Fabrication And Experimental Analysis Of E-Glass Epoxy Laminates

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Abstract: **Composite materials play a vital role in many industrial applications. Researchers are working on fabrication of new composite materials worldwide to enhance the applicability of these materials. The biggest advantage of modern composite materials is that they are light as well as strong. By choosing an appropriate combination of matrix and reinforcement material, a new material can be made that exactly meets the requirements of a particular application. Composites also provide design flexibility because many of them can be moulded into complex shapes. The downside is often the cost. Although the resulting product is more efficient, the raw materials are often expensive. E-glass epoxy laminates have been used in flooring, closets, seating, air ducts, cargo liners, insulating and various other cabin interior parts in aerospace applications. In this study, the E-glass Epoxy laminates is to be manufacture and fabricate as per ASTM (American society of testing and materials) standard 300x300x4mm. The tensile and flexural strength of an E-glass epoxy laminated composite plate is to be analyze by using UTM (Universal testing machine).**

Keywords: **Fiber orientation, Epoxy resin composites, Glass fiber, laminated polymer composites.**

I. INTRODUCTION

A composite laminate is a structural plate consisting of multiple layers of fiber reinforcement encased in cured resin.The number of layers, the type of fiber (carbon, glass, or other), the fabric configuration (e.g., woven, stitched mat, uni-directional), the type of resin, and other factors can be varied to design a structural element that is suitable for a particular need. Raw materials (fiber, resin, and usually some filler) in themselves are not useful as a structural member, but when combined together, the product takes on new properties that make them desirable for use in structures. Laminates, or hardened sheets of composite material, usually are cut up into coupons for mechanical testing to validate the predicted properties.

There are numerous resins on the market, but only the most durable are suitable for use as part of a bridge deck system. For this study, the project team performed a literature search to narrow the number of resins under consideration. They also requested composite test panels (also called “witness panels”) from several composite fabricators, then tested the panels that were received so that a variety of specimens could be compared. The project team also made use of data obtained from a recent project involving a composite “ice shield.” In some cases, incomplete data were obtained from suppliers, but it still made a contribution to the body of knowledge that was being built. Laboratory samples were prepared to make up for samples that were not readily available from other sources.

Various manufacturing processes are being considered: hand, vacuum infusion, and pultrusion. This helps to widen the number of potential fabricators for this type of deck system, and it is hoped this will in turn promote broader acceptance and commercial adoption of the system. Various resins and fiber architectures are being evaluated.

After weighing all viable options, and in consultation with the project team’s manufacturing par tners, a fire-resistant vinyl ester resin (Derakane 510C from Ashland) was selected for use in the combination tube that was developed and will be pultruded. Glass reinforcement was selected, and a layup sequence was adopted based on theoretical predictions. Testing to validate these decisions is ongoing. This report outlines characterization work and testing done to date. The development of laminate configurations is discussed, and physical test data are presented.

II. EXPERIENTAL DETAILS

A. Materials

The matrix material used was medium Epoxy resin widely used in industries due to their strong adhesive properties, chemical resistance and toughness. The reinforcement material employed was E-glass which is a popular fiber. The matrix materials are epoxy resin LY556 and hardener HY951 mixed in appropriate ratio1:10 with room temperature curing

cycle of 48 hours duration.

Instrumental:

The composite laminates were subjected to various loads and computer controlled UTM as shown in fig1. The specimens were clamped and tests were performed. The tests were closely monitored and conducted at room temperature. The load at which the completed fracture of the specimen occurred has been accepted as breakage load.

Fabrication:

The glass/Epoxy composite is fabricated using simple hand layup technique. The procedure consists of placing the glass fibers, layer by layer and applying liquid epoxy mixed with hardener on the glass fibers in order to form a solid network cross-linked polymer. The layup assembly is pressed with the help of roller so that excess air between the layers is expelled out. The laminate is cured at ambient conditions for a period of about 24hrs. The laminate is prepared for three different compositions of E-glass/Epoxy with a size of 300mm×300mm×4mm.

Experimentation:

The fabrication involves three different compositions of composites where the composite plates are cut down according to the ASTM standards in order to carry out tensile, flexural on each specimen.

Plan of Experiments for conducting tests:

Tensile test &3-point bending test ASTM D3039, ASTM D790 standards. ASTM standards for the above stated tests.

B. Figures, Graphs and Tables

Fig1: Computer controlled UTM.

