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Mechanical Properties of Bauhinia Racemosa Fiber Reinforced With Polymer Composites

[1]R.Ramkumar [2]C.Ajitha, [3]K.M.Jayashri, [4]M.Lakshmi
1Assisant professor, Department of Mechanical Engineering ,Ultra college of Engineering and Technology for women
[2,3,4]UG, Scholar, Department of Mechanical Engineering, Ultra college of Engineering and Technology for women.
Corresponding Author *Email:* Jayakarthika95@gmail.com
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ABSTRACT

The tensile, flexural and impact properties of randomly oriented short Indian BAUHINIA RACEMOSA(Aati) Fiber / Polyester (IAFP) composites are described for the first time in this work. Composites were fabricated using Aati Fiber /polyester (IAFP) with varing weight percents of fiber. IAFP composites showed a regular trend of an increase in properties with fiber weight percent up to 50% . Tensile tests revealed that the tensile strength was about 18.8 MPa. The flexural strength was estimated to be around 34.1 MPa respectively. The analysis of the tensile, flexu ral and Water absorption test on IAFP composites displayed a optimu m fiber weight percent of 40%, in Tensile test and flexural test and 10% weight percent denotes less absorption of water.

Keywords: Bauhinia Racemosa Fiber, Aati Fiber, Tensile Strength, Flexu ral Strength, Water absorption test.

1. INTRODUCTION

The composite technology of a polymer matrix reinfo rced with man-made fibers such as glass, Kevlar, Carbon etc. has come of age especially with the advances in aerospace applications since 1950s. The developments in composite material after meeting the challenges of aerospace sector have cascaded down for catering to domestic and industrial applications. Composites, the wonder material with light-weight, high strength-to-weight ratio and stiffness properties have come a long way in replacing the conventional materials like metals etc. The material scientists all over the world focused their attention on natural composites reinforced with jute, sisal, coir, pineapple etc., primarily to cut down the cost of raw materials. Jute as a natural fiber has been traditionally used for making twines, ropes, cords, as packaging material in sacks & gunny bags, as carpet backing and, more recently, as a geo-textile material. But, latterly, a major share of its market has been eroded by the advent of synthetic materials, especially polypropylene. In order to save the crop from extinction and to ensure a reasonable return to the farmers, non-traditional outlets have to be explored for the fiber. Co mposites can be used as a substitute for timber as well as in a number of less demanding applications. Interest in using natural fibers as reinforcement in polymer matrices and also in certain applications as partial replacement of glass fibers has grown significantly in recent years for making low cost composite materials. Pothana et al. [1] analyzed the dynamic mechanical properties of banana fiber reinfo rced polyester composites with special reference to the effect of fiber loading, frequency and temperature. Rana et al. [2] fabricated natural fibers (sisal, kenaf, hemp, jute and coir) reinforced polypropylene composites processed by compression moulding using a film stacking method and analyzed the mechanical properties of the different natural

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fiber co mposites and compared. Idicula et al. [3] fabricated randomly oriented intimately mixed short banana/sisal hybrid fiber reinforced polyester composites and analyzed the dynamic and static mechanical properties of the natural fiber composites. Mathur [4] presented an overview of build ing materials from local resources with a particular attention on natural fibers based composites. Idicula et al. [5] investigated the thermal conductivity, diffusivity and specific heat of polyester/natural fiber (banana/sisal) composites as function of filler concentration and for several fiber surface treatments . K.J. Wong et al (6) studied the fracture behaviour of short bamboo fiber reinfo rced polyester composites is investigated. The matrix is reinforced with fibers ranging from 10 to 50, 30 to 50 and 30 to 60 vol.% at increments of 10 vol.% for bamboo fibers at 4, 7 and 10 mm lengths respectively. Fractured surfaces investigated through the Scanning Electron were carried out on composites made by reinforcing jo war as a new natural fiber into polyester resin matrix. The results of this study indicate that using jowar fibers as reinforcement in polyester matrix could successfully develop a composite material in terms of high strength and rigidity for light weight applications compared to conventional sisal and bamboo. V.S. Sreenivasan et al (8) presented the tensile, flexu ral and impact properties of randomly oriented short Sansevieria cylindrical fiber / polyester (SCFP) composites are described for the first time in this work. K. Ramanaiah et al (9) focused study to utilize waste grass broom natural fibers as reinforcement and polyester resin as matrix for making partially biodegradable green composites. Thermal conductivity, specific heat capacity and thermal diffusivity of composites were investigated as a function of fiber content and temperature. V.S. Sreenivasan et al (10) presented to improve the interfacial bond between Sansevieria cylindrica fibers (SCFs) and polyester matrix, chemical surface treatments have been performed on the fibers. Treatments including alkali, benzoyl peroxide, potassium permanganate and stearic acid were carried out to modify the fiber surface and find out the mechanical properties. In the present work, there has been a growing interest in utilizing Unique natural fiber as reinforcement in polyester composite for making lo w cost materials in recent years. Single natural fibers are selected to additive and reinforce polyester matrix to develop cost - effective and high performance composites because these fiber is strain compatible. Fibers having high cellulose content and low microfibrillar angle possess high tensile Again it can be observed that the elongations at break of.

