International Journal of Scientific Research in Mechanical and Materials Engineering
© 2019 IJSRMME | Volume 3 | Issue 1 | ISSN : 2457-0435

Preparation and Mechanical Testing of E-waste Glass Filled Polymer Composites

Lokesh K. S

Assistant Professor, Department of Mechanical Engineering, Srinivas Institute of Technology, Valachil, Mangaluru, Karnataka State, India

ABSTRACT

It is a great challenge to prepare light weight materials using E-waste products which are difficult to recycle to contribute as a new product due to its inefficiency to recombine with its physico-chemical characteristics. This work aims to prepare and test samples prepared by the E-waste scrap glass mixed with polymer matrix material proportioned with glass fibre. Composites with different filler ratio (0%, 3%, 6%, 9%) are prepared. Tests were performed to calculate tensile properties, flexural strength of the composites. Based on the tensile and flexural test it is depicted that composite with 6% filler material exhibits enhanced properties due to the strong bonding between filler and the matrix material.

Keywords : E Waste, E Glass/Epoxy Composites, Tensile & Flexural Behaviour.

I. INTRODUCTION

A composite material is a heterogeneous solid consisting of two or more different materials that are mechanically or metallurgic-ally bonded together. The word ―composite‖ means, ―consisting of two or more distinct parts.‖ Thus, a material having two or more distinct constituent materials or phases may be considered a composite material. Composite materials emerge as a promising alternative to correct the deficiencies caused by steel reinforcement in concrete structures [1-5]. It is only when the constituent phases have significantly different physical properties and thus the composite properties are noticeably different from the constituent properties that we have come to recognize these materials as composites. The constituents are combined at a macroscopic level and are not soluble in each other. Each of the various constituents retains its identity in the composite and maintains its characteristic structure and properties. There are recognizable interfaces between the materials. One constituent is called the reinforcing phase and the one in which it is embedded is called the matrix. The reinforcing phase material may be in the form of fibers, particles and flakes. The composite material, however, generally possesses characteristic properties such as high strength-to-weight ratio, high stiffness-to-weight ratio, high temperature performance, corrosion resistance and hardness, which are not possible to obtain with the individual components.

II. FABRICATION OF SPECIMENS

The aim of this project is to study the structural and dynamic properties and strength of composite material (E-waste reinforced). These composite specimens were prepared by Hand lay-up technique, as it is relatively cheaper and convenient method of composite preparation, when compared to other fabrication method. The tensile, hardness and 3 point bending tests were carried out in a universal testing machine.

Following are the types of materials used:

Fibre- E-glass 360 GSM Bidirectional

Resin- Epoxy (LY556).
System- Polymer matrix composite.
Type of fabrication-Hand layup technique.
Filler material - E-wastes (powdered to 85 micron).

A. Methodology

Filler powder preparation:

Figure 1 :- Filler powder preparation

Computer monitor is taken and parts containing plastic content are removed. They are broken into smaller pieces. These pieces are scraped into fibre like structure. These fibre like structure are made into powder using mixer grinder. Then finally it is sieved using 85 micron siever.

