ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Vol 9, Issue 8, August 2022

Comparative Study of the Compressive Strength of Different Composites

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Abstract— ***The epoxy resin has excellent tensile properties, such as tensile strength and elongation. However, these resins deform extensively under dynamic loading. Therefore, the reinforcement of epoxy is necessary to improve its mechanical properties (tensile and compressive). In the present work, the epoxy is reinforced with glass fiber, carbon fiber and steel mesh. The epoxy-based composites are fabricated by mixing and moulding process. The compression testing shows that the epoxy-based composites reinforced with different fibers have enhanced mechanical properties than unreinforced epoxy. The composites are reinforced with 10 wt. % steel mesh shows the highest strength of 123. 58 MPa compared to the strength of bare epoxy (71.80 Mpa).***

Keywords: Composites, compressive strength, mechanical properties, fibers

I. INTRODUCTION

Over the last thirty years, composite substances have been utilized in numerous fields due day every day their immoderate power and weight ratio, and daily those facts, composite materials have day-to-day famous amongst researchers, scientists, and engineers. The primary portion of engineering substances consists of composite materials. It's a long way used in huge applications beginning from day to day household articles everyday automobile subject [1]. The composite materials are applied in the automotive area, which includes such as dashboard, roof, ground, the front & returned bumper, A-pillar [2]. Epoxy resin is the commonly used matrix for advanced composites due to its favored residences like thermal, mechanical, and electrical residences, dimensional balance and chemical resistances, and many others. Fibers or debris that are attached in a matrix of any other cloth is a quality example of cutting-edge day composite materials [3]. The project is aimed to perform a comparative study of compressive strength on fabricated glass fiber, carbon fiber and steel mesh with epoxy resin in different compositions. In machines, metals are used generally to make a body that can bear the compression generated by the load. Also, there are high chances of corrosion which cause the sudden failure of the machine part. To prevent the corrosion of the machine parts, we need a material with higher corrosion resistance (weather resistance), and the fabricated composites have good corrosion resistance properties. To avoid the cost of maintenance due to corrosion, metals can be replaced by fabricated composites. Metals have high strength, but they are heavier, so it is not easy to make a gadget portable. On the other hand, fabricated composites have high strength and less weight, so by using fabricated composites, gadgets can be made portable. Metals are very a good deal conducive to power, and once in a while, it was seen that shock hit some of the employees who were operating with the gadget. To save this risky activity, one ought to ought to do proper preservation. But, if metals are replaced with composite materials, i.e. non-conductive to the strength, then it'll be able to save the shocks generated through the energy. Metal generally have a rough surface finish rough surface can create heat due to air resistance in aero plane wings, so we need a material that has a good surface finish.

So by using fabricated composites, air drag can be reduced. So compression of some specific composites materials is to be done to check the compressive behavior of the sample, which can replace the metallic machine parts in various fields, i.e. automobile industries aviation industries any many more

Process chart for the fabrication and analysis of epoxy-based composites:

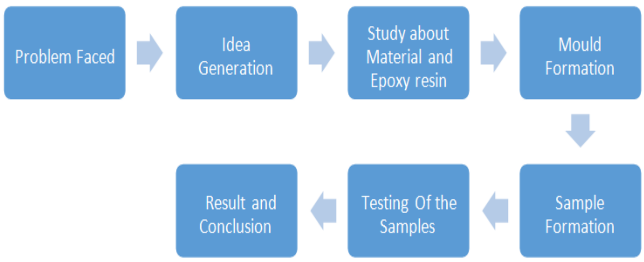

Figure 1.Flow chart of fabrication and analysis.

II. MATERIAL

Glass Fiber: Glass fiber could be a material made of several fine fibers of glass. Now glass fiber is used in many engineering fields such as airspaces, automobile industries &constructions.

Its comparable mechanical properties to other fibers like carbon fiber and polymers. Fiber is employed as a reinforcing agent for several polymer products so as to make an awfully durable and lightweight material called fiberglass.

Fiberglass offers some unique advantages over other materials thanks to its thickness, weight and strength. With such a large range of properties, the fabric can satisfy design and project objectives in many industrial applications.

