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Synthesis and Mechanical Properties of Short Sisal Fibre Dispersed Epoxy Composites

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ABSTRACT

Today scientist and engineers working on materials are very much concerned with environment protection and sustainability issues. Due to several properties like environmental friendly, bio degradable and sustainable, natural fiber composites are potential candidate for advance engineering applications. Now day's natural fibres are widely used to replace the conventional synthetic fibers. In present investigation an Epoxy piece and short Sisal fiber-epoxy composites are prepared using hand lay-up technique. For this purpose, an open type mould made of mild steel plate has been used. Composite E is for neat epoxy and S5, S10, S15, & S20 are composites with sisal fibers of length 5mm, 10mm, 15mm & 20mm respectively. Sisal fibres length varied from 5mm to 20mm. It is revealed that the sisal epoxy composite exhibited better impact strength and flexural strength. Tensile strength decreased with the dispersion of short fibres, but with the increase in the length of sisal fibres tensile strength also slightly improved.

Keywords: *Composites; Sisal fibres; epoxy; mechanical properties*

INTRODUCTION

Natural fibres are renewable resources abundantly available at low cost are biologically degradable in nature and also possess sustainability. Plant-derived natural fibers are cellulose based, generally classified according to the part or type of plant from which they are extracted [1-6]. Among the various natural fibers, sisal fiber possesses ability to stretch, resistance to deterioration in saltwater and moderately high specific strength and stiffness [7-10].

The fiber length plays a significant role in deciding the mechanical properties of sisal composite [11] and chemical and physical treatments of sisal fiber also found to be valuable in improving the mechanical properties like tensile and flexural strength [12-14].

EXPERIMENTAL SETUP

Material and Fabrication

An Epoxy piece and sisal fibre-epoxy composite is prepared using Hand lay-up technique. For this purpose, an open type mould made of mild steel plate (600 mm long × 300 mm wide × 27 mm thick) has been used. Mould is coated with wax (realizing agent) for easy removal of sheet. Then the epoxy resin (Araldite AY103) has been layered on the mould (1-1.5 mm) thickness and sisal fibres placed uni-directionally on it.

There are four types of composite fabricated based upon variation in length of fibre i.e. S5, S10, S15 and S20 with constant 30% weight fraction of matrix. An extra sheet of neat epoxy E is also prepared for the comparison of properties.

Tensile Testing

Tensile tests are performed on the dog bone shaped samples at room temperature using Instron 3369 tensile machine. A constant crosshead speed of 5 mm/min is selected and the stress– strain data are recorded up to the complete breaking of the samples. Three samples are tested for each composition.

Flexural Testing

Flexural tests specimens are prepared as per standard ASTM D 790. The dimensions of the rectangular shaped flexural specimens are 80 mm × 20 mm × 3.2 mm with span length 48 mm. These specimens are also tested on the Tinius Olsen H 10 K-L (bi-axial testing machine, load capacity 10 kN) with 2 mm/min crosshead speed. The flexural testing is done using a three-point bending test.

Impact Testing

Izod impact test specimens are prepared as per standard ASTM D 256 of his dimension 65 mm × 13 mm × 3.2 mm and 2.5 mm V-shape notch. Impact test of specimens are performed on the Impact Testing (104) machine and the results are reported.

Result and Discussion

It is evident from figure 1 Epoxy (specimen E) have tensile strength value is 44.09 MPa and with reinforcement of sisal fibre in epoxy matrix tensile strength is found to decrease compared to neat epoxy i.e for S5-32.2 MPa As we increase the fibre length from 5mm to 20mm tensile strength is also increases from 32.2MPa to 45.45 MPa. Since short fibre in epoxy matrix shows agglomeration and not uniformly distributed within the matrix may cause of decrease in tensile properties for composite S5 and long fibers are homogeneously distributed in matrix and when tensile load is applied on long fibres are elongated in load direction.

