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EXPERIMENTAL ANALYSIS OF CARBON/GLASS/SISAL FIBER HYBRID COMPOSITE MATERIAL

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ABSTRACT

The main objective of this project is create the hybrid composite material by using the fibers of Carbon Fiber, Glass fiber and Sisal fiber with the use of epoxy resin, the fibers are arranged with the CGSSGC, GCSSCG and SCGGCS arrangements are made for this projects and then which arrangement of fiber will get more tensile strength, flexural strength and impact strength for this project, the CGSSGC fiber arrangement will get more strength compare to all other fiber arrangements

Keywords: Tensile Strength, Flexural Strength, Impact strength, Carbon fiber, Glass Fiber, Sisal Fiber

1. INTRODUCTION:

Composite material is a macroscopic combination of two or more distinct materials. having a recognizable interface between them. Composites are used not only for their structural properties, but also for electrical, thermal, and environmental applications.

Nature created materials is the natural fibers which are abundantly available, eco-friendly and have renewable in their behavior. The cultivation and on growing harvesting and primary processing conditions to extract the fiber will dictate the homogeneity. Natural fibers are light in weight which is extremely advantageous but due to its low density can be disadvantageous in processing since the fiber tends to emerge from the matrix specifically liquid resins.

2. MATERIALS

2.1. Glass Fibers

Glass fibers fall into two categories, low-cost general-purpose fibers and premium special-purpose fibers. Over 90% of all glass fibers are general-purpose products. These fibers are known by the designation E-glass and are subject to ASTM specifications. The remaining glass fibers are premium special-purpose products. Many, like E-glass, have letter designations implying special properties. Some have trade name, but not all subjected to ASTM.

A fiberglass component is typically of a thin "shell" construction, sometimes filled on the inside with structural foam, as in the case of surfboards. The component may be of nearly arbitrary shape, limited only by the complexity and tolerances of the mold used for manufacturing the shell.

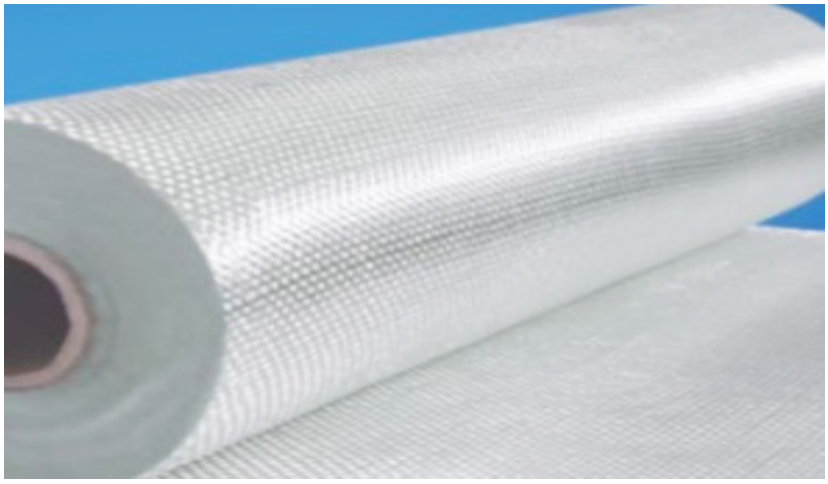

Figure 1 Glass Fiber

2.2. Carbon Fibers

Composites made from carbon fiber are five times stronger than grade 1020 steel for structural parts, yet are still five times lighter. In comparison to 6061 aluminum, carbon fiber composites are seven times stronger and two times stiffer, yet 1.5 times lighter. Carbon fiber composites have fatigue properties superior to all known metals, and, when coupled with the proper resins, carbon fiber composites are one of the most corrosion resistant materials available. Carbon fiber usage is growing in a variety of applications, including aerospace, sporting goods, and a variety of commercial/industrial applications.

