International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 01, January-2016

Mechanical Characterization of Coir Fiber Reinforced Epoxy Composites with and Without Tio_2 Filler

Vijay B R
Assistant Professor,
Mechanical Engineering Department
New Horizon College of Engineering,
Bangalore – 560103, Karnataka, India

Dr. Srikantappa A S
Principal,
Cauvery Institute of Technology
Mandya, Karnataka, India

Abstract - Abstract: **Natural fiber-reinforced polymer composite is rapidly growing both in terms of their industrial applications and fundamental research. They are renewable, cheap, completely or partially recyclable and biodegradable. The present paper reports to develop a coir (natural) fiber reinforced epoxy composites with and without TiO_2 as filler material and evaluate its tensile strength and flexural property.**

Key Words: Coconut coir, Epoxy, Tensile, Flexural and TiO_2 filler.

I INTRODUCTION:

Natural fibers as reinforcement have attracted the attention of researchers recently because of their advantages over other established materials. They are fully biodegradable, environmentally friendly, renewable, cheap, and abundantly available and have low density.

Natural fiber composites include coir, jute, cotton, bamboo, hemp etc. These fibers contain lingo cellulose in nature. The natural fibers can be used to reinforce both thermosetting and thermoplastic matrices. It has been found that these natural fiber composites possess good mechanical properties with low specific mass, better electrical resistance, good thermal and acoustic insulating properties. Despite the attractiveness of natural fiber reinforced polymer matrix composites they suffer from lower modulus, lower strength & relatively poor moisture resistance compared to synthetic fiber reinforced composites such as glass fiber reinforced plastics.

The present study involves the study of composites made of coconut fiber, TiO_2 filler particle and epoxy resin matrix. The objective of this paper is to study the tensile and flexural properties.

II LITERATURE REVIEW:

Fibre reinforced polymeric materials have been widely used due to their superior properties, low density, and manufacturing flexibility. Numerous applications have been allocated for these materials in aerospace and automotive industries such as gears, seals, bearings, cams etc. In order that these components satisfactorily perform under loading conditions, they should have good mechanical, tribological and machining properties. Number of scientists and researchers are carrying out work to develop newer material system and characterize them for their various properties so that they can be selected for specific end use. A brief review of the literature is presented below throwing more light on the above.

Girisha et.al[1] studied Sisal/Coconut Coir Natural fibers–epoxy composites: Water absorption and mechanical properties. They found that the tensile and flexural properties of Natural fiber reinforced Epoxy composite specimens were found to decrease with increase in percentage moisture uptake.

K.Natarajan et al[2] have shown that the Mechanical and Morphological Study of Coir Fiber Reinforced Modified Epoxy Matrix Composites. The result from this work has demonstrated that coir fibers can be considered as potential reinforcing material and the composites so prepared be used in low load bearing applications.

S.P.Venkatesan, et al[3] studied Mechanical Testing of Hybrid Composite Material (Sisal and Coir). They found that the tensile strength of the discontinuous fibre composite is higher at 20% sisal and 20% coir having 3mm fibre length of composites. The flexural strength & impact strength of the composite is higher at 20% sisal and 20% coir having 3mm fibre length of composites.

B.H.Manjunath et al[4] studied the influence of fiber/filler particles reinforcement on epoxy composites. They found that tensile and flexural properties of the composites increased with increase in filler particle and fiber content. The relation between stress & strain found to be linear the moisture absorption increases with the fiber, filler content and duration of immersion in water.

L. Q. N. Tran et la[5] studied about Coir fiber composites: From fiber properties to interfacial adhesion and mechanical properties of composites. They found that the interfacial adhesion of both untreated and treated fibres with maleic anhydride grafted polypropylene and polyvinylidene fluoride are higher than in case of polypropylene. When comparing untreated and treated fibres, the interfacial strength of the alkali treated fibre composites is increased.

