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DEVELOPMENTAND CHARACTERISATION OF HEMP BANANA STEM FIBRE REINFORCED EPOXY BASED COMPOSITES

Ramesh B. T[1*] & ManjunathaSS[2]

[1,2]*Department of Mechanical Engineering, STJ Institute of Technology*
Ranebennur, Karnataka, India

ABSTRACT

Nowadays development of low cost composites with preferable good strength is aforemost issue in investigates area. The Polymeric composites with synthetic fibres provides the Advantages like Strength and High stiffness to weight ratio over the conventional materials(Wood, concrete, and steel) along with the constraint of high cost of materials. In present Work a polymer composite is fabricated by using abundantly available hemp, banana Stem fibre, with jute powder and epoxy resin as matrix. The main objectives of this study was to More than Two fibres combined With fibre reinforced with Epoxy resin composites and to determine the maximum load withstanding capacity of the Epoxy composite laminates when they are subjected to tension as compared to the other composites. The specimens were prepared in different ratios of Fibre to resin volume fraction by weight and are subjected to tensile loading in a UTM and tested by gradually increasing the tensile load until it fractures. The results proved that the properties of Natural Fibre Epoxy Polymer composites were inflated with the Decrease in Natural fibre content maximum up to 80% by weight. Therefore, the findings of this tensile characteristics dependence of Natural Fibre with Epoxy Polymer can contribute to a better understanding in its applications.

INTRODUCTION

In this decade material science has got transition to composites. This composite has become one of the most important materials in varied engineering, aerospace, marine and automobile industrialises, due to its lightweight, high strength, Stiffness and resistance to elevated temperature. Benefits of fibre reinforced plastic over metals are particularly elimination of galvanic corrosion and resistance to marine environment.

Whenever this epoxy polymerized then it will be amorphous and extremely cross joined material. This cross linked micro structure properties are high modulus and failure strength, low creep Etc.Composites are fabricated using compression moulding technique these results shows that hybridization plays very vital role for increasing the mechanical properties of composite material the tensile and bending properties of hybrid composites are markedly improved as compared with non-hybrid composites. Water absorption behaviour of composite was also studied.

Water absorption behaviour indicated that hybrid composites offer better [1].Here the mechanical properties of poisonouscamarafibre reinforced epoxy composite on humidity absorption and its effect. With different weight percentage of fibres Composite samples reinforced were ready by hand lay-up technique. With rise in fibre content up to 30%, Progress in tensile and bending strength was noticed. Humidity absorption tests were allotted in 3 different environmental conditions they are steam, sub-zero temperature and saline water. Moisturepreoccupation of the studied composites was verified to follow the dynamics of a Fiction diffusion method. Once the mechanical tests rupture characteristics scrutiny of the tested specimens was allotted to reveal an affordable communication between the reinforcement and matrix

MATERIAL METHOD

In this thesis the material selection had been made depend very much on cost, availability of material, market value of the product (economical or high-value finish of the market) and product performance requirements.

The details of specimenPreparation, and Experimentation and data acquisition have been discussed in the successive section of this chapter.

MATERIALS

The materials that are utilized in this work are mentioned below. The composites were prepared for 3 combinations, with respect to variation in fiber percentage to resin percentage.
Reinforcement is Hemp Fiber and Banana Stem Fiber, Matrix Material has Epoxy Resin and Filler material has Jute Powder.
In the thesis specimen were prepared for three different fibres and for three volume fractions. The table below shows the information of combinations.

Table 1 Shows Conduction of test for Three Different fibres under Three Volume Fraction

Sl.no	Combination or volume fraction
1	Hemp, banana stem fibre and Jute powder 40% + Epoxy Resin 60%
2	Hemp, Banana stem fibre and jute powder 30% + Epoxy Resin 70%
3	Hemp, bananastem fibres and jute powder 20% + Epoxy Resin 80%

