A review of Mechanical Properties of Jute-glass and Luffa-glass fiber reinforced epoxy hybrid composites

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Abstract: - In this work comparison of the various mechanical properties such as tensile strength, flexural strength, and interlaminar shear strength of distinctive natural fibers of Jute-glass and Luffa-glass fibers reinforced with epoxy hybrid composites is evaluated. For this purpose eight distinctive type laminates have been used. The values of Tensile, Flexural Properties and Inter laminar shear strength of the jute-glass and luffa-glass fiber epoxy hybrid composites are good for stacking sequence of GJJG- jute glass and GLLG.

Key-Words: - Natural, Jute, Luffa, Hybrid composites, Laminate

1 Introduction

Today researchers are motivating by environmental attention, international on the research of polymer composites of natural reinforced fiber and price fine alternative to artificial composites of fiber reinforced. Natural fibers have many desirable properties like much less weight, low density, eco-friendly, comparatively cheaperand excessive unique mechanical properties, natural fiber represents a appropriate renewable and biodegradable. Some downside of natural fiber is like poor surface characteristics, more moisture absorption and nice variation etc. when Luffa is young, the fruit Luffa use as a vegetable. Luffa has bitter taste, when luffa is mature. The purgatives chemicals development in luffa in that time it is mature. Luffa is using as medicine because of its purgative property. The natural mat of Luffa formed when it is dried because of its fibrous vascular system.

The stacking sequences are more affecting the properties of inter laminar shear strength and flexural strength [1]. The mechanical properties of Jute fibers are very weak in compare to glass fiber, but the mechanical properties are improved by the glass fibers are incorporating in Jute fiber [2]. In these days carbon and glass fiber are replace by the natural fibers (like jute, sisal and Luffa) [3]. The Luffa glass hybrid laminates is about 100.4% more strength found to the Luffa cylindrica reinforced fibers. The more good properties are found in Luffa glass hybrid composites comparing the properties of the Luffacylindrica reinforced fiber [9].)

2 Jute Glass and Luffa Glass Fiber Reinforced Epoxy Composites

2.1 Material

In this paper the composites, Luffa, jute, glass as reinforcing material and epoxy as matrix is used. Luffa cylindrica (LC) is a tropical plant belonging to the household of Cucurbitaceous, with a fruit possessing netting like a system of fibrous vascular. The LC struts are characterized through a micro cellular structure with non-stop hollow micro channels which forms vascular bundles and yield a multimodal hierarchical pore system. Woven jute met had been used in this investigation. These jute met cut from the jute bags. Which is used for transporting purpose? After cutting jutemetwas cleaned with pressurized water and dried at 100^0C on oven. The common diameter of the fiber in the met is about 1.5mm with internal fiber spacing about 2mm. Also E-Glass fibers are used. Glass fiber is a similar name like carbon fiber or steel.

Commonly glasses fibers are silica based mostly (50-60% SiO2) and include a host of other oxides of aluminum, calcium boron, iron and sodium. In the E-glass is denoted by the electrical. E-glass is goodinsulatorelectricity in summation to have a good strength and a real looking Young's Moduli.Epoxy is either any of the basic components or the cured end merchandise of epoxy resins, as nicely as a colloquial identify for the epoxide functional group. Epoxy resins, regarded as polyepoxides, are category of reactive prepolymers and polymers which contain epoxide groups. Epoxy resins may be reacted (cross-linked) either with

Figure:-1 Laminates of Luffa and jute fiber.

themselves through catalytic homopolymerisation, or with a wide very of co-reactants which including polyfunctional amines, acids phenols, alcohols and thiols. These co-reactants are often referred to as hardeners or curatives, and the cross-linking reaction is typically referred to as curing. Reaction of polyepoxides with themselves or with hardeners forms a thermosetting polymer, frequently mechanical properties, temperature and chemical resistance.

2.2 Preparation of Composite Specimens

Hybrid composite laminates of Jute-glass and Luffa-glass fiber were prepared by way of hand lay-up technique. A wooden mold length of 150 mm,100mm wide and 6mm thickness was used for manufacturing the composite laminates and then cutting the laminates in required shape. Use of varies eight types of manufactured laminates different stacking sequence are A_1, A_2, A_3, A_4, S_1, S_2, S_3 and S_4 for jute-glass and luffa glass fiber reinforced epoxy laminates are shown in table:-1.

