COMPARATIVE AND EXPERIMENTAL INVESTIGATION OF GLASS FIBER REINFORCED WITH JUTE AND SILICON CARBIDE

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Abstract - *Jute fiber reinforced with Sic and Jute as natural fiberreinforced polymer composites and glass fiber reinforced polymer composites are the primary goals of this project. In order to create ahybrid composite, 10 percent of Silicon Carbide powder is added.*

Researchers looked into theeffects of various mechanical properties such as tensile strength, compression strength, and impact strength under various loading conditions. Hand lay-up process fabrication results in better performance of Natural fiber reinforcement with GF, according to the comparative experimentation. Silicon carbide is an excellent material for absorbing and carrying heavy loads.

Key Words: *High Strength, Cost reduction, Easy to make*

1. Introduction

Basic requirements for thebetter performance efficiency of anaircraft are high strength, high stiffness and low weight. The conventional materials such as metals and alloys could satisfy these requirements only to a certain extent. This led to the need for developing new materials that can whose properties were superior to conventional metals and alloys, were developed.

A composite is a structural material which consists of two or more constituents combined at a macroscopic level. The constituents of a composite material are a continuous phase called matrix and a discontinuous phase called reinforcement.

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The building block of a laminate is a single lamina. Therefore, the mechanical analysis of a lamina precedes that of a laminate. A lamina is an anisotropic and non- homogeneous material. But for approximate macro- mechanical analysis, a lamina is assumed to be homogeneous where the calculation of the average properties are based on individual mechanical properties of fiber and matrix,as well as content, packing geometry and shape of fibers. The lamina is considered as orthotropic, so it can be characterized by nine independent elastic constants: three Young's moduli along each material axis, three Poisson's ratio for each plane and three shear moduli for each plane. Once the properties for each lamina are obtained, properties of a laminate, made of those laminae can be calculated using those individual properties.

In the highly competitive airline market, using composites is moreefficient. Though the material cost may be higher, the reduction in the number of parts in an assembly and the savings in the fuel cost makes more profit. It also lowers the overall mass of the aircraft without reducing the strength and stiffness of its components.

2. Methodology

The specimens were prepared with the glass fiber epoxy laminates with Jute and Silicon Carbide powder accordingto the ASTM standard. The specimens were undergoing for mechanical testing by Universal testing machine and Impact testing machine. These results were compared with conventional GFRP composite.

3. Laminate Materials Methods:

This chapter describes the materials and methods used for the processing of the composites under this investigation.It presents the details of the characterization and tests which the composite samples are subjected to.

In this laminate,

REINFORCEMENT - Glass Fiber Reinforcement Plastic(bi-directional type)

E-glass. MATRIX-
Epoxy.

