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Low Cost Pre Cast Fiber Reinforced Polymer Composites for Rural Applications

Hariyapla Manjunatha[1], Dr. M. Prasanna Kumar[2]

[1]P.G Student, Department of Mechanical Engineering, University B.D.T College of Engineering, Karnataka, India
[2] Associate Professor, Department of Mechanical Engineering, University B.D.T college of Eng., Karnataka, India

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Abstract - *A composite is a basic material, and is comprised of two or more further joined fixings furthermore stand joined by a plainly visible dimension and not resolvable current for each additional. Composites are more applications because it is low cost, popular this project, Jute and E-glass fiber used to fabricate by open mould method. Epoxy resin Lapox-12 (L-12) is utilized as material and for this a suitable hardener K-6 is used. All samples are well-kept in ASTM standards. Focused on the mechanical properties like flexural and tensile, hardness, water absorption behaviour on laminated composites. Consider four combinations under that GJ4 can give good results than the GJ1, GJ2, GJ3 of a flexural strength and tensile strength. If increase the number of layers of jute fiber can cause more absorption of water and then GJ4. If one layer of jute absorption is less. The hardness number is more for GJ4 compare to GJ1, GJ2, and GJ3. Therefore GJ4 combination can give optimum results for mechanical properties like tensile, flexural, Hardness and water absorption.*

Key Words: Jute Fiber, Glass Fiber, laminates, Hardener K-6, Epoxy Resin, Hand Lay up Method

1. INTRODUCTION

A composite is an essential material, and is made up of two or more layers further united ingredients in addition stand joined by a macroscopic level and not resolvable current for each added. Components are reinforcement and matrixes, both are combined to form the composite. Reinforcement phase consist of fibers & flakes. Matrix phase material may consists of epoxy resin, polyester resin etc.

To discusses how best to make use of the natural fibers which is produced by the rural application in to useful product. Since the main concern for this work is to fabricate the jute and e-glass composites by using hand lay-up process and to evaluate mechanical properties of the fabricated composite material. Utilization of a prepared composite material as a, rural application like house interiors, roof tiles, and finally to show the role of natural fiber in the composite materials.

2. Objectives of the work

- To study the morphological and mechanical possessions of the developed composite.
- Fabricate the jute and E-glass board by open mould method and also hot compression method.
- In this reading, the possessions of natural strength is improved by means of combining it with artificial fiber with the help of epoxy resin.
- Mechanical possessions like flexural, tensile, hardness and is find out and compared.
- Low cost pre cost Fiber reinforced polymer composite for rural application.

3. MATERIALS AND METHODS

Jute fiber is obtained from two herbaceous yearly plants, white Corchorus capsularis (white jute) starting from Asia and Corchorus olitorius (Tossa jute) from Africa. By cotton, it is the second most fundamental trademark fiber, created on the planet and broadly created in Bangladesh, China, India, Indonesia, and Brazil. In these jute and e-glass is taken in a Bangalore. Glass fiber is an engineered fiber. Generally glass filaments are embraced in numerous applications. They procedure better quality, speculation for glass fiber is low. What's more, it has most extreme compound obstruction.

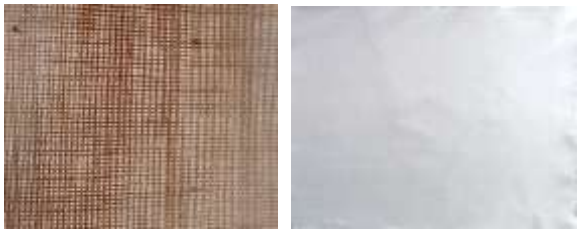


Fig-1. Jute and Glass Fabric matt

3.1 EPOXY RESIN

Epoxy resin was used as a matrix material for fabrication of composite material. The reason for choosing the epoxy resin is that it is another familiar type of thermoset which offers more strength and good dimensional stability. The constituents of matrix system is shown in table 1.

Table -1: constituents of matrix

Constituents	Trade Name	Chemical Name	Density gm/cm^3
Resin	LAPOX L-12	Diglycidylether of Biphenyl A (DGEBA)	1.16
Hardener	K-6	Tri ethylene Tetra amine (TETA)	0.954

4. HAND LAY-UP TECHNIQUE

The hand lay-up is one of the oldest, simplest and most commonly used method for composite parts construction. According to rule of mixture, the resin and hardener are mixed thoroughly in the bowl. In this project constant sized layers of glass fibers and jute fiber are placed one above another. For each layer suitable amount of resin is inserted. The resin is combined with the hardener. The main function of hardener is to harden the resin, which will be helpful for strong bonding of layers. Here the releasing agent will also plays a very important role. In our project wax is used as a releasing agent which does not allow the layers to contact with the mould. The mixture is put into entire mould cavity and then it is closed by the top plate of the mold with required load. The setup is keep in the dry place for 24 hours and the fabricated composite material is taken away from the mold. It has some advantages are low capital investment on equipment. The Composition of fabricated Composite materials are shown in table 2.

