# Effects of Different Natural Fiber Mat with Short Coir Fiber Reinforced Polymer Composites

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**ABSTRACT-Hybridization of Natural/Mat Fibre Reinforced Polymer Composites Has Been Developing to Build Their Applications in The Field of Engineering and Technology. Present Study Deals with Recent Developments of Natural Fibre Reinforced Polymer Hybrid Composites Made by Hand Lay-Up and Compression Moulding Techniques. This Investigation Is to Understand anOutline of the Results Presented On the Incorporation of Natural Fibre with MatFibre Reinforced Polymer Composites. It Focuses the Attention in Terms of Mechanical Characteristics of Hybrid Composites and Related Studies Have Cited. Hybrid Composites Made of Three Different Mat Fibres with Coir Fibre Are Less Widespread Comparable to Natural/Mat Fibre, Yet It Prompts Grow The Applications.**

## I, INTRODUCTION

A composite is combination of two materials in which one of the materials,called the reinforcing phase, is in the form of fibres, sheets, or particles and is embedded in the other materials called the matrix phase. The reinforcing material and the matrix material can be metal, ceramic, or polymer. Composites typicallyhave a fibre or particle phase that is stiffer and stronger than the continuous matrix phase and serve as the principal load carrying members. The matrix acts as a loadtransfer medium between fibers, and in less ideal cases where the loads are complex, the matrix may even have to bear loads transverse to the fiber axis. Thematrix is more ductile than the fibers and thus acts as a source of composite toughness. The matrix also serves to protect the fibers from environmental damage before, during and after composite processing. When designed properly,the new combined material exhibits better strength than would each individual material. Composites are used not only for their structural properties, but also forelectrical, thermal, tribological, and environmental applications. Jartiz stated that"Composites are multifunctional material systems that provide characteristics notobtainable from any discrete material. They are cohesive structures made by physically combining two or more compatible materials, different in compositionand characteristics and sometimes in form". Kelly very clearly stresses that the composites should not be regarded simple as a combination of two materials. In the broader significance; the combination has its own distinctive properties. In terms of strength to resistance to heat or some other desirable quality, it is betterthan either of the components alone or radically different from either of them. Beghezan defines as "The composites are compound materials which differ fromalloys by the fact that the individual components retain their characteristics but are so incorporated into the composite as to take advantage only of their attributes and not of their short comings", in order to obtain improved materials. Van Suchetclan explains composite materials as heterogeneous materials consisting of two or more solid phases, which are in intimate contact with each other on a microscopic scale. The following are some of the reasons why composites are selected for certain applications: High strength to weight ratio (low density high tensile strength).

## II. LITERATURE REVIEW

Andressa Cecília Milanese et al (2012) had used fiber as Woven sisal fiber and resin as Synthetic Phenolic Resin (cascophen) under gone tests like Tensile test,Flexural test . He cocluded that Woven sisal fabric was submitted to heat treatment before mouldings and the influence of moisture content of fiber on thecomposites were removed.It is treated with thermal treatment for 72 hrs at 60ºC.Experimentally the result shows that tensile strength of 25MPa and flexuralstrength of 11Mpa Athijayamani et al (2010) Sisal fiber,Roselle fiber,Glass fiberand resin as Polyester and test were Tensile test ,Impact test and Flexural test and finally conclusion are Length of the fiber 50-150mm.Composite were prepared by varying fiber loading (10-30 wt %) .The Length of glass fiber - 50mm .Tensile,

impact and Flexural strength of glass/polyester composite with10%wt and 50mm length having better mechanical properties .Hybrid composite having Weight fraction 30%wt and 150mm length of Tensile and Flexural strength is higher value .Impact value of Roselle/sisal hybrid composite 10wt%-100mm is having better value Athijayamania et al (2009) were used Roselle fiber ,Sisal fiber and resin as Polyester and under gone test are Tensile test ,Flexural test ,Impact test and conclusion made by them are Dry and wet conduction Roselle and sisal polyester at a ratio of 1:1 .The various weight (10-30wt%) and length (50- 150mm) .The composite specimen to be used for moisture absorption test 12 were first dried in an oven at 50°C .Then these conditioned composite specimens wereimmersed in distilled water at 30°C for about 5days .

## IV, BAMBOO FIBER

Bamboo is from a group of the woody perennial evergreen plant in the true grass family poaceae and sub-family bambuseae and it is considered one of the fastest-growing plants in the world. Generally, bamboo has two patterns during growth namely clumping and running. The clumping bamboo species tend to grow and spread slowly as the pattern of the rhizomes is to simply expand the root mass gradually similar to ornamental grass while the running bamboo needscare even during cultivation due to its potential and aggressive behaviour, (Sinhaand Malik, 2011)

