FABRICATION OF NATURAL FIBER REINFORCED COMPOSITE FOR ECONOMICAL HOUSE HOLD APPLICATION

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ABSTRACT

A composite material is made from two or more constituent materials with significantly different physical and chemical properties. In this work sisal fiber and coconut fiber have been used as a main reinforcement material and the epoxy resin as the matrix in the order to increase the effectiveness of natural fiber. It is envisaged to fabricate synthesis and study the coconut and sisal fiber is a reinforced material in a polymer matrix composites. The natural composite are fabricated by hand layup method or hydraulic method. The mechanical and physical properties have been studied for both the fiber by changing the orientation as uni-directional and bi-directional pattern with epoxy resin as a matrix material initially optimum fiber length and weight percentage will be determine. The hardness, impact and tensile tests will be performed on this fabricated composite.

Keywords: Composite material, coconut fiber and tensile tests.

INTRODUCTION

Over the last thirty years composite materials, plastics and ceramics have been the dominant emerging materials. The volume and number of applications of composite materials have grown steadily, penetrating and conquering new markets relentlessly. Modern composite materials constitute a significant proportion of the engineered materials market ranging from everyday products to sophisticated niche applications. While composites have already proven their worth as weight-saving materials, the current challenge is to make them cost effective. The efforts to produce economically attractive composite components have resulted in several innovative manufacturing techniques currently being used in the composites industry. It is obvious, especially for composites, that the improvement in manufacturing technology alone is not enough to overcome the cost hurdle. It is essential that there be an integrated effort in design, material, process, tooling, quality assurance, manufacturing, and even program management for composites to become competitive with metals.

The composites industry has begun to recognize that the commercial applications of composites promise to offer much larger business opportunities than the aerospace sector due to the sheer size of transportation industry. Thus the shift of composite applications from aircraft to other commercial uses has become prominent in recent years. Increasingly enabled by the introduction of newer polymer resin matrix materials and high performance reinforcement fibers of glass, carbon and aramid, the penetration of these advanced materials has witnessed a steady expansion in uses and volume. The increased volume has resulted in an expected reduction in costs. High performance FRP can now be found in such diverse applications as composite armouring designed to resist explosive impacts, fuel cylinders for natural gas vehicles, windmill blades, industrial drive shafts, support beams of highway bridges and even paper making rollers. For certain applications, the use of composites rather than metals has in fact resulted in savings of both cost and weight. Some examples are cascades for engines, curved fairing and fillets, replacements for welded. metallic parts, cylinders, tubes, ducts, blade containment bands etc. Further, the need of composite for lighter construction materials and more seismic resistant structures has placed high emphasis on the use of new and advanced materials that not only decreases dead weight but also absorbs the shock & vibration through tailored microstructures. Composites are now extensively being used for rehabilitation/ strengthening of pre-existing structures that have to be retrofitted to make them seismic resistant, or to repair damage caused by seismic activity. Unlike conventional materials (e.g., steel), the properties of the composite material can be designed considering the structural aspects.A composite material consists of two or more physically and/or chemically distinct, suitably arranged or distributed phases, with an interface separating them. It has characteristics that are not depicted by any of the components in isolation. For the sake of simplicity, however, composites can be grouped into categories based on the nature of the matrix each type possesses. Methods of fabrication also vary according to physical and chemical properties of the matrices and reinforcing fibers.

MATERIALS AND METHODOLOGY

Epoxy resin (LY-556), Hardener (HY-951), Natural Fibers (Sisal,& Coconut) and NaOH Solution.

Epoxy LY-556 resin belonging to the Epoxide family was taken as the matrix. HY 951 was used as the hardener. Natural fibers such as Sisal, Coconut coir, were taken to fill as reinforcements in the Polymer composite. Sisal is a natural fiber (Scientific name is Agave sisalana) of Agavaceae (Agave) family yields a stiff fiber traditionally used in making twine and rope.

Coir fibers are found between the hard, internal shell and the outer coat of a coconutThe individual fibre cells are narrow and hollow, with thick walls made of cellulose they are pale when immature, but later become hardened and yellowed as a layer of lignin is deposited on their walls. Each cell is about 1 mm (0.04 in) long and 10 to 20 μm (0.0004 to 0.0008 in) in diameter Fibers are typically 10 to 30 centimeters (4 to 12 in) longthe two varieties of coir are brown and white. Brown coir harvested from fully ripened coconuts is thick, strong and has high abrasion resistance.