The experimental density (actual density) of laminates is calculated by Archimedes principle. The composites density is determined in form of weight fraction as shown in equation (1).

$$s_m = \frac{w_0}{(w_0 + (w_a - w_b))} \qquad (1)$$

Where- s_m-actual density,w_0-weight of the sample in air medium, w_a-weight of the wire deep in kerosene, w_b - weight of the sample+wire deep in kerosene.

The theoretical density of the laminates is calculated using Agarwal and Broutman equation (2).

$$\rho_{ct} = \frac{1}{\frac{w_{f1}}{\rho_{f1}} + \frac{w_{f2}}{\rho_{f2}} + \frac{w_m}{\rho_m}} \qquad (2)$$

Where: - w_{f1}, w_{f2}, ρ_{f1}, and ρ_{f2} are the weight and density of the fiber first and second for hybrid composite, w_m and ρ_m are the weight and density of the matrix.

Four layers of Jute fibers, hence name given JJJJ. Similarly GJGJ implies first layer of Glass, second layer of Jute, third layer of glass again and fourth layer is of Jute again.

2.3 Tests Method

2.3.1 Tensile Test

The tensile check is carried out frequently on flat laminates. The most generally used laminates geometries are of dog-bone type and the straight face type. The tensile check used to be carried out in accordance to the ASTM D 3039-76 massive on a computerized Universal Testing Machine (INSTRON H10KS).The check had been carried out at 2 mm/min of constant rate of strain with 10 KN load cell. Numbers of specimens were tested for better accuracy.

2.3.2 Flexural and Inter laminar shear strength

The 3-point methods were used to find out flexural strength according to the ASTM 790-03 standard procedure on computerized Universal Testing Machine (INSTRON H10KS).Specimen of 140 mm length and 15 mm wide were cut and loaded in three points bending fixture with recommended span to depth ratio of 16:1. The specimens were tested at a crosshead speed of 2 mm/min with 10KN load cell. Numbers of laminates for each sample were tested

Table:-1Theoretical and measured densities of different stacking sequence of laminates.

Laminates	Jute-glass-epoxy				Luffa-glass-epoxy			
symbol	A_1	A_2	A_3	A_4	S_1	S_2	S_3	S_4
Stacking sequence	JJJJ	GJGJ	JGGJ	GJJG	LLLL	GLGL	LGGL	GLLG
Theoretical density	1.16	1.19	1.20	1.20	1.01	1.18	1.187	1.188
Measured density	1.1525	1.189	1.189	1.1932	1.009	1.178	1.77	1.179
Volume fraction Of voids	0.646	0.084	0.916	0.566	1.2	0.89	0.878	0.78
J-Jute fiber			L-Luffa fiber		G-Glass fiber			

Figure:-2 A specimen for tensile test

Table: 2. Comparative mechanical properties of jute-glass and luffa-glass fiber epoxy hybrid composite.

Laminates	Jute-glass-epoxy				Luffa-glass-epoxy			
Symbol	A_1	A_2	A_3	A_4	S_1	S_2	S_3	S_4
Stacking sequence	JJJJ	GJGJ	JGGJ	GJJG	LLLL	GLGL	LGGL	GLLG
Tensile Strength (MPa)	21	40.04	36	42	17.63	25.87	32.17	35.34
Flexural Strength (MPa)	117	170	210	241.3	39.10	107.93	63.116	108.36
Inter laminar Shear strength (MPa)	5	4	7	8	2	5	3	5
J-Jute fiber,			L-Luffa fiber,		G-Glass fiber			

for accuracy. The flexural strength were find out the using of given below equation 3.

$$\sigma = \frac{3FL}{2bt^2} \qquad (3)$$

Where: F-Force, L-Length of specimen, b and t-width and thickness

The composite laminate were tested on short beam shear (SBS) test to find out inter laminar shear stress (IILSS) at room temperature. The test was conducted on UTM machine. The inter laminar shear stress is find out using below given equation 4.

$$\text{ILSS} = \frac{3F}{4bt} \qquad (4)$$

Where: - F is maximum load, b and t are width and thickness of specimen.

