International Journal of Emerging Engineering Research and Technology
Volume 2, Issue 5, August 2014, PP 135-138
ISSN 2349-4395 (Print) & ISSN 2349-4409 (Online)

Mechanical Properties of Composite Material Reinforced by Jute and E-Glass Fibers

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Abstract: *In this study the tensile test and analysis over natural jute epoxy E-glass composite plates has been carried out, the natural jute epoxy E-glass composite plates consist of 3 layered (Jute-E glass-Jute) , 4 layered (Jute-E glass-Jute- E glass) and 5 layered (Jute-E glass-Jute- E glass-Jutes) woven mats of jute and E-glass as reinforcement and epoxy adhesive as matrix which both of them I.e., natural jute and E-glass have excellent mechanical properties More over the E-glass have better moisture resistance in comparison with other natural reinforcements, the dimensions of plates 100x300mm The natural jute E-glass composite plates are associated with an external force which includes weights on upper side and a flat plate fixture on down side. The natural jute E-glass composite plates are tested on universal testing machine with 250 KN load capacity has been employed to accomplish this investigation The failure modes of natural jute E-glass composite plates has been investigated and compared the 3 layer and 4 layer composite plates. The results are validated through ANSYS.*

Keywords: *Jute, E-glass, epoxy adhesive, Hybrid fibers, Composite material, ANSYS*

1. INTRODUCTION

Composite material is a material consisting of two or more physically and (or) chemically distinct phase, suitably arranged or distributed. A composite material usually has characteristics that are not depicted by any of its components in isolation [5]. Using this definition, it can be determined that a wide range of engineering materials fall into this category. For example, concrete is a composite because it is a mixture of Portland cement and aggregate. Fiberglass sheet is a composite since it is made of glass fibers imbedded in a polymer [6].

World endowed with an abundant availability of natural fiber such as Jute, Coir, Sisal, Pineapple, Ramie, Bamboo, Banana etc. has focused on the development of natural fiber composites primarily to explore value-added application avenues. Such natural fiber composites are well suited as wood substitutes in the housing and construction sector. The development of natural fiber composites in India is based on two pronged strategy of preventing depletion of forest resources as well as ensuring good economic returns for the cultivation of natural fibers. 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, wood etc. The material scientists all over the world focused their attention on natural composites reinforced with Jute, Sisal, Coir, Pineapple etc. primarily to cut down the cost of raw materials[1].

2. PREPARATION OF COMPOSITE

An important control parameter for such natural yarns is the twist level. It has been shown that very low twisted yarns display a very low strength when tested in air and therefore they cannot be used in processes such as pultrusion or textile manufacturing routes like knitting or weaving. Where heavy loading is experienced by the yarns while processing in the case of short staple (length) fibers, higher twist level is necessary to prevent fiber slippage and to develop sufficient strength [4]. Besides yarn strength, the amount of twist also affects the inter-yarn impregnation while fabricating reinforced composites. With increased twist level yarns become more compact making it difficult for the resin to penetrate into the yarn. Dry yarns lead to lower bonding between yarns and resin thus leading to

delaminating and lowering of the composite tensile properties. Here we have plain weave with 1/1 layer [1].

E-glass fiber reinforcement is often an attractive way to improve the mechanical properties of thermoplastics, the improvement being attributed to the of the fibers and to the better adhesion between the fibers and the polymer matrix when surface treated fibers are used [2-7]

Three samples were manufactured for each tests which different by the layers of reinforcement as shown in Table.1. Hand molding was used to manufacture the samples. Some resin spread in the mould and the fiber layer put on it and this process repeated to obtain the desired thickness First we prepared a rectangular frame of 250mmx150mm with a height of 10 mm then a GI sheet with same dimension prepared. Fiber mat also prepared with respective dimension. Wax is applied to frame and as well as to GI sheet. Then GI sheet is placed in the frame and resin is mixed with hardener with required proportions. We apply the wax to the GI sheet and fiber mat is placed over it and adhesive is applied with help of brushes. When the adhesive applied properly place another layer of fiber over before one and apply adhesive as Epoxy K_6, K_{12} [2] Similarly we can do this whenever there is need for more layers. This increases the thickness of the composite material [1]. Now another GI sheet with wax applied is placed over this and we need to keep small load to avoid voids in the composite material. After the soaking period we get the composite material. These types of fibers used as consecutive layers in same matrix with E-glass and jute. Three samples were manufactured for each tests which different by the layers of reinforcement as shown in Table.1. Hand molding was used to manufacture the samples. Some resin spread in the mould and the fiber layer put on it and this process repeated to obtain the desired thickness.

Table 1. *Structure of samples*

Si.no	Sample	Layers type
1	3 layered	Jute-E glass-Jute
2	4 layered	Jute-E glass-Jute-E glass
3	5 layered	Jute-E glass-Jute-E glass-Jute

3. MECHANICAL TESTS

Tensile test: Tensile Strength Samples: these samples manufactured according to the standards and tested on the universal test used to measure this property with a (20KN) load and their graphs are shown in Figure 1, 2 &3.

