# Automotive Application and Mechanical Property Characterisation of Sisal Fiber Reinforced Epoxy Composite Material

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***Abstract*:- Many work described in the past refers to the mechanical characterisation of fibre reinforced composite materials with an epoxy matrix. Sisal is a natural fibre used as a base mat structure in which the epoxy resin is added for adhesion. Sisal with the botanical name Agave sisalana, is a species of Agave native to southern Mexico but widely cultivated and naturalized in many other countries. Sisal fibre is derived from the leaves of the plant. It is usually obtained by machine decortications in which the leaf is crushed between rollers and then mechanically scraped. The prepared sisal fiber composite is compared with a reference glass fibre reinforced composite and the other natural fibres composites is made. It is also presented the influence of the surface treatment in the mechanical characterizations of the natural fibres. The present study is to investigate the mechanical properties of sisal fiber reinforced composites. The sisal fiber used as mat form and epoxy used as reinforcement for fabricating of composites. The composites were prepared by hand layup technique. The tensile, hardness and impact tests were carried out of composites. The aim of the study is to fabricate new class of epoxy based composites reinforced with randomly oriented short sisal fiber. The results reveals that the major mechanical properties viz Tensile, Hardness and Impact were studied and found to be satisfactory.**

***Keywords: Sisal fiber, tensile, hardness, impact, mechanical testing.***

## I. INTRODUCTION

Research have began to focus attention on natural fiber composites(i.e. coir, jute, sisal, banana, hemp and bagasse fibers) which are composed of natural or synthetic resins, reinforced with natural fibers. Natural fibers exhibit many advantageous properties; they are low density natural yielding relatively light weight composites with high specific properties. These fibers also have significant cost advantages and ease of processing along with being highly renewable resources. Natural fiber composites are very cost effective material especially in building and construction purpose packaging, automobile and railway coach interiors and storage devices. These can be potential candidates for replacement of high cost glass fiber for low load bearing applications. Natural fibers have the advantages of low density, low cost and biodegradability. However, the main disadvantages of natural fibers and matrix and the relative high moisture absorption. Therefore chemical treatments are considered in modifying the fiber surface properties [1].sodium hydroxide (NAOH) treatment on the fiber would remove the impurities like pectin, facts and lignin in the fiber, resulting in improvement in the adhesion between fiber and matrix also increases mechanical (tensile, flexural and compression) properties of fabricated component[2]. The hybrid composites were studied extensively by researchers and they concluded that hybrid composites can offer better resistance to water absorption, cost reduction, weight savings and increase modulus of materials. A fabricated composite specimen of different weight % of alkaline treated sisal fibers and performed mechanical characterization. Results indicate the tensile strength increases with increasing fiber percentage up to a certain limit. The effect of hybridization on mechanical Properties of coir. Composites fabrication was done using compression moulding technique. The results demonstrated that hybridization plays an important role for improving the mechanical properties of composites. The tensile and flexural properties of hybrid composites are improved markedly as compare to un hybrid composites [4]. The tensile and flexural properties of hybrid of glass/sisal fiber and glass/jute fiber reinforced epoxy composites. Glass/sisal fiber reinforced epoxy composite exhibits more tensile strength and glass/jute fiber reinforced epoxy composite exists more flexural strength [5]. The mechanical properties of ukam banana, sisal, hemp, coconut and e-glass fiber reinforced to access the possibility of using it as a new material in engineering application. Samples were fabricated by the hand layup process [6]. The mechanical property of chemically treated hemp fiber reinforced composites. They found that due to

the rapid climate changes in environment, the physical and geometrical characteristics of natural fiber and synthetic fiber components are affected. For better surface finish of the hemp fiber composites the Chemical treatment process like alkali, acetyl and silane treatments are carried out [7].The processing and characterization of hemp fiber textile composites with micro-braiding technique and found that the hemp fiber is suitable reinforcement for textile composites. The literature survey indicates that the overall mechanical properties of natural fiber reinforced hybrid composites are completely depend on the amount and type of fibers used [8].

The present work discuss about the natural fiber sisal reinforced with epoxy resin as a floor mat structure and the mechanical properties were tested and the results are compared with the other natural fibers.

## II. PREPARATION OF COMPOSITE

The fibers required for the testing were obtained from a small-scale rope making industry in Thali, a village in Krishnagiri district. The Sisal plant and raw Sisal fiber is available in the form as shown in Figure 1 & 2.

