

PAPER • OPEN ACCESS

Woven Hybrid Composites - Tensile and Flexural Properties of Jute Mat Fibres with Epoxy Composites

To cite this article: P Gopal *et al* 2017 *IOP Conf. Ser.: Mater. Sci. Eng.* **183** 012001

View the [article online](#) for updates and enhancements.

You may also like

- [Evolution and experience with the ATLAS Simulation at Point1 Project](#)
S Ballestrero, F Brasolin, D Fazio et al.
- [Alpha-particle clustering in excited alpha-conjugate nuclei](#)
B Borderie, Ad R Raduta, G Ademard et al.
- [Round-robin tests of porous disc models](#)
S. Aubrun, M. Bastankhah, R.B. Cal et al.



ECS The Electrochemical Society
Advancing solid state & electrochemical science & technology

ECS UNITED

247th ECS Meeting
Montréal, Canada
May 18-22, 2025
Palais des Congrès de Montréal

Showcase your science!

Abstracts due December 6th

Woven Hybrid Composites - Tensile and Flexural Properties of Jute Mat Fibres with Epoxy Composites

P Gopal¹, V K Bupesh Raja², M Chandrasekaran³ and C Dhanasekaran⁴

¹Research Scholar, Department of Mechanical Engineering, Vels University, Chennai, Tamil Nadu, India.

²Professor & Head, Department of Automobile Engineering, Sathyabama University, Chennai, Tamil Nadu, India.

³Professor, Department of Mechanical Engineering, Vels University, Chennai, Tamil Nadu, India.

⁴Associate Professor, Department of Mechanical Engineering, Vels University, Chennai, Tamil Nadu, India.

E-mail : bupeshvk@gmail.com

Abstract. The jute mat fibers are fabricated with several layers of fiber with opposite orientation in addition with coconut shell powder and resins. In current trends, metallic components are replaced by natural fibers because of the inherent properties such as light in weight, easy to fabricate, less cost and easy availability. This material has high strength and withstands the load. In this investigation the plates are made without stitching the fiber. The result of tensile strength and flexural strength are compared with nano material (coconut shell powder).

1. Introduction

The study or research on the influence of jute fiber without coconut shell powder is very less. Jute is one of the most cost effective and the toughest of all natural fibers [7, 8, 9, 10]. The epoxy and coconut shell powder added the aim of evaluating the efficiency of increasing the reinforcing mechanism able to improve the delamination resistance of laminates[5]. Mohan and Kishore in 1985 reported that jute performed well as a core material in jute-glass hybrid laminates. They investigated flexural properties and compressive properties of the jute-glass reinforced epoxy laminates concocted by a filament winding technique using flat mandrel [11, 12].

This is focused on two classes of cross ply stacking sequences $[0/90]_2s$ $[90/0]_2s$ arranged that the role of controlling damage progression of laminates and their capability to reduce the impact sensitivity. The flexural strength is reduced due to the addition of coconut shell powder. The impact energy is higher than threshold level and delaminations are sufficiently developed. $[0/90]_2s$ laminates on the other hand, stress concentration regions generated by the quality of good mixing.

In another study it was given good aesthetic nature and capable of preventing the initiation and spread of delamination, it induces a clear reduction of damage area when the fabrication is made by water abrasive jet machine. The plates are easily fabricated without any damage by water jet machine with fine accuracy. It is demonstrated that predicting the influence of adding coconut shell powder in different percentage pattern. The variable factors such as types of fiber, resin, lay up configuration and mixing ratio



of powder, loading conditions, etc. without stitching the jute mat, the considerable tensile strength/flexural strength obtained.

2. Experimental Investigation

This paper discusses about the fabrication of jute mat composite with/without coconut shell powder and about the tensile strength/flexural strength obtained. The composite plate specimen with different orientation was fabricated by manned method. The tensile specimens are fabricated as per ASTM standard by abrasive jet machine. Fractographic analysis was conducted on the specimen after testing, which were investigated for failure mode by Scanning electron microscope (SEM).

3. Manufacturing methods

The aluminum plates were taken as mold size (500X500X10mm). The sizes of plate (300X300X3mm) rubber mold were placed over them. To avoid sticking on to the plate a small quantity of mension polish was added. Then resin with hardener was applied in a ratio of 10:1 placing the first jute mat, then applying the brushing by rotter processing. Then the second jute mat was placed over this. Add resin gently, then remove the air bubble by pressing the surface by hand brushes and repeat the same process for 4 jute mat[6]. Placing the 100kg weight over the aluminium plate and allowed to cure for the period of 3 hours. Similarly the coconut shell plates are prepared (the mixing is an epoxy resin / hardener/coconut shell powder 15% of total weight taken for mixing).