MOULD PREPARATION

In this work the sheet metal mould is used and the size of mould is prepared as per ASTM standards giving some allowance our requirement. In the proposed work 3 different sized moulds are prepared.
Pour the estimated amount of Epoxy resin upon the surface we are working. By using squeegee spread epoxy reins on the surface. Then reinforcement hemp fibre as to be placed at a proper position that has planned. We should be careful that not to distort the hemp fibre. We should cover the hands with gloves for protection and make sure that the hemp fibre in the proper position. Then using squeegee gently press starting from centre of the hemp fibre making sure that the squeegee is moving the proper direction of hemp fibre. Keep the fibre straight and gently press the surface into the resin while working through the resin and hemp fibre. It should be very careful while moving so that fibre should not get distorted. In the process we need to use brush with rollers. When the

surface becomes nice and the sheen is flat then the layup is well and good. We should not find any air bubbles in the process. If any air bubbles present just work to edge so that the bubble gets disappeared. Using brush that has been tidy to speckle resin into the areas where there is no proper coverage and at the problem areas. After finishing hand layup technique, broad has to be kept under estimated weight about 24 to 48 hrs. And then expose the surface to sunlight for about 6 to 8 hrs.

EXPERIMENTATION

Tensile Test

Tensile, Compression, and 3 Point bending tests are conducted employing a Universal Testing Machine .The pictographic view of the UTM employed in the current work. According to ASTM D3039 standards tensile test is carried out for composites; the experimental setup is as shown below. Test specimens each of 200mm length, 20mm width and 10mm thickness have beenprepared for the test as shown. For this test 100kN capacity UTM is used as shown in fig. To measure the displacement, Dial gauge is used. Before the use testing machine is calibrated. Between the grippers of UTM the specimen's end are held as shown in fig.To the fastened and movable fixtures of the testing machine the gripper's area unit stiffly connected. To the fastened and movable fixtures of the testing machine self-aligning grips area unit connected within the manner which will align as presently as load applied in tension test, to the applied load the test specimen elongates in parallel direction. By gripping opposite ends of the specimen and paralleling it apart, the load is applied. The load carrying capacity and deflection can be obtained by pulling the specimens attheir ends. The point failure is of much interest is typically its breaking load or ultimate load.

THREE POINT BENDING TEST (FLEXURAL TEST)

According to ASTM D3039 standards Flexural test is conducted for composites; the Test setup is shown below. For individual test specimens of 20mm wide, Length= 140mm, and t= 10mm were prepared. Center to center of rollers, for each specimen is 80mm. the specimen encumbered at the middle of the span from a stacking cell. The test is carried until the specimen fails completely.

COMPRESSION TEST

According to the ASTM D3039 standards Compression test is conducted for composites; the fig shown below is the experimental setup. In this test the specimen is placed in the UTM machine among the portableandstatic plates. And the load is applied till the specimen fails then after note the reading of breaking load and also notesthe deformation. The compression test experimental set up as shown in the below figure.

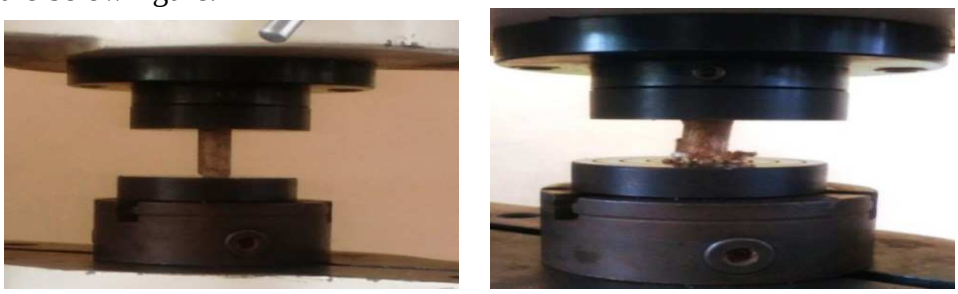

Figure 5 Experimental setup for Compression Testing

Figure 6 Experimental Set up For Water Absorption Test

WATER ABSORPTION TEST

In the water absorption test, initially we need to take the weight of the specimen in dry condition with the help of weighing scale with thecorrectness of 0.001g. After measuring the initial weight of the specimen take three beakers as shown below and put the specimens then pour the normal water in to the beakers. Then the specimen left in the water for 48hrs. After 48hrs.The specimen taken out from the beaker and wiped with tissue paper then the weight of the specimen measured. This is carried out at different intervals until the specimen reaches the saturation level. Then the absorbed moisture is calculated by weight difference. This procedure is repeated for other two proportions. The set up for Water Absorption Test is as shown below.