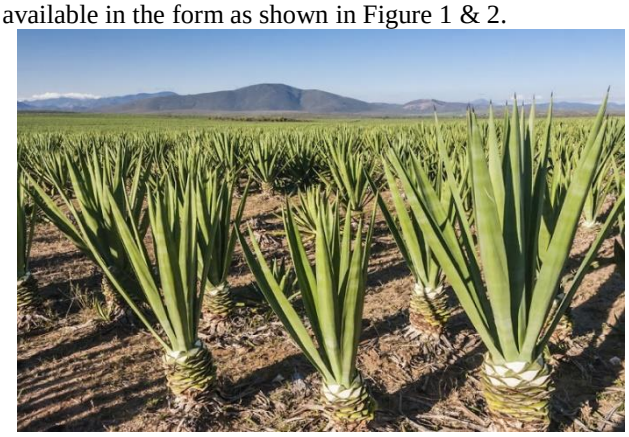


Figure 1. Sisal Plant

Figure 2. Raw Sisal Fiber

The long length fibers were first cleaned to remove the dust and other particles so as to use the fibers for further treatments. The fibers were cut to a length of 200 mm to make the further treatments easy. Alkali treatment is done using 5% NaOH in order to enhance the adhesion property of the fiber with epoxy resin. First the fibers are soaked in NaOH solution for 48hrs and then the fibers are washed in distilled water to remove the traces of NaOH. This treatment improves adhesion by removing the lignin and cellulose content. The prepared Sisal fiber mat as shown in figure 3.

Figure 3. Sisal reinforced epoxy floor mat structure

The percentage of sisal fiber is varied from 4% to 10% in steps of 2%. Similarly epoxy content is varied from 96% to 90% in steps of 2%. Different compositions are named as S1 to S4 as shown in the table 1. In this process hardener composition is kept constant.

Table 1. Composition of Sisal composite

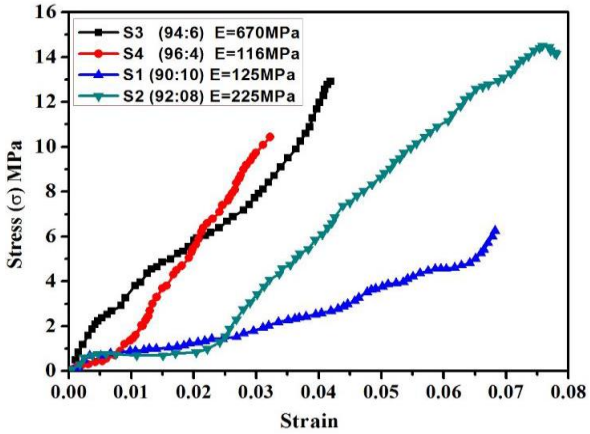
| Composition type | Composition |
|---|---|
| S1 | Epoxy (85 wt %), Sisal fiber (15 wt %) and Hardener (10 wt% of Epoxy). |
| S2 | Epoxy (90 wt %), Sisal fiber (10 wt %) and Hardener (10 wt% of Epoxy). |
| S3 | Epoxy (94 wt %), Sisal fiber (06 wt %) and Hardener (10 wt% of Epoxy). |
| S4 | Epoxy (96 wt %), Sisal fiber (04 wt %) and Hardener (10 wt% of Epoxy). |

## III. RESULT AND DISCUSSION

### *3.1. Tensile test*

According to ASTM D3039 / D3039M standards for composites, the specimens were prepared for tensile test. Fiber configuration and volume fraction are two important factors that affect the properties of the composite. The test process involves placing the test specimen in the testing machine and slowly extending it until it fractures. During this process, the elongation of the gauge section is recorded against the applied force. The tensile testing machine with specimen are shown in Figures 4.

Figure 4 Tensile test Specimen




*3.2 Rockwell Hardness Test*

According to ASTM D 785 standards for composites, the specimens were prepared for Rockwell-B hardness test. Fiber configuration and volume fraction are two important factors that affect the properties of the composite. The hardness properties of the composites are studied by applying indentation load (Figure 5) normal to fibers diameter and normal to fiber length. Surface hardness of the composites is considered as one of the most important factors that govern the wear resistance of the composites. For each of the specimen surface hardness is obtained.

*3.3 Impact Test*

According to ASTM D256, ISO 180 standards for composites, the specimens were prepared for Izod impact test. The impact properties of the composites are studied by applying indentation load normal to fibers diameter and normal to fiber length for various specimen types. The Izod test specimen as per ASTM standard and Test machine are show in Figures 6 respectively. Table 2 represents the impact energy values.

Figure 5. Hardness Tester specimen

Figure 6. Impact test

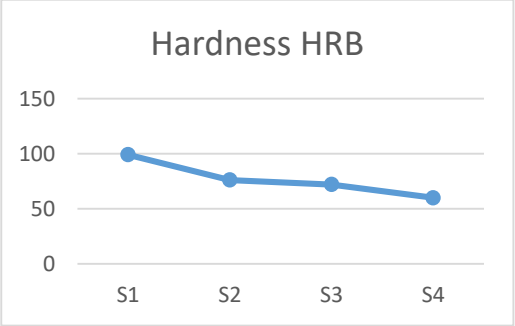



Table 2. Impact energy value

| Composition | Energy in joules |
|---|---|
| **S1** | 4.0 |
| **S2** | 4.0 |
| **S3** | 4.0 |
| **S4** | 4.0 |

## IV. CONCLUSION

Sisal based composites and Characterization of Mechanical Properties of Sisal Fiber Reinforced epoxy resin composites have been studied. The major mechanical properties like Tensile, Hardness and Impact were reported.

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