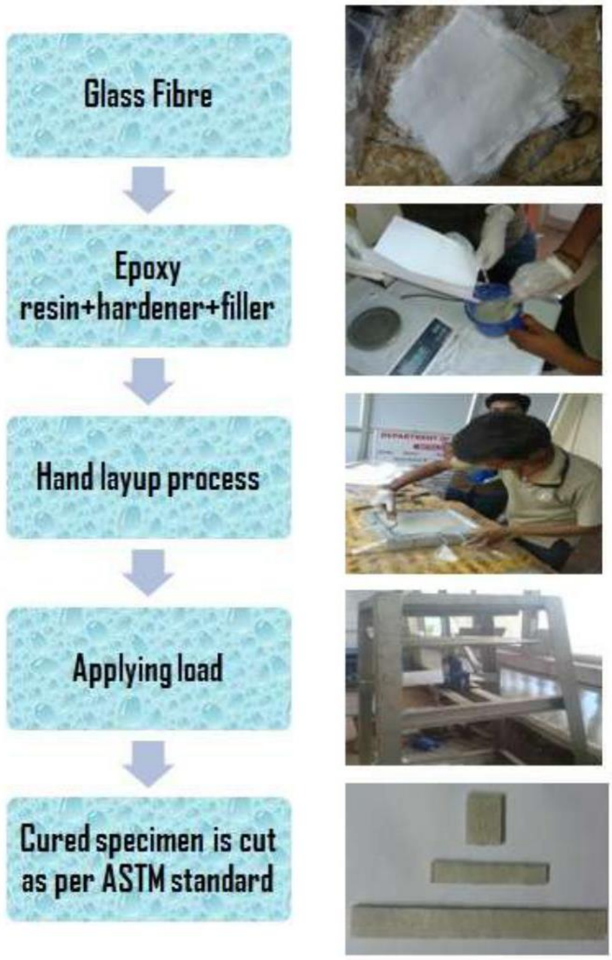

Figure 2 :- Specimen preparation

III. EXPERIMENTAL METHOD A.

Tensile strength testing

The tensile test is generally performed on flat specimens. The commonly used specimens for tensile test are the straight side type. The tensile experiments were performed according to ASTM standard. The specimens that were produced from glass fibre reinforced epoxy with the layup. A universal testing machine was used for the tests. The top end of the specimen was fixed by the grips on the top cross-head of the machine while the bottom end was not fixed before applying the load. A slotted steel plate was placed between the top of the bottom anchor and the bottom of the middle cross-head. When the specimen was loaded, this plate engaged the bottom anchor:

The load was applied at a constant speed of 5mm/min until the failure of the specimen.

Figure 3 : - UTM setup for tensile test

B. Flexural tesT

The short beam shear (SBS) tests are performed on the composite samples at room temperature to evaluate the value of flexural strength (FS). It is a 3-point bend test, which generally promotes failure by inter-laminar shear.

Figure 4 : - UTM setup for bending test

The SBS test is conducted as per ASTM standard D790 using the same UTM. The load was applied at a constant speed of 1mm/min until the failure of the specimen

III. RESULTS & DISCUSSIONS

The composites filled with 3%, 6%, 9% filler were tested using universal testing machine and Rockwell hardness machine. Flexural strength were determined using 3-point bending and stress v/s %strain graph was plotted. The load was applied up to the point of fracture. The behavior of defected composites was obtained from the stress v/s %strain graphs. It was observed that the composite having filler ratio of 6% shows higher tensile strength. This shows that flexural strength increases with increasing the filler ratio of the composites. The results and graphs are listed below

A. Results of Tensile test

Figure 5 : - Stress v/s %strain for composite with 0% filler

Figure 6. Stress v/s %strain for composite with 3% filler

Figure 7. Stress v/s %strain for composite with 3% filler

Figure 8. Stress v/s %strain for composite with 9% filler

B. Results of Flexural test

Figure 9. Stress v/s %strain for composite with 0% fille

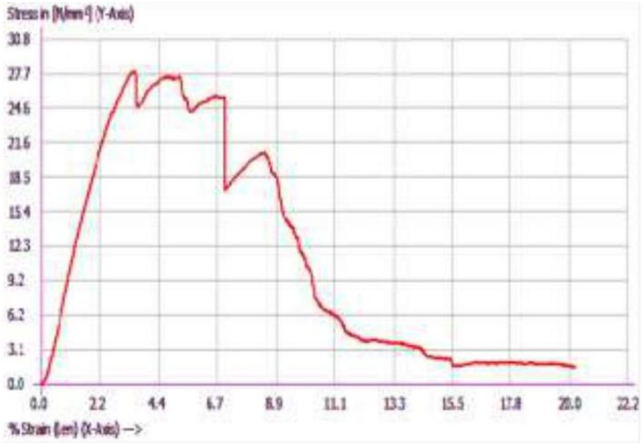

Figure 10. Stress v/s %strain for composite with 3% filler

Figure 11. Stress v/s %strain for composite with 6% fille

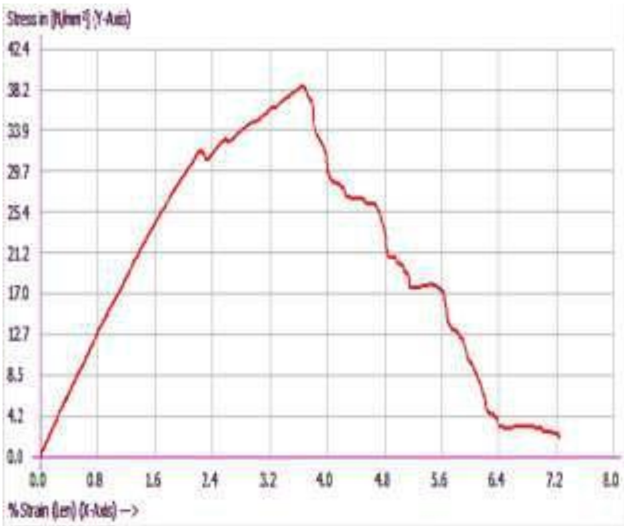

Figure 12. Stress v/s %strain for composite with 9% filler

IV.CONCLUSION

Waste glass reinforced with GFRP composite were

Prepared by employing hand layup technique in 3%, 6%, 9%. The main outcome of the present investigation are as follows:

- Effect of filler content in glass fibre composites seems to play significant role in assessing material behaviour under tensile loading conditions.
- From the experimental results it can be Concluded that e-waste can be recycled Successfully by using it has filler in polymer Composites.
- As the ratio of filler material increases the flexural strength. The composite containing 6% filler shows higher modulus of elasticity.

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Cite this article as :