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EXPERIMENTAL ANALYSIS ON MECHANICAL PROPERTIES OF HEMP- JUTE AND HYBRID E-GLASS GFRP COMPOSITE

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Abstract: In the present trend of research, because of the properties like decrease in density, stiffness, less weight and good mechanical properties the field of composite materials has become the emerging trend. This has found its complete applications in the field of aerospace engineering, automotive, marine and sporting industries. Synthesis of composite materials has been a continuous lookout without settling on both physical and mechanical properties. We are having two types of fibres natural fibre and synthetic fibre. Many researchers have gained attraction over these because they hybrid have the potential reinforcement material for composites, and are in emerging trend. The main practical benefits of these hybrid composites are they offer reduction in density, available at less cost, inexhaustible, biodegradability and naturally innocuous and eco inviting and better mechanical properties when contrasted and synthetic fiber composites. Present research work deals with mechanical properties of jute and Hybrid e-glass laminated reinforced composite at different fibre orientations. Six test specimens were prepared for each by varying fibre orientations and filler materials via, Plain woven bi-directional Hemp jute, Plain woven Hybrid E-glass (one side e-glass and other side chopped standard reinforcement), Hemp jute and Hybrid e-glass, Hemp-jute and Hybrid e-glass with 5% Cu filler, Hemp-jute and Hybrid e-glass with 5% Al filler, Hemp-jute and Hybrid e-glass with 5% graphite filler the following GFRP composites were fabricated according to the standards using hand layup method. The developed composites tested to evaluate their tensile, bending, impact and hardness properties. The best GFRP concluded by comparing the results obtained in the above cases.

Keywords: Jute fibre, Hybrid-E-glass fibre, Epoxy resin, Mechanical properties, Hand layup method.

Introduction:

A mixture of at least two unmistakably different materials which are not solvent in one another and contrast in structure or chemical composition is characterized as a composite material. A material comprises of at least two stages are a composite materials. Concrete, mortar, fiber reinforced plastics, fiber reinforced metals and comparable fiber impregnated materials are the various blends of materials which are known as composite materials

Selection of fibres:

Thermal stability, melting temperature, compatibility with matrix material and density are the focuses to be considered in choosing the fibres. Rigidity and thickness of reinforcing stages are the boundaries on which the productivity of irregularly strengthened composites is dependant. The significant properties for material creation just as end application are density, compatibility, chemical and thermal stability of reinforcement with matrix material. The central issue to be noted for composites utilized in thermal cycling application is the dissension strain among matrix and reinforcement which is considered as the distinction between the CTE of the matrix and reinforcement.

Literature Survey:

[1] I. V. Surendra in his paper "Fabrication and Investigation of Mechanical Properties of Sisal, Jute and Okra Natural Fiber Reinforced Hybrid Polymer Composites" he zeroed in on the manufacturing of hybrid composite includes 35% each of sisal and jute and 30% of okra fiber. Mechanical properties, for example, elasticity, malleable modulus,Flexural quality, Flexural modulus

[2] Dixit S. in his paper "The Effect of Hybridization on Mechanical Behavior of Coir/Sisal/Jute Fibers Reinforced Polyester Composite Material" he inspected, the hybridization effect on mechanical properties on various composites such as CSRP, CJRP, JSRP were surveyed probably. Composites were made using pressure forming methodology. The results show that hybridization recognizes a fundamental part for the mechanical properties improvement of composites. There is an improvement in the malleable and flexural properties of cream composites. Water Sorption coordinates of composite was additionally clarified.

METHODOLOGY

Extraction of Natural Fiber (JUTE)

Jute is one of the significant regular strands after cotton regarding development and use. Development is reliant on the atmosphere, season, and soil. Practically 85% of the world's jute development is gathered in the Ganges Delta. This prolific geographic locale is shared by both Bangladesh and India.