ELECTRON MICROSCOPE (SEM) SCANNING

It is used to identify the direction of propagation of crack, material defect, fracture origin and nature stresses. Using this test tool we can test the above specified feature of the specimen and get the test data, macroscopic observations. The scanning microscope is a form of instrument of microscope that pictures the sample surface by scanning it with high energy beam of electron sin a formation scan pattern. SEM micrographs details concerning but two to five nm in size.

RESULTS AND DISCUSSION

Behavior of Polymer composites under Tensile Load

Table 2 shows the variation of tensile properties for three different varying percentages of fiber and resin has tabulated below.

Sl.no	**Different composition content**					
	60% Resin-40%fiber		**70% Resin-30%fiber**		**80% Resin-20%fiber**	
	Load (Kgf)	**Displacement (mm)**	**Load (Kgf)**	**Displacement (mm)**	**Load (Kgf)**	**Displacement (mm)**
1	0	0	0	0	0	0
2	8	0.1	10	0.1	14	0.1
3	48	0.3	20	0.2	26	0.2
4	64	0.6	32	0.3	38	0.3
5	68	0.9	40	0.4	48	0.34
6	70	1.21	56	0.74	51	0.37

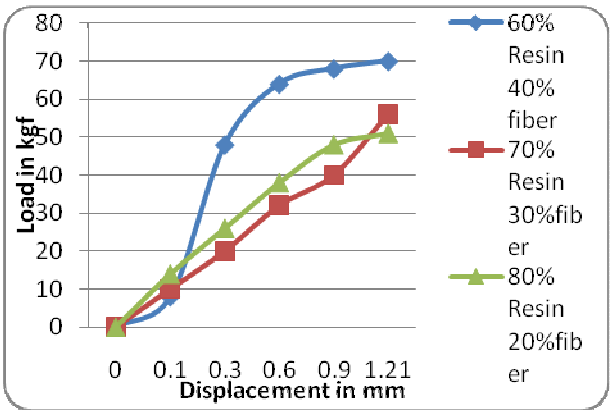

Figure 7 Load V/s Displacement Plot for tensile Specimen

From Figure 7 it is evident that as load increase with increases in deformation. ForComposition of 60% resin and 40% fibre content the deformation is more compare to the other two fibre content, and it shows more tensile strength compare to the other fibre volume content. The decreased of tensile strength in composites with Composition of 80%resin and 20%fiber and matrix content maybe due to the insufficient of fillers to reinforce the matrix of the composites. This is due to improper matrix addition with reinforcement.

Influence of Bending Load on the Polymer Composites

Table 3shows the three different varyingPercentage of fiber and resin has tabulated below (Load Vs. Displacement)

Sl. no	Different composition content					
	80% Resin-20%fiber		70% Resin-30%fiber		60% Resin-40%fiber	
	Load (Kgf)	Displacement (mm)	Load (Kgf)	Displacement (mm)	Load (Kgf)	Displacement (mm)
1	20	0.1	20	0.75	50	0.3
2	25	0.18	60	0.3	105	1.2
3	180	0.2	110	0.6	140	1.5
4	185	0.25	180	0.9	190	1.8
5	192	0.47	191	1.01	208	2.03

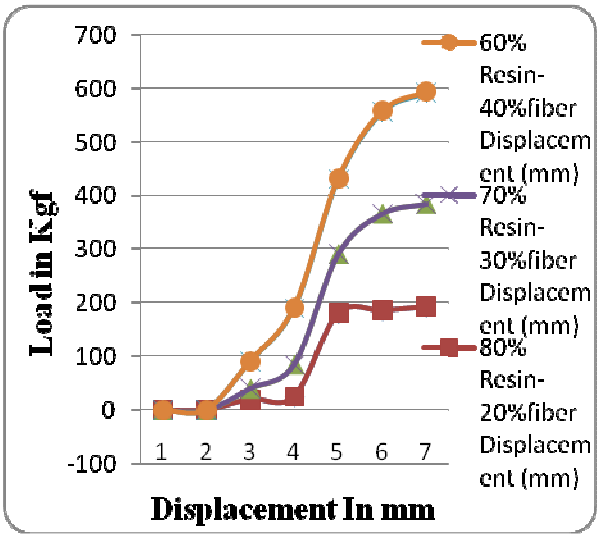

Figure 8 Load V/s Displacement Plot for bending specimen

The results of bending strength for fibre content different combination composites, shown in the Fig.8 it is seen that the strength of composites increases due to increase in the fibre percentage. But the 80%resin material and 20% of fibre content showing linearity in deformation. This may be due to the fibre content decreases the elongation of the fibre will be less and there is tough interfacial regions b/w the fibre and matrix form. Crack travel move not simply through the strong interfacial region and hence there is a decrease in elongation. The maximum bending strength for 60% resin and 40% fibre composite was higher and other two combinations exhibited low bending strength

