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MECHANICAL BEHAVIOUR OF JUTE, COCONUT FIBRE AND HUMAN HAIR REINFORCED EPOXY RESIN

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ABSTRACT

The study is all about combining the composites with natural fibres in order to increase their tensile strength, compressive strength, flexural strength, stiffness and its wide range of characteristics by precise fabrication and testing. Natural fibre (NF) is obtaining more attention in recent years due to its application in various fields including automotive, merchandise, marine, aerospace and aircraft industries. Natural fibre composites such as Jute, Coconut fibre and Human hair polymer composites appear more attractive due to their higher specific strength, light-weight, biodegradability and low cost. Aim of this paper is to fabricate a Jute, Coconut fibre and Human hair reinforced with epoxy laminated composites with certain degrees of 0°, 45° and 60° are prepared and compared with its tensile strength, compressive strength and flexural strength are evaluated and to investigate how the mechanical characteristics are changed by varying strain rates. The obtained results shows that natural fibre as unique characteristics which opens the door for new innovation thoughts to create effective combination of composites along with natural fibres results in results in high stability, increase in stiffness, tensile strength, compressive strength, cost-effective and environmental friendly.

KEYWORDS: *jute, coconut fibre & human hair, FRP, tensile strength, flexural strength.*

I. INTRODUCTION

Focus on the development of natural fibres like jute, coir, sisal, pineapple, ramie, bamboo, banana etc., is to explore its application in low load condition. Composites, the wonder material with light-weight, high strength-to- weight ratio and stiffness properties have come a long way in replacing the conventional materials like metals, woods etc. The replacement of steel with composites can save a 60-80 percentage of component weight and 20-50 weight percentages with th aluminium components. The polymer based composite materials use is increasing *Composite Material*

Composite materials also called composition materials and that is shortened to composites. They are materials made from two or more constituent materials with significantly different physical or chemical properties, that when combined, produce a material with characteristics different from the individual components. The individual components remain separate and distinct within the finished structure. The new material may be preferred for

many reasons: common examples include materials which are stronger, lighter or less expensive when Compared to traditional materials Because of their light weight, good mechanical and tribological responses .However, composites encounter problems such as fibre fracture, matrix cracking and delamination. Of these, fibre fracture and matrix cracking plays an important role in laminates under tensile load [2-5].

After the composite development to meet the challenges of aerospace sector, researchers have focused to cater to needs of domestic and industrial applications. The abundant availability of natural fibres such as jute, coir, sisal, pineapple, ramie, bamboo, banana etc., has given a impetus to the development of natural fibre composites. This development is done considering the deforestation (depletion of forest resources) with an objective of returns for the cultivation of natural fibres. Composite boards have been used in development of panel and flush doors to satisfy the low cost housing needs. Other product development such as panel roofing sheets with sisal fibres and glass added to jute fibre produces large increase in mechanical properties of composites. Since natural fibre composite being cost- effective materials finds it application in building, construction industry (panels, false ceilings, partition boards etc.), packaging, automobile & railway coach interiors and storage devices.

Recent research [6,7] indicates that natural fibres can very well be used as reinforcement replacing the expensive glass fibres in polymer composites. Plywood, medium density fibre boards, panel and plush doors were developed from Jute and coir based composites. The addition of jute fibre (12–24 volume %) in glass showed an increase in mechanical properties of the composites. Hence thus jute fibre shows an effective and value added application. The applications of jute polyester composites in use are lampshades, suitcases, paperweights, helmets, shower, bath units, electrical appliances, covers, pipes, post-boxes, roof tiles, grain storage silos, panels for partition and false ceilings, bio-gas containers, and in the construction of low cost Mobile as well as pre-fabricated buildings for use in times of natural calamities.

The study of natural fibre reinforcement is due its abundant availability in wide variety [8-15].The material scientists all over the world focused their attention on natural composites reinforced with jute, coir, sisal, pineapple, ramie, bamboo, banana primarily to cut down the cost of raw materials is to explore its application in low load condition.

The composites can be prepared with desired properties by orienting the fibres according to the application. The composites are comparatively cheaper to manufacture and there are various manufacturing processes available for the composites. The surface finish of the composite is comparatively much higher and it can be manufactured in different techniques. The use of composites has given more flexibility to design engineers to develop new design and for modifications in the existing design. Since the composites are easier to handle and synthesize.

