A STUDY ON MECHANICAL PROPERTIES OF HEMP-BAGASSE FIBERS REINFORCED WITH EPOXY HYBRID COMPOSITE

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Abstract - Composite are new growth in material science industries. Today's aircraft industries, material needed in low cost, less weight but, it should have high strength to increase the efficiency of aircrafts and also even in automobile industries. The solutions for above things is composite material only. Natural fiber composites can also be very cost effective material for application in building and construction areas, storage devices, furniture, electronic devices, automobile and railway coach interior parts etc., this paper gives the fabrication and investigation of mechanical properties of hemp and bagasse fiber reinforced with epoxy hybrid composite. In this process the fabrication is done by hand-layup method with random orientation of hemp and bagasse fibers. Here by changing the volume fraction of the fibers to 10% & 20% composite laminates were prepared and tested for its mechanical properties such as tensile an flexural test is carriedout as per ASTM standards. And also the hardness test is carried out for both the volume fractions laminates.

Keywords - Hemp fiber, Bagasse fiber, E-glass, Polymer matrix, hand layup, mechanical characteristics.

1. INTRODUCTION

Among day by day development in the materials technology, composite materials are emerged as new generation structural materials quench the needs and demands of rapid growing industrial, automotive and aerospace sectors. Composites are created Investigation on Mechanical Properties of Hemp, bagasse, and E Glass Fiber Reinforced with epoxy hybrid Composites artificially by combining two or more materials of different characteristics. Two main constituents are necessary for successful preparation of composite material, one is reinforcing phase and other is matrix phase. Reinforcing phase is regard as primary load carriers also add strength to the composites, whereas matrix phase is continuous material for bonding between the fibers and carry the load which is acted upon it directly and passed it to the fibers. Reinforcing phase further may classify as fibers, flakes & particulates etc. Composites are characterized by length, size, orientation, volume/weight fraction of fibers and properties comprised by both fibers and matrix. To enhance the properties of the composites more than one fiber is used with single matrix, known as Hybrid Composites. Among various types of fibers used in the preparation of composites Natural fibers plays predominant role.

2. LITERATURE REVIEW

P. Satish, R Keshvan [1] here the researchers investigated that the extensive use of natural hybrid composite in all almost all fields of engineering because of its advantage of having high strength, to weight ratio and biodegradability. Also the investigation of thermal and mechanical properties of banana-kenaf, glass fiber reinforced with epoxy. Hand layup process with different fiber orientation along with different volume fractions is inculcated in the study. The results of the above combinations are evaluated and samples are prepared which are tested for different mechanical properties. **R Bhoopathi et al. [2]** investigates that the role of natural and man-made fibers reinforced hybrid composite materials are growing in a faster rate in the field of engineering and technology due to its favourable properties. Here the study of banana hemp glass fiber is done by using scanning electron microscopy to obtain the different mechanical properties and morphological characteristics. **Ashwani Kumar, Deepak Choudhary [3]** investigates that the banana with epoxy laminates. He suggested that when banana fiber is bind with glass fiber will gives better results of the mechanical properties compare to his literature work. Also he explained that if the proportion of the fiber increases strength of the materials also increases.

Tara Sen, H N Jagannath Reddy [4] investigates that the natural fibers and he used only natural fibers for making a laminate. Hence is explained that better strength of the material besides the impact compare to the tensile and bending properties of other lignocellulose fibers. **D Verma,**

PC Gope, M K Maheshwari, RK Sharma [5] proposed the use of Bagasse fiber and its current status of research and reports the use of bagasse fibers as reinforcements in epoxy. This paper reveals that natural fabric based thermoset composite are generally lower in strength performance compared to hybrid composites, however they have the advantages of design, flexibilities, cost effectiveness, lack of health hazard problems and recycling possibilities.

P Parndaman, Dr. M Jayaraman [6] investigates the effect of hybridization of sugarcane bagasse with coir fiber as reinforcements in the matrix. Paper reveals the chopped fiber reinforcement holds better mechanical properties compared to linear fiber reinforcements. And also it has been concluded that the poor interfacial behaving plays a major role for low mechanical properties.

3. MATERIALS USED

3.1 Hemp Fiber

The Hemp is a Cannabis plant, the cross section of Hemp plant as shown in figure 1. Hemp fiber were extracted from stem of the plant, where it is easily implements to new growth conditions and considered by high species diversity. It is also stating as one of the rational plants and its parts are used in industries. Hemp is twice strong as wood, thus increasing demand for developing biodegradable, sustainable, and recyclable materials.
Hemp fibers are obtained by soaking the hemp stacks in order to separate the fibers and non-fibrous called hurds. Hemp hurds are ligneous woody tissues which are considered as fiber products obtained by secondary manufacturing. In application viz, It is used in building construction and production of Automobile parts. Table 1 shows the properties of hemp fiber

Figure 1 Hemp Fiber

Table 1 Properties of Hemp fiber

Properties	Hemp fiber
Density (g/cm^3)	1.48
Young's modulus (GPa)	30-70
Tensile strength (MPa)	368-800
Elongation at break (%)	1.6

3.2 Bagasse (Sugarcane)

Large varieties of sugarcane grow abundantly in many parts of India and mostly used for production of sugar in sugar industries cane is crushed into milk, due to crushing the cane stalk is going to break into small pieces, this crushed stalk is called as Bagasse. Bagasse reinforced composites having wider application in automotive and railway coaches and buses for public transport system. Figure 2 shown bagasse fiber and from table 2 shows the bagasse fiber properties.

