STUDY THE EFFECT OF SOME MECHANICAL BEHAVIOR FOR CHEMICALLY TREATED NATURAL FIBER BASED POLYMER COMPOSITES

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Abstract- In recent years, natural fiber reinforced polymer composites have enhanced much attention because of their many advantages such as lightweight, nonabrasive,, low cost and biodegradable properties. many research has been studied all over the world on the use of natural fibers as a reinforcing material for the preparation of various types of polymer composites. However, due to the incompatibility between fibers and polymer matrices, the tendency to form aggregates during processing and shortge the use of natural fibers as reinforcements in polymers. Chemical treatments of the surface of natural fiber can clean the fiber surface, stop the moisture absorption process, (chemically modify the surface) , and increase the surface roughness. To this end, in the present research work, the use of sawdust fiber as natural fibers in polymer matrix has been studied. Also, the effect of surface modification of natural fibers on some mechanical properties of sawdust fiber reinforced polymer composites has also been discussed.

Index Terms- Polymer , Natural Fiber, Chemical Tearment .

I. INTRODUCTION

Recently, composite materials have successfully substituted the traditional materials in several light weight and high strength applications. The reasons why composite materials are selected for such applications are mainly their high strength-to- weight ratio, high tensile strength. By qualifier composites are materials consist of two or more chemicallyhaving a purpose interface separating them and having dimension behavior which is considerably different from those of any of the constituents the first medium of composite material having a continuous character is called matrix. Matrix is usually less hard and more ductile. The matrix forms the bulk part. The secondary medium is a discontinuous form is embedded in the matrix. The second medium generally harder as compared to the continuous medium and is called reinforcement. It serves to strengthen the composites and improves the overall mechanical behavior of the matrix. A bonded produces material properties unavailable from the individual constituent materials; while a wide range of matrix and reinforcing materials gives an option to the product designer allows the designer to choose an optimum combination. Depending on the type of matrix materials used composite materials can be classified into three categories such as metal matrix composites, polymer matrix composites and ceramic matrix composites. Each type of composite material is suitable for different applications. Most commonly used matrix material in composite materials is polymer. The reason for this is two folds. Firstly, their strength and stiffness are less as compared to ceramics and metal and these shortcomings are overcome by reinforcing other materials with polymers. The reinforcing medium can either be fibrous or non-fibrous in nature and if the fibers are derived from natural resources like plants or some other living species, they are called natural fibers. Many investigations on the potential of the natural fibers as reinforcements for composites. However, the experimental data of some mechanical properties, particularly when tested under different processing conditions, have shown inconsistent values in many cases [1]-[3].The irregular characteristics of natural fibers are one of the main reasons for this. On the other hand, natural fibers are hydrophilic and many polymers are hydrophobic. This leads, in many cases, to problems associated with the interfacial properties of this type of composite [1]-[3]. Various treatments are used to improve the matrix-fiber adhesion in natural fiber reinforced composites. Most of the studies made on natural fiber composites reveal that their mechanical properties are strongly influenced by a number of parameters such as volume fraction of the fibers, fiber length, fiber aspect ratio, fiber-matrix adhesion, fiber orientation and stress transfer at the interface. Therefore, both the matrix and fiber properties are important in perfection mechanical properties of the composites. A number of investigations have been made on various natural fibers such as kenaf, hemp, flax, bambooand jute to study the effect of these fibers on the mechanical properties of composite materials [4]-[7]. The influence of surface treatment (silane coupling agent) on the interface performance of henequen fiber reinforced HDPE composites has been investigated [8]. It was mentioned that fiber surface salinization resulted in rise interfacial load transfer efficiency and silane treatment of cellulosic fibers can refinethe interfacial strength. The mechanical properties of fiber reinforced composites can be improved by the peroxide induced graft copolymerization of

polyethylene onto cellulose surfaces [9]. The effects of different chemical treatments on fiber reinforced polymer composites has been studied by few investigators [10]-[11]. The effect of chemical treatment on mechanical behavior of banana fiber reinforced polyester composites has been studied and expounded that the mechanical properties of different alkali treated banana fiber composites showed improved fiber matrix interactions [12]-[13].

II. THE EXPERIMENTAL PROCEDURES

Particulars of processing of the composites and the experimental steps followed for their characterization. The raw materials used in this research work are as follows:polyester resin, 2. Short sawdustfibers, 3. Hardener.

