Experimental Performance and Evaluation of Reinforced Polymer Composites for Structural Applications with Acacia Indica

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Abstract.*Natural Fiber composites are the splendid substitutes to the current available conventional and synthetic materials particularly where there is a strong necessity of high electricity to weight ratio sort of applications. Natural fiber composites are having a superb scope for utility in diverse industries like automotive, Aerospace and commercial fabrications mainly because of their superior capabilities like most effective manner ability, great mechanical homes like mild in weight, biodegradability and cheap cost. So Far various combos of fiber reinforced polymer resin matrix composites had been processed and tested successfully. The Current paintings is focused on improvement and have a look at of mechanical homes of a new type of acacia indica strengthened epoxy resin based composite material with altering weight percentage of fibers and their strand sizes, fabricated through hand layup method.*

Keywords:*Fiber reinforced polymer,Acacia indica, Hand layup method.*

1. INTRODUCTION

Fiber configuration plays an important position in obtaining high mechanical power. Different mechanical houses inside the shape of tensile strength and flexural electricity had been recorded for PP/Raw banana fiber, PP/Banana yarn and PP/Banana mat polymer composites. It was observed that, PP/Banana yarn composites possessed the best tensile electricity and flexural power with the increment of 294% and 72%, respectively when compared to those of unreinforced PP[1]. The incorporation of pineapple leaf fibers (PALFs) into DGEBA/TETA epoxy matrix composites brought on a extensive reinforcement effect. As revealed through Weibull statistics, this reinforcement, above10 vol% up to 30 vol%, observe a linear boom to a value of flexural energy around a hundred and twenty MPa[2]. The use of natural materials, such as fowl feather fibers, in the reinforcement of polymeric matrices, may result in interesting houses of thermal and acoustic insulation. Thermal tests showed an growth of approximately 37% on thermal resistance, between samples with 60:forty and 80:20 ratios of bird feather fibers and epoxy resin, respectively. The obtained results are competitive, evaluating to other traits already finished with similar materials, such as natural fibers. These results can be justified by using the morphological characteristics of chook feather, which presents hollow structure that favourably contributes to these residences. Moreover, since the density of the chicken feather fibers is lower than these herbal materials, their use turns into even more exciting inside the improvement of lighter composite materials [3].

2. LITERATURE SURVEY

Defang Zhao [4] et al in their investigation, found that the possibility of incorporating jute fibers into glass fiber reinforced composite by needle-punched system was explored and the hybrid effect on the flexural properties of different composites was studied. The following points are drawn from the experimental results: Flexural modulus of different composites showed little variation in the three-point flexural test. It is noteworthy that JF manifested the lowest flexural strength among the tested samples of different composites, but it also showed a low deflection, indicating a brittle property.

Lea Ghalieh [5] et al investigated that it is different from the failure of glass and carbon FRP confined columns in which the specimens fail by the debonding of the confining layer. 3- The ultimate stresses reached by the hemp FRP confined columns are influenced by the column slenderness ratio. The ultimate strength decreases with the increase of the slenderness ratio. The ductility enhancement also decreases with the increase of the slenderness ratio and this is interpreted by the reduction of the area under the stress strain curve with the increase of the slenderness ratio above the value 2.

Rohan M. Bajracharya[6] investigated the addition of 30 wt. % of cotton gin waste (CGW) results in 42% increment in flexural modulus but around 85% reduction in flexural strength and strain at peak stress as compared to neat PLA. The flexural properties are reduced with the addition of 10-20 wt. % of flax fiber in the hybrid CGW reinforced PLA composites The improvement of modulus of elasticity of composites containing 30 wt. % of CGW is comparable to composites containing 30 wt. % of flax fibers, CGW reinforced PLA composites would be of lower cost therefore suitable for non-structural applications; and for applications needing stiffer PLA at reduced cost.

Veronica Scarpini Candido[7] et al investigated that The incorporation of sugarcane bagasse fiber in volume fractions of 10, 20 and 30% into a polyester matrix compos-ites continuously increases the notch toughness of Charpy impact tested composites. The impact energy increase followed a linear relationship and indicates that higher toughness might be attained with increasing volume fraction. The macroscopic aspect of the impact ruptured specimens was brittle and typical of a polyester fracture. The incorporation of bagasse fiber interfered with crack propagation in the polyester matrix and promotes fiber pull-out and secondary crack propagation along the fiber/matrix interface.

Marcos Vinicius Fonseca Ferreira[8] et al Thermo gravimetric analysis based on TG/DTG curves of both neat polyester and polyester matrix composites incorporated with 30, 40 and 50 vol% of eucalyptus fibers revealed only minor effects caused by the fibers. About 50◦C decrease in the onset of water release in the composites as compared to the neat polyester is assigned to surface adsorbed moisture in hydrophilic eucalyptus fiber. The onset of TG major weight loss stage is less than 15◦Clower in the composites as compared to the neat polyester.

