

## Mechanical Properties of Sisal Fibre Reinforced Polymer Matrix Composite

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The composite materials plays a vital role in increase the strength and weight reduction purpose. The natural fibers increase the additional strength to the composites. This paper is related to the mechanical properties of the sisal fiber reinforced composites and it is compared with the another preparation of sisal fiber reinforced composite. The graphs shows the comparison about the mechanical properties on the fiber reinforced composites. The strength can be improved by using some melted polypropylene to increase the bonding between the matrix and the fiber. The sample material is immersed in water for twenty four hours and at the same time the properties also measured by using various testing methods. The final comparison indicates the better process for the preparation of the composite.

*Keywords:* sisal fiber, reinforcement, polymer matrix, coupling agent.

### 1. Introduction

The natural fibers are most important to make composite materials. Because the intermediate bonding between natural fibers are used in most of the processes. In the method of preparing composites should have high strength and it is eco-friendly to the environment. The collection of natural fiber is easy and their cost is also minimum when compared to the artificial reinforcement materials. There are many types of epoxy and polymers reinforced composites are available to make a high strength to composites. But in the present day of operations natural fibers play a vital role. Most of the fibers can be used to prepare a composite, But the physical, electrical and mechanical properties of the material is most important. The prepared composite materials are used in automobile, air craft structure and it is great alternative for glass fibers. The composite materials can be used to reduce

the total weight of the system and increase the strength of the materials. Some of the composite materials replaced in handicap sticks, chairs and vehicle body. In automobile industry it is used for weight reduction purpose and to increase the efficiency of the total design. The natural fibers reduce the raw material cost and it is easily degradable. So it is not polluted to the environment. The coir, sisal, banana and hemp fibers are used in most of the composite materials. But in these paper the various mechanical properties of the natural fibers reinforced composites materials are related.

## 2. Reinforcement material

The reinforcement is to increase the additional strength of the material and it is maximized the bonding between the acid and fibers. The reinforcement has done on the animal and natural fibers. But the natural fibers are in simple cost and adoptable to the environment. In our preparing process of composite material the sisal fiber is used for the reinforcing material. Normally the sisal fiber having high strength when compared with all other natural fibers.



**Figure 1** Sisal fiber images

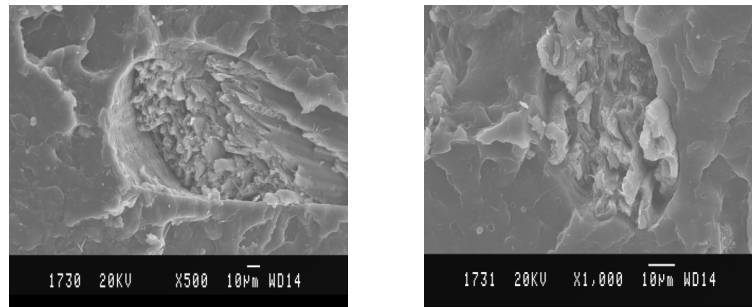
## 3. Coupling agent

In the process of preparing composite material the coupling agents are used to increase the additional bonding between the fibers and matrix phase. The coupling agents are of two types. The one is to react with the fiber surface and another one is to co-polymerize the matrix between the fiber and matrix. Some of the matrix agents used are triazines, melted polymers. Coupling agents are used to increase the tensile strength of the composites.

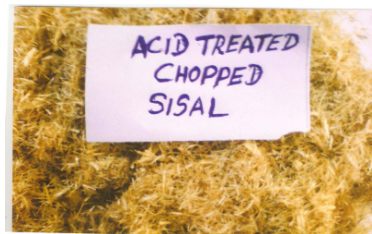
## 4. Preparation

The injection moulding machine is used to form the final object and the required composition has been prepared by the following processes. Initially the natural fibers are chopped in to two mm length of the fiber and it is immersed with the sodium hydroxide solution. Now the reaction takes place in between the fiber and acid. After the immersion a few droplets of acetic acid is sprayed and the distilled

water is used for cleaning the acid treated solution. The preparation has to be dried at nearly  $900^{\circ}\text{C}$  for few minutes. Now the coupling agent is added to the composition and it is used to increase the bonding between the fibers and matrix.



**Figure 2** SEM images of acid treated sisal fiber



**Figure 3** Acid treated sisal fiber

## 5. Machines

The twin extruder and injection machines are used to prepare the output material using the composition. In twin extruder machine the materials are blended with ratio of ten percentage of fiber and ninety percentage of plastic material. In time it is added some amount of coupling agent for the purpose of bonding between them. The injection moulding machine has the high pressure of molten polymer it is passed through the hopper. The final output has obtained by using the injection moulding machine.



Figure 4 Twin extruder machine



Figure 5 Injection moulding machine

Table 1 Properties of sisal fiber

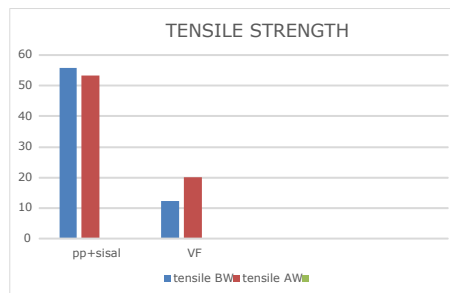
S.N	Blend R. ratio	Tensile Strength	Tensile Modulus	% of Elongation	Flexural Strength	Flexural Modulus	Impact Strength	Hardness	% of Water absorption	Time
1	PP + Sisal	55.686	1538.13	50.19	93.33	1614.90	13.8	78	0.01	Before water absorption
2	PP + Sisal	53.43	1493.72	54.019	91.274	1593.921	12.5	77	-	After water absorption

## 6. Testing

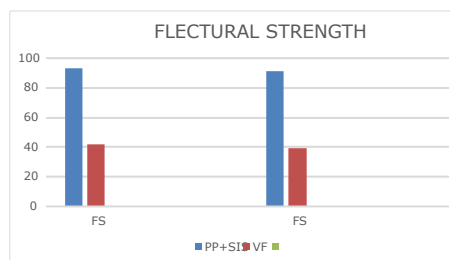
Testing has been conducted for the material such as tensile, flexural, impact, hardness test and water absorption test and the results are evaluated.

**Table 2** Properties of sisal fiber [2] R

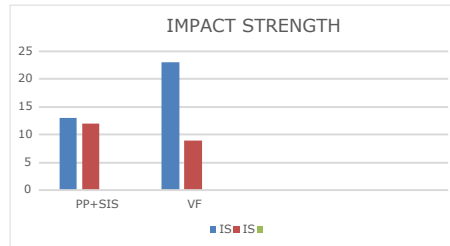
S.no	Volume fraction	Tensile Strength MPa	Flexural Strength MPa	Flexural Modulus MPA	Impact Strength J/cm
1	0.15	12.168	23.23	1366	9.84
2	0.2	20.14	42.15	2386	21.63
3	0.25	14.11	39.65	2154	13.77



**Figure 6** comparison graph of sisal fiber's tensile strength



**Figure 7** Comparison graph of sisal fiber's flexural strength



**Figure 8** Comparison graph of sisal fiber's impact strength

## 7. Conclusion

The comparison of the sisal fiber having two different compositions and preparation processes are studied. In which the tensile strength and tensile modulus is very high for polymer matrix composites. Also flexural strength and modulus, impact strength is maximum for the polymer matrix composites. It is concluded that all the properties of the sisal fiber having high strength is polymer matrix composites when compared to the inter cohesion of sisal fiber reinforced composites.

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