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BAMBOO FIBER COMPOSITE MATERIAL IN ECO-FRIENDLY SHOE DESIGN

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This paper discusses the application of bamboo fiber composites in the design of environmentally friendly shoes and analyzes the properties, production process, and market potential of these composites. By studying current trends and future directions, this study aims to highlight the role of bamboo fiber composites in advancing sustainable footwear design. Compared to conventional materials, bamboo fiber composites are a promising alternative, offering aesthetic appeal, durability and environmental benefits.

Key words: bamboo fiber composite materials, environmentally friendly materials, sustainable shoe design, biodegradable.

INTRODUCTION

The global shoe industry is undergoing a transformative shift to sustainability amid growing concerns about resource depletion, pollution, and waste generation. Traditional materials such as leather, synthetic rubber, and petroleum-based plastics are increasingly being replaced by environmentally friendly materials. Among them, bamboo fiber composites have received much attention for their unique properties and environmental benefits [1].

Bamboo is one of the fastest-growing renewable resources. When processed into fibers and composites, bamboo provides a lightweight, durable, hygroscopic, antibacterial, biodegradable material consistent with the principles of sustainable design [2]. This paper studies the application of bamboo fiber composites in the design of environmentally friendly shoes, focusing on their advantages and future potential.

PURPOSE

The main objective of this study is to investigate the application of bamboo fiber composites in the design of environmentally friendly shoes. Specifically, analyzes the properties and production process of bamboo fiber composites, and assesses their performance in shoe design applications.

RESULTS AND DISCUSSION

Bamboo fiber composites are being used in innovative ways to create environmentally friendly shoes. Bamboo fiber composites are used to make a breathable and durable upper instead of traditional leather or synthetic materials. The sports shoe upper of the brand Walkerbamboo is made of natural bamboo fiber fabric, which has excellent breathability and moisture absorption. At the same time,



the bamboo fiber contains Zhukun, which gives it good antibacterial and bacteriostatic effects. The hygroscopic properties of bamboo fiber make it an ideal choice for insoles and liners, improving comfort and hygiene. For instance, insole products for diabetic patients, it has both anti-bacterial and antimicrobial performance inhibiting bacteria's growth [3]. Bamboo fiber composites can be integrated into the midsole or outsole to provide buffer and support while reducing environmental impact. Xu, Kingston from Princeton University designed and manufactured a running shoe whose sole's main mechanism for shock absorption is a cantilever spring made of bamboo material. It has been determined that durable and comfortable shoes made of bamboo are highly feasible [4]. Bamboo fiber material can also be applied to the design of the entire shoe body. Chinese brand warrior released a series of sports shoes designed with bamboo weaving craftsmanship in 2024. The products cleverly combined the traditional bamboo weaving technique with modern design, breaking through people's stereotypical impressions of bamboo woven products (fig.1).



Fig.1. The bamboo woven sneakers of the brand Warrior

Bamboo fiber composites combine the natural fibers of bamboo with other environmentally friendly materials (such as PLA) to create a versatile material suitable for various applications. Key attributes include:

Lightweight, flexible and tear-resistant: bamboo fiber is light, durable, and easy to bend, ideal for the construction of the shoe, such as the upper and sole.

Hygroscopic absorption and air permeability: bamboo fiber can naturally absorb water and sweat, enhancing the comfort of wearing.

Antimicrobial properties: bamboo fiber material because of its own properties, can play a natural antibacterial effect.

Biodegradability: unlike chemical synthetic materials, bamboo fiber composites can naturally decompose [4].

CONCLUSIONS

The application of bamboo fiber reflects the breakthrough and innovation of eco-friendly shoe design, providing a sustainable alternative to traditional materials. The lightweight, durable, breathable, antibacterial, and biodegradable properties of bamboo fiber materials are very attractive to both designers and consumers. By combining bamboo fiber material with different structures of shoes, it can meet the



diverse needs of users. The composite material obtained by combining bamboo fiber material with other environmentally friendly materials can not only reflect the advantages of bamboo fiber but also make up for the disadvantages of bamboo fiber material. The focus of the research is on various experiments that combine bamboo fiber material with other materials. As the fashion industry continues to promote the concept of sustainability, bamboo fiber composites will play a much more critical role in the future of footwear design. Various composite materials mainly composed of bamboo fibers will be further explored. By adopting this material, designers can create products that not only meet aesthetic and functional standards but also reflect their responsibility and contribution to the human environment. At the same time, the application of bamboo fiber material in shoe products can not only bring a better environmental experience but also play a more important role in promoting the development of the bamboo industry.

REFERENCES

1. Alsubari, S., et al. Potential of natural fiber reinforced polymer composites in sandwich structures: A review on its mechanical properties. *Polymers*. 2021. Vol.13(3), 423. <https://doi.org/10.3390/polym13030423>
2. Behera A.K., Mohanty C., Das N. Synthetic glass and jute fabric reinforced soy-based biocomposites: Development and characterization. *Polymers and Polymer Composites*. 2021. 29(9_suppl). P.678-687. <https://doi.org/10.1177/09673911211020609>
3. Xu K Z. Unconventional Sneaker Design: The Design and Exploration of a Bamboo Spring-Actuated Running Shoe. *Mechanical and Aerospace Engineering*. 2016. <http://arks.princeton.edu/ark:/88435/dsp018623j119s>
4. Chin S.C., Tee K.F., Tong F.S., Ong H.R., Gimbin J. Thermal and mechanical properties of bamboo fiber reinforced composites. *Materials Today Communications*. 2020. 23, 100876. <https://doi.org/10.1016/j.mtcomm.2019.100876>

ЧЖАН Цзунхай, ЯЦЕНКО М. КОМПОЗИТНИЙ МАТЕРІАЛ З БАМБУКОВОГО ВОЛОКНА В ЕКОЛОГІЧНОМУ ДИЗАЙНІ ВЗУТТЯ

У цій роботі розглянуто застосування композитів з бамбукового волокна в дизайні екологічно чистого взуття та проаналізовано властивості, процес виробництва та ринковий потенціал цих композитів. Вивчаючи поточні тенденції та майбутні напрями, це дослідження має на меті висвітлити роль композитів з бамбукового волокна в просуванні екологічного дизайну взуття. У порівнянні зі звичайними матеріалами композити з бамбукового волокна є багатообіцяючою альтернативою, пропонуючи естетичну привабливість, довговічність і екологічні переваги.

Ключові слова: композиційні матеріали з бамбукового волокна, екологічно чисті матеріали, стійкий дизайн взуття, біорозкладаність.