Bamboo Fiber

## V. COTTON FIBER

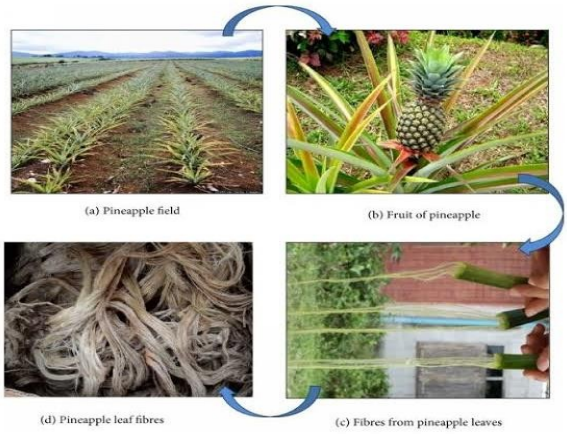
The fiber king cotton is a single-cell fiber obtained from the seeds of cotton plants belonging to the Malvaceae family. Cotton is the backbone of textile applications. Cotton is a soft white fibrous substance and is a natural fiber knownfor its comfort and durability. Leaf and best fibers are very important but they can't be compared with textile fibers, seed fibers, and cotton. As cotton has someunique structure, it can absorb water up to 2.7 times its weight. India stands second in producing cotton after China. Out of the total cultivated area, cotton grown area occupies 3% in the world. India has its unique position in producing cotton and is also one of the main exports of cotton yarn and garments. (Daga 2012) the cotton plant has flowers in white and the flowers turn purple after twodays of blooming while its length ranges from 3/8" to 2".

Cotton Fibre

## VI. PINEAPPLE FIBER

Pineapple is one of the most important commercially grown fiber crops sinceit yields fruit and textile fiber both. Pineapple is a common tropical plant, which

belongs to the family of Bromelia. While most Bromeliads grow on trees, the pineapple is a ground fruit. This plant is native to the southern part of Brazil and Paraguay. The quality of the pineapple which is used for extraction of fiber is different from what is grown as a fruit. The leaves of a fruit bearing plant also yield fiber; however, they do not yield good quality fiber. Pineapple plants, with long leaves, specially cultivated for its fiber give the finest quality of pineapple leaf fiber.




Pineapple Fiber

## VII. COIR FIBER

Coir is extracted from coconut husks. The fibers are separated, spun into yarn, and woven into rugs, ropes, floor coverings, and many other kinds of products. There are traditional and modern methods of coir fiber extraction, and these vary according to where the coir is being produced. In the traditional practice of coir fiber extraction, the husks are separated from the coconuts and soaked in lagoons or brackish waters for up to 10 months. This method is very demanding and time-consuming. While submerged, the husks undergo anaerobic fermentation, which causes them to soften and separate. Then, the fibers are washed, dried, and cleaned by hand. This traditional retting process yields the highest quality white fiber, which can be used for spinning and weaving.

Coir Fiber

## VIII. EPOXY RESIN AND HARDENER

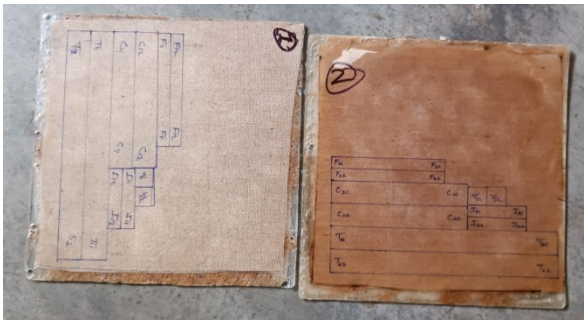
In this present work Epoxy resin is used as matrix material (LY 556).Epoxyis a thermosetting peroxide polymer that cures (polymers and cross links) when mixed with a catalyzing agent or “hardener”. Most common Epoxy resin are produced from a reaction between epichlorohydrin and biphenyl-A. The reactionproduct is high in viscosity and can either undergo further reaction process to yield a lower viscosity resin. Epoxy resin is often modified using other product to improve some measured property of the final product such as toughness or sensibleness. Epoxy resin and additives contribute to the viscosity of the system and to the shrinking charactertics. The amount of the fillers and diluents will impact both the physical and handling properties of the resin system. Epoxy resin are part of a two component thermo-set plastic that requires an Epoxy hardener to determine the majority of the handling and physical properties of the base. Theuse of several variations of unmodified and modified Epoxy resin with 23 the same Epoxy hardener will produce some variations in their property; however, the Epoxy hardener is the primary factor in the base property.

## IX. SPECIMEN PREPARATION Natural Fiber Reinforced Composite

In this study compression molding method was used to make the composite laminates. The specimens were prepared for 40wt% reinforcement, and the percentage of different fibers was modified to fabricate different composites. Table 2 lists the stacking sequences. The mold surfaces were first coated with a releasing agent (wax) and fabric layers were laid one by one on the flat mold forthe fabrication of composite materials, and then the epoxy resin was applied on each layer of fabrics and evenly distributed using brushes followed by hand lay-up. The top coat was placed on the laminated layers after the hand lay-up. Then the mold was closed and 1500 psi (10.34 MPa) pressure was applied on it. Finally the fabrics have been fully cured with matrix the temperature of 80°C for 1 hour was applied. After that, the laminates were taken out of the mold and cut into desired specimen dimensions.

| S.No | Weight Percentage (Wt%) | Skin layers |
|---|---|---|
| 1 | 40wt % Constant Coir Fiber | Pineapple Mat |
| 2 | 40wt % Constant Coir Fiber | Bamboo Mat |
| 3 | 40wt % Constant Coir Fiber | Cotton Mat |

Laminate stacking layers



Composite Sample

Specimen

## X. MECHANICAL TESTING

After fabrication the test specimens were subjected to various mechanical testing as per ASTM standards. The mechanical tests that carried out are tensile test, flexural test, impact test. The specimen size and shape for corresponding tests are as follows.

