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Research Article

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Chemical treatment on hybrid reinforced composites

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ABSTRACT

During the last few years, natural fibers have received much more attention than ever before from the research community all over the world. These natural fibers offer a number of advantages over traditional synthetic fibers. In the present communication, a study on the synthesis and mechanical properties of new series of green composites involving Hemp (Cannabis Sativa L) and Abaca (Musa textilis) fiber as a reinforcing material in Epoxy resin based polymer matrix has been reported. Static mechanical properties of randomly oriented intimately mixed Hemp (Cannabis Sativa L) and Abaca (Musa textilis) fiber reinforced polymer composites such as flexural, Impact, hardness strength, water absorption properties etc, were investigated as a function of fiber loading as per ASTM standards. Initially Epoxy resin prepared was subjected to evaluation of its optimum mechanical properties. Then reinforcing of the resin with Hemp (Cannabis Sativa L) and Abaca (Musa textilis) fiber was accomplished in three different forms: particle size, short fiber and long fiber by employing optimized resin. Present work reveals that mechanical properties such as flexural, hardness, water absorption and etc of the epoxy resin increases to considerable extent when reinforced with the fiber.

Key words: Hemp (Cannabis Sativa L); Abaca (Musa textilis); Polymer; Chemical treatment

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INTRODUCTION

Composite materials (or composites for short) are engineering materials made from two or more components. One component is often a strong fiber such as fiberglass, quartz, Kevlar or carbon fiber that gives the material its tensile strength, while another component (often called a matrix) is often a resin such as polyester or epoxy that binds the fibers together and renders the material stiff and rigid.

The efforts to produce economically attractive composite components have resulted in several innovative manufacturing techniques currently being used in the composites industry. It is obvious, especially for composites, that the improvement in manufacturing technology alone is not enough to overcome the cost hurdle. It is essential that there be an integrated effort in design, material, process, tooling, quality assurance, manufacturing, and even program management for composites to become competitive with metals.

The composites industry has 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. Thus the shift of composite applications from aircraft to other commercial uses has become prominent in recent years. Increasingly enabled by the introduction of newer polymer resin matrix materials and high performance reinforcement fibers of glass, carbon and aramid, the penetration of these advanced materials has witnessed a steady expansion in uses and volume. The increased volume has resulted in an expected reduction in costs. High performance FRP can now be found in such diverse applications as composite armoring designed to resist explosive impacts, fuel cylinders for natural gas vehicles, windmill blades, industrial drive shafts, support beams of highway bridges and even paper making rollers. 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, replacements for welded metallic parts, cylinders, tubes, ducts, blade containment bands etc. Further, the need of composite for lighter construction materials and more seismic resistant structures has placed high emphasis on the use of new and advanced materials that not only decreases dead weight but also absorbs the shock & vibration through tailored microstructures. 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 (e.g., steel), the properties of the composite material can be designed considering the structural aspects.

EXPERIMENTAL SECTION

The raw materials used in this work are
1. Hemp (Cannabis Sativa L)
2. Abaca (Musa textilis)
3. Epoxy resin
4. Hardener

Fiber treatment

Alkaline Treatment

Alkaline treatment or mercerization is one of the most used chemical treatment of natural fibers when used to reinforce thermoplastics and thermosets. The important modification done by alkaline treatment is the disruption of hydrogen bonding in the network structure, thereby increasing surface roughness. This treatment removes a certain amount of lignin, wax and oils covering the external surface of the fiber cell wall, depolymerizes cellulose and exposes the short length crystallites. Addition of aqueous sodium hydroxide (NaOH) to natural fiber promotes the ionization of the hydroxyl group to the alkoxide. A glass beaker is taken and 5% NaOH is added and 80% of distilled water is added and a solution is made. After adequate drying of the fibers in normal shading for 2 to 3 hours, the fibers are taken and soaked in the prepared NaOH solution. Soaking is carried out for different time intervals depending upon the strength of fiber required. In this study, the fibers are soaked in the solution for three hours. After the fibers are taken out and washed in running water, these are dried for another 2 hours. The fibers are then taken for the next fabrication process namely the Procasting process.

