

Design and Experimental Analysis of Composite Leaf Spring

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ABSTRACT: Reducing weight and increasing the strength of products is the highly important research issue in today's world. Composite materials attracting the researchers and being solutions of many issue. In this paper we discuss about the design and analysis of composite leaf spring. For this experiment, a leaf spring of a old OMNI is considered.

KEYWORDS: Composite, E Glass, Leaf Spring,

I. INTRODUCTION

Composites are the most wanted engineering Material now a days. All are showing more interest in this Field. Because they are lighter in weight and also very cheep. So We decided to Make a leaf spring using this Composite materials. We chose Eglass as our raw material. We tried different compositions of eglass and epoxy in our experiment. It was explained in detail in this paper.

II. MATERIALS USED

The Materials we used in this Process were,

- E Glass Fiber
- Epoxy Resin
- Hardener
- Wax

A. E Glass Fiber

The use of E-Glass as the reinforcement material in polymer matrix composites is extremely common. Because it has Good resistance to abrasion and vibrations. And it also ha good dielectric strength and good dimensional stability Some of the other glass fibers are S Glass Fiber , C Glass Fiber , AR Glass Fiber , D Glass Fiber etc...

B. Epoxy Resin

Epoxy refers to any of a basic components or cured-end products of epoxy. Epoxy resins, also known as polyepoxides. Most of the commercially used epoxy monomers are produced by the reaction of a compound with acidic hydroxy groups and epichlorohydrin.

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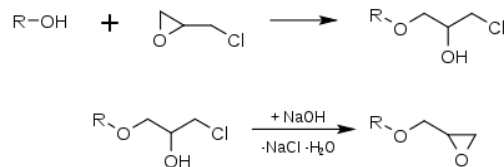


Fig1. Epoxy Reaction

C. Hardener

A hardener is a component of certain types of mixtures. It is used to increase the resilience of the mixture once it sets. It is used to gel two parts. In this it is used to harden the eglass epoxy composition. Hardeners are always needed to make an epoxy resin useful for its own purpose. Without a hardener, epoxy do not achieve its mechanical and chemical properties.

D. Wax

Wax is a potential commercial candidate due to its high reproducibility, low production cost, improved stability, environmental friendliness, and low initial capital investment. It can also reduce the rate of water flow in capillaries and significantly increase the dimensional stability of wet specimens.

III. FABRICATION PROCEDURE

HAND LAYUP METHOD

Hand lay-up is a molding process in which fiber reinforcement are placed by our hand and then wet with the resin. It is the most common and the cheap molding method because it needs the less amount of equipment. Fiber reinforcements are placed by our hand in a mold and resin is applied using a brush or roller. This process is used to make both large and small items.

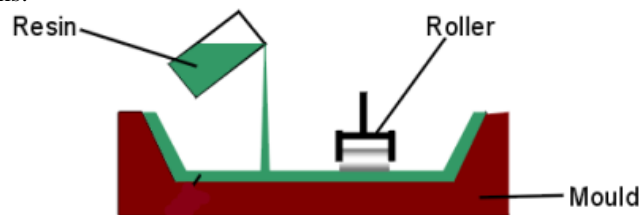


Fig.2 Hand layup Method

IV. PROCEDURE

From the literature survey, it was found that the performance of composites with the combination of 30% E-glass and 70% epoxy matrix was better. So that, as per the literature survey we had decided to manufacture the composites with Two Different combinations of

- 40% E Glass fiber and 60% Epoxy Matrix. (Sample 1)
- 50% E Glass fiber and 50 % Epoxy Matrix. (Sample 2)

In this work the above two composition matrix is considered for the manufacturing of Composite Material Leaf Spring Epoxy Resin and hardener were also used in this.

As per the recommendation, a mixture of hardener and epoxy resin was used in the ratio 1:10 by weight. A Double side Sticker is Attached over the base of the mould. It is attached to remove the Leaf Spring without

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Difficult after it is kept in Sun for 24hrs for Drying Purpose. E-Glass fiber strip is placed on the mould, and then the composite matrix is Applied on the glass fiber strip.

Composite Matrix is Nothing but hardener and Epoxy Resin. Apply composite matrix in such a way that, all air should be removed. For that, a roller is moved on the mould after applying the matrix to remove the excess resin and air to avoid the formation of a void in the spring. Continue this process until the required thickness is achieved. After that, the load was placed over the Composite Material Leaf Spring and allowed to cure for the period of 24 h, then removed the Composite Material Leaf Spring from the mould.



