# FABRICATION AND TESTING OF E-GLASS WITH E-WASTE AS FILLER MATERIAL

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**Abstract -** *Composite materials have been playing an important role in day to daily life. A Composite material has replaced many conservative materials because of its versatile properties, these made composite material widely used in Automotive, Aerospace and Defense sector. The usage of high performance polymeric composites is a valuable alternative to conventional materials due to their high mechanical properties, cost effectiveness and reduced weight. E-waste accumulation has become a major concern for most of the environmental problems. Recycling is the major way to dispose E-waste materials. Replacing the E-waste into the useful products. The main objective is to fabricate and testing of E-glass fiber reinforced epoxy composite with E-waste as filler material and filler material is varied in the ratio of 0%,5%,15%.The hybrid composite are fabricated using epoxy resin combination of hand lay-up method and cold press method. specimens are made according to ASTM standard by water jet machining. Mechanical tests like tensile test, compression test, flexural test are conducted to study various mechanical properties like tensile strength, flexural strength and stiffness.*

***Key Words***: **E-Glass, E-Waste, Epoxy, Water jet Machining, hand layup, mechanical testing**.

## 1. INTRODUCTION

Composite is structural material that composed of two or more distinct phases and having bulk properties significantly different form those of any of the constituents. The primary phase, having a continuous character, is called matrix. Matrix is usually more ductile and less hard phase. The material be in the form of metals, ceramic. The second phase embedded in the matrix in a discontinuous form is called reinforcing phase. The material in the form of fibers, particles. Electronic waste is also known as e-waste which is obtained from discarded electrical and electronic components. In India, e-waste growth is increasing at the rate of 30% per annum. developing countries like india are facing critical issues like disposing of these wastes and also health hazardous to the human beings. To overcome this disposal problem, we are in need to reuse and recycle this waste into useful composite materials with various compositions

## 2. Materials and Fabrication

Hand lay-up technique is the simplest method of composite processing. The infrastructural requirement for this method is also minimal. The processing steps are quite simple. First of all, a release gel is sprayed on the mold surface to avoid the sticking of polymer to the surface. Thin plastic sheets are used at the top and bottom of the mold plate to get good surface finish of the product. Reinforcement in the form of woven mats or chopped strand mats are cut as per the mold size and placed at the surface of mold after Perspex sheet. Then thermosetting polymer in liquid form is mixed thoroughly in suitable proportion with a prescribed hardener (curing agent) and poured onto the surface of mat already placed in the mold. The polymer is uniformly spread with the help of brush. Second layer of mat is then placed on the polymer surface and a roller is moved with a mild pressure on the mat-polymer layer to remove any air trapped as well as the excess polymer present. The process is repeated for each layer of polymer and mat, till the required layers are stacked.

After placing the plastic sheet, release gel is sprayed on the inner surface of the top mold plate which is then kept on the stacked layers and the pressure is applied. After curing either at room temperature or at some specific temperature, mold is opened and the developed composite part is taken out and further processed. The time of curing depends on type of polymer used for composite processing. For example, for epoxy based system, normal curing time at room temperature is 24-48 hours. This method is mainly suitable for thermosetting polymer based composites. Capital and infrastructural requirement is less as compared to other methods. Production rate is less and high volume fraction of reinforcement is difficult to achieve in the processed composites. Hand lay-up method finds application in many areas like aircraft components, automotive parts, boat hulls, dais board, deck etc.

## 3. Testing and Experimental Results

a) Tensile test

Tensile is performed to determine tensile strength of samples. Tensile strength is the key attributes for designing engineering application products. The laminated composite panels were fabricated as explained above and it is cut into the required shape and dimension by water jet machining. The tensile test specimens were prepared according to the

ASTM D-3039 standard as used by many researchers. The tensile test is carried out on the universal testing machine. The experiment was repeated for three times each for every composite .The dimension of fabricated specimen is 250mm×30mm×2.05mm.

b) Flexural test

The flexural test specimen were prepared according to the ASTM D-790 standard. Three point flexural test was performed on specimens. Means of cross head position was used to determine the deflection in specimens. The experiments are carried out at a room temperature. The size of fabricated samples is 250mm×25mm×2.05mm.

c)Compression test

A compression test is used to determine the behavior or response of a material. By testing a material in compression the compressive strength, yield strength, ultimate strength, elastic limit, and the elastic modulus among other parameters may all be determined. ASTM D6695-15 standard was adopted to prepare specimens. The size of specimen is 85mm×25mm×2.05mm.

d)Hardness test

Hardness test characterizes the indentation hardness of materials through the depth of penetration of an indenter, loaded on a material sample. By testing a material hardness number(BHN) of composite is determined. ASTM E10 standard was adopted to prepare specimens. The size of specimen is 10mmm×10mm×2.05.