2. EXPERIMENTAL

2.1 MATERIAL

IAF was separated from Aati stem, which is shown fig.1 and it was collected from farms around the city of Theni, Tamil Nadu, India. The matrix used for the investigation was commercially available unsaturated polyester, trade name Satyan polymer. Methyl ethyl ketone peroxide [MEKP] and cobalt naphthenate were used as curing catalyst and accelerator.

Fig.1 Aati tree – Fiber (stem) plant

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Hence stress is transferred fro m fiber to matrix. So single natural fibers can be selected to additive and reinforce polyester material and a combination of properties of fiber can be achieved in the additive composites. An attempt was made to use raw IAF as reinforcement in a polyester matrix. A detailed investigation was also carried out on randomly oriented short natural IAFP composites, especially on the effect of varying fiber weight percent. The tensile, flexural and water absorption performance of these composites were analysed. The optimum fiber weight percent for short IAFP composites were identified and reported.

2.2 Preparation of Composite S pecimen

The Compression Moulding Method was adopted for the fabrication of composites. The cleaned and dried IAF were chopped into lengths of 30 mm. A known weight of IAF of definite 30mm length of Aati fiber was randomly spread; Extreme care was taken to obtain a uniform distribution of fibers. A load of 10 kg was applied on the mild steel plates by compression to form a single sheet. This compressed sheet was placed in a mould with a size of 300mm x300mm x6mm. Then, 97.5% of unsaturated polyester resin was mixed with 2% M EKP (catalyst) and 0.5% cobalt naphthenate (accelerator). The prepared matrix solution was degassed before pouring. The degassed matrix solution was applied on the compressed sheet by using a brush, and air bubbles were removed carefully with a grooved roller. The mould was closed, and hydraulic pressure was applied until complete closure. The closed mould was kept under pressure for 24 h. The composites were fabricated in the form of a flat plate with a size of 300mm x 300mm x 6mm. Composite

3. Results and discussion

3.1 Tensile behavior

It is necessary to examine the suitability of Aati fiber as reinforcement prior to making of the composites. The tensile properties and density of Aati fiber along with those of some important natural fiber are presented in Table 1 for better comparison. From the Table 1 it is clearly evident that the tensile strength of Aati fiber is better than those of all available fiber shown in table. The tensile modulus is much higher than that of elephant grass fiber & banana fiber. The density of Aati fiber is lower than for established fiber like Banana, Coconut and sisal fiber which is an attractive parameter in manufacturing light weight material.

Table 1

Fibers	Density n(kg/m3)	Diameter µm)	Tensile strength (Mpa)	Tensile modulus (Gpa)	Elongation (%)
Palmy ra	1090	70-130	180-215	7.4- 60.4	7-15
Elephant grass	817	70-140	185	7.4	2.5
Aati	1450	80-300	227-700	9-20	1.85
Banana	817.53	70-400	185	7.40	2.50

Comparison between the tensile properties of Aati fibers and coconut sheath with other natural fibers

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Tensile test is done on the composite specimen prepared with the size of 246mm x 29mm x 3mm by using tensile testing attachment in the universal testing machine. The ultimate tensile stress for Aati fibers composites is 18.8 MPa. At 40% of Aatifiber composites. As the load increases, the deformation begins to increases. The composite deforms due to the breaking of fiber particles and the composite material breaks at the point of breaking load. The influence of the fiber weight percent on the tensile properties of short Aati fiber Polyester composites is shown from Fig 2.

