Evaluation of tensile properties of natural fiber composites

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Abstract —
In the present work of natural fibers was correlated with their mechanical properties via image analysis. Cane, Palm and sun grass fibers were tested under direct tension in a universal testing machine. For the cane fiber the tests were performed for several gauge lengths in order to investigate its influence on the tensile strength and to compute them accurately.
Natural fiber composites are generally used in automobile, drone and other house hold applications because of its highstrength and attractiveproperties such as, its high tensile strength, lightweight and low cost. In this work it deals to evaluate the tensile properties of different types of natural fiber composite materials. Such fibers are used in this sample are Cane fiber, Palm Fiber, Sun grass, natural fiber epoxy resin (LY-556), mixed with Hardener HY-9 and the prepared fiber we investigate their tensile strengths and are evaluated and compared with other composite fibers. The composite fiber are developed using Hand-Lay-Up technique. From the observed results it indicates thatthe matrix of Cane fiber, Palm fiber and Sun grass composite given us ahigh tensile strength as compared to other types of natural fiber composite such as Jute, banana and lufa fibers.

Keywords — *Natural fibers, Palm, Cane, Sun grass, Epoxy, Hardener, Hand-Lay-Up, Tensile properties.*

I. INTRODUCTION

Composites fibers have been designed to develop for low weight applications such as drone, aerospace and other automobile industries its high performance and light weight are very attractive for industrialist therefore they offer several advantages over traditional engineering materials and are as follows. A composite fiber is a structural material that consists of two ormore constituents which are combined at a microscopic level and are not soluble in each other. One constituent is called the reinforcing phase and the other is matrix. The reinforcing phase material may be in the form of fibers, mate. The matrix phase materials are generally continuous.

Ramesh M.et.al.mentioned in his research studies that the Composite materials provide capabilities for part of integration [19]. Mishra S. et.al says in his paper that several metallic components can be replaced by a single composite component. Composites offer the stiffness of steel at one fifth the weight and equal the stiffness of aluminum at one half the weights. [3]

II. NATURAL FIBERS

Natural fibers such as fiber extraction from Palm, Cane, Sun grass, Sisal, Jute, Coir, Flax, Hemp, Pineapple, Kenaf and Banana and several other tree and plant provide environmental and technical value add. Recent studies in natural fiber composites offer significant improvement in materials from renewable sources with enhanced support for global sustainability. These natural fiber composites possess high/moderate strength, low cost, low density, and thermal stability when they are recyclable, but the problems of using pure biodegradable polymers are their low strength and transition temperature [4].

A. Palm Fiber

Fig. No. (1) Palm fiber

Palmfibers are extracted from the leaves of Palm tree. Palm fibers are typically composed of cellulose, hemi cellulose, and lignin. Natural cellulose fibers have been extracted from various types and parts of the palm tree. Native to upper Jharkhand, West Bengal and Bihar (doum palm) was used as a source to extract fibers from the leaflet and leaf stalks.The fibers

are extracted from hand extraction machine composed of either serrated or non serrated knives. . Proper drying is important as fiber quality depends largely on moisture content. Artificial drying has been found to result in generally better grades of fiber than sun drying, but is not feasible in the developing countries where Palm is produced.

B. Cane Fiber

Fig. No: (2) Cane fiber

Cane is a traditional material for garden furniture. To sit on, cane is warmer and softer than metal, because it does not conduct body heat. Cane is a natural material for use in a natural setting. Cane has a warm soft colour and bends easily into elegant curves. Another property of cane furniture is its light weight, an advantage when you want to move furniture around and a disadvantage in windy conditions. Cane is used to make chairs, table benches. The most serious worry with cane garden furniture concerns its durability. Providing cane is well in fact last a long time out of doors. Moisture keeps cane supply and prevents cracking. Many people therefore leave cane furniture outside during summer.

The material known as ‘cane’ in fact comes from two different plants; bamboo and rattan.Cane is a long, soft, shiny vegetable fiber that can be spun into coarse, astrong fibers. It is produced from plants in the genus , canefiber grows to a height of 12-15 ft.

C. Sun grass Fiber

Fig. No- (3) Sun grass

Sun grass fiber is a plant in the shrubs grass family, it found most probably native of southern Asia, though its exact natural origin is unknown. Sun grass is one of the allied fibers of forest grass and shows similar characteristics. It is an annual or biennial herbaceous plant (rarely a short – lived perennial) growing to 1m - 1.5m tall with a soft base. The stems are 1.2 m long, often but not always branched.

III. EXPERIMENTAL WORK

A.Fabrication of Natural Fiber Composite:-

Fig. No (4) – Cane, Palm, Sun grass fiber

The composite materials used for the present investigation is fabricated by hand layup technique. Cane, Palm, and Sun grass mats were used to prepare the specimen. The surface treatment was carried out on natural fibers. The first step in fabrication of natural fiber composite is initially the Sun grass fiber is mounted on the table. The Glass fiber is then completely filled with epoxy resin , after the application of resign the second layer of natural fiber Palmis mounted over the Epoxy mixedhardener . The sequence of layer is arranged according to the required composites. The applied epoxy resin is distributed to the entire surface by means of roller. The air gap formed between the layers during the processing are gently squeezed out. The processed composite is held in for 36 hours and the excess resin is removed automatically. This process is repeated for other samples of composites also.
Finally these specimens are taken to the hydraulic press to force the air gap to remove any excess air present in between the fibers and resin, and then kept for several hours to get the perfect samples. After the composite material get hardened completely, the composite material is taken out from the hydraulic press and rough edges are neatly cut and removed as per the required dimensions of 300 x 300 x 3 mm. Similarly this process is continued to the other composite specimens, as shown in fig. (4) .

