Mechanical Enhancement of Jute–Sisal Fibre Reinforced Epoxy Composites with Coconut Shell Ash

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ABSTRACT

World is starting at now focusing on exchange material sources that are condition pleasing and biodegradable in nature. In view of the growing normal concerns, bio composite delivered out of customary fiber and polymeric tar, is one of the late headways in the business and comprises the present degree of experimental work. The utilization of composite materials field is expanding bit by bit in designing. The composite comprises of fundamentally two stages for example grid and fiber. Fiber fortified polymer composites has various inclinations, for instance, by and large negligible exertion of creation, easy to create and preferred quality difference over immaculate polymer tars due with this reason fiber reinforced polymer composite used inside a combination of arrangement as class of structure material. This work depict the evaluation of mechanical properties such as Tensile Strength, Compressive and Impact tests.

Keywords: ***Jute and Sisal fibers, Resin, Coconut Shell Ash.***

1. 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 applications. While composites have already proven their worth as weight-saving materials, the current challenge is to make them cost effective. Natural fiber has excellent mechanical properties, such as flexibility, stiffness and modulus of elasticity compared to fiber glass. Recently, natural fibers, such as sia fiber have replaced fiber glass and carbon fiber because of their availability and cost. The order of the layers has a greater effect on the flexibility and properties of the interlayer shear, and the placement of GRP layers at the edges provides good mechanical strength.

2. FABRICATION METHODS OF PMCS

The method of manufacturing composites is very important to the design and outcome of the product with traditional materials one starts out with a blank piece of material ie: rod, ingot, sheet, etc and works it to produce the desired part.There are a wide variety of processes available to the composites manufacturer to produce cost efficient products. Each of the fabrication processes has characteristics that define the type of products to be produced. This is advantageous because this expertise allows the manufacturer to provide the best solution for the customer.There are two general divisions of composites manufacturing processes: open moulding and closed moulding. With open moulding, the gel coat and laminate are exposed to the atmosphere during the fabrication process. In closed moulding, the composite is processed in a two-part mould set, or within a vacuum bag. There are a variety of processing methods within the open and closed moulding categories.

2.1 Open Moulding Method

(a) Hand Lay-Up.
(b) Spray-Up.
(c) Filament Winding.

(a) Hand Lay-Up

Hand lay-up molding is the method of laying down fabrics made of reinforcement and painting with the matrix resin layer by layer until the desired thickness is obtained. This is the most time and labor consuming, composite processing method but majority of aerospace composite products are made by this method in combination with the autoclave method. Due to the hand assembly involved in the lay-up procedure, one can align long fibers with controlled orientational quality. Another advantage of this method is the ability to accommodate irregular-shaped products. Hand lay-up is an open molding method suitable for making a wide variety of composites products from very small to very large. Production volume per mold is low; however, it is feasible to produce substantial production quantities using multiple molds. Hand lay-up is the simplest composites molding method, offering low cost tooling, simple processing, and a wide range of part sizes. Design changes are readily made. There is a minimum investment in equipment. With skilled operators, good production rates and consistent quality are obtainable.

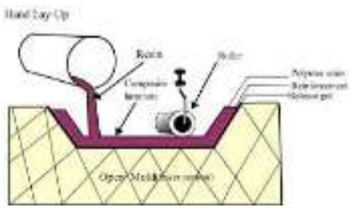


Figure 1: Hand Lay-Up Technique

2.2 NATURAL FIBRES

Natural fibres are fibers that are produced by plants, animals, and geological processes. They can be used as a component of composite materials, where the orientation of fibers impacts the properties. Natural fibres can be classified according to their origin. The vegetable, or cellulose-base, class includes such important fibres as cotton, flax, and jute. The animal, or protein-base, fibres include wool, mohair, and silk. An important fibre in the mineral class is asbestos.