V. P. Arthanarieswaran[9] investigated that the The mechanical and thermal properties of ALF reinforced epoxy composites are highly influenced by fiber content and alkali treatment of fiber. The mechanical properties of composites increase with increase in fiber content up to 20wt. % and then decrease. Hence the optimum fiber content for better mechanical properties of this present composite is found to be 20wt. %. Likewise, optimally 5% NaOH treatment of ALF highly enhanced the interfacial bond of the fiber with the epoxy resin. This phenomenon was confirmed by FTIR spectra and it leads to better mechanical and thermal properties related to the raw fibers. The decline in surface roughness parameters of 20ATAFC due to chemical treatment was confirmed by AFM analysis.

3. **PREPARATION OF COMPOSITE SPECIMEN**

In the present investigation the specimen are fabricated with a hand layup technique. The fabricated specimen includes uniform distribution of fibers of Acacia Indica respectively. Before coming into the hand layup system the Acacia Indica fibers are uncovered to sunlight for six hours to get the dry layers. A rubber matt mold is developed with the scale of 20 X 20cm and Dura wax is carried out on the floor making use of Dura wax on the rubber matt surface will help in putting off the fabricated portions with-out sticking to the matt very easily.A curler is used to get rid of air gaps between each a pair of successive layers. After the addition of layers the mould matt is closed and is kept below press for 24 hours any excess quantity of air/air gaps are removed beneath hydraulic press. Once the hardness is achieved the composites are taken out and trimmed to required dimensions. The three versions of composite specimen are numerous by changing the strand sizes of fibers which includes proven in below figures.

Fig: 3.1 Fiber Strands of size 30mm

Fig: 3.2 Fiber Strands of size 50mm

4. EXPERIMENTAL INVESTIGATION

4.1. Mechanical Testings of Composites

4.1.1. Tensile Test:

Tensile test is performed by using ASTM D638 method.ASTM D638 is a standard test for evaluating behavior of both reinforced and unreinforced plastics under tensile loading. Conditions such as machine operating speed input humidity and some other pretreatment conditions should be defined before doing the test, the maximum thickness of the specimen in ASTMD638 should not exceed 14 mm, thin sheets and very thin films having 1mm thickness are less than that can be also tested through these standard tests. The composites are trimmed in to required dimensions and smooth finishing by using emery paper the gauge length dimensions and cross head speeds are followed as per ASTM D638 manual specimen for tensile test once the specimen are conformed to dimensions, each specimen is mounted in to the machine for conducting the tensile test . The load is gradually applied till the specimen is failed the results are recorded as a function of gauge length and applied force in each variety specimen are made to the encounter the test.

Fig: 4.1 Tensile test specimens of 30mm fiber strands

Fig: 4.2 Tensile test specimens of 50mm fiber strands

4.1.2.FLEXURAL TEST:

Flexural test is performed by using ASTM D790. Three point flexural test as per ASTM D790 standard is conducted on the specimen the specimen deflection is the out put of theflexural test and it is measured with cross head position, theresults of the test are displacement corresponded to flexural strength to conduct flexural test the test specimen is placed in the UTM and the force is applied till there is a fracture/break the specimen for flexural test,the specimen after testing are shown in fig. The flexural test is conducted at the room tempretaure is 24 deg centigarde with an average relative humidity of 50% the tested specimen using flexural test.

Fig: 4.3 Flexural test specimens of 30mm fiber strands

Fig: 4.4 Flexural test specimens of 50mm fiber strands

5 RESULTS AND DISCUSSION

5.1. Mechanical Properties of Composites:

The composites are prepared with a combination of Acacia Indica fibers with Epoxy resin. Mechanical testing’s such as tensile test (ASTM D638), and flexural (ASTMD790) are conducted on three different specimen in each variety three specimen are fabricated .Totally 18 specimens are fabricated and tested for the evaluation of mechanical properties.

