Experimental Analysis of Coir Based Hybrid Natural Fiber Reinforced Polymer Matrix Composites

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***Abstract*: Natural materials employed are fiber-reinforced polymer composites in a variety of fields, including basic research and engineering. They are less expensive and may be easily recycled. These composites have a low due to the rapid renewability and availability of basic components, it has a high density and low cost, as well as good mechanical qualities. This is due to the fact that each componentof the system is unique. System is interconnected. fibre crop offers chances for generating traditional and novel products for a wide range of applications in textiles,packaging, constructions, automotive, marine, electronic, and home usage, both in upstream and downstream processing. Coconut coir's mechanical properties and wool fibre aresupplemented with matrix in this study. LapoxL-12 with K-6 as a hardener and araldite AW106 with HV 953 IN as a hardener are two samples. All samples were handcrafted, and specimens were treated inaccordance with ASTM D953. In accordance with the ASTM D3039 standard, The samples were put throughtheir paces on an ASTM D3039 universal testing machine (UTM). The effect of maximum bearing load on failure load of hybridised untreated coir and wool fibrereinforced polymer matrix composites isinvestigated experimentally using tensile, bending, and flexural testing methods.**

1. INTRODUCTION

Composites, plastics, and ceramics have dominated engineering materials for decades. Composite material uses have greatly expanded, and Some people have even found new markets. Composite materials of the present day are made up ofa wide range of materials that are employedin both ordinary life and high-tech applications. While composites have previously proven their worth as lightweight materials, the current issue is tomake them more durable. robust enough toreplace other materials. materials while remaining cost-effective. As a result, numerous innovative techniques that arecurrently in use in the business have been developed. The composites sector has started to

notice the different industrial uses particularly in transportation. Glass fibres made with high-performance polymer resin matrix materials and novel polymer resin matrix materials The introduction of

new materials such as carbon and aramid has resulted in a rise in composite usage and volume. As a result of this growth, there has been a substantial cost reduction. Composite armouring to defend against High-performance FRP can be found in explosions, windmill blades, industrial shafts, natural gas car fuel cylinders, paper industry bridge support beams, and even rollers. Existing structures that will need tobe repaired updated in order to becomemore energy efficient them Composite materials are also utilised to buildearthquake-resistant structures and to repairdamage caused by earthquakes. While composites are an obvious choice in many applications, the materials chosen will be determined by Working life, lifetime needs,product shape complexity, number of things to be produced, cost savings, and the designer's experience Composites are formed by mixing two or more materials to create a unique combination of qualities, one of which is made up of stiff, long fibres and the other isa binder or 'matrix' that holds the fibres in place.

2. METHODS OF FABRICATION

This chapter describes the manufacturing process for composites as well as the testingmethods required to assess their mechanicalproperties. Different methods of composite fabrications are, Techniques for hand layupand spray up Filament winding is a processin which a filament is wound around a Pultrusion. Compression moulding is a type of plastic moulding thatis used to create a Vacuum assisted resin transfer moulding. The method that is used in the present work is hand layup, which isthe oldest method that was used to get the composite materials

3. MATERIAL USED

Fabrication materials include a variety of materials. Fibre made of coir Wool from sheep Hardener for epoxy resin following the literature review, the raw materials were gathered based on commercial availability in the market. Untreated coir fibre and sheep wool are utilised as reinforcing materials. LAPOX L-12, an epoxy resinwith a medium viscosity, and (Araldite AW-106) were utilised in the matrix, as well as a polyamine hardener that cures at ambient temperature (K-6)and (HV 953 IN), both from YUJE business Bangalore Ltd in Karnataka, India. Because of its high alkali resistance, this matrix was chosen. and works well as an adhesive. properties.

4. OBJECTIVES

Hybrid Natural fibre reinforced polymermatrix composites are created by combining natural fibres with a polymer matrix. a hand layup method. To generate specimens with different compositions to establish the properties of (20-80, 25-75, 30-70) and such hybridised composites with different compositions. The purpose of this study was to compare the mechanical properties of various resin materials utilisedas the matrix in composites. Experiments such as tensile and bending tests, as well asdetermining the mechanical properties of all compositions, are required. to plan the route graph and compare the results, as wellas to understand the effect of natural fibre hybridisation in compositesApart from that, the goal is to build low-cost composites byadding lower-cost reinforcing components into a polymeric resin. This research is alsoexpected to introduce a new type ofpolymer composite.

