Study on Static and Dynamic Properties on Hemp Natural Fiber Reinforce Polyester Composite Material

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***ABSTRACT*:**

Mechanical properties of hemp fibers and strong laminates were determine to assess the prospect of using it as new material in engineering applications. Samples were fabricated by the hand lay-up technique (20:80 fiber and matrix magnitude relation by weight) and the properties were evaluated using the UTM material testing system. The mechanical properties were tested and showed that hemp laminate has the tensile strength of 5.5 KN, bending strength of 4.380KN and frequency and damping for healthy specimen. Results indicated that natural fibers square measure of interest for inexpensive engineering applications and should deal with artificial hemp fibers once a high stiffness per unit weight is fascinating. Results to boot indicated that future analysis towards important enhancements in compressive and impact strength of these styles of composites.Have to be required to specialize in the optimization of fiber strength rather than surface bond strength.

Keywords: *Hemp Fibre ,Composite, Polyster,Tensile Test, Bending Test, Frequency And Damping.*

I. INTRODUCTION

Research and development of natural fibers as reinforcement for automotive sectors may be a growing interest to scientists and engineers. Nowadays, natural fibers kind is a remarkable choice for the foremost wide applied fiber within the composite technology. Several studies on natural studies like hemp Fiber bolstered composites with thermoplastic matrices have with success verified their high qualities in varied fields of engineering application. However, Natural fibers usually have poor mechanical properties compared with artificial fibers however these composites were used as a supply of energy to form shelters, clothes, and construction of weapons. High price of artificial fibers and health hazards of abestorsfibers have extremely necessitated the exploration of natural fibers. Consequently, natural fibers have continually shaped wide applications from the time they gained business recognition. They possess fascinating properties like bio-degrability, renewability, combustibility, lower sturdiness, wonderful mechanical properties, density and low worth.

II. METHODOLOGY AND EXPERIMENTATION:

Laminate Manufacture's methods throughout this study, samples of laminates were prepared by using hand lay-up methodology. The strategy used during this study was used due to its simplicity and accessibility of the items. Details

of the procedures taken among the assembly of laminates via hand lay-up methodology square measure elsewhere mentioned.

2.1. Tensile take a look at the tensile tests were performed employing a testing in UTM. The breadth and also the thickness of the specimens were measured and recorded (250 millimeter by 25 millimeter by 3 mm). The tensile tests were dole out per ASTM D 3039. The tensile strengths were calculated from this take a look at.

Fig 1.Tensile Specimen

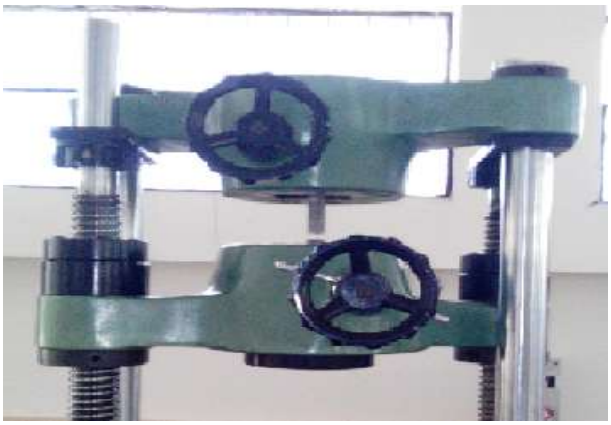

Fig 2. Tensile Test

2.2. Bending take a look at 3 purpose bending tests were performed employing a testing machine in accordance to ASTM D 790 standards. For the bending take a look at, samples with dimensions of 300 millimeter × 13 millimeter × 3 millimeters were used. The bending strength take a look at was dole out on the tensometer with its attachment fastened properly bending strengths were evaluated.

Fig 3Bending specimen

Fig 4Bending test

3.3 To test the damping of the specimen its considered with Accelerometer, Hammer, Dynamic Signal Analyser and specified with standard dimension 150 millimeter × 15 millimeter × 3 millimeters were used. From this experiment obtained frequency and damping by using 36 modes plotted on specimen and later notices that the frequencies evaluated in different mode shapes by using ME's Scope software.