Table- 2: Composition of fabricated Composite materials

Sl. No	Volume of composite
GJ1	20% glass + 40% jute + 40% resin (6 layers of glass + 5 layers of jute)
GJ2	30% glass + 30% jute + 40% resin (8 layers of glass + 4 layers of jute)
GJ3	40% glass + 20% jute + 40% resin (10 layers of glass + 3 layers of jute)
GJ4	50% glass + 10% jute + 40% resin (14 layers of glass + 1 layers of jute)

5. PREPARATION OF BOARD

In order obtain the required specimens initially we prepared composite board of 250×250×3mm size by normal method. Initially glass and jute characters are available in the form of fabric mat, and then this fabric mat is cut into required dimensions. In this work a square shaped jute and glass fabric is obtained with length and breadth of 3mm thickness. In accordance with the volume fraction board is prepared for four proportions as shown in above table.

6. RESULTS AND DISCUSSIONS

6.1. Tensile strength

The fabricated hybrid composite specimens were subjected to tensile load and the results were analyzed. The experiment were carried out as per ASTM D3039 standards. According to the results, composite specimens with fibre weight fraction of GJ4 perform better than other compositions and it holds the highest value, and also can withstand the tensile strength of 151 MPa. The Tensile strength properties for fabricated specimens is shown in Table 4. This is due to the increase in the matrix material and the material will become brittle hence reduces its strength. In the presence of voids in the fabricated specimens, leading to stress concentrations and therefore the material becomes brittle and weak. It can be concluded that specimens with 50% E-glass, 40% epoxy resin and 10% jute indicates better strength.

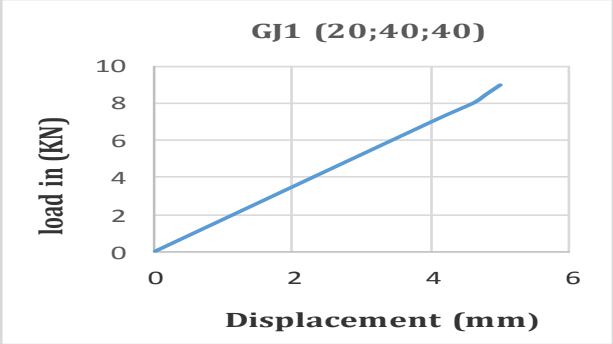
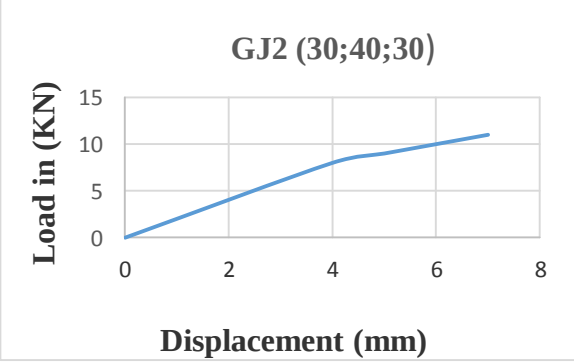
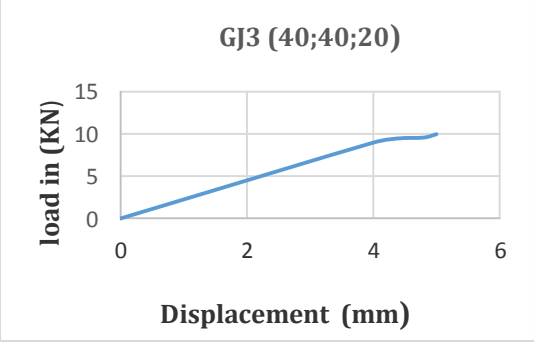
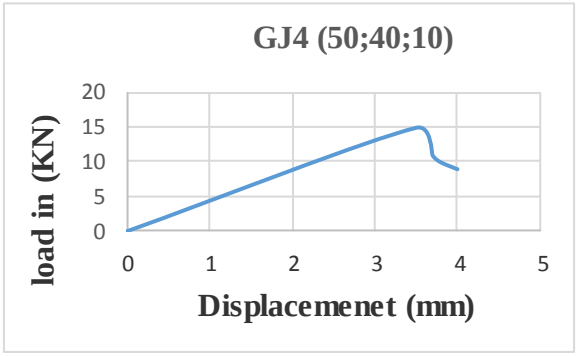