Table 4 Shows the Average %of Weight Gain

Sl.no	No of Days/Hrs.	Average % of Weight gain		
		40%fiber 70% resin	30%fiber 70% resin	20%fiber 80% resin
1	48	19.1	16.3	15.2
2	144	15.2	17.1	12.2
3	240	11.9	13	11.4

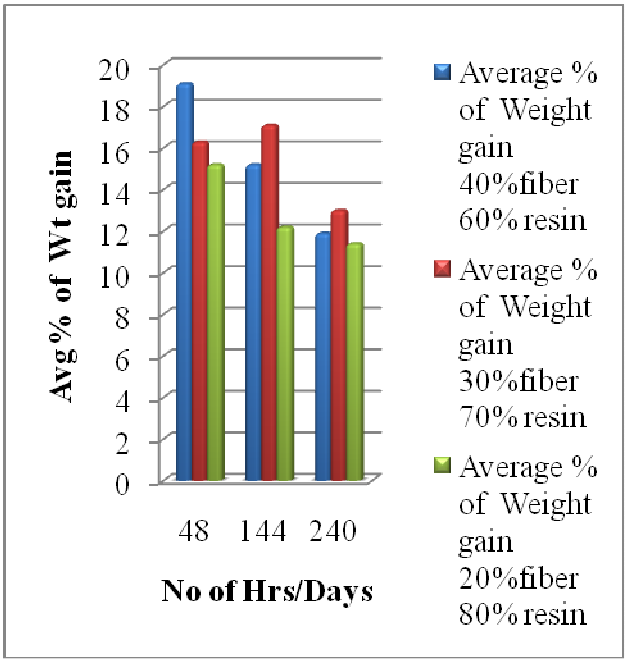

Figure 9 Average % of Weight gain Vs No. of hrs/day for water absorption specimen

From above Graph it is clearly indicates that the combination of 40% fibre 60% resin having more average percentage of water absorption than 30% fibre and 70% resin and 20% fibre 80% resin the combination of 20% fibre 80% resin having Less average % of water absorption, hence from this result it concluded that the More Average percentage of H_2O absorption have affect mechanical properties of composites then the other two combination.

Scanning Electron Microscope Analysis

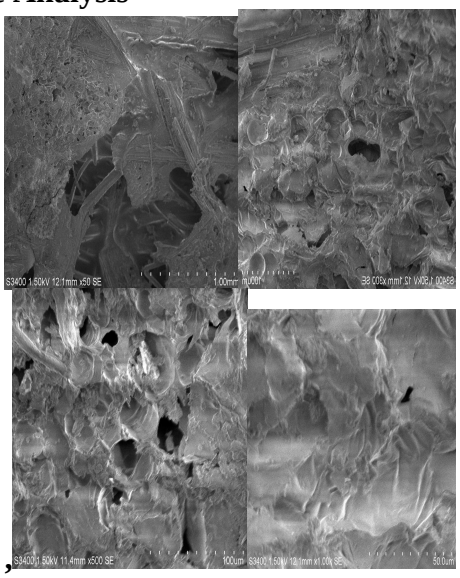

Figure 10 SEM Scanned Images of Bending Test Specimen of composition 40% fibre and 60% Resin

The above figure 10 shows SEM Scanned Images of bending Test specimen with different Magnification they are fallows 1.x50 2.x300 3.x1.00k 4.x500as seen in the above fig 10 fractured

surfaces under load condition as shown that the nature of orientation of fibre is random. And also it shows good binding b/wfibre and matrix. Observation were made from the figures it discloses that fibres were broken randomly. This was the result of inadequate bonding of matrix on fibres, weak adhesion b/w fibre and matrix, bare fibres and less amount of matrix adhered to fibre

