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EXPERIMENTALLY AND INVESTIGATION ON MECHANICAL PROPERTIES OF KENAF & FLAX WITH DIFFERENT COMPOSITIONS USING HAND LAYUP TECHNIQUE

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Abstract: A composite material is made from two or more constituent materials; having better properties compared two both two parent materials. The composite is stronger, lighter, and less expensive compared with the traditional materials. In current years composites have considerable importance as a potential operational material. Less cost, less weight , more specific modulus, biodegradability and renew ability are the most basic and common attractive features of composites that make them useful for industrial applications. With less cost, ,more specific mechanical properties natural fiber signifies a worthy renewable and biodegradable composite. Among those kenaf, flax and its hybrid fibers. The present work has been done with an objective to explore the use of kenaf fiber, flax fibre and its combinations (hybrid) are used as a reinforcement material in epoxy base, final find out the mechanical properties like tensile, hardness, impact and grain structure of kenaf fiber, flax fiber and its combination (hybrid) composites.

Keywords : Kenaf fiber, Flax fiber, Hybrid Fiber, Tensile test, hardness test, Impact test, Grain structure

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I INTRODUCTION

A "Composite" can be defined as where two or more different materials are physically combined together. Two constituent materials which are having different mechanical, physical and chemical properties are bonded will produce a material with different characteristics from the individual material is called a composite material. The two constituents are reinforcement and matrix .The reinforcement and matrix are the main load carrying elements in a composite material. This matrix can maintain the alignment of fiber, shape and from environmental fortify. The reinforcement can improve the strength of the material.

The properties of composite material are exhaustion life, electrical protection, wear resistance, warm protection

quality, light weight, solidness, warm conductivity, fire resistance, temperature-subordinate conduct, and warm protection. The utilization of composite materials is very long. These composite materials are renewable biodegradable. Composite materials have good fatigue resistance compared to other metals. Low radar visibility and Molding to complex forms of composites are easy compared to other materials. The wide use of composite materials in surface transportation is because of their huge size. The strength-weight ratio is higher than other materials which results in the effective use of composite materials in surface transportation. Resilience and good productivity are the basic required qualities of a good composite material.

CLASSIFICATION OF COMPOSITES

Composite materials can be classified in various ways. Classification dependent on the geometry of an representative unit of reinforcement is advantageous since it is the geometry of the support which is answerable for the mechanical properties and superior of the composites.

A typical classification is presented in table1.1. The two broad classes of composites are

(1) Particulate composites

(2) fibrous composites.

CLASSIFICATION OF FIBERS

Fibers are mainly classified into two types:

Natural fibers:
coir, banana, jute, bamboo, vakka, palm, corn, kenaf,flax etc.
Man made fibers or synthetic fibers:
carbon, boron, glass, Kevlar, graphite etc.

NATURAL FIBERS

Food producing plants, fiber producing plants play a significant role in modern civilization. Fiber is an anatomical structure obtained from trees, stems, leaves, roots and seeds. Fibers are derived from meristematic tissue of primary or secondary origin depending on the species. Vegetable fibers consist of cellulose, lignocelluloses, hemicelluloses, pectin depending on the vegetable species. Worldwide, now a days there is a great demand for modern synthetic fibers and vegetable fibers for quality resistance, durability and luster.

Analysis of growth and productivity of the fiber crops are most important due to the intense competition between natural and industrial fibers. The place of cotton as a fiber crop has been well documented, so this work concentrate mainly on vegetable fibers that are short called as short vegetable fibers.

Classification of Natural Fibers

Generally natural fibers are sub divided into,

Animal fibers: wool, hair, silk extracted animal fibers

Mineral fibers: Asbestos

Vegetable fibers: woody fibers, seed fibers

FLAX:

Figure 1Flax fiber

Flax also known as linseed. Its binomial name is linum lisitssimum. Flax comes under the family of Linacease. Flax was extensively cultivated in ancient egypt. Flax grows to 1.2 m tall with slender stems with 20-40 mm long and 3mm broad. The leaves are in glaucous green colour.