3 Results

The composite laminates properties completely dependent on the properties of fiber. The composite strength is varies because of loading of various fibers in composite. The variations in densities of the composite laminates are shown in table-1 and comparisons by graph are shown in figure (6) for jute-glass and luffa-glass fiber epoxy hybrid composite. The different variation of tensile Properties, flexural Properties and inter laminar shear strength are shown in table-2and comparisons by graph are shown in figure (3), (4) and (5) for Jute-glass and Luffa-glass fiber epoxy hybrid composites.

4 Conclusions

The following conclusions are observed based on the review study.

The values of Tensile, Flexural Properties and Inter laminar shear strength of the jute-glass and luffa-glass fiber epoxy hybrid composites are good for stacking sequence of GJJG- jute glass and GLLG.

The density of jute-glass and luffa-glass fiber epoxy hybrid composites laminates are quit varies for various stacking sequence except neat jute and luffa fiber.

The tensile strength of the jute-glass fiber reinforced epoxy hybrid composites is higher than theLuffa-glass fiber reinforced epoxy hybrid composites.

Flexural strength of the jute-glass fiber reinforced epoxy hybrid composites much higher than the Luffa-glass fiber reinforced epoxy hybrid composites.

Inter laminar shear strength of the sequence GJGJ and GLGL are same and other Luffa-glass fiber reinforced epoxy hybrid composites sequence have lower also densities are lower than jute-glass fiber reinforced epoxy hybrid composites.

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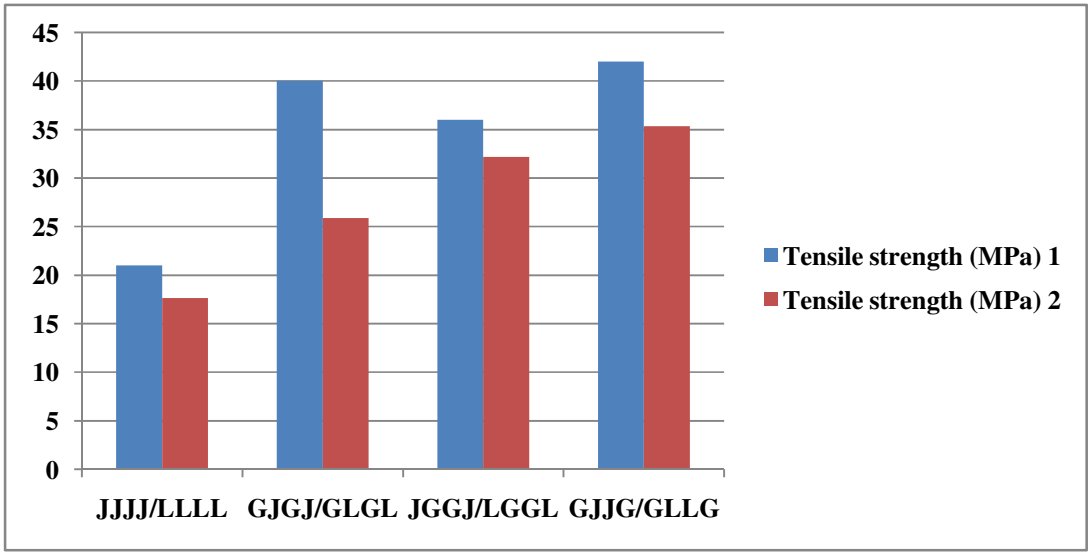

Figure-3 Tensile Properties of the Jute-glass and Luffa-glass fiber epoxy hybrid composites.

