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Review on Fabrication and Applications of Jute Fiber Epoxy Composite Reinforced Bio composite

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Abstract

This journal review provides a comprehensive examination of recent research and developments in the domain of jute fiber epoxy composite reinforced polymer bio composites. These bio composites have garnered significant attention in recent years due to their sustainability, lightweight properties, and potential applications across various industries. This review synthesizes the current state of knowledge regarding their fabrication techniques, mechanical properties, and applications.

Keywords: *Biocomposites, Fiber, Applications, Fabrictaion.*

1. INTRODUCTION

Bio composites, composed of jute fibers and epoxy matrix, have emerged as sustainable alternatives to traditional materials in many sectors. Their renewable and biodegradable properties make them attractive for a variety of applications [1]. This review aims to consolidate the existing research on jute fiber epoxy composites, offering insights into their fabrication methods, mechanical characteristics, and diverse application prospects. Bio composites are an increasingly significant class of materials in the quest for sustainable alternatives to traditional composites. These materials leverage the natural strength and eco-friendly qualities of jute fibers while utilizing epoxy matrices to achieve a balance between environmental responsibility and mechanical performance [2]. The aim of this review is to comprehensively analyze the state of research in the field of jute fiber epoxy composites, focusing on their manufacturing processes, mechanical properties, and wide-ranging application possibilities. Jute is a natural and renewable plant-based fiber, making it an eco-friendly choice for composite materials. The cultivation of jute requires minimal pesticide and chemical inputs, making it a sustainable alternative to synthetic fibers. Jute fibers also biodegrade naturally, reducing environmental impact [3]. Jute Fiber Epoxy Composites offer a sustainable and cost-effective solution with desirable mechanical properties for a wide range of applications. As industries increasingly focus on environmentally friendly materials, the utilization of jute fibers in epoxy composites represents a promising avenue for achieving both performance and sustainability goals [4].

1.1 Objective

1. The primary goal is to gather and consolidate the existing body of research on jute fiber epoxy composites. This involves collecting and analyzing studies, articles, and data related to these materials.
2. To comprehensively understand the fabrication methods used in the production of jute fiber epoxy composites. This includes investigating various techniques, processes, and technologies involved in their manufacturing.
3. To explore the diverse range of applications where jute fiber epoxy composites can be utilized. This includes identifying potential industries and sectors that can benefit from these sustainable materials.

2. FABRICATION TECHNIQUES

The fabrication of jute fiber epoxy composites begins with the extraction and treatment of jute fibers. These natural fibers, derived from plants of the Corchorus genus, are known for their inherent strength and eco-friendly attributes [5]. Various treatment methods are employed to enhance their compatibility with epoxy matrices:

2.1 Jute Fiber Extraction and Preparation

Jute fibers are harvested from the jute plant (Corchorus capsularis and Corchorus olitorius), typically grown in tropical regions. The fibers are cleaned, retted, and separated into bundles to remove non-fibrous materials [6]. Mechanical processes, such as carding and spinning, and are used to create uniform jute yarns or fabrics for composite reinforcement [7].

Figure 1. Jute Fiber

2.2 Fiber Surface Treatment

To improve adhesion between jute fibers and epoxy resin, surface treatments like alkali treatment, silane coupling agent treatment, and acetylation are employed. These treatments modify the fiber's surface chemistry, enhancing its compatibility with the hydrophobic epoxy matrix [8]. Fiber surface treatment is a process in which the outer layer of individual fibers, typically used in composite materials, textiles, and various industrial applications, is modified or enhanced to improve its compatibility, adhesion, and performance characteristics when incorporated into a composite matrix or other materials [9]. This treatment is essential to optimize the interaction between fibers and the surrounding matrix, leading to improved overall material properties [10]. Fiber surface treatment can involve various chemical, physical, or mechanical processes tailored to specific fiber types and intended applications [11].

3. MECHANICAL PROPERTIES

Jute fiber epoxy composites exhibit a range of mechanical properties that make them suitable for various applications. Key characteristics include:

3.1 Tensile Strength

Jute fibers high tensile strength is effectively transferred to the composite, resulting in impressive tensile properties. The alignment and distribution of fibers within the matrix significantly impact tensile strength [12]. The exceptional tensile strength of jute fibers is effectively transferred to the composite, rendering impressive tensile properties. Fiber alignment and distribution within the matrix significantly influence tensile strength [13].

3.2 Flexural Strength

Bio composites display good flexural strength, making them suitable for applications requiring resistance to bending and deformation. These bio composites demonstrate commendable flexural strength, making them suitable for applications demanding resistance to bending and deformation [14].

3.3 Impact Resistance

The ability to absorb energy during impact is a notable property, making these composites suitable for automotive and construction components [15]. The ability to absorb and dissipate energy during impact is a noteworthy attribute, rendering these composites suitable for applications in the automotive and construction sectors.

4. APPLICATIONS

Certainly, jute fiber epoxy composites have a wide range of applications across various industries due to their unique combination of eco-friendliness, lightweight properties, and desirable mechanical characteristics [16]. Here are some key sectors where these composites are finding use:

4.1 Automotive Sector

Bio composites are used in the manufacturing of interior panels, seat backs, and trunk liners due to their lightweight and eco-friendly attributes [17]. The lightweight nature of these bio composites makes them ideal for use in automotive components such as interior panels, seat backs, and trunk liners, reducing overall vehicle weight and enhancing fuel efficiency [18].

4.2 Construction Industry

Bio composite materials are employed in non-structural components like door panels, window frames, and decorative elements Bio composite materials are employed in non-structural elements like door panels, window frames, and decorative elements, contributing to sustainable building practices [19].

4.3 Packaging Materials

The biodegradability of jute fibers makes them an ideal choice for sustainable packaging solutions. The biodegradability of jute fibers makes them an attractive choice for eco-friendly packaging solutions, aligning with the global push for sustainability [20].

5. CONCLUSION

The jute fiber epoxy composite reinforced polymer bio composites are at the forefront of sustainable materials, offering both environmental friendliness and impressive mechanical properties. The successful implementation of fabrication techniques, including surface treatments, has opened doors to a diverse array of applications across industries. However, it is clear that further research and innovation are essential to fully unlock the potential of these materials for various sectors. As we continue to delve into the possibilities of jute fiber epoxy composites, we take a significant step towards a more sustainable and eco-conscious future. These materials hold the promise of reducing our environmental footprint while delivering high-performance solutions across numerous domains, ultimately contributing to a more harmonious coexistence with our planet.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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