NATURAL COMPOSITE MATERIAL USING MUSA PARADISIACA PSEUDO STEM

V.RAJIVE

Assistant professor, Dept of Mechanical Engineering, Apollo College of engineering, Chennai, Tamil Nadu ,India

---***---

Abstract - : Natural fiber composite is obtained from nature in the form of leaf, seeds, tree, fruit wastage from these parts are used for manufacture of composite materials to deliberately combined to from heterogeneous structures with desired properties .This is also called as reinforced polymer composite materials. Guard rails are easily manufacture using Natural fiber composite. Before scientists have created many natural fibers from different materials, they also determined physical properties of these composite materials. This composite materials in continuous of above I have create the composite material using the fiber of Musa paradisica and I have found the characterizes like(tensile strength, hardness, water aberration ,and flexural rigidity)of the composite materials this materials find usage in the manufacture of play wood, automobile body, construction board, insulation board ,flooring and manufacturing of chair and seat etc .This Musa paradisicaisin abundant is available it is weight less material, and has desired strength, low specific gravity.

Key Words: Natural fiber (Musa paradisiaca) ,Epoxy resin ,Hardener, Patterns.

1. INTRODUCTION

1.1. Overview of Composites

Over the last three decades composite materials, plastics and ceramics have been emerging as dominant materials. The volume and number of application of composite materials have grown steadily, penetrating and conquering new markets relentlessly. The efforts to produce economically attractive composite components have resulted in several innovative manufacturing techniques currently being used in the composite industry. It is obvious, especially for composites, that the improvement in manufacturing technology alone is not enough to overcome the cost hurdle. It is essentially that there is an integrated effort in design, materials, process, tooling, quality assurance, manufacturing and even program management for composites to become competitive with metals.

The composites industry has been begun to recognize that the commercial applications of composites promise to offer much larger business opportunities than the aerospace sector due to the sheer size of transportation industry. For certain applications, the use of composites rather than metals has in fact resulted in savings of both cost and weight. Some examples are cascades for engines, curved fairing and fillets, replacement for welded metallic parts, cylinders, tubes, ducts, blade containment bands etc. Composites are now extensively being used for rehabilitation strengthening of pre-existing structures that have to be retrofitted to make them seismic resistant, or to repair damage caused by seismic activity. Unlike conventional materials (eg. Steel), the properties of the composite material can be designed considering the structural aspects. The design of a structural component using composites involves both material and structural design.

1.2. Hybrid Composite Materials

Hybrid composite are more advanced composites as compared to conventional FRP composites. Hybrid can have more than one reinforcing phase or a single reinforcing phase with multiple matrix phases.

They have better flexibility as compared to other fiber reinforced composites. Normally it contains a high modulus fiber with a low modulus fiber. The high modulus fiber provides the stiffness and load bearing qualities, whereas the low modulus fiber makes the composite material more damage tolerant and keeps the material cost low. The mechanical properties of a hybrid composite can be varied by changing volume ratio and stacking sequence in different plies.

There are several types of hybrid composites characterized as follows.

1. Interplay or Tow-by-Tow, in which tows of the two or more constituent types of fiber are mixed in a regular or random manner.
2. Sandwich hybrids, also known as core shell in which one material is sandwich between two layer of another.
3. Interplay or laminated, where alternate layers of the two or more materials are stacked in a regular manner.

1.3. Fiber Reinforcement

Common fiber reinforcing agents include asbestos, carbon / graphite fibers, beryllium carbide, beryllium oxide, molybdenum, aluminum oxide, glass fibers, polyamide, natural fibers etc. similarly common matrix materials include epoxy, phenolic, polyester, polyurethane, poly etherether ketone (PEEK), vinyl Ester etc. Among these resin materials, PEEK is most widely used. Epoxy which has higher adhesion and less shrinkage than PEEK, comes in second for its high cost.

1.4.Fibers

Fibers are a class of hair like material that are continuous filaments or are in a discrete elongated piece, similar to pieces of thread. They can be spun into filaments, thread, or rope.