2.3 Structure of Natural Fibre

Natural fiber plants have two main classification they are primary and secondary. Primary plants are plants that are planted based on fiber content, and secondary plants are plants whose fibers are a by-product of the previously used. Hemp, kenaf, hemp, chopped and cotton are examples of main crops, and pineapples, cereals, stems, agave, oil palm and coconuts are examples of secondary plants. Natural fibers have intrinsic properties they are low weight, cost, high specific strength, and specific stiffness.

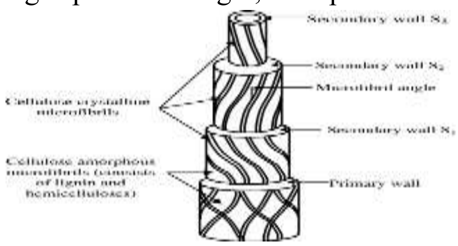


Figure 2: Structure of natural fibre

3. PROBLEM DEFINITION

In the present work, jute and sisal fibers reinforced epoxy composites filled with groundnut shell ash was prepared and the mechanical properties of these composites are evaluated. The composite samples with different coconut shell ash and epoxy weight fractions were prepared by using the hand lay-up process and apply pressure at room temperature. Later, the samples were tested for the evaluation of mechanical properties such as tensile strength compression and impact tests.

THE EPOXY AND RESIN WEIGHT RATIOS ARE:

1. 250 gms of (epoxy hardener)+45 gms of jute & sisal fibre mats.
2. 240 gms of (epoxy hardener)+45 gms of jute & sisal fibre mats+10 gms of coconut shell ash.
3. 235 gms of (epoxy hardener)+45 gms of jute & sisal fibre mats+15 gms of coconut shell ash.
4. 230 gms of (epoxy hardener)+45gms of jute & sisal fibre mats+20 gms of coconut shell ash.

4. MATERIALS

4.1 MATRIX MATERIAL

In The matrix is basically a homogeneous and monolithic material in which a fiber system of a composite is embedded. It is completely continuous. The matrix provides a medium for binding and holding reinforcements together into a solid. It offers protection to the reinforcements from environmental damage, serves to transfer load, and provides finish, texture, colour, durability and functionality. The matrix binds the fiber reinforcement, gives the composite component its shape and determines its surface quality. A composite matrix may be a polymer, ceramic, metal or carbon. Here's a guide to selection.

Figure 3: Epoxy LY556 & Hardener HY951

5. FIBRE MATERIAL

Composite fibers are built up of two or more different components, which can be of inorganic and organic origin. These so-called organic/inorganic composite fibers are prominent in the literature and applications with cellulose as organic component are especially mentioned. The cellulose builds up the backbone of the fiber, while the inorganic component is responsible for the functionalization of the fiber. The inorganic component embedded into the cellulosic fiber is the carrier of the function. Due to the broad variety of possible functions inorganic compounds can exhibit, the functionalization of cellulosic-based composite fibers can be related to many different fields of application. This chapter introduces the possible functions and the used functional inorganic additives. Main functionalizations reported are related to radiation protection, optical properties, biocidal fibers, and flame-retardant fiber materials.

Figure 4: Jute fibre & Sisal fiber

5.1. COCONUT SHELL ASH

Coconut shell is one of the most important natural fillers produced in tropical countries like Malaysia, Indonesia, Thailand, and Sri Lanka. Many works have been devoted to use of other natural fillers in composites in the recent and past years and coconut shell filler is a potential candidate for the development of new composites because they have high strength and modulus properties along with the added advantage of high lignin content. The high lignin content makes the composites made with these fillers more weather resistant and hence, more suitable for application as a construction material. Coconut shell flour is also extensively used to make products like furnishing materials, rope etc. The shells also absorb less moisture due to its low cellulose content the report focuses on studying the effectiveness of coconut shell particles as a source of natural material for reinforcing epoxy resins towards their flexural properties. coconut shells were kept in Electrical furnance at 1400°C temperature for ½ hr to burn completely. After this, burned coconut shells are pulverised into ash. Then, the filler was dried in an oven at a temperature of 250 °C for 3 hrs.

