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Investigation on Properties of Banana and Bamboo Fiber Composites by Experimentation

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Abstract: The fibers from the natural fruit crust that are nowadays disposed as an unwanted waste, might be seen as a recyclable potential alternative to be used in polymeric matrix composite materials. The natural banana tree (Cocos nucifera) is a multivalent fiber producer. Its fiber can be extracted from any part of the tree, including the long leaf sheath, the midribs of the leaves, the bark of the stalk and the fruit crust. Natural fibers such as cotton, flax and sisal have been used since historical times in a large variety of products, ranging from clothes to house roofing. Today, these fibers are appraised as environmentally correct materials owing to their biodegradability and renewable characteristics. Moreover, lignocellulosic fibers are neutral with respect to the emission of CO_2.This is an extremely important aspect and puts lignocellulosic fibers as materials in context with the Kyoto protocol.

Key words: Natural fibers · Cocos nucifera · Clothes

INTRODUCTION

Although fiber-reinforced polymers (FRP) have until now been largely applied to various fields of engineering, these materials have also been used in many technical applications, especially where high strength and stiffness are required, but with low component weight. The good specific (i.e., weight-related) properties are due to the low density of the applied matrix systems (unsaturated polyesters, polyurethanes, phenolic or epoxy resins) and to the embedded fibers that provide the high strength and stiffness (bamboo, aramid and carbon fibers). Furthermore, great use is made of the fact that composite parts can be tailor-made during production specifically by orientating the reinforcing fibers in the directions of the applied load compound material is itself a direct result of structural manufacture and many different technologies have been developed in order to achieve the required property. Murali Mohan Rao,[1] studied the tensile, flexural and dielectric properties of composites made by reinforcing vakka as a new natural fiber into a polyester resin matrix. The fibers extracted by manual processes have been used to fabricate the composites. These composites are tested for tensile, flexural and dielectric properties and compared with those of established composites like Banana, bamboo and banana made under same conditions. S. Padma Priya [2].has developed Waste silk fabric-reinforced epoxy laminates by varying content of silk fabric. The mechanical properties like tensile strength and flexural strength of the composites were determined. These properties were found to increase with silk fabric content. These composites also showed good chemical resistance to some acids, alkalies and solvents. The interfacial bonding between the reinforcement and the matrix was examined using SEM technique Kalaprasad.G [3] had done theoretical modeling of tensile properties of Banana fiber reinforced low density polyethylene composites, The experimentally observed tensile properties (tensile strength and modulus) of short Banana fiber-reinforced LDPE with different fiber loading have been compared with the existing theories of reinforcement.

S.M. Sapuan [4] Investigated the tensile and flexural (three-point bending) properties of woven natural fiber composite (Banana/Epoxy). Three samples were prepared from woven banana fiber composites of different geometries were used. Statistical analysis using ANOVA-one way has showed that the differences of results obtained from those three samples are not significant, which confirm a very stable mechanical behavior of the composites under dif researchers to develop an adequate system for producing a good quality of woven banana fiber composite which may be used for household utilities.

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Composites: Many natural fibers traditionally employed in weaving, sacking and ropes; present various potentials to be used as reinforcement elements in composites. Retrofitting of flexural concrete element is traditionally accomplished by externally bonding steel plates to concrete. The background of the research that has been carried out is the awareness that the demand of hybrid and hybrid products is slowly decreasing and that other The matrix phase materials are generally continuous; they may be metal, ceramic or polymer. The strong fiber surrounded by a weaker matrix material. The example of composites systems include concert reinforced with steel n epoxy reinforced with graphite fibers. Wood, straw, mud are everyday composites. Composites have been used to optimize the performance of some conventional weapons. Composites are very anisotropic and heterogeneous. Due to the exponential growth of human population on Earth we face environmental problems more and more. Now, in 21st century, it is clear that we are paying for advanced technology with ecological troubles and even disasters sometimes. And it is in our interests to look for solution. Therefore, from the materials science point of view, there is growing interest in green, environmentally friendly materials. If we consider composites, one of solutions can be use of natural fibers instead of more traditional bamboo and carbon fibers.

MATERIALS AND METHODS

Banana Fiber: Banana is a plant of the agave family Agave Banana. The stalk grows to about one meter in height. The fiber is contained in the lance-shaped leaves that grow out from the stalk in a dense rosette. The Banana plant produces approximately three hundred leaves throughout its productive period. To extract the fiber the leaves are crushed and the pulp scraped from the fiber. This is then washed and dried. The Banana fiber strands are usually creamy white, when harvested, the Banana fiber is coarse and relatively inflexible. The process of turning these fibers into silky fabric involves a high degree of beating and pulping. Because of the amount of work to process the Banana into this sheer fabric its value is very high.