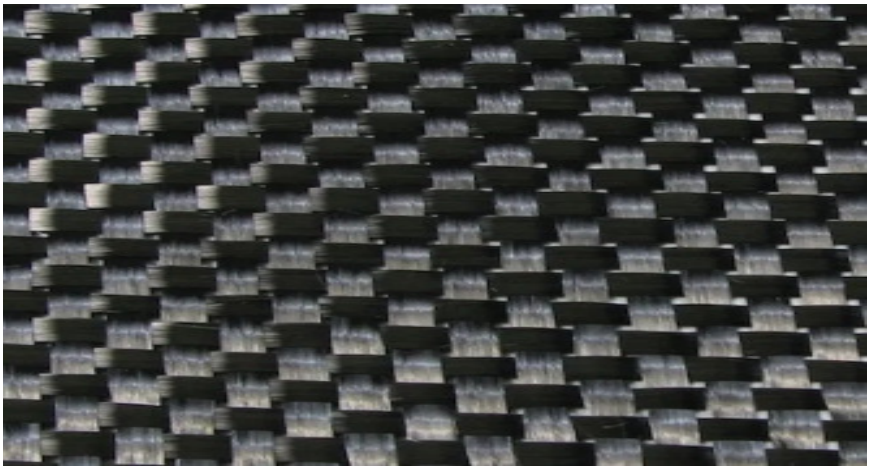

Figure 2 Carbon Fiber

2.3. Sisal Fiber

Sisal fiber is extracted from the leaves by retting, scraping, or mechanical decortications. The sisal plant produces sword-like leaves with teeth and loses this tooth in maturity. Decortications are the most common method for extracting sisal fiber. In this process, the leaves are crushed between blunt knives and moisture and the fleshy pulp are removed from the fiber. Water is

used to clean debris that is present in the leaves. The sisal fiber that is obtained is dried in the hot sun.

Figure 3 Sisal Fiber

3. MANUFACTURING PROCESS

3.1. Hand layup Method

Hand lay-up technique is the simplest method of composite processing. The infrastructural requirement for this method is also minimal. The processing steps are quite simple. First of all, a release gel is sprayed on the mold surface to avoid the sticking of polymer to the surface. Thin plastic sheets are used at the top and bottom of the mold plate to get good surface finish of the product. Reinforcement in the form of woven mats or chopped strand mats are cut as per the mold size and placed at the surface of mold after perspex sheet.

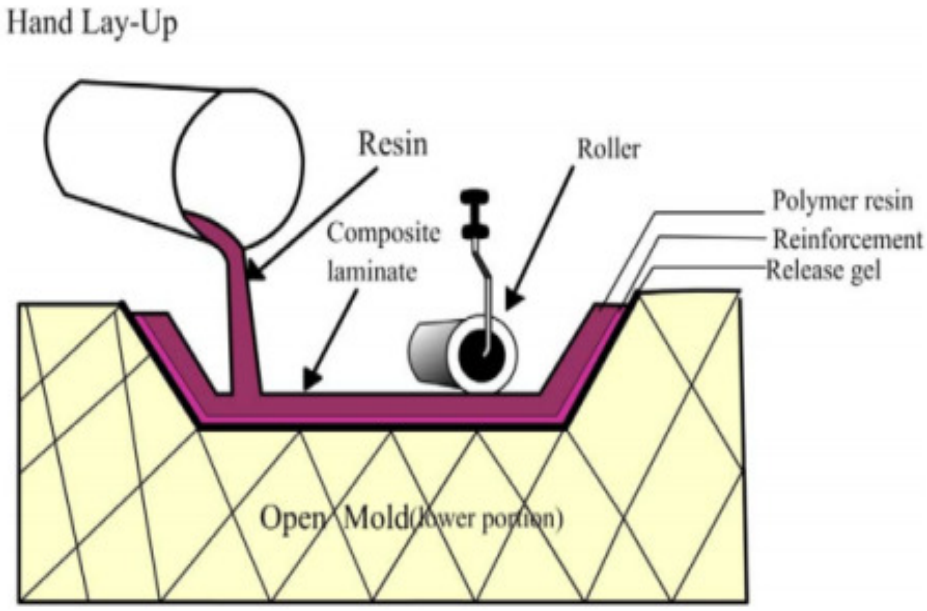

Figure 4 Hand lay-up method

4. MATERIAL TESTING

4.1. Impact Test (Izod)

Izod impact testing is an ASTM standard method of determining the impact resistance of materials. A pivoting arm is raised to a specific height (constant potential energy) and then released. The arm swings down hitting the sample, breaking the specimen. The energy absorbed by the sample is calculated from the height the arm swings to after hitting the sample. A notched sample is generally used to determine impact energy and notch sensitivity.