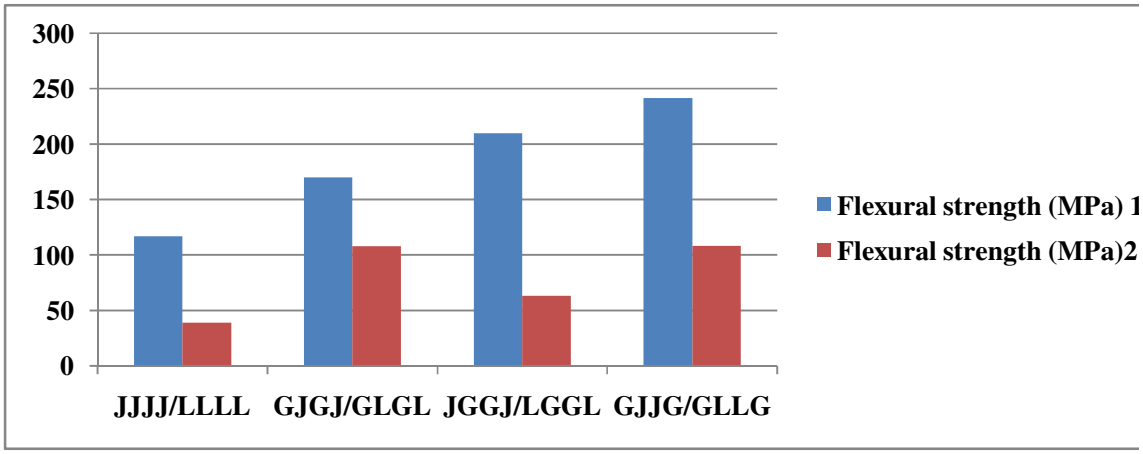

Figure-4 Flexural Properties of the Jute-glass and Luffa-glass fiber epoxy hybrid composites.

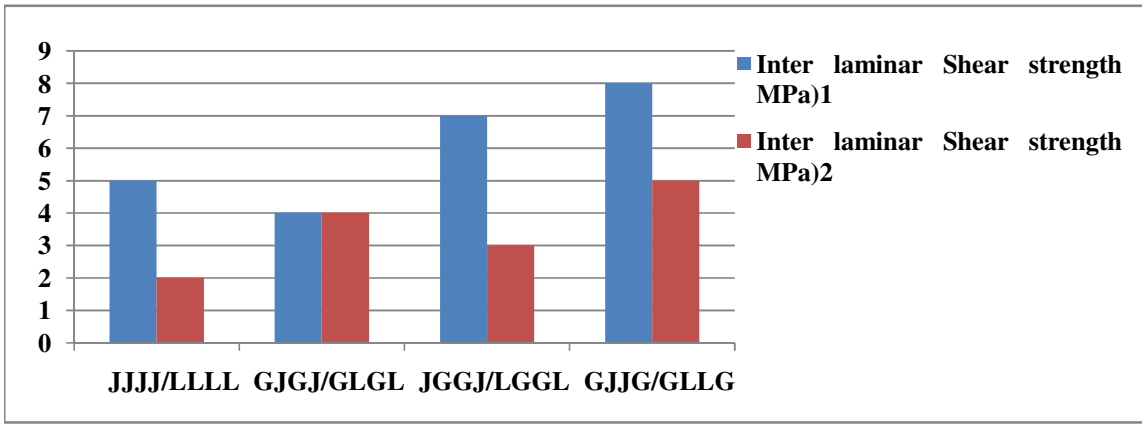

Figure-5 Inter laminar shear strength of the jute-glass and Luffa-glass fiber epoxy hybrid composite.

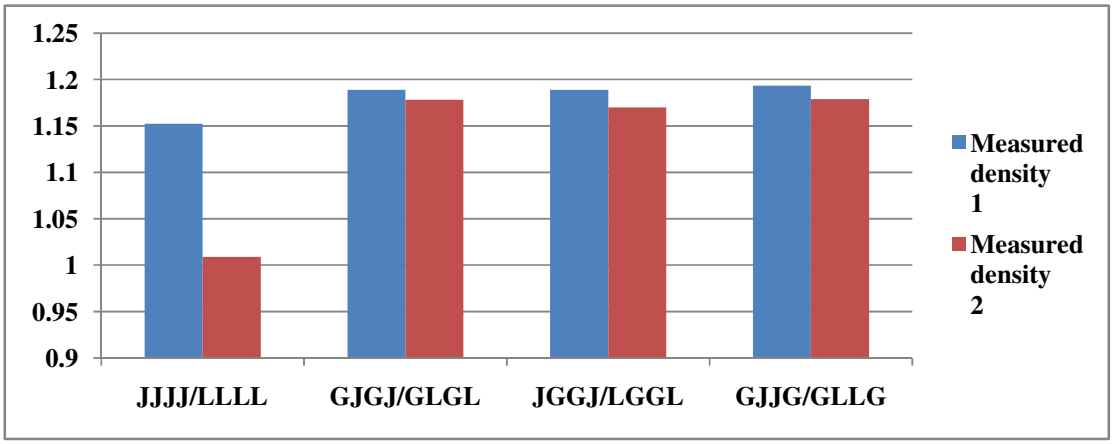

Figure-6Actual densities of the jute-glass and Luffa-glass fiber epoxy hybrid composite.