Experimental Study on Mechanical Properties of Coconut Shell ash as Reinforcement Material in Epoxy Material and comparison with hand lay-up and vacuum bagging method

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ABSTRACT

The high cost of synthetic fibers such as glass, carbon, kevars etc, results in high cost of production and products derived from these materials which has necessitated alternative means of materials development. This has also informed the utilization of locally available coconut shell ash for composite materials development.

Natural fiber has emerged as a renewable and cheaper substitute to synthetic materials such as glass, carbon and aramid, which are used as reinforcements. In this work, the objective was to develop, investigate and analyze the mechanical properties of a composite material using coconut shell ash polymer. The long coconut shell ash was extracted from coconut shell. The fabrication of the composite was carried out using epoxy resin as the matrix and the coconut shell as has reinforcement. Tests were carried out to determine the mechanical properties such as tensile, hardness and compressive strengths. The results were studied and compared with the conventional materials and it process that the material developed can be used in structural applications with strong dependence on its mechanical properties.

INTRODUCTION

In addition to these naturally occurring composite, there are many other engineering materials that are composite in general ways and have been in use for a long time. They include carbon black in rubber, Portland cement or asphalt mixed with sand, and glass fibers in resin etc. Since the early 1960's, there have been increasing demands for materials that are stiffer and stronger yet higher in fields as diverse as aerospace, energy, civil and mechanical constructions. The demand placed on materials for better overall performance is so great and diverse that no one material can satisfy them. This limitation has led to a resurgence of the ancient concept of combining different materials in an integrate-composite materials to satisfy the user requirement, this composite material system result in a performance that cannot be attained by individual constituent which offer a great advantage of a flexible design.

Natural fibers are now regarded as a serious alternative to glass fiber for use as reinforcements in composite materials. Their advantages include low cost, low density, high

strength-to-weight ratio, and resistance to breakage during processing, low energy content and recyclability. The properties of natural fiber-based composites can be affected or modified by a number of factors such as fiber combinations, processing method, fiber volume fraction, aspect ratio, water absorption, etc. The process parameters and their influence on the final properties vary with different fiber-matrix combinations. The fabrication method has a significant impact on the resulting properties. Various processing methods, e.g. compression moulding, injection moulding, extrusion moulding, and hand lay-up, are available for natural fiber composite materials. Injection moulding improves the fiber dispersion, hence increasing the tensile and flexural properties. However, extrusion and injection moulding have detrimental effects on the properties of natural fibers.

Coconut shell ashes have emerged as a renewable and cheaper substitute for synthetic fibers such as glass and carbon, which are used as reinforcement in making structural components.

OBJECTIVES & METHODOLOGY

Following objectives are dealt in the present work:

1. To make a study on understanding the character of the coconut shell ash composite with epoxy resin.
2. To conduct a mechanical characteristic analysis like tensile test, bending test, Hardness test.
3. Experimental Study on Mechanical Properties of Coconut Shell Fibers as Reinforcement Material in Epoxy Material and comparison with hand lay-up and vacuum bagging method

MATERIAL DESCRIPTION

- COCONUT SHELL ASH
- EPOXY RESIN

COCONUT SHELL ASH

Coconut shell is an agricultural waste and is available in very large quantities throughout the tropical countries of the world. Moreover, coconut is becoming an important agricultural product for tropical countries around the world as a new source of energy-bio fuel. Previously, coconut shell was burnt as a means of solid waste disposal which contributed significantly to CO2 and methane emissions. However as the cost of fuel oil, natural gas and electricity supply has increased and become erratic, coconut shell has come to be regarded as source of fuel rather than refuse. Presently, the Nigeria coconut shell is used as a source of fuel for the boilers, and residual coconut shell is disposed of as gravel for plantation roads maintenance. Black smiths also buy the coconut shell as fuel material in their casting and forging operations.

EPOXY RESIN

Epoxy is a term used to denote both the basic components and the cured end products of epoxy resins, as well as a colloquial name for the epoxide functional group. Epoxy resins, also known as polyepoxides, are a class of reactive pre polymers and polymers which contain epoxide groups. Epoxy resins may be reacted (cross-linked) either with themselves through catalytic homopolymerisation, or with a wide range of co-reactants including poly functional amines, acids (and acid anhydrides), phenols, alcohols and thiols. These co-reactants are often referred to as hardeners or curatives, and the cross-linking reaction is commonly referred to as curing. Reaction of polyepoxides with themselves or with poly

functional hardeners forms a thermosetting polymer, often with high mechanical properties, temperature and chemical resistance. Epoxy has a wide range of applications, including metal coatings, use in electronics / electrical components, high tension electrical insulators, fiber-reinforced plastic materials and structural adhesives.

Materials and Methods

This Chapter describes the details of processing of the composites and the experimental procedures carried out for their characterization and tests which the composite specimens are subjected to the raw materials used in this work are: coconut shell ash, Resin Epoxy (LY-556) and hardener(HY-917).

FABRICATION PROCESS BY USING VACUUM PUMP

MATERIAL DESCRIPTION

- COCONUT SHELL ASH
- EPOXY RESIN

Methodology

1. The fabrications of composite slab are carried out by conventional hand layup technique. The dimensions of length and breadth is of 300*300mm was used to prepare the specimen.
2. A measured amount of epoxy is taken and mixed with the hardener in the ratio of 10:1. The layers of fibers were fabricated by adding the required amount of epoxy resin. The coconut ash with jute fibre is mounted on the table and then epoxy resin applies and next layer is jute fiber.
3. Before the resin gets dried, the second layer of natural fiber is mounted over the coconut and jute fiber. The process is repeated till 3 layers of fiber. The epoxy resin applied is distributed to the entire surface by means of a roller.
4. The air gaps formed between the layers during the processing were gently squeezed out.
5. The whole composite is covered by high grade polythene bag, a hose pipe from vacuum pump is placed in the bag.
6. The bag is completely sealed by using two side tape
7. The vacuum created inside the bag by turn on the pump due to which uniform clamping pressure is applied on the composite and this process is continued about 4 hours
8. The processed wet composite were then pressed hard or dead weight are applied on to it and kept for curing under room temperature the excess resin is removed and dried.
9. After the composite material dried completely, the composite material was taken out and rough edges were neatly cut and removed as per the required ASTM standards.
10. With this process we can minimize the air entrapped during the fabrication composite material

TEST CARRIED OUT

- TENSILE TEST
- HARDNES TEST
- BENDING TEST

Test Procedure:

The specimen is first placed on a hard flat surface. The indenter for the instrument is then pressed into the specimen making sure that it is parallel to the surface. The hardness is read within one second (or as specified by the customer) of firm contact with the specimen.

Specimen size:

The test specimens are as per the ASTM standards .It is possible to pile Several specimens to achieve the standards, but one specimen is preferred.

RESULT DISCUSSION

Comparisons between hand layup and vacuum bagging Composites

Composite Name		
Coconut shell ash	**Hand lay up**	**Vacuum bagging method**
Bending strength	**5.273N/mm^2**	**7.273 N/mm^2**
Tensile strength	**20.298N/mm^2**	**21.286 N/mm^2**
Hardness	**85**	**87**

CONCLUSION

In this work we have done a mechanical character analysis on coconut shell ash with epoxy composite. By seeing the test results and above comparisons table we here by conclude that the coconut shell ash with epoxy resin composite made by vacuum bagging method has good mechanical characteristics.

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