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Coir Based Composite for Various Application

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***Abstract*: This paper deals with the development of coir-based composite with the help of LY556 Epoxy resin as a polymer matrix material and coir fibre as a reinforcement material. The coconut coir fibre is reinforced with epoxy resin of different lamina and the coir fibres by treating the fibres with NaOH by fraction of 5% significantly after NaOH treatment the properties of the coir fibre are changed. All the samples were made using compression moulding hand layup technique. The samples were under gone tensile test and impact test to find the suitable applications. The significant finding of the research showed that samples with various lamina shows different values according to their fibre arrangement.**

***Keywords*: Coir fibre, Composite, LY556 Epoxy resin, NaOH treatment, Compression moulding, Hand laying, Lamina.**

1. Introduction

A composite material is a combination of two materials with different physical and chemical properties. When they are combined, they create a material which is specialised to do a certain job, for instance to become stronger, lighter or resistant to electricity. They can also improve strength and stiffness. The reason for their use over traditional materials is because they improve the properties of their base materials and are applicable in many situations. Composites have been the most widely used applications for coir fibres One of the simplest approaches for manufacturing coir fibres-based composites is to use the fibres as reinforcement and epoxy or other synthetic polymers as resins.

Coconut fibre is the most well-known fibrous waste from the coconut's cultivation. Every year the world produces at least 30 million tons of coconut, which are abundant in coastal areas of tropical countries. The coconut husk is composed of 30% fibre and 70% pith, with high lignin and phenolic content. Due to the high lignin content, coconut fibre is very elastic, durable, and resistant 30% fibre and 70% pith, with high lignin and phenolic content. Due to the high lignin content, coconut fibre is very elastic, durable, and resistant to rotting. coconut husk fibres with a mean diameter of 400 µm and mean length of 103 mm, being more resilient than oil palm bark fibres.

Epoxy resins are characterized by the presence of more than one1, 2- epoxide groups per molecule. Cross-linking is achieved by introducing curatives that react with epoxy and hydroxyl groups situated on adjacent chains.

The reinforcement in a composite material is to enhance the mechanical properties of the resin system. All of the distinct fibres that are used in composites have distinct properties and so affect the properties of the composite.

2. Experimental

The development of coir-based composite with the help of LY556 Epoxy resin here coir fibre as reinforcement material and epoxy resin as polymer matrix. The samples were developed with various lamina like unidirectional, discontinuous and the samples are prepared using compression moulding machine and the prepared samples were under gone computerized tensile test and Impact test.

3. Methodology

A. Preparation of the Fibre

The Coconut Husk was dried under sunlight and fibres were extracted manually from the coconut husk. To ensure proper interaction between fibre and matrix material, the outer most wax layer of the coir was removed by soaking the coir in hot water.

Fig. 1. Hot water treatment

B. Alkaline Treatment

The alkaline treatment or mercerization is a chemical treatment in which the natural fibres are immersed in a known concentration of aqueous sodium hydroxide (NaOH) for a given temperature and a period of time. The alkaline treatment modifies the surface of fibres by removing a certain rate of lignin, hemicellulose, wax, and oils covering the external surface of natural fibres. For example, in the fibres of hemp, the alkaline treatment completely eliminates pectin without a residue, but the remaining lignin depends on the concentration of NaOH. The partially removed lignin wax and hemicellulose enhance the matrix–fibre interface and ensure good adhesion between the matrix and natural fibres. If the treatment parameters are not optimized, the mercerization can cause fibre

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defibrillation, pore formation, and fibre embrittlement. Alkaline treatment increases the density of fibre by removing noncellulosic components (hemicellulose and lignin), which are less dense. After mercerization, the fibres become more and more yellowish when the NaOH concentration increases. During the alkaline treatment, the fibres are separated from one another, resulting in an increase in the effective surface area available for wetting by the resin. In addition, the alkaline treatment modifies the crystallinity, the unit cell structure, and fibre orientation.

The solution of 5% aq. NaOH and 95% of water was prepared (100g NaOH and 2litre water). Fibres of 30g are soaked in the solution for 24 hours.

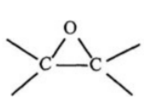
Fig. 2. Fibres soaked in solution

After 24 hours, fibres were removed from solution and washed with distilled water 2 to 3 times to remove waste particles. These fibres were dried under the sunlight for 24 hours.

Fig. 3. Treated fibre

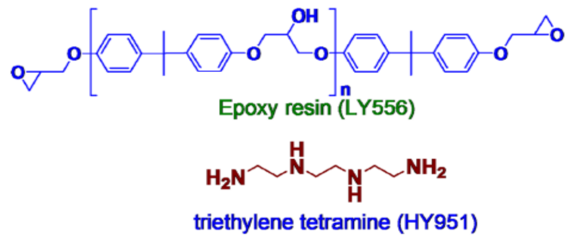
C. *Epoxy Resin*

Epoxy resins are reactive intermediates that, before they can be useful products, must be "cured" or cross-linked by polymerization into a three-dimensional infusible network with co-reactants (curing agents). Cross-linking of the resin can occur through the epoxide or hydroxyl groups, and proceeds basically by only two types of curing mechanisms: direct coupling of the resin molecules by a catalytic homo polymerization, or coupling through a reactive intermediate. Reactions used to cure low molecular weight epoxy resins occur with the epoxide ring.