KENAF:

Kenaf is a plant in the family Malvaceae likewise called Deccan hemp and Java jute. Hibiscus cannabinus is in the class Hibiscus and is local to southern Asia, however its definite birthplace is unknown. The name additionally applies to the fiber got from this plant. Kenaf is one of the united strands of jute and shows comparable qualities.

Figure 2 Kneaf fiber

MATRIX

Polymers are used as matrix materials which are also commonly known as resins.

The matrix resin occupies 30 to 40 % by volume of a composite material. Matrix acting as a stress transfer medium and maintaining the shape of the composite structure. Matrix material protects the fibers from the ambient conditions like corrosion, abrasion, humidity etc. Generally epoxy, polyester, polyethylene, phenolics, polystyrene, polyether-ether- ketone are used as matrix materials. Polyester comes under thermo sets and which are having advantages of low cost, high strength, definite shelf life, low strains to failure and simple manufacturing principl1es.

POLYESTER RESIN

Generally polyester resins can be made by Di basic organic acid and a dihydricalcohol.

There are two types of polyester:

1. Saturated polyester
2. Unsaturated polyester

To form the composite matrix unsaturated group of dibasic acids are used. The polyester resin is usually dissolved in monomer and co polymerizes with it and gives the final properties of the cured resin. Different types of polyester resins can be made by varying acid and alcohol. Frequently used catalyst is methyl ethyl ketone peroxide or benzoyl peroxide. The addition of catalyst will cause the resin to cure. The catalyst will decompose in polyester resin to form free radicals, to initiate the polymerization. Higher temperature or more the catalyst gives the faster reactions. After resin turns from liquid to brittle solid post cure is needed at higher temperature. Isophthalic polyesters gives excellent environment resistance and improved mechanical properties than orthophthalic polyesters.

II LITERATURE REVIEW

C AJAY SRINIVAS et al. [1] in this paper we can find the interest of creator's ideology in the utilization of natural fibers. Rapid increase in the utilization of natural composite fibers in industrial applications as an alternative to fiber reinforced composites makes this study more effective. Low in cost, good mechanical properties with high specific strength, environmentally friendly and bio–degradability exploited as a replacement for conventional fiber.

A.V RATNA PRASAD et al. [2] in this paper we can observe study which has been explained out to examine the tensile, flexural and dielectric properties of composites which are made by reinforcing vakka as natural fiber into a polyester resin matrix. The fibers extracted by retting processes have been used to fabricate the composites. These fabricated composites are examined for tensile, flexural and dielectric properties and estimate with those of composites like sisal, bamboo and banana. These composites are fabricated up to a maximum volume fraction of fiber of 0.37 for tensile testing, and 0.39 for flexural and dielectric testing. We can observe the tensile properties increase w.r.t volume fraction of fiber for vakka fiber composite and are also more than sisal and banana composites and comparable to those of bamboo composites. The flexural strength of vakka fiber composite is more than of banana composite and is closer to sisal fiber composite. We can find the dielectric strength of vakka fiber composite which increases with increase in volume fraction of fiber in the composite. The dielectric strength being an additional feature of vakka fiber composite can be recommended for electrical insulation applications.

RAMANAIAH .K et al. [3] in this study the main aim of this work is to examine a new natural borassus seed shoot fiber as reinforcement in polymers for making partially green polymer composites. The fiber present in the composites was varied from ~ 0.116 to0.305 by volume fraction and the analysis of mechanical properties such as tensile, flexural and impact properties in each part were examined. The tensile and flexural strength of Borassus seed shoot fiber composite had been improvement to 77.1%and112.6% respectively over pure matrix. The fracture measured in impact at maximum volume fraction of fiber is found to be 88.54 J/m.