They can be used as a component of composites materials. They can also be matted into sheets to make products such as paper or felt. Fibers are the principle constituent in fiber reinforcement composite. They occupy the largest volume fraction in a composite structure and share the major load acting on it. Proper selection of the fiber, fiber volume fraction, fiber length and orientation of the fiber is very important in composites.

1.5 Natural Fiber Reinforcement Composites

The interest in natural fiber-reinforced polymer composite materials is rapidly growing both in terms of their industrial applications and fundamental research. They are renewable, cheap, completely or partially recyclable and bio-degradable. Plants such as flax, cotton, jute, sisal, kenaf, pineapple, ramie, bamboo, banana, etc., as well as wood, used from time immemorial as a source of lignocelluosic fibers, are more and more often applied as the reinforcement of composites.

Their availability, renewability, low density, and price as well as satisfactory mechanical properties make them an attractive ecological alternative to glass, carbon and man-made fibers used for the manufacturing of composites. The natural fiber-containing composites are more environmental friendly, and are used in transportation (automobiles, railway coaches, aerospace), military applications, building and construction industries (ceiling paneling, partition boards), packaging, consumer products, etc.

2. EXPERIMENTAL PROCEDURES

2.1 List of Components

1. Sisal and mudar fibers.
2. Resin (epoxy resin).
3. Hardener (tri ethylene tetra amine (teta)).
4. Naoh.
5. Adhesive sheet and other needed d materials

2.2 BananaFibre

Banana plant not only gives the delicious fruit but it also provides textile fiber, the banana fiber. It grows easily as it sets out young shoots and is most commonly found in hot tropical climates. All varieties of banana plants have fibers in abundance. These fibers are obtained after the fruit is harvested and fall in the group of bast fibers. This plant has long been a good source for high quality textiles in many parts of the world, especially in Japan and Nepal.

2.3 Treated Fiber

Processing involves grinding the feathers and separating them into fiber and quill fractions. All examined quill fractions were composed of both inner and outer quill. Details on how the feathers are processed technique are proprietary. Sample was cut by hand into fiber and quill fractions. The fiber fraction was then chopped to achieve 50 mm or less in length. Then the fiber is treated with NaOH and then dried under room temperature for 4 - 6 hours.

2.4POLYMER: EPOXY RESIN:

Epoxy resin (Araldite LY 556) made by CIBA GUGYE Limited, having the following outstanding properties has been used.

Table 1 Characteristic and Properties of Polyester

CHARACTERISTICS / PROPERTIES	STATUS
Flexural strength	Good
Tensile strength	Good
Percentage Elongation	Good
Water absorption capacity	Good
Hardness	Good
Pot life	4 – 7 minutes
Working time	20 – 30 minutes
Shelf life	18 – 24 months
Catalyst	Methyl Ethyl ketone peroxide
Cure time	6 – 8 hours.

Table 2 Physical properties of banana and carbon fibers

Physical properties	Banana fiber
Density (kg/cm^3)	1.35
Tensile Strength (MPa)	54
Young's Modulus (GPa)	3.48
Flexural Modulus (GPa)	2-5
Moisture Absorption (%)	10-11
Specific Modulus (approx.)	9
Elognation (%)	1.5-9
Cellulose (wt %)	63-67.6

Physical properties	Banana fiber
Hemi-cellulose (wt %)	10-19
Lignin (wt %)	5

2.5 Hardener (Tri ethylene tetra amine (TETA))

Triethylenetetra amine is an organic compound. This oily liquid is colorless but like many amines, assumes a yellowish color due to impurities resulting from air – oxidation. The reactivity and the uses of TETA are similar to those for the related polyamines ethylenetriamine. It was primarily used as a cross linker (hardener) in epoxy curing.

3. MANUFACTURING PROCESS

Initially the board has to be placed on the ground or table, then the surface should be cleaned and adhesion sheet is placed on it. Then paraffin or wax is applied on the surface for easy removal of the composite material after finishing the procedures, here for this manufacturing process OHP sheet is used as that surface. For this composite material, 100 ml of hardener is added to one liter of epoxy resin.