The fabrication of composite by using jute, coconut fibre and human hair is a simple hand layup technique has been used for preparation of specimen. The working surfaces are treated with polyvinyl alcohol to facilitate easy removal of moulds. Each layer of fabric is pre-impregnated with matrix material and place over the other in the mould, taking care to maintain practically achievable tolerance on fabric alignment. Arrangements were made to avoid leakage of matrix material by keeping the two opposite ends open to allow hot air to escape during curing. The casting is cured under light pressure for 30 min before removal of the mould and the final specimens were shaped according to ASTM standard of particular machine. The mechanical properties were evaluated such as flexural strength, tensile strength, impact strength, and tensile modulus, elongation at break, flexural modulus and hardness of the composites [16].

Experimental Procedure:-

During the fabrication of the material, the material was placed with different orientation. There are 3 composites plates were fabricated in the aligned order of jute fibre ,coconut fibre, human hair then again coconut fibre and jute fibre in the orientation of 0̊, 45̊ and 60̊, that is one complete composite plate is arranged in the manner of 0̊ similarly 45̊ and 60̊ were arranged.

And from each composite plates for tensile test, composite test and flexural test the specimens is sized according to the ASTM standard of the testing machine. Then for tensile test specimen were from 0̊, 45̊ and 60̊ orientation, similarly for composites and flexural and totally 9 specimens.

The tensile test, composite test and flexural test is tested in the universal testing machine. The specimen was held on the machine and tensile force was applied. The displacement was measured and the force Vs displacement graphs were plotted, similarly for composites and flexural.

After finishing these processes the final fibre will look like the below figure 4.

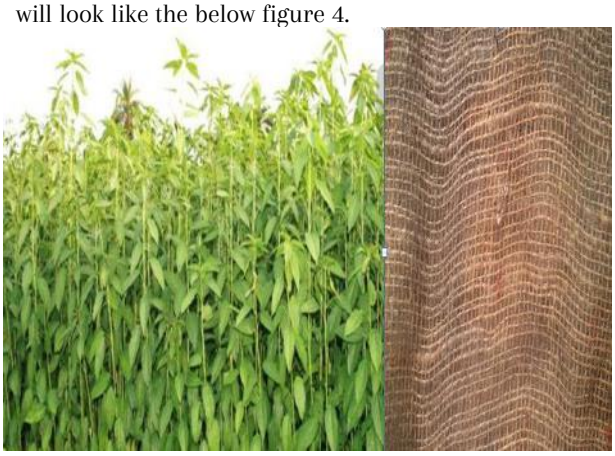


FIG. 1 Jute Fibre

Fig. 2 Human Hair &Coconut Fibre

II. LITERATURE REVIEW

Mohd Edeerozey et al (2007): Studied the performance of Jute bast fibres in terms of alkali treatment in different concentrations. Chemical treatment of the fibre can clean the fibre surface, chemically modify the surface, stop the moisture absorption process and increase the surface roughness. A series of fibre bundle tensile tests were also performed to evaluate the effect of the treatments on the fibre tensile strength.

Anuar et al (2008): Studied the tensile and morphological properties of hybrid composite of thermoplastic natural rubber (TPNR) reinforced with Hibiscus cannabinus L. fibre (jute fibre: KF) and short glass fibre (GF). The result of tensile strength has shown that the increase in jute fibre content substantially reduced the tensile strength and modulus.

Shibata et al (2008): Studied the Young's modulus and flexural modulus of bio based polymer composites made from jute, bamboo and biodegradable resin. The flexural modulus increased with increasing fibre content.

Symington et al (2009): Studied the tensile properties of jute, jute, flax, abaca, sisal, hemp and coir fibres for samples exposed to (1) room temperature and humidity, (2) 65% moisture content, (3) 90% moisture content, and (4) soaked fibre. It can also be concluded that the process of fibre alkalization has effect on the base strength of natural fibre, and there may be an optimum process condition if performance of the fibre in composite material form is to be maximized.

III. PROPOSED METHODOLOGY

This chapter deals with which kind of method used for forming composite material and various type of methods used for testing the behaviour of prepared composite material.

The formation process is involves fibre combined with the resin. The type of resin used in this composite material is poly propylene.

The strength of Jute fibre, coconut fibre and human hair is increased with the addition of resin. The method used for forming the composite material is a compression molding process. Composite produced on this type of formation method is uses thermal energy to increase bonding capacity of composites.

Fig.3 Methodology

Fig.4 Final Specimen

The testing which are conducted in prepared specimens are follows

A. Tensile test
B. Flexural test
C. Compression test

A.Tensile Test:-

Tensile test is a measurement of the ability of a material to withstand forces that tend to pull it apart and to what extent the material stretches before breaking.

The specimens were positioned vertically in the grips of the testing machine.

Specimens for the Tensile Test are cut on a jig saw machine as per ASTM standards. The dimensional of each type of specimen are (250mm x 25mm).