Fig 5 Damping equipment

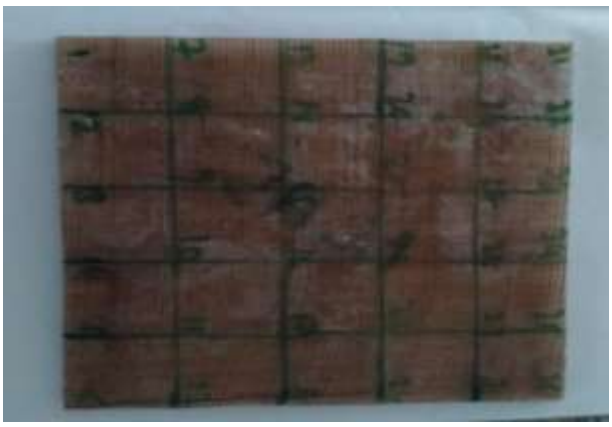

Fig 6 Damping Specimen

III. RESULTS AND DISCUSSION

3.1 Testing results:

Tensile load for 80% polyester+ 20%hemp

Maximum load for specimen1 (P max) = 5.5KN = 5500 N

Maximum load for specimen2 (P max) = 5.14KN = 5140 N

$$\text{Tensile strength}(\sigma t) = \frac{\text{Load ar failur(Pmax)}}{\text{Cross sectional area(A)}} \ldots\ldots\ldots \text{MPa} \quad \ldots\ldots(1)$$

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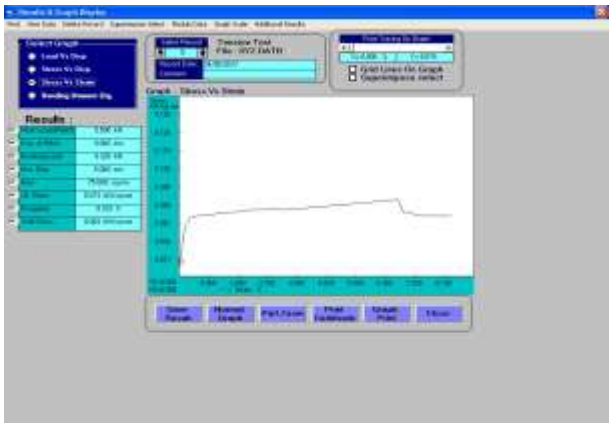
Area of rectangular specimens (A)

$A = w * t = 25*3 = 75\ mm^2.$

$\sigma_t = P/A = 5500/75 + 5140/75 = 141.866\ Mpa$

$\sigma_{t\,a} = 141.866/2 = 70.933\ Mpa$



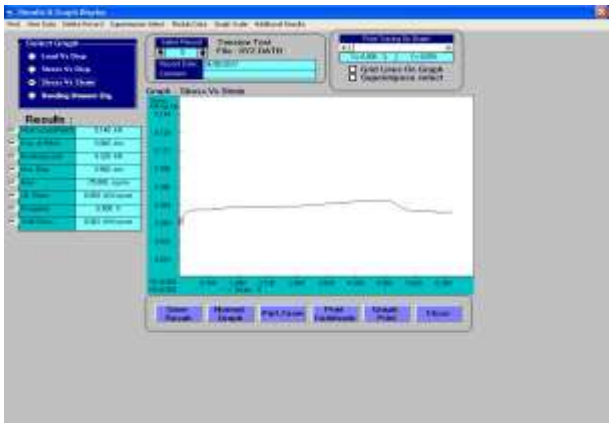


Fig 7Stress v/s strain diagram TensileSpecimen 1Fig 8Stress v/s strain diagram Tensile Specimen 2

Table: 1 Tensile Test Results

Peak load (FMAX)	5.500 kN	5.140 kN
Disp of FMAX	4.000 mm	3.000 mm
Braking Load	4.320 kN	4.320 kN
Max disp	5.000 mm	3.900 mm
Area	75.000sq mm	75.000sq mm
Ult. Stress	0.073 kN/sq.mm	0.069 kN/sq.mm
Elongation	8.33 %	6.500 %
Yield stress	0.064 kN/sq mm	0.062 kN/sq mm

The PMCs specimen is subjected to tensile load as shown in fig2. The stress v/s strain diagramshown in fig 7 and 8.For 80% polyester and 20% hemp. From the graph observed that the stress is increases with respect to strain, once the stress is reached to ultimate stress then its strength is decreases and load will be decreases. After testing of all PMCs specimen the highest tensile load is considered.