Then an catalyst is added to the mixture and stir well for about 15 minutes. Immediately hardenisation reaction started. Hence coating of vinyl ester resin should be coated on the wax coated surface and allow sufficient time. Then randomly spread the fibers on the resin surface in the discontinuous and random manner. Close the resin mixture coated surface with a laminated sheet and then with glass for smooth surface finish and for perfect heat transfer while reaction between resin and mixtures and fiber.

FIG 3.1 : Mixture Of Fiber And Resin Applied On The Wooden Pattern Board

The impregnated layers were placed in the resin matrix and pressed using wooden board and screwed using bolt and nut for attaining maximum compression load. The setup is allowed to rest for 18 to 16 hours. Then the composites were removed from the mold and cured at room temperature for 24 hours.

3.1 Machined Composite

FIG 3.2 Banana Fibre Composites Brought Out From The Wooden Board

3.2TESTING AND RESULT

3.2.1Hardness Test

There are several scales of Dorumeter , used for materials with different properties. The two most common scales , using slightly different measurement systems, are the ASTM D2240 type A and type D scales. The A scale is for softer plastics while the D scale is for harder ones. However the ASTM D2240-00 testing standard calls for a total of scales, depending on the intended use. Type A,B, C, D, DO, E, M, O, OO, OOO, OOO-S and R. Each scale results in a value between 0 and 100, with higher values indicating a harder material.

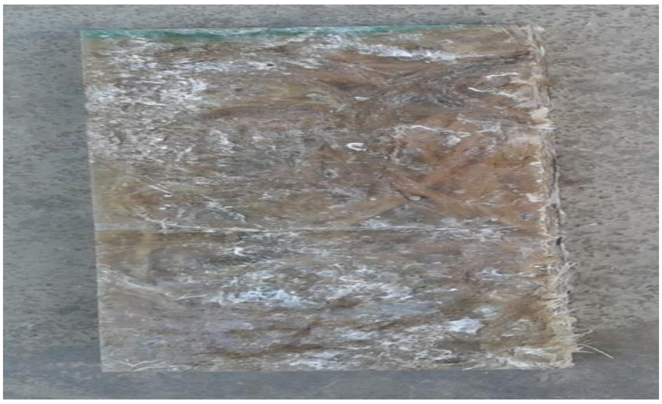


Fig 3.3 Specimen used for hardness test(hybridcomposite)

3.2.2 Relation between ASTM D2240 hardness and Elastic modulus

Using linier elastic intendation hardness, a relation between the ASTM D2240 hardness and the young's modulus for elastomers has been derived by Gent and by mix and Giacomin. Gent's relation has the form

$$E = \frac{0.0981\,(56 + 7.62336\,S)}{0.137505\,(254 - 2.54\,S)}$$

Where E is young's modulus in MPa and S is the ASTM 2240 type A hardness. This gives the value of $E = \infty$ at $S = 100$ but departs from experimental data for $S < 40$. Mix and Giacomin derive comparable equations for all 12 scales that the standardized by ASTM 2240.Another linier relationship between the ASTM D2240 and the elastic modulus has the form:

$\log_{10}E = 0.0235\,S - 0.6403\,S = \{ S_A$ for $20 < S_A < 80$; $\{ S_D + 50$ for $30 < S_D < 85$.

a) Impact test

An impact test is a dynamic test in which a selected specimen which is usually notched is struck and broken by a single below in a specially designed machine In Omega Inspection and Analysis Laboratory, Guindy, Chennai – 32, impact Testing is done by the Charpy test Experimental Setup.

b) Charpy Test.

The purpose of the impact test is to measure toughness, or the energy absorption capacity of the materials. The principal difference between Charpy Test and the Izod Impact Test is the manner in which the specimen is supported. In the charpy Test the specimen is supported as simple beam with a notch in the center. The specimen is supported so that the notch is on the vertical face away from the point of impact.

