Investigating the Strength of Papaya Tree Fiber

S.Santhosh Kumar[1], M.Sonachalam[2], S.Sajith Kumar[3]

[1,2]Lecturer, Department of Mechanical Engineering, St.Joseph University in Tanzania

[3]UG Student, Immanuel Arasar JJ college of Engineering

Abstract - A composite material is a combination of two or more materials arranged in the form of layer one on the other layer using binding material through some prescribed methods. Many of the methods are using to produce composite material in this project the materials to form the mixer of araldite resin and hardener with the fiber materials, the mixer of composites are prepared by the standard pattern. The materials used in this project are papaya tree hybrid composite method, the epoxy resin is used as binding material, in which one layer is formed of three types of laminates are prepared by using the resin of LY556 and hardness HY951. The types of laminates is papaya tree fiber reinforced layer(PFR). As per ASTM standard, specimens are prepared and various tests such as tensile, flexural, From the characterization papaya tree fiber.

Keywords: Composite, Papaya tree fiber, Epoxy resin, ASTM standard.

I. INTRODUCTION

The composite materials is basically experimented to reduce the density of the basic material and to increase the strength of the material. The usage of composite material is initially started with aircraft materials, where the material requires high strength and low density. Thousand of experiments have been conducted for finding out the properties of the composite material and also to achieve the desired quality in the characteristics of composite material. In this experiment, it is tried to see the change in characteristics of natural papaya fibers composites to find the tensile strength, fineness, weight distribution. The effect of natural waxy surface layer of the fiber on the fiber and the strength of composites. From the above articles, it was observed that the strength of the papaya fiber reinforced composites could be increased by increasing the bonding material, temperature and other parameters, then we are used instead of natural papaya fiber is mixed with araldite 106 resin and hardener H 93 the epoxy resin and hardener are given heavy strength and good bonding capacity of the composite material. the resin and hardener are increased flexural properties of biodegradable composites.

II. LITERATURE SURVEY

In this Kenaf and bagasse were mixed with corn-starch biodegradable resin, and composite flexural specimens were fabricated by press forming. The flexural modulus of the natural fiber composite made from Kenaf and bagasse increased, with an increase in fiber volume fraction up to 60% for Kenaf, and up to 66% for bagasse. investigated the thermal conductivity, diffusivity and specific heat of polyester/natural fiber (banana/sisal) composites as a function of filler concentration and for several fiber surface treatments, finally we got tensile and flexure test by the computerized UTL machine for find the application strength. Natural fiber reinforced polymer composites have raised great attentions and interests among materials scientists and engineers in recent years due to the considerations of developing an environmental friendly material and partly replacing currently used glass or carbon fibers in fiber reinforced composites. They are high specific strength and modulus materials, low prices, recyclable, easy available in some countries. The mechanical properties of a natural fiber-reinforced composite depend on many parameters, such as fiber strength, modulus, fiber content and orientation, in addition to the fiber-matrix interfacial bond strength. A strong fiber-matrix interface bond is critical for high mechanical properties of composites. A good interfacial bond is required for effective stress transfer from the matrix to the fiber whereby maximum utilization of the fiber strength in the composite is achieved . Modification to the fiber also improves resistance to moisture induced degradation of the interface and the composite properties. In addition, factors like processing conditions or techniques have significant influence on the mechanical properties of fiber reinforced composites. Mechanical properties of natural fibers, especially flax, hemp, jute, corn and sisal, are very good and may compete with glass fiber in specific strength and modulus. A number of investigations have been conducted on several types of natural fibers such as kenaf, hemp, flax, bamboo, and jute to study the effect of these fibers on the mechanical properties of composite materials. Mansur and Aziz studied bamboo-mesh reinforced cement composites, and found that this reinforcing material could enhance the ductility and toughness of the cement matrix, and increase significantly its tensile, flexural, and impact strengths. On the other hand, jute fabric-reinforced polyester composites were tested for the evaluation of mechanical properties and compared with wood composite, and it was found that the jute fiber composite has better strengths than wood composites. A pulp fiber reinforced thermoplastic composite was investigated and found to have a combination of stiffness increased by a factor of 5.2 and strength increased by a factor of 2.3 relative to the virgin polymer. Information on the usage of banana fibers in reinforcing polymers is limited in the literature. In dynamic mechanical analysis, Laly et al. have investigated banana fiber reinforced polyester composites and found that the optimum content of banana fiber is 40%. Mechanical properties of banana–fiber–cement composites were investigated physically.