Experimental Results:

| Composite Code | Tensile test | Flexural test | Compression test | Hardness number |
|---|---|---|---|---|
| | stress (MPa) | Stress (MPa) | Stress (MPa) | (BHN) |
| (A)E-glass with E-waste(0%) | 149.5 | 4.9 | 74.4 | 14 |
| (B)E-glass with E-waste(5%) | 117.2 | 5.3 | 123 | 11 |
| (C)E-glass with E-waste(15%) | 82.8 | 5.5 | 122.6 | 7 |

Tensile Strength

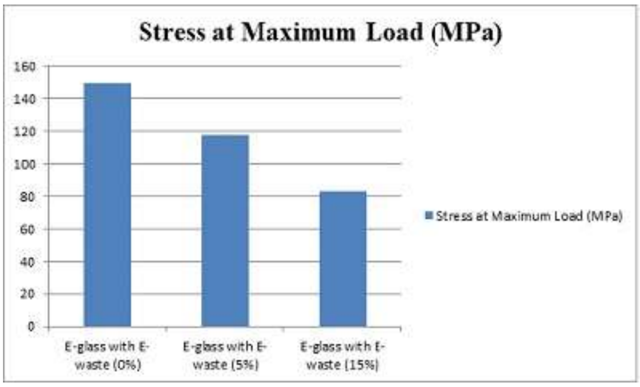


**Fig 3.1:** Stress at maximum load for fabricated composites

Flexural Strength

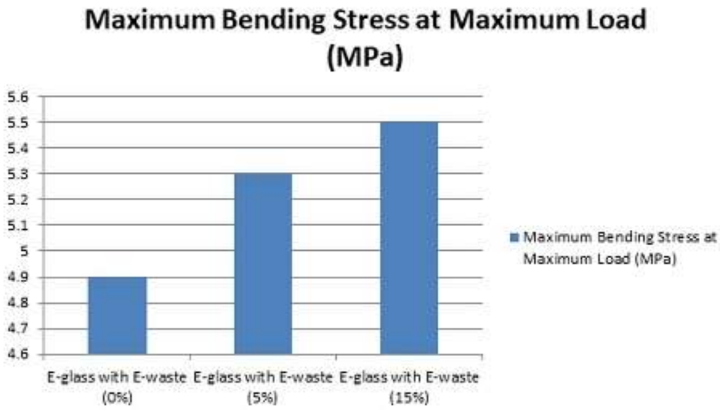


**Fig: 3.2:** Maximum Bending stress for fabricated composites

Compressive Strength

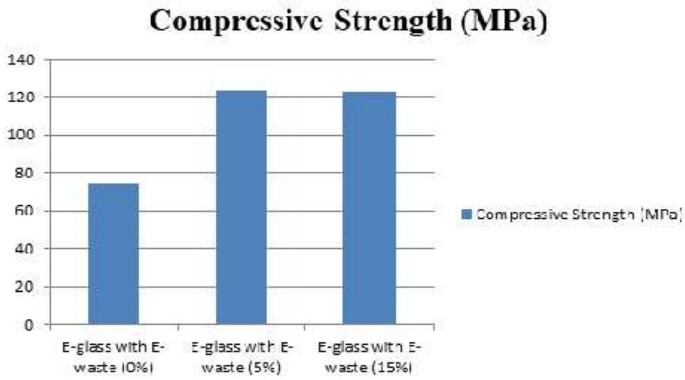


**Fig 3.3:** Compressive strength for fabricated specimen

Brinell Hardness test

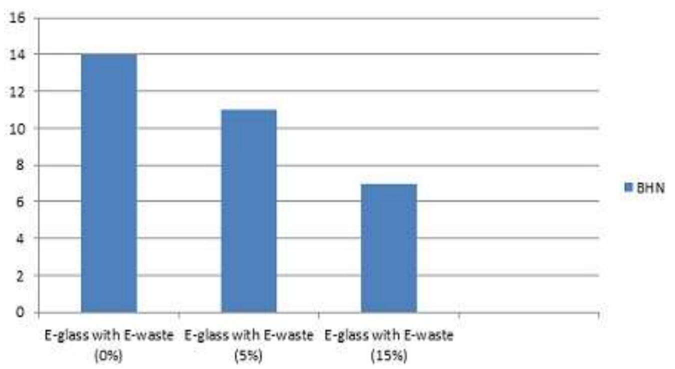


**Fig 3.4:** Plot of Hardness Number for fabricated composites

## 4. CONCLUSIONS

Using hand layup method, E-glass fiber can be successfully reinforced with E-waste to fabricate hybrid composite material.

From the test conducted mechanical properties of the fabricated specimen showed the following outcomes.

- Tests conducted to determine ultimate tensile strength reveals that composite containing 0% of E-waste showed better tensile properties than composite containing 5% and 15% of E-waste. As the % E-waste in composite material increases it is observed that tensile strength decreases. It may be due to good particle dispersion and strong polymer/filler interface adhesion for effective stress transfer.
- The improvement in the flexural strength is observed but it was marginal. Among the composites, higher flexural strength is exhibited by 15% with 5.5 MPa and lowest being 0% with 4.9 MPa.
- The compressive strength of the composite material is found to be increased but the composite containing 5% of E-waste shown highest compressive strength with 123 MPa and composite containing 15% of E-waste showed some abrupt changes in compressive strength with 122.6 MPa. This may be due to void content and manufacturing.
- The hardness number goes on decreasing with increase in the weight% of e-waste in composite.

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