RESEARCH ARTICLE OPEN ACCESS

# Fabrication of Composite Material (Jute Fiber) Using Vacuum Bagging Equipment

Channabasanagouda S Patil*
*(Thermal Power Engineering, VTU Belgaum/VDIT, Haliyal, Karnataka
Email: gchannu9@gmail.com)

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## Abstract:

Processing of plastic composites using natural fibers as reinforcement has increased in recent years. The advantage of composite materials over conventional materials originate comes mainly from their higher specific strength, stiffness and fatigue characteristics that allows structural designs to be more versatile. The main objective of the paper is to make jute fiber composite material in an economic way and the mechanical properties such as tensile strength of jute composite is evaluated and the results of hand layup method and vacuum bagging method are compared.

*Keywords* **— Reinforcement, fibres, composite material, hand layup and vacuum bagging .**

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## I. INTRODUCTION

Nowadays world faces unprecedented challenges within the social, environmental and economic dimensions. Industrial design has a crucial contribution shown in all of these dimensions with solutions that provide positive answers. The depleting resources called for a need of alternate or contemporary materials to replace the fast depleting conventional resources. Composite materials are engineered or naturally occurring materials made up of two or more constituents materials with significantly different physical or chemical properties which remain separate and distinct at macroscopic and microscopic scale within finished structure. These materials comprise strong load carrying material called as reinforcement embedded in weaker material called as matrix [1]. Reinforcement provides strength and rigidity, helping to support structural load. The matrix or binder (organic or inorganic) maintains the position and orientation of the reinforcement. The reinforcement may be particles, platelets or fibres and are usually added to enhance mechanical property like stiffness, strength and toughness of the matrix material.

## II. LITERATURE SURVEY

The physical and mechanical properties of $Al_2O_3$ filled jute fiber reinforced epoxy composites were studied by Priyadarshini Tapas et al. [2]. The experiment was conducted to find the effect of filler on properties of composites. Jute and $Al_2O_3$ taken as reinforcement and epoxy as matrix, they have found that filler makes significant changes on different properties of composites. They have also found that hardness, strength, flexural and tensile modulus increased with increase in the fiber and filler and inter laminar shear strength increased only by increasing fiber and decreased in addition of filler on composites.

The mechanical properties of jute, sisal and glass fiber reinforced composites were studied by M. Ramesh et al. [3]. In addition they found maximum tensile strength of glass fiber into jute fiber composite. They have also found that sisal and jute mixture composites sample is capable having maximum flexural strength and maximum impact strength. The changes in flexural strength, tensile strength and compressive strength of epoxy based sisal-glass hybrid composites are also studied.

H. Ranganna et al. [4] found that 2 cm fiber length hybrid composites showed maximum flexural tensile and compressive strength than 1 and 3 cm. They found that treated hybrid composites showed higher strength than untreated composites. The effect of alkali treatment on the tensile flexural and compressive properties has also been studied.

The mechanical behavior of jute fiber in polyester and epoxy matrices and their results showed that jute-polyester processing time interval is minor as compared to jute-epoxy laminate were studied by Gopinath et al. [5].

## III. MANUFACTURING OF COMPOSITES

Composite fabrication process involve some form of moulding, to shape the resin and reinforcement. A mould tool is required to give the unformed resin/fibre combination its shape prior to and during cure. We made composite material by using two methods which are

Hand layup method

Vacuum bagging method

The resin used is YD128 and K46

### A. Hand layup method

The most basic fabrication method for thermo=set composites is hand layup, which typically consists of laying dry fabric layers and apply resin to dry fibres by placing one over the other. Resin is applied between two layers and load is kept over it. The composite is allowed to dry at room temperature and is ready for use.

