Synthesis of Laptop Sleeves and Panel Covers Using Areca Catechu Nut Fiber Reinforced Epoxy Polymer Composites

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ABSTRACT
Laptop users have become exceedingly prevalent during the course of the twentieth century. Many people also make changes to their system models and use cases as time goes on. Several more people are apprehensive to use their computers for extended periods of time than previously reported. As a result of this mentality, they are compelled to replace their laptop bags/cases as their models change. Many laptop sleeves and bags are constructed of plastic or other synthetic materials, which can contribute to a number of environmental problems when they are disposed of improperly. Scientists have been working on developing sustainable goods and materials to combat pollution and the depletion of limited non-biodegradable and non-renewable resources in order to combat these issues. For the purpose of addressing this essential issue, a natural and environmentally friendly material is suggested for use in the production of mobile phone cases, laptop sleeves and power bank covers. Material recommendations for this application were conducted and chopped areca nut fibre reinforced epoxy polymer composites are found to be a good alternative. Areca fibres, for example, have a slew of obvious advantages over synthetic fabrics, including the ability to breathe. When the tribological and mechanical properties of Areca fibre reinforced epoxy polymer composites were examined, researchers discovered that the fibre with a 20-volume percentage of the composite had superior properties when compared with 10 wt%, 15 wt%, 20 wt%, 25 wt% and 30 wt%. Hence, this particular type of composition is provided for the construction of the aforementioned laptop sleeves and panel covers. It offers various advantages over synthetic materials, including a decreased thickness, enhanced ease of waste transfer, and a quality that is comparable to synthetic materials.

Keywords: Sleeves. Sustainable. Biodegradable. Chopped. Synthetic. Reinforced

1. INTRODUCTION

Scientists have been working on developing sustainable items and materials to combat pollution and the depletion of precious non-biodegradable and non-renewable resources. An innovative strategy of using a natural and eco-friendly material for the production of laptop covers and panels was devised to address this essential issue.As time passes, many people change their laptop models. A growing number of consumers are afraid to use the same gadgets for long periods of time. When a result of the aforementioned philosophy, they are required to alter their sleeves and panels as their models evolve. Many of the system panels and sleeves are composed of plastic or other synthetic materials that, when disposed, could result in a range of environmental issues.Non-biodegradability and non-renewability are two further drawbacks of the current system. The shortcomings of currently existing laptop panels and sleeves are addressed by this technology.The following are some of the benefits of using laptop panels and sleeves made from this material:low weight, low cost of production, renewable, biodegradable environmentally friendly, naturally accessible, high strength high stiffness, easy to transform into different shapes, good tensile &impact Properties, improved hardness and flexural properties, and excellent tribological properties

1.2 Areca Catechu Fibers

In the areas of surface treatment optimization, production technology, and the use of areca fiber as a reinforcing material in composites, it has been found that less extensive study has been conducted. There is currently relatively little study on the use of areca fiber as reinforcement in composites, suggesting that the fiber is being underused despite its many advantages. The fiber has benefits like complete biodegradability, complete recyclability, renewability, sustainability, economy, wide availability, high-potential perennial crop, inherited qualities, superior properties, and superior mechanical properties compared to other fibers like kenaf, jute, and coir [1]. Statistics show that 1,073,000 areca nuts are produced worldwide each year, and each one may produce around 2.5 g of areca husk [1]. The use of betel nuts in the tropical Pacific, Eastern Africa, and Asia may be the reason why areca husk fiber production is less than that of other natural fibers like jute, coir, and kenaf, according to annual data on the production of natural fibers worldwide.Other names for Areca catechu include Areca Palm, Areca Nut Palm, and Betel Palm. It also goes by the name Pinang in Malaysia. A. catechu is found in the tropical Pacific, Eastern Africa, and Asia, including Malaysia, the Philippines, India, and Sri Lanka.

