

Influence of Mechanical Properties on the Hybrid Composites

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ABSTRACT: This paper deals about design and development of dirt bike by using hybrid composites. In this work an old two stroke bike is taken and making a new kind of frame and designing a body by using hybrid fiber composites. In this study, 50% of natural fiber composites is chosen because it has a good strength and light in weight. Hence the weight of the bike is reduced the performance of the bike as good as the existing model. When the weight of vehicle's body parts are reduced automatically the rate of fuel consumption would have been reduced, this in turn, increases the mileage of the vehicle. Instead of using sheet metal, 50% of natural fiber and 50% of glass fibers are used because they are eco-friendly. From the experimental result, the tensile and impact strength of the hybrid composite sample shows the better result compared with natural and synthetic fiber.

KEYWORDS: Mechanical Properties, Fiber, Tensile Strength, Impact Strength, Composite.

I. INTRODUCTION

A composite material is a combination of two (or) more materials in right proportions to get single entity and improved qualities from the single material[1].Fiber reinforcement composite materials are finding increased application in aircraft, spacecraft, automobile fields and electronic industry since, it has high strength to weight ratio and stiffness. In recent years, hybrid composites are considered as viable engineering constructions and representation of special type of materials. Hybrid composites offer many advantage over conventionally processed materials including lightweight, high strength to weight ratio, high flexural rigidity, high stability, and high thermal and acoustical insulation.

The main drawbacks of polymer matrix composites include low operating temperatures, high coefficients of thermal and moisture expansion and low elastic properties in certain directions. In General, composites have been widely used across industries like aerospace, wind energy, automotive, marine, oil and gas [2].Two or more chemically different constituents combined macroscopically to yield a useful material. Glass fiber is most commonly used fiber. Roving's wool fiber is a natural fiber. Fibers are used in the form of chopped strand CSM or continuous filament mat (CFM) (300 to 600 g/m²), woven-roving (450 to 900 g/m²) or 'COMBI' (a combination of CSM and woven) roving. It is also possible to use a 'COREMAT', in order to increase specific stiffness.

A roving is a long and narrow bundle of fiber. Roving's are produced during the process of making spun yarn from wool fleece, raw cotton, or other fibers. In this work, roving and glass fiber are used. It gives a better strength and toughness. This hybrid composite fiber has a good bending stress. Compared to metal & plastic body of bike this fiber is light weighted and has a good strength. A suitable resin for combining the fiberglass with a plastic was developed in 1936. During the Second World War, it was developed as a replacement for the molded plywood used in aircraft.

Fredrik Stig and Steffan Hallstroml [3], reported about a fully interlaced 3D fabric which is produced by a new technology, and is utilized to produce woven carbon fiber. The purpose of this study is to assess the mechanical performance of this new type of composite material. A prototype loom was used to weave which performs with rectangular cross section warp and weft yarns were fully interlaced in plain weave. Tensile, compressive, out-of-plane, shear and flexural properties of the composite flat beam specimens were tested. The in-plane stiffness and strength were found to be lower, while the out-of-plane properties were higher compared to conventional 2D laminates. In terms

of strength, it was not possible to quantify the difference, since the specimens with 3D woven material exhibited other failure modes than those tested for. N.K. Naik, S.K Azad and P.Durga [4] focuses on predicting the failure behavior of three dimensional angles interlock woven composites under on-axis uniaxial static tensile loading and shear loading. The model is based on two-level discretization of the repeating unit cell. The repeating unit cell is discretized into sections, elements, subsections and sub elements. The model predicts the stress levels at which the secondary failure take place at sub element level. The effect of secondary failure is considered for further analysis and the ultimate tensile strength and shear strength and the corresponding strains are predicted. A parametric study has been carried for different 3D angle interlock woven composite configuration.

