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Applications of Banana Fiber - A General Overview

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Abstract: ***Banana fiber, an eco-friendly and sustainable natural fiber extracted from banana plant pseudostems, has gained significant attention in various industries due to its remarkable properties, including high tensile strength, biodegradability, and lightweight nature. This review provides a comprehensive overview of the diverse applications of banana fiber across multiple sectors, such as textiles, composites, paper production, automotive components, and bioplastics. In the textile industry, banana fiber is utilized as a sustainable alternative to synthetic fibers, offering superior moisture absorption and durability. In the field of composite materials, banana fiber is increasingly used as reinforcement in polymer matrices, enhancing mechanical strength while reducing environmental impact. The pulp and paper industry benefits from banana fiber's cellulose-rich composition, making it a viable substitute for conventional wood pulp. Furthermore, in the automotive sector, banana fiber-reinforced biocomposites are employed for interior panels and seat cushioning, contributing to lightweight and fuel-efficient vehicle designs. The growing demand for biodegradable and renewable packaging solutions has also propelled the use of banana fiber in eco-friendly packaging materials. With its vast potential in reducing plastic waste and promoting sustainable development, banana fiber is emerging as a key material in green innovations. However, challenges such as fiber extraction efficiency, processing limitations, and cost-effectiveness need further research and technological advancements. This paper aims to highlight the current applications, benefits, and prospects of banana fiber, emphasizing its role in fostering an environmentally friendly and circular economy.***

Keywords: Banana fiber, sustainable materials, natural fiber composites, eco-friendly textiles, biodegradable packaging, green innovations.

I. INTRODUCTION

The developing interest for sustainable materials in different businesses has provoked analysts and producers to investigate alternative assets that limit environmental effect. (1) Among these, banana filaments certainly stand out enough to be noticed because of their bountiful accessibility and amazing mechanical properties (2). This article intends to give an extensive outline of banana fiber composites, zeroing in on their assembling processes, mechanical execution, and likely applications. (3)We will likewise examine the natural advantages of utilizing banana strands, underlining their job in advancing supportability and supporting a circular economy. (4) By investigating the properties and benefits of banana fiber composites, we feature their capability to alter different areas, including the car, development, and bundling. World, different sorts of regular filaments accessible like sisal, bamboo, Okra, pineapple, jute, banana, coconut, , flax, and hemp which are developed as plants and strands removed from those are utilized as support particularly in the polymer grids to create the composites and have found their applications in different family things to car parts. Agricultural waste has been attracting increasing attention in geotechnical engineering as a natural soil reinforcement in improving strength and stability of soils. Agricultural waste fiber was chosen as it is cheap, locally available, bio-degradable and eco-friendly. In this study, the implementation of banana fibers has been used as a natural soil reinforcement in influencing the strength of clay soil.[5]

II. MUSA FIBER

New banana pseudo stems will be gathered, and filaments will be extricated utilizing mechanical or manual techniques. The filaments will be cleaned, dried, and treated to upgrade their properties. A reasonable biopolymer lattice, for example, chitosan, gelatin, or polyvinyl alcohol (PVA), will be chosen for the composite. Banana filaments will be absorbed by a substance arrangement to eliminate lignin and hemicellulose, expanding fiber virtue and further developing bond with the framework.[7] The treated strands will be dried at room temperature to eliminate overabundance of moisture. The treated banana filaments will be joined with the picked polymer grid. Different fiber-to-framework proportions will be tried to decide the ideal arrangement.

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The blend will be filled in forms and permitted to set at room temperature or in a broiler at a predefined temperature to work with relieving. Elasticity, prolongation at break, and flexural strength will be estimated utilizing standard testing techniques. Differential scanning calorimetry (DSC) and thermogravimetric examination (TGA) will be performed to evaluate the thermal stability of the composites.[8] The dampness content of the composites will be assessed by submerging tests in water and estimating weight changes after some time. The composites will be cut into suitable sizes and shapes for wound wraps. Disinfection The swathes will be sanitized utilizing ethylene oxide or gamma radiation to guarantee they are ok for clinical use. Cytotoxicity tests will be directed utilizing cell lines to assess the biocompatibility of the wraps. The adequacy of the gauzes will be tried in controlled conditions utilizing normalized twisted models to evaluate recuperating rates and tissue reaction. Factual investigation will be led on the gathered information to decide the meaning of the outcomes and distinguish the ideal definition for the banana fiber composites wound swathes. In light of the outcomes, ends will be drawn for the mechanical, warm, and natural execution of the banana fiber composites. Suggestions for future examination and potential clinical applications will likewise be given. Composite materials created a revolution in the materials world, especially the natural fiber composite, which has had the most influence on it based on their physical properties, availability, and economic support when compared with the metals[9]