Fig-2.tensile strength of the specimen







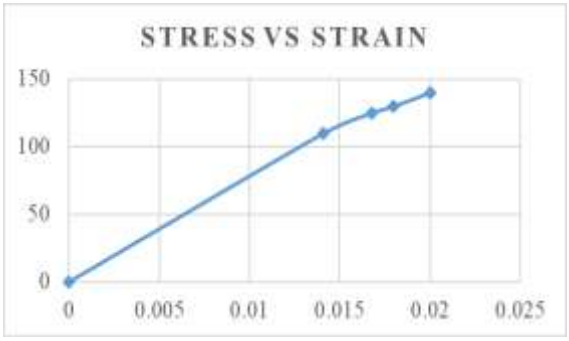


Fig-3. Stress v/s strain for tensile test

Table -4: tensile strength

SN	Maximum Load(kN)	Displacement (mm)	strain	Ultimate tensile Strength(Mpa)	Tensile Modulus(Mpa)
1	7.65	3.53	0.0141	102.155	7245.03
2	8.63	4.2	0.0168	115.01	6845.83
3	8.325	3.25	0.0133	110.75	8327.06
4	11.375	3.64	0.01455	151.66	10423.3

The mechanical behavior of jute texture and e-glass fiber material under elastic load is examined and the outcomes are accounted for underneath separately. The elastic properties of jute texture strengthened with e-glass fiber are explored at room temperature and contrasted and texture fortified with epoxy polymer. The elastic properties of jute texture strengthened with e-glass fiber and epoxy gums. Additionally the load v/s displacement and stress v/s strain are thought about and created in the fig.3 this figure shows that tensile strength of GJ4 composite more than GJ1 ,GJ2,GJ3,that of material composites.

6.2. Flexural strength

Table -5: *Flexural* strength

S.I	Composites	Maximum load (N)	Displacement (mm)	Ultimate flexural strength (Mpa)
1.	20 : 40 : 40	503.55	11.1	337.5
2.	30 : 40 : 30	378.245	15.55	252.163
3	40 : 40 : 20	427.065	13.56	284.71
4.	50 : 40 : 10	475.067	11.3	316.7

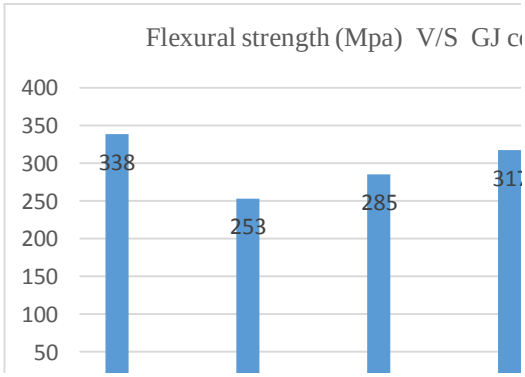


Fig-4. Flexural Strength

The mechanical behavior of jute texture and e-glass fiber material under flexural load is examined and the outcomes are accounted for underneath separately. The flexural properties of jute texture strengthened with e-glass fiber are explored at room temperature and compared and texture fortified with epoxy polymer. The bending properties of jute texture strengthened with e-glass fiber and epoxy gums. Additionally the load v/s displacement and created in the figure-4. Shows that bending strength of GJ1 composite more than GJ2, GJ3, GJ4, that of material composite. Therefore if number of jute fiber is equal to number of E-glass can give good flexural strength.

6.3. Hardness strength

The hardness test specimen are prepared as per ASTM D785 standard is maintained .Apply minor load that is 10kg and as per the procedure followed. Apply major load that is 100kg as per the procedure and hold the load still needle following in rest and after removing the major load hardness value is observed in the indicator and final minor load also removed that is 10kg. Hardness value is computed by the equation RHN –B = Dial reading + 30. The mechanical behaviour of jute smoothness and e-glass fiber material under hardness is examined and the outcomes are accounted for below individually. The hardness properties of jute texture fortified with e-glass fiber are researched at room temperature. The hardness number of the GJ4 = more hardness number than that of GJ2, GJ3, GJ4, and material composite.

