Journal Of Harmonized Research (JOHR)

Journal Of Harmonized Research in Engineering
3(2), 2015, 85-88

ISSN 2347 – 7393

Original Research Article

FLEXURAL FAILURE ANALYSE ON BANANA FIBERS REINFORCED POLYMER COMPOSITES

Alok Kumar Rathore, Amit Kumar Kachhawaha, Harsh Pandey

Dr. C V Raman University, Kota, India

Abstract: The present research work is undertaken to study the development, characterization and erosion wear performance of two different categories of fibers when reinforced in polymers.Attempts have been made to explore the possible use of a natural fiber as filler material in composites. To make an assessment of their (banana fiber) reinforcing potential in terms of flexural performance of the composites are studied in details and its comparison with a similar set of composites with glass fiber as a filler material is reported.

Introduction

There are quite a few terms to describe various wear modes which can be clubbed into four principal categories viz. abrasion, adhesion, erosion and surface fatigue [3]. Generally, abrasive wear occurs when two surfaces in contact move against each other and the harder particle in one cut through the other. This form of wear comes into play when a tangential motion causes the material removal by the simultaneous micro-ploughing and micro-cutting [1].However, wear due to localized bonding between contacting solid surfaces leading to material transfer between the two surfaces or the loss from either surface is termed as adhesive wear. Similarly, surface fatigue is another wear process that takes place when tiny wear particles are dislodged from a surface by fracture on repeated rolling or sliding on the surface. Owing to a repeated loading action subsurface cracks grow from pre-existing defects, join hands with other vicinal cracks and finally come to the surface removing a small chunk of material [3]. In the erosion wear mode, a progressive loss of material occurs from a solid surface due to mechanical interaction between that surface and a fluid, a multi-component fluid, or impinging liquid or solid particles [4].In view of the wide range of applications of composites as materials for wear related applications, systematic and comprehensive study of mechanical and wear (tribological) behavior of existing and new class of composites becomes important both from scientific as well as commercial angles.Rosa et

For Correspondence:
alok13.mintu@gmail.com
Received on: April 2015
Accepted after revision: April 2015

al. [5] studied the application of life cycle assessment (LCA) methodology in order to explore the possibility of improving the eco efficiency of glass fiber composite materials by replacing part of the glass fibers with hemp mats. The main purpose and contribution of this study is the exploration of the eco-efficiency of this new material. The study is a development of a previous work conducted on a pipe system used to transport cooling sea waters in a Sicilian petrochemical company. Mishra et al. [6] assessed the degree of mechanical reinforcement that could be obtained by the introduction of glass fibers in bio fiber (pineapple leaf fiber/sisal fiber) reinforced polyester composites experimentally. It has been observed that water uptakes of hybrid composites are less than that of unhybridized composites. Scanning electron microscopic studies have been carried out to study the fiber-matrix adhesion. Husic et al. [7] prepared two series of polyurethane resins using Soypolyol 204 derived from soybean oil and petrochemical polyolJeffol G30-650. Polyurethanes from soybean oil have good thermal, oxidative and weather stability, and can be used as a matrix in composite materials. The objective of this study was to compare the mechanical properties of untreated E-glass fiber reinforced composites prepared with soybean oil-based polyurethanes to that of the petrochemical polyol based ones.

Matrix Material

Matrix materials are of different types like metals, ceramics and polymers. Polymer matrices are most commonly used because of cost efficiency, ease of fabricating complex parts with less tooling cost and they also have excellent room temperature properties when compared to metals and ceramic matrices. Polymer matrices can be either thermoplastic or thermoset. Thermoset matrices are formed due to an irreversible chemical transformation of the resin into an amorphous cross-linked polymer matrix.The most commonly used thermoset resins are epoxy, polyester, vinyl ester and phenolics. Among them, the epoxy resins are being widely used for many advanced composites due to their excellent adhesion to a wide variety of fibers, superior mechanical and electrical properties and good performance at elevated temperatures. In addition to that they have low shrinkage upon curing and good chemical resistance. Due to several advantages over other thermoset polymers as mentioned above, epoxy (LY 556) is chosen as the matrix material for the present research work.Currently, the extracted fibres were used for making bags, purse, etc. In order to improve the application of banana fiber an attempt was made to reinforce it in an epoxy matrix to form a composite.

Table 1 Typical properties of banana fibers

Material	Density (g/cm^3)	Tensile Strength (MPa)	Young's Modulus (GPa)	% Elongation at break
Banana fiber	1.45	400-550	15-22	5.7

Fig. 1 Short banana fiber

Experimental Details

Low temperature curing epoxy resin (LY 556) and corresponding hardener (HY951) are mixed in a ratio of 10:1 by weight as recommended. Short glass fibres were reinforced in the resin to prepare the composites in different proportions according to the experimental requirement. The uniformly mixed dough (epoxy filled with glass fiber) is then slowly decanted into the plastic molds, coated beforehand with wax and a uniform thin film of silicone-releasing agent. The composites were cast in these molds so as to get the rectangular type specimens (100mm Diameter, thickness 4 mm). Composites of 7 different compositions with varying filler content (Table 2) are made. The castings were left to cure at room temperature for about 24 hous after which the samples are released from the mould.