Fig. 2.Tensile properties of IAFP composites at different fiber weight percents

3.2. Flexural Behavior

Flexural test is also known as bending test and is done on the composite material with size 100mm x 25mm x 3mm by using flexural test attachment in the universal testing machine. In the flexural test three point flexural loads is applied at center of the material. When the point load is applied, the specimen bends and subjected to bending moments. The maximum flexural strength attained for Aati fiber composites is 34.1 MPa at 40 %.

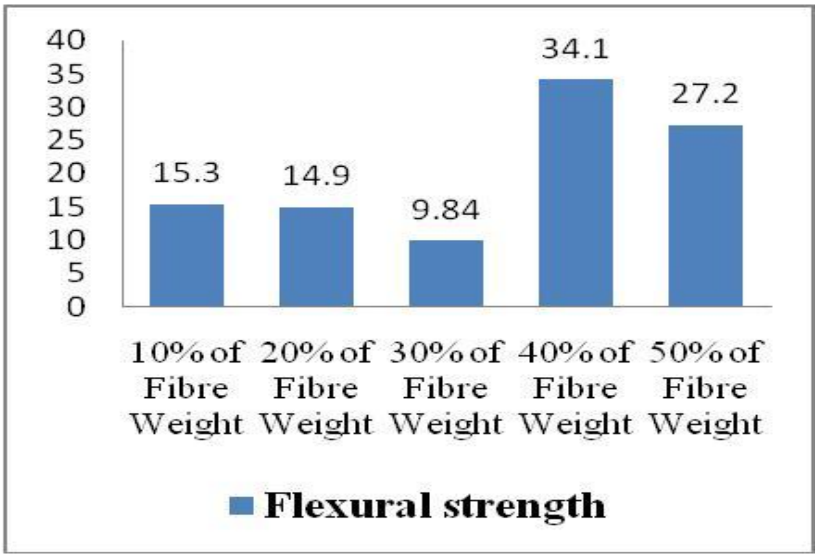

Fig. 3.Flexural properties of IAFP composites at different fiber weight percents

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3. 3 Water Absorption Test Properties

Water absorption test is used to determine the amount of water absorbed under specified conditions. Factors affecting water absorption include: type of plastic,additives used, temperature and length of exposure. The data sheds light on the performance of the materials in water or humid environments. Water absorption is expressed as increase in weight percent. Percent Water Absorption = [(Wet weight - Dry weight)/Dry weight] x 100. The water absorption test is done as per the ASTM D 570-99 standard. The composite material is then emerged in water at agreed upon conditions, often 23°C for 24 hours or until equilibrium. The weights are noted down after 24hrs for normal water shown in fig 4, for the hot water the specimen was immersed in the water at (50°C-100°C) for 2hrs shown in fig 5. The weights of the specimens was measured after keeping the speciments immersed in cold water about 24 hrs maintained at the same temperature shown in fig 6.

