

Fabrication and Analysis of Flax Preperg Natural Fiber Reinforced Epoxy Composite Material for Helmet Outer Shell

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ABSTRACT: The aim of this paper describes the Helmet manufacturing over the years are seeking to develop protective systems which are both effectively thermal insulated and lightweight. From this point of view, natural fibers and natural fillers have attracted the attention of researchers due to their low density with high specific strengths, abundance, availability, renewability and being environmental-friendly. This paper reports the potential use of coconut shell powder-epoxy composite bonded with coconut leaf midrib and glass fiber. In this paper, natural filler reinforced material coconut shell powder, coconut leaf midrib and glass fiber reinforced polymer composite material with epoxy resin shall be used for fabrication of helmet outer shell. The coconut shell powder is mixed with epoxy resin (COEX) and then a sandwich composite material of COEX, coconut leaf midrib and glass fiber is made using hand layup process. The Impact strength values are identified on both dry and wet Conditions. The experimental results obtained as per ASTM standards are compared using LS Dyna and both the results are agreed. Then the properties such as stiffness, strength young's modules, and Poisson ratio of helmet from existing model is compared with this natural filler composite material.

KEYWORDS: coconut shell powder is mixed with epoxy resin (COEX),

INTRODUCTION

I. The advantage of composite materials over conventional materials seem largely from their higher specific strength, stiffness and fatigue characteristics, which enables structural design to be more versatile. By definition, composite materials consist of two or more constituents with physically separable phases. However, only when the composite phase materials have notably different physical properties it is recognized as being a composite material. Composites are materials that comprise strong load carrying material (known as reinforcement) imbedded in weaker material (known as matrix) Reinforcement provides strength and rigidity, helping to support structural load. The matrix or binder (organic or inorganic) maintains the position and orientation of the reinforcement. Significantly, constituents of the composites retain their individual, physical and chemical properties; yet together they produce a combination of qualities which individual constituents would be incapable of producing long fibers that are oriented in the direction of loading offer the most efficient load transfer. This is because the stress transfer zone extends only over a small part of the fiber-matrix interface and perturbation effects at fiber ends may be neglected. In other words, the ineffective fiber length is small. Popular fibers available as continuous filaments for use in high performance composites are glass, carbon and aramid fibers.

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HELMET

A helmet is a form of protective gear worn on the head to protect it from injuries. Most helmets are made from resin or plastic, which may be reinforced with fibers such as aramids. All helmets attempt to protect the user's head by absorbing mechanical energy and protecting against penetration. Their structure and protective capacity are altered in high-energy impacts. Beside their energy-absorption capability, their volume and weight are also important issues, since higher volume and weight increase the injury risk for the user's head and neck. Anatomical helmets adapted to the inner head structure were invented by neurosurgeons at the end of the 20th century.

MATERIALS

Most helmets are made from resin or plastic, which may be reinforced with synthetic fibers such as

- Aramid
- Twaron

SELECTION & PROPERTIES OF RAW MATERIALS

The details of selection and properties of raw materials. The raw materials used in this work are listed below.

1. Coconut shell powder
2. Coconut leaf midrib
3. Glass fiber
4. Thermoset epoxy resin

II. SELECTION OF COCONUT SHELL POWDER

The coconut shell was dried in open air and grinded into powder using a pulverizing machine, the powder was sieved in accordance with BS 1377:1990 standard.



The chemical analysis of the coconut shell was done with Absorption Spectrometer (AAS)-Peckinhelma 2006 model. The particle size used was 100 μm .

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Properties of Coconut shell powder

Appearance	Clear light brown free flowing powder
Moisture	10 per cent max.
Apparent density	0.6 to 0.7 g/cc
Ash content	1.5 max.
Sieve analysis - BS sieve	Retained on 200 mesh shall not exceed 0.1%

Coconut palm mainly cultivated in the tropical regions of the world and the product from the palm is applied in food and non-food products, which sustain the lively hood of the people all over the globe. The coconut palm comprises of a white meat which has total percentage by weight of 28 surrounded by a protective shell and husk which has a percentage by weight of 12 and 35 respectively. The husk from coconut palm comprises 30% weight of fiber and 70% weight of pith material. The fiber is extracted from the husk by several methods such as retting, which is traditional way, decortications. Using bacterial and fungus, mechanical and chemical process, for products of building and package material, ropes and yarns, brushes and padding of mattress and so on, such a material is chosen for the project.