Fig. No.(4) – prepared fiber composite plate

B. Tensile Test

Fig. No (5) – Tensile test

Fig. 4. shows the universal tensile testing machine. The hybrid composite material fabricated is cut into required dimension using a saw cutter and the edges finished by using energy paper for mechanical testing. The tensile test specimen is prepared according to the ASTM D638-03 standards of 240 x 25 x 3 mm. The dimensions, gauge length andcross-head speeds are chosen according to the ASTM D638-03 standard. A tensile test involves mounting the specimen in a machine and subjecting it to the tension. The testing process involves placing the test specimen in the testing machine and applying tension to it until it fractures. The test is performed on the universal testing machine and the surrounding temperature is 22ºC. the tensile force is recorded as a function of the increase in gauge length. During the application of tension, the elongation of the gauge section is recorded against the applied force. The tensile test is performed on the Universal Testing Machine (UTM). The different composite specimens consist of Cane – Palm –Sun grass composite.

Fig. No (6).- Composite fabricated plate

The fabricated specimen for tensile test is presented in Fig. 3.

The load vs displacement of different combination of composite specimens are presented in Fig. 4. Stressvs. strain curve is plotted for the determination of ultimate tensile strength. The sample graph is generated directly from the machine for tensile test with respect to load and

displacement for Cane – Palm – Sun grass fibers is presented in Fig. 5. The result indicated that Glass – Jute composite specimen gives better tensile strength then the other composites. This test result is taken directly from UTM.

	Specimen label	Maximum Force [kN]	Tensile stress at Maximum Force [MPa]	Tensile strain (Displacement) at Maximum Force [%]	Load at Break (Standard) [kN]	Tensile stress at Break (Standard) [MPa]	Tensile strain (Extension) at Break (Standard) [%]	Tensile stress at Yield (Zero Slope) [MPa]	Modulus (E-modulus) [MPa]	Comment
1	Sample 01	1.35	14.12	0.69	1.35	14.12	0.69	-----	-----	
2	Sample - 02	1.37	14.28	0.65	1.37	14.28	0.65	-----	-----	
3	Sample 03	1.26	15.06	0.71	1.20	14.36	0.87	-----	-----	
Mean		1.33	14.49	0.69	1.31	14.25	0.74	-----	-----	

Table No. (1) Table obtained by UTM

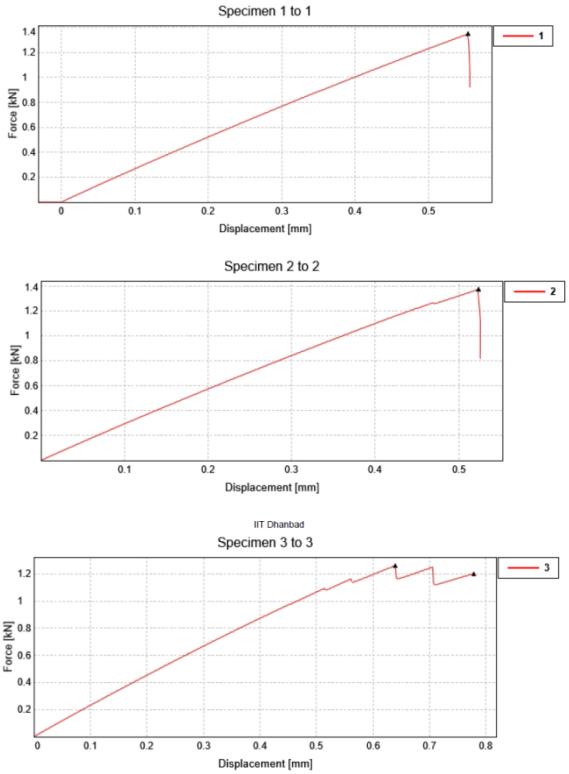

Table No. 2:- Tensile graph of force vs Displacement.

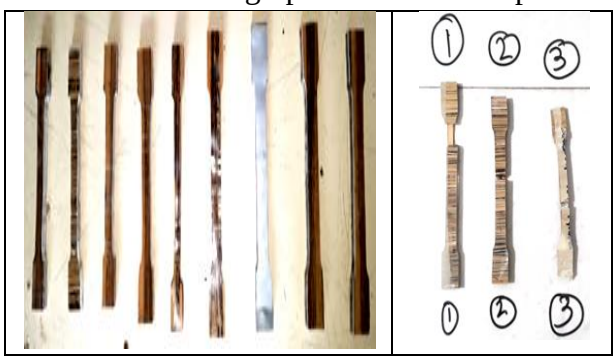

Fig No.:- (7) Specimens after tensile test

3. Results And Discussion

In this study, samples made from cane fiber mat, palm wood fiber, and sun grass fiber composites were employed. They were prepared using these three natural fiber sources. According to the findings of the tensile, flexural, and impact tests performed on the hybrid composites, the higher strength than the other fibers.

V. CONCLUSIONS

The different composite specimens are fabricated such as Cane – Palm – Sun grass,. The tensile properties are evaluated and compared with each other. Based on the result the following conclusions are derived: 1. The results indicated that the Cane – Palm – Sun grass composite material gives maximum tensile strength than other type of hybrid composite material and can hold the strength up to 14.38MPa.

2. The addition of sun grass fiber gives comparatively low tensile strength than the other types of composites.

3. Cane – palm – sun grass Composite gives more displacement during the application of load.

4. Cane fiber gives better displacement property.

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