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PROCESSING AND EVOLUTION OF MECHANICAL PROPERTIES OF BANANA JUTE REINFORCED NATURAL GLUE FIBER

Matcha karthikeya[(1)] sri rama chandra murthy.k[(2)] V V Ramakrishna[(3)]

[1] M.Tech student, Pydah college of engineering patavala, Kakinada
[2] Assistant Professor, Pydah college of engineering patavala, Kakinada
[3] Associate Professor, Pydah college of engineering patavala, Kakinada

ABSTRACT: The present work is carried out for the processing and evolution of the mechanical properties of banana jute-reinforced natural glue fiber. In this study, banana jute is used as a reinforcing material and natural glue as a matrix material. Fiber is made from natural glue, which is water repellent, eco-friendly, and biodegradable. Fibers from natural sources have more advantages than synthetic fibers, such as being non-toxic, low density, low cost, comparable strength, and abundantly available. Fiber is made by hand using a layout technique, and its mechanical properties are investigated. The specimens are made with different banana jute orientations, such as 00, 450, and $90^{0.}$ and volume fraction of natural glue, such as 30%, 40%, and 50%. The mechanical properties like tensile strength and flexural strength are evaluated. This study relieves the fiber of fiber orientation and volume fraction.

Keywords: banana jute fiber, natural glue. Orientation, volume fraction, tensile strength, flextural strength

1. Background

Many Natural fibers are well defined in terms of composition and mechanical properties when we compare with the synthetic fibers. The main advantage of this natural fiber utilization is eco friendly and bio degradable. Some properties of natural fiber is comparatively varies with the synthetic fibers. All natural fibers will contain the Natural adhesives are made from organic sources such as vegetable starch (dextrin), natural resins, or animals where as in artificial ad synthetic fibers will contain the combination of cellulose, hemi cellulose and few lignin. Lignocellulosic fibers may vary greatly in mechanical properties even the product of the same plant due to several factors during plant life cycle, growth conditions, ripeness of the fiber during harvesting, method used for extraction of fiber and storage. Plant fibers come from various parts of the plants main fibers from stem exhibit better mechanical properties.

General application of natural fiber is preparation of cabins, paneling and some of window frames due to their sustainability and light weight. The biggest problem faced during the poor in bonding between banana fiber and tendency to absorb moisture. There are two methods for improving this bonding one method involves roughing the surface and other method is to force applying on the fiber this increases the compatibility of the material.

1.1 Banana fiber:

Banana fibers are obtained from the banana plants. All type of banana plants produces fibers obtained from the stem after fruit is harvested after the banana production the trunk (pseudostems) of the plan is left as agriculture waste. These pseudostems can be used effectively for the production of banana fiber. To create banana fiber, the pseudostems of the tree is allowed to soaked in water for softening,

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to separate the fibres, later th fiber is extracted either by stripping machine or by hand and then knotted to yarn.

Fig-1: Banana jute

Then the fiber is dried in controlled atmosphere to make fiber moisture free. The table-1 shows the properties of the banana jute fiber.

Properties	**Value**
Fineness	17.15
Moisture Regain	13.00%
Elongation	6.54
Total Cellulose	81.20%
Alpha Cellulose	60.50%
Residual Gum	40.90%
Lignin	15.00%
Tensile Strength (Mpa)	823
Specific Tensile Strength (Mpa)	446
Young's Modulus (Gpa)	30
Specific Young's Modulus (Gpa)	22
Failure Strain (%)	2.5
Density (Kg/m)	840

Table-1 Properties of banana jute fiber.

1.2 Natural glue (lignins):

Lignins are 3D polymers produced by vascular terrestrial plants. They are naturally abundance cellulose is used as natural gluethat holds the plant fibers together tightly. Lignins have both the polymeric and phenolic characters. This eco friendly glue might not be applicable for all the adhesives. To get the best adhesion with eco-friendly gelatin or dextrin glue porous surface is required. General application are for paper works and card boards and chipboards.

Fig-2: Hardner and treated lignins

2. Experimental setup:

2.1. Processing:

Banana jute natural glue fiber is prepared by using hand layout process in two different types. One layer of banana jute and another layer of lignin. In this form three layers are made to make fiber.

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Fig-3: fiber made according to the jute orientation

In the second type composition is placed according to the volume fraction and packed in a confined volume and placed under dead weight for compression. Here two different fibers are formed one with orientation of fiber and other with volume fraction. That is 30%, 40% and 50%.

Fig-4: Fiber is made according to the volume fraction

2.2. Specimen preparation:

Specimen for tensile test and bending test is made according ASTM standards for plastic material and fibers. As shown in figure. The specimen is cut into rectangular block of length 100mm breath 10mm and thickness 6mm. and machined according to the required dimensions. Tensile test is performed using UTM.

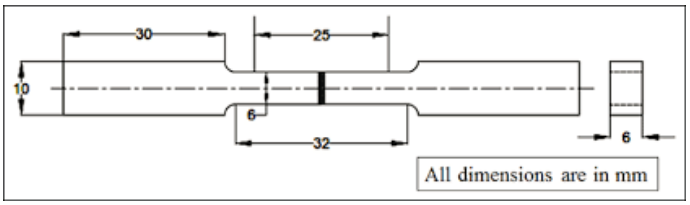

Fig-5: ASTM standard tensile test specimen dimensions for plastic and fibers,

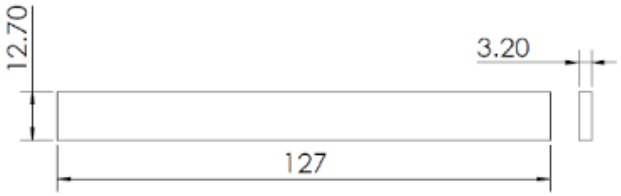

Fig-6: ASTM standard bending test specimen dimensions for plastic and fibers.