Resin: Araldite LY 556 by Huntsman is a medium-viscosity, unmodified epoxy resin based on bisphenol-A. Possesses excellent mechanical properties and resistance to chemicals, which can be modified within wide limits by using different hardeners as well as fillers. Araldite LY 556 has a low tendency to crystallize.

Thickener: Hardener HY951 is a Low viscosity, unfilled epoxy casting resin system, curing at room temperature. High filler addition possibility. Key Properties. Good mechanical strength. Good resistance to atmospheric to atmospheric and chemical degradation.



For sample preparation we have taken a 50ml of LY556 Epoxy sap and 5ml of hardener HY951 thickener at the proportion of 1:10 and blend the pitch in which the assistance of stirrer for 5 to 10 min

Fig. 4. Epoxy resin and thickener

D. *Compression Molding*

Compression molding is a molding process that uses compressive force to squeeze a charge of material into shape. The mold consists of the lower part and the upper part. Each of these parts may consist of several components but essentially works as one mechanism when applying the compression. When these two parts meets, a cavity is left between them that defines the desired shape. Therefore, the parts would meet at the widest cross-section of the shape. To facilitate the ejection of the product once it is cured.

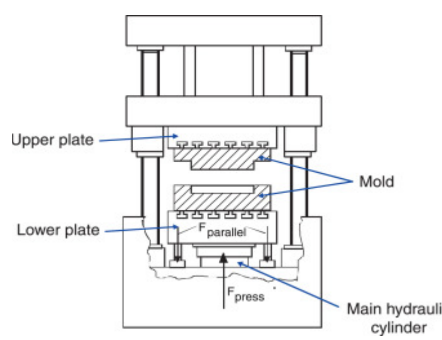


Fig. 5. Compression molding machine

After fibre extraction and resin preparation the resins is pore in the mold of size 170 * 50 * 3 mm dimension and the fibres are hand laid using compression molding 50 pascal pressure for 48hrs of curing time.

Fig. 6. Mold

E. Sample Preparation

Samples are prepared with the help of mold and compression molding machine. Samples with various lamina are prepared for testing, first sample is prepared only with epoxy resin and remaining samples are prepared with various lamina like unidirectional, discontinuous and continuous fibre arrangement in reinforcement structure.

Fig. 7. Only with Epoxy resin

Fig. 8. Discontinuous structure

Fig. 9. Unidirectional structure

Fig. 10. Discontinuous structure

Fig. 11. Continuous structure

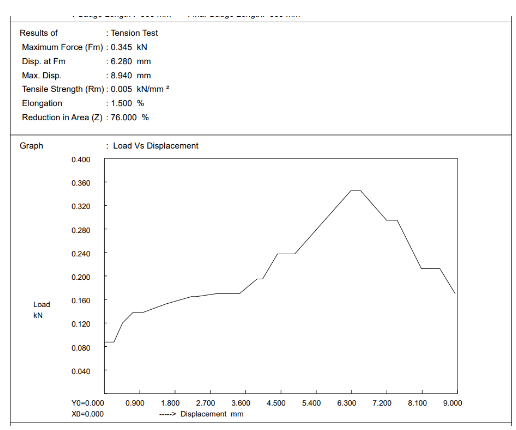
4. Result and Discussion

A. Tensile Test

A tensile tester, also known as a pull tester or universal testing machine (UTM), is an electromechanical test system that applies a tensile (pull) force to a material to determine the tensile strength and deformation behavior until break. A typical tensile testing machine consists of a load cell, crosshead, extensometer, specimen grips, electronics and a drive system. It is controlled by testing software used to define machine and safety settings and store test parameters specified by testing standards such as ASTM and ISO. The amount of force applied to the machine and the elongation of the specimen are recorded throughout the test. Measuring the force required to stretch or elongate a material to the point of permanent deformation or break helps designers and manufacturers predict how materials will perform when implemented for their intended purpose.

Fig. 12. Computerized tensile testing machine

The mean tensile strength of coir fibre is quite low compared to other natural fibre such as jute, flax, hemp, ramie or sisal fibre. However, the strain at failure of coir fibre is quite high compared with other natural and synthetic fibres such as glass and carbon. Alkali treatment of coir fibres improved significantly their tensile properties. It is seen that at 5% alkali solution when soaking time increases from 24 h to 72 h. Tensile properties of prepared samples are varied according to their laminal arrangement.