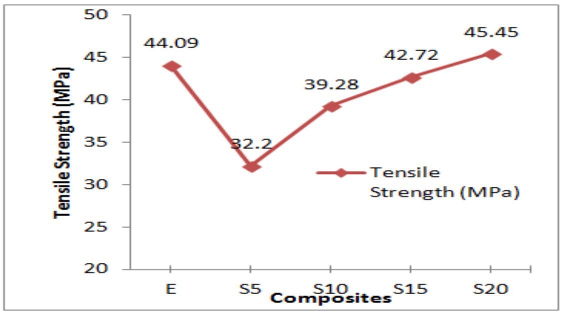

Fig 1. *Tensile strength of composites*

Flexural properties shown in figure 2 reveal that E has flexural strength 99.76 MPa and flexural modulus 4.61 GPa. Composite- S20 gives the optimum values of flexural strength and flexural modulus 115.86MPa, 5.84 GPa respectively. In view of the fact that short fiber might be acts as a defect at macroscopic scale.

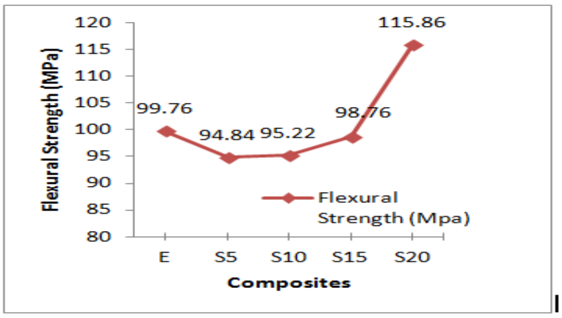

Fig 2. *Flexural strength of composites*

Impact properties are shown in figure 3 (a & b), E has 0.1224 J impact energy and 5.1244GPa impact strength. From Composite-S5 to S20 shows increase in impact energy and impact strength. We know strength of composites also depends on interfacial bonding between the reinforcement and the matrix, with the increase in length of fibres it seems that interfacial bonding is also improved which is clear from the obtained results.

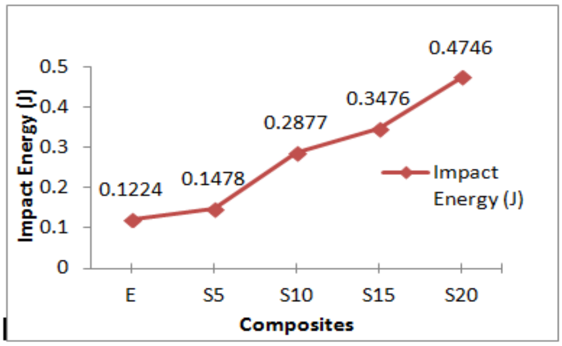

Fig 3a. *Impact energy of composites*

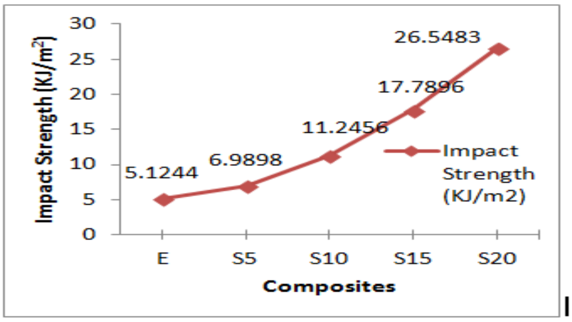

Fig 3b. *Impact strength of composites*

Conclusions

It can be concluded from the above results that the tensile strength of epoxy improves with the reinforcement of long sisal fibre. Flexural strength and impact strength also improved with the sisal fibre reinforcement. It seems that with the increase in length of fibre interfacial bonding improves and chances of agglomeration also decrease. Orientation of fibres also improves which results in overall improvement of mechanical properties. Such composites can be a good choice for various engineering applications like automobile industries, structural and domestic purposes.

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