The following figures shows the tested specimens

Fig 5.1 flexure tested specimen of fiber strand size 30mm

Fig 5.2 flexure tested specimen of fiber strand size 50mm

Fig 5.3 tensile tested specimen of fiber strand size 30mm

Fig 5.4 tensile tested specimen of fiber strand size 50 mm

The Following Graphs Shows the Results of the Tensile tested specimens

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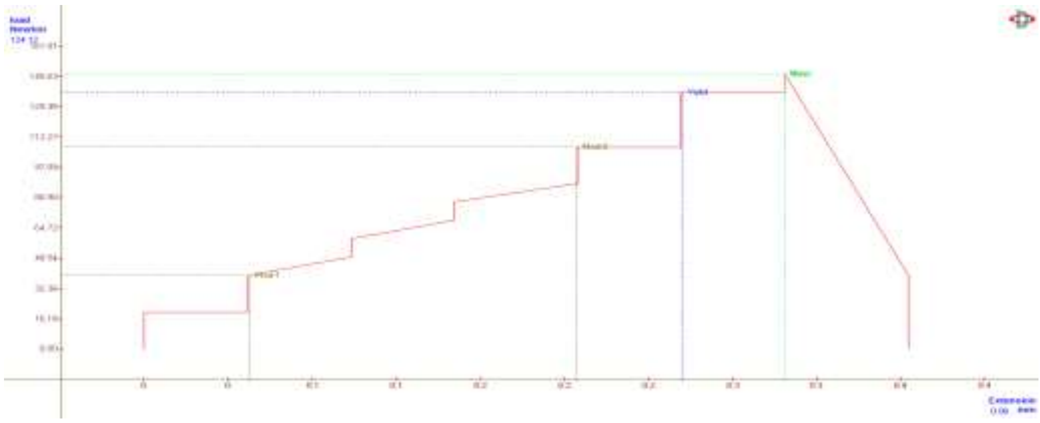

DISPLACEMENT

Graph:- 5.1 Load vs displacement graph of 30mm fiber size tensile tested specimen

Table: 5.1 Obtained average results of 30mm fiber size tensile tested specimen

Obtained Results

Sr. No.	Results	Value	
1	Area	**108.3894**	**mm²**
2	Yield Force	**137.22**	**N**
3	Yield Elongation	**0.26**	**mm**
4	Break Force	**147.1**	**N**
5	Break Elongation	**0.31**	**Mm**
6	Tensile Strength at Yield	**1.27**	**N/mm²**
7	Tensile Strength at Break	**1.36**	**N/mm²**
8	Tensile Strength at Max	**1.36**	**N/mm²**
9	%Elongation	**0.44**	**%**
10	Max Force	**147.10**	**N**
11	MaxElongation	**0.31**	**Mm**
12	Modulus of Elasticity	**280.02**	**N/mm²**

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DISPLACEMENT

Graph:- 5.2 Load vs displacement graph of 50mm fiber size tensile tested specimen

Table: 5.2 Obtained average results of 50mm fiber size tensile tested specimen

Obtained Results

Sr. No.	Results	Value	
1	Area	**72.8344**	**mm²**
2	Yield Force	**312.54**	**N**
3	Yield Elongation	**0.47**	**mm**
4	Break Force	**343.2**	**N**
5	Break Elongation	**0.52**	**Mm**
6	Tensile Strength at Yield	**4.29**	**N/mm²**
7	Tensile Strength at Break	**4.71**	**N/mm²**
8	Tensile Strength at Max	**4.71**	**N/mm²**
9	%Elongation	**0.74**	**%**
10	Max Force	**343.23**	**N**
11	MaxElongation	**0.52**	**Mm**
12	Modulus of Elasticity	**761.42**	**N/mm²**

Results of flexural tested specimens

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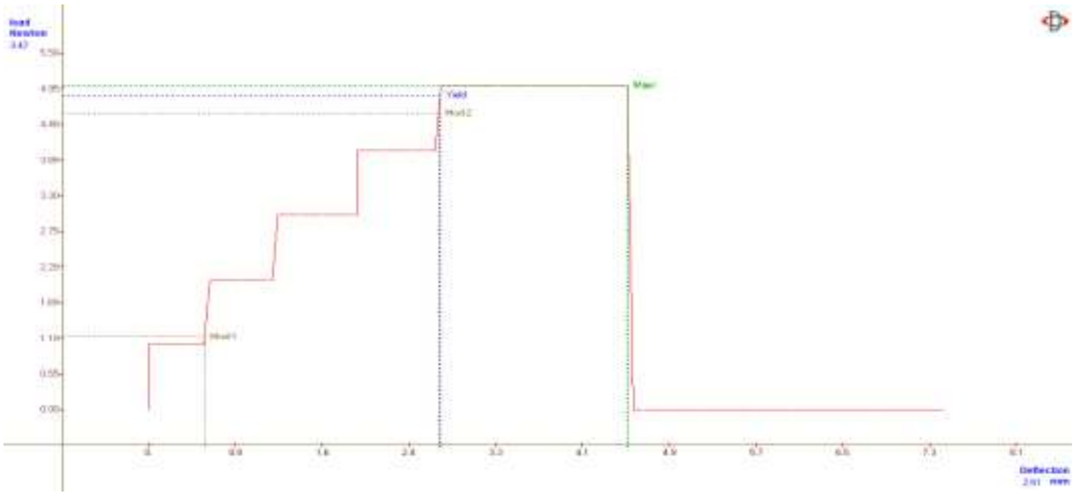

