International Conference on Advances in Materials, Computing and Communication Technologies
In Association withInternational Journal of Scientific Research in Science and Technology
Volume 9 | Issue 1 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X (www.ijsrst.com)

Design and Fabrication Of hybrid (Glass/Fibre) Composite Materials

L Robinson[1], S Muthu[1], Dr. V Manikandan[2], Dr. A Krishnaraju[2]
[1]BE students, Department of Mechanical & Automation Engineering, PSN College Of Engineering & Technology, Tirunelveli, Tamil Nadu, India
[2]Professors, Department of Mechanical & Automation Engineering, PSN College Of Engineering & Technology, Tirunelveli, Tamil Nadu, India

ABSTRACT

Nowaday's composites are playing a dominant role in many industrial applications. Different types of composites are fabricated by using hand layup method. Natural fibers are very tough, lightweight and also comparatively very cheap. This work concerns the production of hybrid composites by hand lay-up method and predict the effect of process parameter on tensile, flexural and compression strength of jute and glass fiber reinforced polyester-based hybrid composites. The mechanical properties like tensile, flexural and compressive strength were evaluated for the specimen cut from the fabricated composite plates to the dimensions according ASTM standard.

I. INTRODUCTION

Composites are combinations of materials differing in composition, where the individual constituents retaintheir separate identities. Among all the synthetic fibers, glass fibers are now dominant due to their low cost andcomparatively better physic-mechanical properties. Natural fibers are very thin hair like material. They aredirectly obtained from a vegetable, animal, or mineralresource and convertible into non-woven fabrics like felt orafter spinning into yarns, or paper into woven cloth. Theincreased demand of natural fiber is due to their low cost,renew-ability, low density, bio-degradability, and abundance. When two or more materials with different properties are combined together, they forma composite material. Composite material comprise of strong load carrying material (known asreinforcement) imbedded with weaker materials (known as matrix).The primary functions ofthe matrix are to transfer stresses between the reinforcing fibres/particles and to protect themfrom mechanical and/or environmental damage whereas the presence of fibres/particles in acomposite improves its mechanical properties like tensile strength, flexural strength, impactstrength, stiffness etc.

II. THEORETICAL BACKGROUND

Composite materials having a range of advantages overother conventional materials such as tensile strength, impact strength, flexural strengths,stiffness and fatigue characteristics. The development of composite materials and their related design and manufacturingtechnologies is one of the most important advances in the history of materials.

Composites arethe material used in various fields having exclusive mechanical and physical properties and aredeveloped for particular application.In order to obtain the preferred material properties for a particular application, it is important to know how the material performance changes with the fibre content and fibre orientation under given loading conditions.By combining fiber and resin a bulk materials is produced with a strength and stiffness close to that of the fibers and with the chemical resistance to the plastic.The arrangement or orientation of the fibres relative to one another within thematrix can affect the performance of a composite. In order to obtain the preferred materialproperties for a particular application, it is important to know how the material performancechanges with the fibre content and fibre orientation under given loading conditions.

Table 1 Physical properties of natural fibres

Fibre	Tensile strength (Mpa)	Young's modulus(Gpa)	Elongation at break(%)	Density(g/cm3)
Jute	393-773	26.50	1.50-1.80	1.30
Bamboo	140-230	11-17	----	0.60-1.10
Cotton	287-597	5.50-12.60	7-8	1.50-1.60
Flax	345-1035	27.60	2.70-3.20	1.50
Hemp	690	70	1.60	1.48
Sisal	511-635	9.40-22	2.0-2.50	1.50
E-glass	3400	72	---	2.5

A great deal of work has been carried out to measure the potential of natural fibre as reinforcement in polymer such as jute, coir, bamboo ,sisal, banana and wood fibres have been reportedThe present research work thus is undertaken to study the processing, characterization and mechanical behaviour of jute/glass fibre reinforced epoxy based hybrid composites

III. MATERIALS AND METHODOLOGY

The details of processing of the composites and the experimental procedures carried out for their characterization and testing of samples which the composite specimens are subjected to. The major raw materials used in this project are:

Materials and Fabrication:-

1. Jute fiber
2. Glass fiber
3. Epoxy resin and
4. Hardener

Material:

The hybrid composite material used in this research was fabricated using light weight chopped strand mat of E-glass fabrics as synthetic reinforcement. Jute fibers were used as natural reinforcement. Jute fibers and the plant from which they are extracted are shown in figure 1.polyester resins with initiator (Methyl ethyl Kenton Peroxide) and accelerator International(cobalt) were used as matrix materials.

Fabrication:-

The composites are fabricated by conventional hand layup method. The jute fiber and the glass fibers are taken as reinforcement and epoxy is used as matrix material. Glass fibers are obtained from Go Green products Ltd. The low temperature epoxy resin and hardener are mixed in a ratio of 3:1 by weight percentage respectively. Composites of different compositions with three differentfiber loading (30wt%, 40wt% and 50wt %) are made .

Figure 1 Jute Fibre

Figure 2 Glass Fibre

TensileTest:

The tensile test generally performed on flat specimen.Tensile test of composite sample is carried out in ASTM D3039-76 teststandard. In tensile test, a uniaxial load was applied through both the end. Tensile test is a measurement of the ability of amaterial to applied forces tending to pull it apart and observe the extent of material stretches before breaking. Different typesof plastic materials are often compared based on tensile property data (i.e. strength, modulus, and elongation data) As atesting machine, the machine of a constant-rate-of-crosshead movement, containing a stationary member carrying one grip,and a moveable member carrying the second grip, is used.