Fig.3 Sample Piece

V. TESTING PROCESS

Normal Tests Conducted on Composite are,

- 1) Tensile Test
- 2) Fluxural Test
- 3) Hardness Test

Lets discuss one by one,

A. Tensile Test

Tensile testing is also known as tension testing. Properties that can be directly measured via tensile testing are ultimate tensile strength, breaking strength, maximum elongation. From these measurements the properties like Young's modulus, Poisson's ratio, yield strength, can be determined



Fig.4 Tensile Testing Machine

B. Flexural Test

Flexure tests are used to determine the flexural modulus or flexural strength of the material. A flexure test is more affordable comparing to the tensile test and test results are slightly different. The most common purpose of a

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flexural test is to measure flexural strength and flexural modulus. Flexural strength is defined as the maximum stress at the outermost fiber on either the compression or tension side of the specimen

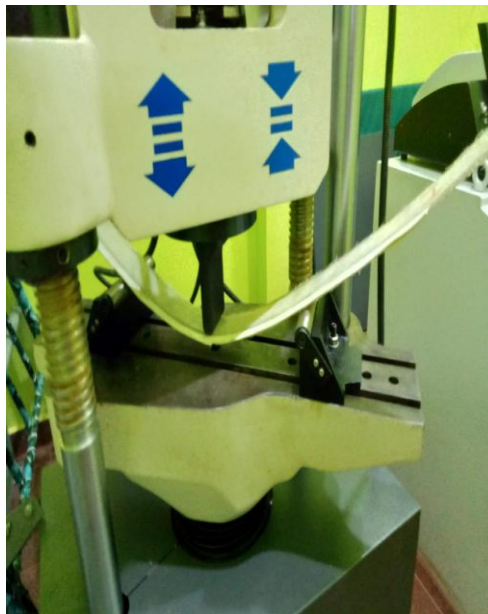


Fig.5 Flexural Testing Machine

C. Hardness Test

It is used to find the hardness of the Material.

Hardness is a characteristic of the material and not a fundamental physical property. The Rockwell test is generally easier to perform, and more accurate than other types of hardness testing methods



Fig.6 Hardness Test

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V. RESULTS & DICUSSION

Results of Sample One

| | | | | |
|----------------------|---------------|--------------------|--------------------|--------------------------|
| Sample Details | : Shape | : Rectangle | Area | : 572.07 mm ² |
| | Width | : 59.22 mm | Thickness | : 9.66 mm |
| | Gauge Length | : 0.00 mm | Final Gauge Length | : 0.00 mm |
| | Sample No. | : | Batch No. | : |
| | Heat No. | : | Description | : Composite Materials |
| Test Type | : Compression | Ultimate Load (Fm) | : 2010.000 N | |
| Displacement at Fm | : 37.84 mm | Max Displacement | : 44.91 mm | |
| Compressive Strength | : 3.514 Mpa | | | |

| Sr No | Force | Displacement | Sr No | Force | Displacement |
|-------|-------|--------------|-------|-------|--------------|
| 1 | 0.06 | 0.00 | 21 | 1.92 | 35.80 |
| 2 | 0.14 | 1.79 | 22 | 1.98 | 37.59 |
| 3 | 0.25 | 3.58 | 23 | 1.98 | 39.38 |
| 4 | 0.37 | 5.37 | 24 | 0.99 | 41.17 |
| 5 | 0.48 | 7.16 | 25 | 0.87 | 42.96 |
| 6 | 0.60 | 8.95 | 26 | 0.51 | 44.75 |
| 7 | 0.74 | 10.74 | | | |
| 8 | 0.83 | 12.53 | | | |
| 9 | 0.93 | 14.32 | | | |
| 10 | 1.05 | 16.11 | | | |
| 11 | 1.16 | 17.90 | | | |
| 12 | 1.23 | 19.69 | | | |
| 13 | 1.35 | 21.48 | | | |
| 14 | 1.41 | 23.27 | | | |
| 15 | 1.53 | 25.06 | | | |
| 16 | 1.59 | 26.85 | | | |
| 17 | 1.66 | 28.64 | | | |
| 18 | 1.77 | 30.43 | | | |
| 19 | 1.83 | 32.22 | | | |
| 20 | 1.86 | 34.01 | | | |