Hardness test: In this test the "Shore hardness method" was used to measure hardness

Bending test: In this samples are tested on UTM

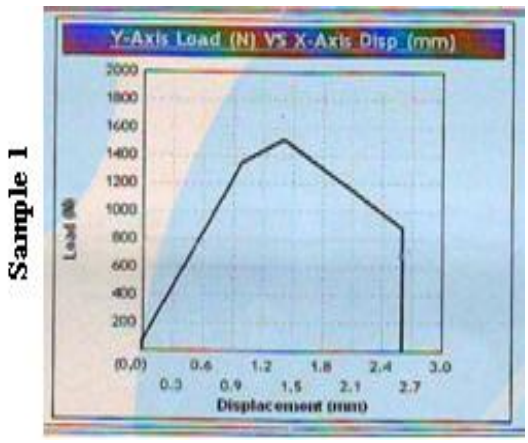


Figure 1. *Tensile graph of sample 1*

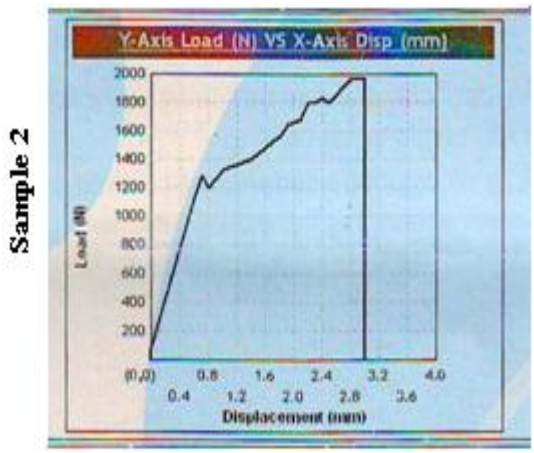


Figure 2. *Tensile graph of sample 2*

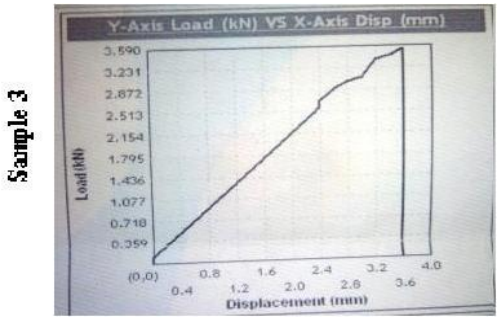


Figure 3. *Tensile graph of sample 3*

3.1 Results

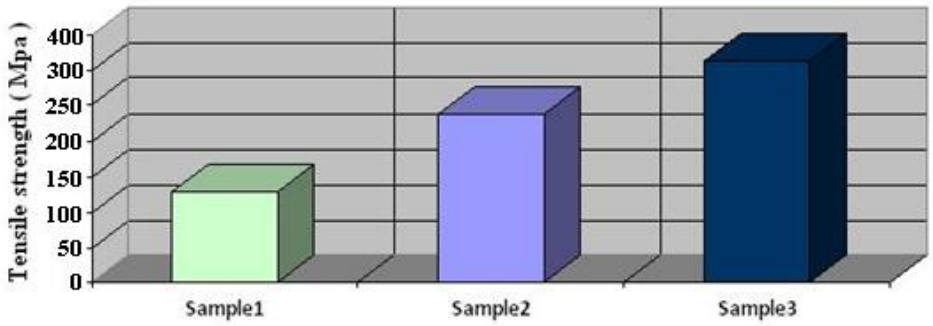
The samples are tested on universal testing machine for tensile test and bending test, hardness test is done on shore hardness machine at Jyothy Spectro Analysis and the results shown in Table 2.

Table 2. *Results of the mechanical test*

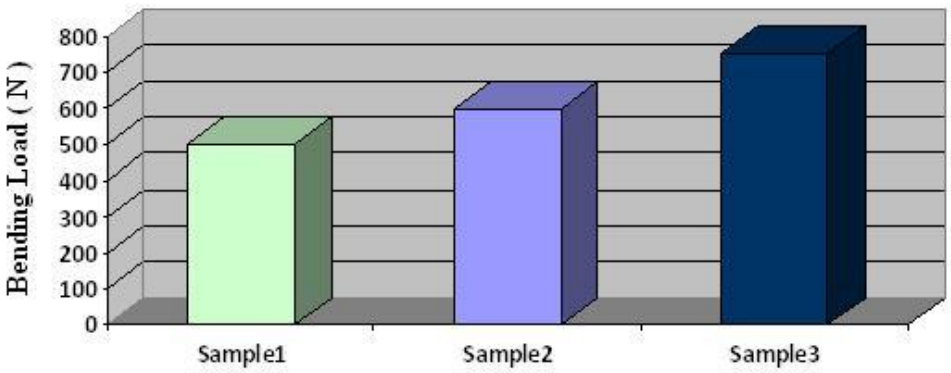
Si.no	Mechanical test	Results		
		3 layered sample	4 layered sample	5 layered sample
1	Tensile strength	130.06 Mpa	238.84 Mpa	354.0 Mpa
2	Shore hardness "D"	91	91	91*
3	Bending load	500N	600N	750N

3.2 Discussion

The jute fiber tensile strength is very low, but after reinforcing by E-glass fiber this property will be improved greatly, where the fibers will withstand the maximum part of loads and by consequence will raise the strength of composite material .The tensile strength will be increased as the material layers increased as shown in the Graph 1. The flexural strength of the material will be raised to the producing material because the high modulus of elasticity of these fibers will helps to carry a large amount of loads and raise this strength as shown in the Graph 2. The hardness of this material is constant and it not changes by increasing the layers.



Graph 1. *Tensile strength*



Graph 2. B*ending loads*

4. CONCLUSIONS

Low mechanical properties (Tensile strength, bending load and hardness) of the jute fiber are been improved after reinforced by E-glass fiber with Epoxy adhesive. By increasing the number of layers the tensile strength and bending loads are increasing as well as hardness of the material is not changing.

5. SCOPE

It uses natural fiber composite panels where biodegradable resins have been incorporated as the matrix material. It has been recently predicted that the most important technologies of the future that incorporate natural fiber, composite materials are natural fibers for injection moulded products, composite materials are followed by bio plastic matrix and modified fibers for the use in advanced applications.

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