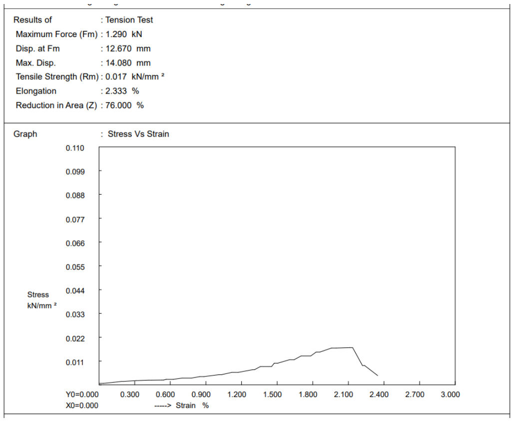


Fig. 13. Tensile test for only with epoxy sample

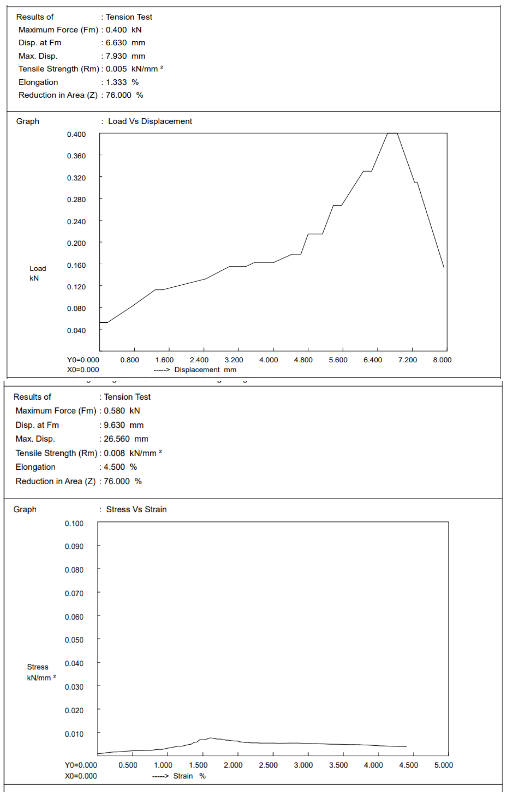
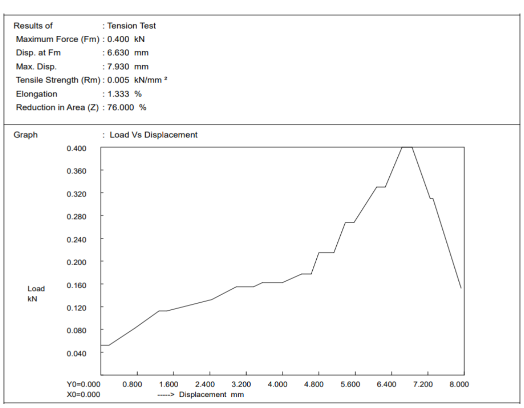


Fig. 14. Tensile test for unidirectional sample



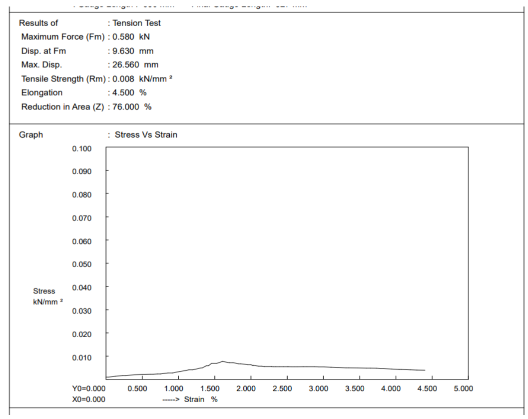


Fig. 15. Tensile test for unidirectional sample

According to the results shown on the graph Discontinuous fibre arrangement sample gets it pick 0.580kN Fm and 26,560mm displacement but elongation property is quite higher in unidirectional fibre arrangement sample 4.500% elongation.

Table 1

	Load vs. Disp.	Elongation
Sample only with resin	0.345kN * 8.940 mm	2.333%
Discontinuous	0.580kN * 26,560 mm	2.333%
Unidirectional (Horizontal)	0.400kN * 7.930 mm	4.500%

B. *Impact Test*

The pendulum is mounted on antifriction bearings. It has two starting positions, the upper one for Charpy the lower one for Izod testing. On release, the pendulum swings down to break the specimen & the energy absorbed in doing so is measured as the difference between the height of drop before rupture of the test specimen and is read from the maximum pointer position on the dial scale.

Fig. 16. Analogue impact testing machine

The samples were cut into 50*25mm dimensions for fitting sample, with the help of pendulum action the result values are displayed on the analogue meter. The result values are taken in Joules.

Fig. 17. Fitting sample

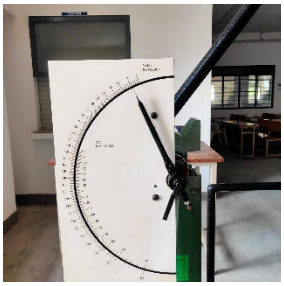


Fig. 18. Analogue meter

Table 2

Sample only with resin	5 Joules
Discontinuous	10 Joules
Unidirectional (Horizontal)	8 Joules
Unidirectional (Vertical)	9 Joules

5. Conculation

According to results and discussion the properties and behaviour of the samples are varied with their laminal arrangement this will shows that different laminal arrangement will applicable for different applications. We clime that coir fibre reinforcement composite is the better alternative for glass fibre it has more stress and strain compare to some synthetic fibres. This coir fibres are easily available nature and it have salt water resistance property so it can be useful in ship building applications.

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