Mechanical Properties of Glass Fibre Reinforced Graphite/Epoxy Composites
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Abstract— This project deals the Fabrication and Analysis of Graphite Epoxy glass fibre composites the composition of the selected glass fibre reinforced material used on the aircraft structures, space stations and space vehicles. There is an existing problem such as that glass fiber material which is used in an aircraft which is having problem with Mechanical properties of wear and thermal stresses used with other materials. The major advantage of the material is that by mixing graphite and Epoxy resin on propositions to the quantity of the Epoxy resin to the glass fiber material there is a capacity to withstand Mechanical Properties of wear and thermal stresses. Compared to other glass fiber material used in aircraft which increases reliability of the material. To solve the problems on the aircraft manufacturing industry on weight reduction of the aircraft, which increases the efficiency of the aircraft, decreases the fuel consumption. It is capable of withstanding regular types of loads, thermal stresses while in flight condition. It also withstands stresses at high levels compared to alloys and other composites.

Key words: Graphite, Epoxy, Glass Fibre etc

I. INTRODUCTION
Man's evolution has been tied to his progress in materials. Yesterday it was the Stone, Bronze and Iron Ages. Today it is the Age of Composites. However, even in these earlier ages man experimented with and learned to use composite materials. This is evidenced by the Israelites' use of chopped straw in their brick, the Egyptian sarcophagi fashioned from glued and laminated wood veneer and also their use of cloth tape soaked in resin for mummy embalming; the Mongol warriors' high-performance, re curved archery bows of bullock tendon, horn, bamboo strips, silk and pine resin, which are 80% as strong as our modern fiberglass bows. Chinese bamboo rockets reinforced with rope wrappings. Japanese Samurai swords formed by the repeated folding of a steel bar back on itself, the early fabrication of steel and of iron gun barrels in Damascus and the Roman artisans' use of ground marble in their lime plaster, frescoes and pozzolanic mortar. The ancients also used goat hair in their clay for the fabrication of pottery which, after firing, was converted to a form of carbon, the forerunner of modern carbon fiber reinforced ceramics.

Composites are becoming the essential part of today's materials because they offer advantages such as low weight, corrosion resistance, high fatigue strength, faster assembly etc. Composites are used as material ranging from making aircraft structure to golf club, electronic packaging to medical equipment and space vehicles to home buildings. Composites are generating curiosity and interest in student all over the world. They are seeing everyday application of composite material in commercial market and job opportunities are also increasing in this field.

C. Characterization
1) Light weight.
2) High specific strength and modulus, as well as high fatigue strength and fatigue damage tolerance.
3) Isotropic in nature.
4) Designable or tailor able materials for both microstructure and properties.
5) Production of both material and structure or component in a single operation- manufacturing flexible, net-shape, complex geometry.
6) Corrosion resistance and durable.
7) Easy moldable to complex forms.
8) Easy bondable.
9) Good dumping.
10) Low electrical conductivity and thermal expansion.
11) Good fatigue resistance.
12) Part consolidation due to lower overall system costs.
13) Low radar visibility.
14) Internal energy storage and release.
15) Other unique functional properties—damping, low CTE (coefficient of thermal expansion).

D. Testing Methods

Testing methods for samples are selected to calculate the thermal wears, stress strain etc. Testing methods used are as follows:
- Tensile test.
- Flexural test.
- Heat deflection temperature test.

1) Tensile Test

Tensile testing, also known as tension testing is a fundamental materials science test in which a sample is subjected to a controlled tension until failure. The results from the test are commonly used to select a material for an application, for quality control, and to predict how a material will react under other types of forces. Properties that are directly measured via a tensile test are ultimate tensile strength, maximum elongation and reduction in area. From these measurements the following properties can also be determined
- Young's modulus
- Poisson's ratio
- Yield strength
- Strain-hardening characteristics

Uniaxial tensile testing is the most commonly used for obtaining the mechanical characteristics of isotropic materials. For anisotropic materials, such as composite materials and textiles, biaxial tensile testing is required.