Preparation of composites

Short sawdust fibers which are taken as reinforcement is collected and the polyester resin and the corresponding hardener. A glass mouldhaving dimensions of (200 × 200 × 20) mm^3 is used for composite fabrication. The short sawdust fibers are mixed with polyester resin by the hand layout method. Three different types of composites were fabricated: first set of composites without treatment; second set of composites with alkali treated fibers; and third set of composites with silane treated fibers. In alkali treatment, short sawdust fibers were immersed in 10% sodium hydroxide solution for a half an hour. Then the fibers washed thoroughly with water and to remove the final traces of alkali, put it in water containing a few drops of HCl. Then the fibers were dried in an oven. In silane treatment, short sawdust fibers were allowed to react with silane by immersing in silane dissolved in a water acetone mixture for one hour. After that the solution is emptied and the fiber is dried. (Figure 1) shows short sawdust fiber and sawdust fiber reinforced polyester composite and (Table 1) shows the details of composition and designation of the composites are presented. The cast of each composite is cured in (50 0 C for 5 hours) after it removed from the mould and the Specimens of suitable dimension are cut for mechanical tests.



Figure 1 shows short sawdust fiber

Table 1- the Specimens composites

Composites	Composition
Specimen-1	100% Polyester+0wt% sawdust fiber
Specimen-2	85%Polyester+15wt% sawdust fiber
Specimen-3	70% Polyester+30wt% sawdust fiber
Specimen-4	55% Polyester+45wt% sawdust fiber

III. MECHANICAL TESTING

After fabrication of the composites, the test specimens were subjected to various mechanical tests according to ASTM standards. the tensile test and three-point flexural tests of composites were carried out using instron 1195. the ASTM standard test method for tensile properties of fiber resin composites has the designation d 3039-76. micro-hardness measurement is done using a vicker's micro-hardness tester. a right pyramid shape diamond indenter, having a square base and 136° angle between two opposite faces, is forced into the material under a load f. after sweep the load, the arithmetic mean l of the two diagonals x and y of the indentation left on the surface of the material is calculated. in the present study.

IV. MECHANICAL PROPERTIES OF COMPOSITES

The properties of the short sawdust fiber reinforced polyester composites with sawdust fibers loading under this research are presented in Table 2 ,3 and 4 . The mechanical properties and physical properties of natural fibers differs largely depending on the chemical and structural composition, fiber type and growth conditions. Mechanical properties of plant fibers are much lower when compared to those of the most widely used competing reinforcing glass fibers. However, because of their low density, the specific properties (property-to-density ratio), strength, and stiffness of plant fibers are comparable to the values of glass fibers [14].

A-1- INFLUENCE OF FIBER LOADING ON HARDNESS OF COMPOSITES

Figure 1 shows hardness of untreated and treated short sawdust fiber reinforced polyester composites. It untreated sawdust first increases up to 30wt% of fiber loading and then remains constant with increase in fiber loading up to 45wt%. The treated fiber composites show increase in hardness up to 45wt% fiber loading but alkali treated sawdust fiber showed more hardness than silane treatment as observed in Figure 1. As treated fibers composites exhibits higher hardness values than composites with untreated fiber reinforcements

Table2- Effect of fiber loading on hardness of composites

Composites	untreated	Alkali Treatment	Silane Treatment
Specimen-1	29	29	29
Specimen-2	36	50	42
Specimen-3	42	56	48
Specimen-4	42	60	51

A-2INFLUENCE OF FIBER LOADING ON TENSILE STRENGTH OF COMPOSITES

Tensile strength measurements are among the most important indicators of strength in a material and are most widely specified property. [15] . Tensile strength of matrix and randomly oriented untreated short sawdust fiber reinforced composites, NaOH (Alkali Treatment) and Silane Treatment (3-amino propyl try ethoxysilane) sawdust fiber composites with different fiber weight ratios are presented in the Table 1. The tensile strength of short sawdust fiber /polyester composites at different fiber loading are shown in Figure 3. It is clear that tensile strength of the composites increase with fiber loading. By the addition of 30wt% fiber loading (specimen-3), the strength is found to be increased to 40 % compared to neat polyester system, The effect of different chemical treatments on tensile strength of short sawdust fiber /polyester composites is given in Table 4.1. It is clear that in most cases an improvement is observed. The increase is fluent in the case of silane treated fiber composite. The amino silane used in this work helps to bond with hydroxyl groups through hydrolyzablealkoxy group and amino group capable of interacting with the polyester resin. During alkali treatment, waxes, hemicellulose and part of the lignin present on the fiber surface will be removed [16]. The removal these compounds increase the surface roughness, which allows mechanical interlocking. The formation of strong covalent bonds between the isocyanate and hydroxyl groups of cellulose lead to main improvement in strength. The improvement in the case of resin impregnated fiber is auxiliary with the increased moistening as well as due to the presence of strong polyester bonds within the technical fiber. But it is found that modified silane treated sawdust fiber reduced the strength and modulus after 30wt% fiber loading.