Fig.1 Jute Fibre

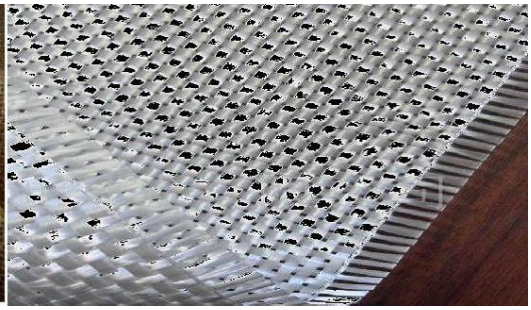

Fig.2 Glass Fibre

Extraction of E-Glass Fibre

E-Glass or electrical evaluation glass was at first created for stay off covers for electrical wiring. It was later found to have stunning fiber moulding limits and is as of now used uniquely as the strengthening stage in the material ordinarily known as fiber glass.

Glass strands are by and large created utilizing melt turning methods. These include melting the glass composition into a platinum crown which has little openings for the liquid glass to stream. Persistent fibres can be drawn out through the openings and wound onto axles, while short fibres might be delivered by turning the crown, which powers molten glass out through the openings radially. Fibres are sliced to length utilizing mechanical methods or air jets.

HAND LAY-UP TECHNIQUE

Hand lay-up system is the most clear procedure for composite orchestrating. The infrastructural requirement for this framework is also pointless. The figuring everything out advances are pivotal. Glass is arranged genuinely in the open shape, and pitch is poured, brushed, or sprinkled over and into the glass utilizes. Entrapped air is taken out actually with squeegees or rollers to complete the overlays structure. Room temperature mitigating polyesters and epoxies are the most usually used structure pitches. Calming is begun by a driving force in the pitch structure, which sets the fiber fortified sap composite without outside heat. A pigmented gel coat is first applied to the structure

surface or working surface for an outstanding surface. The hour of restoring wearisome deftly of polymer utilized for composite coordinating. For instance, for epoxy based structure, standard diminishing time at room temperature is 24-48 hours.

FABRICATION OF COMPOSITES

In this evaluation, manual hand layup procedure is used for arranging composite. In particular, the structure surface is showered with movement gel to overcome the adhering of epoxy to the surface. dainty plastic sheets are used at the both ends of the shape plate to get a fair surface fulfillment of the thing. Support as woven bunch jute surfaces and E- Glass strands are cut by the shape size and set at the outside of structure after Perspex sheet. By then epoxy in liquid structure is mixed absolutely in authentic degree in with a proposed hardener and poured onto the outside of tangle starting late masterminded in the shape. Happening to easing at a temperature at 60˚C - 80˚C, the shape is opened and further coordinated.

TESTING OF COMPOSITE MATERIALS

Equipment for tensile and Flexural testing:

A 400KN capacity computerized universal testing machine, TUE-C-400 model, supplied by perfect electronics solutions, Vijayawada, is utilized to locate the tractable and flexural quality of composites. Its ability can be changed by load cells of 20kg, 200kg ,and 2000kg. A heap of 200kg is utilized for testing composites. Self adjusted speedy grasp throw is utilized to hold composite examples. A computerized micrometer is utilized to quantify the thickness and width of composites

Method of Testing for Flexural Properties:

Standard test technique, ASTM TUE-C-400 for flexural properties of fiber epoxy composite has been utilized to test the composite examples. The composite materials utilized in the current investigation involve cross breed E-glass and hemp fiber and epoxy. The standard example size required is embraced for the current examination. The readied examples are tried for flexural quality utilizing 3-point bowing standard. This test is directed on a similar UTM which is utilized for malleable testing (by changing holds for flexural test).

Fig.3 Specimens before Tensile Test

Fig.4 specimen after Tensile test

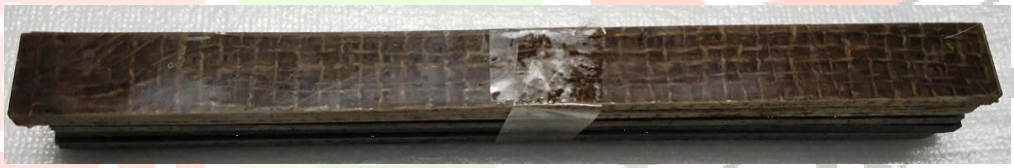

Fig.5 specimen before flexural test

Fig.6 specimen after flexural test

EXPERIMENTAL OBSERVATIONS AND DISCUSSIONS:

TESTED TENSILE PROPERTIES OF HEMP-JUTE AND HYBRID E-GLASS FIBER:

One grip is fixed in which the specimen is loaded and the other grip is movable manually. There should be no slackness while fixing the specimen. Power is supplied to measure the load and extension of the specimen. Extensometer was adjusted to zero, when the load on the specimen was zero. At every 0.5 mm extension the load indicator shows the applied load values and these are noted until the specimen breaks. Now final load and elongation values were recorded at the end of the test. The test was conducted at 240 c and 50 % relative humidity. Then the stress, strain and Young's modulus are calculated from that data. The test specimen dimensions are 200 x15 x 3.5 mm.

