Estimation of Tensile Properties for Jute Natural and its Hybrid Laminate Composites

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***Abstract*—In this paper the tensile properties of jute natural and its hybrid laminate composites are evaluated.For hybrid composite Jute fiber laminate is laminated with E-Glass fiber laminate along with epoxy matrix. The laminates are fabricated using hand layup technique with reinforcement and matrix weight fraction ratio of 40:60. The tensile test was performed for composites with and without water. The jute/glass hybrid composite has 1.4 times more ultimate tensile strength than that of jute natural fiber laminate composite. Also, it was observed that the strength of the moisture content of hybrid jute/glass laminate composites will be more than that of jute natural composite.**

Keywords- Jute fibre, Glass fibre, Hand lay-up technique.

I. INTRODUCTION

A composite material is defined as the mixture of two or more than two materials having different properties, combination of materials having different property would give results having better properties than those of the properties of the individual when used alone[1]. In recent years, the concept of natural resources has gained key importance due to the necessity to preserve our natural environment [2]. Natural fiber reinforced hybrid epoxy composite materials are considered as one of the new class of engineering materials. Interest in this area is rapidly growing both in terms of their industrial applications and fundamental research as they are renewable, cheap, completely or partially recyclable, and biodegradable. Among all the natural fiber reinforcing materials, jute appears to be a promising material because it is relatively inexpensive and commercially available in the required form [3]. E-Glass Fibre is a synthetic fibre made of a plastic matrix reinforced by fine fibres of glass. Fiber glass is a lightweight, strong, and robust material used in different industries due to their excellent properties [4-5]. Hybridization of glass fiber with jute fiber resulted in composites having a superior mechanical performance. A positive hybrid effect is observed in the tensile property. Thus, glass and jute fiber reinforcement in resin resulted in a cost effective and a lightweight composite having good performance qualities [6]. These composites may find applications as structural materials where higher strength and cost considerations are important. [7-9]. Light-weight structure using advanced material and novel design is one of the keys to design the new generation mechanical applications. The requirement of high strength to weight ratio and the ability to withstand most of the working condition is imperative leading to use of composite materials [10-12]. Glass fibre is one of the renowned materials having numerous applications like building automobile bodies, thermal and electrical insulation and various sports goods [13]. The study of the water absorption process in jute composites and their hybrids was also conducted by immersing them into a water container at room temperatures for specific time duration [14]. The hybridization approach [15] is used to make cost effective composites. Hence, the objective of our work is to predict the tensile property of hybrid jute/glass laminate composite over convectional natural jute laminate composites.

II. EXPERIMENTAL DETAILS

A. Materials for fabrication

In this present investigation 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 were considered as matrix to bind the reinforcement. A hardner and resin mixture of 1:10 ratio are used to obtain optimum matrix composition composite.

B. Composite specimen fabrication

The composite laminate used for the present work was fabricated using hand layup technique. Two different configurations of laminates are prepared in the investigation which contains different weight percentage of jute fiber mat layers, glass fiber mat layers and epoxy resin. First configuration of laminate fabricated with pure natural jute fiber mat layers. Similarly, for the second configuration of laminate includes alternate jute and glass fiber mat layers with epoxy resin, weight fraction maintained according to the measurement of fibers. 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 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. The 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. The processes will be similar to the earlier work of [16].

III. EXPERIMENTATION

A. *Tensile test*

After fabrication, the ASTM standards tensile test specimens were subjected in computerized Universal Testing Machine (UTM) 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 test speed of 5 mm/ min. In each case, six specimens were tested to obtain the average value. Tensile test specimens of natural jute and its hybrid laminated composites are shown in Fig. 1 and Fig.2 for dry condition.

Fig.1: *Tensile test specimens of natural jute laminated dry composite.*

Fig.2: *Tensile test specimens of hybrid jute/glass laminated dry*

Tensile test specimens of natural jute and jute/glass hybrid laminated composite with water are shown in Fig.3. 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 comparisions are made on the basis of results. The processes will be similar to the earlier work of [16].

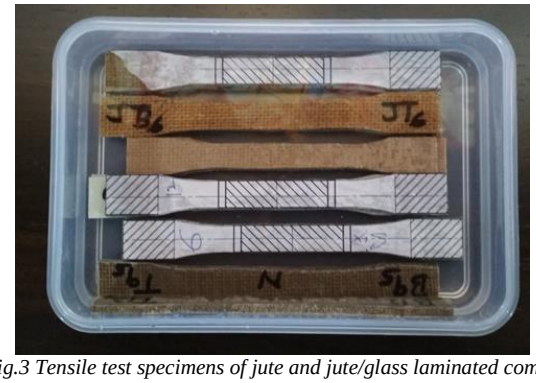

Fig.3 Tensile test specimens of jute and jute/glass laminated composite with water for 48hours.

