Investigation of Mechanical Properties of Natural Fiber Reinforced Polymer Matrix Composite Using China Clay as Filler Material

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Abstract- *The natural fiber composites market is growing demand for sustainable and Eco friendly products, increasing penetration of fibers in the automotive industry. In this research work, sisal fiber is added to rubber grade china clay with polyester resin as reinforcement. The mechanical tests were carried out to find the strength of fiber. The china clay is added with sisal fiber with certain percentage(0-8wt%). The addition of china clay shows increase in strength up to 4wt% and gradually decreases in mechanical properties. The addition of fiber shows better improvement in the mechanical properties. The maximum tensile strength, and flexural strength are 48 N/mm^2 and 64.35 MPa respectively and maximum impact energy obtained is 1 J.*

Keywords:- Sisal, china clay, polyester resin, mechanical tests.

I. INTRODUCTION

The strength of natural fiber is comparatively lower than glass fiber because of less stiff. The matrix material serves for two different purposes. The variation will show depends upon the way of temperature shown. The weight and easy handling depend upon the type of composite material chosen. In some of the composites, it provides two interfaces between each side of the interface and its constituents. The major development is carried out in the area of rubber composite. Poor interfacial adhesion due to the hydrophilic nature of fiber is the major disadvantage. The experimental papers already proved that the addition of sisal fiber with glass fiber shows much improvement. Sisal fiber usage leads to reduction in shrinkage. By immersing sisal fiber in calcium hydroxide leads to strength the fibers. The major advantage of sisal fiber is good resistant to heat and moisture content and have good tensile strength.

Some composites provides interface when surface dissimilar constituents interact with each other. The fabrication method depends on its matrix properties and the effect of matrix properties of reinforcements. Lot of investigations have been conducted on several types of natural fibers such as kenaf, hemp, flax, bamboo, and jute are used to study the effect of these fibers on the mechanical properties of composite materials. Most PMC materials in use today have thermosetting matrices; consequently, after they have been cured, they have no apparent scrap value. Although attempts have been made to grind them up and use them as fillers, this has not proven to be economically practical.

The reuse of uncured PMCs offers little economic incentive; most scrap is simply discarded, By contrast, one of the potential advantages of PMCs with thermoplastic matrices is that the scrap can be recycled, Cured PMCs present no particular disposal problem; they are chemically inert and can be used for landfill.

II. MATERIALS AND METHOD

A. Materials

In this experiment, the composite specimen sisal fiber, china clay and polyester resin used. The raw sisal had collected from Coimbatore District, Tamil Nadu, India. The china clay powder had collected in the same area (rubber grade). The rubber grade clay is the best quality. Polyester resin collected from Coimbatore

B. Composite preparation

The material had prepared by using hand lay-up technique. Pure sisal fiber of 35mm length had taken for specimen preparation. The fiber is processed by using polyester resin and then dried under sunlight for 6 to 8 hours. Due to this process air gap formed between the layers, to avoid this during fabrication it was squeezed out using the roller in a gently manner. Finally the plates are kept in press for one day (24 hours) to get the desired shape and perfect thickness. After the plates get dried, the edges are neatly cut by using machines.

III. MECHANICAL PROPERTIES

A. Tensile Test

By using file and emery paper the edges of plates are in correct shape for testing the piece. The specimen is prepared according to the ASTM standard and the dimension and gauge length are accurate. By using Universal Testing Machine (UTM) the specimen is tested at room temperature. The specimen is placed in testing machine and then applying load to find its strength. The test is conducted until the piece get fracture. Then, the experiment is repeated for three times to determine its average value.

B. Flexural Test

The specimen is prepared and set the dimension according to ASTM D790 standards and the piece is tested by using 3-point flexure test. The deflection is noted and the tests were carried out at an average temperature. The same method is repeated to determine its average value.

C. Impact Test

The V- shaped notch is prepared and then the fiber is cut into standard size and test the piece until it gets fracture.