Table 2 Epoxy composites filled with short glass fiber(**Set 1**)

Composition
Epoxy + 0 wt % Short banana fiber
Epoxy + 5 wt % Short banana fiber
Epoxy + 10 wt % Short banana fiber
Epoxy + 15 wt % Short banana fiber
Epoxy + 20 wt % Short banana fiber
Epoxy + 25 wt % Short banana fiber
Epoxy + 30 wt % Short banana fiber

Fig. 2: Short banana fiber reinforced epoxy composites

Flexural Strength

The determination of flexural strength is an important characterization of any structural material. The photograph of the machine and the loading arrangement for the specimens are shown in Fig 3respectively.It is the ability of a material to withstand the bending before reaching the breaking point. Conventionally a three point bend test is conducted for finding out this material property. In the present investigation also the composites were subjected to this test in a testing machine Instron 1195. A span of 30 mm was taken and cross head speed was maintained at 10 mm/min. The strength of a material in bending is expressed as the stress on the outermost fibres of a bent test specimen, at the instant of failure. In a conventional test, flexural strength expressed in MPa is equal to:

$$FS = \frac{3PL}{2bt^2}$$

Where P= applied central load (N)
L= test span of the sample (m)
b= width of the specimen (m)
d= thickness of specimen under test (m)

Fig. 3 Loading arrangement for the specimens

Discussion

A gradual improvement in flexural strength with fiber loading is recorded in both sets of fabricated composites. An increase in flexural strength from minimum of 48 MPa in neat epoxy to a maximum of 88.7 MPa in epoxy composites with 30 wt % glass fiber is recorded. Similarly for banana fiber reinforced epoxy composite, flexural strength reaches maximum to 82.3 MPa. The enhancement in the flexural strengths of the composites with fiber loading is probably caused because of excellent compatibility of the fibers and the epoxy matrix, leading to strong interfacial bonding. The higher values of flexural properties may also be attributed to good fiber to fiber interaction, less voids and uniform dispersion. However, it also depends on other factors such as the size, shape and type of the fiber material.

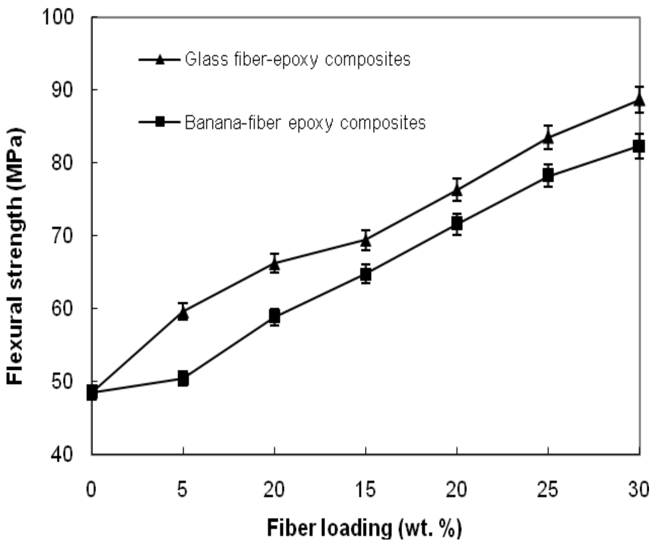

Fig. 4: Effect of fiber loading on flexural strength

Conclusion

Hardness values have been found to have improved invariably for all the composites on addition of fibers. The improvement in hardness with the incorporation of fiber can be explained as follows: a compression or pressing stress is in action. So the polymeric matrix phase and the solid filler phase would be pressed together and touch each other more tightly. Thus, the interface can transfer pressure more effectively although the interfacial bond may be poor. This might have resulted in an enhancement of hardness.

Reference

[1] S.J. Pickering, R.M. Kelly, J.R. Kennerley, C.D. Rudd and N.J. Fenwick, “A Fluidized-Bed Process for the Recovery of Glass Fibers from Scrap Thermoset Composites”, Composites Science and Technology, Vol. 60, pp. 509-523, (2000).

[2] PäiviKivikytö-Reponen, (2006). Correlation of Material Characteristics and Wear of Powder Metallurgical Metal Matrix Composites, Doctoral Theses in Materials and Earth Sciences, Helsinki University of Technology, Laboratory of Materials Science, Espoo.

[3] Budinski K.G, (1998). Surface Engineering for Wear Resistance, Prentice Hall, New Jersey.

[4] Robinowicz E, (1965). Friction and wear of materials, John Willey, New York, USA.

[5] A.D. La Rosa, G. Cozzo, A. Latteri, A. Recca, A. Björklund, E. Parrinello and G. Cicala, “Life Cycle Assessment of a Novel Hybrid Glass-Hemp/Thermoset Composite”, Journal of Cleaner Production, Vol. 44, pp. 69-76, (2013).

[6] S. Mishra, A.K. Mohanty, L.T. Drzal, M. Misra, S. Parija, S.K. Nayak and S.S. Tripathy, “Studies on Mechanical Performance of Biofibre/Glass Reinforcedpolyester Hybrid Composites”, Composites Science and Technology, Vol. 63, pp. 1377–1385, (2003).

[7] SuhretaHusic, Ivan Javni&Zoran S. Petrovic, “Thermal and Mechanical Properties of Glass Reinforced Soy-Based Polyurethane Composites”, Composites Science and Technology, Vol. 65, pp. 19–25, (2005).