EVALUTION OF MECHANICAL PROPERTIES OF NATURAL FIBRE REINFORCED COMPOSITE MATERIAL(SISAL)

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***Abstract*—** Natural Fibers have an outstanding potential as reinforcement in thermoplastics. The objectives of this experiment are to evaluate the suitability of producing natural fiber composites using sisal fiber. This study deals with the preparation of composites by using hand layup method in which good interfacial adhesion is generated by a combination of fiber modification and matrix methods. Initially the sisal fiber were treated in order to improve resin fiber interfacial bonding. Generally, composites that contain treated fiber have a higher tensile modulus and greater flexural modulus than do untreated fiber composites. The goal of this project is which composites fiber best and related to other composites .In this type of project to determine mechanical properties and strength calculation identify this result. Composites with volumetric amounts of fiber in 30% were fabricated and they were arranged in continuous oriented discontinues form.

Here using continuous orientation method for composite fibers with polyester resin to check tensile strength, flexural strength, impact strength to give greater strength composite materials. It was observed that the effects of reinforcing vinyl ester matrix with the fibers caused the composites to be more flexible and easilydeform due to high strain values and reduction of high resonant amplitude.

Keywords -- Vegetable fibers , Mineral fibers , Animal fibers

I. INTRODUCTION

Recently, because of their extensive use in many diverse fields, plastics, including FRP (fiber reinforced plastics) products have become indispensable to our daily lives. However, the primary raw material used in plastic production is petroleum and there are strong social and economic pressures to conserve petroleum resources. Furthermore, because FRP wastes are non flammable, they must be disposed of in landfills after use, and this contributes to high environmental loads. In order to reduce the environmental load generated from the disposal of used plastic products, significant attention has been placed on biodegradable plastics. These plastics can be completely resolved into water and carbon dioxide by the action of the microorganism, when disposed of in the soil. Moreover, there are no emissions of toxic gases during incineration. Recently, biodegradable plastics have been used in commercial products such as ball-point pens, toothbrushes, garbage bags, fishing lines, tennis racket strings, wrapping paper and many others. The application of biodegradable plastics has been restricted due to their relatively lower strength compared to conventional plastics such as nylon. Over the past few years a considerable number of studies [1-13] have been performed on biodegradable composites containing biodegradable plastics with reinforcements of biodegradable natural fibers. The natural fibers such as flax[1-3], ramie [3,4], jute[3,5], sisal[6-8], pineapple[9], henequen[12] and hemp[13] were used for reinforcements in these studies. In this study, sisal fibers were selected as a reinforcement of the biodegradable composites due to their high strength and excellent thermal stability. In order to increase the fraction of the fibers, emulsion-type biodegradable resin was used as the matrix. The unidirectional fiber reinforced composites were fabricated by hot pressing. Moreover, heat resistance of sisal fibers and sisal fiber reinforced plastics was investigated.

Sisal is obtained from the husk of the fruit of the planate Sisal. The fruits are defused with on a spike and after retting, the fibers are subtracted from the husk with beating and washing. The fibers are strong, light and easily withstand heat and saltwater. The combined use of plan tea and sisal short fibers seem to delayed restrained plastic shrinkage controlling crack development at early ages. Sisal is an abundant, versatile, renewable, cheap, and bio degradable fiber used for making a wide variety of products. Sisal has also been tested as filler or reinforcement in different composite materials.

Sisal fiber is the most interesting products as it has the lowest thermal conductivity and bulk density. The addition of plan tae Sisal reduced the thermal conductivity of the composite specimens and yielded a lightweight product. Development of composite materials for buildings using natural fiber as plan tae Sisal with low thermal conductivity is an interesting alternative which would solve environment and energy concern.

II. LITERATURE REVIEW

Mansur and Aziz studied sisal-mesh reinforced cement composites, and found that these reinforcing materials could

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enhance the strength and toughness of the cement matrix, and increase its tensile, flexural, and impact strengths significantly. On the other hand, jute fabric-reinforced polyester composites were tested for the evaluation of mechanical properties and compared with wood composite, and it was found that the jute fiber composite has better strengths than wood composites.