The top betel nut producers are India, Myanmar, Bangladesh, China, and Indonesia, according to the Food and Agriculture Organization of the United Nations [2]. The two countries with the greatest concentrations of A. catechu plants are Sri Lanka and India, whose citizens also consume betel nuts in addition to betel leaves that have been coated with limestone paste [3]. However, betel nut fibers are traditionally utilized as a home insulation material in some nations. Areca fruit has a variety of medical applications, including dental implants, wound healing medications, sore healing, diphtheria, excessive menstrual blood flow, diarrhea, and ulcers [4]. Biodegradable disposable plates, on the other hand, are produced from areca leaf sheaths, which naturally fall from trees, or green garbage. Areca plates are frequently used in India because the use of plastic is prohibited. These plates are manufactured in nations such as China, Vietnam, Ukraine, Sri Lanka, Malaysia, and the United Arab Emirates, in addition to India. Figure 1.3 shows an Areca Tree with its leafs and fruits.

Figure 1. Areca Catechu Tree & Areca fruit

The areca tree has a single, upright stem with a diameter of 10 to 15 cm, annular scars left by sheaths or fronds that have fallen to the ground, and may reach heights of 10 to 20 m. The leaves are between 150 and 200 cm long, with several pinnate-shaped leaves and 8 to 12 fronds on the upper half. Areca trees can grow to be up to 15 meters tall when fully established. However, soil conditions have the greatest influence on the growth of such plants [5, 6]. A. catechu is a monocotyledonous plant that is a member of the Arecaceae or Palmae plant family and one of the Areca species [7]. It includes additional palm species as well as the oil palm, date palm, and coconut palm. Generally speaking, palmae plants are tropical trees, shrubs, and vines with a tall, columnar trunk and a canopy of enormous leaves. There have been several research on the use of plant fibers gathered from the plant family. They contend that Areca catechu fibers may be used as reinforcement in composites made of natural fibers [8, 9, 10, 11].

2. Material Analysis and Experimental Evaluation

2.1. Characterization of the Material

The chemical used to make epoxy is comprising of a resin and a hardening agent in a specific proportion. LY556 is utilised as the resin in this work, while HY951 is employed as the hardening agent. Based on an examination of the literature and from the information given in various data sheets, the manufacturer determined that the resin to hardener ratio should be 10:1. Fibers used in this research work were purchased from Vruksha Composites & Services, Andra Pradesh.

2.2. Alkali Treatment

When areca fibre is treated with an alkaline chemical, the link between the fibre and the epoxy resin is found to be strengthened. The treatment technique implemented in this investigation is continuously soaking areca fiber for 2 hours in a five percent NaOH solution. Figure 1(a, b) depicts the areca-fiber that has been cut into the chopped form.

Figure 2. Alkali treated Areca

2.3 Fabrication of the Composite

Compression molding is a widely used technique in the manufacturing of composite materials. It is particularly suitable for producing large and intricate parts with high fiber volume fractions.Compression molding is widely used in the production of various composite parts, including automotive components, aerospace structures, sporting goods, and more. Its ability to produce high-strength, complex parts in a cost-effective manner makes it a preferred choice for certain applications.

Each composite required around 300 grams of epoxy and 30 grams of hardener. Compression moulding was the most widely utilised and most straightforward method known. The chemical compositions of the composite materials that have been created are in the table below. The finished material had mixed quantities of epoxy resin and hardener, which were 10:1. This study utilised 300g of Epoxy and 30g of Hardener and found the optimal fibre volume percentage to be 5%. The liquid was poured over the chopped NaOH-treated areca fibres. To cure the combination, the metal mould was covered in the mixture, compressed, and left for three hours before the metal mould was removed. A size limit of 200mm by 200mm is imposed on the produced composite, which must not exceed 6mm in thickness. After curing, the normal ASTM dimensions were machined using water jet cutting on these test pieces. Table 2.1 describes the various laminate codes used in this work.

