Fabrication and characterization of Kevlar/Jute Reinforced Epoxy

Shashidhar S Patil[1], Praveen B A[2], Dr. U.N.Kempaiah[3], Dr. Adarsha.H[4]

[1]*Student Dept. of Mechanical Engg. NITTE Meenakshi Institute of Technology, Bengaluru*
[2]*Assistant Professor Dept. of Mechanical Engg. NITTE Meenakshi Institute of Technology, Bengaluru*
[3] *Professor Dept. of Mechanical Engg. University Visvesvaraya College of Engineering, Bengaluru*
[4] *Professor School of engineering and technology, Jain University Jakkasandra*

---***---

Abstract - *With a specific end goal to ration common assets and conserve vitality, weight decrease has been the principle center of vehicle producers in the present situation. Weight decrease can be accomplished fundamentally by the presentation of low thickness materials. So the Industry has demonstrated increment enthusiasm for supplanting of steel material with that of composite material. The point of this work was to decide the rigidity, Modulus of versatility, flexural quality, affect quality, weight and cost of Kevlar-Jute composite. Epoxy SE 70 grid was utilized for the composite of Kevlar and Jute. Test tests were readied utilizing pressure shaping. This is an outstanding method to create composite items. Diagnostically, the volume portion and weight division, rigidity, modulus of versatility, weight and cost of composite example was figured. Trial test led on example utilizing Universal Testing Machine (UTM). The outcomes demonstrated that the properties of Kevlar-Jute composites can be extensively enhanced by joining of Kevlar in jute fiber composites upgrading the properties of coming about half breed composites. Stacking arrangement (modifying the position of Kevlar handles) altogether influences the flexural quality. For a similar relative weight division of Kevlar and Jute fiber, layering grouping has little impact on tractable properties. The Kevlar to jute proportion builds the ductile, flexural quality, affect vitality, strain vitality and lessens the heaviness of example. Progressively the Kevlar rate brings down the epoxy rate so the cost is lessened of example.*

***Key Words*: Kevlar, Woven Jute, Epoxy, UTM Machine**

1. INTRODUCTION

Keeping in mind the end goal to moderate common assets and manage vitality, weight decrease has been the fundamental concentration of car makers in the present situation. Weight diminishment can be accomplished principally by the presentation of better material, plan improvement and better assembling forms. The presentation of composite materials made it conceivable to diminish the heaviness of part with no decrease on stack conveying limit and solidness. The composite materials have more flexible strain vitality stockpiling limit and high quality to weight proportion. The composite material offer open doors for significant weight sparing however not generally are practical over their steel partners. A composite material is a material in which at least two unmistakable materials are consolidated together yet remain remarkably identifiable in the blend. The most well-known illustration is, maybe, fiber-glass, in which glass strands are blended with a polymeric pitch. In the event that we break the composite, the filaments and tar would be effortlessly recognized.

2. LITRATURE SURVEY

P. J. Roe. Directed a few investigations to examine the wettability of jute filaments on epoxy pitch. He found that epoxy sap shapes a personal bond with jute strands up to a volume division of 0.6, above which the amount of sap is inadequate to wet the fiber totally. Facilitate in his examinations he analyzed the properties of jute and glass filaments with epoxy as the grid material and found that on a weight and the cost essential jute strands are much prevalent in many regards as a composite fortification.

Li et al. led an exploration to think about the mechanical properties, particularly interfacial exhibitions of the composites in view of normal filaments because of the poor interfacial holding between the hydrophilic common strands and the hydrophobic polymer networks. Two sorts of fiber surface treatment techniques, to be specific synthetic holding and oxidization were utilized to enhance the interfacial holding properties of characteristic fiber strengthened polymeric composites. Interfacial properties were assessed and broke down by single fiber haul out test and the hypothetical model. The interfacial shear quality (IFSS) was acquired by the factual parameters. The outcomes were contrasted and those acquired by customary ways. In light of this investigation, an enhanced technique which could all the more precisely assess the interfacial properties between regular fiber and polymeric lattices was proposed.

Girishaet. al. [1] taken a shot at E-glass, Jute and epoxy and found that the mechanical properties are higher in the 90 degree arranged cross breed composite than in 45 degree and 30 degree introduction. There were signs that by the joining of the two filaments the polyester pitch balanced out mechanical properties than epoxy sap. **Braga et al. [2]** worked on E-glass, Jute and epoxy and found that the effect quality, elasticity and thermal properties were a greater amount of E64-J18-V19 test example yet flexural quality did not have essentially expanded. **Margoto et al. [3]** worked on polypropylene (PP) and Jute and found that the tensile and flexural tests showed increase in some mechanical properties of the composite, such as strength values, maximum tension and deformation, mainly for composites PP matrix with two layers of fabric jute in flexural tests as compared to PP matrix without fabric jute.