A pulp fiber reinforced thermoplastic composite was investigated and found to have a combination of stiffness increased by a factor of 5.2 and its strength increased by a factor of 2.3 relative to the virgin polymer. Information on the usage of banana fibers in reinforcing polymers is limited in the literature. In dynamic mechanical analysishave investigated banana fiber reinforced polyester composites and found that the optimum content of banana fiber is 40%. Mechanical properties of banana–fiber–cement composites were investigated physically and mechanically by CorbiereNicollier*etal*. It was reported that pulped banana fiber composite has good flexural strength. In addition, short banana fiber reinforced polyester composite was studied by the study concentrated on the effect of fiber length and fiber content. The maximum tensile strength was observed at 30 mm fiber length while maximum impact strength was observed at 40 mm fiber length. Incorporation of 40% untreated fibers provides a 20% increase in the tensile strength and a 34% increase in impact strength. Joseph *et al*. tested banana fiber and glass fiber with varying fiber length and fiber content as well. Luo and Netravali studied the tensile and flexural properties of the green composites with different pineapple fiber content and compared with the virgin resin.

Sisal fiber is fairly coarse and inflexible. It has good strength, durability, ability to stretch, affinity for certain dyestuffs and resistance to deterioration in seawater. Sisal ropes and twines are widely used for marine, agricultural, shipping, and general industrial use. Belmeresetal.found that sisal, henequen, and palm fiber have very similar physical, chemical, and tensile properties. Cazaurangetal.carried out a systematic study on the properties of henequen fiber and pointed out that these fibers have mechanical properties suitable for reinforcing thermoplastic resins. Ahmed et al. carried out research work on filament wound cotton fiber reinforced for reinforcing high- density polyethylene (HDPE) resin. Khalid et al. also studied the use of cotton fiber reinforced epoxy composites along with glass fiber reinforced polymers.

David Emery's company, Feather fiber Corporation, is one of three in the nation that has the licensed technology. Emery's company separates feather from quill, allowing the lightweight but strong feathers to be used. The key to easy separation lies in the fact that quills are bulkier and heavier. There have been many new uses discovered for feather fiber by scientists around the country, and research using feather fiber continues. Recently, scientists such as Abe Widra have discovered that hair and possibly other sources of keratin can be broken down into a liquid keratin (alpha keratose) which can be used as a blood plasma expander. Other scientists are also researching the benefits and uses of this liquid keratin because of the keratin's properties and strength (Widra, 2001) & (Emery, 2005).

III. CLASSIFICATIONOF NATURAL FIBERS

Fibers are a class of hair-like material that are continuous filaments or are in discrete elongated pieces, similar to pieces of thread. They can be spun into filaments, thread, or rope. They can be used as a component of composites materials. They can also be matted into sheets to make products such as paper or felt. Fibers are of two types:

- Natural fiber and
- Man made or synthetic fiber.

1) SOURCES OF NATURAL FIBRES:

Natural fibers include those made from plant, animal and mineral sources. Natural fibers can be classified according to their origin.

- Vegetable fibers
- Mineral fibers
- Animal fibers

2) APPLICATIONS OF NATURAL FIBER COMPOSITES:

- Storage devices: post-boxes, grain storage silos, bio-gas containers, etc.
- Furniture: chair, table, shower, bath units, etc.
- Electric devices: electrical appliances, pipes, etc.
- Everyday applications: lampshades, suitcases, helmets, etc.
- Transportation: automobile and railway coach interior, boat, etc.
- The reasons for the application of natural fibers in the automotive industry include.

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(1) Characteristics	Polyester Resin
Flexural Strength	Good
Tensile Strength	Good
Elongation %	Good
Water Absorption	Good
Hardness	Good
Pot Life	4 – 7 Minutes
Working Time	20 – 30 Minutes
Above Waterline	Yes
Below Waterline	Yes
Major Construction	Yes
General Repairs	Yes
Shelf Life	18 –24 Months
Catalyst	MEKP
Cure Time	6 – 8 Hours

IV. ADVANTAGES OF NATURAL FIBER COMPOSITES

- Low specific weight, resulting in a higher specific strength and stiffness than glass fiber.
- It is a renewable source, the production requires little energy, and CO2 is used while oxygen is given back to the environment.
- Producible with low investment at low cost, which makes the material an interesting product for low wage countries.
- Reduced wear of tooling, healthier working condition, and no skin irritation.
- Thermal recycling is possible while glass causes problem in combustion furnaces.
- Good thermal and acoustic insulating properties.

V. EXPERIMENTAL PROCEDURES MATERIALS LIST:

- Fiber (sisal).
- Resin (vinyl ester).
- Catalyst (methyl ethyl ketene peroxide).
- Accelerator(cobalt 92)

1) MANUFACTURING PROCESS:

Figure 1

Initially the pattern has to be placed on the ground or table, then a surface should be made and apply paraffin (or) wax on the surface to easily remove the composite material after finishing the procedures, here for this manufacturing process OHP sheet is used as that surface. In composite material prepared of 1litre vinyl resin and 20ml of promoter& catalyst and 15ml of accelerator this things stirred by 15 minutes Apply a coating of general vinyl ester resin on the surface that is wax coated and allow sufficient time.Then the fibers are placed on the resin surface in the continuous and random manner. Then after sufficient time apply the mixture of general vinyl ester resin and catalyst (Methyl Ethyl Ketene peroxide), promoter (dimethyl aniline) and accelerator (Cobalt 93) as binding agents on the surface of the fiber. Close the resin mixture coated surface with a laminated sheet and then with glass for smooth surface finish and for perfect heat transfer while reaction between resin mixtures and sisal & coal ash.