III. BIOLOGICAL STRUCTURE OF PAPAYA FIBER

The papaya fiber is a most available natural fiber in the world, The properties of the papaya fibers are very high strength and high flexible. The papaya fiber is obtained from the dried plant of papaya tree. The papaya plant (Carica papaya L.) has been described with a large variety of adjectives, which acknowledge the structural and functional complexity and the high phenotypic plasticity of this giant tropical herb (León 1987). C. papaya , with a somatic chromosome number of 18, is the sole species of this genus of the Caricaceae, a family well represented in the Neotropics, that includes six genera with at least 35 species (Fisher 1980 ; Ming et al. 2008 ; Carvalho and Renner 2013).Most likely, papaya originated along the Caribbean coast of Mesoamerica (Fitch2005) and spread to many tropical and subtropical regions around the world (Kimet al. 2002), where its distribution is limited by chilling sensitivity (Allan 2002 ; Dhekney et al. 2007). Domestication eventually led to substantial changes in vegetative growth and sexual forms that distinguish wild populations from cultivated genotypes (Paz and Vázquez-Yanes 1998 ; Niklas and Marler 2007). Because of its high yield, nutritional value, functional properties, and year-round fruit production, the importance of this crop around the world is undeniable. The papaya plant is a semi-woody, latex-producing, usually single-stemmed, short-lived perennial herb. The relatively small genome of this species shows peculiar major gene groups involved in cell size and signification, carbohydrate economy, photoperiodic responses, and secondary metabolites, which place the papaya in an intermediate position between herbs and trees (Ming et al. 2008). Reproductive precocity, high photosynthetic rates of short-lived leaves, fast growth.

Papaya seed and root system. (a) Germinating papaya seed. (b) Ten-day-old papaya seedling showing cotyledonary leaves and first true leaves. (c) Three-week-old papaya seedling with six true leaves.(d) Side view of an excavated5-month-old papaya root system, showing the main and secondary roots. (e) Upper view of the same root system, showing horizontal Although papayas are considered sun-loving plants, morphological plasticity in the shade is high and involves changes in many characteristics such as leaf mass per area, chlorophyll a/b ratio, stomata density, inter node length, and degree of blade lobbing (Buisson and Lee 1993). This plasticity is evidenced by the morphology adopted by papayas growing in multi storied agro ecosystems and in high-density orchards as well (Marler and Discekici 1997 ; Iyer and Kurian 2006). Papaya seedlings and adults are very responsive to mechanical stimuli and show strong thermo morphed responses or touch-regulated phenotypes (Fisher and Mueller1983 ; Porter et al. 2009). These responses could be essential to the success of papaya in harsh, early succession sites exposed to high winds, because it triggers hardening mechanisms that result in compact architecture, increased signification, and the formation of petiole cork outgrowths.

The Stem: Support and Transport Systems

In papaya plants, the single stem provides structural support, body mass, storage capacity, defense substances, height, and competitive ability, and carries a bidirectional flow of water, nutrients, various organic compounds, and chemical and physical signals that regulate root and shoot relations (Reis et al. 2006). Stem diameters of adult plants vary from 10 to 30 cm at the base to 5–10 cm at the crown. Stem density is only 0.13 g cm -3 . The lower internodes are compact and wider and seem to mechanically support the entire weight of the plant (Morton 1987).In papaya stems, a thick, single layer of secondary phloem, rich in fibers.

IV. EPOXY RESIN

Epoxies generally out-perform most other resin types in terms of mechanical properties and resistance to environmental degradation. For this reason, epoxy resins are the most used resins in the aerospace industry for high performance fiber reinforced composites. It’s also the most expensive resin, exceeding the price level of polyester by 3 to 8 times. The term 'epoxy' refers to a chemical group consisting of an oxygen atom bonded to two carbon atoms that are already bonded in some way. Epoxies differ from polyester and vinylester resins in that they are cured by a 'hardener' rather than a catalyst. Low shrinkage (around 2%), due to the different curing method, is in part responsible for the improved mechanical properties over polyester and vinylester.