Figure 2. Glass fiber

Carbon fiber: Carbon fiber is a polymer consisting of thin & strong crystalline filaments of carbon. It is also known as graphite fiber. The diameter of carbon fiber is above 5 to 10 micrometers. It is extremely strong & stiff. The weight to strength ratio for carbon fiber is very less & much lower than steel. Feature of electrical conductivity may be useful or maybe a hindrance. It has good tensile strength because of these properties. It has high demand in the automobile industry, aviation industry etc. It is corrosion resistance. It is popular in fiber bicycle & automatic racing cars tube to less weight to strength ratio & its resistance towards the flame.

If we say about the downside of carbon fiber these are very few, and it may be a high production cost; that's why it can't easily be mass-produced. Recycling carbon fiber is not easy. The only method available to recycle carbon fiber is thermal depolymerization.

Figure 3. Carbon fiber

Steel Mesh: Steel Mesh is an essential material for the construction which is used with concrete and concrete is widely used in civil engineering field in which engineers used to construct the roads, skyscrapers, Bridges and many more civil structures[4]. As energetic improvement of engineering creation, concrete is reinforced with fiber which overall gives very high performance than normal concrete, and it is implemented steadily in essential engineering systems [5]. Among those concretes with very high performance, for the benefit of low fee, clean and clearly fabricated, and overall enhancements in performance, manifestly, metal fiber-bolstered concrete become extensively used inside the present-day engineering subject [6]. Also, the observation showed that rough incorporation of metallic fiber might affect the flowing characteristics and uniformity of the concrete blending and even result in fiber bonding, which affect the reinforcement effect of mechanical properties sooner or later [7]. However, presently vibratory mixing era is no longer been broadly used in engineering sectors, and studies on its development of concrete mechanical houses are insufficient at home and abroad. These are the reasons for which, a specimen using layering and resin mixed together to test and analyze the compression strength and other mechanical behavior and properties.

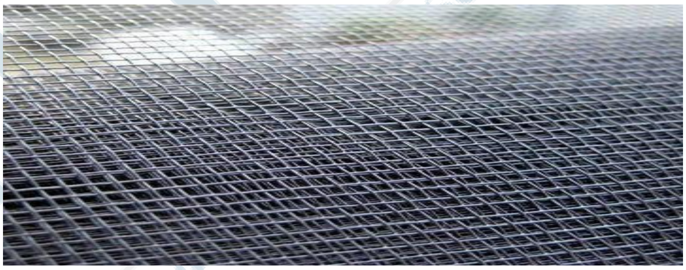

Figure 4.Steel mesh

III. EXPERIMENTAL PROCEDURE

Preparation of Resin: The resin mixture is ready, which encompass resin epoxy and hardener. Its miles combined in the ratio of 3:1, that is, 3gm of resin and hardener of 1gms and stirred it continuously till the elimination of air bubble and homogeneity.

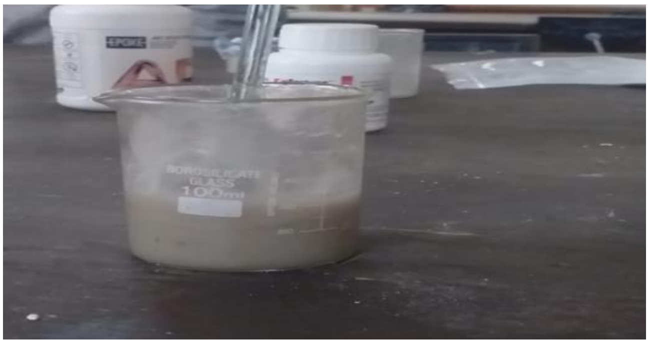

Figure 5. Preparation of resin

Preparation of Mould: The thermocol Mould is ready for making the composite sample of 42mm×21mm×11mm. The mildew is made leak-evidence to save the flow of resin via laminate it as shown in the figure.