Figure 2 Un treated Sisal fiber

2) TESTING OF SISAL REINFORCED MATERIAL:

The sisal & coal ash reinforced fiber is tested by Universal Testing machine, Hardness testing machine, impact testing machine. Its helps to identify the properties of the compositesReinforced fiber. The following test are carried out by using above machines.
(i) HARDNESS TEST
(ii) IMPACT TEST
(iii) FLEXURALTEST

3) TENSILE TEST:

Sl. No	Fiber length(mm)	Tensile Strength (KN)
1	25cm	1.420

4) RESULTS OF SEM:

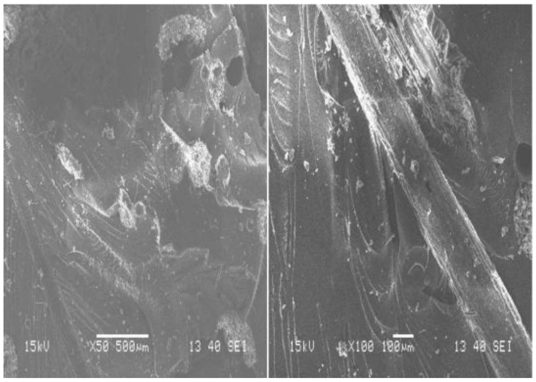

Figure 3

It is observed that the treatment has improved the surface roughness of the fiber as compared to the untreated or raw fibre. From fig (a) it is confirmed that the adhesion between the fiber and matrix is poor and bubbles are there as there are gap around the fiber at the interface whereas in the treated composite the fiber matrix adhesion is shown by fiber breakage rather than fiber pull out.

5) FLEXURAL TEST FOR SISAL COMPOSITE:

Sl. No	Fiber length(mm)	Flexural Strength(N)
1	25Cm	86.024

6) RESULTS OF FTIR:

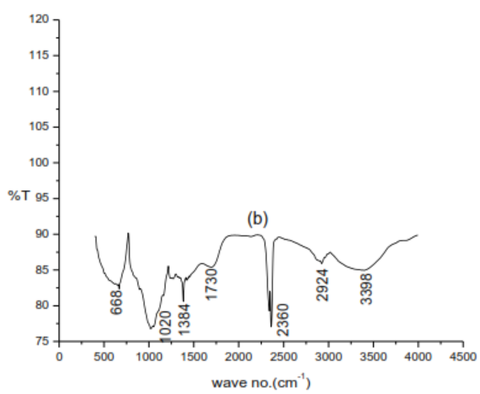

Figure 4

From fig (5.1) peak 3422-3398 (O-H stretch) The O-H group increases in case of de- waxed sisal fiber in. Peak 2928-2924 (Alkyl C-H) The C-H group also increases in dewaxed sisal fiber . In case of dewaxed fiber peak position 1674 (Aromatic C=C bending), for raw fiber peak position 1730 (Aldehyde C=O stretch) . Here shifting ofbonds accure. Peak 1052-1020 (C-O A strong absorption). 528-668. Here also sift of peak accure.

VI. CONCLUSION:

Based on the test analysis of the new composite material which is fabricated with an ingredient of NaOH treated sisal and vinyl ester resin have higher strength than the other composite materials. Since the sisal ash is conventional in nature it is very cheaper and easy to fabricate and use. Bio-composites were prepared with the help of sisal fiber and epoxy and hardener using handmade mould.

- Tensile strength results indicate that the aspect ratio of fiber fraction particles was too low to allow for a precise characterization of their tensile strength1.420KN is more than sisal composite. Hardness test indicates that they are more flexible due to high strain values and reduction of resonant amplitude.
- In flexural test has been determined for1cm length of sisal , hence the test of sisal is more efficient86.61N is more than Existing composite like coir and banana .
- From all above characterization it is concluded that after the sisal becomes more efficient for binding with matrix for making composites.
- Because of the strength of the material it is applicable in the field of automobiles. The Low load automobile components can be replaced by sisal composites by two reasons namely, low cost and ease of decomposability. Since this new material is flexible in environment and eco-friendly they do not promote any environmental pollution and the wastage materials is also used in the environment.

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