Calculation of Impact strength:

From the above procedure, the impact strength is calculated from the formula,

$$\text{Impact Strength} = \frac{\text{Energy Absorbed in Joules}}{\text{Cross sectional Area } (m^2)}$$

For sisal composite,

Width = 15 mm
Thickness = 12 mm
Cross sectional area = 0.015 X 0.012 m^2
= 0.00018 m^2

(i) Impact strength = 2 / 0.00018
= 11111.11 Joule / m^2

(ii) Impact strength = 4 / 0.00018
= 22222.22 Joule / m^2

c) Tensile Test

Tension test is conducted by gripping the test specimen between the upper and lower cross heads, compression, transverse, bending, shear and hardness tests and conducted between the lower cross head and the table. The lower cross head can be raised or lowered rapidly by operating the screwed columns thus facilitating ease of fixing of the specimen.

d) Universal Testing Machine

The load is applied by a hydrostatically lubricated ram. The power pack generates the maximum pressure of 200 kgf / cm^2 and the hydraulic pump provides continuously non-pulsating oil flow. Hence the load application is very smooth.

After clamping the test specimen in the UTM the test is carried out by applying the gradual load. Once it reaches the ultimate load the test specimen would broken and result of the specimen is obtained.

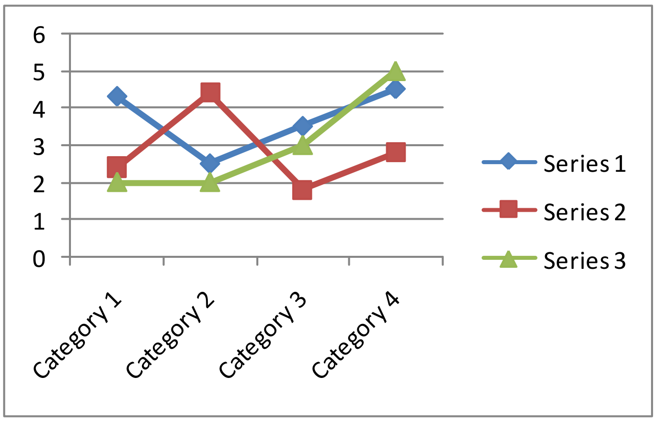
e) Flexural Test

A rectangular test piece of 100 x 25.8 x 15.5 dimension for flexural test was cut from the prepared non woven composites. Flexural test was conducted as ASTM D790. The test was conducted on the universal testing machine with Series I X software using load cell of 10 kN at 2.8 mm/min rate of loading.The specimen was freely supported by a beam and the load was applied in the middle oe specimen. The tests were carried out at a temperature of 27^{o} C and the relative humidity of 50%. For statistical purposes, a total of 5 samples were tested.

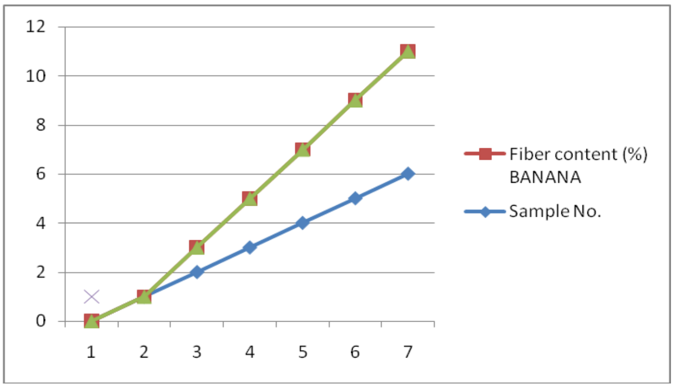
Fig 3.4 Broken Specimen After the load is applied in Universal Testing machine