Figure 5 Impact Test Specimen

Figure 6 Impact Testing Machine

4.2. Flexural Test

The three point bending flexural test provides values for the modulus of elasticity in bending Ef, flexural stress sigma f, flexural strain epsilon f and the flexural stress-strain response of the material. The main advantage of a three-point flexural test is the ease of the specimen preparation and testing. However, this method has also some disadvantages: the results of the testing method are sensitive to specimen and loading geometry and strain rate.

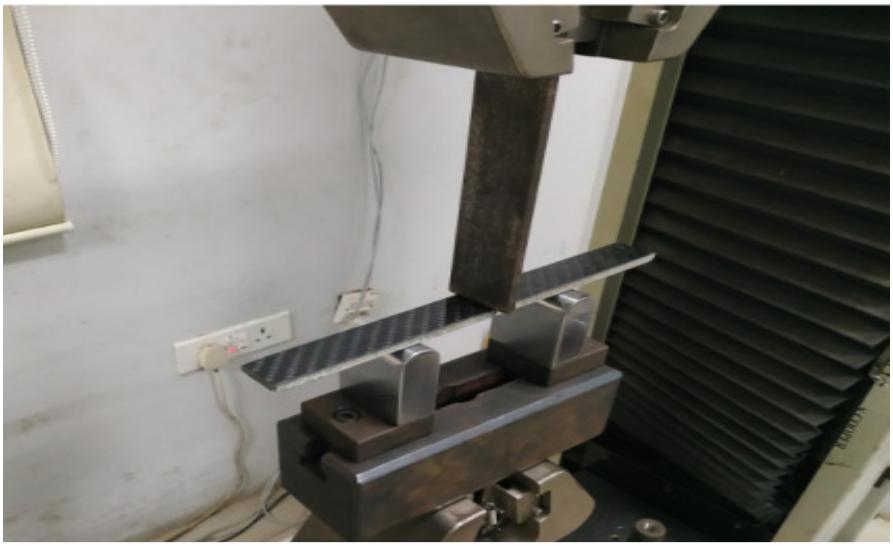

Figure 7 Flexural Testing Machine

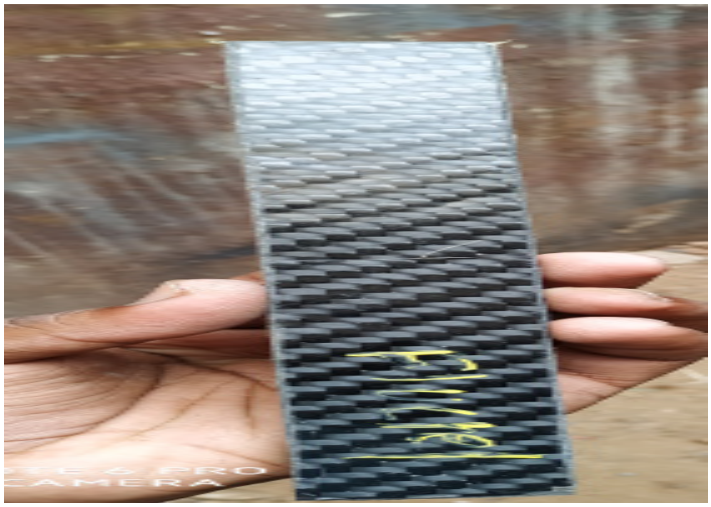

Figure 8 Flexural Testing Specimen

4.3. Tensile Testing

Tensile testing, is also known as tension testing, is a fundamental materials science test in which a sample is subjected to a controlled tension until failure. The results from the test are commonly used to select a material for an application, for quality control, and to predict how a material will react under other types of forces. Properties that are directly measured via a tensile test are ultimate tensile strength, maximum elongation and reduction in area. From these measurements the following properties can also be determined: Young's modulus, Poisson's ratio, yield strength, and strain-hardening characteristics. Uni axial tensile testing is the most commonly used for obtaining the mechanical characteristics of isotropic materials. For anisotropic materials, such as composite materials and textiles, biaxial tensile testing is required.