Tensile Test

ASTM D3039 tensile testing is used to measure the force required to break a composite specimen and the extent to which the specimen stretches or elongatesto that breaking point. The data is often used to specify a material, to design parts to withstand application of force and as a quality control check of materials. Since the physical properties of many materials at temperatures that stimulate the intended end user environment. The most common specimen for ASTM D3039 has a constant rectangular cross section, 25mm wide and 250mm long. Optionaltabs can be bonded to the ends of the specimen to prevent gripping damage.

Tensile test of the specimen

Impact Test

## XI. RESULTS AND DISCUSSIONS

This chapter presents the mechanical properties of the Cotton fiber / Epoxy, composites prepared for this present investigation. Details of processing of thesecomposites and the tests conducted on them have been described in the privies chapter. The results of various characterisation tests are reported here. These includes evaluation of tensile strength, flexural strength, impact strength has beenstudied and discussed.

TENSILE TEST

Tensile testing of specimen prepared according to ASTM D3039 type two sample was carried out, using electronic tensile testing machine with cross head speed of2mm/min and a gauge length of 100mm. The tensile modulus and elongation at peak of the composites were calculated from the stress strain curve. Three specimens were tested for each set of samples and mean values were reported.

| | Pineapple Mat +Coir (40wt %) | Bamboo Mat+Coir (40wt %) | Cotton Mat + Coir(40wt %) |
|---|---|---|---|
| Tensile strength(Mpa) | 17.73 | 28.28 | 29.67 |

FLEXURAL TEST

The flexural test was performed by the three point bending method according to ASTM D790, and cross head speed of 1mm/min. Three specimens were tested, and the average was calculated. The specimen was freely supported by a beam, the maximum load was applied in the middle of the specimen, and the flexural module is calculated from the slope of the initial portion of the load deflection.

| | Pineapple Mat+ Coir (40wt%) | Bamboo Mat+Coir (40wt %) | Cotton Mat +Coir (40wt %) |
|---|---|---|---|
| Flexural test(Mpa) | 52.44 | 164.73 | 125.67 |

IMPACT TEST

The impact property of a material shows its capacity to absorb and dissipate energies under impact or shock loading. The impact energy level of the composites depends upon several factors such as the nature of the constituents, construction and geometry of the composites, fiber arrangement, fiber/matrix adhesion, and test conditions. The matrix fracture, fiber matrix debonding, fiber breakage and fiber pull out are important modes of failure in the fiber compositesdue to impact loading. The applied load, transferred by shear to the fibers, may exceed the fiber/matrix interfacial bond and debonding may occur. The frictionalforce along the interface may transfer the stress to debond fiber.

| | Pineapple Mat + Coir (40wt%) | Bamboo Mat+Coir (40wt %) | Cotton Mat +Coir (40wt %) |
|---|---|---|---|
| Impact strength in J/mm$^2$ | 0.60 | 0.70 | 0.27 |

WATER ABSORPTION TEST

It is clear composites absorb water very rapidly at the initial stage, and later a saturation level was attained without any further increase in water absorption. In the case of low fiber content, higher water absorption,14.57%, may be due to poor wet ability and adhesion between fiber and matrix, and defects such as voids. Both the initial rate of water absorption and the maximum water uptake increase as the void content increases. The hydrophilicity is responsible for the higher percentage of water uptake in natural fiber composites due to the present of lignin and hemicelluloses component. Hemicelluloses are mainly responsible for the water uptake, although no crystalline cellulose and lignin also play an important role in the process. The water swells the cell wall of the fiber until its saturation. Next, it goes on to occupy the void spaces of the fiber,and this free water does not cause further swelling

| | PineappleMat +Coir (40wt%) | Bamboo Mat+Coir (40wt %) | Cotton Mat +Coir (40wt %) |
|---|---|---|---|
| % of Water Absorption | 15. 3 | 18.65 | 14.5 |

COMPRESSION TEST

The compressive strength values for mat/ coir fiber composites. Buckling occurswhen material's fibers open up or become misaligned, causing the link to break.As long as the beam remains straight, compression testing that uses a long column straight beam with a rectangular cross-section applied to a compressive axial load can be analyzed using tension or compression load theories. However, buckling theory must be applied if the deflection suddenly becomes large and leads to catastrophic failure.

| | Pineapple Mat + Coir (40wt %) | Bamboo Mat+Coir (40wt %) | Cotton Mat +Coir (40wt %) |
|---|---|---|---|
| Compression test(Mpa) | 5.24 | 16.72 | 13.21 |

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