for dry composite specimens. Results indicate that displacement increases with increasing of load for jute/glass hybrid with and without flyash for dry specimens. The maximum withstanding capacity of load for hybrid laminate composite with 6% flyash composite specimens is more compared to other laminate composites. It is found that the withstanding capacity hybrid laminate composite with 6% flyash is almost 2.6 to 2.8 times than that of other laminate composite.

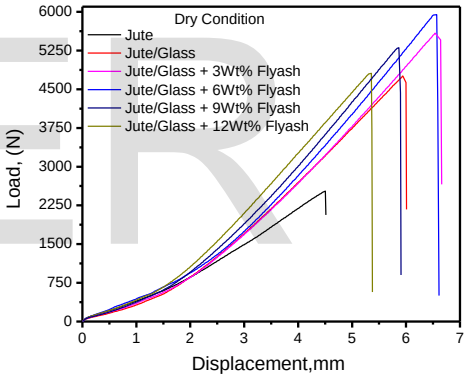

Fig.7: load vs. displacement of different composite specimens for dry condition.

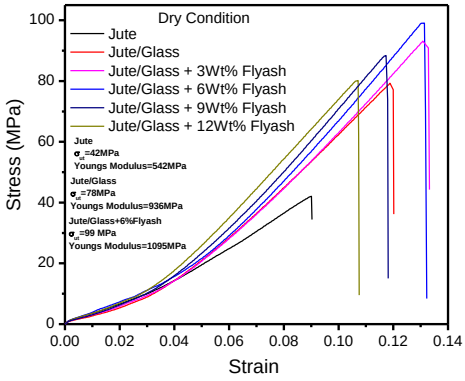

Fig.8: stress vs. strain of different composite specimens for dry condition.

Fig 8 depicts the variation of stress vs. strain for hybrid laminate composites without flyash and with for dry conditions. Results indicate that the ultimate stress and Young's modulus values are more in hybrid laminate composite with 6% flyash compared to other laminate composites. The corresponding

values of ultimate strength and young's modulus are as shown in Fig 8.

4.2 WET SPECIMENS

A series of experimental work carried out on hybrid laminate composite with and without flyash of different percentages for wet condition. Fig 9 depicts load vs. displacement graph for jute/glass hybrid composite with and without flyash composition for wet composite specimens. Results indicate that displacement increases with increasing of load for all the composite wet specimens. The maximum withstanding capacity of load for jute/glass hybrid laminate with 6% flyash composition composite is more compare to all other composites. It is found that the withstanding capacity of jute hybrid laminate composite with 6% flyash is almost 3 times than that of other laminate composites.

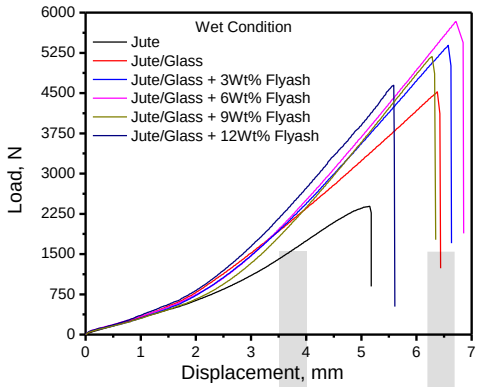

Fig.9: load vs. displacement of different composite specimens for wet condition.

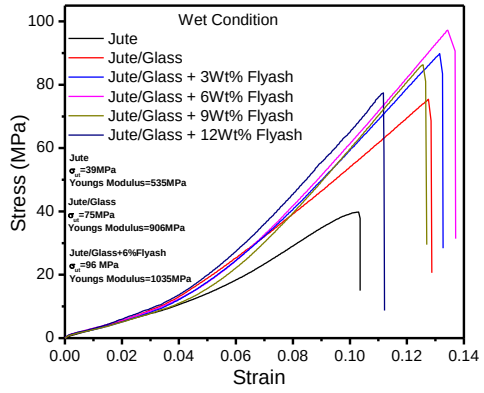

Fig.10: stress vs. strain of different composite specimens for dry condition.

Fig 10 depicts the variation of stress vs. strain for jute/ glass hybrid laminate composites with and without fly ash percentage variation for wet conditions. Results indicate that the ultimate stress and Young's modulus values are more in jute/glass hybrid laminate composite with 6% flyash is more compare to its other laminate composites. The corresponding values of ultimate and Young's modulus are as shown in Fig.10. It is observed that the jute hybrid laminate composite with 6% flyash strength under wet conditions will be more compare to other laminate composite. Hence, jute hybrid composite with filler material of 6% flyash will be more suitable for pressure vessel application compare to other laminate composite. The corresponding values of ultimate strength and young's modulus are as shown in Table 1.

Table.1: values of ultimate strength and Young's modulus for dry and wet condition of composite specimens.

Sl NO	Composition	Youngs Modulus	Ultimate strength
Dry Condition			
1	Jute	542 MPa	41.8 MPa
2	Jute/Glass	936 MPa	79.5 MPa
3	Jute/Glass+3 wt% Flyash	1025 MPa	92.6 MPa
4	Jute/Glass+6 wt% Flyash	1095 MPa	99.8 MPa
5	Jute/Glass+9 wt% Flyash	980 MPa	87.9 MPa
6	Jute/Glass+12 wt% Flyash	952 MPa	80.5 MPa
Wet Condition			
7	Jute	935 MPa	39.8 MPa
8	Jute/Glass	920 MPa	75.0 MPa
9	Jute/Glass+3 wt% Flyash	1015 MPa	89.3 MPa
10	Jute/Glass+6 wt% Flyash	1035 MPa	97.1 MPa
11	Jute/Glass+9 wt% Flyash	955 MPa	56.5 MPa
12	Jute/Glass+12 wt% Flyash	930 MPa	77.2 MPa

5 CONCLUSIONS

At the end we can conclude that the evaluation of tensile strength has been made between Glass/Jute laminated composites along with various flyash weight percentages under dry and wet conditions. It is found that jute/glass hybrid laminate with 6% flyash composite is having more strength compared to other natural laminate composites for both dry and wet conditions.

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