Experimental Investigation on flax fiber, kenaf Fiber Hybrid Laminated Composites

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Abstract **- The possibilities of traditional materials such as metals and their alloys are so exhausted that even when using the most modern techniques it may be difficult to achieve the highest material characteristics and thus higher performance parameters, the durability and reliability of the proposed structures and equipment. Fiber reinforced polymer (FRP) composites have many merits, such as high stiffness to weight ratio and strength to weight ratio, advanced fatigue and corrosion resistances, etc., The objective of present work is to evaluate the mechanical properties of flax fiber and kenaf fiber reinforced with epoxy as matrix and also evaluate the mechanical properties of hybrid composite. The mechanical properties such as impact strength and hardness of composites are examined. The specimens are prepared by using the Hand Layup fabrication technique. Experiments are conducted to investigate the mechanical properties such as Impact test, Rockwell hardness test. The hybrid composite has obtained high properties such as toughness up to 12.6j/mm^2 Hardness up to 69 HRB.**

Index Terms **- epoxy resin, kenaf fiber, flax fiber, hybridization.**

I.INTRODUCTION

New technologies need materials that combine properties such as high resistance to corrosion, high dimensional stability, and high strength to weight ratio, high rigidity, high fatigue strength, and durability that conventional materials cannot satisfy. Composites are the combination of two or more materials with different physical and chemical properties to give superior properties to those of the individual constituents. Composites offer advantages such as improved strength, stiffness, fatigue and impact resistance, thermal conductivity, corrosion resistance, etc. Natural fibres are an excellent alternative to substitute synthetic fibers in terms of availability, price, carbon emissions, and recyclability [1].

Natural Fiber composite Materials with no extra coating of epoxy resins are likely to be affected or subjected to the water absorption, oxidative decomposition and thermal degradation greatly and affect the cellulose structure of fiber material [2].

Kenaf fiber increases tensile, flexural strength & modulus, impact & thermal behaviour of hybrid composite if it is varying several parameters like processing method, temperature, chemical treatment of fiber, orientation of fibers, stacking sequence, volume fraction of fibers and weave pattern effectively influenced the properties of composite [3].

Fabrication of composite mudguard is carried out by using A- Glass/ Epoxy bidirectional laminates with kenaf and banana fiber. Compared to steel mudguard, the composite mudguard is found to have 64% higher factor of safety and 80% less in cost [4].

Stacking sequence had negligible effect on the tensile strength, but flexural strength and water absorption properties were largely improved by placing the woven glass fiber fabric at the extremes [5].

compression and water absorption properties are improved with increasing the percentage of fiber [6].

Energy absorbing characteristics found in the kenaf/glass hybrid composite with NaOH treatment pave the way to apply this material composite for the attenuator in the frontal assembly of the automotive cars [7].

The tensile, flexural, and impact performance of hybrid composites clearly shows that properties are largely affected due to the presence of Kevlar - kenaf fiber [8].

The tensile strength is increased with increased in fibre percentage loading, ultimate tensile strength is maximum in case of epoxy (85% weight) composition and minimum in case of epoxy (95% weight) composition [9].

By increasing the volume of Chopped Stranded Mat (CSM) into the IPN (Interpenetrating Polymer Networks) matrix increases the static torque capacity of the composite tube. the 5% CSM reinforced composite shaft could bear maximum amount of static load [10].

The kenaf/sisal fiber fabrics reinforced bio epoxy composites presents constant mechanical properties irrespective of the weathering conditions [11].

Kenaf bast fibre has excellent tensile strength combined with superior flexural strength, kenaf fibre has great probability of substituting the synthetic fibers (glass) for flexural and tensile applications [12].

II.MATERIAL PREPARATION

Kenaf fiber and Flax fiber are used as reinforcement materials in this work, where kenaf fiber and flax fiber both are natural fibers. In the hybrid composite, the matrix used is Epoxy Araldite (LY556) with a 10:1 Epoxy to Hardener ratio where the hardener is Aradur (HY951).

The relative weights of the fibers and resins:

Fiber and resin weight ratio for flax fiber is 1:3 and for kenaf fiber is 1:3.5.

Table 1: Number of layers and weight of the individual fiber.