Fig 1: Extracted Banana fiber.

Bamboo Fiber: Bamboo fibers are the most widely used and least expensive as all fibers. The composite material is called bamboo fiber reinforced plastic and may contain between 30% & 60%. Fiber bamboo, is a material consisting of numerous extremely fine fibers of bamboo. Bamboo makers throughout history have experimented with bamboo fibers, but mass manufacture of fiber bamboo was only made possible with the invention of finer machine tooling. In 1893, Edward Drummond Libbey exhibited a dress at the World's Columbian Exposition incorporating bamboo fibers with the diameter and texture of natural fibers. This was first worn by the popular stage actress of the time Georgia Cayvan.

Fig. 2: Bundle of fiber bamboo.

Table 1: Properties of Composites.

Properties	Bamboo Fiber	Banana Fiber
Density (kg/m^3)	1600	1450
Flexural modulus (GPa)	2-5	12.5-17.5
Tensile strength (MPa)	54	68
Young's modulus (GPa)	3.4878	3.774

Fabrication of Composite: The methods of preparation of specimen are as follows:(Mould prepared by using bamboo plates) Banana and Banana fiber are dried and chopped into short fiber of 10mm length. As per volume fraction of fiber, fibers are weighed. Epoxy and hardener are mixed properly in the ratio of 10:1 at room temperature. A release agent (remover) is applied on the mould and dries it for few minutes. Short fiber and epoxy mixture are mixed properly at room temperature. The Fiber and epoxy mixture is poured uniformly on to the mould and excess amount of epoxy mixture was removed and leveling is done by using roller. The mould is closed and the composite material was pressed uniformly for 24 hours for curing at room temperature. Once the Composites are dried, it is separated from the mould. The test specimens are cut according to the ASTM Standard.

RESULTS AND DISCUSSIONS

Based on the test analysis of the new composite material which is fabricated with an ingredient of NaOH treated banana & bamboo fiber and vinyl ester resin have higher strength than the individual fiber.

Tension Test:

Fig. 2: Tension test Graph for Banana & Bamboo composite.

Tensile strength results indicate that the aspect ratio of fiber fraction particles was too low to allow for a precise characterization of their tensile strength1.540KN is more then banana and bamboo composite. Hardness test indicates that they are more flexible due to high strain values and reduction of resonant amplitude.

Ultimate break load = 3.780KN
Displacement at FMAX = 5.700mm
Maximum Displacement = 2.900mm
Ultimate stress = 0.009kN/mm^2
Elongation = 2.500%

Flexural Test:

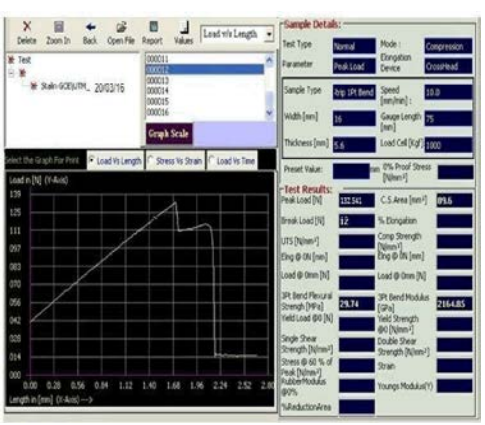

Fig. 3: Flexural test Graph for Banana & Bamboo composite

In flexural test has been determined for12cm length of banana & bamboo fiber, hence the test of banana & bamboo fiber is more efficient134.651N is more than existing composite like banana and bamboo.

Table 2: Comparison of fibers and composites

Test	Banana	Bamboo	Banana&Bamboo
Hardness Strength (Kgf)	80	100	100
Impact Strength (kj/m^2)	32	35	29
Tensile Strength (KN)	1.14	1.2	1.560
Flexural Test (N)	86	132	134.541

CONCLUSION

From all above test results the banana and bamboo composite properties are more efficient than the individual fiber's. The strength to weight ratio is also better. The Low load automobile components can be replaced by banana composites for two reasons namely, low cost and ease of decomposability. Since this new material is flexible in environment and eco-friendly they do not promote any environmental pollution.

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