It is reported that alkaline treatment has two effects on the fiber: (1) it increases surface roughness resulting in better mechanical interlocking; and (2) it increases the amount of cellulose exposed on the fiber surface, thus increasing the number of possible reaction sites Alkaline treatment also significantly improved the mechanical, impact fatigue and dynamic mechanical behaviors of fiber-reinforced composites.

Acrylonitrile Treatment

A solution was made of 3% acrylonitrile, 0.5 hydrogen peroxide, and 96.5% ethanol (all % weight) and stirred in a covered beaker for 3 hours[6]. In Acrylonitrile Treatment, fibers are immersed in 5% aqueous NaOH solution for 1h at room temperature.The fibers were oriented in the mould, and the mold placed in the solution and allowed to soak for 15 minutes. The fibers were then drained and allowed to dry under the hood for 30 minutes.

Benzoylation Treatment

Benzoylation is an important transformation in organic synthesis. Benzoyl chloride is most often used in fiber treatment. Benzoyl chloride includes benzoyl which is attributed to the decreased hydrophilic nature of the treated fiber and improved interaction with the hydrophobic PS matrix. Benzoylation of fiber improves fiber matrix adhesion, thereby considerably increasing the strength of composite, decreasing its water absorption and improving its thermal stability. The isolated fibers were then soaked in ethanol for1 hour to remove the benzoyl chloride and finally was washed with water and dried in the oven at 80°C for 24 h.

Mould design for specimen preparation

The dimension of the hybrid fiber reinforced composite boards was 300 mm (L) x 150 mm (W) and the boards had 3 mm thickness. The mould was made up of steel. The required equipments for the mould that was used to lay the material down into mats were including glass, transparency plastic for the bottom layer and spacer frame.

Fabrication of composite plate

The composite sheets can be prepared with various fiber orientations. The various fiber orientations are as follows
- Randomly Chopped Discontinuous Fibers
- Random fiber Reinforced Composite Material

In this project work the fiber orientation chosen were randomly discontinuous fibers of
5% Hybrid Fiber (Cannabis Sativa L and Musa textilis)
10% Hybrid Fiber (Cannabis Sativa L and Musa textilis)

15% Hybrid Fiber (Cannabis Sativa L and Musa textilis) of volume fraction.

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

RESULTS AND DISCUSSION

Flexural test
Flexural test were using the 3-point bending method according to ASTM D790-99[3]. The specimen dimensions were 157 mm (L) x 13 mm (W) and had 4 mm thickness. Flexural test was conducted to study the behavior and ability of material under bending load. The load was applied to the specimen until it is totally break. The flexural test was conducted for three different types of fibers volume fractions of composite. **Figure 1** shows Flexural Load Vs Deflection of specimens and **Figure 2** shows Flexural Strength of specimens.

