TENSILE AND FLEXURAL STRENGTH OF GLASS FIBER EPOXY COMPOSITES

S.Pichi Reddy[1*], P.V.Chandra Sekhar Rao[1], A.Chennakesava Reddy[2], G.Parmeswari[1]

1. Department of Mechanical Engineering, L.B.Reddy College of Engineering, Mylavaram, Andhra Pradesh-521230
2. Department of Mechanical Engineering, JNTUH College of Engineering, JNTUH, Hyderabad-500085

Abstract: Glass fiber reinforced epoxy composites are most widely used as composite materials. The demand for light weight composite materials has led to the development of fly ash based composite materials. In the present work, the effect of fly ash content on tensile strength and flexural strength of 10wt% glass fiber epoxy composites is studied. The fly ash content is varied from 0 to 10grams in steps of 2grams. The composite with 6grams fly ash exhibited better tensile strength when compared to the other composites. Similarly the composite with 4grams fly ash exhibited better flexural strength.

Keywords: epoxy composites, fly ash, tensile strength, flexural strength.

Address all correspondence to: seelamspr@gmail.com

1. INTRODUCTION

Glass fiber reinforced epoxy composites results in an attractive combination of physical and mechanical properties which cannot be obtained by monolithic materials [1, 2]. These are widely used due to ease of availability of glass fibers and economic processing techniques adopted for production of components. Developments are still under way to tailor their properties for extreme loading conditions. One way to improve the strength of the FRP composites is to add various filler materials. These filler materials act as additional reinforcing components and enhance their mechanical properties. The properties of these composites depend on the type and size of the filler material used [3, 4]. Addition of silicon carbide, alumina, and titanium carbide improves hardness, strength and wear resistance of the composites [5, 6]. Graphite particles improved erosive wear resistance of glass fiber epoxy composites [7]. Interest in reinforcing fly ash to FRP composites is mainly due to low density, low coefficient of thermal expansion and high strength obtained in these composites. The addition of fly ash and mica particles to the polyetheretherketone (PEEK) composites increased the tensile strength, tensile modulus and flexural modulus [8]. The addition of fly ash to epoxy resin composites increased the compressive strength [9]. The addition of fly ash as filler material in glass vinylester composite increased its wear resistance [10]. The impact strength of the epoxy laminated bamboo composite increased with addition of cenospher as a filler material [11]. The addition of coal ash to glass fiber polymer matrix composites improved their mechanical strength [12]. In the present work

an attempt is made to study the effect of fly ash as a filler material in epoxy glass fiber reinforced composites.

2. EXPERIMENTATION

The following section highlights the materials used, fabrication and testing of composites.

2.1 Materials

The matrix material used for fabrication of the composites is Epoxy resin (L12 grade) and corresponding hardener (K-6) is used. E-glass fiber is used as the reinforcing material and the fly ash collected from NTTPS-Vijayawada, is used as the filler material.

2.2 Fabrication and Testing of Composites

Hand lay-up technique is adopted for fabrication of the composites. The mould used is shown in figure 1. Releasing agent is applied in the mould and a cut ply of glass fiber is placed in the mould. The resin mixed with the fly ash is poured into the mould and allowed to dry for two hours. The dried sample is removed from the mould and cut into the shape of standard specimens. The specimen used for tensile test is shown in figure 2 and the specimen used for 3-point bend test is shown in figure 3. The designation of the specimens is shown in Table 1. Electronic tensometer is used for determining the tensile and flexural strength of the composites.

Figure 1: Mould for preparation of composite specimen

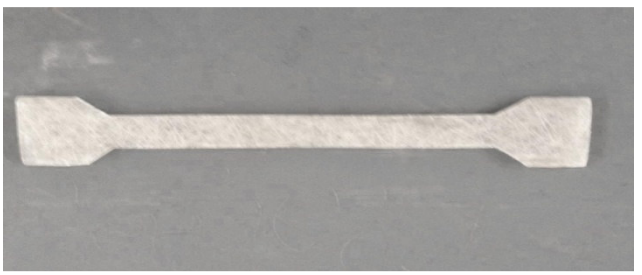

Figure 2: Tensile test specimen

Figure 3: Three point bend test specimen

Table 1: Designation of the Specimen.