Table 3 - Tensile strength of composites

Composites	Untreated	Alkali Treatment	Silane Treatment
specimen-1	3.62	3.62	3.62
specimen-2	6.59	7.5	13.14
specimen-3	9.086	10.2	18.33
specimen-4	11.48	11.77	12.667

A-3- INFLUENCE OF FIBER LOADING ON FLEXURAL STRENGTH OF COMPOSITES

Flexural strength is one of the important mechanical properties of the composites. For a composite to be used as the structural materials it must has higher flexural strength. The flexural strength values for different weight ratios of (i.e. i.e. 100:0, 85:15, 70:30 and 55:45) untreated, NaOH and silane treatment composites are presented in Table 4, It is observed that the flexural strength for different fiber weight ratios of the composites is more when alkali treatment fiber is used in the composites.

Table 4 - Flexural strength of composites

Composites	Untreated	Alkali Treatment	Silane Treatment
Specimen-1	12.31	12.31	12.31
specimen -2	23.3	25.68	24.1
Specimen-3	29.27	35.54	32.4
Specimen-4	17.593	26.25	22.515

Table 4 shows that is clearly seeming that the flexural strength composites are higher than those of the matrix. From the table it is also observed that the flexural strength increases with increase the weight ratio offiberin the composite as shown in Figure 3. The change of flexural strength of untreated, NaOH and silane treatment sawdust fiber composites with different weight ratios of fibers in composites are presented in Figure 4.3. From the figure it is remarked that the flexural properties of the sawdust fiber reinforced composites improve the properties treatment is generally required for short sawdust fiber reinforced composites and from the figures it is also observed that moisture NaOH sawdust fiber reinforced composites have higher flexural strength than untreated sawdust fiber reinforced composites. A possible perfection in the bonding strength between the reinforcement and the matrix is done by the alkali treatment which increased the flexural properties of the composites. The reason for this is that the alkali treatment improved the adherent property of sawdust fiber surface by extruding cellulose, thereby producing rough surface topography [15].

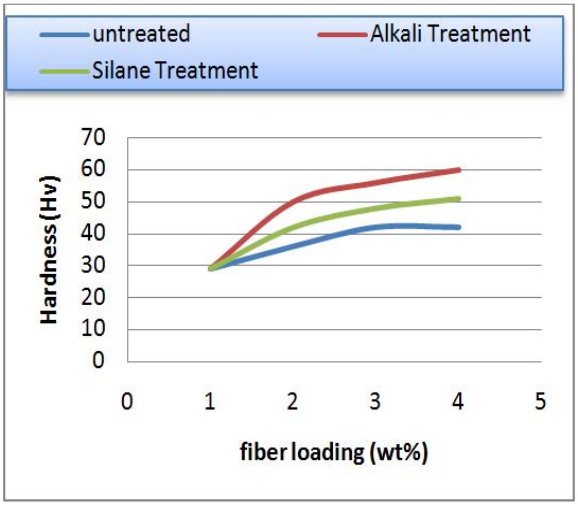


Figure 2-- Influence of fiber loading on Hardness of composites

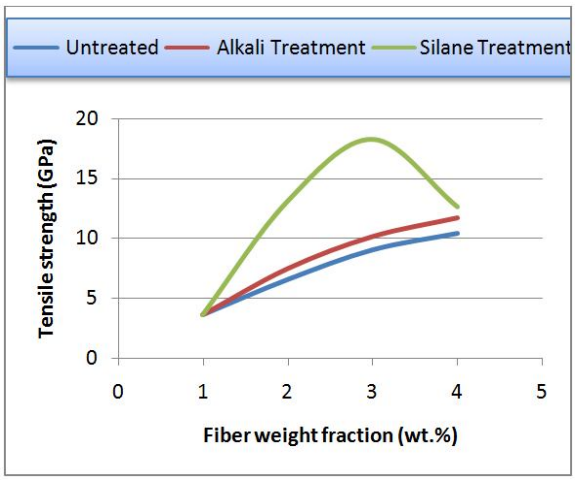


Figure 3--Influence of fiber loading on tensile strength of composites

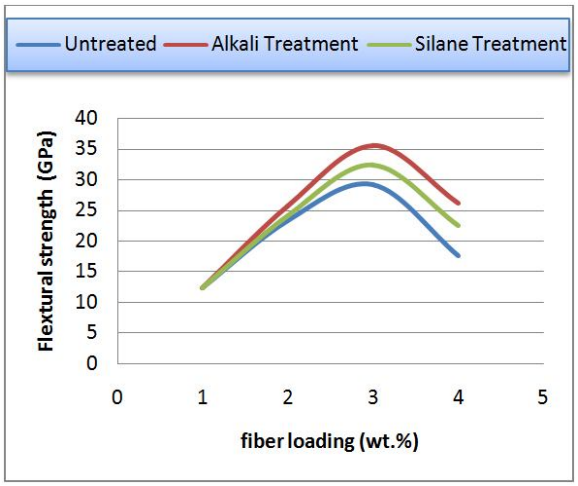


Figure 4- Influenceof fiber loading on flexural strength of composites

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