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Exploration on mechanical characterization of natural fibre matrix composites produced through hand-lay method

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***ABSTRACT**--Presently there has been an enormous increase in demand for novel material to produce complex with better **quality**. Hence plant fibre shall be used to achieve this goal. Natural fibre composites can fulfil these requirements. This research article deals with manufacturing, mechanical characterization of a hybrid (GFRP+orange+GFRP) composite and also the comparison of it with the (GFRP+banana+GFRP) based composite. These composites are fabricated using hand lay-up technique. The mechanical tests such as tensile and flexural test. Epoxy resin alongside with HY951 hardener is used as the binding agent throughout the layer. Glass fibre laminates are used on both sides for improving the surface finish and surface hardness. Test results shows that the hybrid natural composite has excellent properties under tensile and flexural loading.*

***Keywords**-- Natural fiber, Mechanical properties, Hand-lay method, Banana fibre, Orange fibre.*

I. INTRODUCTION

Novel composites materials show desirable chemical, tribological and mechanical properties like superior strength, outstanding specific modulus and higher corrosive protection. Light weight matrix based composite materials have multipurpose applications in structural and automobile factories owing to their remarkable characteristics like superior tribological and corrosion protection [1-26]. Natural fibers are eco-friendly and it is extracted from plants, vegetables, minerals and animal wastes. The foremost behaviour of natural fibers are its less weight, superior specific strength, and outstanding tribological characteristics and non-toxic in nature. The main category if these natural fibers are its simple to replace the synthetic fiber as well as conventional metallic materials [27-32]. Natural fibers are employed as filler material for several industrial applications. Realistic applications are switch boxes, dashboards, door panels and etc. In this work, two types of plant based natural fibers (banana, orange) and their hybridized combinations such as (i) GFRC/Banana/GRFC, and (ii) GFRC/Orange/GRFC were used in woven mat (or) loose fibre form to be reinforced with epoxy matrix.

II. MATERIALS AND METHODS

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2.1 Hardener and Resin

HY951 hardener is employed to boost the interfacial adhesion and toughness of the composite. Epoxy resin is utilized to provide superior binding characteristics between the natural fibre layers to form the matrix. The epoxy resin utilized at normal atmosphere temperature is LY556. A epoxy resin and the hardener mixture of 10:1 is utilized to succeeded augment matrix composition. Figure. 1. exhibits the hardener and resin.

Figure. 1. Hardener and resin

2.2. Glass fiber

Glass fiber is a material involving of numerous extremely fine fibers of glass. It is developed when thin strands of silica glass are extruded into several fibers with small diameters. It is weightless, extraordinarily strong and durable. Figure.2. exhibits the lightweight glass fiber.