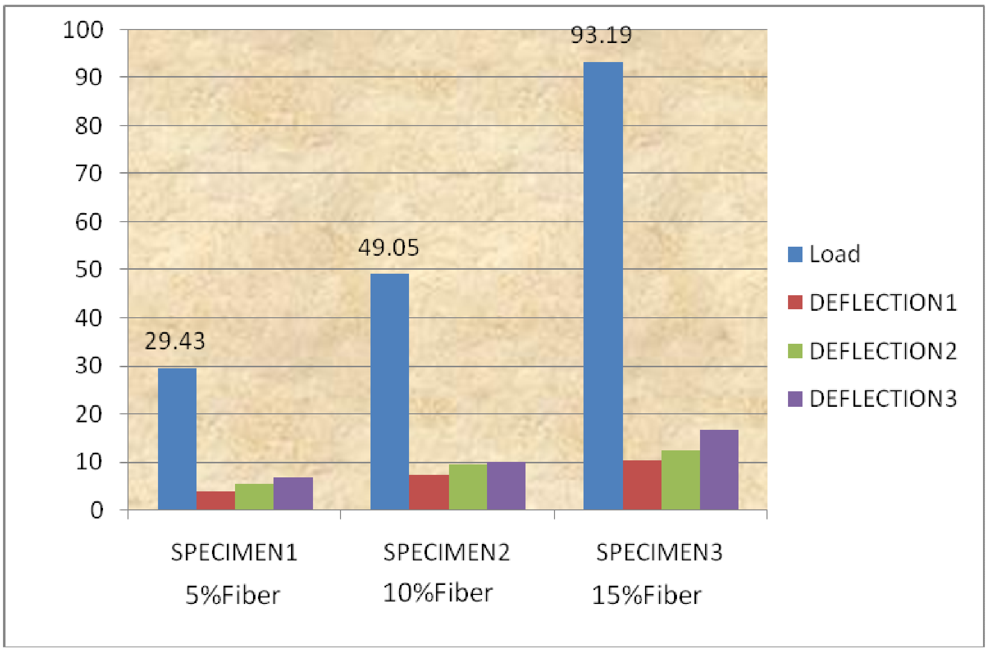

Figure 1 Flexural Load Vs Deflection Graph

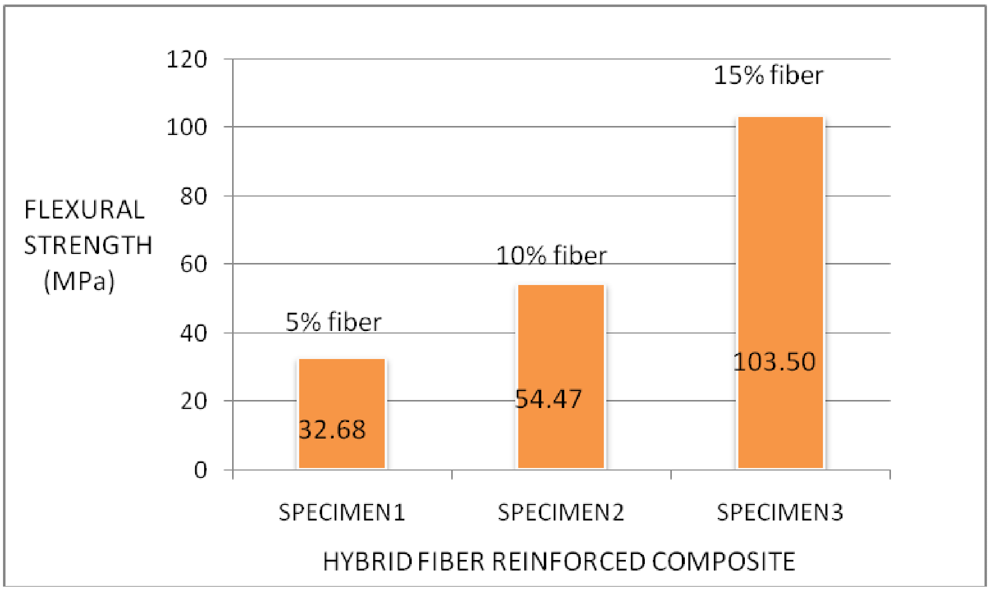

Figure 2 Flexural Strength Graph

Impact Test

Impact is a single point test that measures a materials resistance to impact from a swinging pendulum. Impact is defined as the kinetic energy needed to initiate fracture and continue the fracture until the specimen is broken. This test can be used as quick and easy quality control check to determine if a material meets specific impact properties or to compare materials for general toughness. The standard specimen for ASTM is 64 x 12.7 x 3.2 mm (2 ½ x ½ x 1/8 inches). The most common specimen thickness is 3.2 mm (0.12 inch) but the preferred thickness is 6.4 mm (0.25 inch) because it is not as likely to bend or crush. **Figure 3 shows** Impact Strength of specimens.