Figure 5: Coconut shell ash

6. EXPERIMENTATION

6.1CHEMICAL TREATMENT OF JUTE FIBRES

The fibres were immersed in the 1% NAOH solution for 30 min and then washed with tap water. The washed fibres are wiped with cloth and then placed in oven at 50°C for 45 min for complete removal of moisture

Figure 6: Jute fibres dipped in 1% NAOH Solution Composite

Figure 7: Coconut shell ash mixed with epoxy

7.0 MECHANICAL TESTS

7.1TENSILE TEST

The universal testing machine is used for to determine the mechanical properties like: strength and the stress, strain elongation of the given standard specimen made up of the different combinations. A universal testing machine is used to test the tensile stress and compressive strength of materials. It is named after the fact that it can perform many standard tensile and compression tests on materials, components, and structures. Here we have to check the strength of the composite which is in the standard cuboid in shape for the measuring of the tensile strength. We have taken the twospecimen.

Figure 8: Specimens

Figure 9: Universal Testing Machine

S.NO	WEIGHT OF COCONUT SHELL ASH (GRAMS)	MAXIMUM LOAD (kN)	LOAD AT BREAK (kN)	UTS (MPa)
1	0	2.72313	2.72	13.20
2	10	2.89322	2.89	14.29
3	15	3.93015	3.93	16.04
4	20	2.43732	2.43	11.62

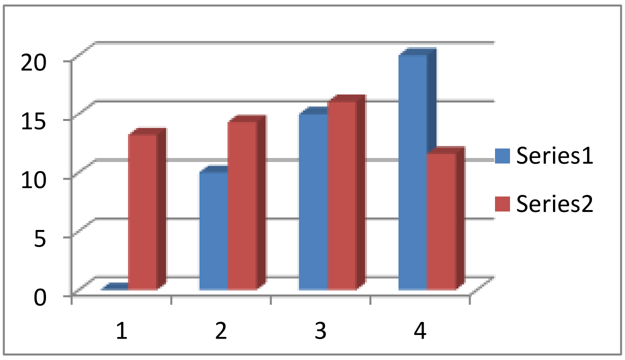
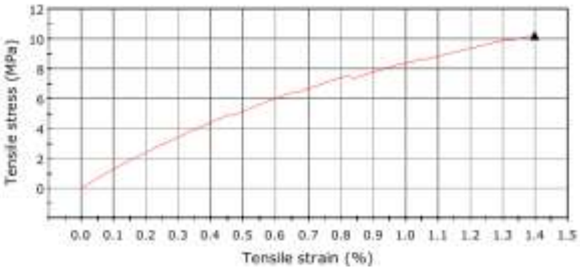