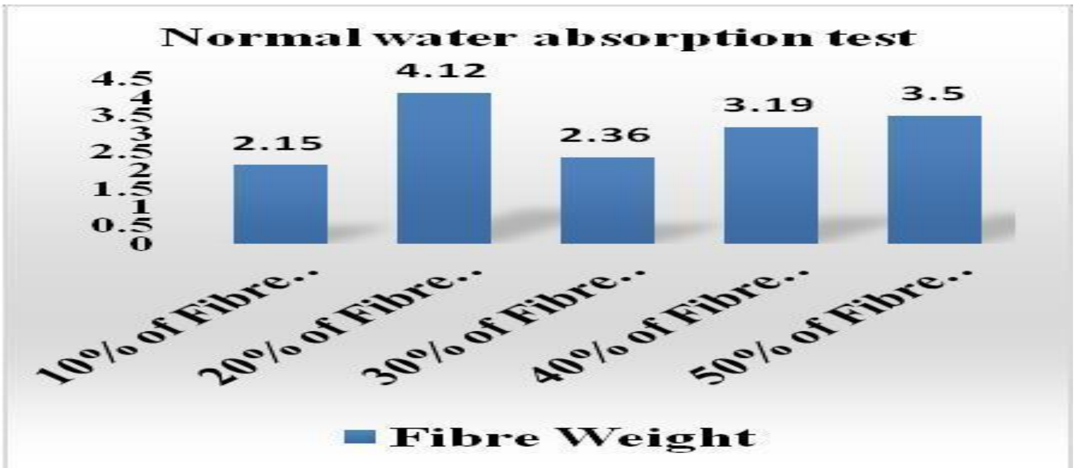

Fig.4 Normal Water properties of IAFP composites at different fiber weight percents