Figure. 2. Glass fiber

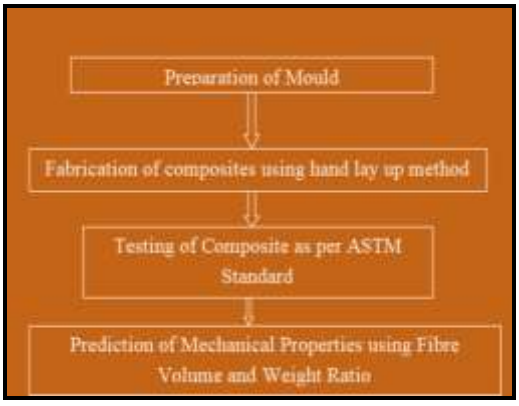

Figure. 3. Flow chart of the fabrication process

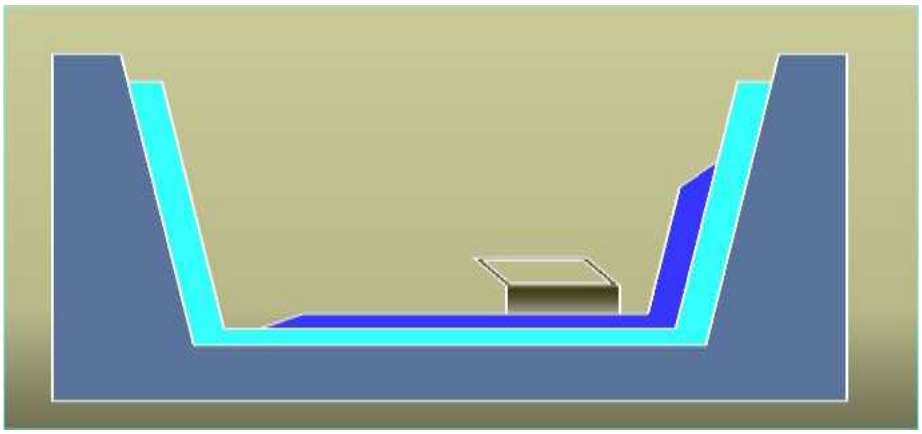

Figure. 4. Schematic diagram of hand layup process

2.3.Fabrication of composites

Figure 3. reveals the flow chart of the fabrication process. Figure. 4. reveals the schematic diagram of hand layup process. Initially, Mica sheet on top and bottom of the wooden board. Wooden board to be placed flat surface. In the beginning the epoxy and hardener (HY951) mix with the Mixing ratio 10:1. Hardener is embraced to break the chemical bonding of epoxy resin (LY556) by augmenting the temperature and then curing. Hardener fraction is exactly proportional to the curing time. In this experimental work the hybrid composite samples were produced via three layers. Two samples manufactured in several layer orientation, Trial1 (GF+O+GF) 1^{st} layer E-Glass fiber is placed on the Wooden board brushed epoxy resin onto the glass fiber. 2^{nd} layer Orange (woven form) fiber is placed then epoxy resin is brushed. Lastly again glass fiber is to be placed on the wooden board. Now, apply the load which is directly proportional to the thickness of the composite laminate plate then curing with 3600 minutes. Finally, gradually eliminate the load, the prepared plates are machined 20cm x 20cm dimensions and below 6 mm thickness. Similarly the above methods to follow through manufacturing the Trial 2 banana based composites (GF+B+B+GF). Figure. 5. reveals the development of composite.

Figure 5. Development of composite.

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III. RESULTS AND DISCUSSIONS

3.1 Tensile test

Figure 6. reveals the tensile test sample standard dimesnion. The tensile test of composites was conducted through computerized integrated universal testing machine (CIUTM). The tensile test results exposed in Figure.7. The tensile strength of the GF+B+GF composites and GF+O+GF composites are in the range of 181 MPa and 205 MPa respectively. From the experimental outcome exposed that the higher tensile strength is attained for GF+O+GF composites followed through GF+B+GF composites.