Figure 2 Bagasse fiber

Table 2 Properties of Bagasse Fiber

Properties	Bagasse fiber
Density (g/cm^3)	1.25
Young's modulus (GPa)	17
Tensile strength (MPa)	290

3.1 E-glass

In composite material the usually used glass fiber is E-glass. It have some advantages compare to other fibers like, strength, cost, high temperature with stand capacity and also high chemical resistance. It has low thermal coefficient, low dielectric coefficient and high electrical resistance, properties are shown in table 3.

Table 3 E-glass fiber properties

Properties	E-glass
Specific gravity	2.55g/cm^3
Young's modulus	72.40GPa
Ultimate strength	3447MPa
Co-efficient of thermal expansion	5.04µm/m/◦c

3.4 Resin and Hardener

Epoxy resin is used to give great binding properties between fiber layers and the matrix. The epoxy resin used at room temperature is Araldite LY 556. Hardener (HY 951) is employed to improve the interfacial adhesion and impart strength to the composite. A resin and hardener mixture of 10:1 is used for prepare the laminate.

4. ALKALI TREATMENT OF FIBERS

Hemp and bagasse fiber were treated with 5% concentration of NaoH and Nacl to remove the lignin and cellulose content in the natural fiber. A quantity of 500gm of NaoH is mixed with 10liters of water which the water level consist of pH 7 after that the hemp and bagasse fiber were immersed in a ub for 2 hours. After 2 hours the fibers were taken out and cleaned with the water and again a quantity of 500gm of Nacl is taken with 10 liters of water and immersed in another tub. And again it is cleaned with the distilled water now the fibers are taken out and dried at room temperature for 24 hours.

5. HAND LAYUP PROCESS

A simple hand layup technique is used to prepare the composite laminates. An open mold is prepared as per dimension of 300 ×300×3 mm. The laminates were prepared as per the rule of mixtures the various fiber weigth proportions are calculated in the ratio's of 10:90 and 20:80 respectively. The natural fibers are chopped at 10mm length for 10% of volume fraction fibers and 20mm length for 20% volume fraction. Woven E-glass fabric is used for top and bottom layer of the laminate and the proper mixture of resin and hardener is made in the ratio of 10:1. After molding the laminate a dead weight is placed in order to avoid and remove the air bubbles in the laminate and after naturally curing the laminates were kept in suitable temperature for removing the remaining moisture content with the help of oven at 70^{0}C. The composite laminates were cut by using wire cut hacksaw machine for required ASTM standards.

6. RESULTS AND DISCUSSION

6.1 Tensile Test

The tensile test specimen was cut according to ASTM D3039 dimension i.e., 250 ×25× 3mm.

Table 4 Tensile Test Result

Sl. No.	Specimen composition	Peak load (N)	Ultimate tensile strength (Mpa)
1	10%	3150	42
2	20%	2170	28.93

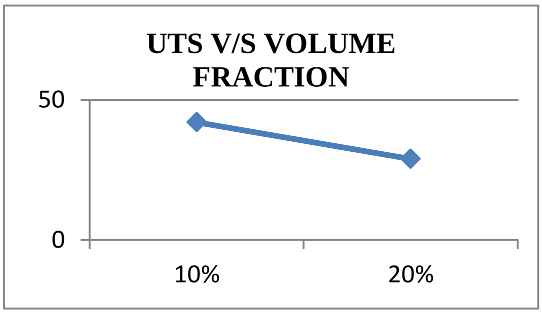

Figure 3 shows the graph of ultimate tensile strength v/s volume fraction

6.2 FLEXURAL TEST

According to ASTM D 790 the specimen were cut in the dimension of 125×12.5×3 mm.

Table 5 Flexural Test Result

Sl. No.	Specimen composition	Peak load (N)	3 point flexural strength (Mpa)
1	10%	134	71.67
2	20%	146	77.90

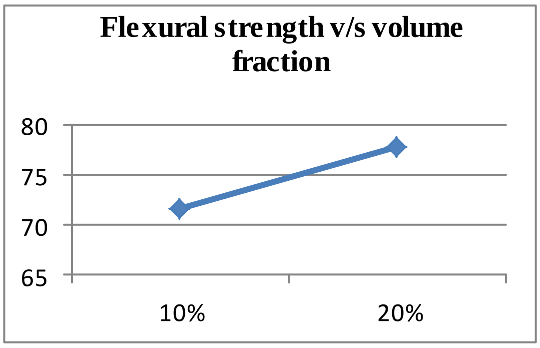

Figure 4 shows the graph of flexural strength v/s volume fraction.

6.3 HARDNESS TEST

For hardness test a dimension of 60×50×3 mm specimen was cut by the fabricated composite. Hardness is defined as the ability to oppose to indentation, which is obtained by measuring the stable depth of the indentation. Test was calculated by the Brinell hardness test machine. In this we can find the Brinell hardness number.

Table 6 Hardness Test Results.

Sl. No.	Specimen composition	Load in kg	Average BHN
1	10%	60	83
2	20%	60	71

7. CONCLUSION

From the experimental test we obtained the ultimate tensile strength of the laminate is 42MPa and young's modulus is 369.46 GPa in sample 1 specimen. other sample of ultimate tensile strength and young's modulus are less. So for tensile applications better volume fraction is 10% . The flexural test shows that sample 2 as maximum stress value of 77.90MPa and for bending applications the volume fraction should be more. And also a hardness test is carried out for different samples and a better hardness value is obtained.

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