Tensile test and3-point bending tests are carried out in accordance with ASTM D3039 and ASTM D790 standards respectively under displacement control using an UTM/E-40 with resolution of the piston movement of 0.01mm.

Fig.2 Fabrication Process of Composite Materials

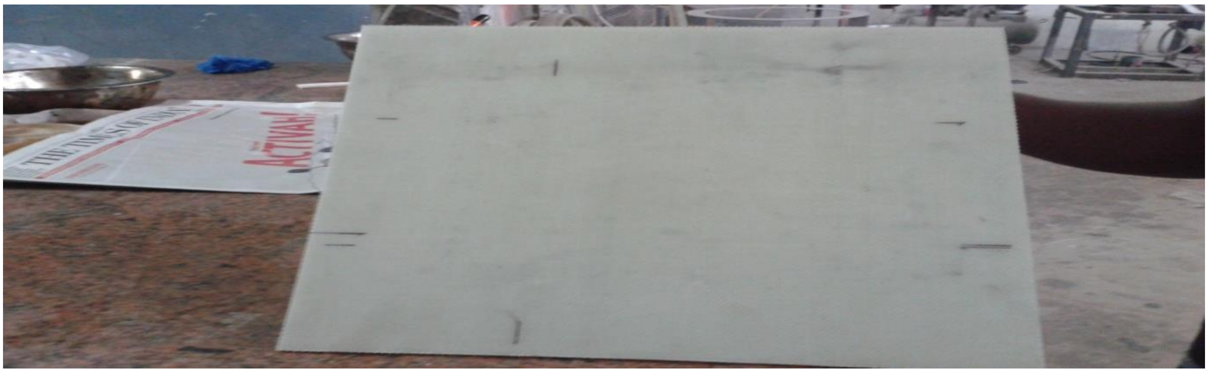

Fig.3 Manufactured sheet of dimensions 300x300x4mm

Fig.4 Tensile test specimen of dimensions 250x25.4x4mm.

Fig.5 Flexural test specimen of dimensions 120x15x4mm.

Experimental result in tensile &flexural specimens

TENSILE TEST RESULT

Table.1 Experimental result on tensile test specimen

DETAILS	EGLASSEPOXY LAMINATE
LENGTH OF SPECIMEN (mm)	250
WIDTH OF SPECIMEN (mm)	25.4
THICKNESS OF SPECIMEN (mm)	4
CROSS-SECTIONAL AREA [mm²]	101.6
LOAD (N)	43117.559
STRESS [N/mm²]	424.38
STRAIN	0.07092
YONG'S MODULUS [N/mm²]	5984

Fig.6 Tensile test specimen after test

BENDING TEST RESULT

Table.2 Experiment result on bending test specim

DETAILS	EGLASSEPOXY LAMINATE
LENGTH OF SPECIMEN (mm)	120
WIDTH OF SPECIMEN (mm)	15
THICKNESS OF SPECIMEN (mm)	4
CROSS-SECTIONAL AREA [mm²]	60
LOAD (N)	43117.559
STRESS [N/mm²]	19.65
STRAIN	0.06208
BEND FLEXURAL STRENGTH [N/mm²]	442.3

Fig.7 bending test specimen after test

III. CONCLUSIONS

In this work, specimens are prepared in the laboratory by using hand lay -up technique with woven, glass as a fiber and epoxy resin as an adhesive. The specimens are prepared for testing as per ASTM standards to estimate the tensile & flexural properties.

The behavior of e glass epoxy laminates were subjected to TENSILE &BENDING loading at continuous varying energy levels had investigated using UTM. These tests have shown that the static response of the systems depends on the elastic properties of fiber material

MATERIAL PROPERTIES MATERIALS	Tensile Strength(N/mm^2)	Flexural strength (N/mm^2)
E glass epoxy laminate	**424.38**	**19.65**
Aluminized Carbon Steel	**380**	**18**

As compared to the aluminized carbon steel the tensile &flexural strength of e glass epoxy laminate has more strength according to the ASTM .

- Using E glass epoxy tensile strength is improved by than that of Al carbon steel.
- Using E glass epoxy flexural strength is improved by than that of Al carbon steel.

A composite laminate is a structural plate consisting of multiple layers of fiber reinforcement encased in curved resin. The number of layers, the type of fibers, the fabric configuration, the type of resin, and other factors can be varied to design a structural element that is suitable for particular need.raw materials in themselves are not useful as a structural member, but when combined together, the product takes a new properties that makes them desirable for use in structures.

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