Ultimate Tensile strength: When the ratio of ultimate load at failure and the cross sectional area of the specimen is taken we consider it as Ultimate tensile strength

Area of the Specimen Stress = Load/ (Area) Strain Young's Modulus: Width X Depth

=15 X 4.3 (N/ mm2)

: =Change in length / Original length =Change in Length / 200 =stress/strain (N/mm2)

Table 1 Tensile Test Values For Jute/E-Glass Specimens

Sample name	Orientation	Load at the yield (KN)	Elongation at the yield (mm)	Load at the peak (KN)	Elongation at the peak (mm)	Yield stress (N/mm^2)	Tensile strength (N/mm^2)
Natural	Hemp jute 0^o	0.98	0.08	6.94	2.490	16.88	119.552
Synthetic	Hybrid E-glass 0^o	5.74	0.09	12.98	6.660	98.88	223.600
Hybrid	Hemp-jute+Hybrid E-glass 0^o	8.28	3.53	10.38	5.370	142.63	178.811
Hybrid	Hemp-jute+ Hybrid E- glass+ 5 gm copper	5.5	0.44	11.98	6.89	94.74	206.374
Hybrid	Hemp-jute+ Hybrid E-glass+ 5 gm Aluminum 0^o	5.82	0.13	11.76	6.44	100.25	202.584
Hybrid	Hemp-jute+ Hybrid E-glass+ 5 gm graphite 0^o	5.54	0.08	13.22	6.77	95.43	227.735

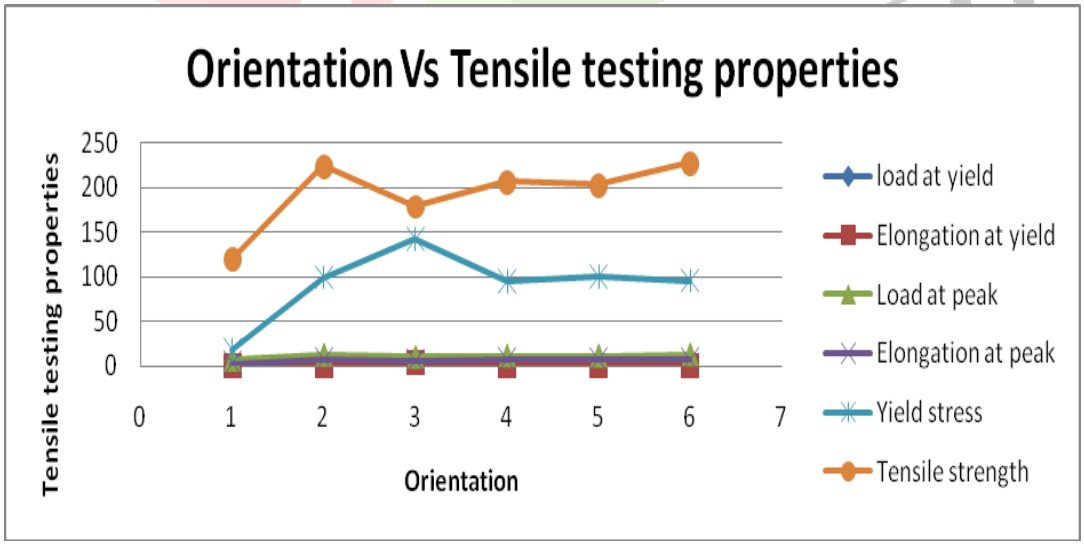

Fig.7. Orientation Vs Tensile testing Properties

COMPRESSIVE TESTING PROPERTIES OF JUTE/E-GLASS FIBRE

Table 2: Different test values for jute/ E- Glass fiber

Sample name	Orientation	ompressive strength (N/mm^2)	Charpy impact nergy (J/m)	rdness Rc
Natural	Hemp jute	69.76	58	62
Synthetic	Hybrid E-glass	73.127	63	75
Hybrid	e + Hybrid E- glass	72.35	66	73
Hybrid	emp-jute + Hybrid E glass+5 gm copper	72.35	62	70
Hybrid	Hemp-jute + Hybrid E-glass+5 gm Aluminum	72.35	60	61
Hybrid	emp-jute + Hybrid E-glass+5 gm graphite	74.16	64	69