Freshly drawn fibers generally include lots of impurities that can adversely affect the fiber matrix bonding. Consequently the composite material made from such fibers may not possess satisfactory mechanical properties. Therefore it is desirable to eliminate the impurity content of the fibers and perhaps enhance the surface topography of the fibers to obtain a stronger fiber-matrix bonding. The fibers were left to treat with 5% NaOH for 3-4 hrs. Later they were drawn and dried under sunlight for 1-2 hours (8)

Hand lay-up technique is the simplest method of composite processing. The infrastructural requirement for this method is also minimal. The processing steps are quite The polymer is uniformly spread with the help of brush. Second layer of mat is then placed on the polymer surface and a roller is moved with a mild pressure on the mat-polymer layer to remove any air trapped as well as the excess polymer present. The process is repeated for each layer of polymer and mat, till the required layers are stacked. After placing the plastic sheet, release gel is sprayed on the inner surface of the top mold plate which is then kept on the stacked layers and the pressure is applied. After curing either at room temperature or at some specific temperature, mold is opened and the developed composite part is taken out and further processed. The time of curing depends on type of polymer used for composite processing. For example, for epoxy based system, normal curing time at room temperature is 24-48 hours. This method is mainly suitable for thermosetting polymer based composites.

RESULTS AND DISCSSION

Hardness, tensile, Notched-bar impact test were performed and observation given in tables (1-3) and fig.4.

The hardness test was carried by brinell hardness testing machine. The specimen after the hardness is shown I the figure. The following result are shown below

Fig 1. Specimen after hardness test

The tensile test was carried out by universal testing machine. The specimen after tensile test is shown in the figure. The following result is shown below

Fig 2. Specimen after tensile test

The impact test was carried out by testing machine. The specimen after impact test is shown in the figure. The following result is shown below.

Fig 3. Specimen after impact test

Specification: SISAL&COIR WITH EPOXY RESIN

Test method: ASTM D 2240

Table 1 Detail of Testing Facility

Machine no	CL/ME/SHRD 40
Model	SHORE-D GOLD
Ambient temp,°C	25.2

Table2 Tabulation for hardness test

S. No	**Sample Id**	**Observed values, HRA**			**Average, HR15N**
		1	**2**	**3**	
1	Coir and sisal with epoxy resin	78	77	77	77

Table 3 Tabulation for impact test

Specimen	**Joule**	Joule/m (SI)	Kg.cm/cm (ASTM)
Sisal with coir	0.80	266.66	27.19

TENSILE TEST REPORT

Test File Name : CL C287.Utm.

Test Type : Tensile Test

Test Standard : ASTMA370:2017

INPUT DATA

Specimen shape : Flat

Specimen type : Sisal and coir with Epoxy Resin

Specimen width : 13.51 mm

Final Gauge Length : 13.25 mm

Specimen C S Area : 179.01 mm2

OUTPUT DATA

Load At Yield : 0.67 KN

Yield Stress : 2.456N/mm2

Load at peak : 0.940 KN

Tensile Strength : 5.251N/mm2

Elongation : 1.64 %

STRESS VS. STRAIN

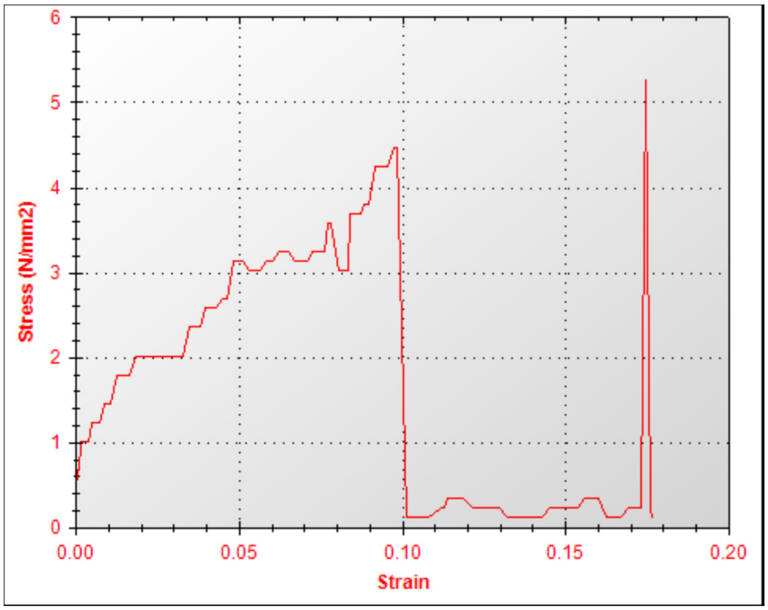

Fig 4 Stress vs Strain

CONCLUSION

Natural fibers, when used as reinforcement, compete with such conventional fiber as Sisal and coir fiber. The advantages of the conventional fibers are good mechanical properties. Natural Fibers are renewable raw materials and they are recyclable. The following conclusions can be drawn from the present research.

- It has been noticed that the mechanical properties of the composites such as
- Tensile strength is **5.251 N/mm2**
- Impact strength is **0.80 Joule**
- Hardness strength is **77 HRA** for **HR15N**

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