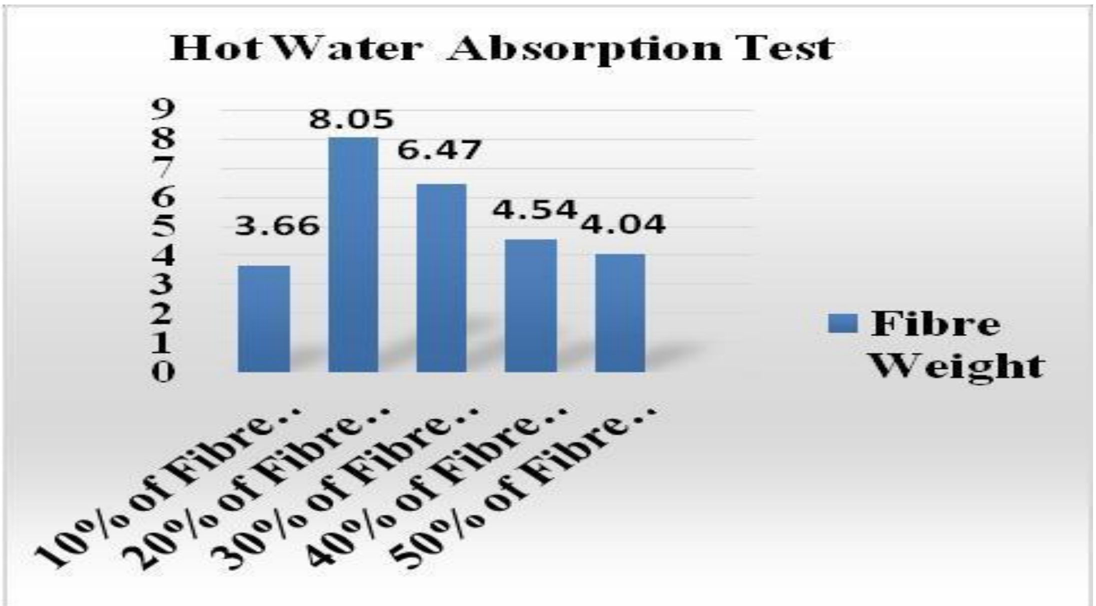

Fig.5 Hot Water properties of IAFP composites at different fiber weight percents

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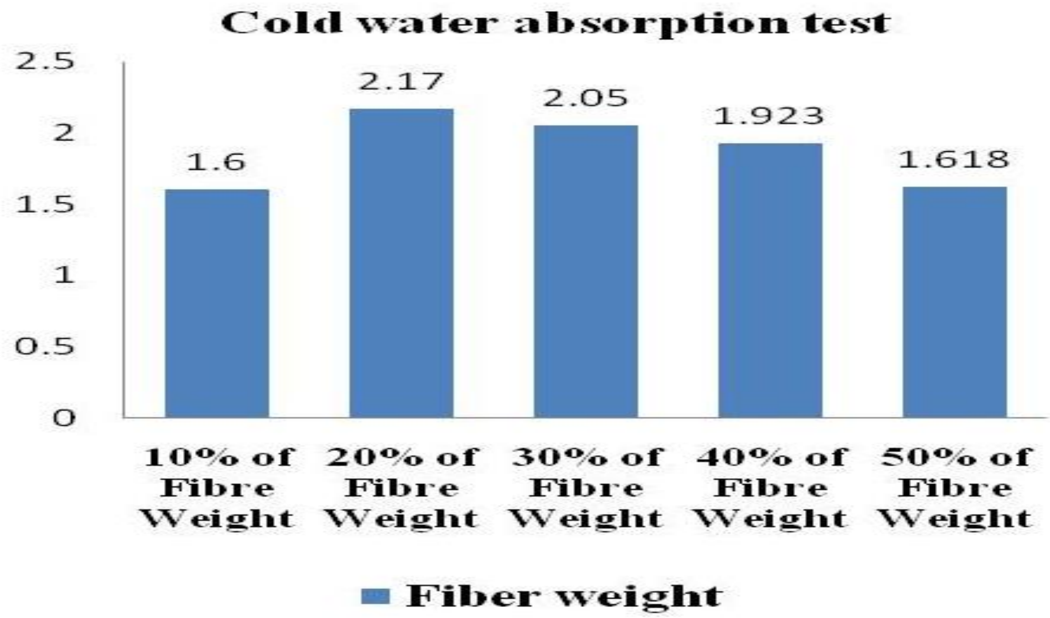

Fig.6 Cold Water properties of IAFP composites at different fiber weight percents

6. Conclusion

The process of extraction of Aati fiber is simple and results in Good quality, quantity and lengthy fiber useful for fabrication of large size components. The mechanical properties of Aati fiber reinforced with polyester composites are analyzed and compared with other natural fibers polyester composites. From the testing analysis of the Aati fiber composites, Two major conclusions were drawn from the test results. First, the tensile, flexural and Water absorption randomly oriented Aati fiber reinforced with polyester composites were found to be dependent on the fiber weight percent, indicating a optimum fiber weight percent 40%, and 10%respectively. Second, the tensile strength of Aati fiber reinforced with polyester composites were around 18.8 MPa. Flexural tests revealed that the flexural strength is approximately 34.1 MPa . In water absorption test all types of water absorbs less water content in 10% of fiber. Hence, the Aati fiber was extracted from an abundantly available agricultural resource, renewable, cheaper and due to the good mechanical properties of its reinforced composites identified from the investigation in the present research work, Hence the newly developed composite material can be used for application such as automobile interior parts, electronic packages, building construction, car bonnets and sport goods.

REFERENCES

1.Pothana L.A., Oo mmenb Z., and Tho masc S. (2003),'Dynamic mechanical analysis of banana fiber reinforced polyester composites', Composites Science and Technology, Vol. 63, pp.283– 293.

2.Rana A.K., Mandal A. and Bandyopadhyay S.(2003), 'Short jute fiber reinforced polypropylene composites: effect of compatib iliser, impact modifier and fiber loading', Co mposites Science and Technology, Vol.6, pp.801–806.

3.Maries Idicula,S.K.Malhotra ,Kuruvilla Joseph,Sabu Thomas, (2005),'Dynamic mechanical analysis of randomly oriented intimately mixed short banana/sisal hybrid fiber reinforced polyester composites',Co mposites Science and Technology,Vo l.61, pp.1077 - 1087.

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4. Mattone R.(2005), 'Sisal fiber reinforced soil with cement or cactus pulp in bahareque technique', Cement & Concrete Co mposites,Vo l.27, pp. 611–616.

5.Idicu la M., Abderrahim Boudenne A., Umadevi L., Ibos L., Candau Y. and Thomas S.(2006),'Thermophysical properties of natural fiber reinforced polyester composites', Composites Science Technology, Vo l.66, pp.2719–2725.

6.Mathur V.K.(2006), 'Co mposite materials fro m local resources', Construction and Build ing Materials,Vo l.20, pp.470–477.

7.Asasutjarit C., Hirunlabh J., Khedari J., Charoenvai S., Zeghmat i B and Cheul Shin U. (2007),'Development of coconut coir-based lightweight cement board', Construction and Building Materials, Vo l. 21, pp. 277– 288.

8.Facca A.G.,Kortschot M.T.and Yan N.(2007), 'Pred icting the tensile strength of natural fiber reinforced thermoplastics', Co mposites Science and Technology,Vol.21, pp.2454–2466.