### B. Vacuum bagging method

Vacuum bagging uses atmospheric pressure as a clamp to hold laminate piles together. The laminate is sealed within an airtight envelope. The envelope may be an airtight mould on one side and an airtight bag on the other side. When the bag is sealed to the mould pressure on the outside and inside of this envelope is equal to atmospheric pressure: approximately 765 mm of Hg or 1 atm. As vacuum pump evacuates air from the sides of the envelope and everything within the envelope remains at 1 atm. Atmospheric pressure forces the sides of the envelope and everything within the envelope and everything within the envelope together, putting equal and even pressure over the surface of the envelope as shown in the figure 1. The pressure differential between inside and outside of the envelope determines the amount of clamping force on the laminate [6].

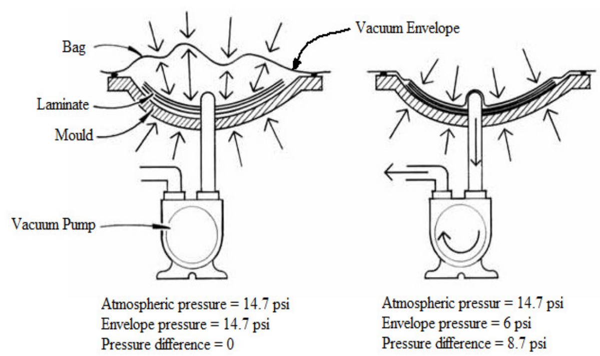


Fig. 1 Vacuum bagging process [6].

TABLE I
MATERIALS USED FOR MANUFACTURING COMPOSITES

| Sl No. | Materials | Specifications |
|---|---|---|
| 1 | Jute Fiber | Gunny Bag (Jute) cut in square size of 300 mm X 300 mm |
| 2 | Resin- YD128 | Density: @ 35°C 1.16g/ml Viscosity @ 25°C 11000-14000cp |
| 3 | Vacuum pump | 1/8 hp diaphragam pump, Displacement 1.2 CFM, Maximum vacuum pressure 24 Hg |
| 4 | Flat surface mould | 470 mm X 445 mm |

## IV. RESULTS

The tensile test is conducted on composite materials made by hand layup method and vacuum bagging method.

  

TABLE III
TENSILE TEST RESULT OF HAND LAYUP METHOD

| Sl No. | Load in N | Extension in mm |
|---|---|---|
| 1 | 0 | 175 |
| 2 | 409.81 | 176.5 |
| 3 | 809.81 | 176.5 |
| 4 | 1309.81 | 177 |
| 5 | 1609.81 | 177 |
| 6 | 2009.81 | 177.5 |
| 7 | 2409.81 | 177.5 |
| 8 | 2809.81 | 178 |
| 9 | 3209.81 | 178 |
| 10 | 4009.81 | 181 |
| 11 | 4409.81 | 182 |
| 12 | 4809.81 | 182.5 |