Hybrid structures are mainly produced by sewing and warp-knitting technologies. The basis of manufacturing these structures is the combination of the properties of two independent structures manufactured under the form of a composite in a single operation. In this way, a synergetic effect of properties is achieved, where each structure contributes its properties to the behavior of a structure with better properties than those of each component [5]. Hybrid structures are the result of a combination of different kinds of structures with the main purpose of balancing some characteristics or weakness of individual materials being used in specific applications. In this study, 50% of natural fiber 50% of glass fibers are used for hybrid composite, whereas

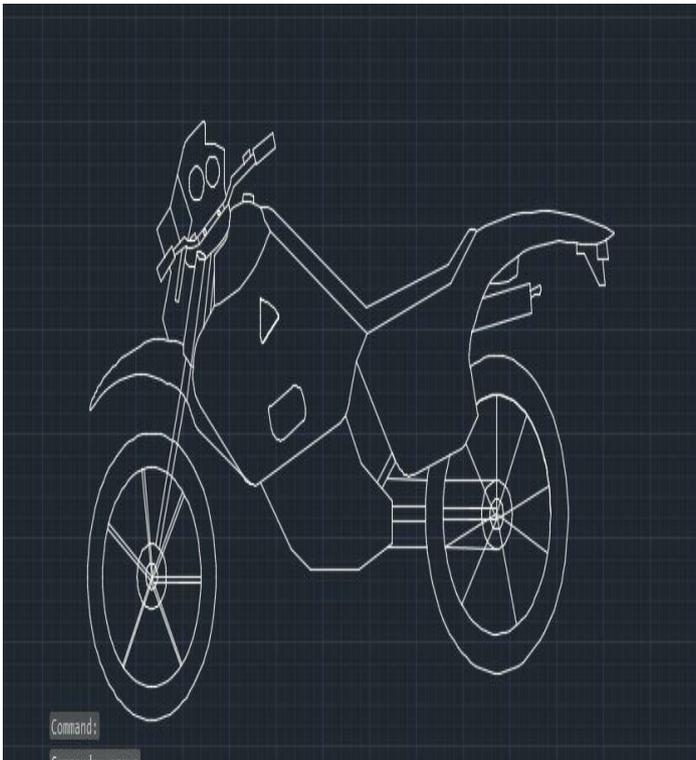


Figure 1: Schematic Diagram of Bike Model

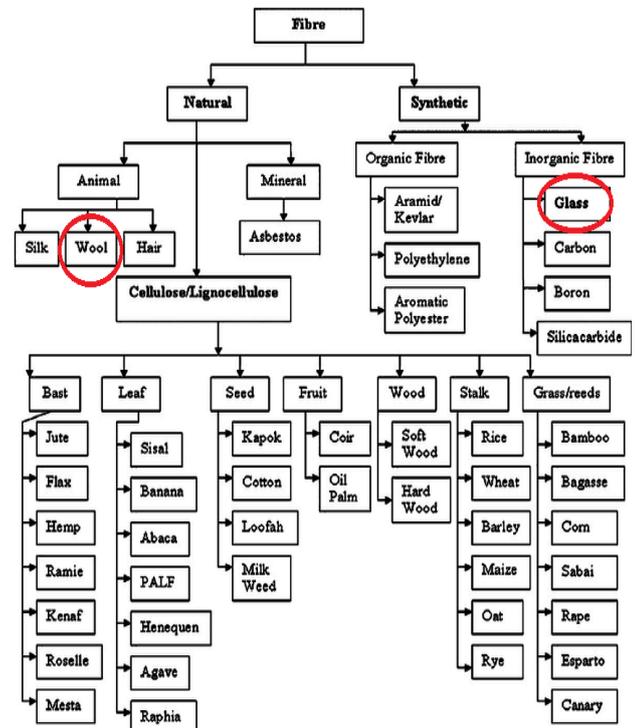


Figure 2: Classification of Fibers



Figure 3: Glass Fiber



Figure 4: Woven-roving

II. EXPERIMENTAL WORK

Materials and Methods

Fig.3 shows the synthetic glass fibers are artificially manufactured fibers were made from polymers obtained from petrochemical. These fibers are called synthetic or artificial fibers. A roving is a long and narrow bundle of fiber as shown in Fig.4. Roving's are produced during the process of making spun yarn from wool fleece, raw cotton. Chalk is a soft, white, porous, sedimentary carbonate rock, a form of limestone composed of the mineral calcite. Calcite is an ionic salt called calcium carbonate or CaCO_3 . In order to get effective and no sticking effect on the surface of the polymer composite a preprocessing of Wax polishing is preferred. Wax Polish is a polishing substance that is used to make the surface smooth on which it is applied and it prevents the surface from other foreign particles after applied. In this work, Epoxy resins are used as matrix material. Epoxy resins are higher molecular weight polymers which normally contain at least two epoxide groups the raw materials for epoxy resin production are today largely petroleum derived, although some plant derived sources are now becoming commercially available [3]. Table 1 shows some advantages of glass fiber.

Table 1: Advantages of Fiber glass Composites [1]

Corrosion Resistant	Long Life in harsh environment, zero maintenance