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Table.1 Results of Sample 1

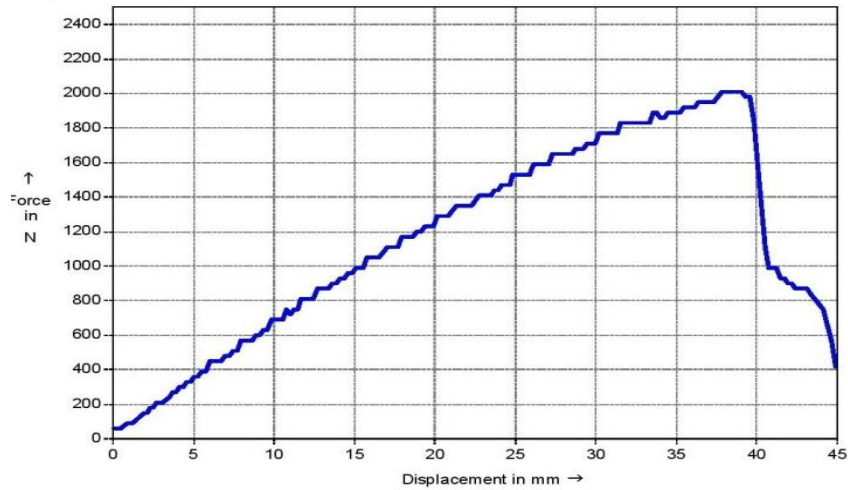


Fig 7. Graph between Force & Displacement

Results of Sample Two

Sample Details : Shape : Rectangle Area : 425.48 mm²
 Width : 52.27 mm Thickness : 8.14 mm
 Gauge Length : 0.00 mm, Final Gauge Length : 0.00 mm
 Sample No. : Batch No :
 Heat No. : Description : Composite Materials

Test Type : Compression Ultimate Load (Fm) : 2190.000 N
 Displacement at Fm : 31.59 mm Max Displacement : 39.47 mm
 Compressive Strength : 5.147 Mpa

| Sr No | Force | Displacement | Sr No | Force | Displacement |
|-------|-------|--------------|-------|-------|--------------|
| 1 | 0.09 | 0.00 | 21 | 2.19 | 31.58 |
| 2 | 0.16 | 1.58 | 22 | 2.14 | 33.15 |
| 3 | 0.32 | 3.16 | 23 | 2.19 | 34.73 |
| 4 | 0.45 | 4.74 | 24 | 2.13 | 36.31 |
| 5 | 0.57 | 6.32 | 25 | 1.40 | 37.89 |
| 6 | 0.73 | 7.89 | | | |
| 7 | 0.87 | 9.47 | | | |
| 8 | 0.99 | 11.05 | | | |
| 9 | 1.10 | 12.63 | | | |
| 10 | 1.23 | 14.21 | | | |
| 11 | 1.35 | 15.79 | | | |
| 12 | 1.44 | 17.37 | | | |
| 13 | 1.56 | 18.95 | | | |
| 14 | 1.65 | 20.52 | | | |
| 15 | 1.77 | 22.10 | | | |
| 16 | 1.83 | 23.68 | | | |
| 17 | 1.92 | 25.26 | | | |
| 18 | 2.01 | 26.84 | | | |
| 19 | 2.04 | 28.42 | | | |
| 20 | 2.10 | 30.00 | | | |

Table 2. Results of Sample Two

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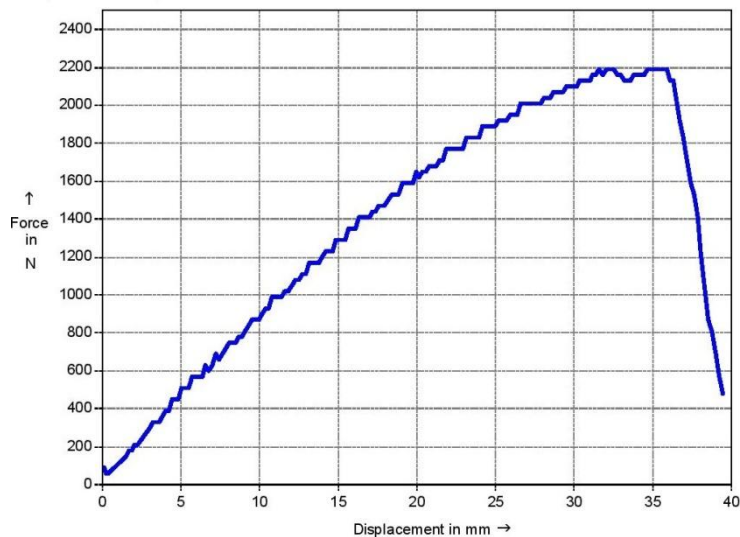


Fig 8 Graph between Force & Displacement

RESULT OF SAMPLE 1 :

(40% EGLASS 60% EPOXY)
Fmax = 2010N
Bending Stress = 3.514 M Pa

RESULT OF SAMPLE 2 :

(50% EGLASS 50% EPOXY)
Fmax = 2190N
Bending Stress = 5.147 M Pa

These are the Results of all the 3 Samples of Various Compositions. Comparitively we are getting better Results than the Sample Leaf Spring we took from Literature Survey.

VI. CONCLUSION

We had Compared two Samples of Various Compositions. By seeing the above results we can clearly understand that Samples two has better result comparing to Sample one

Bending Stress in Sample 1 : 3.514 M Pa

Bending Stress in Sample 2 : 5.147 M Pa

We are Getting better Results in 50% Eglass 50% Epoxy Sample comparing to 40% Eglass 60% Epoxy Sample.

So this Indicates when the Eglass Dominates the Matrix , the Strength of the matrix also got Increased. We also checked an old journal, in that they used 30% Eglass & 70% epoxy composition. They got 2.9MPa in experimental Results and 2.92MPa Analytically. So We had Confirmed that when EGlass is more in the Composition the Results are Better.

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