

Fabrication and Testing of Novel Hybrid Carbon Composite for Aircraft Applications

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Abstract - Even though many advanced composite material fabrication method is available, still hand layup method is a major part of a research work. Hand-layup process is time consuming and inconsistent method, but due its low cost and versatility, this method is used for production of composites. In this project, a hybrid carbon composite has been fabricated and tested for two different compositions. From testing results we studied that carbon-glass composite fiber is tougher than the glass-bagasse-carbon composite fiber and which is harder than the glass-bagasse-carbon composite fiber. The limitation of the carbon-glass composite fiber is more costly than the glass-bagasse-carbon composite fiber but it gives more strength.

Keywords: Hand-Layup, Carbon Fiber, Glass Fiber, Bagsse Fiber, Epoxy Resin

I INTRODUCTION

A large number of composite plastic products are produced by hand laying. A few examples of the methods used are: boats, portable toilets, picnic tables, car bodies, diesel truck cables, hard shell covers and airbags and indoors. Traditional building materials include aluminum, steel and titanium to replace a wide range of composites such as fiberglass. The operational benefits associated with the reduction in aircraft structure have been a major impetus for the development of a combination of military aircraft. In aircraft construction, most types of composites are those made of fiberglass, carbon fiber.

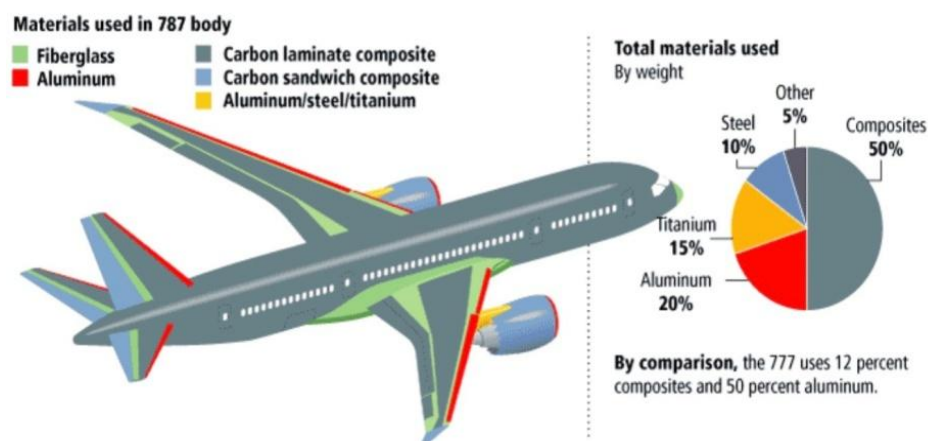


Figure 1: Composition of Aircraft Material

The objective of the present paper is to perform hand-layup process to construct carbon-glass fibre and Bagasse composites. We are going to discuss about hand-layup process of carbon-glass composite fibre, which is used as the skin of fuselage compared with

hand-layup process of carbon-glass and bagasse composite fibre, which is a new composite material.

Hand Layup Process

Samples were prepared for specific steps. First, the molding surface is treated with a mold-releasing agent to avoid polymer adhesion to the surface. Then, a thin plastic sheet is applied to the top and bottom of the molding plate to obtain a smooth surface for the product. Layers of woven reinforcement are cut as needed and placed on top of the mold. Therefore, as mentioned earlier the resin is mixed with other ingredients and applied to the already hardened surface applied to the skin using a release brush to spread the uniform. Then some mats are placed on top of the pre-polymer layer and pressed using a roller to remove any trapped air bubbles and excess polymer. The mold closes and pressure is released to obtain a single mat. After curing the room temperature, the mold is opened and the woven mixture is removed from the mold. The production process known as 'hand structure' involves laying down individual layers or 'pieces' of a type of reinforcement known as 'prepreg'. This consists of thousands of fibers, pre-soaked with resin and assembled into toys and arranged in a single pattern or stitched together.



Figure 2: Hand Layup Process

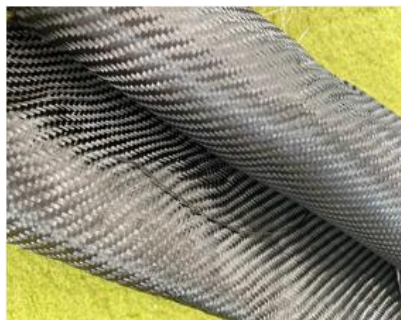
II COMPONENTS USED

Table 1: Component Specification

SI NO.	COMPONENT	SPECIFICATION
01.	Roller	Polyester Roller (9")
02.	Bagasse	Chopped Strand
03.	Epoxy Resin	Carbon Balck Laminating Resin
04.	Glass Fiber	E-Glass Fiber Chopped Strand Mat

05.	Carbon Fiber	2x2 TWILL WOVEN
06.	Epoxy Hardner	Carbon Balck Laminating Hardner
07.	Mould Release Wax	Carbon Black Composite
08.	Brush, Scale, Gloves	Brush - 50 Mm

Carbon Fibre



Woven Carbon Fiber: Carbon fiber usually comes in the form of woven fabric, which makes it easier to work with and can provide additional structural strength depending on the application. As a result there are many different fabrics used for carbon fiber fabric.