Fibers	No of layers of fibers	Weight of fibers in grams	Weight of resin in grams
Flax fiber composite	6	70	210
Kenaf fiber composite	6	75	260
Hybrid composite	3+3	73	237

Table 2: The composite fiber and matrix weight ratio.

S. No	Specimen name	Composition of composite by(wt%)
1	Flax fiber composite	Flax (25%) + Epoxy (75%)
2	Kenaf fiber composite	Flax (21.9%) + Epoxy (78.1%)
3	Hybrid composite	Flax (20.6%) +kenaf (22.8%) +epoxy (56.6%)

III.MECHANICAL TESTING

On the fabricated hybrid composite material, the following tests are performed.

(a) Charpy impact test

(b) Rockwell hardness test

Hardness test was conducted on the Rockwell Hardness test machine and a toughness test was conducted on the Charpy impact test machine.

(a) Rockwell hardness test:

Hardness of the test specimen is measured by Rockwell hardness test machine (under 60 kgf). Specimen of size 35 × 20 × 3mm^3 with ASTM D785 standards.

Fig.1. Rockwell hardness testing machine

(b) Charpy Impact Test

Toughness of the test specimen is measured by Charpy impact testing machine (maximum capacity 300J). Error in reading 2J.

Fig .2: Impact testing machine

IV.RESULTS AND DISCUSSION

(a) Hardness test results:

Fig.9 shows the details of the hardness test conducted on the three composites. The hybrid composite has better hardness 69 then the remaining two composites.

Table 3: Hardness test results.

S. No	Specimen name	Rockwell hardness number
1	Flax fiber composite	55HRB
2	Kenaf fiber composite	47HRB
3	Hybrid composite	69HRB

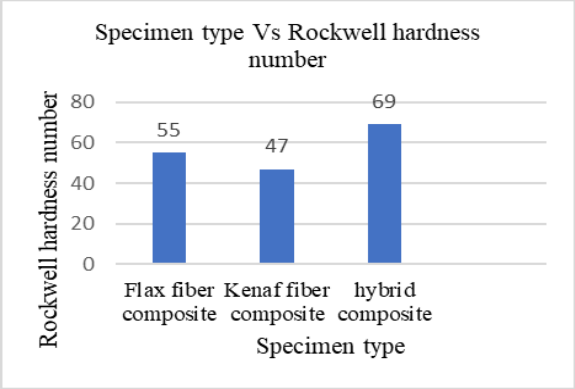

Fig.3. Plot between specimen type and Rockwell hardness number

(b) Charpy Impact Test Result

The hybrid composite has better toughness value than individual composites. Maximum value of impact strength is obtained for hybrid composite with 5gm of filler material (12.6 J/mm^2).

Charpy Impact Test Result

Table 4: Impact test results

S. No	Specimen name	Toughness J/mm^2
1	Flax fiber composite	11
2	Kenaf fiber composite	11.52
3	Hybrid composite	12.6

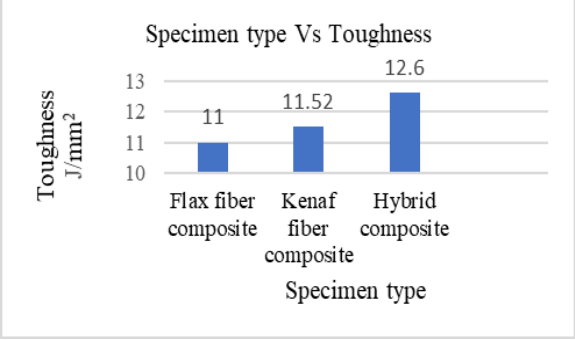

Fig.4. Plot between specimen type and Toughness

V.CONCLUSION

By studying the results obtained from different tests conducted on specimens the following conclusions are presented.

It is observed that the hybrid composite has obtained superior properties over the other specimen

Hardness is increased up to 69 kg/mm^2 for hybrid composite.

Toughness is also increased up to 12.6 J/mm^2 for hybrid composite.

Results show that the mechanical properties of the composite material are improved due to the hybridization.

The tests show a trendline of a gradual and significant increase in the mechanical properties by hybridization technique.

VI.FUTURE SCOPE

In this paper the mechanical behavior of the fabricated individual and hybrid composite studied. This work can further be continued to perform surface analysis of the composite materials by using SEM (scanning electron microscope) images.

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