MECHANICAL PROPERTIES OF FLYASH FILLER IN NATURAL FIBER- HYBRID EPOXY COMPOSITES

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Abstract

In the present investigation a new hybrid composites with epoxy as a resin and reinforcing both bio waste (jute) and industrial waste (fly ash) and study of the effect of the fly ash filler on tensile and flexural properties experimentally. Composites were prepared by using hand lay-up technique. All the laminates were prepared with a total of 4 piles. One group of glass laminate was also fabricated for comparison purpose. Specimen preparation and testing was carried out as per ASTM standards. Due to incorporation of fly ash fillers in to the jute composites there is 10 % of strength increment in tensile and 20 % in flexural.

Keywords: *hybrid, fly ash, jute, glass, tensile,*

1. Introduction

The industrial and bio waste materials may become threat to environment if proper disposal/use of it is not found out. A small amount of waste is utilized in different purpose like making bricks, concrete, cement and roads etc the rest is used for landfills or simply lying on the site of disposal. There is a need to find out the other area for use.Natural fibres also offer noteworthy cost advantages and benefits associated with processing, as compared to synthetic fibres such as glass, nylon, carbon, etc. When compared to the traditional fibers the properties such as tensile and flexural properties of natural fibre composites are much lower. Another disadvantage of natural fibre composites which makes them less attractive is the poor resistance to moisture absorption [1]. Hence use of natural fibre alone in polymer matrix is inadequate in satisfactorily tackling all the technical needs of a fibre reinforced composite. In an effort to reduce the traditional filler and as well increase the utilization of natural bio waste in the field of materials, a natural fibre can be combined with a synthetic fibre in the same matrix material so as to take the best advantage of the properties of both the fibres. This results in a hybrid composite. The incorporation of several different types of fibres or fillers into a single matrix has led to the development of hybrid composites. The total behaviour of hybrid composites is a weighed sum of the individual components in which there is a more favourable balance between the intrinsic advantages and disadvantages. Also, using a hybrid composite that contains two or more types of fibre, the advantages of one type of fibre could neutralize with what are lacking in the other. As a consequence, a balance in cost and performance can be achieved through proper material design [2]. Fly ash, a waste by-product generated abundantly in industries and electric power plants, is a hollow micro-balloon ceramic. Fly ash consists of inorganic matter present in the coal that has been fused during coal combustion. It is primarily composed of SiO_2 and Al_2O_3. In recent years, the utilization of fly ash as an additive component in metal matrix composites and polymer-matrix composites has received increased attention. Radically development is largely due to the many advantages of fly ash such as low density, strong filling ability, excellent fluidity, and good processibility of the filled materials [3]. Fly ash has been used as filler to increase the properties of aluminium [4], polyester [5], epoxy [6], polyurethane and various rubbers. Furthermore, as a waste by-product, its usage decreases the overall cost of the composites and the pressure on the environment.

In this backdrop of utilization of the bio, industrial waste and mainly to replace the traditional glass filler composites in the industrial applications an effort is made to fabricate new hybrid composites and studied the mechanical and morphologies properties.

2. Materials and Methods

Raw materials used in this presentment investigation are Jute fiber, E glass fiber, Epoxy resin, Hardener HY-951 and fly ash. The fly ash utilized in this study was procured from Rourkela steel plant of SAIL (Steel Authority of India Limited), Rourkela, India.

Composites of woven jute and glass mat with 4 plies were manufactured by hand lay-up technique. A wooden mold of 150x60x5 mm was used for manufacturing the composite. For quick and easy removal of the composite sheet a mold release sheet was put over the glass plate. Mold release spray was also applied at the inner surface of the mold wall after it was set on the glass plate. Different composite samples with varying the fly ash percentage fillers with 4 plies of jute as continues fibers were manufactured for comparison purpose. Care was taken to avoid formation of air bubbles during pouring. Pressure was then applied from the top and the mold was allowed to cure at room temperature for 72 hrs.

The tension test is generally performed on flat specimens. The most commonly used specimen geometries are the dog-bone specimen and straight-sided specimen with end tabs. The standard test method as per ASTM D 3039-76 has been used; length of the test specimen used is 140 mm. A rate of loading of 10 mm/min was used for testing. Flexural tests were conducted as per ASTM D2344-84 standards. Specimens of 140mm length and 15mm wide were cut and were loaded in three points bending with a recommended span to depth ratio of 16:1 both the tests are performed in universal testing machine INSTRON H10KS. Scanning electron microscopy was used in order to study the fly ash distribution and the fiber breakage under different conditions.

3. Results and Discussion

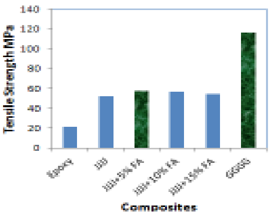

Figure 1. tensile Strength

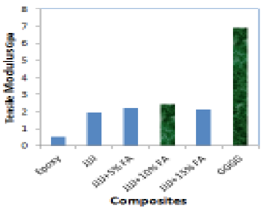

Figure 2. Tensile Modulus

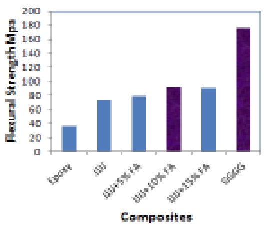

Figure 3. Flexural Strength

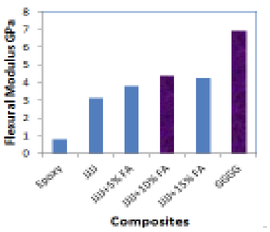

Figure 4. Flexural Modulus

The tensile strength and modulus of unreinforced epoxy resin is found to be 21.28MPa and 0.528GPa. The variation of tensile strength and modulus for various composites are shown in Fig 1 and 2, respectively. The tensile strength and modulus of laminate when only jute fibers are reinforced in the matrix is found to be 45% and 30% greater than that of the neat epoxy resin. The tensile strength and modulus of the jute composites is increases as the fly ash content increases up to 5% for 10 and 15 % there is a slight decrease in strength this may due to increase of ceramic particles. The 5 % fly ash filler jute reinforced composites gives 50% strength of the glass fibers where as the pure jute gives 40% only.

The flexural strength and modulus of unreinforced epoxy resin is found to be 36.23MPa and 0.783GPa. The variation of flexural strength and modulus for various composites are shown in Fig 3 and 4, respectively. The flexural strength and modulus is more for the composite prepared with 10 % fly ash filler epoxy composite. The 10% fly ash filler jute reinforced composites gives 55% strength of the glass fibers where as the pure jute gives 40% only.

(a) (b) (c) (d)

Figure 5 (a-d) Morphology of composites

Figure 5(a) shows the morphology of the 15 % fly ash jute composite due to the more filler content voids are observed. Figure 5(b) shows the morphology of tensile strength of the glass fiber composites in this it is observed that the breakage of glass fibers is observed. Figure 5(c) shows flexural specimen morphology in this due to load the fiber bending is clearly visible the end fibers are broken and the middle layers under gone bending. Figure 5(d) show the morphology of jute composites due to ceramic particles bonding the fibers are stretched to some extent is visible in the figure.

4. Conclusions

Based on this study the following conclusions are drawn: By incorporation of bio and industrial waste in to the polymer material the mechanical properties almost enhanced to greater extent. Due to incorporation of the fly ash fillers in to jute composite the tensile and flexural properties increased. The 10% fly ash filler reinforced composites give almost 55% of the glass fiber composite strength

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