3.2 Bending test

Bending load for 80% polyester+ 20%hemp

Maximum load for specimen1 (P max) = 4.380KN =4380 N

Maximum load for specimen1 (P max) =4.320 KN = 4320N

$$\text{Flexural strength} = \frac{3PL}{2bd^2} \quad \text{.....(2)}$$

Where

P = Load in KN, b = breadth of specimens,

L = span length, d = Thickness of specimen.

b = 12.7 mm, d = 3 mm, L = 70 mm

Maximum load for specimen 1 (P max) = 4.400 KN = 4400 N

Maximum load for specimen 2 (P max) = 4.340 KN = 4340N

Flexural strength = [3*4380*70] / [2*12.7*9] + [3*4320*70] / [2*12.7*9] = 7.992 MPa.

Average flexural strength = 8.028/2 = 3.996 KN/mm

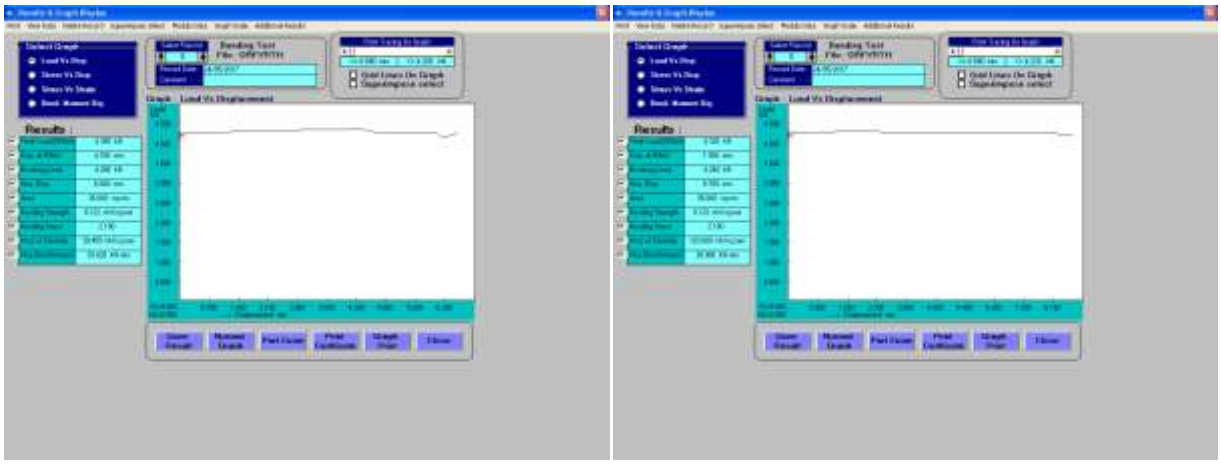


Fig 9Load v/s displacement diagram Bending Specimen 1Fig 10Load v/s displacement diagram Bending Specimen 2

Table: 2 Tensile Test Results

Peak load (FMAX)	4.380 kN	4.320 kN
Disp of FMAX	4.100 mm	1.500 mm
Braking Load	4.260 kN	4.240 kN
Max disp	6.600 mm	8.700 mm
Area	36.000sq mm	36.000sq mm
Bending strength	0.122kN/sq.mm	0.120kN/sq.mm
Bending Stress	2.190	2.160
Maxium Bending Moment	39.420 kN.mm	38.880 kN.mm

The PMCs specimen is subjected to three point bending load, supported at two edge and load is applied on centre of the specimens Fig 4. The bending moment diagram is maximum where point load is applied on specimen shown in fig 9 and 10.

Damping test:

Healthy specimen:

