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Fabrication and analysis of Kenaf fibre reinforced composite

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Abstract
Now-a day's number of industries such as the automotive, construction and packaging; have turned towards utilization of new bio-composite materials as an alternative way to fabricate fiber composites. These composites have been developed using various natural fibers like sisal, jute, kenaf, palmyra, etc., and polyester and epoxy resins. For this work, natural fiber composite Lamina is developed with treated and untreated kenaf fiber (4 mm and 8 mm) with Polyester resin as matrix material and flexural test, and water absorption tests are carried out as per ASTM standards.

Keywords: natural fiber, FRC, ASTM and PMC

Introduction

The entire human activity is entwined with the use of materials. For millennia, humans have endeavored to use readily available materials like stone, clay, mud, wood, bone, hide and other vegetable produce for the construction of their homes, tools and implements and means of transport. As centuries rolled, man discovered the secrets of nature and learned to exploit. He started building synthetic materials [1]. Fiber reinforced composites, a new class of synthetic materials have attracted the aerospace and transportation industry due to their weight savings and many other superior properties over conventional metallic materials [2]. Today they find wide applications in containers, sports goods, electronics and appliances as well as in medical field. These composites are synthesized from different kinds of fibers, such as: glass, aramid, graphite, carbon, boron, etc., and matrix materials such as polyester and epoxy resins. These composites have been developed using various natural fibers like sisal, jute, kenaf, palmyra, etc., and polyester and epoxy resins [3]. The objective of the present proposed work is to develop short natural composite laminas. The aim of this Project is to project the potential of natural fiber composite laminas and to explore the possibility of producing them on commercial basis [4]. It is aimed to encourage more plantations that yield fibers which will provide employment in the agriculture and handloom sectors for extracting fibers and preparing mats and further to promote cottage industries in the rural areas for producing natural fiber products for domestic applications [5].

2. Materials and Methods

2.1 Materials Used

- Kenaf fiber
- Unsaturated Polyester resins
- Laminas

2.2 Processing of fibers

The quality of a fiber reinforced composite depends considerably on the fiber-matrix interface because the interface acts as a binder and transfers stress between the matrix and fibers. Bonding between fibers and binder can be increased by chemical treatment of fibers using chemical agent like sodium hydroxide (NaOH).

Fig 1: Showing Treated, Untreated Fibres

Then the fibers are soaked in the water for 24 hours and then the fibers are washed thoroughly with distilled water to remove the final residues of alkali. Good bonding is expected due to improved wetting of fibers with the matrix. It is clearly shown in the figure 1 that the treated and untreated of natural fiber.

Fig 2: Showing 4mm and 8 mm natural fibres

2.3 Fabrication of Lamina

The laminas are prepared by hand layup technique. The hand layup is the one of the Fabrication technique. First Wax polish is applied on the surfaces of the base plates and poly vinyl alcohol (PVA) is applied with a brush and allowed to dry for few minutes to form a thin layer. These two items will help in easy removal of the laminate from the base plates. PVA also provides a glossy finish to the surfaces of the laminate. The general purpose Unsaturated Isopthalic Polyester Resin is taken along with 2% each of catalyst-Methyl Ethyl Ketone Peroxide (MEKP) and accelerator-Cobalt Napthalate. The weight of the resin is 25 times the weight of the short fibre taken for the laminate.

Fig 3: (a, b, c) Wax, PVA and Accelerator with MEKP

The catalyst initiates the polymerization process and the accelerator speeds up this process. Initially the catalyst is added and then the accelerator. The resin is mixed with the short fibres initially next catalyst is mixed and finally accelerator is added. The total composite is now evenly distributed in the mould by hand layup method. It is always preferable to add lesser quantity of accelerator than the specified amount to avoid solidification of the contents before they are poured and evenly layered up in the mould. Then the top base plate that was already applied with the wax and PVA is placed on the laid resin and a weight of about 1000 N is placed over for about 24 hours.

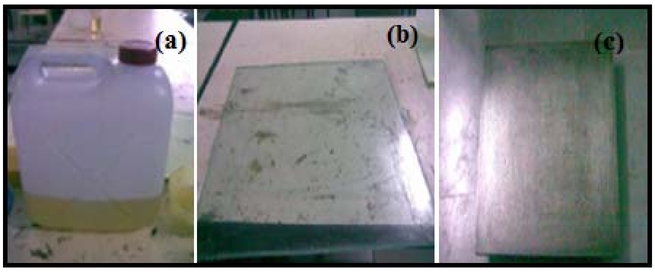

Fig 4: (a, b, c) Polyester resin and glass with surface plate

Specimens for flexural test are cut from laminas as per ASTM D790 standards. The standard dimensions for test specimen are shown in the Figure 5.