V. TESTING PROCEDURE

To make the pattern in the size of 300×150×3mm, and to coat the wax inside of pattern around all areas, to make the mixer of individually coir with resin and hardener, hair with resin and hardener, husk with resin and hardener in the ratio of 5gs fibers with 91g:39g resin and hardener, To form first individually make the mould in the pattern and then to form the moulding in combines of three materials to make the mould in the pattern, dry out the materials around two days then takeout the mould from the pattern. To cut and prepare the materials the range 25cm ×2.5cm and 8cm× 2.5cm, then to take the tensile testing and flexure testing by computerized UTM machine.

Fig. 5.1 Papaya Fiber

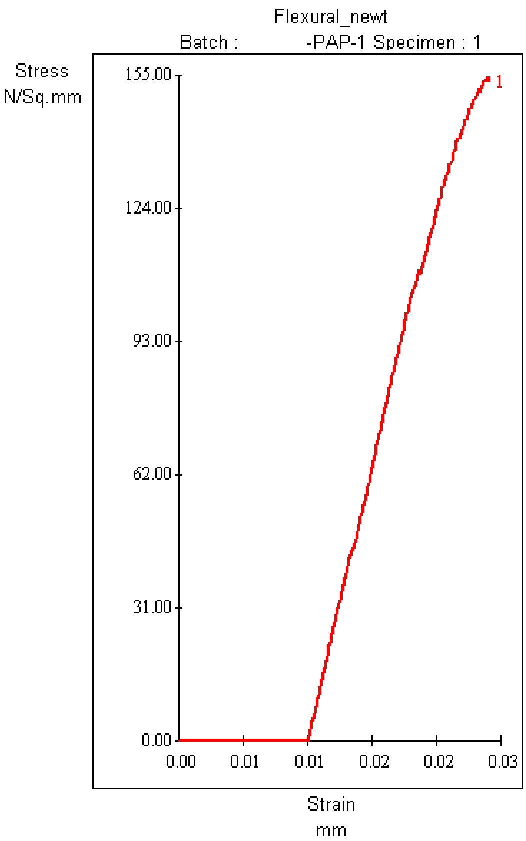

Fig. 5.2 Flexural Strength of Papaya Fiber

Test Name: Flexural_newt
Batch Code: 000267
Specimen No: **PAPAYA** 000001

Load (Kg.)	Travel (Cm.)	Time (Sec.)
0.000000	0.001977	0.656000
0.000000	0.002977	0.750000
0.000000	0.003977	0.859000
0.000000	0.005977	0.968000
0.000000	0.006977	1.062000
0.000000	0.007977	1.156000
0.000000	0.008977	1.250000
0.000000	0.009977	1.359000
0.000000	0.010977	1.467000
0.000000	0.012977	1.562000
0.000000	0.013977	1.656000
0.000000	0.014977	1.765000
0.000000	0.015977	1.859000
0.100000	0.016977	1.953000
0.100000	0.017977	2.062000
0.100000	0.019977	2.156000
0.100000	0.020977	2.264000
0.100000	0.021977	2.359000
0.100000	0.022977	2.453000
0.100000	0.023977	2.546000
0.200000	0.024977	2.671000
0.200000	0.026977	2.764000
0.200000	0.027977	2.859000
0.200000	0.028977	2.953000
0.200000	0.029977	3.062000
0.300000	0.030977	3.156000
0.300000	0.031977	3.264000
0.300000	0.033977	3.359000
0.300000	0.034977	3.453000
0.400000	0.035977	3.562000
0.400000	0.036977	3.656000
0.400000	0.037977	3.750000
0.400000	0.039977	3.859000
0.400000	0.040977	3.968000