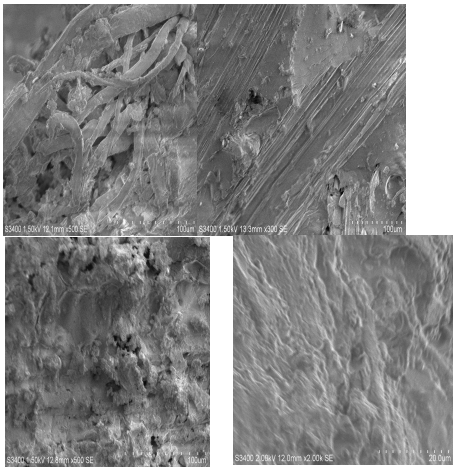

Figure 11 SEM scanned images of bending test specimen with Composition 30% fibre and 70% Resin

It is seen from the figure 11 shows SEM photographs of bending specimen with different Magnification they are 1..x500 2.x2.00k 3.x300

As per the figure 11 fractured surface under bending load for 30% fibre and 70% resin It is found that the nature of failure is due to breakage of fibre as seen in figure 11 broken surface under bending load have shown some fibre or matrix debonds, voids and broken downfibres are shown above figure 5.8

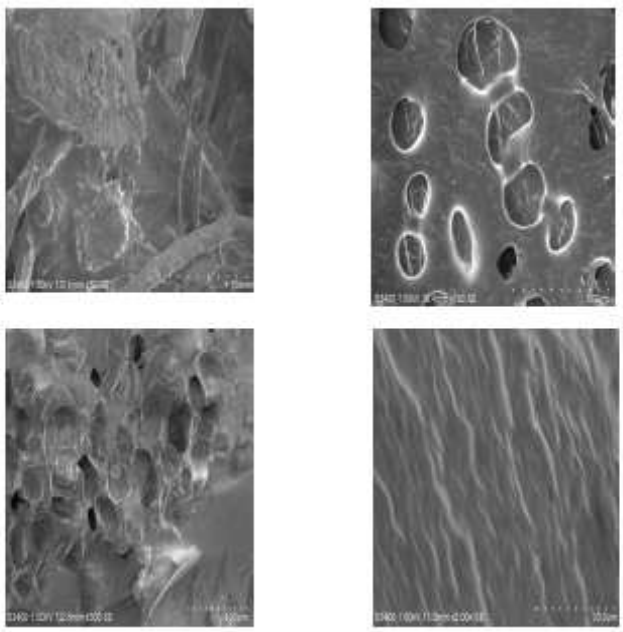

Figure 12 SEM scanned images of bending test specimen with 20% fibre and 80% Resin

It is seen from the figure 12 shows SEM photographs of bending specimen with different Magnification they are 1..x500 2.x100 3.x300 4.x2.00k.
It is clearly indicates that the type of failure is due to breakage of fibre and seen that nature of failure is brittle and fibre pull out is occurred in and seen that fibre
It is observed that in some areas strong adhesion as taken place and some weak addition between fibre and matrix has been taken place and seen that nuggets of resin are found.

CONCLUSION

1.Tensile Test Were Conducted under tensile loads the tensile results revel that the volume fraction (composition) 40% fiber and 60% resin has shown greater load carrying capacity when compared to other two composition.
2. With respect to load deformation relation 40% fiber 60% resin combination shows better load bearing capacity than 30% fibre 70% resin and 20% fiber 80% resin and also with respect to Stress-Strain relation 40% fiber 60% resin combination shows maximum stress than 30% fiber 70% resin.
3. Compression Test were conducted under compressive load it is evident that as load goes on increases with increases in displacement, at certain it compresses. For 80% Resin and 20% Fiber has more load carrying capacity compared to other two compositions of reinforced composites. In the comparison with volume fraction 20%fiber 80% of resin and high displacement compared to other two compositions.
4. Water Absorption test conducted under normal water it is clearly evident that the composition 40% fiber 60% resin having more average percentage of water absorption than other percentages.
5. SEM images of bending test specimens, of unfilled composites show bare fiber and less amount of matrix adhered. Whereas, in the case of filled composites, fiber were broken neatly, and also strong bonding between fiber and matrix was noticed. And it also noticed that the nature of failure is brittle.

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