III. PROPERTIES OF BANANA FIBRE COMPOSITES

1) Biodegradability: Banana fiber is a characteristic material that disintegrates effectively, making it harmless to the ecosystem.
2) High Strength: The strands have a high elasticity, which adds to the solidness of the composite.
3) Lightweight: Banana fiber composites are lightweight, making them appropriate for different material applications without adding mass.[10]
4) Dampness Retention: The strands have great dampness wicking properties, upgrading comfort in articles of clothing.
5) Breathability: Materials produced using banana fiber permit air dissemination, which manages temperature and diminishes sweat.[2]
6) Regular Tone: Banana filaments have a characteristic tint that can be utilized in materials without the requirement for substance colors.
7) Antimicrobial Properties: Banana fiber has normal antimicrobial properties, decreasing smells and upgrading cleanliness.[7]
8) UV Obstruction: The filaments offer a level of protection from UV radiation, making them reasonable for outside applications.[4]
9) Substance Opposition: Banana fiber composites can endure openness to different synthetic compounds, expanding their adaptability.
10) Feasible Obtaining: Banana strands are obtained from agrarian waste, advancing manageability and decreasing waste.[5]
11) Low Warm Conductivity: The filaments give great protection, keeping the wearer warm in cooler circumstances.
12) Adaptability in Mixing: Banana fiber can be mixed with different filaments (normal or engineered) to improve properties and make crossover materials.
13) Solace: Materials produced using banana fiber are frequently delicate and agreeable against the skin[9].
14) Tasteful Allure: The exceptional surface and normal appearance of banana fiber can add visual interest to textures.
15) Savvy: Using banana strands can be monetarily valuable, particularly in locales where bananas are developed richly.[11]

IV. APPLICATIONS

A. *Medical Textiles*

Wound Bandages

The banana fiber-biopolymer composite dressing could alter twisted care with its wide applications and positive effect on wellbeing and the climate. Elsevier as of late distributed this work in the Worldwide Diary of Natural Macromolecules.[14]

Properties

- Mechanical Strength: Banana fiber displays high elasticity, giving solidness and backing to wound insurance.[15]
- Dampness Ingestion: The gauzes can retain dampness, assisting with keeping a clammy mending climate, which is helpful for wound recuperation.
- Antimicrobial Properties: The regular properties of banana filaments can repress the development of microbes, lessening the gamble of contamination.[16]
- Breathability: The permeable design takes into account air course, advancing better mending and forestalling maceration of the injury.[17]

- Adaptability: The composites are adaptable, adjusting great to body shapes for upgraded solace during use.[18]

B. Sustainable Papers

Banana fiber composites are sustainable because banana fiber is a natural, biodegradable material that can be utilized to make eco-friendly products [19]

Properties

- Biodegradable: Banana fiber is a characteristic material that can separate in landfills without hurting the climate. Dissimilar to manufactured textures, which can require hundreds of years to deteriorate, banana fiber separates somewhat rapidly.
- Eco-accommodating: Banana fiber is produced using the tail of the banana plant, which is horticultural waste that would somehow hurt the climate.[20]
- Adaptable: Banana fiber can be utilized in different applications, including materials, family items, and paper.[21]
- Top caliber: Banana fiber paper is top notch and eco-accommodating. It has a lower thickness, higher solidity, higher superfluity, higher inexhaustibility, and higher elasticity contrasted with conventional paper.
- Support material: Banana fiber is being investigated as a support material for car applications. [22]

C. Packaging Materials

Banana fiber composites can be utilized as a feasible, biodegradable option in contrast to plastic and wood-based bundling materials. Banana fiber composites can be produced using an assortment of banana parts, including the leaves, stalks, and trunks, which are plentiful byproducts from banana and plantain cultivating [25]

Properties

- Banana fiber and polyvinyl alcohol: Can be blended to make a film for food bundling.[26]
- Banana fiber and cow dung: Can be consolidated to make paperboard with expanded tractable and burst strength, and diminished oxygen and water fume transmission rates.[27]
- Banana fiber and nonwovens: Can be built up with epoxy or polyester lattices.
- Banana fiber and high-thickness polyethylene (HDPE): Can be consolidated utilizing expulsion infusion shaping.[28]

D. Tissues

Banana fiber composite tissue paper is a tissue paper produced using banana strands, a characteristic, biodegradable, and solid fiber from the banana tree stem[29]

Properties

- Strength: Banana filaments are one of the world's most durable natural fibers.[30]
- Water retention: Banana strands have great water absorption.
- Breathability: Banana filaments are breathable.[31]
- Antibacterial: Banana filaments are antibacterial and clean.
- UV assurance: Banana strands give UV security [32]