B. Flexural Test:-

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.

C.Compression Test:-

A SHPB apparatus is designed for dynamic type compressive testing of various materials such as metals, ceramics, and polymeric composites under a large range of strain rates up to several thousand per second. Compared to dynamic tension and torsion SHPB tests, the dynamic compressive test is most commonly used in practice because of its simplicity in both test technique and sample designs.

IV. RESULTS AND DISCUSSION

The mechanical behaviour of jute, coconut fibre and human hair reinforced epoxy composites were subjected to mechanical characterization. Its mechanical properties studied are compared. The results revealed that the jute - epoxy exhibited better mechanical properties. The jute contains a fairly high proportion of stiff natural cellulose amongst the other lingo cellulosic fibres. The mechanical properties of jute fibres tend to be controlled by the cellulose content and micro fibril angle based on the morphology and fibre composition. Finally when compared to the natural fibre composites with the orientation 0°, the other degrees like 45° and 60° are given good results.

TEST RESULTS

The test results for the Tensile, Flexural and compression testing for the three varieties of the composite samples are presented as in the Chart and graph format are given below.

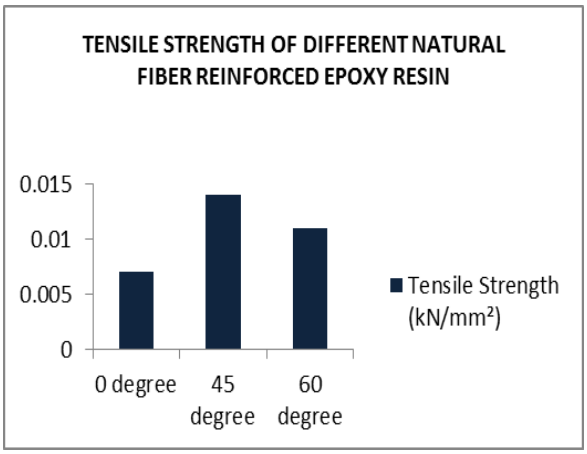


Chart.1 Test Results for Tension

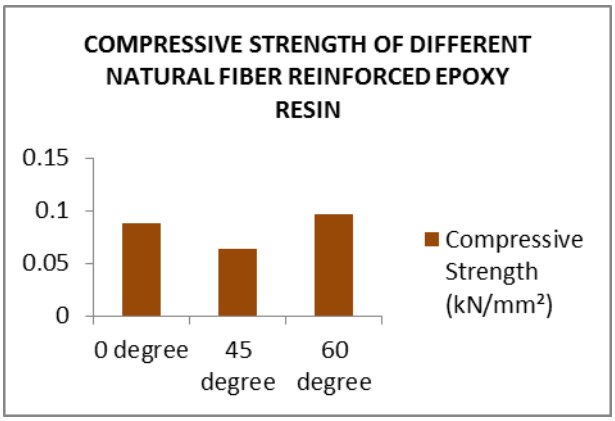


Chart.2 Test Results for Compressio

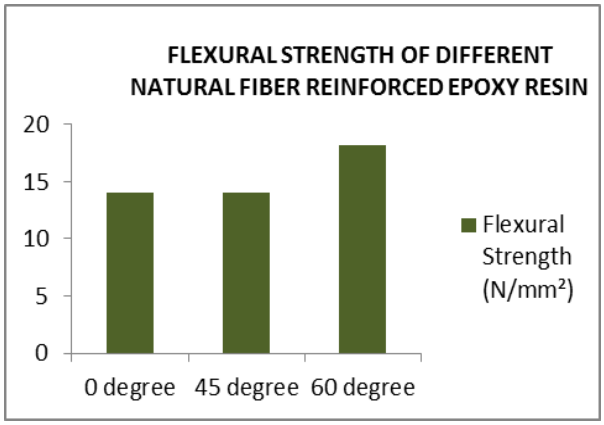
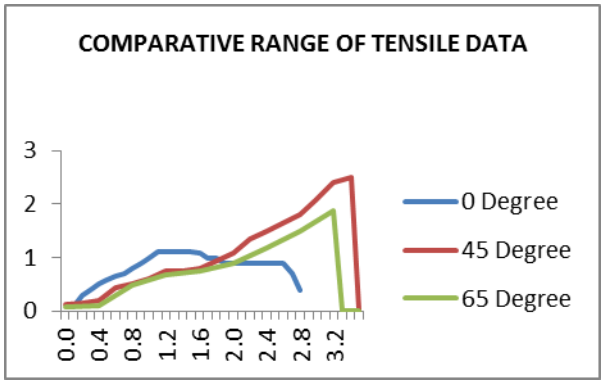
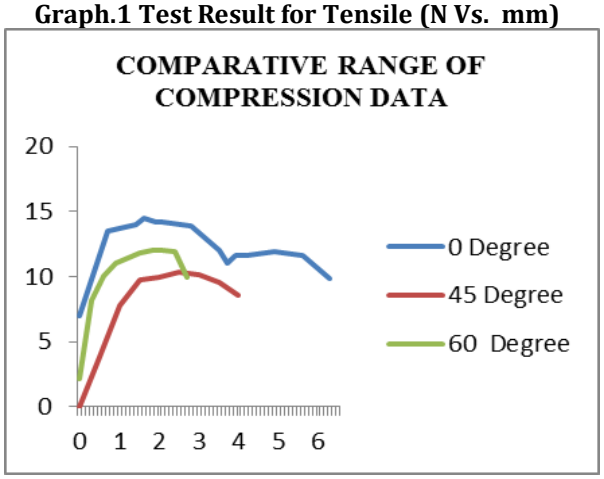