Table 1. List depicting the codes of the present study's composite laminates

Laminate Code	Epoxy Quantity	Hardener Quantity	Areca Fiber Volume Fraction
I	300 g	30 g	10 wt %
II	300 g	30 g	15 wt %
III	300 g	30 g	20 wt %
IV	300 g	30 g	25 wt %
V	300 g	30 g	30 wt %

3. Testing & Analysis

3.1 Evaluation of Tensile Strength

Evaluation of Tensile strength was carried out on a universal testing machine. Different applications may have specific requirements for tensile strength. For example, in the aerospace industry, composites used for structural components need to meet stringent tensile strength criteria to ensure the safety and performance of the aircraft.In summary, the tensile strength of composites is a critical factor influencing material selection, structural performance, durability, and the overall success of various applications. Engineers and designers must carefully consider the specific requirements of their projects and choose or design composites with the appropriate tensile strength to meet those needs. Tensile strength values for areca fibre epoxy composites are supplied in the Figure 3.1 The tensile strength of combination III (which contains 20% areca fibre) are higher than those of the other combinations, registering 28.24 MPa.

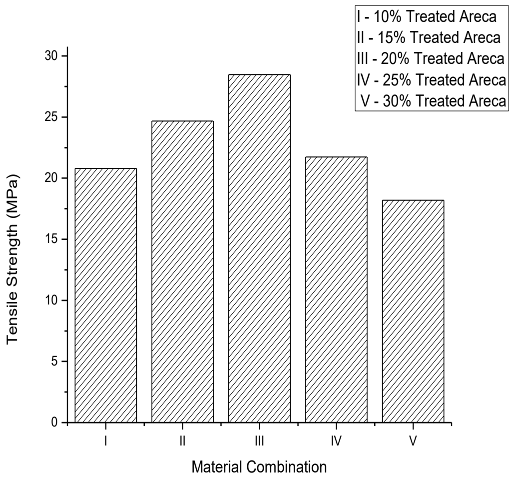

Fig 3.1. Tensile Strength of Composites

3.2 Evaluation of Flexural Strength

Flexural strength is a critical mechanical property in the design and analysis of composite materials. Flexural strength, also known as bending strength, is a measure of a material's ability to resist deformation under applied bending loads.Figure 3.2 illustrates the observations after the tests conducted for finding the flexural strength the areca fibre reinforced epoxy polymer composites. Flexural strength values are higher in combination III (which contains 20% areca fibre) than in the other two combinations, with values of 52.11 MPa and 4878.32 MPa, respectively. Flexural strength is a key property that must be carefully considered in the design and application of composite materials. Understanding the factors that influence flexural strength helps engineers and designers optimize composite formulations for specific performance requirements.

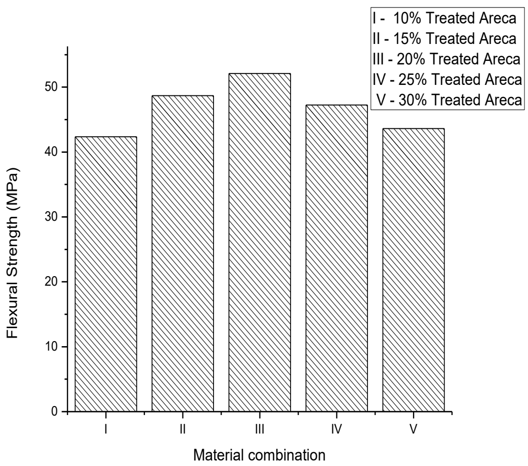

Fig 3.2. Flexural Strength of Composites

3.3 Evaluation of Hardness

Hardness is an important mechanical property that characterizes the resistance of a material to deformation, scratching, or abrasion. In composites, which are materials made by combining two or more constituent materials with distinct properties, hardness can have various effects depending on the nature of the composite and its intended application.Hardness is described as a composite material's resistance to various form changes when subjected to a force. The outcome of the hardness test is depicted in Figure 3.3. The combination III (with 20% areca fibre) has a clearly greater hardness grade of 86 shore D.It's important to note that the specific effects of hardness in composites will depend on the type of composite, the properties of the constituent materials, and the intended application. Engineers and material scientists carefully tailor these properties to meet the performance requirements of the end product.