E. Wall Coverings

Banana fiber composite wall covers address an imaginative and economical way to deal with inside plan and development. By bridling the regular strength and tasteful allure of banana strands, these wall covers offer an exceptional blend of usefulness, sturdiness, and eco-neighborliness.[33]

Properties

- Sustainability: Produced using sustainable banana plants, these composites are biodegradable and contribute to decreasing the natural effect.[34]
- Aesthetic Appeal: The normal surface and variety of banana strands give an outwardly engaging completion that adds warmth and character to interiors.[34]
- Durability: The composite construction offers protection from wear, tear, and dampness, making it appropriate for different indoor conditions.
- Insulation: Banana fiber composites have great thermal and acoustic protection properties, upgrading energy efficiency and sound retention in spaces.[35]

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- Fire Resistance: When treated with suitable fire-retardant synthetic substances, these covers can give an additional layer of security in inside applications.
- Installation: Banana fiber composite wall covers can be introduced utilizing glue or mechanical affixing strategies. Their lightweight nature works well with more straightforward care of and application.[36]

F. Automative

Banana fiber composites are arising as a practical option for auto interior parts. Using normal filaments from banana plants, these composites offer a lightweight, strong, and eco-accommodating choice that satisfies the developing need for greener auto arrangements.[37]

- Dashboard Panels: Banana fiber composites can be utilized to make in vogue and durable dashboard boards.[37]
- Entryway Trims: Inside entryway boards produced using banana fiber composites can supplant customary materials.[38]
- Seat Backs: Banana fiber composites can be used for seat back structures, upgrading comfort and backing.[12]
- Headliners: The roof of the vehicle can be fixed with banana fiber composites for a novel surface and look[39].
- Flooring Mats: Banana fiber composites can be utilized to make solid and eco-accommodating deck mats.[39]
- Inside Trim Pieces: Little trim parts, for example, cup holders and control center additions, can be produced using banana fiber composites. [14]
- Warm Protection: These strands give powerful warm protection, assisting with keeping up with agreeable lodge

Properties

- Temperatures. This property can add to energy reserve funds by lessening dependence on heating and cooling systems.[40]
- Biodegradability: As a characteristic fiber, banana fiber is biodegradable, making it harmless to the ecosystem choice. This lineup with the auto business' rising spotlight on manageability and diminishing carbon impressions.[41]
- Lightweight: Banana strands are altogether lighter than numerous engineered other options, assisting with lessening in general vehicle weight. This can prompt better eco-friendliness and execution.[41]
- High Rigidity: The strands have superb rigidity, making them sturdy and impervious to mileage. This property is vital for parts like seat covers and inside trim that should endure day-to-day use[42]

G. Building Roofing Materials

Banana fiber composites are arising as a reasonable and inventive answer for building roofing materials. Using the normal strength and flexibility of banana filaments, these composites offer a lightweight, sturdy, and harmless to the ecosystem choice for current development.[43]

Properties

- Lightweight: The composite roofing materials are altogether lighter than customary material choices, decreasing the heap on supporting designs.[44]
- Solidness: Impervious to dampness, irritations, and UV debasement, banana fiber composites offer durable execution in different environments.[44]
- Warm Protection: These materials give great protection, assisting with keeping up with agreeable indoor temperatures and lessen energy utilization.[47]
- Sound Retention: The permeable construction of banana fiber composites helps in sound reduction, adding to a calmer indoor climate. Banana fiber, obtained from the pseudo stems of banana plants, is acquiring prominence in the design and textile industry. Its novel properties make it an optimal material for attire, sacks, and different adornments, combining sustainability with style.[46]

H. Textile And Home Textiles

1) Clothing

Banana strands can be turned into yarn and woven or woven into texture, offering a lightweight, breathable, 46] and solid choice for clothing. Biodegradable and got from a sustainable asset. Delicate surface that is delicate on the skin. Great dampness wicking properties keep the wearer cool and dry.[47]

2) Packs

Banana fiber composites can be utilized to make a scope of packs, including handbags, knapsacks, and purses. Solid filaments make for vigorous packs that can endure everyday use.: An optimal option in contrast to manufactured materials, interesting to naturally cognizant customers[48]. The regular surface and appearance add a particular style that sticks out.: Embellishments like caps, belts, and adornments can be made from banana fiber composites.[48]

3) Accessories

Accessories such as hats, belts, and jewelry can be crafted from banana fiber composites. Comfortable to wear without compromising on style. Can be dyed or printed with various designs, allowing for customization. Provides a unique look that complements eco-friendly fashion trends.[49]

Properties

- Strength: Banana fiber has a high elasticity and is superior to other customary strands in such manner.[48]
- Weight: Banana fiber is lightweight.
- Imperviousness to fire: Banana fiber is heat proof.[49]
- Dampness ingestion: Banana fiber has a high limit for engrossing dampness, and it rapidly retains and delivers it.
- Biodegradability: Banana fiber is biodegradable and decomposes normally.[49]