5. SELECTION OF MATRIXMATERIAL

The matrix was made out of From the Epoxide family, Lapox L-12 with hardenerK-6 and Araldite AW-106 with hardener HV 953 IN. Epoxy Resin with Hardener Epoxy resins are a type of thermoset material commonly used in structural applications. composites because they provide a unique combination of qualities not seen in other thermoset resins. Because of their great strength and mechanical adhesiveness, epoxy resin is frequently employed in industrial applications. These resins are excellent solvents and chemicallyresistant. Hardener is an epoxy or fiberglass curing agent. To begin curing, epoxy resin requires a the component that hardens the adhesive when mixed with resin is known as a hardener, sometimes known as a catalyst. It's all in the details. The ultimate attributes and suitability of an epoxy coating for a given environment are decided by the epoxy and hardener components chosen and combined.

Fig 5.1: Lapoxy L-12 with hardener K-6

Hardener HV 953U epoxy/AralditeAW 106 resin adhesive is viscous, multi-purpose substances that can be used to join Metal, ceramic, and wood are among the materials used. The electrically insulating adhesive can be applied manually with a spatula andstiff brush, or mechanically with a meter/mix and coating equipment. Figure 4.3 depicts the curing of Araldite AW 106 resin/Hardener HV 953 epoxy adhesive at temperatures ranging from 20 to 95 degrees Fahrenheit. 180 degrees Celsius.

Fig 5.2: Araldite AW106 with hardener HV953

6. NATURAL FIBER SELECTION FOR REINFORCEMENT

Fig 6.1: Coir fiber

Fiber from coconut coir: As indicated in Fig. 4, the husk of the coconut fruit is used to make coir, a natural fiber manufactured from coconut husk.

Coir fiber:

The skin of the husk is made up Coir is a type of natural fiber. Fiber and pith, which is a crinkly tissue it's smade up of a liquid, fibers, and a few soluble substances. When compared to other natural resources fibers, coir is more long-lasting because it's high lignin content. Natural fibers, such as coir-based composites, are seeing increased use railways, autos Coachesand buses for public transportation systems, as theemphasis on fuel systems, as theemphasis on fuel efficiency the importance of fuel economy grows.

Fabrication for a wide range of architectural applications using coir- based composites is a fantastic opportunity**.** Reconstituted wood, flooring tiles, and other boards and blocks so on are used in building.

Table 6.1: Composition of fibers, Resin and Hardner

Specimen	Specimen Composition			
	Fibre length	Araldite	Coir fibre	Sheep wool
CWEA-1	Random	80%	10%	10%
CWEA-2	Random	75%	15%	10%
CWEA-3	Random	70%	20%	10%

7. HAND LAYUP TECHNIQUE

The most popular type of Open Moldingis Hand Layup. The layup by hand is a labor-intensive, manual process that entails the following steps:

- A release anti-adhesive agent is appliedto the mould to prevent The prime surface layer of the part is generated by applying gel coating to the moulded partof the mould surface.
- Epoxy resin and hardener are combinedto make the gel coating, which is then leftwithout filler.
- Fine fibre reinforcing tissue is applied as a layer.
- You can use a brush or a roll to apply the resin mixture.

The part can be left to cure for up to 24 hours.

The portion is taken out of the mold's surface. Low reinforcing phaseconcentration and composite densification are two disadvantages of Hand Layup procedures.

8. MOULD

Fig 8.1: Mould

The mould is made in accordance withASTM specifications. There will be tests carried out. To keep the composites from clinging to the mouldwall, the inside of the mould was first smeared with the releasing agent. Coir fiber and sheep wool cut to desired to length of 20, 30, 40mm are separately mixed along In a container, combine epoxy resin and hardener, and stir thoroughly for about 5 minutes. The examples are The prepared items are stored at room temperature for 24 hoursto dry. After the samples have dried, are taken from mould. Similarly the samples are prepared using araldite and hardener.

9. TENSILE TEST

Normally, a tensile test is performed. on a universal examinations equipment, as indicated in the image. Generally, flat specimens are used for the tension test. The test-piece employed here was rectangular inshape and had dimensions that were compliant with industry requirements. The specimen's dimensions are 180mmx50mmx10mm. For both the treated and untreated composite specimens, athickness of 10mm is maintained. Throughthe ends, a uni-axial load is applied. The samples were subjected to a tension test in accordance with ASTM D953 test guidelines. In the inquiry below, the specifications of the UTM machine are provided, as well as the composites that were exposed to this test in a testing machine. Figure depicts an image of the machine as well as the specimen loading setup. a period of time flexural test is performed.