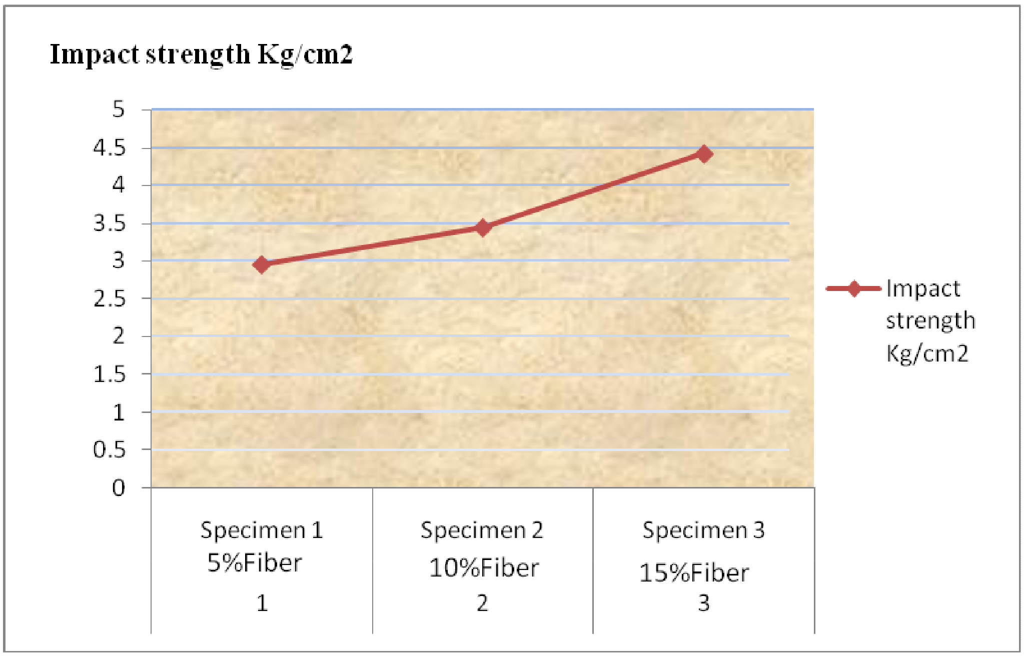

Figure 3 Impact Strength Graph

Water absorption test

In this water absorption test the composite specimen is subjected to the calculation of how much water, the specimen will absorb. The specimen size for water absorption test is taken as 100mm x 100mm shown in **Figure 4.**

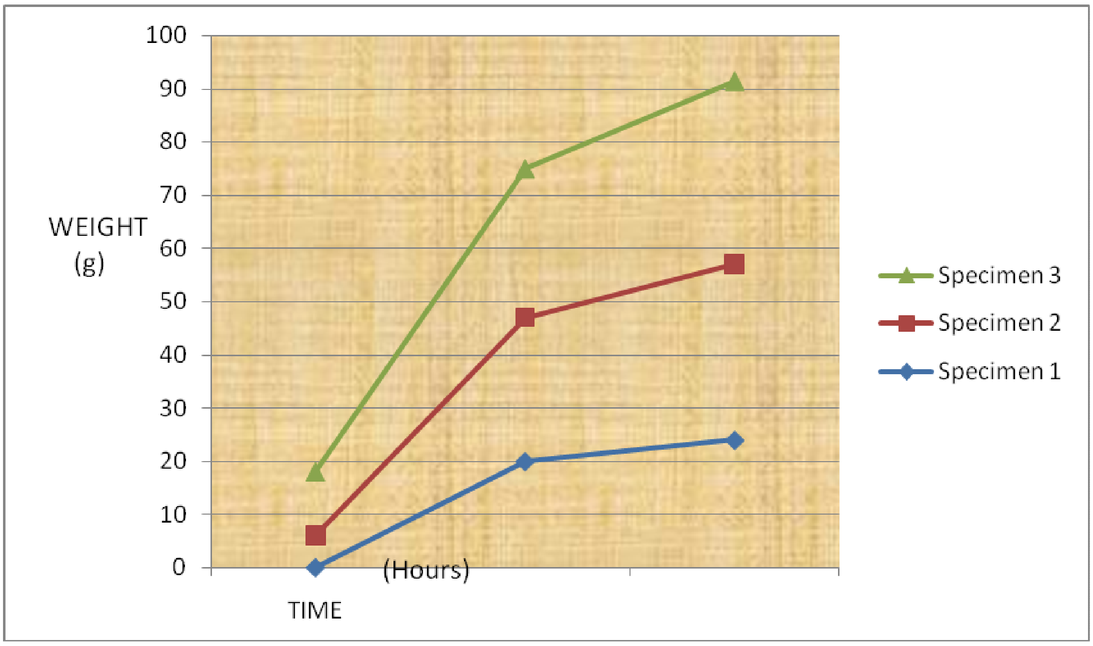

Figure 4 Time Vs Weight Graph

Rock well hardness test

In this rock well hardness test the composite specimen is subjected to determine the hardness number. The specimen size for hardness test is taken as 50mm x 50mm. **Figure 5** shows Load Vs Hardness Number of specimens.