Substantial research work has been carried out to investigate the mechanical behavior of natural fiber reinforced epoxy composite with and without addition of fillers. Though number of fillers has been tried out, the effect of adding TiO^2 filler on the mechanical behavior of fiber reinforced polymeric composites is not much reported. In this context, the present work is carried out with the main objective of characterizing the mechanical characterization of coir fiber reinforced epoxy composites with and without the addition of TiO_2 filler.

III EXPERIMENTAL METHOD

MATERIALS:

Table 1. Composite selected for study

Material	Matrix	Filler
Coir –Epoxy (C-E)	60	-
TiO_2 Filled(C-E1)	57	3

Specimen Preparation

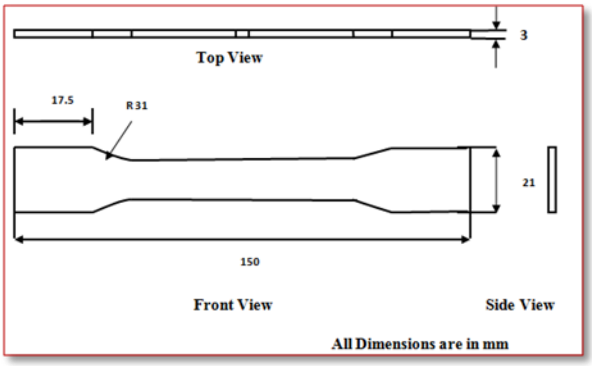
A hand layup procedure was adopted for making C-E composites. The reinforcement material consists of coir fibers which are randomly oriented. LY 556 epoxy was used as the resin for the matrix material with HY 951 grade room temperature curing. The layup procedure consisted of placing a glass surface mat to give smooth surface finish to the top and bottom layers of the cured composite. On this, a resin hardener mix prepared for this purpose was smeared. Over this, another layer of fabric was laid down and the resin was spread once again. The process was repeated till all the 8 layers of fabric (arrived at by trial experiments) made ready for the layup, were used up in the stacking arrangement. Use of spacers of about 3mm thickness helped in obtaining laminates of the required thickness following final curing.

IV MECHANICAL TESTING:

After fabrication the specimens were subjected to various mechanical tests as per ASTM standards. The mechanical tests that were carried out are tensile test and flexural test.

TENSILE TEST:

Test was conducted on the Hounstill's universal testing machine. This testing machine has constant rate of cross head movement and comprises fixed member, movable member and grips. Fixed grips are rigidly attached to the fixed and movable members of the testing machine. Self aligning grips are attached to the fixed and movable members of the testing machine in such a manner that they will align as soon as any load is applied. Tensile test was conducted according to ASTM D-638. Specimens were prepared as per the ASTM standard and schematic of the same is shown in figure. Universal testing machine is calibrated before use. Specimen plate is enclosed between the grippers, the distance between the grips is 115m. Load is slowly applied at the rate of 5mm/min. At some load the specimen gets fractured. The Load corresponding to deformation is noted down. Then stresses at this load and corresponding deformation were established. Similar procedure is repeated for specimen of 3% TiO_2 filler filled composites.



FLEXURAL TEST:

The test specimens were prepared according to ASTM D790. Most commonly, the specimen lies on a support span and the load is applied at the centre by the loading nose, thus producing three point bending at a specified rate. The parameters for this test are the support span, the speed of loading, and the maximum deflection for the test. The test was carried out at a slow speed and continued till the material has achieved 5% deflection or breaks. The load at fracture is noted. Flexural strength and modulus was established.

V RESULT AND DISCUSSION:

TENSILE TEST:

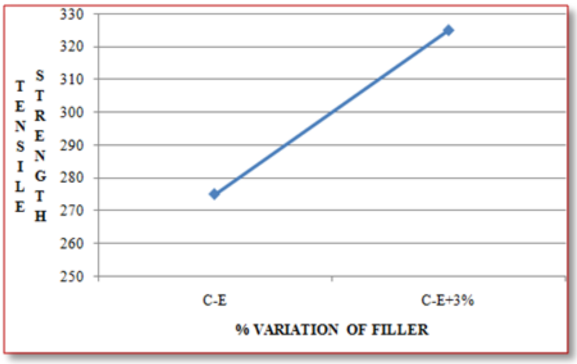


Fig 5.1. Tensile Strength Vs Percentage of filler

In this study, percentage of tensile strength at fracture of unfilled and TiO_2 filled coir fiber reinforced epoxy composites are plotted as a function of TiO_2 filler and the same is shown in Fig. It is observed that, the coir fiber reinforced epoxy composites with 3% TiO_2 filler has highest tensile strength when compared with coir fiber reinforced epoxy composite without TiO_2 filler.