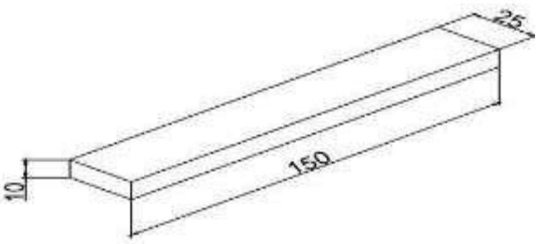

Fig 9.1: Tensile Test

Fig 9.2: Universal Testing Machine

10. TENSILE EXAMINATIONSPECIMEN

The tensile test specimen was made in accordance with ASTM guidelines. A rectangular bar measuring 180x50x10mm was employed as thetest specimen. Figure 1 depicts a visual depiction of the specimen. Tensile test specimen in accordance with ASTMstandards.

The specimen for the tensile test is prepared in accordance with ASTM D953. The dimensions of the specimens areshows.

Fig 10.1: Tensile Test

11. HARDNESS TEST

We are using a **Rockwell hardness test** here for the experiment. Hardness is a property of a substance, not a physical trait in and of itself. It's true. Measured by determining the indentation's permanent depth and The capacity to resist indentation is known as indentation resistance. Simply said, when an indentation is formed with a certain force (load) and a specific indenter, the harder the material is. To determine Rockwell hardness, the Rockwell hardness test technique, as described by ASTM E10, is employed. Castings and forgings, for example, are commonly used to test materials with a structure or surface that is too coarse or roughto be appraised using traditional methods. another test method. A high-test load (3000 kg) and a 10mm broad test window are typically used in Rockwell testing. Indenter such that the bulk of surface and sub-surface differences are averaged out.

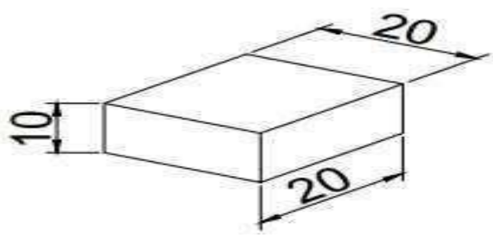

Fig 11.1: Hardness Test

12. TEST SPECIMEN FORHARDNESS

The ASTM D785 standard was used to construct the hardness test specimen. This is the specimen used is having a size of20x20x10mm. The specimen's graphical aspect is as follows figure ASTM standard specimen for hardness testing.

Fig 12.1: Hardness Test Specimen

13. DISCUSSIONS AND RESULTS

Tensile Examination

The tensile test is used to determine the maximum strength of a material. bearing load for various hybridised Compositions of reinforcement of coir and wool fibres with a variety of matrix materials such as lapox and araldite resins For different Hybridized Natural Fibers compositions, the maximum bearing tensile load Reinforced Polymer Composites (RPCs) are a type of reinforced polymer composite.

Table 13.1: Composition

Sl no	Composition	Maximum a loadbearing in N
1	CWEL-1	2700
2	CWEL-2	1940
3	CWEL-3	2000
4	CWEA-1	5120
5	CWEA-2	6120
6	CWEA-3	3800

Test for toughness

The Rockwell Hardness Number is determined by testing different combinations of hybridised strengthening of various matrix materials such as lapox and araldite resins with coir and wool fibresThe RHN for Hybridized Natural Fibers Reinforced Polymer Composites is illustrated in various compositions.

CONCLUSION

1. In this study, the effect of Hybridised untreated coir and wool fibre reinforced polymer matrix composites with maximum bearing load on failure load is investigatedexperimentally using tensile and bending tests, as well as a hardness test to determine the RHN for various compositions.
2. During the analysis, two variableswere looked into**.** The composition is varied as coir- 20%, and matrix material-80%, coir-15% wool- 10% and matrix material-75%, coir-30%, and matrix material-70%.
3. The two Different matrixmaterials, such as lapox and araldite, are used, and the composite CWEA shows the highesttensile bearing load when compared to the composite CWEL, with CWEA-2 (coir 15%, wool 10%, and araldite 75%) having thehighest bearing load of 6120N. composites CWEA-1, CWEA-3, and other CWEL-1, CWEL-2, and CWEL-Compared to other composites CWEA-1, CWEA-3 and other CWEL- 1, CWEL-2 and CWEL-3.
4. The composite CWEA has the highest hardness number when compared to the composite CWEA, with CWEL-2 (coir 15%, wool 10%, and lapox 75%) having the highest hardness number of 80 when compared to other composites. CWEL-1,CWEL-3 and other CWEA-1,CWEA-2 and CWEA- 3.

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