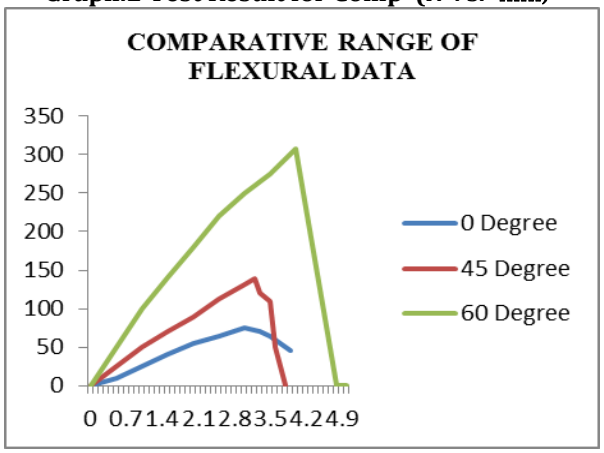
Chart.3 Test Results for Flexural



Graph.1 Test Result for Tensile (N Vs. mm)



Graph.2 Test Result for Comp (N Vs. mm)



Graph.3 Test Result For Flexural (N Vs. mm)

V CONCLUSIONS

This experimental investigation on Jute, coconut fibre & human hair Reinforced with epoxy resin composites leads to the following conclusions: This work shows that successful fabrication of Jute, coconut fibre and human hair Reinforced with epoxy resin composites with different fibre orientation is possible by simple hand lay-up technique. It has been noticed that the mechanical properties of the composites such as tensile strength, flexural strength, compressive strength of the composites are also greatly influenced by the fibre orientation.

In Tensile test – while comparing the tensile strength and also for load(N) Vs. Displacement (mm) graph among the 3 degree orientation, 45° given the best result.

In Compression test - while comparing the compressive strength of 3 degree orientation, 60° have got good strength at the same time comparing the load (N) Vs. Displacement (mm) graphs for compressive , its shows like 0° is the best. This difference is exactly shows the endurance capability of the composites in the orientation of 60° when compared to 0 °.0° composite sudden distraction from the path is the main reason.

In Flexural test - while comparing the flexural strength and also for load(N) Vs. Displacement (mm) graph among the 3 degree orientation, 60° given the best result.

Finally when compared to the natural fibre composites with the orientation 0°, the other degrees like 45° and 60° are given good results.

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REFERENCES

1. *Stamm in 1947 Rana et al. (1997) Composites Reinforced with Cellulose Based Fibres, Progress in Polymer Science, 1999, 24, 221–274.*
2. *Roy (1995)145 Natural Fibre Eco-composites, Polymer Composites, 1995, 28(1), 98-107.*
3. *Pandey and Majumdar (2001)120 M. S., Reinforced Plastic Composites, Polymer Engineering and Science, 2001, 41 (9), 1471-1485.*
4. *Samanta and Das (1997)148., Natural-Fibre-Reinforced Polymer Composites in Automotive Applications, JOM, 2006, 11, 80-86.*
5. *Ghosh and coworkers "Aufladepotentiel und Sekundäremissionelektronenbestrahlter Körper".Zeitschrift fürtechnischePhysik 16: 467–475*
6. *Sarkar (2005)151 M., Hinrichsen, G., Biofibres, Biodegradable Polymers and Biocomposites: An Overview, Macromolecules and Material Engineering, 2005, 276/277, 1-24.*
7. *Ghosh G., Principles of Polymerization 4th Edition, John Wiley & Sons, Inc: New Jersey, 2004*