ISSN (Online) 2456-1290

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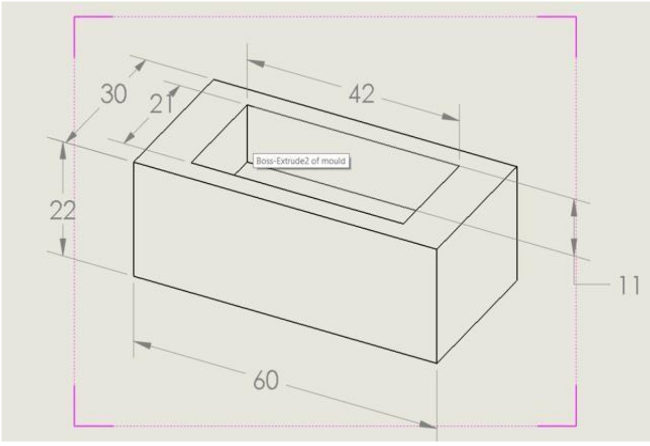

Figure 6. Mould

IV. PREPARATION OF COMPOSITES

The Preparation of composite slabs is finished via the hand layup method, as shown in figures. In this approach, bidirectional jute and aramid fiber are used as reinforcement, and epoxy resin is used as matrix fabric.

Steps were taken in the production of the composite; take a look at debris.

- The surface of the mould should be cleaned.
- Over the gel coat, the resin needs to be applied with the assist of a brush; then required fabric layer is located over the resin and rolled by way of the curler to remove air bubbles.
- Follow the resin once more at the cloth layer with the assist of the brush, then the fabric layer is placed over resin and rolled thru the curler and repeat the approach till the specified thickness.
- Allow the composite to dry for seventy-two hours to make the perfect bond.
- As soon as the Preparation of glass and carbon composite substances are over, the specimen is subjected to compression; take a look at it.

(a) (b) (c)

Figure 7. (a)Fabrication of simple epoxy sample, (b)fabrication of composition of steel mesh 20 % by wt. of epoxy, (c) fabrication of composition of steel mesh 10 % by wt. of epoxy

(d) (e) (f)

Figure 8. (a)Fabrication of composition of Glass fiber 10% by wt. of epoxy , (b)fabrication of composition of Glass fiber 20 % by wt. of epoxy, (c) fabrication of composition of Carbon fiber 5 % by wt. of epoxy

V. RESULTS AND DISCUSSION

Epoxy Resin:

Table 1: Numeric values obtained by Compression tests in simple epoxy.

Wt. percentage of epoxy	Fabric Measurement in mm	Peak load in kN	Max. dislocation in mm	Compressive power in Mpa
100	initial width =19 initial thickness=16	21.830	8.46	71.80

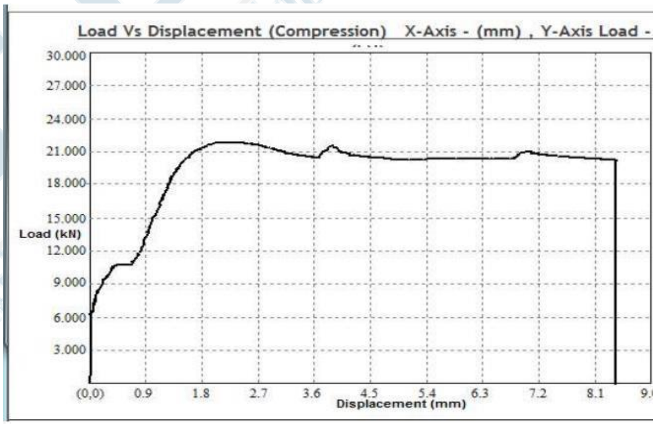

Figure 9.Compression test of simple epoxy

Figure 10. Deformation of simple epoxy after compression test

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ISSN (Online) 2456-1290

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Steel Mesh:-

Table 2: Numeric values obtained by Compression tests in steel mesh.

