A STUDY ON EFFECT OF CARBON AND ASH FILLERS ON FLEXURAL PROPERTIES IN GFRP COMPOSITES

Mr. C HEMANATH [1], Mr. D.HARSHA VARDHAN [2]

[1]P.G. Scholar, Sri Venkateswara Institute of Technology, Anantapuram, AP
[2] HOD, Department of Mechanical Engineering, Sri Venkateswara Institute of Technology, Anantapuram, AP

***

Abstract - *Recent years in manufacturing industry composite materials applications are extensively growing because of their versatile properties. An attempt have been made in this research work to study on effect of fillers on the mechanical behavior of glass fibre reinforced epoxy composites. Here the composites were fabricated using simple hand lay-up technique. Carbon and ash fillers are mixed with the composite material and then flexural properties of specimens subjected to both with filler and without filler combinations were evaluated and compared alongside. It has been observed that there is a significant effect of cement filler on the flexural strength of glass fibre reinforced epoxy based composites.*

Key Words: *fillers, Glass fibre, Flexural strength, GFRP.*

1. INTRODUCTION

Composite material are made up of two or more different materials with different physical and chemical properties from the individual materials. These materials are used in ancient Egypt, people used to build walls from the bricks made of mud with straw as reinforcing component. Hybrid composites are commonly termed as the mixture of two or more reinforcing fibres in a single matrix system. Through proper fibre selection and design, the performance of hybrid composites could be achieved through hybridization.

Epoxy resins are widely used for matrix composites due to their excellent adhesive, dielectric, and mechanical properties and alone provide most of the properties required for composites. The fibrous composites, especially glass fiber–reinforced epoxy composites in which glass fiber is the primary load carrying element, are being increasingly used in military and aerospace applications owing to several desirable properties including high specific strength, high specific stiffness, and controlled anisotropy.

The mechanical properties of composites are most important, because they can be influenced by parameters such as type of filler, type of matrix, alignment of fibers, type of fibers, aspect ratio of fibers, the fiber matrix interphase properties or adhesion between fiber and resin matrix. When two or more materials with different properties are combined together, they form a composite materials. In general, the properties of composite materials are superior in many respects, to those of the individual constituents. This has provided the main motivation for the research and development of composite materials.

Shyamkumar Shah [7] studied the effect of filler material (coal ash) on mechanical properties of E-Glass fibre reinforced polymer has been studied out by varying filler materials. For these study three different types of specimens were prepared, viz FRP without filler material, the FRP with 10% volume percentages of coal ash and the FRP with 5% volume percentage of Fly ash as filler material. The polyester composites were fabricated by hand layup method. Mechanical properties of the specimens are analyzed using computerized Universal Testing Machine as per ASTM D 638 standards and compared to those of the FRP without filler material. Mechanical properties such as ultimate tensile strength, percentage of elongation, yield strength, Poisson's ratio and percentage reduction in area were found out. Raffi Mohammed [10] investigated on the mechanical properties of E-glass Reinforced epoxy based composites without and with filler materials (Bagasse fiber (B.F) / Bagasse Ash (B.A) / Coal powder (C.P) /Coal Fly Ash (C.F.A)) which acts as epoxy modifiers. Composites filled with 10 wt.% concentration of Bagasse Fiber, Bagasse Ash, Coal Powder and Fly Ash from Coal, were fabricated by hand lay-up technique. The fabricated composites are cut in to specimens according to the ASTM standards and the mechanical properties like Tensile strength, Flexural strength, Impact strength, Inter laminar shear strength (ILSS) and tensile modules of the specimens were determined. The Test Results shows that composite filled by 10 wt. % Bagasse Ash exhibited maximum Tensile strength, flexural strength and Inter laminar shear strength when compared with the other filler composites. The composite filled by 10 wt % coal powder exhibited maximum impact strength and composites filled by 10 wt. % Coal Fly Ash exhibited maximum tensile modulus.

2. MATERIALS AND METHODS

Current work is on composite made up of woven glass fibre reinforcement and epoxy as matrix material. The epoxy resin LY556 and the corresponding hardener HY-951 is used as matrix material.

2.1 Composite fabrication

The fabrications of the composite slab were carried out by conventional hand layup technique. The low-temperature curing epoxy resin and corresponding hardener were mixed in a ratio of 10:1 by weight is taken. Composites were fabricated and subjected to post-curing at room temperature for 24 h. Then sample specimens are cut for required dimensions. Total 3 samples were considered for study and samples without filler and with two different fillers.

2.2 filer

Fillers a variety of solid particulate materials (inorganic, organic) that may be irregular, acicular, fibrous or plate-like in shape and which are used in reasonably large volume loadings in plastics. There is significant diversity in the chemical structures, forms, shapes, sizes, and inherent properties of the various inorganic and organic compounds that are used as fillers. They are usually rigid materials, immiscible with the matrix in both the molten and solid states, and, as such, form distinct dispersed morphologies. Their common characteristic is that they are used at relatively high concentrations (> 5% by volume), although some surface modifiers and processing aids are used at lower concentrations.

Here we used two types of fillers are carbon and ash. Ash has collected by burning of coconut shells in closed room and grained to Nano particle size and we made epoxy based GFRP hybrid composite material and flexural tests are conducted on ASTM standard specimens.

2.3 Flexural strength

The flexural strength of a composite is determined by the maximum bending stress that it can withstand during bending before getting the breaking point. The flexural strength measured in three-point bend test to understand the flexural behaviour of composites using the universal testing machine on ASTM D790 [10] specimen using UTM. Samples are tested at a cross head speed of 10 mm/min, in an UTM machine.