Total twelve specimens are prepared according to the orientation six specimens (3 tensile test and 3 bending test). According to the volume fraction six specimens (3 tensile test and 3 for compression test). Figure shows the pair of finished specimen.

Fig-7: Specimen for tensile and bending stress.

Results and discussions:

The samples are tested in machines the results are evaluated for tensile strength and flexural strength in both of fiber orientation and volume fraction.

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In fiber orientation tensile strength and flexural strength is maximum when it is in 90^0 orientation angle 132.40 MPa, and moderate in the 45^0 angle orientation 108.50 MPa and minimum at 0^0 angle orientation 88.72 J. The detailed test result values are shown in the table-2.

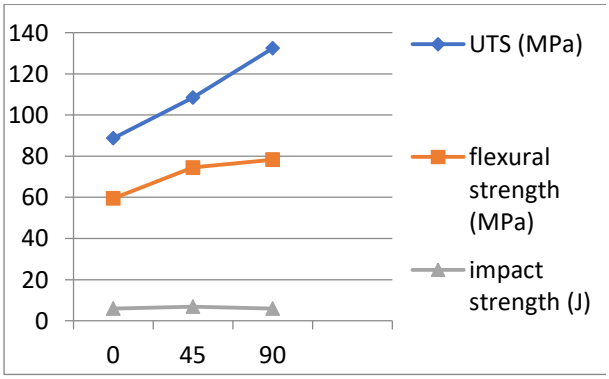
Samples	Tensile strength (MPa)	Flexural strength (MPa)	Impact strengt (Joules
90^0 fiber orientation	132.40	78.28	8.96
45^0 fiber orientation	108.50	74.53	6.89
0^0 fiber orientation	88.72	59.47	5.94

Table-2: Fiber orientation vs. tensile, flexural and impact strength

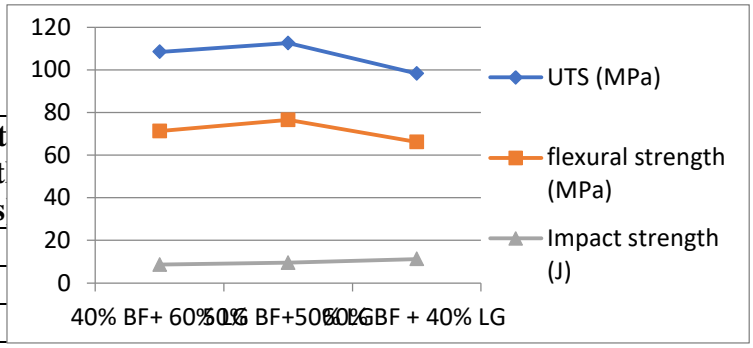
In the volume fraction the fiber and glue containing equal proportion (50:50) results in the best mechanical properties like tensile strength 112.58 MPa and flexural strength 76.53 MPa but where as in impact strength the 60% banana fiber and 40% lignin glue posses maximum value.

Samples	Tensile strength (MPa)	Flexural strength (MPa)	Impact strength (Joules)
40% banana fiber+ 60% lignins glue	108.42	71.28	8.62
50% banana fiber+ 50% lignins glue	112.58	76.53	9.48
60% banana fiber+ 40% lignins glue	98.3	66.18	11.22

Table-3: volume fraction vs tensile flexural and impact



Graph-1: On X-axis fiber orientation i.e., 0^0,45^0 and 90^0 on Y-axis tensile strength, flexural strength and impact strength were represented.



Graph-2: On X-axis volume fraction of banana fiber (BF) and lignin glue (LG) and on Y-axis tensile strength, flexural strength and impact strength were represented.

Conclusion:

From the study we conclude that

- Banana fiber with 90^0 orientation provides high tensile and flexural strength and impact strength i.e., 132.40 MPa, 78.28 Mpa and 8.96 J.
- Banana fiber and lignins glue of equal proportion (50:50) results in high tensile strength and flexural strength i.e., 112.58 MPa, 76.53 MPa.
- 60% Banana fiber and 40% lignins glue results in the high impact strength.
- In volume fraction impact strength increases with increasing in the fiber percentage.

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By.

Name: MATCHA KARTHIKEYA(1)
Designation:(M.Tech)
Mobile number:9533395569
Email id: karthikmatsa@gmail.com
College address: Pydah college of engineering, patavala,kakinada.

Name: SRI RAMA CHANDRA MURTHY.K(2)
Designation: Assistant Professor
Mobile number:7799838226
Email id: KSRCMURTHY@pydha.edu.in
College address: Pydah college of engineering, patavala,kakinada.

Name: VV. Ramakrishna(3)
Designation: Associate professor & HOD
Mobile no : 9618270225
Email id: vvrk98@gmail.com
College address: Pydah college of engineering, patavala, kakinada

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