Fig. 1. Specimen prepared for tensile test

Fig. 2. Specimen prepared for flexural test

IV. RESULTS AND DISCUSSION

A. Tensile Properties

The samples of composite material were tested by using Universal Testing Machine. The ultimate tensile strength of different samples was tested. The result shows in the table 1.

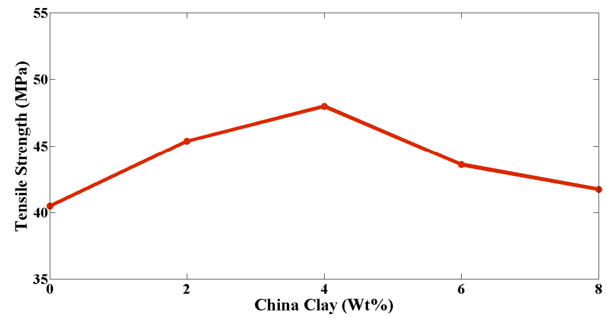

Fig. 3. The graph of tensile strength.

B. Flexural Properties

The properties which based on flexural were tested and then the stress strain curve was plotted. The Flexural strength of different samples was tested. The result shows in the table 2.

C. Impact Properties

The samples were tested and the results shown in below table.

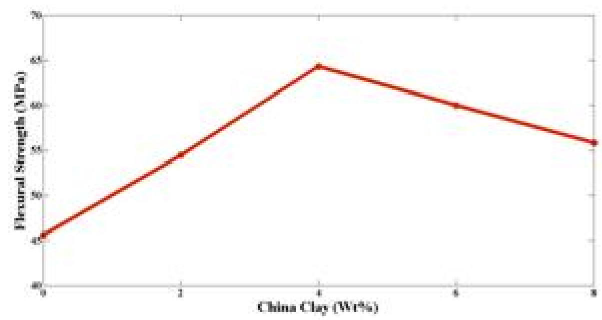

Fig. 4. The graph of flexural strength.

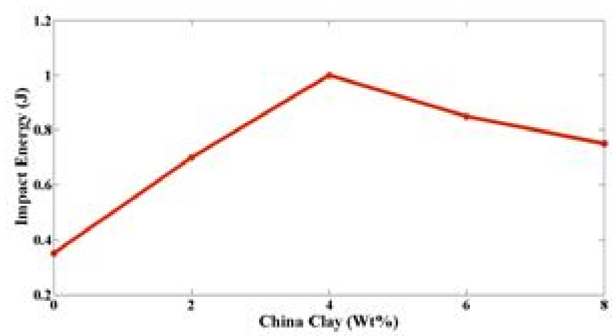

Fig. 5. The graph of impact energy.

TABLE. I TENSILE PROPERTIES OF THE COMPOSITES

Wt % of china clay	Peak Load (N)	% Elongation	UTS (N/mm^2)
0	881.222	3.9	40.475
2	945.382	5.4	45.375
4	1117.948	4.0	48.00
6	932.426	6.2	43.596
8	761.325	5.2	41.731

TABLE. II FLEXURAL PROPERTIES OF THE COMPOSITES

Wt % of china clay.	Peak Load (N)	Flexural Strength (MPa)	Flexural Modulus (Mpa)
0	62.943	45.62	1541.672
2	74.253	54.47	2541.966
4	79.726	64.35	2662.716
6	72.582	60.02	2212.720
8	67.381	55.84	1942.062

TABLE. III IMPACT ENERGY OF THE COMPOSITES

Wt % of china clay	Izod Impact Energy for 3 mm Thick Specimen in J
0	0.35
2	0.70
4	1.00
6	0.85
8	0.75

V. CONCLUSION

In this research work, mechanical tests were conducted on sisal fiber and china clay, based on the experimental results the following conclusions are made:

1. Addition of china clay shows improvement in mechanical properties up to 4 percent weight percentage.
2. Tensile, Impact and Flexural strength have gradually increased up to 4 percent weight percentage and after that it decreases slowly.
3. Addition of clay more than 4% leads to gradual decrease in strength because of its properties.

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