- Dimensions of ASTM D790 Flexural specimen are 127×13×3 mm^3

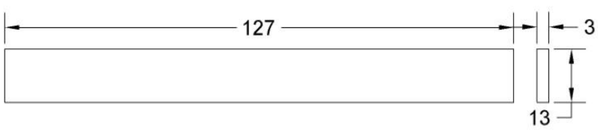

Figure 2: Dimensions of flexural test specimen Flexural strength = 3PL/2bd2 Where, "P" represent maximum load. "b" width of specimen. "t" thickness of specimen "L" span length of the specimen.

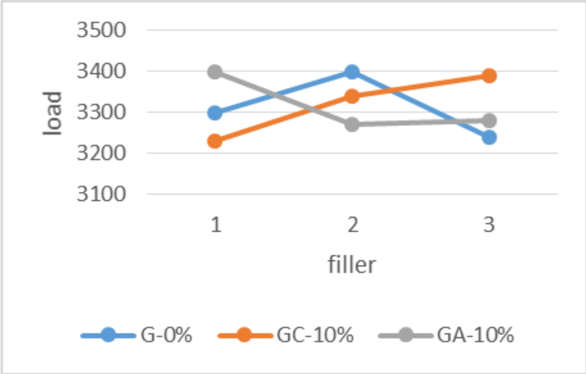

Figure 1: Effect of filler on flexural load.

Filler (%)	Flexural strength (N/mm2)
G-0%	**4247.86**
GC-10%	**4256.41**
GA-10%	**4252.14**

Figure 2: Effect of filler percentage on flexural strength.

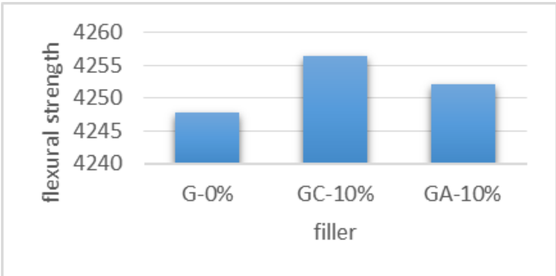

Chart -1: Filler type Vs. Flexural strength.

3. CONCLUSIONS

The experimental study on the effect of filers on flexural strength for glass fibre reinforced epoxy based composites leads to the following conclusions.

1. Glass fibre composite material hybrid composite with carbon filler has significant increase in flexural strength.

2. Hybrid composite material with ash filler have better flexural strength compared without filler GFRP material.

REFERENCES

[1] Herakovich C.T., (1998). Mechanics of fibrous composites. New York:Wiley; p. 1–27.

[2] K.L.Loewenstein,The ManufacturingnTechnology of Continuous Glass Fibers, 3r reviseded., Elsevier, 1993.

[3] F.T. Wallenberger, Structural Silicate and Silica Glass Fibers, in Advanced Inorganic Fibers Processes, Structures, Properties, Applications, F.T. Wallenberger, Ed., Kluwer Academic Publishers, 1999, p 129–168

[4] F.T. Wallenberger, Melt Viscosity and Modulus of Bulk Glasses and Fibers: Challenges for the Next Decade, in Present State and Future Prospects of Glass Science and Technology, Proc. of the Norbert Kreidl Symposium (Triesenberg, Liechtenstein), 1994, p 63–78.

[5] "Standard Specification for Glass Fiber Strands", D 578-98, Annual Book of ASTM Standards.

[6] P.K. Gupta, Glass Fibers for Composite Materials, Fiber Reinforcements for Composite Materials, A.R. Bunsell, Ed., Elsevier Publishers,1988, p 19–72.

[7] Effect of Coal Ash as a Filler on Mechanical Properties of Glass Fiber Reinforced Material [1]Shyamkumar Shah, [2]Akshaykumar Patil, M. Ramachandran[3], Kanak Kalita[4], International Journal of Applied Engineering Research ISSN 0973-4562 Volume 9, Number 22 (2014) pp. 14269-14277.

[8] Enhancement of interfacial adhesion in glass fiber/epoxy compositesby electrophoretic deposition of graphene oxide on glass fibersHaroon Mahmood [a], Manoj Tripathi b, Nicola Pugno c, Elsevier publications Composites Science and Technology 126 (2016) page 149-157

[9] Influence of Ceria Oxide as filler Material on e-glass fiber/epoxy Reinforced Hybrid Composites Vithal Rao Chauhan 1, Dr. K R Dinesh 2, Dr. K Veeresh 3, Veerabhadrappa Algur4, Manjunath Shettar 5, International Journal of Advances in Scientific Research and Engineering (IJASRE) ISSN: 2454-8006 [Vol. 02, Issue 06, July -2016]

[10] Effect of Epoxy modifiers (Bagasse fiber / Bagasse ash / Coal powder /Coal Fly ash) on mechanical properties of Epoxy / Glass fiber hybrid composites, Raffi Mohammed 1, Dr. B Ram Gopal Reddy, V Sridhar Reddy, International Journal of Applied Engineering Research, ISSN 0973-4562 Vol. 10 No.24 (2015) PP 45625-45630.

BIOGRAPHIES

P.G. Scholar, Sri Venkateswara Institute of Technology, Anantapuram, Andhra Pradesh.

HOD, Department of Mechanical Engineering, Sri Venkateswara Institute of Technology, Anantapuram, Andhra Pradesh.