S.No	Specimen Designation	Glass fiber (grams)	Resin (grams)	Fly ash (grams)
1	C1	5	50	0
2	C2	5	48	2
3	C3	5	46	4
4	C4	5	44	6
5	C5	5	42	8
6	C6	5	40	10

3. RESULTS AND DISCUSSIONS

From the fabricated composites, the test specimens are prepared as per ASTM standards and are tested to evaluate their tensile and flexural strength. The results obtained by conducting these tests are given below.

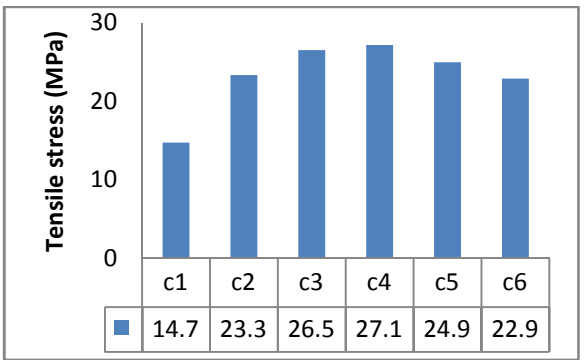

Figure 4: Tensile strength of composites

3.1 Tensile Strength

The effect of fly ash content on the tensile strength of the composite is shown in figure 4. It is observed that the tensile strength varies from 14.7727MPa to 27.179MPa. The tensile strength increases with the increase in fly ash upto 6grmas and thereafter it decreases. The increase in tensile strength with the increase in fly ash can be attributed to the good interfacial bonding between the fly ash and the matrix. As the fly ash

content is further increased the composite transforms into brittle and hence the tensile strength decreases.

3.2 Tensile Modulus of Elasticity

Figure 5 shows the effect of fly ash on the tensile modulus of elasticity for various composites. The tensile modulus of elasticity varies from 946.067MPa to 2548.428MPa and the maximum is obtained for specimen with fly ash content equal to 8grams.

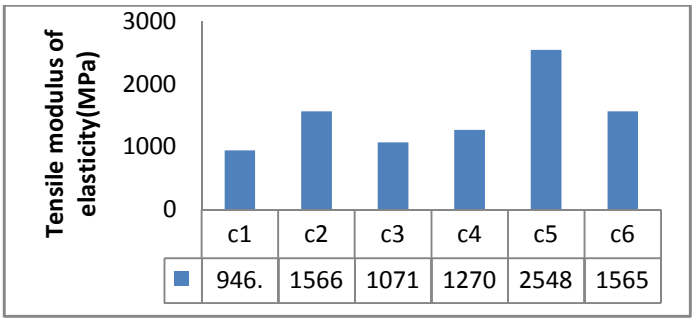

Figure 5: Tensile modulus of composites

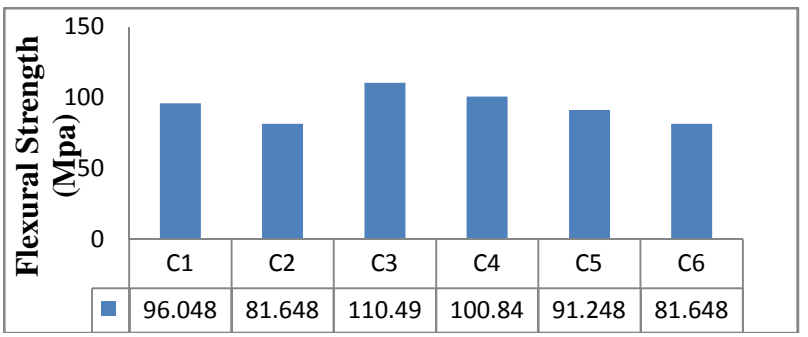

Figure 6: Flexural strength of composites

3.3 Flexural Strength

The flexural strength of the composite is determined from 3-point bend test. The flexural strength for various composites is shown in figure 6. The flexural strength of the composites varies from 81.648MPa to 110.497MPa and the maximum value is obtained for composite with 4grams of fly ash. The flexural strength decreases, reaches a maximum value and again decreases with the addition of fly ash in the epoxy matrix.