FlexuralTest:

This test is done on a three point bend test. Flexural test is todetermine the capability of a material to withstand the bending before reachingthebreakingpoint. Inter-laminarsheartestisalsoperformedonthesameequipment .Theflexuretestdoesnotmeasurefundamentalmaterialpropertiesas compression test or tension test.Flexure tests are usually performed toevaluate the flexural modulus or flexural strength of a material. It is moreaffordablethanatensiletestandtheresultsaresome whatdifferent.Thematerial is laid vertically with supports and load support is placed at middle ofthe specimen and then a force is applied to specimen until the sample fails

InterlaminarShearTest:

Inter-laminarsheartestisalsoperformedonthesameequipment . Aspanof40mmwas taken andcross headspeed wasmaintainedat2mm/min

IV. RESULTS:

% wtof Jute	% wtof Glass	Ultimatetensilestrengthin MPa	Avg.UTSinMPa
10	20	59.1	79.4
15	15	74.2	72.4
20	10	69.4	66.2

Textile composite materials are composed of fibres, yarn or fabric systemand matrix material that is bind and protect the fibres. At first, jute

Table 2

Tensiletestresults:

The woven fabricand non-woven glass were cut into the desired size. As jute content moisture soitwasdriedat100ºCfor1hourinadryingoven.InJute/polyesterandglass/polyester composites, mechanical properties such as tensile properties,bending properties and impact strength increase with the increases of stackingsequences

The tensile strength and tensile modulus of the compositesthatareunderinfluenceoffiberloadingisshownin thetable2respectively.Therefore from the the table 2the tensile strength of the composites with60%matrix and 40% fiber is higher than other two compositions. The maximumtensilestrengthisobserved for compositewith 40wt%fiberloading

Flexuraltestresults:

Theflexuralpropertiesofvarioushybridcompositesatdifferent fiber loading of reinforcement are shown in table IV. The results showthat adding up natural fiber content in glass fibers increases the overall flexuralstrength of composites. However, natural fiber content should be lesser thansyntheticfibercontent.Themaximumflexuralstrengthisobservedforcompositewith 20%ofglass and10%of jutefiberloading.

It can be concluded from the graphs that the hybrid composites have betterpropertiesthansinglefiber composites.Though the composites have some pros and cons, the combination of the usefulpropertiesoftwodifferentmaterials,quickerprocessingtime,lowermanufacturing cost, etc., make them as an adaptable material in the field ofengineering and technology. Hence with this conclusion, it is sure that thetechnologyshowscompositeisthemosthuntedmaterialinthemoderntrend.This is clear that E-glass fiber composites retained much of its tensile propertiesthan that of the jute composites during soil degradation. Finally the strength andmodulus of jute composites decreased almost 23 and 11% respectively after 6months. On the other hand, E-glass composites showed only 5.8 and 6% loss ofFSandFMrespectivelyinthe sameperiod

Table 3

% wtof Jute	% wtofGlass	FlexuralstrengthinMPa	Avg.Flex.strengthinMPa
10	20	219	168
15	15	254	218
20	10	264	279

V. CONCLUSION

Theexperimentalstudyonthe effect of fiber loading on mechanical behavior of jute/glass fiber reinforcedpolyesterbasedhybridcomposites leadstothefollowingconclusions

- TheeffectofreinforcementofJutefiberandglassfiber intoepoxyresinmatrixisinvestigatedonthebasis onthefiber loading.
- Alsothechangeinflexuralstrengthisquitemarginalfrom10-30%ofglass fiber content.
- Costanalysisformanufacturingofhybrid compositesshows38.46%costreduction

Scope forfuturework

There is a wide scope for futurescholars to explore thecurrent research area. The present work can be further extended to studyother aspects of composites like use of other natural fibres and evaluationoftheirdynamicmechanical,thermal,tribological propertiesandtheexperimentalresultscanbe similarlybe analyzed.

VI. REFERENCES

[1]. Gowda,T.M.,Naidu,A.C.B.,&Chhaya,R.(1999).SomeMechanicalPropertiesofUntreatedJuteFabric-ReinforcedPolyesterComposites.CompositesPart A:AppliedScienceandManufacturing,Vol.30(3),pp.277-284.

[2]. Kumar,P.A.andS.Chakraborty,Fixed-bedcolumnstudyfor

[3]. hexavalentchromiumremovalandrecoverybyshort-chainpolyaniline synthesized on jute fiber. Journal of hazardous materials,2009.162(2): p.1086-1098

[4]. G. K. Sathiya, A. Elayaperumal, and of tensile properties of natural-hybridB,2012.

[5]. John, M. J., & Anandjiwala, R. D. (2008). Recent developments inchemicalmodificationandcharacterizationofnaturalfiber-reinforcedcomposites.Polymercomposites,Vol.29(2),pp.187-207.

[6]. Pavithran,C.,Mukherjee,P.S.,Brahmakumar,M.&Damodaran,A.D.(1987).Impactpropertiesofnaturalfibrecomposites.JournalofMaterialsScienceLetters,Vol.6(8),pp.882-884.

[7]. Jansons,J.O.,Glejbol,K.,Rytter,J.,Aniskevich,A.N.,Arnautov,A.K.&Kulakov,V.L.(2002).Effectofwaterabsorption,elevatedtemperaturesandfatigueontheproperties.