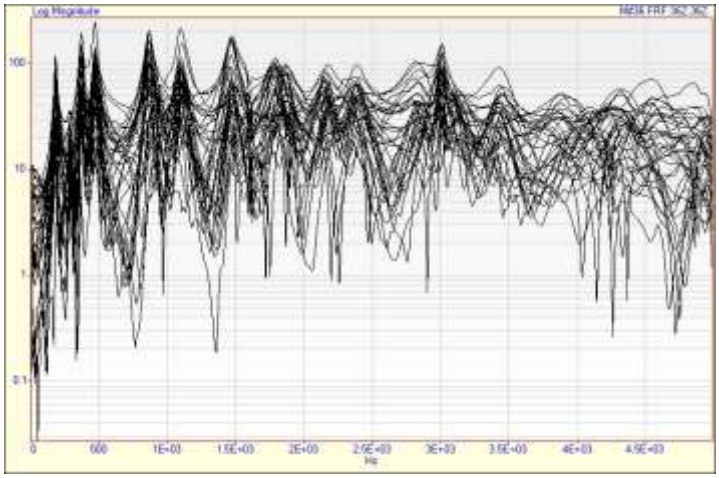
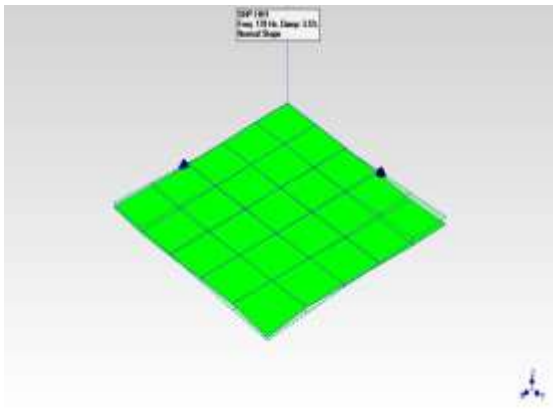


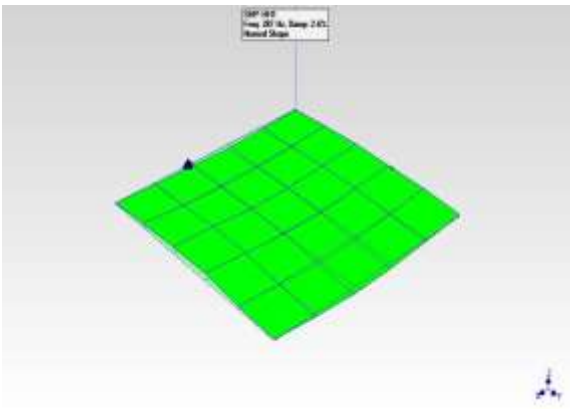
Fig 11 FRF magnitude v/s frequency in HZ

Select shape	Frequency (or time)	Damping	Damping (%)
1.	179	6.2	3.5
2.	287	7.48	2.6
3.	368	9.99	2.72
4.	469	13.8	2.93

Table 3 Experimental result for healthy specimen



Mode 1



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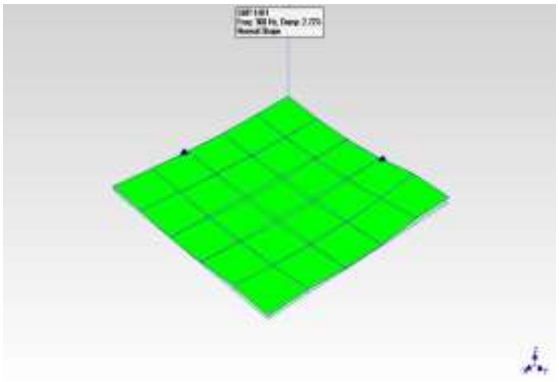

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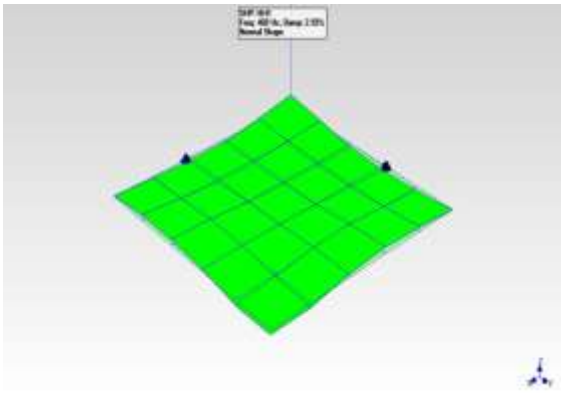

Mode 4

IV. CONCLUSION

The following conclusions were drawn based experimental investigation on mechanical properties of fiber bolstered composites:

1) The fiber composite factory-made by hand lay-up method provides a chance of replacement existing materials with the next strength, low value different that's environmentally friendly.

2) Mechanical properties viz., Bending strength, strength of the hemp fiber bolstered stuff is greatly remarkable.Hence,hempfiberswillbesensiblereinforcement candidates for prime performance chemical compound composites

3) Hemp composites factory-made by hand lay-up Method offer a chance of replacement existing materials with the next strength, low value different that's environmentally friendly

4) From the experiment understood that specimen behaved in differently on varied vibrations and which further analysed damping and frequency by using of ME's Scope software.

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