4. Tensile testing

Tensile testing is a testing procedure done to calculate the material's property's ability to resist tensile forces, deformation and flexural failure. The test is conducted in UTM (Universal Testing Machine).

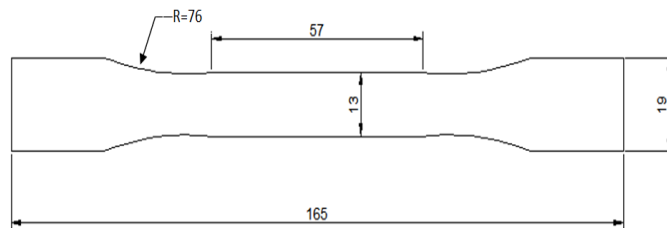
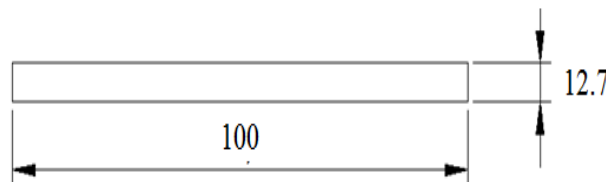


Figure.1 Tensile Specimen



All dimensions are in mm

Figure.2 Flexural Specimen

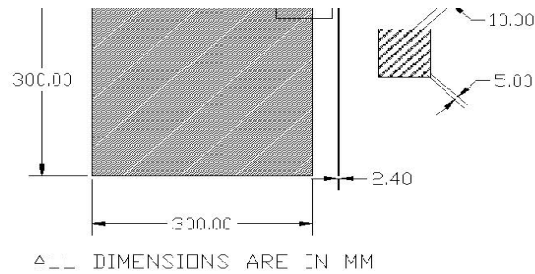


Figure.3 Flexural Specimen



Figure.4 Universal Testing Machine

The tensile test specimen/flexural specimen were fabricated in the abrasive water jet machine as per the standard as shown in figure 1. The tensile specimen subjected to uniaxial loading in a universal testing machine as shown in figure 4.

5. Results

The tensile test/flexural test results are tabulated as shown in the table. This indicates that the tensile and flexural test are increased in coconut shell powder added plates.

Table.1 Tensile & Flexural strength of specimen

Sl.no	Composite plate	Ultimate tensile strength	Flexural strength
1	Jute mat without coconut powder	1475	0.140
2	Jute mat with coconut powder	1848	0.170

Comparing the characterization of jute mat composite plate with coconut powder is higher tensile/flexural strength.

The fractography images obtained from the scanning electron microscope (SEM) shows lack of bonding and failure due to fiber pull and breakage. In this case the plate without nano particle is in lack of bonding properties. Whereas in the case of coconut shell powder and epoxy mixed with jute mat is a perfect bonding between resin and fiber and thereby no delamination occurs.