In the pursuit of newer materials, the characterization of midribs of coconut leaves which form one of the renewable resources of many tropical countries which cultivate coconut trees. The density, chemical constituents and mechanical properties of these midribs are evaluated before and after subjecting them to natural weathering conditions. It is found that cellulose and lignin vary from about 30 and 16% before subjecting to weathering to about 27 and 32%, respectively, after exposure to weathering for 2 years. Alternate wet and dry conditions for 25 cycles result in a decrease of the breaking load of the midrib from 747 to 620 N. These observed properties along with the fracture mechanisms in the midrib are explained on the basis of its structural parameters studied using optical and scanning electron microscopy.

FABRICATION METHOD

The wick structure provides a path for liquid to travel from condenser to the evaporator using capillary action. Wick structures have performance advantages and disadvantages depending on the desired characteristics of the heat sink design. Some structures have low capillary limits making them unsuitable for applications where they must work without gravity assist.

1. A mold of 60-mm length and 40-mm dimension was created using GI sheet mold.
2. An MOP Sheet was taken and a releasing agent was applied over it and fitted with the inner side of the mold and allowed to dry.
3. A glass beaker and a glass rod or a stirrer were taken and cleaned well with running water and subsequently with warm water.
4. Then, calculated quantity of coconut shell powder, bio epoxy resin Grade Ly 556 and Hardener Hy951 (COEX) were added and the mixture was stirred for nearly 15 min.

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5. Stirring was done to create a homogeneous mixture of resin and accelerator molecules.
6. Subsequently, the coconut leaf midrib was arranged with uniform spacing.
7. Then, the mixture was poured into the mold and rammed mildly for uniform settlement.
8. The mold was allowed to solidify for nearly 24 hours.

B.COCONUT SHEEL POWDER MIXTURE



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C.FABRICATION OF HELMET



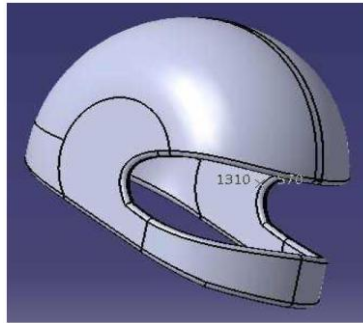
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D.MODELING OF HELMET USING CATIA

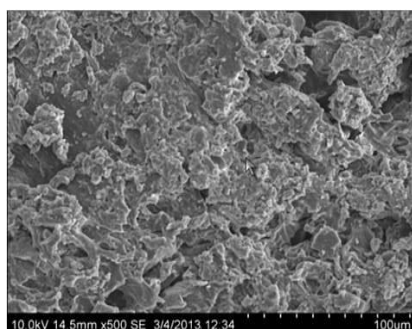
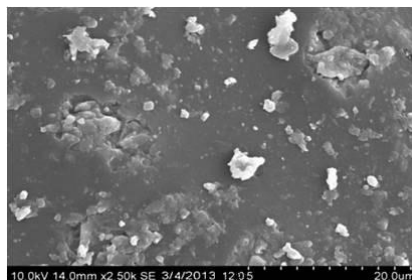
The helmet model is generated using CATIA v5 modeling software using the medium size of motor cycle safety helmet. The file is later transferred to the initial graphics exchange system file that can be transfer to the Analysis software and crash flow analysis is performed using dynamic loading procedure in ANSYS.



The process of modeling the helmet using CATIA v5 version is done in the surface modeling tools. The base part of helmet is designed in the x-z plane of a ellipse shape and the datum plane of same x-z plane is offset to 50 mm each and about 4 planes are created. Then in each plane elliptical shape of helmet is drawn with variation of size and shape according to helmet round size. The top most plane of datum plane is referred with y-z plane and a curve is used to close the helmet top part. Later using pocket cut tool the face visor is removed and later edges of the helmet is chamfered with 4mm radius.

VI.RESULT & DISCUSSIONS

The result of the fabrication of helmet using composite material for applying tensile load and flexural load analysis.

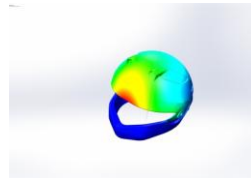


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The fabrication of helmet using ansys.



VII.CONCLUSIONS

To determine the material properties of COEX reinforced composite using tensile test, flexural test and impact test. The COEX composites showed comparatively better performance. Thus by analyzing the helmet model, and Experimental Results, it has shown that Natural filler reinforced composite material of coconut shell coconut leaf midrib material has a sustainable strength for the application of Motor cycle Safety helmets.

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