Correct ratio of resin and hardener is 2:1
Resin: LY556 Hardener: HY951

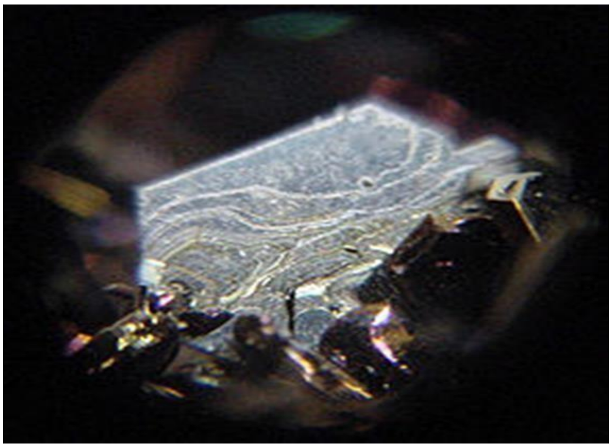

Fig 1: **A replication of H.J. Round's LED experiments**

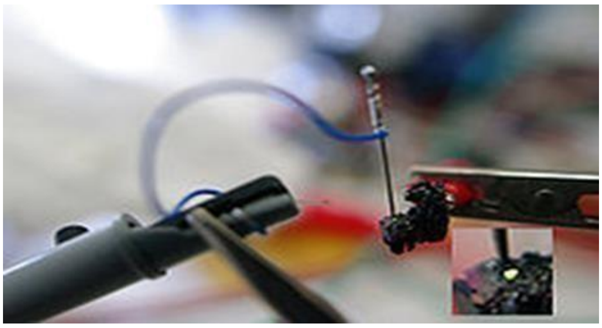

Fig 2: **Moissanite single crystal (≈1 mm in size)**

Fig 3: **Cutting disks made of Sic**

4.Various Natural Fiber

Composite materials from man-made fibers (i.e., glass fiber, carbon fiber etc.) are already available as products for consumer and industrial uses. A relatively newer concept is to consider natural fibers as a reinforcing material. Stringent environmental legislation and consumer awareness has forced industries to support long term sustainable growth and develop new technology based on renewable feedstock that are independent of fossil fuels. As the current status quo, the main reinforcement for the composite industry is glass fibers; 22.3 million tons (metric) are produced globally on an annual basis. Although glass fiber products have somewhat superior mechanical properties, their life cycle performance is very questionable. Manufacturing of these products not only consume huge energy but their disposal at the end of their life cycle is also very difficult since there is virtually no recycling option.

Annual industrial crops grown for fiber, have the potential to supply enough renewable biomass for various bio-products including composites. The scope of possible uses of natural fibers is enormous. This is substantiated by the declaration of United Nation for 2009 as International Year of Natural Fibers (IYNF).

All over the world, the bio-composite industry is developing at a significant pace to meet growing consumer awareness and follow new environmental regulations. A survey done by Canadian Agri-Food Research Council (CARC) in 2003 showed that the European automotive industry has already taken the lead and uses approximately 22,000 tons of natural plant fiber in low stress applications in cars. In 2005, 19000 tons of natural fibers were used in Germany for automotive composite. Lignocellulosic bio-fiber derived from various origins such as leaf, bast, fruit, grass or cane; contribute to the strength of bio as well as synthetic polymer composites in various applications. These fibers are renewable, non- abrasive to process equipment, and can be incinerated at the end of their life cycle for energy recovery as they possess a good deal of calorific value. They are also very safe during handling, processing and use. Major natural fibers of vegetative origin used as reinforcement are shown in Table- 1. Both thermoset and thermoplastic matrices are used for development of natural fiber reinforced composite, the comparative study of these two types of matrices are shown in Table- 2

5. Testing:

In view of this, the present work is to investigate the mechanical properties like Tensile, Flexural (compression*) and Impact Strength of glass fiber epoxy laminate with and without Aluminum alloy.

5.1 Tensile Test

Tensile load applied to a composite. The response of a composite to tensile loads is very dependent on the tensile stiffness and strength properties of the reinforcement fibers, since these are far higher than the resin system on its own.

Test was carried out with the help of UTM (Universal Testing Machine)