2) Flexural Test

The three points bending flexural test provides values for the modulus of elasticity in bending,
- Flexural stress.
- Flexural strain.
- Flexural stress-strain response of the material.

The main advantage of a three point flexural test is the ease of the specimen preparation and testing. However, this method has also some disadvantages: the results of the testing method are sensitive to specimen and loading geometry and strain rate. The test method for conducting the test usually involves a specified test fixture on a universal testing machine. Details of the test preparation, conditioning, and conduct affect the test results. The sample is placed on two supporting pins a set distance apart and a third loading pin is lowered from above at a constant rate until sample failure.

3) Heat Deflection Temperature Testing

The deflection temperature is a measure of a polymer's ability to bear a given load at elevated temperatures. The deflection temperature is also known as the “deflection temperature under load” (DTUL), 'heat deflection temperature', or 'heat distortion temperature' (HDT). The two common loads used are 0.46 MPa (66 psi) and 1.8 MPa (264 psi), although tests performed at higher loads such as 5.0 MPa (725 psi) or 8.0 MPa (1160 psi) are occasionally encountered. The common ASTM test is ASTM D 648 while the analogous ISO test is ISO 75. The test using a 1.8 MPa load is performed under ISO 75 Method A while the test using a 0.46 MPa load is performed under ISO 75 Method B. The figure below, from Quadrant Engineering Plastic Products, shows the test geometry. The value obtained for a specific polymer grade will depend on the base resin and on the presence of reinforcing agents. Deflection temperatures of glass fiber or carbon fiber reinforced engineering polymers will often approach the melting point of the base resin. The deflection temperature test results are a useful measure of relative service temperature for a polymer when used in load-bearing parts. However, the deflection temperature test is a short-term test and should not be used alone for product design. Other factors such as the time of exposure to elevated temperature, the rate of temperature increase, and the part geometry all affect the performance.

III. RESULTS AND DISCUSSION

A. Microstructure

Scanning electron microscope image of the cross section of glass fibre reinforced graphite/epoxy composites with concentration of 2% and 4% graphite as shown in figure 1 and 2.

Fig. 1 2: % of graphite concentration

Fig. 2 4: % of graphite concentration

The test results for the manufactured plates are given below

B. Flexural Tests:

For 2% graphite +epoxy +glass fibre

Fig. 3: Load Vs Displacement
For 4% graphite +epoxy +glass fibre

C. Tensile Testing

For 2% graphite +epoxy +glass fibre

D. Heat Deflection Testing

<table>
<thead>
<tr>
<th>Graphite</th>
<th>Epoxide</th>
<th>Glass Fibre</th>
<th>Breaking Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>1%</td>
<td>2%</td>
<td>3%</td>
<td>4%</td>
</tr>
<tr>
<td>195°C</td>
<td>205°C</td>
<td>220°C</td>
<td>232°C</td>
</tr>
</tbody>
</table>

IV. Conclusion

In this project work the properties of composite materials, their classification, advantages and disadvantages and also their application have been studied. It came to know that Graphite Epoxy glass fiber reinforced composite materials having thermal and mechanical characteristic in addition to Graphite to Epoxy resin. In order to expand applications of the fiber reinforced composite, the hand layup method has been done for the preparation of the respective material. For increasing the thermal properties of the composite material graphite has been used which gave good results. Also when graphite with Epoxy has been added which haven’t changed the curing property of epoxy resin but after a heat treatment we finally got the finished material which is having good and improved thermal and mechanical properties which are verified through various tests. In this project Fabrication analysis of GFRC, Low Filler material gave Flexural and Tensile result analysis properties of the manufactured material and by mixing the proportion of graphite powder to the Epoxy resin increases the thermal properties and heat withstanding capacity through Heat Deflection Temperature Testing.

1) In Tensile Testing the 2% of graphite+epoxy material have high tensile strength.
2) In Flexural Testing 2% of graphite+epoxy material have high Flexural strength.
3) In Heat deflection testing Temperature testing 5% of graphite+epoxy material gives highest heat withstanding capacity.

REFERENCES


BIOGRAPHIES