Maximum load, P = 4809.81 N

Area of specimen (Composite),
A = 25 mm X 10 mm = 250 $mm^2$

Initial Extension = 175 mm

Final Extension = 182.5 mm

Stress = P/A = 19.239 $N/mm^2$

Strain = Change in length/ original length
= (182.5 – 175)/175 = 0.0429

Young's Modulus,
E = Stress/ Strain = 19.239/0.0429 = 448.46 $N/mm^2$

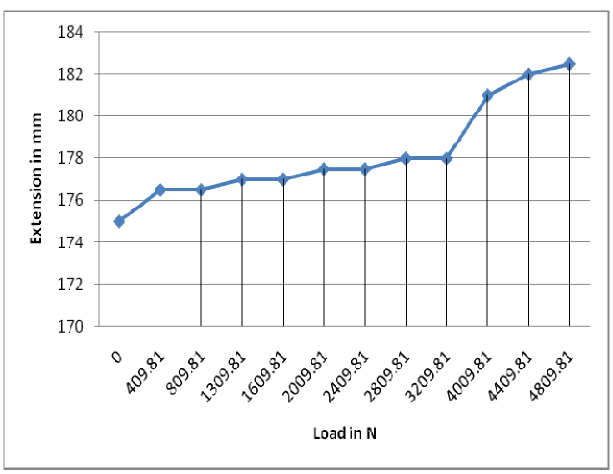


Fig. 2 Load applied Vs. Extension of the hand layup specimen

TABLE IIIII
TENSILE TEST RESULT OF VACUUM BAGGING METHOD

| Sl No. | Load in N | Extension in mm |
|---|---|---|
| 1 | 0 | 175 |
| 2 | 609.81 | 176.5 |
| 3 | 1209.81 | 177 |
| 4 | 1609.81 | 177 |
| 5 | 2009.81 | 177 |
| 6 | 2409.81 | 177.5 |
| 7 | 2809.81 | 177.5 |
| 8 | 3209.81 | 178 |
| 9 | 3609.81 | 178.5 |
| 10 | 4009.81 | 179 |
| 11 | 4809.81 | 180 |
| 12 | 5209.81 | 180 |

Maximum load, P = 5209.81 N

Area of specimen (Composite),
A = 25 mm X 10 mm = 250 $mm^2$

Initial Extension = 175 mm

Final Extension = 180 mm

Stress = P/A = 20.839 $N/mm^2$

Strain = Change in length/ original length
= (180 – 175)/175 = 0.0286

Young's Modulus,
E = Stress/ Strain = 20.839/0.0286 = 728.64 $N/mm^2$

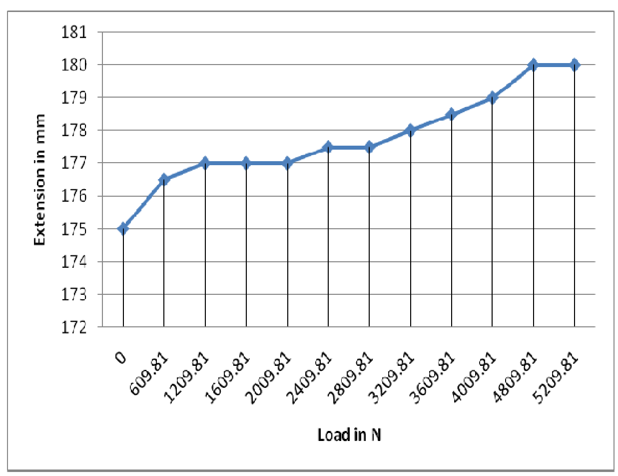


Fig. 3 Load applied Vs. Extension of the vacuum bagging specimen

## V. CONCLUSIONS

The results obtained by tensile test done for both hand layup specimen and vacuum bagging specimen shows that the specimen made by vacuum bagging have better mechanical properties. By comparing the tensile test results of hand layup and vacuum bagging method we can see that the Young's Modulus of specimen made by vacuum bagging method is greater than hand layup method specimen. Even though the mechanical properties of jute composites do not possess strengths as high as those of conventional composites, they do have better strengths than wood composites and some plastics. Therefore composites could be considered for use as future materials.

## REFERENCES

[1] Shah AN, Lakkad SC, Mechanical properties of jute reinforced plastics. Fibre science and technology 1981.
[2] Priyadhrshini tapas Swain, P.T.R. and Biswas, S, "Physical and Mechanical Behavior of Al2O3 Filled Jute Fibre Reinforced Epoxy Composites",
[3] Ramesh M, Palanikumar K. and Reddy K H, "Mechanical Property Evaluation of Sisal-Jute-Glass Fibre Reinforced Polyester Composites", Composites: Part B, Vol. 48, pp. 1-9, 2013
[4] Gopinath A , Senthil Kumar M and Elayaperumal A, "Experimental Investigations on Mechanical Properties of Jute Fibre Reinforced Composites with Polyester and Epoxy Resin Matrices" , 12th Global Congress on Manufacturing and Management, Procedia Engineering, 2014.
[5] Gowthami A, Ramanaiah K, Prasad A V R, Reddy K H C and Rao K M, "Effect of Silica on Thermal and Mechanical Properties If Sisal Fibre Reinforced Polyster Composites", Journal of Material Environment Science, Vol. 4, pp.199-204, 2012
[6] Vacuum Bagging Techniques Published by Gougeon Brothers Inc.P.O. Box 908 Bay City, MI 48707866-937-8797www.westsystem.com 7th Edition—April, 2010

  