Wt. percentage of steel mesh	Wt. percentage of Epoxy resin	Fabric Measurement in mm	Peak load in kN	Max. dislocation in mm	Compressive power in Mpa
10 %	90%	initial width =17.5 initial thickness =11	23.790	5.50	123.58
20%	80%	initial width =20 initial thickness =11	23.900	5.29	108.63

Figure 11. Deformation of steel mesh 10% by wt. after compression test

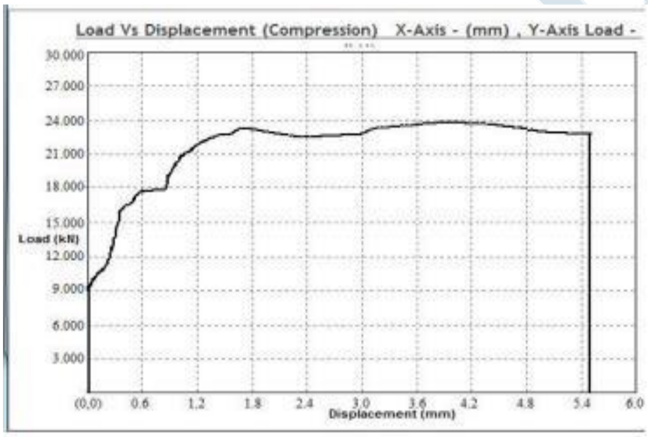

Figure 12. Compression test of steel mesh 10% by wt.

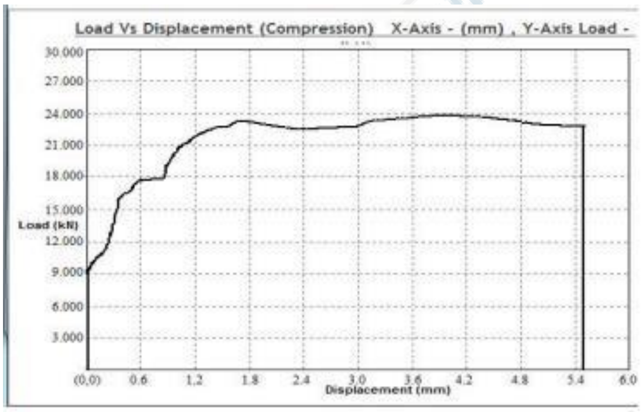

Figure 13. Compression test of steel mesh 20% by wt.

Figure 14. Deformation of steel mesh 20% by wt. after compression test

Glass Fiber:

Table 3: numeric values obtained by Compression tests in Glass fiber.

Wt. percentage of steel mesh	Wt. percentage of Epoxy resin	Fabric Measurement in mm	Peak load in kN	Max. dislocation in mm	Compressive power in Mpa
10%	90%	initial width =17.5 initial thickness =11	17.920	5.06	93.09
20%	80%	initial width =20 initial thickness =11	20.400	5.02	105.97

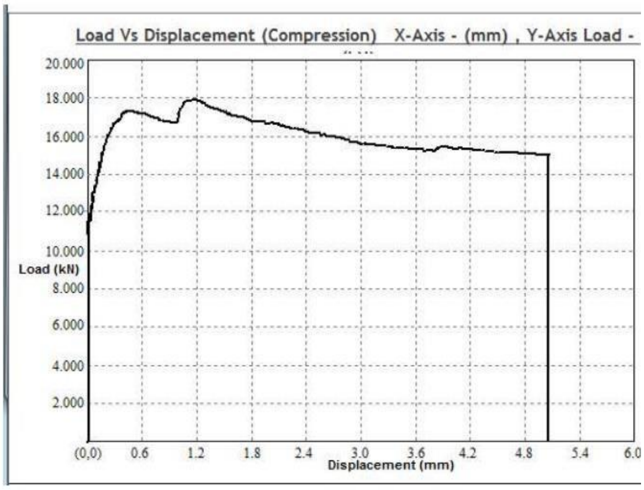

Figure 15. Compression test of glass fiber 10% by wt.