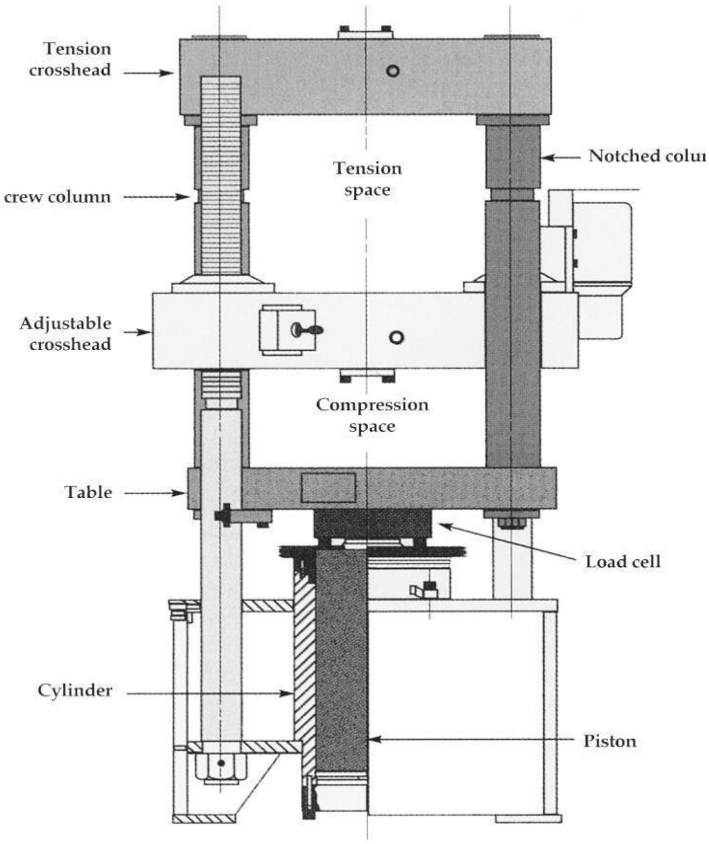

Fig 4: **Universal testing machine (UTM)**

The most common testing machines are universal testers, which test materials in tension, compression, or bending. Their primary function is to create the str estrin curve described in the following section in this chapter. Testing machines are eitherelectromechanical or hydraulic. The principal difference is the method by which the load is applied. Electromechanical machines are based on a variable-speed electric motor; a gear reduction system; and one, two, or four screws that move the crosshead up or down. This motion loads the specimen in tension or compression. Crosshead speeds can be changed by changingthe speed of the motor.

A microprocessor-based closed-loop servo system can be implemented to accurately control the speed of the crosshead. Hydraulic testing machines (Fig. 3) are based on either a single or dual-acting piston that moves the crosshead up or down. However, most static hydraulic testing machines have a single acting piston or ram. In a manually operated machine, the operator adjusts the orifice of a pressure- compensated needle valve to control the rate of loading. In a closed- loop hydraulic servo system, the needle valve is replaced by an electrically operated servo valve for precise control.

5.2 COMPRESSION TEST* (FLEXURE)

When a beam having an arbitrary cross section is subjected to a transverse loads the beam will bend. In addition to bending the other effects such as twisting and buckling may occur, and to investigate a problem that includes all the combined effects of bending, twisting and buckling could become a complicated one. Thus, we are interested to investigate the bending effects alone, in order to do so, we have to put certain constraints on the geometry of the beam and the manner of loading.

Assumptions:
The constraints put on the geometry would form the **assumptions:**

1. Beam is initially **straight,** and has a **constant cross-section.**
2. Beam is made of **homogeneous material** and the beam has alongitudinal plane of symmetry.
3. Resultant of the applied loads lies in the plane of symmetry.
4. The geometry of the overall member is such that bendingnotbuckling is the primary cause of failure.
5. Elastic limit is nowhere exceeded and **'E'** is same in tension andcompression.
6. Plane cross - sections remains plane before and after bending.

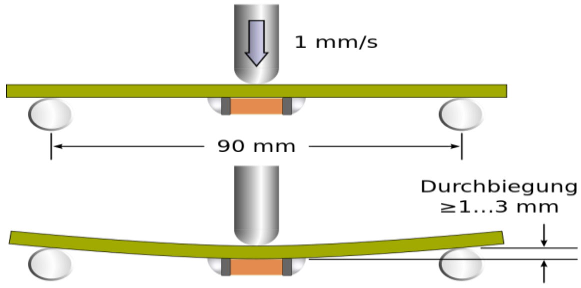

Fig 5: Compression Test Concept

Let us consider a beam initially unstressed as shown in fig 5.8. Nowthe beam is subjected to a constant bending moment (i.e., 'Zero Shearing Force') along its length as would be obtained by applyingequal couples at each end. The beam will bend to the radius R asshown in Fig 5.8

As a result of this bending, the top fibers of the beam will be subjected to tension and the bottom to compression it is reasonableto suppose, therefore, that somewhere between the two there are points at which the stress is zero. The locus of all such points is known as neutral axis. The radius of curvature R is then measured to this axis. For symmetrical sections the N. A. is the axis of symmetry but whatever the section N. A. will always pass through the center ofthe area or centroid.

The above restrictions have been taken so as to eliminate the possibility of 'twisting' of the beam.

5.3 Impact Test

Static tension tests of the unnotched specimen's do not always reveal the susceptibility of metal to brittle fracture. This important factor is determined in impact tests. In impact tests we use the notched specimen's

This specimen is placed on its supportson anvil so that blow of the striker is