Figure 9 Tensile Testing Machine

Figure 10 Tensile Testing Specimen

5. RESULTS AND DISCUSSIONS

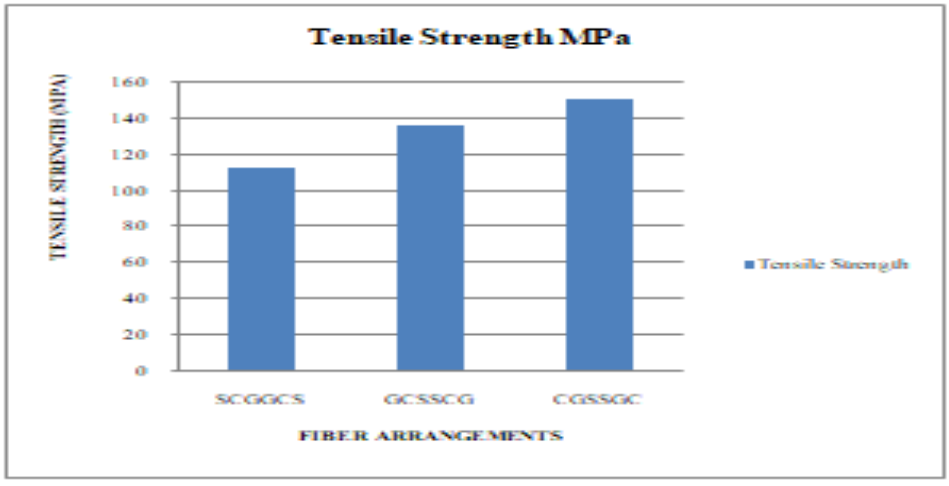

Figure 11 Tensile Strength Comparisons

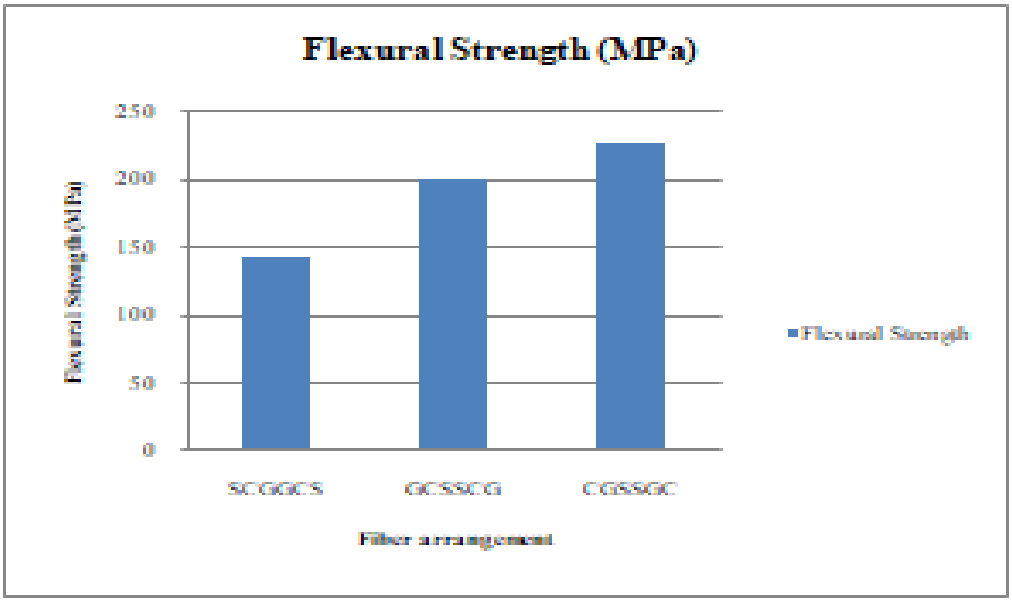

Figure 12 Flexural Strength Comparison

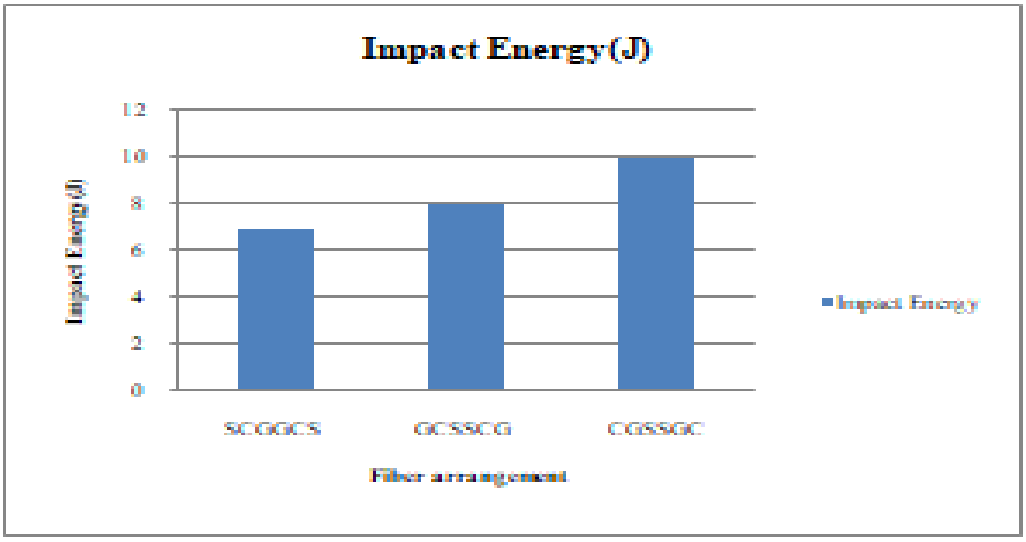

Figure 13 Impact Strength Comparison

6. CONCLUSION

The hybrid composite material of glass fiber, carbon fiber and sisal natural fiber was made with the different fiber orientations like SCGGCS, GCSSCG and CGSSGC fibers combinations in these combinations ansys structural analysis taken for above three material combinations with constant tensile load conditions of 1000N in this combination CGSSGC combination get the very less stress value in the operation, this CGSSGC combination is manufactured by using hand layup method in the hand layup method of fabricated fibers tensile test specimen, flexural test specimen and impact test specimens are taken as per the ASTM Standards and tensile and flexural tests are done in Universal Testing Machine(UTM), and Izod test conducted through impact testing machine and get the values of ultimate flexural strength 227.7 MPa, and Tensile Strength of 151.6 MPa and impact strength is 10 J. and this material is have more flexural strength so this material is mostly suggested for the turbo machines applications like fan blades, wind turbine blades and compressor blades.