0.400000	0.041977	4.061000
0.500000	0.042977	4.156000
0.500000	0.043977	4.250000
0.500000	0.044977	4.359000
0.500000	0.045977	4.468000
0.500000	0.047977	4.562000
0.500000	0.048977	4.656000
0.500000	0.049977	4.750000
0.600000	0.050977	4.859000
0.600000	0.051977	4.968000
0.600000	0.052977	5.062000
0.600000	0.054977	5.156000
0.600000	0.055977	5.265000
0.600000	0.056977	5.359000
0.700000	0.057977	5.453000
0.700000	0.058977	5.562000
0.700000	0.059977	5.656000
0.700000	0.061977	5.765000
0.700000	0.062977	5.859000
0.800000	0.063977	5.953000
0.800000	0.064977	6.046000
0.800000	0.065977	6.171000
0.800000	0.066977	6.265000
0.800000	0.068977	6.359000
0.900000	0.069977	6.453000
0.900000	0.070977	6.562000
0.900000	0.071977	6.656000
0.900000	0.072977	6.765000
0.900000	0.073977	6.859000
0.900000	0.075977	6.953000
1.000000	0.076977	7.062000
1.000000	0.077977	7.156000
1.000000	0.078977	7.250000
1.000000	0.079977	7.359000
1.000000	0.080977	7.453000
1.100000	0.082977	7.562000
1.100000	0.083977	7.656000
1.100000	0.084977	7.765000
1.100000	0.085977	7.859000
1.100000	0.086977	7.953000
1.200000	0.087977	8.062000
1.200000	0.089977	8.156000
1.200000	0.090977	8.250000
1.200000	0.091977	8.359000
1.200000	0.092977	8.468000
1.200000	0.093977	8.562000
1.200000	0.094977	8.656000
1.200000	0.096977	8.750000
1.300000	0.097977	8.859000
1.300000	0.098977	8.968000
1.300000	0.099977	9.062000
1.300000	0.100977	9.156000
1.300000	0.101977	9.250000
1.300000	0.103977	9.359000
1.300000	0.104977	9.453000
1.300000	0.105977	9.562000
1.300000	0.106977	9.656000
1.300000	0.107977	9.765000
1.400000	0.109977	9.859000
1.400000	0.110977	9.953000
1.400000	0.111977	10.046000
1.500000	0.112977	10.156000
1.500000	0.113977	10.265000
1.500000	0.114977	10.359000
1.500000	0.115977	10.453000
1.500000	0.117977	10.546000
1.600000	0.118977	10.656000
1.600000	0.119977	10.765000
1.600000	0.120977	10.859000
1.600000	0.121977	10.953000
1.700000	0.123977	11.062000
1.700000	0.124977	11.156000
1.700000	0.125977	11.250000
1.600000	0.126977	11.359000
1.700000	0.127977	11.453000
1.700000	0.128977	11.562000
1.700000	0.129977	11.65600

VI. CONCLUSION

From the characterization of papaya tree fiber, composite by using the resin is observed that Eco-friendly papaya tree laminates have significantly influenced the mechanical properties. To produce the natural fiber materials like papaya tree fiber will significantly reduces the uses of conventional materials like steel.

REFERENCES

[1] McLean M, 1982, Proc 3rd Risø Symposium Fatigue & Creep of Composite Materials, September 1982 (editors H Lilholt & R Talreja) (Risø National Laboratory, Roskilde, Denmark)

[2] McLean M, 1985, Compos Sci and Technol, 23, 37-52. McLean M, 1986, in Proc 4th Conference of the Irish Durability & Fracture Committee (editor FR Montgomery).

[3] Mensitieri G, Apicella A, Nicolais L and Del Nobile MA, 1996, in Progress in Durability Analysis of Composite Systems (editors AH Cardon , H Fukuda and K Reifsnider).

[4] Mileiko ST, 1970, J Mater Sci, 5, 254-261. Miranda Guedes R (Royal Society, London), 19-28. Schapery RA, 1996, in Progress in Durability

[5] Analysis of Composite Systems (editors AH Cardon, H Fukuda and K Reifsnider), (AA Balkema, Rotterdam , The Netherlands), 21-38.

[6] Shen CH and Springer GS, 1976, J Compos Mater, 10, 2-20. Smith WS, 1979, Environmental Effects on Aramid Composites.