Table 1: Ultimate Tensile strength readings

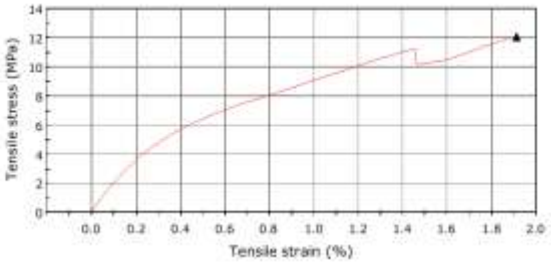
Graph 1: Weight of Coconut shell ash

Vs ultimate tensile strength

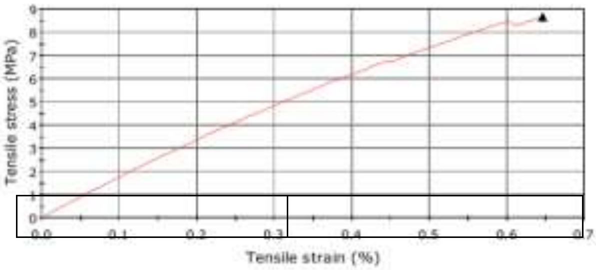
Tensile Stress vs Strain Diagram



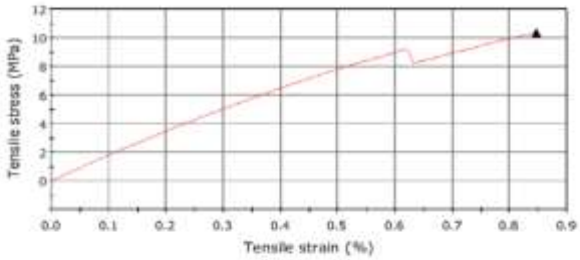
Graph 2: Zero grams of Coconut shell ash



Graph 3: Ten grams of Coconut shell Ash tensile stress-strain graph tensile stress-strain graph



Graph 4: Fifteen grams of Coconut shell ash ash tensile stress-strain graph

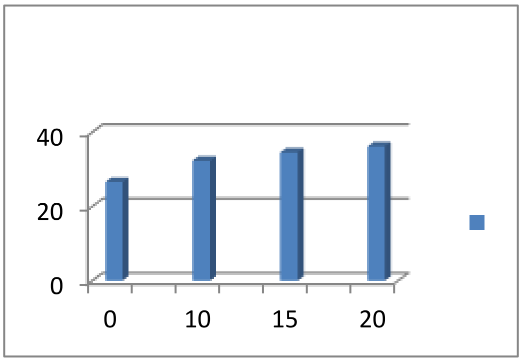


Graph 5: Twenty grams of Coconut shell ash tensile stress-strain graph

7.2 COMPRESSION TEST RESULTS

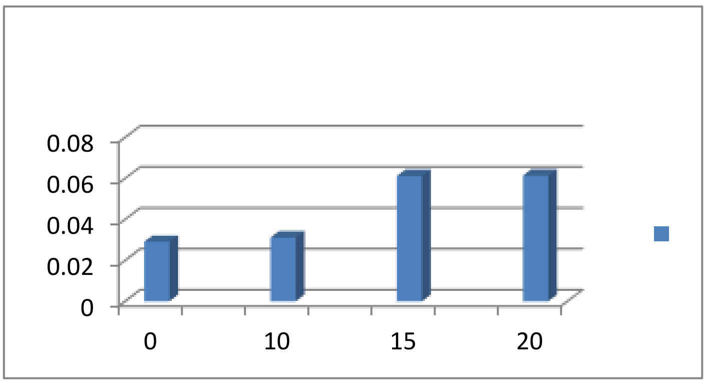
S.NO	WEIGHT OF COCONUT SHELL ASH (GRAMS)	IMPACT STRENGTH ON IZOD (J/MM^2)
1	0	0.029
2	10	0.0312
3	15	0.0611
4	20	0.0613

Table 2: Compression test results



Graph 6: Weight of Coconut shell ash Vs Compression strength

7.3 IMPACT TEST



Graph 7: Weight of Coconut shell ash Vs Impact Test

WEIGHT OF COCONUT SHELL ASH (GMS)	PEAK LOAD (kN)
0	26.5
10	32.4
15	34.6
20	36.2

Table 3: Imapct Test readings

8. CONCLUSION

The mechanical tests of all the four specimens were evaluated. The experimental investigation on the composites with different weight ratios have been carried out. The conclusions drawn from the present work are:

235 gms of (epoxy hardener)+45 gms of jute & sisal fibre mats+15 gms of coconut shell ash shows best tensile strength 16.04Mpa.among other proportions.

230 gms of (epoxy hardener)+45gms of jute & sisal fibre mats+20 gms of coconut shell ash shows best compression strength 36.2kN

230 gms of (epoxy hardener)+45gms of jute & sisal fibre mats+20 gms of coconut shell ash shows best 0.0613 J/MM^2 impact test.

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