High Strength	Can replace conventional materials
Non-Conductive	Thermally energy saving
Electrically Insulating	Very Safe as per IS 10192
Electromagnetic Transparency	Excellent for Wireless Communication Technology
Lightweight	Weighs 70% less than Steel, Ease in handling
Easy to fabricate and install	Saves time

Dimensional Stability	No additional stresses induced
Fire Retardant	As per IS-6746 / ASTM E-84
Weather Resistant	Suitable for outdoor - UV resistant

Fiber glass molds are commonly used to make multiple copies of a part that may have a complex shape. The materials are inexpensive, they are easy to make, last many years and can be used to produce hundreds of parts [6]. The process starts with a pattern that you wish to copy. Clean the surface of the mould with the help of poly vinyl acetylene followed by wax polish [7,8]. Epoxy resin with 10% of chalk powder is used for the matrix material and then the glass fiber and woven rovings are placed with resin coating has done.

Model and Methodology

Fig.1 and Fig.2 shows the design of bike model and the classification of fibers. Weight of the bike has decreased and it increases the mileage of the bike. The weight comparison details are discussed below:

Details of Old Bike Model

Weight of the bike	-110kgs
Weight of fuel tank (Without Fuel)	-3.75kgs
Weight of fuel tank (With Fuel)	-12.61kgs
Fuel tank Capacity	-12 liters
Fuel tank material	-Iron
Weight of bike (frame, wheel &engine)	-85kgs
Mileage	-32-35kms

Details of Modified Bike

Weight of the bike	-90kgs
Weight of fuel tank (Without Fuel)	-2.25kgs
Weight of fuel tank (With Fuel)	-6.44kgs
Fuel tank Capacity	-5 liters
Fuel tank material	-Hybrid fiber
Weight of bike (frame, wheel &engine)	-81kgs
Mileage	-35-38kms

Tensile Strength

Ultimate tensile strength (UTS), often shortened to tensile strength (TS) or ultimate strength is the capacity of a material or structure to withstand loads tending to elongate, as opposed to compressive strength, which withstands loads tending to reduce size [3,9]. Figure 5 shows the tensile strength of glass fiber is 62.09MPa and tensile strength of woven-roving fiber is 95.06MPa and combination of these two fibers (hybrid) gives a tensile strength of 187.04MPa. As shown in graph this hybrid composites gives a good tensile strength.