REFERENCES

[1] Ali I.Al-Mosawi, Mohammad H.Al-Maamori, ZaynabA.Wetwet (2012) "Mechanical Properties ofComposite Material Reinforcing by Natural-Synthetic Fibres"

[2] Brahim, S.B., and Cheikh, R.B. (2006). "Influence of fibre orientation and volume fraction on the tensile properties of Unidirectional Alfa-Polyester Composite." Composites Science and Technology.

[3] Durga Prasad, B. G.Kiran Reddy, A.AnushaYadav (2014) "Mechanical Properties of Composite Material Reinforced by Jute and E-Glass Fibre"

[4] Ewins, D.J. (1984). Modal Testing: Theory and Practice, Research Studies Press Ltd., Hertfordshire, England.

[5] Harris, B. "Engineering Composite Materials", Institute of Materials, London, 1999.

[6] Jahangir A.Khan, Mubarak A.Khan, Rabiul Islam, AdbulGafur (2010) "Mechanical, Thermal and Interfacial Properties of Jute Fabric-Reinforced Polypropylene Composites: Effect of Potassium Dichromate"

[7] Mariana Etcheverry, Silvia E. Barbosa (2012) "Glass Fibre Reinforced Polypropylene Mechanical Properties Enhancement by Adhesion Improvement." Materials 2012, 5(6), 1084-1113