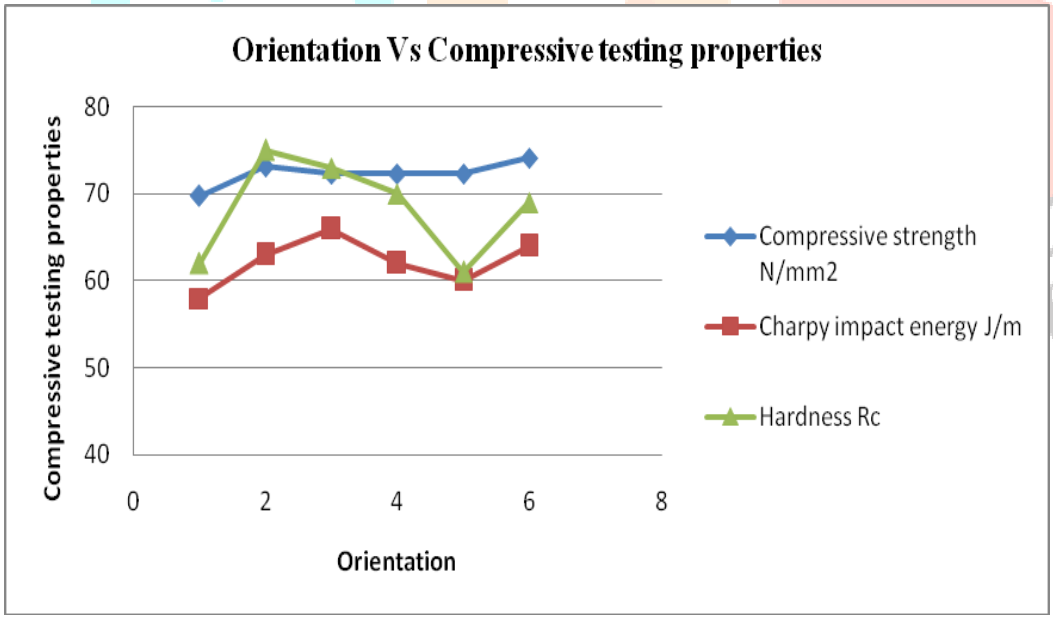

Fig.8. Orientation Vs Compressive testing Properties

The above results shows that (hybrid E-glass + 5 gm graphite) and only Hybrid E-glass (One side E-glass and other side chopped mat) gives higher tensile strength values compared to other specimen, even compressive strength is slightly higher than other specimens. But impact energy absorption capacity is more for hybrid material (hemp- jute +hybrid E-glass material) because natural fiber has greater tendency to absorb energy. But the hardness values are higher for synthetic fiber only.

Conclusion:

1. In tensile strength specimen Hemp-jute+ hybrid E-glass +5gm graphite has obtained highest value 227.73 N/mm²
2. Hybrid E-glass (synthetic) fibre has 223.6 N/mm2. From the above tests we conclude that due to addition of filler material tensile strength properties was increased.
3. Due to addition of graphite - 227.73 N/mm^2
   Copper - 206.37 N/mm^2 Aluminum - 202.58 N/mm^2.
4. The impact energy absorption capacity is higher for Hybrid (jute+ Hybrid E- glass) = 66 J/m and for Hybrid (jute + hybrid E-glass + 5gm Graphite) = 64 J/m
5. In case of hardness
   Hybrid E-glass = 75 Rc value Hybrid (jute+ e-glass) = 73 Rc value

FUTURE SCOPE

In this study only mechanical properties are considered. This work can be extended by considering the metallurgical and thermal properties. Also this work can be extended to different orientation of fibres as well as different weight fractions. This work will be analysed by abacus software to do moderate research.

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