Fabrication of Glass/Jute/Epoxy Composite Based Industrial Safety Helmet

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Abstract

This work focused on the development and characterization of hybrid glass/jute reinforced epoxy composite for industrial safety helmet. The total numbers of fiber layers are fixed and by varying the weight percentage of matrix and different fiber layers. Five different composites were manufactured using hand lay-up technique. One layer of glass and three layers of jute reinforce epoxy hybrid composite achieved maximum flexural strength of 100.78 MPa. Three layer of glass and one layer of jute reinforce epoxy hybrid composite achieved maximum impact strength of 72.24 J/m. The study results shows that 3-Glass 1-Jute fiber reinforced epoxy composite which has maximum impact strength can be used to replace the existing industrial safety helmet material.

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Keywords: Glass fiber; jute fiber; hybrid composite; industrial safety helmet.

1. Introduction

Uses of natural fiber based polymer composite is expanding due to various environmental and health issues related to synthetic based plastics [1-2]. Hybrid polymer composites combines the properties of different constituents (different fibers) and result in a more versatile product. Sanjay and Yogesha [3] analyzed the mechanical properties of jute/E-glass fiber reinforced epoxy hybrid composite fabricated by using hand layup technique. The authors concluded that jute/E-glass fiber reinforced epoxy hybrid composite has achieved better properties than the jute fiber reinforced epoxy composite. Sanjay et al. [4] fabricated the jute/glass fibers reinforced polyester composite by varying the weight fraction of jute/glass. The tensile and flexural properties of the developed composite were
examined and the authors concluded that tensile strength was maximum when weight percentage of jute and glass fiber in equal percentage then the other developed composites. Ram et al. [5] reviewed the properties of natural fiber composites to replace the existing safety helmet material. The authors showed that natural fiber hybrid composites can replace the existing industrial safety helmet materials which are eco-friendly and light in weight. Kumar et al. [6] fabricated the carbon/PCB powder (E-WASTE) epoxy composite for industrial safety helmet using compression moulding method. The authors concluded that 52/48 weight percentage of carbon/PCB (E-WASTE) powder has maximum tensile strength, flexural strength and impact strength which can replace the existing industrial safety helmet. sanjay et al.[7] studied the natural fiber composites application for engineering and commercial purpose. The authors compared the mechanical properties of natural fibers with synthetic fibers and showed the various applications of natural fiber based composites and their hybrid composites. Arthanarieswaram et al. [8] analyzed the effect of glass fiber hybridization with randomly oriented natural fibers. The authors concluded that glass fiber improved the tensile strength and impact strength of natural fiber composite. Gopinath et al. [9] analyzed the mechanical properties of jute/epoxy reinforced epoxy composites and jute/polyester reinforced epoxy composites. The composite were synthesized at 18:82 fibers resin weight percentages. The authors concluded that jute reinforced epoxy composites shown superior mechanical properties than jute-polyester reinforced epoxy composites. Khan et al. [10] analyzed the mechanical properties of woven jute fabric reinforced polyactic acid composites. The authors concluded that woven structure exhibited better properties under tensile, flexural and impact loading as compared to non-woven reinforced polyactic acid composites. Surendra et al. [11] fabricated the sisal fiber reinforced polymer composite and sisal/jute-okra fiber reinforced polymer hybrid composite. The authors concluded that the mechanical properties of sisal/jute/okra fiber reinforced polymer hybrid composites were better than the sisal fiber reinforced polymer composite. Ramesh et al. [12] fabricated the banana fiber reinforced polymer composite using hand layup technique by varying the weight percentage of fiber as 40, 50 and 60. The authors concluded that the composite having 50 weight percentage of fiber content can be used as an alternative material for synthetic fiber reinforced polymer composites. Murali et al. [13] fabricated the sisal/banana/jute particle reinforced epoxy composite for industrial safety helmet using hand lay-up technique. The authors concluded that sisal/banana/jute particle fiber reinforced epoxy composite can be used as an alternate material of ABS plastics for industrial helmet.

The purpose of the present investigation is development and mechanical characterization of hybrid glass/jute fiber reinforced epoxy composites for industrial safety helmet. In this study, the consequences of hybridization of jute fiber with glass fiber reinforced epoxy composite are examined.

2. Methods and materials

Two types of fibers, Jute and glass are used in this study for the fabrication of fiber reinforced polymer composite. Jute fibers are supplied by Jute N fabrics, New Delhi (India) in woven mat form and S-glass are supplied by Hindustan Tech fibers pvt. Ltd., New Delhi (India) in woven mat form. Epoxy polymer used as the matrix material, is supplied by Shankar Dyes and Chemicals, New Delhi-06 (India).

3. Processing

Hand lay-up technique has been used for the fabrication of composites specimen and industrial safety helmet. Open mould plastic board was used for the fabrication of composite. The epoxy was thoroughly mixed with hardener (curing agent) in a suitable proportion. First plastic board was covered by non-reactive thin plastic sheet to give fine surface finish. After that, silica gel was applied on the plastic sheet to avoid sticking of polymer to surface. A layer of polymer was applied by using brush and then woven fiber mat was placed over it and then a roller was used to remove the air bubbles trapped in it. The same process was repeated for the four layers of fiber and covered by applying silica gel on thin plastic sheet and placed on last layer of polymer. On the plastic sheet plastic board was placed and the dead load of 15-20 kg was applied. After curing at room temperature for 40-48 hours, developed composite were taken out. The helmet mould has been prepared by plaster of Paris (POP) as shown in figure 1. Table 1 shows the detailed composition of fibers used for the manufacturing of the composites.
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