DISPLACEMENT

Graph:- 5.3 Load vs displacement graph of 30mm fiber size flexural tested specimen

Table: 5.3 Obtained average results of 30mm fiber size flexural tested specimen

Obtained Results

Sr. No.	Results	Value	Unit
1	Area	204.0381	**mm²**
2	YIELD Force	47.61292105	**N**
3	YIELD Deflection	2.74	**mm**
4	Max Force	5.0	**N**
5	Max Deflection	4.5	**mm**
6	FLEXURAL STRENGTH @ YIELD	2.59	**N/mm²**
7	FLEXURAL STRENGTH @ Max	0.585351101	**Mpa**
8	Flexural Strain	0.010911342	
9	Flexural Modulus at 1% Strain	240.89	**Mpa**
10	FLEXURAL MODULUS OF ELASTICITY	531.2971863	**N/mm²**

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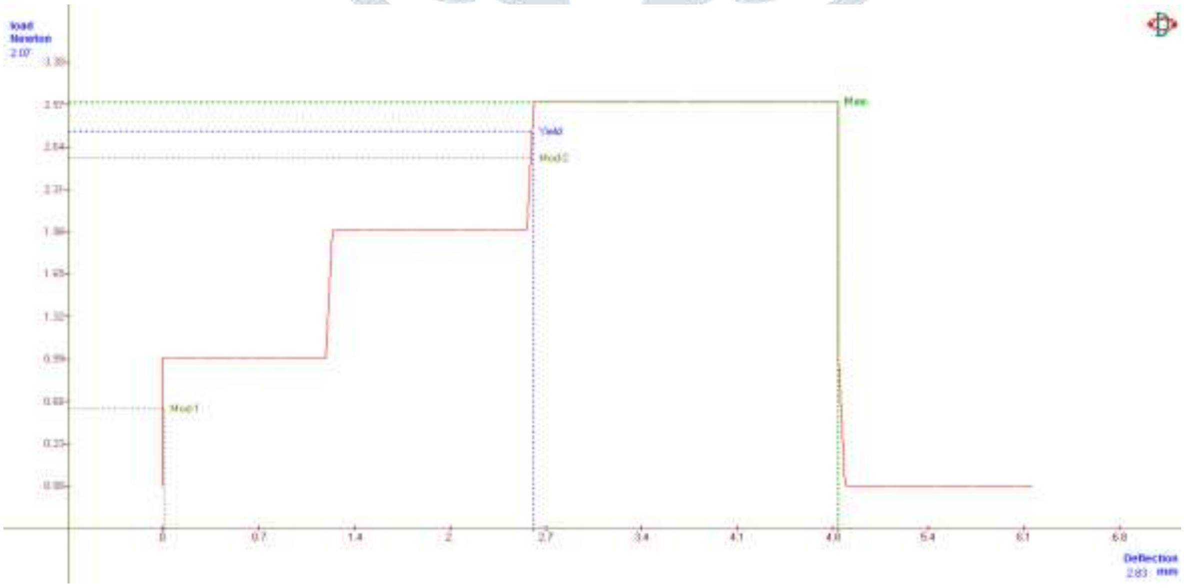

DISPLACEMENT

Graph:- 5.4 Load vs displacement graph of 50mm fiber size flexural tested specimen

Table: 5.4 Obtained average results of 50mm fiber size flexural tested specimen

Obtained Results

Sr. No.	Results	Value	Unit
1	Area	206.6580	**mm^2**
2	Yield force	36.34280648	**N**
3	Yield deflection	2.36	**mm**
4	Max force	4.0	**N**
5	Max deflection	2.8	**mm**
6	Flexural strength @ yield	2.32	**N/mm^2**
7	Flexural strength @ max	0.461981183	**Mpa**
8	Flexural strain	0.006116461	
9	Flexural Modulus at 1% Strain	208.35	**Mpa**
10	Flexural modulus of elasticity	527.8312554	**N/mm^2**

6 CONCLUSION

At last subsequent to testing the examples of the differentfiber variation examples of acacia indica the accompanying results are noted.

1. The results of the tensile tested specimens indicated that the 50mm fiber variant sample is showing the maximum tensile strength and can hold up to 4.71N/mm^2.
2. The results of the Flexural tested specimens indicated that the 30mm fiber variant sample is showing the maximum Flexural strength and can hold up to 0.58Mpa.Hence this composition can be evaluated for further testing and utilized for more engineering Applications.

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