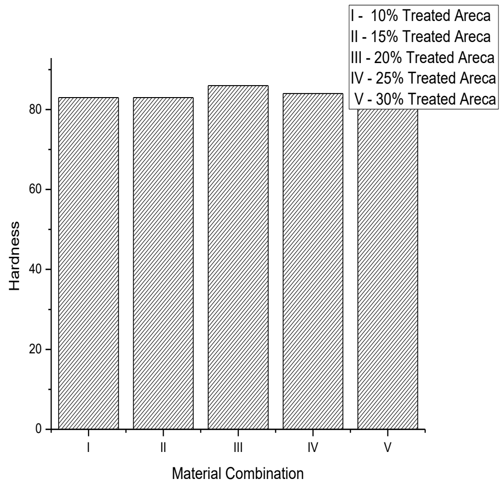

Fig 3.3. Hardness of Composites

3.4 Evaluation of Impact Strength

The impact strength of composite materials is a crucial mechanical property that influences their performance and application in various industries. Impact strength refers to the ability of a material to absorb energy under sudden loading conditions, such as those encountered during impact or collision events. The toughness of specimens formed of areca fibre reinforced epoxy composite was evaluated using an impact test. The outcome of the impact test is depicted in Figure 3.4. When compared to other fibre epoxy combinations, the composite III (with 20% areca fibre) performs better impact strength of 3.34 KJ/m2, as shown in the figure. The impact strength of composites plays a vital role in determining their suitability for specific applications, affecting material selection, performance, safety, and manufacturing considerations. It is a key parameter that engineers and designers must consider to ensure the reliability and effectiveness of composite structures in diverse industries.

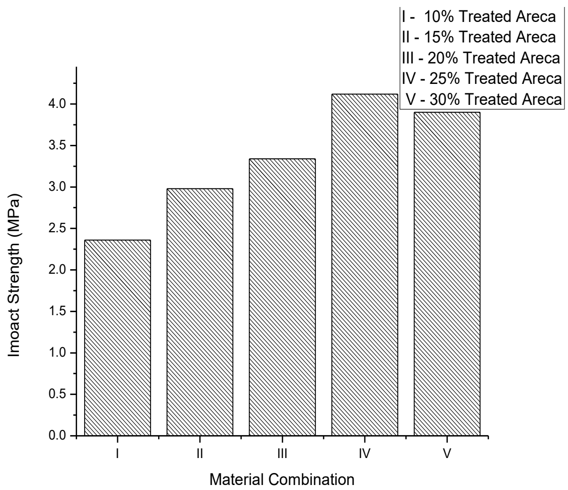

Fig 3.4. Evaluation of Impact Strength

4. Application in Contriving Laptop Sleeves and Panels

As time passes, many people change their laptop models. A growing number of consumers are afraid to use the same gadgets for long periods of time. When a result of the aforementioned philosophy, they are required to alter their sleeves and panels as their models evolve. Many of the system panels and sleeves are composed of plastic or other synthetic materials that, when disposed, could result in a range of environmental issues.Non-biodegradability and non-renewability are two further drawbacks of the current system. The shortcomings of currently existing laptop panels and sleeves are addressed by this technology. Figure 4.1 describes the major benefits of using the areca catechu nut fiber reinforced composite materials for fabrication of laptop panels and cases.

Fig 4.1. Benefits of using the aforementioned material for fabrication of laptop panels & sleeves

The present innovation aims to create an environmentally benign, renewable, and biodegradable material for the manufacture of laptop panels and cases. The aforementioned traits are not present in existing systems. The proposed material for constructing the proposed gadget panels and sleeves is Areca fiber reinforced epoxy polymer composites with a fiber volume percentage of 20%.

Fig 4.2. Stages involved in the process of contriving laptop panels & sleeves

5. CONCLUSION

They were made by compression moulding using NaOH treated chopped areca fibre reinforcement epoxy composites. Following the testing and characterising process, the following findings were made:

- Alkali treated fiber reinforced composites exhibits better properties when compared with the untreated ones.
- Comparing all the properties examined, areca fiber reinforced composites with 20 wt % composition exhibits better results. Hence this particular combination can be suggested for contriving laptop sleeves and panels.
- The material proposed in this novel stratagem is biodegradable, renewable, and has good features.
- This material's panels and sleeves are easily decomposable and can be replaced with newer variants.
- It offers various advantages over synthetic materials, including a decreased thickness, enhanced ease of waste transfer, and a quality that is comparable to synthetic materials.

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