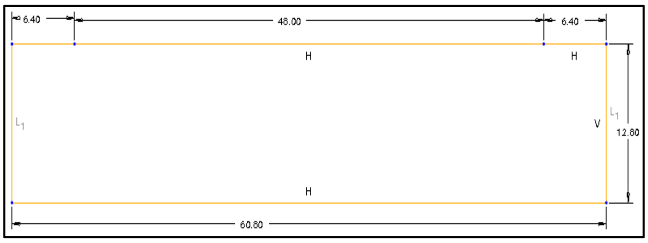

Fig 5: Flexural Test Specimen Dimensions

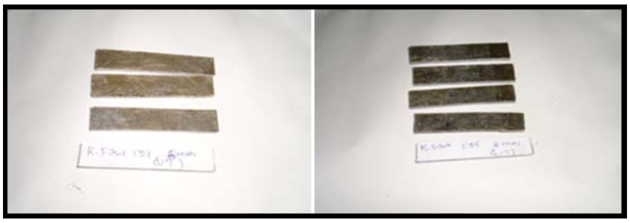

Fig 6: Samples of untreated fibres at 4mm and 8mm

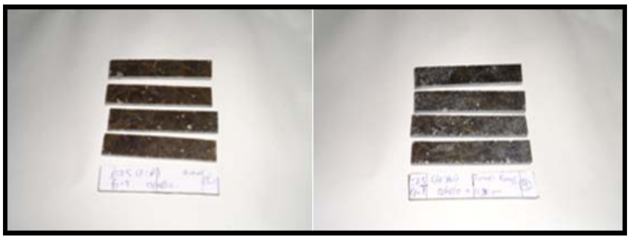

Fig 7: Samples of treated fibres at 4mm and 8mm

2.4 Flexural Testing

Flexural strength is the ability of the material to withstand bending forces applied perpendicular to its longitudinal axis. Sometime it is referred as cross breaking strength where maximum stress developed when a bar-shaped test piece, acting as a simple beam, is subjected to a bending force perpendicular to the bar. There are two methods that cover the determination of flexural properties of material: three-point loading system and four point loading system. As described in ASTM D790, three-point loading system applied on a supported beam was utilized.

Table 1: Untreated lamina at 4mm for kenaf fiber

Deflection (mm)	specimen 1	specimen 2	specimen 3
0.05	8	7.5	8
0.1	16	15.5	15.5
0.15	24.5	24	23.5
0.2	34	34.5	32
0.25	41	42	39
0.3	48.5	47	46
0.35	50	48	51

Fig 8: Flexure Tested specimen of untreated kenaf fiber at 4mm

Deflection (mm)	specimen 1	specimen 2	specimen 3
0.05	11	11	11.5
0.1	22	21	22
0.15	30	31	31
0.2	39	42	42
0.25	47	47	46

Table 2: Treated lamina for *kenaf fiber at 4mm*

3. Results and Discussions

3.1 Flexural Analysis

The flexure strength of the 8 mm untreated fiber composite is 139.5 MPa. The composite with treated 4mm fibers has shown highest flexural strength of 166.2MPa. This shows, in case of treated fiber composite the flexure strength increased by 19.13% times.

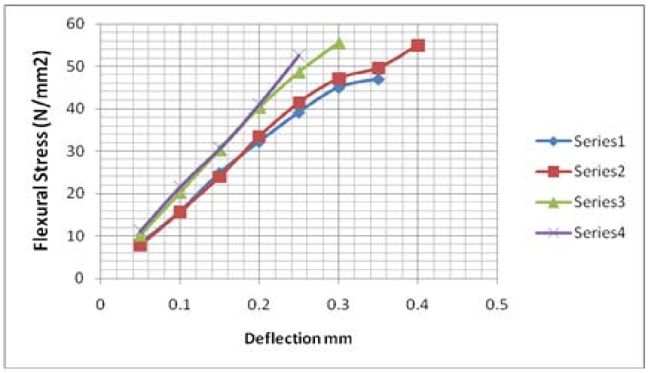

Fig 9: flexural analysis for treated and un treated laminate

At 4 mm Treated fiber composite highest flexure modulus of 18720MPa; it is an increase of 9.1% to that of 8mm Treated fiber composite, and 70% to that of 4 mm Untreated fiber composite. In case of treated lamina, increased adhesion between fiber and resin increased the flexure modulus. The untreated 4mm fiber composite exhibited highest % of Moisture Absorption of 0.768%. The treated composite has absorbed slightly less water absorbed compared to untreated composites.

3.2 Water Absorption Test

During 24 hour immersion of specimens, untreated 4mm kenaf fiber composite exhibited higher water absorption property. Treatment with NaOH has made the fibers less hydrophilic, it can be observed with the significant effect of surface treatment on water absorption capacity. The treated composite has absorbed less water compared to untreated composites.

S.NO	Type of composite	% increase in wt of specimen	% amount of soluble matter lost	% of water absorbed
1	Kenaf T-4mm laminate composite	0.529	0.23	0.759
2	Kenaf T-8mm laminate composite	0.516	0.14	0.656
3	Kenaf UT-4mm laminate composite	0.576	0.192	0.768
4	Kenaf UT-8mm laminate composite	0.556	0.143	0.699

Table 3: % of water absorbed for different laminates

4. Conclusions

The Flexural Strength is increased by 13.8%, 12.8%, 1.6% for treated Kenaf at 4mm laminate, Kenaf treated laminate at 8mm, Kenaf UT-4mm laminate respectively. But it is observed that the Flexural Strength is decreased by 4.4% for Kenaf untreated at 8mm laminate when compared to resin lamina. Surface treatment of fiber had a significant effect on fiber/matrix adhesion due to increase in Flexural strength. By observing the results the Short Kenaf fiber reinforced composites can be used in many applications.

5. References

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