International Journal of Engineering Research-Online
A Peer Reviewed International Journal
Articles available online http://www.ijoer.in

Vol.3., Issue.6., 2015
(Nov.-Dec.,)

RESEARCH ARTICLE

ISSN: 2321-7758

PREPARATION AND CHARACTERIZATION OF SHORT KENAF FIBER REINFORCED COMPOSITE

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ABSTRACT

Now a day's environmental awareness motivates the researchers to study on natural fibre, reinforced polymer composite and cost effective option to synthetic fibre reinforced composites. Accordingly extensive studies on preparation and properties of polymer matrix composite (PMC) replacing the synthetic fibre with natural fibre like Jute, Sisal, Pineapple, Bamboo, Kenaf and Bagasse were carried out. These plant fibres have many advantages over glass fibre or carbon fibre like renewable, environmental friendly, low cost, lightweight and high specific mechanical performance. In the proposed work, natural fibre composite Lamina is developed with treated and untreated short kenaf fibre (4mm and 8 mm) with Polyester Isophthalic resin as matrix material and flexural test, and water absorption tests are carried out as per ASTM standards. By conducting these tests I determined the Flexural Strength, Flexural Modulus.

Keywords: natural fibre, FRC, RPC and PMC

1. INTRODUCTION

Global warming and green house effect are due to man's undue exploitation of the gifts of nature for his comfort and conveniences. To help our future generations in sustaining the hardships of life, it is our responsibility to contribute for preserving the nature as the safe abode for human existence [1]. It can be done by adopting policies for development and application of materials and technologies that cause least damage to the environment. The earlier concept of producing things that are rare, exotic and for trade gains has altogether changed towards preserving or enhancing the environment and life processes [2].

During the past decade, number of industries such as the automotive, construction and packaging; have turned towards utilization of new bi-composites materials as an alternative to synthetic fiber composites [3]. These composites have been developed using various natural fibers like sisal, jute, kenaf, palmyra, etc., and polyester and epoxy resins.

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. 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. The entire activity is aimed to develop new materials for enhanced performance and for sustainability of the environment for the generations to come [4].

The *kenaf* plants are abundantly found in the areas of A.P. These plants yield strong fibers that are traditionally used by the farmers in domestic and agricultural applications. Observing these features, fiber have been chosen to produce green composite products that can be used for several applications such as panels in construction, casings for various domestic products, packaging applications, sport goods etc [5].

2. Materials and Methods:

2.1 Materials Used:

- Kenaf fiber
- Polyester resins
- Laminas

2.2 Treatment 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), for treatment process water by volume is taken along with 2% of NaOH.

Fig 1: Treatment of Fiber in 2% NaOH solution

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.

Fig 2: Showing Treated, Untreated Fibres

Fig 3: showing 4mm and 8 mm short 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. 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: Untreated 8mm and 4mm fibre laminates

Fig 5: Treated 4mm and 8 mm fibre laminate

Specimens for flexural test are cut from laminas as per ASTM D790 standards. The standard dimensions for test specimen are shown in the Figure 6.

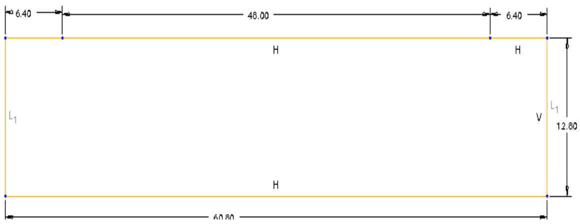

Fig 6: Flexural Test Specimen Dimensions

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. Flexural test is important for designer as well as manufacturer in the form of a beam. If the service failure is significant in bending, flexural test is more relevant for design and specification purpose than tensile test.

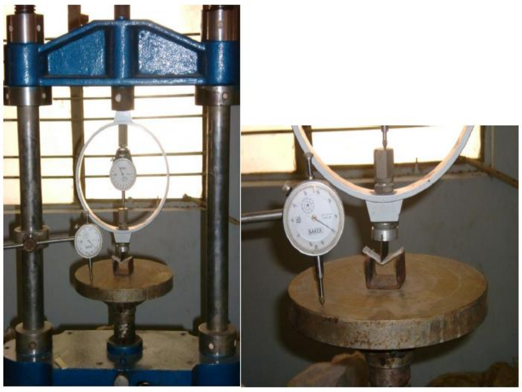

Fig 7: Load frame

Flexural test was done by compression testing machine supplied by Hydraulic and Engineering Instruments, New Delhi, with a cross head speed of 1.25 mm/minute at standard laboratory atmosphere of 23°C ± 2°C (73.4°F ± 3.6°F) and 50 ± 5 percent relative humidity. There were two important parameters being determined in the flexural test, they are flexural strength and tangent modulus of elasticity in bending.

Table 1: Mean values of flexure test observations for kenaf *fiber 8mm* UT lamina

Deflection (mm)	Mean Load	Stress in outer fiber (N/mm^2)	Standard Deviation
0.05	8.25	23.75	14.56
0.1	15.875	47.117	29.15
0.15	24.91	73.9	43.16
0.2	32.25	95.74	55.85
0.25	39.166	116.24	67.84
0.3	45	133.56	77.94

The Flexural Modulus for Different laminas shown in Figure 9. The 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.

Table 2: Mean values of flexure test observations for treated kenaf *fiber at 8mm*

Deflection (mm)	Mean Load	Stress in outer fiber (n/mm²)	Standard Deviation
0.05	10.166	30.166	17.61
0.1	20.33	60.33	35.22
0.15	30.33	90.03	50.22
0.2	40.33	119.69	67
0.25	48.66	144.42	84.29
0.3	55.55	164.72	78.5

3. Results and Discussions:

3.1 Flexural Analysis:

S.NO	Type of Composite	Flexure Strength (MPa)	Flexural Modulus (MPa)
1	4 mm treated fiber composite	166.2	18720
2	8 mm treated fiber composite	164.7	17136
3	4 mm untreated fiber composite	148.4	13256
4	4 mm untreated fiber composite	139.5	12800

Table 3: Flexural strength, Flexural Modulus for different composites

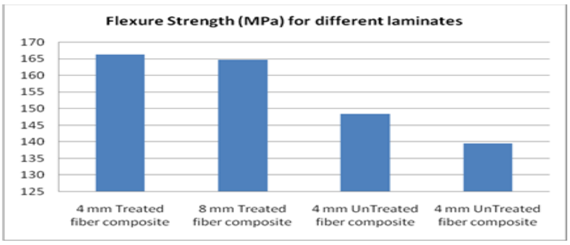

Fig 8: Flexure Strength for different laminates

Results of flexural behavior for different composites are given in Table 3. The Flexural Strength for different laminas shown in Figure 8. The flexure strength of the 8 mm un treated fiber composite is 139.5MPa. 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.

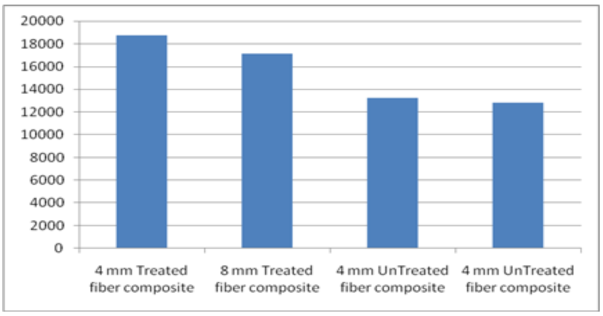

Fig 9: Flexural Modulus for different laminates

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.

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