Table 1 Experimental results of the banana/carbon fiber composites

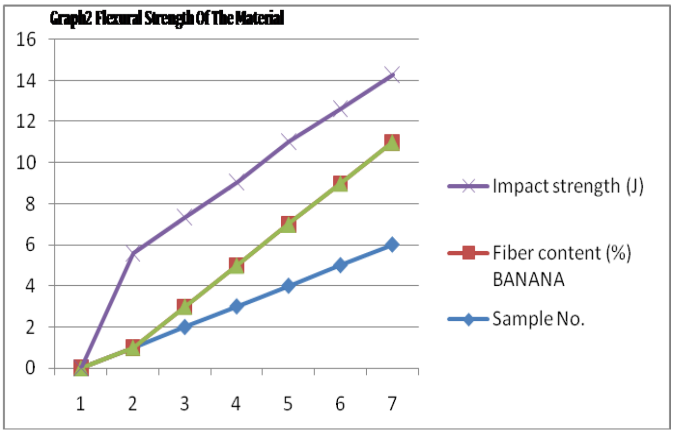
Sample No.	Fiber content (%) BANANA	Tensile strength (MPa)	Flexural strength (kN)	Impact strength (J)
1	0	288.03	3.12	4.58
2	1	277.06	3.07	4.36
3	2	276.04	2.57	4.04
4	3	276.03	2.38	4
5	4	275	2.26	3.62
6	5	252	1.96	3.28



Graph1 Tensile Strength Of The Material



Graph2 Impact Strength Of The Material



Graph3 Flexural Strength Of The Material

4. CONCLUSIONS

In this work, the fiber Musa paradisiac has been characterized for their properties. Natural fibers have good strength, uniformity, finned and excellent moisture absorption. In this study the feasibility of applying fiber namely mudar as an alternative raw material for fiber – reinforced composite (FRC) is investigated.

- Natural treated fibers give better result in flexural strength while comparing other fibers. Based on the test and analysis of the new composite material which is fabricated with an ingredient of NaOH treated banana fiber and epoxy resin have high strength than other composite materials.
- The maximum flexural strength of 3.13 kN holds by the pure carbon fiber composites and in the case of hybrid composites, the sample S2 (21% carbon fiber and 81% banana fiber) holds the value of 3.005 kN.
- The maximum impact strength of the banana-carbon fiber hybrid composites are 4.12 Joules. This is just behind the pure carbon fibre composites which hold the value of 4.24 Joules.

The low load automobile components can be replaced by coir composites by two reasons namely, low cost and ease of decomposability. Since this new material is flexible to environment and eco-friendly they do not promote any environmental pollution and the wastage materials is also used in the environment.

ACKNOWLEDGEMENT

This research was supported/partially supported by [Apollo Engineering College, Chennai]. I thank our colleagues from [Mechanical Department] who provided insight and expertise that greatly assisted the research, although they may not agree with all of the interpretations/conclusions of this paper.

REFERENCES

1. Sinha.R, 2000. Outlines of polymer technology, prentice hall by India private limited, New Delhi
2. Sharifah. H. A, Martin. P. A, Simon. T. C, Simon. R. P, 2005, Modified polyester resins for Natural fiber composites. Compos. Sci. Technol. 65:525-535.
3. Roe.P and Ansell. M, 1985, Jute reinforced polyester composites. J. Mater. Sci. 20:4015-4020.
4. Pal. S, Mukhophadhayay. D, Sanyal. S, Mukherjee. R, 1988. Studied on proceed variables for natural fiber composites – effect of peap as interfacial agent . J. Appl. Polym. Sci. 35:973-895.
5. Devi. L, Bhagawan. S and Thomas. S, 1997, Mechanical properties of Pine apple leaf fiber

reinforced polyester composites. J. Appl. Polym. Sci 64:1739-1748.

6. M. A. Malequel, A. saifull and S. M. Sapuan2. Effect of volume fraction of Pseudo stem banana fiber on the particles of epoxy composite. International conference on the mechanical engineering 2005(ICME 2005) on 28-30 december 2005, Dhaka, Bangaladesh.

BIOGRAPHIES

V.RAJIVE

Assistant professor, Dept of Mechanical Engineering, Apollo College of engineering, Chennai, Tamil Nadu, India