Table -6: *Hardness* strength

S.I	Composition	Average DR	RHN-B DR+30
1.	20 : 40 : 40	32	62
2.	30 : 40 : 30	34	64
3	40 : 40 : 20	48	78
4.	50 : 40 : 10	51	81

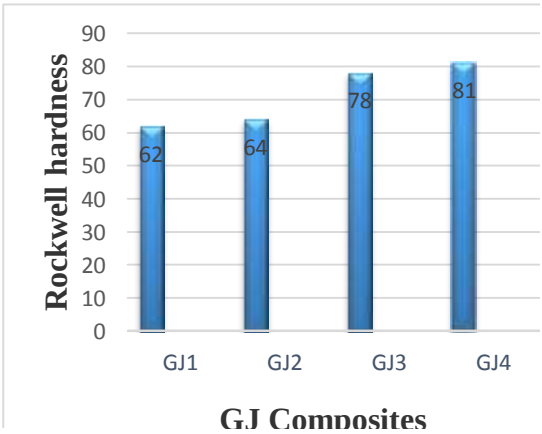


Fig-5. Rockwell Hardness of tested Specimen

The mechanical behavior of jute smoothness and e-glass fiber material under hardness is examined and the outcomes are accounted for below individually. The hardness properties of jute texture fortified with e-glass fiber are researched at room temperature. Fig-5 figure demonstrates that of the GJ4 more hardness number than that of GJ2, GJ3, GJ4, material composite. Therefore number of E-glass fiber layer is increased with decreasing jute fiber can give a good Rockwell –B hardness number.

6.4. Water Absorption Test

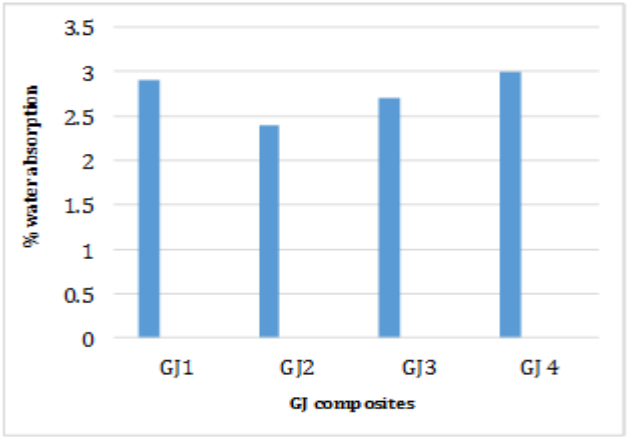


Fig-6. Water absorption tested Specimen

The mechanical behavior of jute texture and e-glass fiber material submerged retentions is examined and the outcomes are accounted for beneath individually. The Water assimilations properties of jute texture fortified with e-glass fiber are explored at room temperature. The Water absorptions property of jute texture, e-glass and epoxy sap. The figure-6, demonstrates that of the GJ1 more Water retentions than that of GJ2, GJ3, GJ4, material composite. Therefore if increasing the number of jute fiber layers can cause moisture absorption more compare to E-glass fiber.

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7. CONCLUSIONS

- The tensile and flexural properties are good for (GJ4) 50% E-glass, 40% resin and 10% jute specimen. Stretchable and bending possessions of jute and e-glass fabric strengthened epoxy combinations to increase material strength.
- The maximum stretchy strength of complexes (GJ4) 50% E-glass, 10% jute fiber and 40% epoxy resin and minimum strength of composite is (GJ1) 20% E-glass, 40% jute and 40% epoxy resin and also Load carrying capacity increase with increasing the thickness and width of material. In ultimate stretchy strength higher the young's modulus of (GJ4) complex and lower (GJ2) 30% E-glass, 30% jute fiber and 40% epoxy resin composites, and we also found the strain.
- In hardness test by increasing the E- glass fiber layer for increasing hardness of the composite (GJ4) 50% E-glass, 10% jute fiber and 40% epoxy resin and also possibility of (GJ3) 40% E-glass, 20% jute fiber and 40% epoxy resin composites.
- Increment in the hardness properties of the composites as the artificial fiber content has enlarged.
- In this work 14 layers of E-glass fibers and 1-layer of jute fiber can give an optimum results of the composite.
- In absorption test increasing layers in jute fibers can cause larger absorption of water. And hence increase water absorption composition but it depending on quantity of water required.

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BIOGRAPHIES

Mr. Hariyapla Manjunatha is graduated in Mechanical Engineering from GMIT, Davanagere and M-Tech in Machine Design Engineering, P.G Student, Visvesvaraya Technical university - Belagavi, Department of Mechanical Engineering, University B.D.T College of Engineering, Karnataka, India.