G.DILLI BABU et al. [4] in this paper the main study relates to favourable mechanical and machining properties of luffa fiber in thermoplastic matrix composite and an experimental analysis of mechanical and machining potential of Luffa fiber reinforced composite. The main aspects of this study are low cost, high specific modulus, light weight renewability and biodegradability of composites which are useful for industrial applications make author interested. By utilizing numerous potential natural resources in Indian forest and agriculture the Luffa - aegytiaca locally called as sponge-gourd is one such natural resource

A.V.S.S.K.S GUPTA et al. [5] in this article the main analysis is done on rice straw fiber which is fabricated by polyester resin and is subjected to tensile and impact tests. This rice straw fiber has a Tensile strength around 69.72Mpa and Tensile Modulus of2.427Gpa.A maximum of 40% volume fraction of fiber is used to fabricate and resulting tensile strengths extracted are 46Mpa which is more than pure polyester resin of 31.5%.Tensile modulus also increased by 1.66 times than pure polyester and settle down at 1045Mpa. Impact strength is up to 284J/m at 46% of volume fraction. In structural based products this straw fiber composites are used.

III PROBLEM STATEMENT

RESEARCH NEEDS:

These typical fibers have a key part in long time past days. These individuals, in

light of these fibers they make them for their private uses like range homes cruising strength etc. The examination has exhibited that, these built fiber advancements are offered by an impelled development, then again, these investigates are to upgrade the application, quality and effectiveness of customary fibers.

These standard fiber composites have various inclinations of being strong, unassuming, and light, more eco friendly and safe. Regardless, by using of these trademark fibers there are a couple of request raised up that how such sort of materials are to be striven for sturdiness and quality. More works ought to be required before these regular fiber composites are used as a piece of asking for conditions. From these trademark fiber sustained plastics, Daimler Benz have used gateway sheets for their Mercedes G class cars besides they have courses of action to construct the material containing normal fiber fortified plastics for various portions. Once after developed, the advancement would be a dynamic making of a broad number of Eco-friendly things.

In our country India, there are far reaching particular blended packs of regenerative plants and trees with some fiber content. In them, some are created from the times and some are wild plants, creepers, and trees that create in woodlands and woods. It is a known fact that any material which is in stringy structure is more grounded than in the mass structure. Thus, these strong filaments are used.In any case, same business identified with this fiber is all that abundantly obliged when stood out from various filaments. This examination incorporates to explore the possible usage of filaments in making of new blended sack of composites for weight passing on structures. The propose of trademark filaments is to extend the quality. A vast bit of the ordinary composites are less costly than the produced fiber composites.

ASPECTS OF THE PROPOSED RESEARCH WORK:

he proposed investigation work is to investigate the advantages of using the trademark fiber as reinforced material in composites. The examination work gives the central information and perception of the behavior and response of typical fiber. Diverse parts of basic filaments have been explored. Preparation of characteristic fiber-Extraction of fiber, kenaf and flax Tensile properties and -kenaf fiber composite specimens, according to ASTM guidelines.

- Tensile properties-flax composite specimens, according to ASTM guidelines.
- Tensile properties-Hybrid fiber composites specimens, according to ASTM guidelines.
- Hardness properties-kenaf fiber composite specimens, according to ASTM guidelines.
- Hardness properties- flax fiber, according to ASTM guidelines.
- Hardness properties- Hybrid fiber composite.
- Impact properties-kenaf fiber composite specimens, according to ASTM guidelines.
- Impact properties-Hybrid fiber composite, according to ASTM guidelines.

FABRICATION OF COMPOSITE SPECIMENS (HAND LAYUP):

Hand lay-up technique is the simple and cheapest method of composite processing. The infrastructural need for this technique is also minimal .The standard test procedure for Mechanical properties of fiber-resin composites; ASTM-D790M-86 is utilized to according to the measurements.