Sanjay et al. [4] worked on E-glass, Jute and epoxy and found that the impact, flexure, and laminar shear strength of the specimen L4 are more than the L_1, L_2 and L_3 specimen. **Ahmeda et al. [5]** taken a shot at E-glass, jute and polyester and found that the properties of jute composites can be impressively enhanced by consolidation of glass fiber as outrageous glass handles. The layer arrangement has more prominent impact on flexural and bury laminar shear properties than the ductile properties. A general correlation between the properties of the considerable number of covers uncovered that the half and half overlay with two extraordinary glass handles on either side is the ideal blend with a decent harmony between the properties and cost.

3. OBJECTIVES

The objectives of this project are as follows:

- The primary objective of the present work is to fabricate composite laminates with:
  Jute fabric + Kevlar fiber + Epoxy resin using simple hand layup technique.
- To prepare test specimens for flexural test from the above fabricated laminates.
- To conduct 3-point flexural tests.
- To acquire different outcomes for these tests i.e. Flexural Strength in Mpa and Displacement at Ultimate Load in mm for the examples utilized and to think about the qualities got for these examples.

4. EXPERIMENTAL DETAILS

4.1 MATERIALS

Reinforcing Fiber	Jute Fiber & Kevlar Fiber
Matrix System	Epoxy Resin (lapox L-12) and Hardener K-6
Molding Process	Hand lay-up followed by Room temperature molding.
Reinforcements: matrix ratio	65:35

4.2 MANUFACTURE OF THE TEST LAMINATES

Test overlays of 300 mm X 300 mm were at first created to get ready mechanical test examples by Hand lay-up followed by Room temperature.

4.3 PREPARATION OF THE RESIN HARDENER SYSTEM

The resin and hardener were to be blended in a proportion of 100:10 by weight, as follows:

- An empty bowl and brush were taken and weighed.
- Resin was added to the bowl and the brush setup and was placed on the electronic balance, till it registered the constant weight.
- The hardener was added to the bowl and bowl was removed from the balance.
- The resin and hardener were blended completely utilizing brush and is utilized. Quickly in the preparation of the laminate, from now on this mixture will be referred to as a "resin system".

4.4 PREPARATION OF THE REINFORCING MATERIAL

The texture utilized are jute fiber, Kevlar fiber as rolls. The texture roll is spread on the level surface and required measurement of 300 mm x 300 mm is checked utilizing the marker pen on the texture spread and cut utilizing a scissor physically. Required such layers of texture were sliced to get the required thickness of cover in this examination.

4.5 SPECIMEN CALCULATIONS

Ex: Jute, Kevlar / Epoxy:

- **Density of laminate** = (Weight fraction of Jute fiber × Density of Jute fiber) + (Weight fraction of Kevlar fiber × Density of Kevlar fiber) + (Weight fraction of resin × density of epoxy resin).
- **Mass of laminate** = Density × Volume of sample.
- **Mass of resin and hardener used (35%)** = Mass of laminate × 0.35
- **Ratio of mass of resin to mass of hardener** = 100:10
- **Mass of resin** = Mass of resin and hardener × (100 / 110).
- **Mass of hardener** = Mass of resin and hardener × (10 / 110).
- **Mass of jute and Kevlar fiber**

Number of fiber layers for each laminates:

- ➢ Jute + Kevlar + Epoxy laminate of 2mm thickness = 5 layers.
- ➢ Jute + Kevlar + Epoxy laminate of 3mm thickness = 7 layers.
- ➢ Jute + Kevlar + Epoxy laminate of 4mm thickness = 9 layers.

4.6 SPECIMENS PREPARED FOR FLEXURAL TESTS

5. RESULT AND DISCUSSION

5.1 TENSILE TESTS

Material	Peak load(N)	Max. displacement (mm)		UTS (N/mm²)	
		ANSYS Result	Experimental Result	Experimental Result	ANSYS Result
Jute/Kevlar/Epoxy with 2mm thick laminate	5539	3.2	3.14	92.31	94.45
Jute/Kevlar/Epoxy with 3mm thick laminate	8702	3.72	3.57	96.69	98.93
Jute/Kevlar/Epoxy with 4mm thick laminate	7961	5.20	5	66.34	68.54

5.2 COMPRESSION TEST

Material	Peak load(N)	Max. displacement (mm)		Compressive Strength (N/mm²)	
		ANSYS Result	Experimental Result	Experimental Result	ANSYS Result
Jute/Kevlar/Epoxy with 2mm thick laminate	59	1.99	1.64	1.18	1.21
Jute/Kevlar/Epoxy with 3mm thick laminate	390	9.78	12.28	5.20	5.36
Jute/Kevlar/Epoxy with 4mm thick laminate	184	2.09	2.17	1.83	3.3