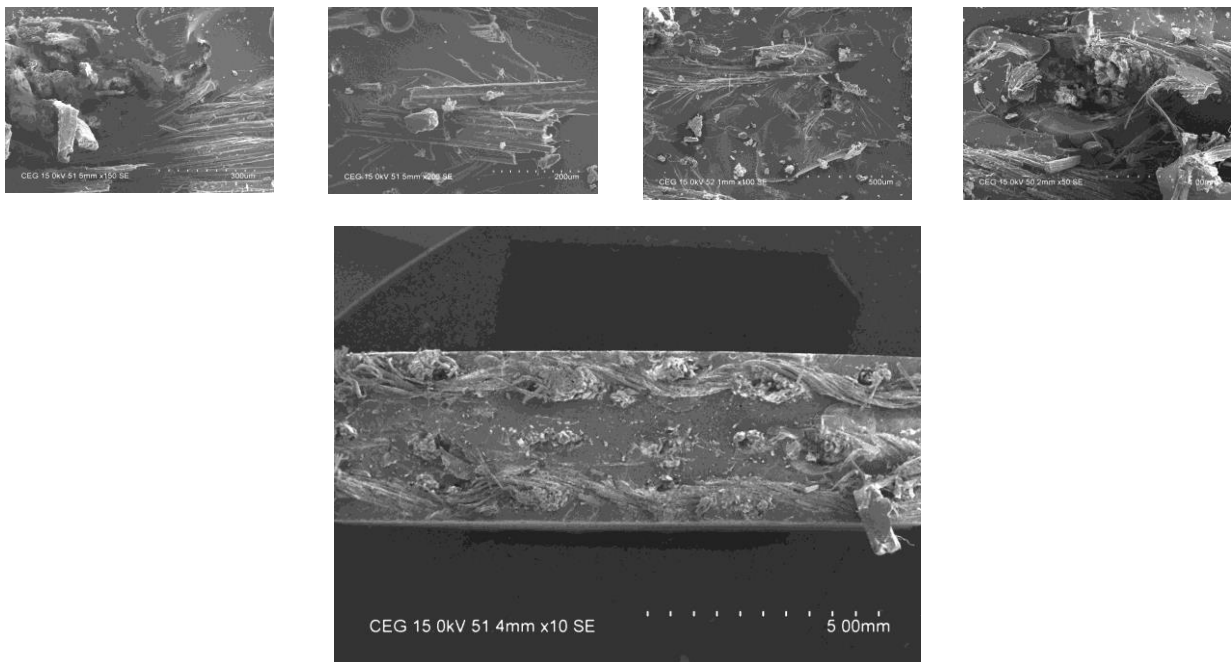


Figure.5 This figure shows that the jute fiber with the cross stitching with coconut shell powder particle as a function of SEM image.

6. Conclusion

The tensile test and flexural test were conducted and the results are compared. The composite plate without powder is less tensile and less flexural whereas proper mixing of coconut shell powder will give good tensile strength and flexural strength and further the laminate improve the tension and the delamination properties. The tensile specimen opted for fractographic studies will indicate the influence of nano particle will improve the tensile and flexural character of natural fibers. This is also a green composite of hybrids.

7. References

- [1] V Lopresto 2006 Effect of stitches on the impact behaviour of graphite/epoxy composites. *Composites science and technology* **66** 206-214.
- [2] Bupesh Raja V K 2012 Experimental Investigation on Tensile Strength of Cross Stitched and Un-stitched Fibre Glass-Epoxy Laminates in *International Journal on Design and Manufacturing Technologies (IJODM)* **6(1)**
- [3] Bupesh Raja V K, et al., 2012 Experimental Investigation on Impact Strength of Cross Stitched and UN-stitched Fibre Glass-Epoxy Laminates In the *Processing of International Conference on Recent Advances in Mechanical Engineering(INCRAME'12)*.
- [4] Bupesh Raja V K., et al., 2012 Fracture Topography Investigation of Cross Stitched and Un-stitched Fiber Glass-Epoxy laminates *National Conference on Evolving Techniques in Mechanical Engineering (NCETME-2012)*.
- [5] Md. Faruk Hossen , Sinin Hamdan , Md. RezaurRahman, Md. Saiful Islam , FuiKiewLiew , Josephine Chang hui Lai , Md. MizanurRahman 2016 Effect of clay content on the morphological, thermo-mechanical and chemical resistance properties of propionic anhydride treated jute fiber/polyethylene/nanoclaynano composites; *Measurement* **90** 404–411
- [6] M. Jawaid, H.P.S. Abdul Khalil, A. Abu Bakar 2011 woven hybrid composites: Tensile and flexural properties of oil palm-woven jute fibres based epoxy composites *Materials Science and Engineering A* **528** 5190–5195
- [7] J A Khan and M A Khan 2015 The use of jute fibers as reinforcements in composites; *Biofiber Reinforcements in Composite Materials* 3–34
- [8] B C Kundu , K C Basak and P B Sarkar 1959 Jute in India Indian Central Jute Committee Calcutta India.
- [9] A Majumder , S Samajpati , P K Ganguly , D Sardar and P C Das Gupta 1980 Swelling of jute: Heterogeneity of crimp formation *Textile Research Journal* **50** 575 – 578
- [10] A road map for jute *International Jute Study Group (IJSJG) Dhaka, Bangladesh and International Trade Centre UNCTAD/WTO (ITC) Geneva Switzerland.*
- [11] Kishore and Mohan R 1983 Compressive strength of jute-glass hybrid fibre composites. *J. Mater. Sci. Lett.* **2**, 99–102.
- [12] Kishore and Rengarajan Mohan 1985 Jute-glass sandwich composites. *J. Reinf. Plast.Compos.* **4**, 186–194.