FLEXURAL TEST:

Fig shows the variation of flexural strength as a function of TiO_2 filler. Coir fiber reinforced epoxy composite with 4% TiO_2 additives showed the maximum flexural strength when compared with unfilled one.

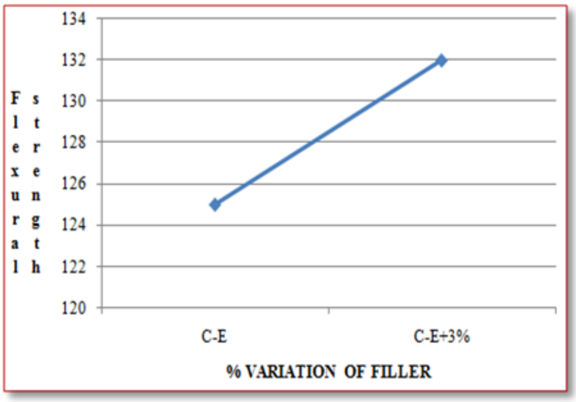


Fig 5.2. Flexural Strength Vs Percentage of filler

VI CONCLUSION:

Coir fiber reinforcement and the addition of fillers to the epoxy matrix generally improved the mechanical properties of the composites. The following conclusions are made:

Coir fiber reinforced epoxy composite with 4% TiO_2 filler content showed the maximum tensile strength and flexural strength when compared with unfilled one.

VII REFERENCE:

[1] Girish.C, Sanjeevamurathy, GuntirangaSrinivas "Sisal/Coconut Coir Natural Fibers- Epoxy Composites: Water Absorption and Mechanical Properties". IJEIT, Sep2012.

[2] K. Natarajan, Padma. C. Balasubramanya "Mechanical And Morphological Study Of Coir Fiber Reinforced Modified Epoxy Composites". IJEIT, Dec 2013.

[3] G.Velmurugan, S.P.Venkatesan, P.V.Prakash, N.Sathishkumar, N.Vijayakumar "Mechanical Testing Of Hybrid Composite Material (Sisal/Coir)". ISSN, July 2014, 2250-3153.

[4] B.H.Manjunath, Dr. K PrahladaRao "Infuence Of Fiber/Filler Particles Reinforcement On Epoxy composites". ISSN:2248-9622, May-Jun 2013,pp01147-1151.

[5] L.Q.N.Tran, C.Fuentes,C.Dupont-Gillain, A.VanVuure, I. Verpoest "Coir Fiber Composites: From Fiber Properties To Interfacial Adhesion And Mechanical Properties Of Composites". ECCM15, 24-28, June 2012.

[6] A.Karthikeyan,K.BalamuruganAndA.Kalpana "The Effect Of SLS Treatment On Tensile Property Of Coconut Fiber Reinfored Epoxy Composites". IJST, 2014, pp 157-166.

[7] Arpitha G.R, Sanjay M.R, L.LaxmanaNaik, B.Yogesha "Mechanical Properties Of Epoxy Based Hybride Composites Reinforced with Sisal/SIC/Glass Fibers. IJEIT, Aug-Sep,2014.

[8] A. Karthikeyan, K.Balamurugan and A. Kalpana "The new approach to improve the impact property of coconut fiber reinforced epoxy composites using sodium laulryl sulfate treatment". JSIR, Feb 2013, pp. 132-136.

[9] U.S.Bongarde, V.D.Shinde "Review on natural fiber reinforcement polymer composites". IJEST, March 2014