Evaluation of Mechanical Properties in Short Banana fiber Reinforced Epoxy Composites

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Abstract: Polymer matrix composites prepared from conventional fibers like glass and carbon finds lot of applications in structural material development due to their strength, light weight and other important mechanical properties. In these work short Banana fibers of various length is used along with epoxy resin. The composites were prepared used hand layup method were tested for mechanical properties like tensile test and impact test. Also fracture surface of tested specimen were analyzed using scanning electron microscopy to study fiber matric interfacial bonding.

Keywords: Banana, fibers, epoxy, composites,fracture, Scanning electron microscopy.

Introduction

Development of Natural fiber reinforced polymer composites has become a trend in material development. Material scientists are developing many polymer composites using available natural fibers like jute, sisal, hemp, kenaf etc, the advantages of using natural fiber are environmental friendly, ease of machining, exhibits similar properties when compared with conventional synthetic fibers.

The natural fibers are hydrophilic in nature, which will affect the geometry of the structure when exposed in moisture, due to this reasons most of the fibers are chemically treated or sometimes coupling agents are added in order to reduce this effect.

This paper proposes the potential of banana fibers (short fibers) when reinforced in epoxy resin. The composites were prepared using hand layup method, which can be used in structural applications. Firstly mechanical properties like tensile, impact strength were discussed, and then the fracture surfaces of tested samples were analyzed using scanning electron microscope.

Materials

Preparation of Banana Fibers and Matrix Materials

The short banana fiber reinforced epoxy composite was prepared by the hand lay-up method. The fibers are extracted from pseudo stem part of plan, which were conditioned by removing moisture content by drying. The dried fibers are chopped to approximate length of 5, 8 and 10mm. banana fibers which are cleaned were dipped in 10 % solution of NaOH for 6 hour and then washed in dilute acid to remove any particles of alkali.

Epoxy resin (LY556) and hardener (grade HY951) were used in the preparation of composites. These two materials were thoroughly mixed and stirred at low speed until it become uniform. The banana fibers and matrix are mixed in the ratio of 60% and 40% respectively by weight fraction. The matrix material was poured into the mould slowly in order to avoid air trapping. The three layered composite was cured at room temperature until it was dry, then dried samples were tested according to ASTM standards. All the laminates were prepared for 4mm thickness. The tensile test specimen was prepared according to ASTM D638 and tested for tensile strength using, Instron universal Houhns field 25kN tester. Izod impact test is conducted on the specimens using Izod impact tester. The dimension of the specimens was 64 x 12.7 x 4 mm. scanning electron microscope (SEM) LEO 440i was used to identify the tensile fracture morphology of the composite samples.

Results and Discussion

Tensile strength

As it is seen in the table 1, the ultimate tensile strength of the 5mm short length banana fiber showed highest value of 63.40 MPa which is due the better fiber matrix adhesion which can bear load on fiber and matrix. Also importantly as the length of fiber decreases the matrix bonding increases by covering complete surface area of fiber. The least value of ultimate tensile

strength is seen in 10mm short length banana fiber which is of 60.16 MPa. It is evident from SEM image that more fiber pullout are observed, due to poor fiber matrix bonding.

Impact Strength

The impact response in short banana fiber reinforced epoxy composites reflects that as the fiber length increased the impact strength also increased, this is due more impact energy is absorbed by the fiber. Also Higher impact strength value leads to the higher toughness properties of the material. The higher value of impact strength 27.67J/m is observed in 10mm short fiber banana composite sample.

Table.1.tensile properties of Banana-epoxy composites

Sl no	Banana fiber length	Tensile strength (MPa)	Impact strength J/m
1	5mm	63.40	21.31
2	8mm	62.01	23.56
3	10mm	60.16	27.67

Fracture Surface Study by SEM

The fracture surface study of short banana epoxy composite is shown in Figures 1. From the SEM micrograph of the fracture surface after the tensile test, it can be seen that the banana fiber composite exhibits a ductile appearance with minimum plastic deformation. A fracture profile in the form of a ridge appears on the surface, with the presence of continuous banana fibers. Higher magnification also showed the continuous banana fibers with a fractured epoxy matrix, which again depicts the ductile characteristics and high strength carrying capacity of the fibers.

The fig1 a shows that better fiber matrix bonding and no voids are seen, and fibers are fractured instead of pull out. Also in fig 1.b SEM image shows that matrix are covered around some part of the fiber but not completely.this leads to partial load transfer between fiber and matrix. The last SEM image fig 1.c shows that poor fiber matrix interfacial bonding which leads to decrease in tensile strength, but impact strength is more due to presence of more fiber.

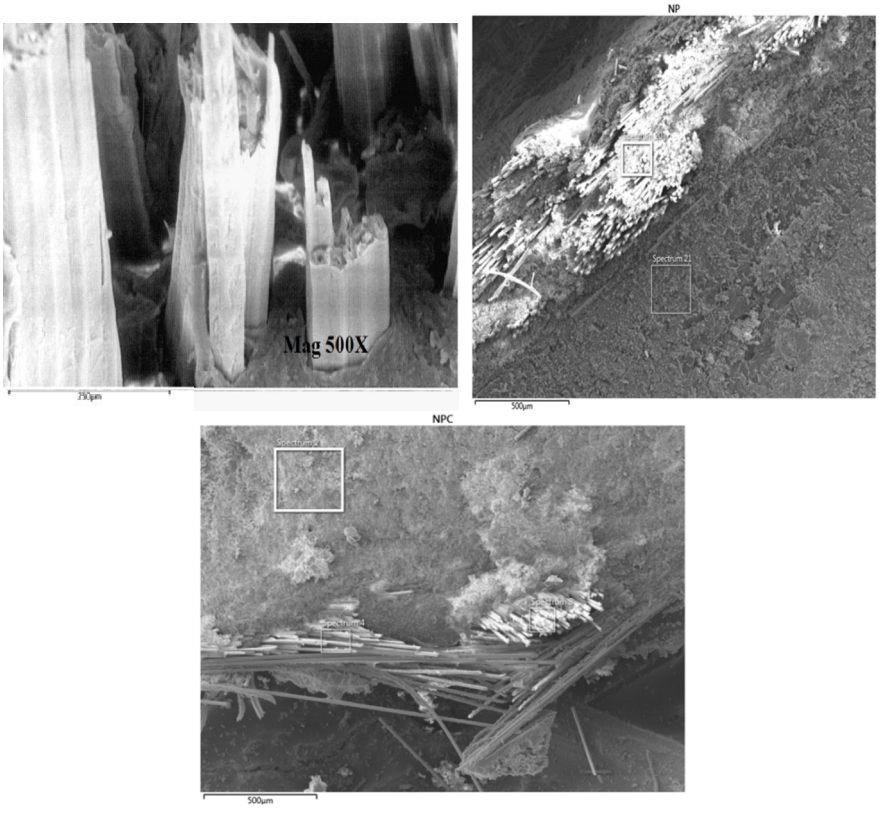

Fig 1.SEM image of Banana-epoxy composites

The composites showed comparatively better performance, the micrographs taken for the fractured banana, composites. On tensile loading condition, showed a brittle like failure,. More fiber pull out is observed and this could be reason for the reduction in the tensile strength. The composites showed comparatively better performance.

Conclusion

The present study has been undertaken, with an objective to explore the potential of the Banana fiber polymer composites and to study the mechanical properties of composites. The present paper reports the use of Banana fibers, as reinforcements in polymer matrix. This study focused at providing knowledge to enhance further research in this area. The possibility of surface chemical modification of Banana fibers have been extensively used in a wide variety of application, e.g., packaging, furniture's etc.

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