The mold is prepared on smooth clear film with 2 way tape to the required measurement. At that surface mold is prepared keeping the 2 way tape on the clear film. The reinforcement in the form of long fiber are cut as per the mold size and placed on the surface of thin plastic sheet. Then the thermosetting polymer in liquid form is assorted thoroughly in appropriate proportion with a recommended hardener (curing agent) and poured on the surface of clear .The polymer is uniformly spread with the help of brush. Then second layer of fiber is placed on the polymer surface and another layer of polymer is applied after this is closed with another thin plastic sheet after squeezer is moved with a gentle pressure on the thin plastic sheet to remove air .The consequential mold is cured for 24 hours at room temperature.

Al powder is mixed with epoxy resign and stirred uniformly half and hour and same process is follow to produce Al composites

After fabrication specimens are cut form sheets according to the ASME statndards165mm long, 12.5mm in width and 4mm in thick are fabricated for tensile testing. 100mm long, 25mm width and 4mm in thick are fabricated for flexural testing. 63.5mm long, 12.36mm width and 6mm thick are fabricated for impact testing.

ALKALI TREATMENT:

Kenaf and flax fibers were soaked in 5 and 5 (wt)% of NaOH solutions at 25°C for 7 h, maintaining a liquor ratio of 15:1. The fibers were washed for several times with distilled water

to remove any alkali solution sticking on their surface, after fiber are dried in sun light as shown below figures.

Figure 3 Alkali treatment

Figure 4Fiber preparation

IV TESTING OF COMPOSITES

TENSILE TESTING OF COMPOSITES:

A 2 ton limits electronic tensometer, METM 2000 ER-1 model (Plate II-18), supplied by M/S microtech Pune, is used to determine the elasticity of composites. Its capability can be changed by burden cells of 20 kg, 200 kg and 2 ton. A burden cell of 2 ton is used for testing composite specimens. Self-adjusted brisk grasp throw is used to hold composite specimens.

IMPACT TESTING OF COMPOSITES:

Standard test procedure, ASTM D256-97, for effect properties of fiber composites has been used to examine the unidirectional composite specimens. The specimens to be examined are of dimensions 63.5mm long, 12.36mm wide and 10mm in thick. A V-point is placed in impact tester record having an included point of 450 at the focal point of the specimen, and at 90¬¬0 to the specimen pivot. The profundity of the specimen to be examined under the indent is 2 mm.

BEFORE TESTING

Figure 5 Tensile test specimens

HARDNESS TEST :

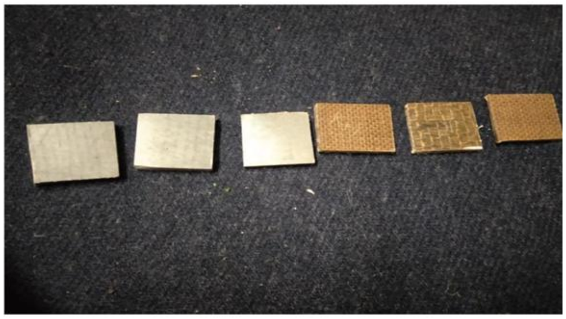

Figure 6Hardness test Specimens before testing

IMPACT TEST :

Figure 7 Impact test Specimens before testing

AFTER TESTING

SPECIMENS: TENSILE TEST

Figure 8 Tensile test Specimens Afore testing

IMPACT TEST

Figure 9 Impact test Specimens Afore testing

HARDNESS TEST :