Glass Fiber



E-glass fiber has been used since the 1930s, in large industrial systems, such as high temperature protection for electrical conductors. E-glass fibers are widely used, either in the textile industry or in composite materials, and are available in 90% reinforcement. About 50 percent of the weight of modern aircraft may be composed of synthetic compounds.

Laminates made of reinforced Vetrotex E-Glass compounds can be found on the floor, cabinets, chairs, air ducts, cargo lines, heat shields and other interior components of various cabinets.

Bagasse



Bagasse is a renewable source and natural fiber, which provides good strength, Light weight, Low cost. As its chopped strands fabrication process is bit difficult to complete. Bagasse is a sustainable product because it is available with very little environmental impact. It can be easily filled because the residue can be obtained after harvest. The main drawback of Styrofoam is that it never degrades. Plastic is durable but can take up to 400 years to decompose.

Epoxy Resin and Hardener



Epoxy resin and hardener are mixed in a ratio of 2: 1, to obtain the ideal ratio of 2: 1 mix in volume, just measure two parts of the resin in 1 part hardener before mixing the components. Weight - The exact weight of these measurements is slightly different in volume measurement due to resin and durability. Epoxy resins are available in two components: resin and hardener. When the two components are mixed, a chemical reaction results in the production of heat. This heat converts the epoxy resin from liquid to solid. Epoxy resin, like other resins, is mixed together with a certain amount or amount of resin to a hardener.

Mould Release Wax



Mold Release Wax is a special combination of imported waxes that are specially designed to provide the maximum release per request. Used for fiberglass applications. In particular it is helpful in the use of tools and new mold. This wax is white non-silicone glue that is specially formulated to produce a strong, durable, shiny surface.

Rollers and Gloves



Rollers are used to roll over the compound to remove excess resin and air bubble; The rollers help to provide sufficient pressure for the joint to fine-tune the resins and resin. Hand gloves used to prevent any contact with the skin and parts of the liquid resin should be avoided using gloves and protective clothing. Many of the chemical components used in resins are effective and harmful to the skin.

Brush, Scissor, Scale, Weighing Machine



III EXPERIMENTAL INVESTIGATIONS

FABRICATION PROCESS

Mould Preparation



A smooth flat mould is taken, for the smooth surface finish of the model; 30cm * 30 cm square cross section is taken and bordered with the double sided gum tape.

Gel Coating



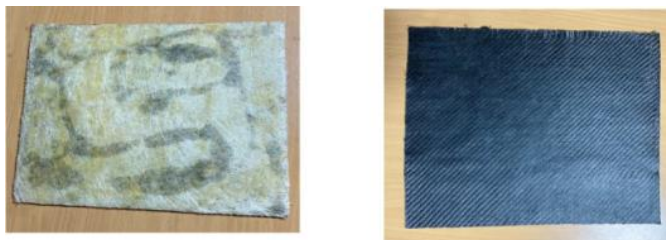
Mould release wax is applied gently all over mould, mould release wax used is carbon black composite mould release wax which helps to remove the model from mould easily, after the wax cured, we go on to next step to apply 2:1 mixture of resin and hardener over the mould thoroughly.

Layup Process



A layer of fiber is applied gently over resin hardener layer, now roller is used to roll over fiber to remove excess resin, air bubbles and to supply sufficient pressure for fabrication. Now new layer of resin and hardener is applied. Again same procedure is continued until desired layer of fiber is applied.

Mould Removal Part



After the curing of around 24 hours, the part is removed from the mould gently. The part must not be removed from mould before curing which would result in loss of strength of the part. Curing is necessary for good strength of material.

IV TEST RESULT

Table 2: Test Results

S. NO	TEST	A	B
01.	IZOD IMPACT TEST	3 JOULE	5 JOULE
02.	CHARPY IMPACT TEST	4 JOULE	6 JOULE
03.	ROCKWELL HARDNESS TEST (1/6) BALL INDENTOR, 60KGF LOAD.	44	88



Figure 3: Specimen A Length:55 mm Width:10 mm Thickness:3mm



Figure 4: Specimen B Length: 55 mm Width: 10mm Thickness: 5mm

V CONCLUSION

The results obtained shows that the behavior of a composite varies from test to test based on the applied load, hence the purpose of the use. Carbon-glass composite fiber is tougher than the glass-bagasse-carbon composite fiber. Carbon-glass composite fiber is harder than the glass-bagasse-carbon composite fiber. Carbon-glass composite fiber is more costly than the glass-bagasse-carbon composite fiber. Even though, Hand-layup process is time consuming and inconsistent method, due its low cost and versatility, this method can be used for production of composites.

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