Figure 16. Deformation of Glass fiber 10% by wt. after compression test

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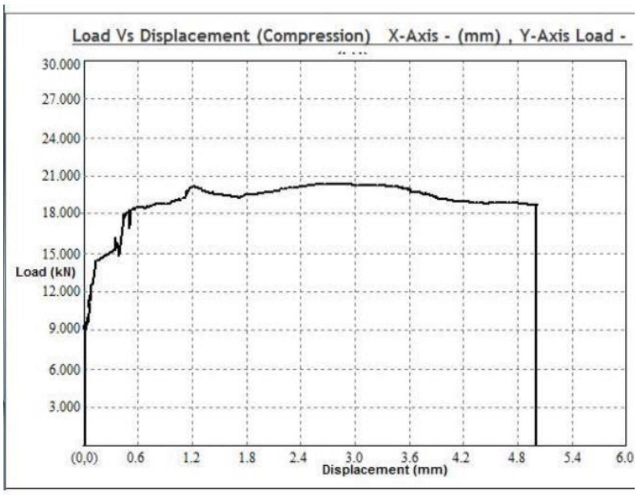

Figure 17. Compression test of glass fiber 20% by wt.

Figure 18. Deformation of Glass fiber 20% by wt. after compression test

Carbon Fiber:

Table 3: numeric values obtained by Compression tests in carbon fiber.

Wt. percentage of steel mesh	Wt. percentage of Epoxy resin	Fabric Measurement in mm	Peak load in kN	Max. dislocation in mm	Compressive power in Mpa
5%	95%	initial width=20 initial thickness=12	18.040	5.369	75.16

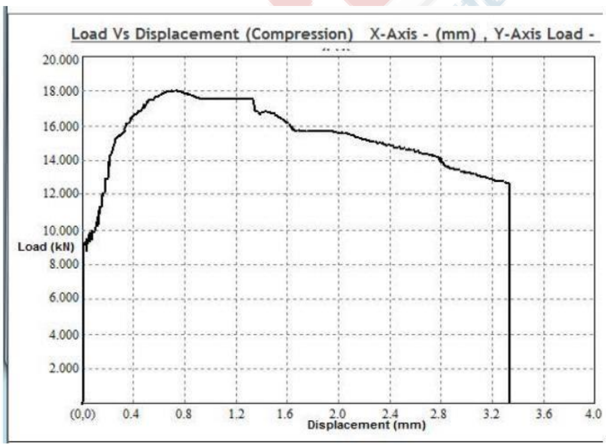

Figure 19.Compression test of carbon fiber 5% by wt.

Figure 20. Deformation of carbon fiber 5 % by wt. after compression test.

Comparison of Compressive Power of Different Composites:

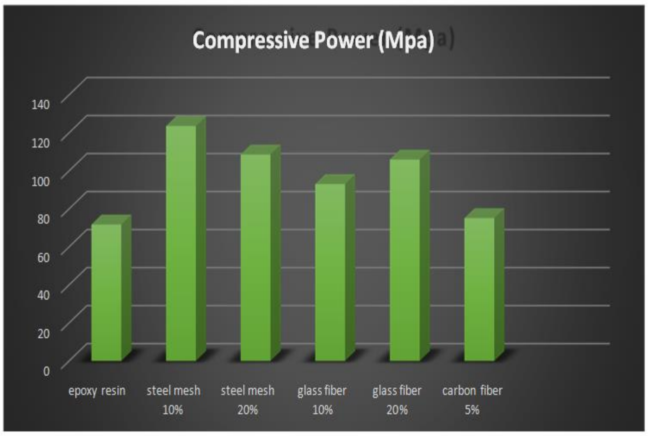

Figure 21.Comparison of compressive power

VI. CONCLUSION

The experiment of the compressive power of reinforced glass fiber, carbon fiber and steel mesh with epoxy-based composites have the following conclusions.

- The result Acquired by means of epoxy resin indicates a very good compressive power even after applying 21.830 KN of load; the specimen has no longer shown any displacement. After that, the displacement will occur along the tangential direction of the fiber layer.
- The result acquired by means of the composites in which **20%** of Glass fiber and **80 %** of epoxy resin indicate the very good compressive power as compared to **10%** of Glass fiber and **90%** of the epoxy resin composition.
- The result was acquired by means of the composites in which **10%** of Steel Mesh and **90 %** of epoxy resin indicate the very good compressive power as compared to **20%** of Glass fiber and **80%** of the epoxy resin composition.

Acknowledgement:

We thank the Department of Mechanical Engineering Rajkiya engineering college, Manipuri, for imparting the ability to conduct the experiment and for the necessary guide.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

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