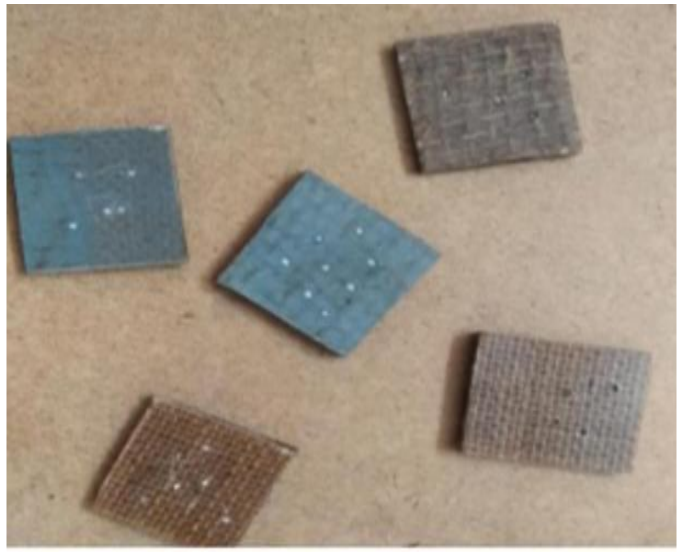

Figure 10 Hardness test Specimens Afore testing

V RESULT AND DISCUSSION

MECHANICAL CHARACTERISTICS OF COMPOSITES:

The properties of the hemp & pineapple grass fiber reinforced epoxy hybrid composites with of fiber under this investigation are presented in below Tables &figures respectively. Details of processing of these composites and the tests conducted on them have been described in the previous chapter.

The results of various characterization tests are reported here. This includes evaluation of tensile strength, flexural strength, impact strength. Has been studied and discussed.

Based on the tabulated results, various graphs are plotted and presented in figs for composites.

VI TENSILE TEST KENAF , FLAX AND HYBRID COMPOSITE:

Table 6.1: Tensile test results

TENSILE TEST	LOAD	ELONGATION
KENAF FIBRE	1932	5.04
KENAF+FLAX HYBRID FIBRES	1167	2.85
FLAX FIBRE	951.3	3.37
HYBRID+10%AL	1490.7	4.20
HYBRID+20%AL	1520.5	5.08
HYBRID+30%AL	2716.5	6.72

IMPACT TEST PROPERTIES OFKENAF, HYBRID AND FLAX:

IMPACT TEST	NEWTONS
KENAF	0.5
FLAX	0.3
KENAF + FLAX(HYBRID)	0.6
HYBRID+10%AL	0.4
HYBRID+20%AL	0.6
HYBRID+30%AL	0.8

Table 6.2: Impact test results

HARDNESS TEST PROPERTIES OF KENAF, HYBRID AND FLAX:

HARDNESS TEST	DEPTH OF INDENTATION
KENAF	31
FLAX	28.5
KENAF + FLAX(HYBRID)	30.5
HYBRID+10%AL	23
HYBRID+20%AL	30
HYBRID+30%AL	33

Table 6.3: Hardness test results

VII CONCLUSION

1. The present work has been done with an objective to explore the use of kenaf fiber, flax fibre and its combinations (hybrid) are used as a reinforcement material in epoxy base, final find out the mechanical properties like tensile,impact,hardness anf grain structure of kenaf fiber, flax fiber and its combination (hybrid) composites. The mechanical behavior of kenaf fiberand flax fiber reinforced hybrid natural fiber composite lead to the following conclusions

2. Our project natural fiber reinforced epoxy hybrid composites are successfully fabricated using hand lay-up technique.

3. By increasing the weight percentage of fiber, the mechanical properties also increases up to certain limit. Further, addition causes them to decrease due to poor interfacial bonding between fiber and matrix.

4. By increasing length of the fibers we can get more strength.

5. By increasing the thickness of specimen we can get better properties than this thickness.

6. Due to the low density of proposed natural fibers compared to the synthetic fibers (Glass fibers, carbon fibers, etc...), the composites can be regarded as a useful engineering materials in light weight applications.

7. Finally hybride(kenaf+flax) fibre with 30% Al is the concluded this project because good strength and stiffness compared to remaining composites.

REFERENCES

1.**Belgacem, M. N., & Gandini, A. (2005).** The surface modification of cellulose fibers for use as reinforcing elements in composite materials. Composite Interfaces, 12, 41–75

2. **Morales, J., Olayo, M. G., Cruz, G. J., Herrera-Franco, P., & Olayo, R. (2006).** Plasma modification of cellulose fibers for composite materials. Journal of Applied Polymer Science, 101(6), 3821–3828**Kalia, S.Kaith, B.S., & Kaur, I. (2009).** Pretreatments of natural fibers and their application as reinforcing material in polymer composites – A review. PolymerEngineering & Science, 49(7), 1253–1272.