IV. RESULTS AND DISCUSSION

A. *Dry Specimens*

A series of experimental work carried out both on jute and its hybrid laminate composite for dry condition. Fig 4 depicts load *vs.* displacement graph for jute and jute/glass dry composite specimens. Results indicate that displacement increases with increasing of load for jute and jute/glass dry specimens. The maximum withstanding capacity of load for jute/glass hybrid laminate composite is more compare to natural jute laminate composite. It is found that the withstanding capacity of jute hybrid laminate composite is almost 2 times than that of natural laminate composite.

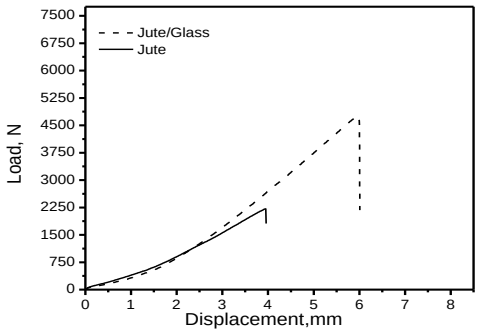

Fig.4: *load vs. displacement of jute natural and its hybrid for dry conditions.*

Fig 5 depicts the variation of stress *vs.* strain for jute natural and its hybrid laminate composites for dry conditions. Results indicate that the ultimate stress and young's modulus values are more in jute hybrid laminate composite compare to its natural laminate composites. The corresponding values of ultimate and young's modulus are as shown in Fig.5.

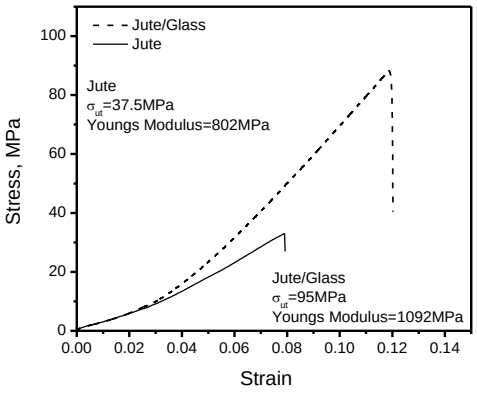

Fig.5 stress vs. strain of jute natural and its hybrid for dry conditions.

B. Wet Two Day Specimens

A series of experimental work carried out both on jute and its hybrid laminate composite for wet condition. Fig 6 depicts load *vs.* displacement graph for jute and jute/glass wet composite specimens. Results indicate that displacement increases with increasing of load for jute and jute/glass wet specimens. The maximum withstanding capacity of load for jute/glass hybrid laminate composite is more compare to natural jute laminate composite. It is found that the withstanding capacity of jute hybrid laminate composite is almost 1.5 times than that of natural laminate composite.

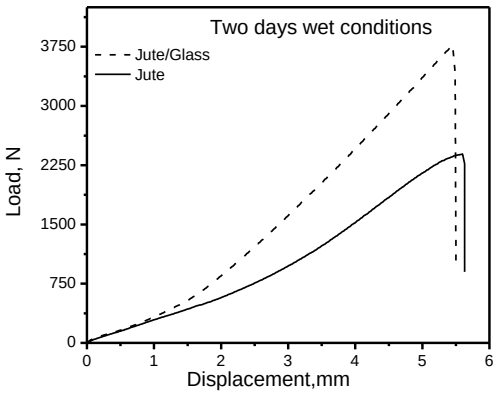

Fig.6: load vs. displacement of jute natural and its hybrid for wet conditions.

Fig 7 depicts the variation of stress *vs.* strain for jute natural and its hybrid laminate composites for wet conditions. Results indicate that the ultimate stress and Young's modulus values are more in jute hybrid laminate composite is more compare to its natural laminate composites. The corresponding values of ultimate and young's modulus are as shown in Fig.7. It is observed that the jute hybrid laminate composite strength under wet conditions will be more compare to dry condition of pure jute laminate composite. Hence, jute hybrid composite will be more suitable for pressure vessel applications compare to natural laminate composite.

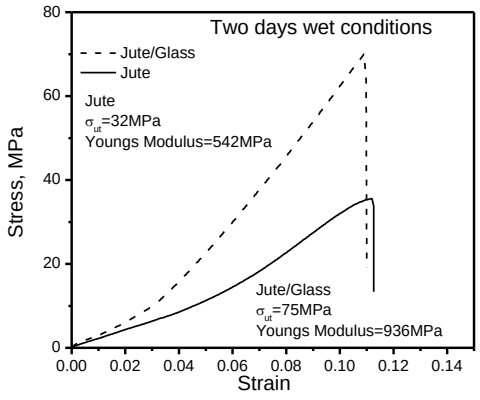

Fig.7 stress vs. strain of jute natural and its hybrid for wet conditions.

V. CONCLUSIONS

At the end we can conclude that the evaluation of mechanical property like tensile strength has been made between for jute natural and its hybrid laminate composite under dry and wet conditions. It is found that jute/glass hybrid laminate composite is having more strength compared to pure jute natural laminate composite for both dry and wet conditions.

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