5.3 BENDING TEST

Material	Peak load(N)	Max. displacement (mm)		Flexural Strength(N/mm²)	
		ANSYS Result	Experimental Result	Experimental Result	ANSYS Result
Jute/Kevlar/Epoxy with 2mm thick laminate	73	7.1	7.05	73.31	78.51
Jute/Kevlar/Epoxy with 3mm thick laminate	143	9.58	9.32	63.45	58.55
Jute/Kevlar/Epoxy with 4mm thick laminate	102	8.1	7.94	25.45	23.07

The experimental results showed that:

- Tensile strength of composite for 3mm was more than that of 2mm and 4mm
- Compressive Strength of composite for 3mm was 65 % more than that of 2mm and 53 % more than that of 4mm
- Bending strength of 3mm thickness was 20.45 % more than that of 2mm and 7.77 % more than the one of 4mm.

6. CONCLUSION

Effect of stacking sequence on tensile, compressive, and Bending Strength of Kevlar-Jute fabric reinforced epoxy composites, have been experimentally evaluated and compared with results obtained from ansys. From the results of this study, the following conclusions are drawn.

- Incorporation of Kevlar in jute fiber composites enhances the properties of resulting hybrid composites.
- Stacking sequence (altering the position of Kevlar plies) significantly affects the flexural strength.
- For the same relative weight fraction of Kevlar and Jute fiber, layering sequence has little effect on tensile properties.
- The Kevlar to jute ration increases the tensile, compressive, bending strength and reduces the weight of specimen.
- More the Kevlar percentage lower the epoxy percentage so the cost of specimen is reduced.

7. FUTURE SCOPE

In this work, the flexural strength investigation was carried out on different fibers but at the same time, this work can be extended to other natural fibers such as bamboo, banana etc. available in the market.

In addition, other test like

- Moisture absorption test
- Impact test
- FFT analysis
- Hardness test

Further work can also be done on different polymers and for different percentage of fiber and reinforcement fraction.

REFERENCES

[1] Khedari J, Nankongnab N, Hirunlabh J, Teekasap S. New low-cost insulation Particleboards from mixture of durian peel and coconut coir. Build Environ 2004;39(1):59–65.

[2] Mueller D.H and Krobjilowski A, “New Discovery in the Properties of Composites Reinforced with Natural Fibers”, Journal of Industrial Textiles, 33(2), 2003, pp.111-129.

[3] Lilholt H and Lawther J.M, “Comprehensive Composite Materials”, chapter 1.10, 2000, Elsevier Ltd.

[4] Rosa MF, Chiou B-S, Medeiros ES, Wood DF, Williams TG, Mattoso LHC, et al. Effect of fiber treatments on tensile and thermal properties of starch/ethylene vinyl alcohol copolymers/coir biocomposites.

BioresourTechnol 2009;100(21):5196–202.

[5] Schaffer, J.P., Saxena, A., Antolovich, S.D., Sanders, T.H. Jr., and S.B. Warner. The Science and Design of

Engineering Materials; 2nd Edition, WCB/McGrawHill,Chicago, USA (1999).

[6] S.V. Joshi, L.T. Drzal, A.K. Mohanty, S. Arora “The mechanical properties of vinylester resin matrix composites reinforced with alkali-treated jute fibers” Part A 32 (2001) 119–127.

[7] A. K. Rana, a. Mandal, b.c.mitra, r. Jacobson, r. Rowell, a. N. Banerjee “Short Jute Fiber-Reinforced Polypropylene Composites: Effect of Compatibilizer” Journal of Applied Polymer Science, Vol. 69, 329-338 (1998).

[8] Asasutjarit C, Charoenvai S, Hirunlabh J, Khedari J. Materials and mechanical properties of pretreated coirbased green composites. Composites Part B

2009;40(7):633–7.

[9] Rozman HD, Tan KW, Kumar RN, Abubakar A, MohdIshak ZA, Ismail H. The effect of lignin as a compatibilizer on the physical properties of coconut fiber– Polypropylene composites. EurPolym J 2000;36(7):1483–94.

[10] Mahlberg R, Paajanen L, Nurmi A, Kivistö A, Koskela K and Rowell R.M, “Effect of chemical modification of wood on the mechanical and adhesion properties of wood fiber polypropylene fiber and polypropylene/veneer composites”, HolzalsRoh-und Werkstoff, 59(5), 2000, pp. 319-326.

[11] Mckenjie, A.W.andYuritta ,J.P., Appita, 32(6), 460465(1979).

[12] Woodhams, R.T., Thomas, G. and Rodgeers, D.K, Polym.Engi.Sci 24(15).1166-1171(1984).