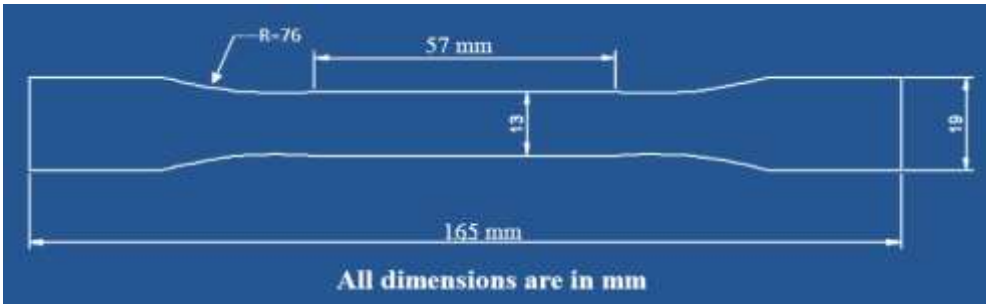

Figure 6. Tensile test sample standard dimesnion

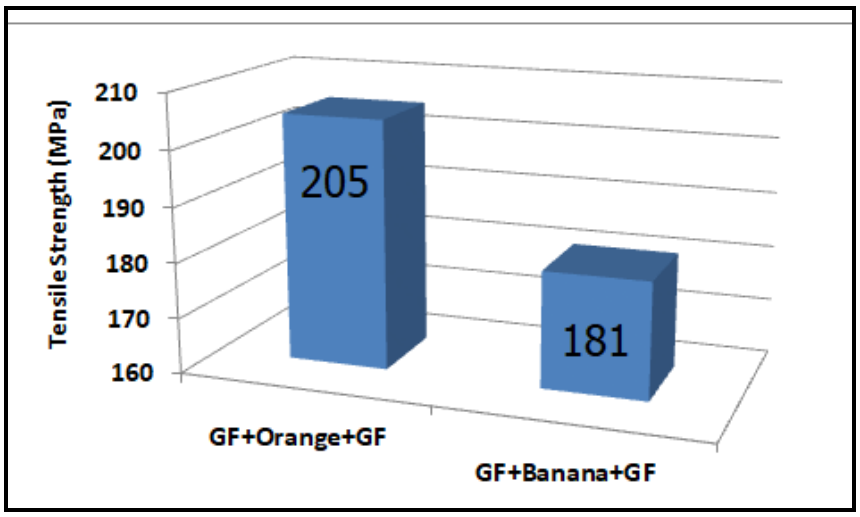

Figure. 7, Tensile strength of the composite

3.2 Flexural test

Figure 8. reveal the flexural test sample standard dimesnion. The flexural properties including flexural break load, maximum displacement, ultimate flexural strength, flexural modulus, stiffness of the composites namely GF+O+GF and GF+B+GF are revealed in the Figure 9. It can be seen that almost all the properties of GF+O+GF composites are higher than GF+B+GF.

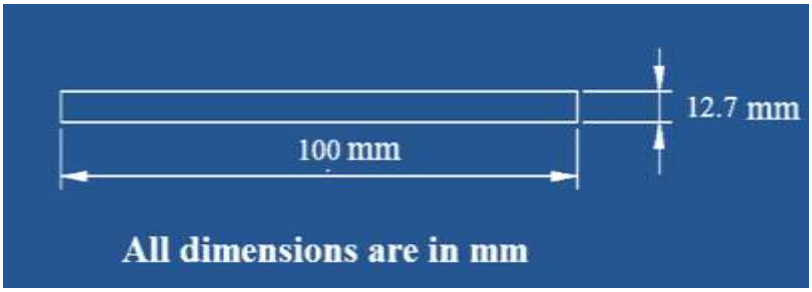

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Figure 8. Flexural test sample standard dimesnion

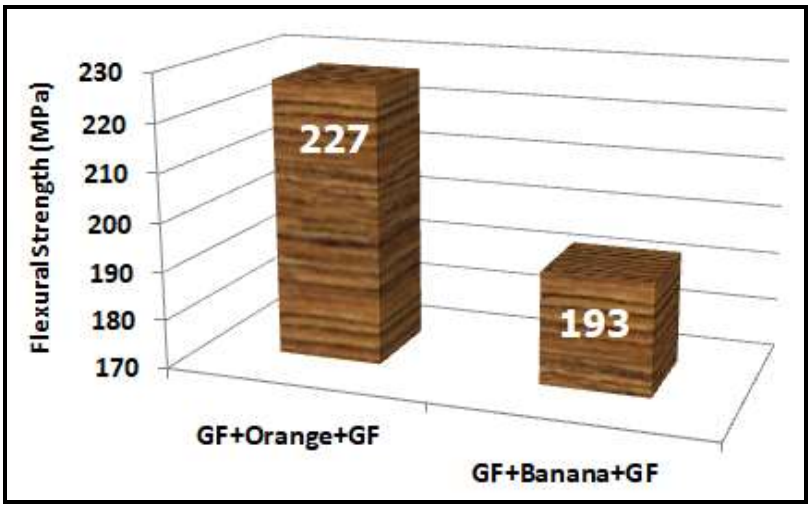

Figure. 9. Flexural strength of the composites

IV. CONCLUSIONS

The E-glass/Orange, E-glass/Banana composite samples are produced. The manufactured composites are subjected to mechanical testing like flexural and tensile test. Based on the outcomes, the following conclusions are drawn:

1. The flexural strength of the GF+Orange+GF sample is 227 MPa which is greater than that of GF+Banana+GF with 193 MPa.
2. The tensile strength of GF+Orange+GF (205 MPa) sample is comparatively augment than (181 MPa) of GF+Banana+GF sample.

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