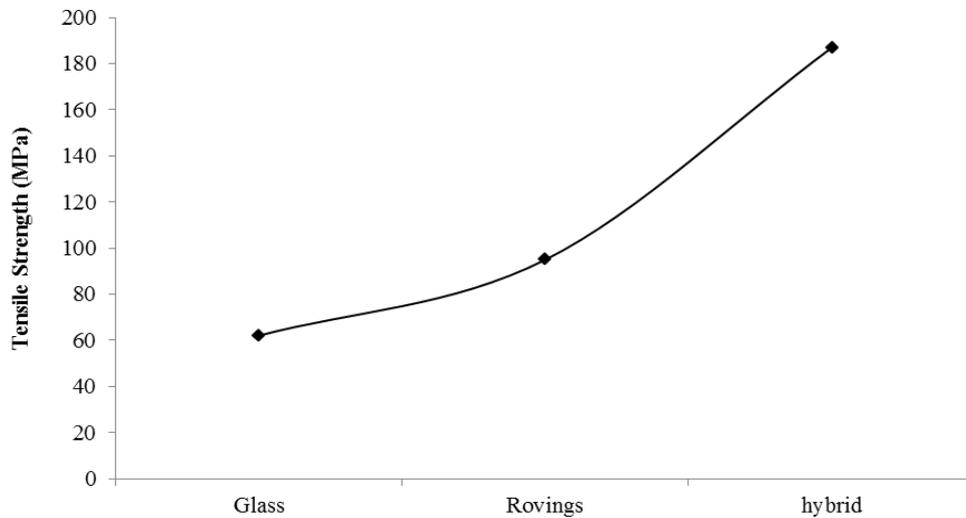


Figure 5: Ultimate tensile strength values of various fibers

Impact Test

This absorbed energy is a measure of a given material's notch toughness and acts as a tool to study temperature-dependent ductile-brittle transition [3,9]. Figure 6 shows the impact value of glass fiber is 2 Joules and impact value of woven-roving fiber is 5 Joules and combination of these two fibers (hybrid) gives an impact value of 8 Joules. As shown in graph this hybrid composites gives a good tensile strength. From this result the energy absorption rate is high due to adhesion between the hybrid composites.

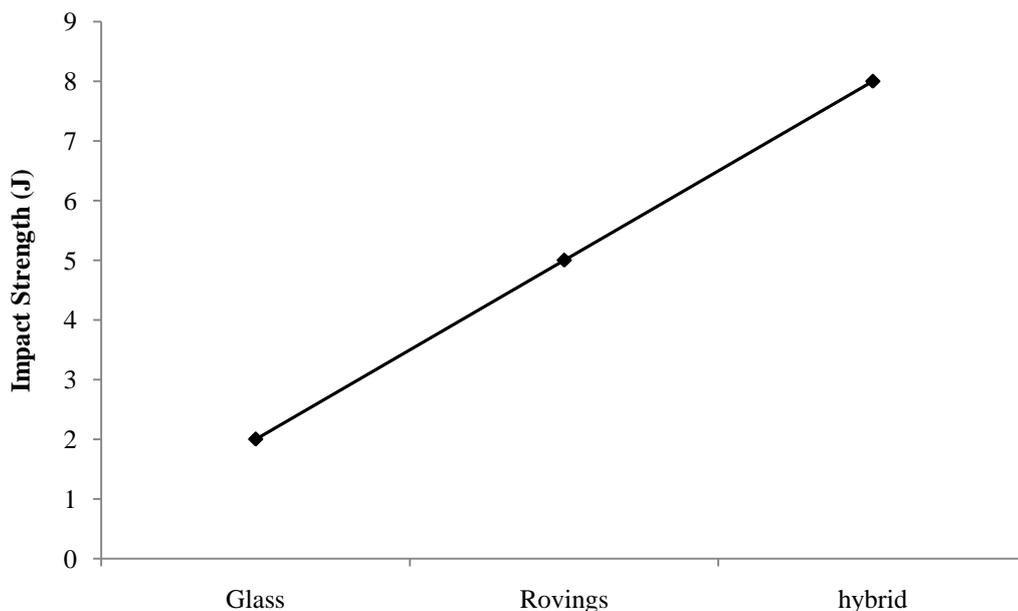


Figure 6: Impact values of various fibers

III. BEFORE AND AFTER FABRICATION PROCESS



IV. CONCLUSION

1. Hybrid composite specimen has given better tensile strength as compared with other two fibers.
2. Weight of the bike has decreased to 18% of total weight of the bike. This in turn, increases a mileage and performance of bike.
3. Cost saving of 10-30% over conventional moulding system.
4. This material is eco-friendly material because 50% of natural fiber has used and it consumes less energy during the fabrication of the composite.
5. The experiments can be extended by other potential natural fibers, by changing the fiber orientation and fiber content and their mechanical and machining characteristics may be analyzed.
6. The present research work leaves a wide scope for future investigators to explore many other aspects of such hybrid composites.

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