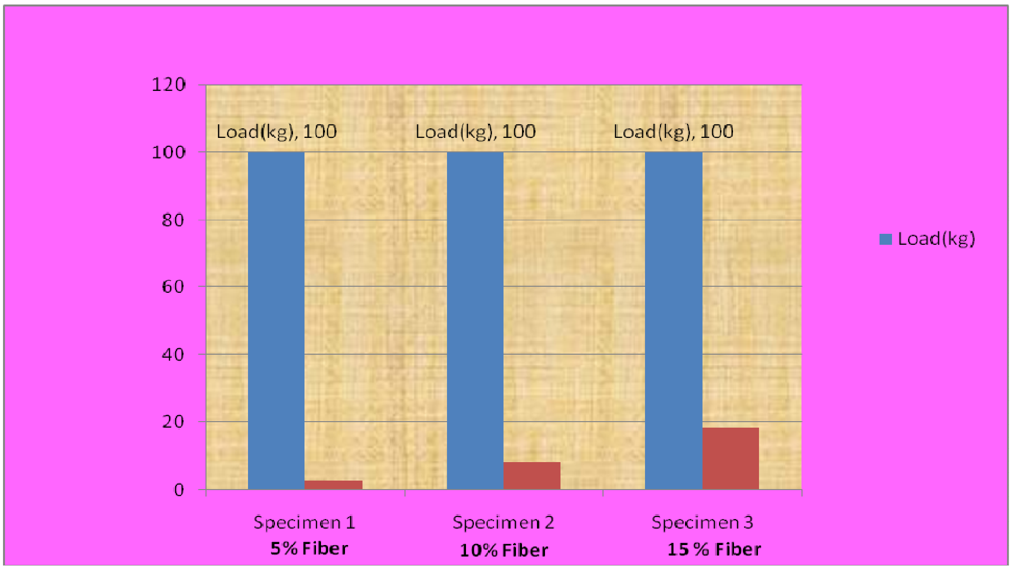

Figure 5 Load Vs Hardness Number

CONCLUSION

In this work, hybrid fibers Hemp (Cannabis Sativa L) Abaca (Musa textilis) have been characterized for their properties. Hybrid fibers have good length, strength, uniformity, fineness, and excellent moisture absorption. In this study the feasibility of applying hybrid fibers, namely Hemp fibers as an alternative raw material for fiber-reinforced composite (FRC) is investigated. Hybrid fiber (Cannabis Sativa L and Musa textilis) gives better result in flexural strength while comparing than other fiber. The experimental investigation of mechanical behavior of Hybrid fiber reinforced epoxy composites leads to the following conclusions: This work shows that successful fabrication of a hybrid fiber reinforced epoxy composites with different proportions is possible by simple hand lay-up technique. It has been noticed that the mechanical properties of the composites such as water absorption, flexural strength, hardness strength etc. of the composites are also greatly influenced for different volume fraction of fiber and discontinuous fiber reinforced composite material. It is known that the water absorption capacity of hybrid fiber reinforced composite material is less than the jute, agave, and banana reinforced composite material.

REFERENCES

[1] A Bledzki; J Gassan, *Progress in polymer science.*, **1999**, 24(2), 221-274.
[2] M Sreekal; et al, *Composites Science and Technology*., **2002**, 62(3), 339-353.
[3] I Varma; S Anantha Krishnan; S.Krishnamoorthy, *Composites.*, **1989**, 20(4), 383-388.
[4] LA Pothan; Z. Oommen; S.Thomas, *Composites Science and Technology*, **2003**, 63(2), 283-293.
[5] B Murali; Chandra mohan D, *Journal of Chemical and Pharmaceutical Research.*, **2014**, 6(9), 419-423.
[6] S Blazewicz; et al. *Biomaterials*., **1997**, 18, 437-439.
[7] CM Clemons; DF Caulfield. *J. Rein. Plastics Comp*., **1994**,1, 1, 1354-66.
[8] K Joseph; R Dias; T Filho; B James. S Thomas, *Composites Revista Brasileira de Engenharia Agrícola e Ambiental*., **1999,** 3, 367-379.