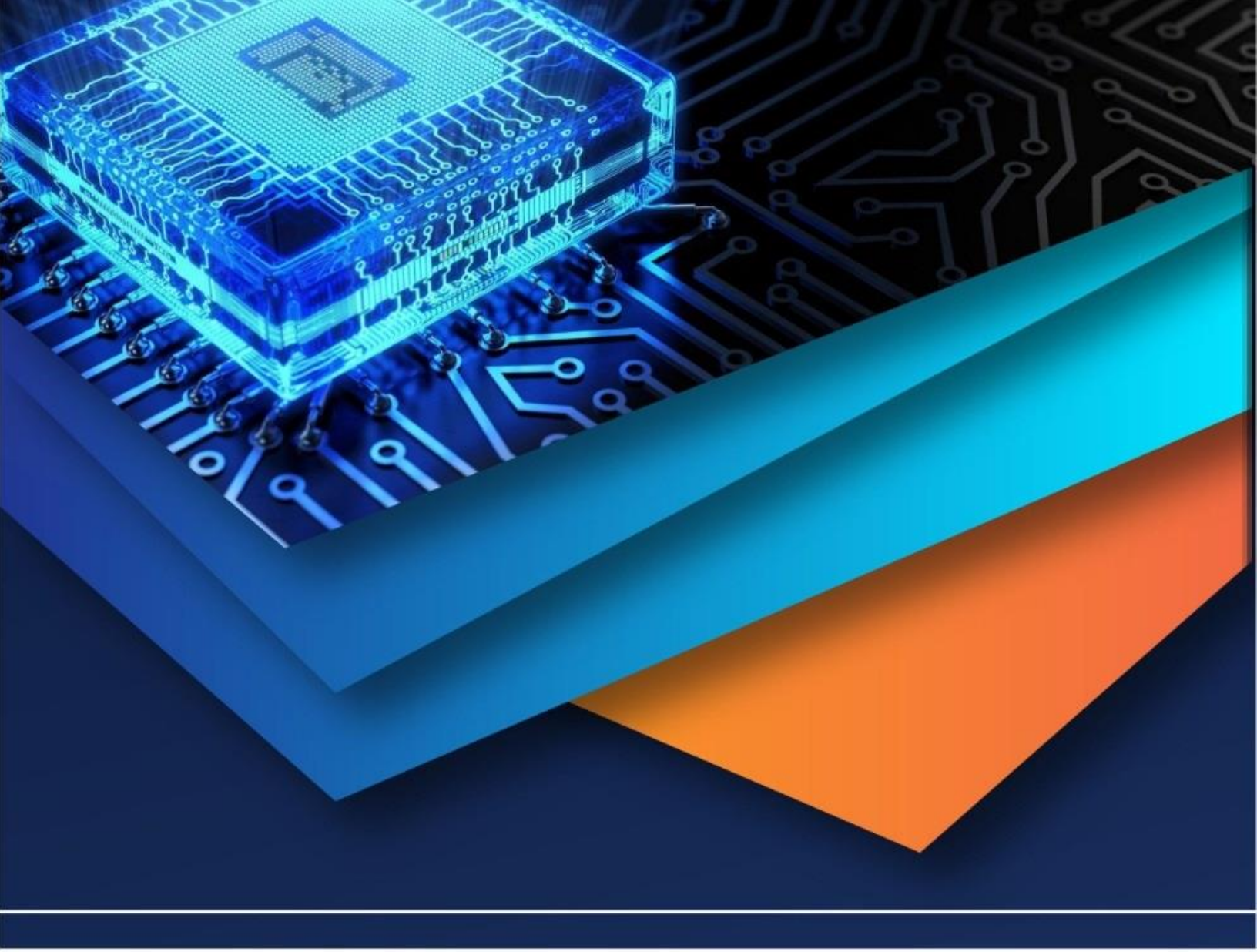
V. CONCLUSION

All in all, banana fiber composites present a promising and manageable option for different material applications. Their novel properties, like high elasticity, lightweight nature, and biodegradability, make them ideal for both traditional and creative purposes in the material business. The ecological advantages of using banana strands, obtained from rural waste, add to a more manageable creation cycle, diminishing dependence on engineered filaments. Besides, progressing exploration and headways in handling methods are improving the exhibition and flexibility of banana fiber composites, preparing for their expanded reception in style, inside plan, and modern materials. As purchaser request shifts towards eco-accommodating materials, banana fiber composites are strategically set up to address this issue, offering a mix of usefulness, manageability, and stylish allure. Stressing their true capacity in advancing feasible practices, banana fiber composites can assume a huge part in store for the material business.

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