4. CONCLUSIONS

The experimental investigation on tensile and flexural behaviour of fly ash reinforced glass fiber epoxy composites with different weight percent of fly ash have been carried out. The conclusions drawn from the present work are.

1. The tensile strength of the composites varied from 14.7727MPa to 27.1790MPa and the maximum is obtained for composite with 6grams fly ash.
2. The maximum tensile modulus of elasticity is obtained for the composite with 8grams fly ash.
3. The flexural strength of the composite varies from 81.648MPa to 110.497MPa. The maximum flexural strength is obtained for the composite with 4grams fly ash.

REFERENCES

1. B. Kotiveerachari, A. Chennakesava Reddy, Interfacial effect on the fracture mechanism in GFRP composites, CEMILAC Conference, Ministry of Defence, India, 20-21st August 1999:, B85-87.
2. A. Chennakesava Reddy, M. Vidya Sagar, Two-dimensional theoretical modeling of anisotropic wear in carbon/epoxy FRP composites: comparison with experimental data, International Journal of Theoretical and Applied Mechanics, 2010:6(1), pp.47-57.
3. R.Sateesh Raja, K.Manisekar, and V.Manikandan, Effect of fly ash filler size on mechanical properties of polymer matrix composites, International Journal of Mining, Metallurgy and Mechanical Engineering, 2013: (1-1),pp.34-37.
4. K.Devendra, and T.Rangaswamy, Strength characterization of E-glass fiber reinforced epoxy composites with filler materials, Journal of Minerals, Material Characterization and Engineering, 2013:(1),pp.353-357.
5. Amar Patnaik and S.S Mahapatra, Study on mechanical and erosion wear behavior of hybrid composites using taguchi experimental design, Journal of Materials and Design, 2009:(30),pp.2791-2801.
6. S.Chauhan, A.Kumar, A.Patnaik, A.Satapathy and I.Singh, Mechanical and wear characterization of GF reinforced vinyl ester resin composites with different comonomers, Journal of Reinforced Plastic Composites, 2009: (28), pp. 2675-2684.
7. T. Basava and A.N.Harirao, Development of graphite particles filled epoxy resin composite material and its erosive wear behavior, Interantional Journal on Manufacturing and Material Science, 2011 :(1-2), pp. 28-30.
8. M. Rahail Parvaiz, Smita Mohanty, Sanjay K. Nayak and P. A. Mahanwar, Polyetheretherketone (PEEK) composites reinforced with fly ash and mica, Journal of Minerals Materials Characterization and Engineering, 2010: (9-1), pp.25-41.
9. Manoj Singla , Vikas Chawla, Mechanical properties of epoxy resin – fly ash composite, Journal of Minerals Materials Characterization and Engineering, 2010: (9-3), pp.199-210.
10. S.R. Chauhan, Anoop Kumar , I. Singh , and Prashant Kumar, Effect of fly ash content on friction and dry sliding wear behavior of glass fiber reinforced polymer composites - A taguchi approach, Journal of Minerals Materials Characterization and Engineering, 2010: (9-4), pp.365-387.
11. Hemalata Jena, Mihir Ku. Pandit, and Arun Ku. Pradhan, Study the impact property of laminated bamboo-fibre composite filled with cenosphere, International Journal of Environmental Science and Development, 2012: (3-5), pp.456-459.
12. K. Naresh Kumar, M. Prasanth Kumar, V. Krishna, and D. Srinivasa Rao, Experimental investigation on mechanical properties of coal ash reinforced glass fiber polymer matrix composites, International Journal of Emerging Technology and Advanced Engineering, 2013: (3-8), pp. 250-258.