3. **Xie, Y., Hill, C. A. S., Xiao, Z., Militz, H., & Mai, C**. (2010). Silane coupling agents used fornatural fiber/polymer composites: A review. Composites Part A: Applied Science And Manufacturing, 41(7), 806–819.

4. **Munikenche Gowda, T., Naidu, A. C. B., & Chhaya, R. (1999).** Some mechanical properties of untreated jute fabric-reinforced polyester composites. Composites Part A: Applied Science and Manufacturing, 30(3), 277–284.

5. **Sreekala, M. S., George, J., Kumaran, M. G., & Thomas, S. (2002).** The mechanical performance of hybrid phenol-formaldehyde-based composites reinforced with glass and oil palm fibers. Composites Science and Technology, 62(3), 339–353.

6. **Abu Bakar, A., Hariharan, & Khalil, H. P. S. A. (2005).** Lignocelluloses-based hybrid belayed laminate composite: Part I – Studies on tensile and impact behavior of

7. Oil palm fiber–glass fiber-reinforced epoxy resin. Journal of Composite Materials, 39(8), 663–684.

8. **M. Ramesh, K. Palanikumar, K.Hemachandra Reddy. (2012)**. Mechanical property evaluation of sisal–jute–glass fiber reinforced polyester composites.

9. **Sreekala, M. S., George, J. Kumaran, M. G., & Thomas, S. (2002).** The mechanical performance of hybrid phenol-formaldehyde-based composites reinforced with glass and oil hemp fibers. Composites Science and Technology, 62(3), 339–353.

10. **Jones, F. R. (1994).** Handbook of polymer composites. England: Longman Scientific and Technical

11. **John, M. J., & Thomas, S. (2008).** Biofibres and biocomposites. Carbohydrate Polymers, 71(3), 343–364

12. **Jacob, M., Thomas, S., & Varughesew, K. T. (2004a).** Mechanical properties of pine apple /oil hemp, hybrid fiber reinforced natural rubber composites. Composites Science and Technology, 64(7–8), 955–965.**Flex Form. (2011).** Molding the future with natural fiber composites.

13. **John, M. J., &Anandjiwala, R.D(2008).**Recent developments in chemical modification and characterization of natural fiber-reinforced composites. PolymerComposites, 29(2), 187–207.

14. **Koradiya, S. B., Patel, J. P., & Parsania, P. H. (2010).** The preparation and Physicochemical study of glass, jute and hybrid glass–jute bisphenol-C-based Epoxy resin composites. Polymer-Plastics Technology and Engineering, 49(14),1445–1449.

15. **Srivastav, A. K., Behera, M. K., & Ray, B. C. (2007).** Loading rate sensitivity of jute/glasshybrid reinforced epoxy composites: Effect of surface modifications. Journal of Reinforced Plastics and Composites, 26(9), 851–860.

16. **Gatenholm, P., Bertilsson, H., & Mathiasson, A. (1993).** Effect of chemical composition of interphase on dispersion of cellulose fibers in polymers. I .PVC-coated cellulose in polystyrene. Journal of Applied Polymer Science, 49(2),197–208.

17. **Kong, K., Hejda, M., Young, R. J., & Eichhorn, S. J. (2009).** Deformation micromechanics of a model cellulose/glass fiber hybrid composite. Composites Science and Technology, 69(13), 2218–2224.

18. **Patel, V. A., Vasoya, P. J., Bhuva, B. D., & Parsania, P. H. (2008).** Preparation and physicochemical study of hybrid hemp (treated and untreated) biphenyl- C-based mixed epoxy phenolic resin composites. Polymer-Plastics TechnologyAnd Engineering, 47(8), 842–846.