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AN ECOLOGICAL PACKAGING: INNOVATION AND DESIGN OF NATURAL MATERIALS AND MULTILAYER STRUCTURES

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This paper analyses a new type of environmentally friendly packaging design with a structure with gradually increasing density using compressed straw natural materials to achieve effective protection for fragile products. The results of the study show that the design can effectively protect the product from external impacts, and at the same time has the characteristics of environmental protection and sustainability, which is in line with the urgent needs of contemporary society for environmentally friendly packaging. At the same time, the design's artistic aesthetics and natural affinity add a unique charm to the user experience and brand image.

Key words: *packaging design, ecological packaging, natural materials, multilayer structures.*

INTRODUCTION

The global packaging industry is facing multiple environmental challenges such as plastic pollution, resource consumption, and carbon emissions. As a result, there is a growing demand for environmentally friendly packaging materials. People have higher expectations for packaging materials that are biodegradable, recyclable, low-carbon, and resource-saving, hoping to reduce the negative impact on the environment and drive the packaging industry in a more sustainable direction. Traditional packaging materials such as Styrofoam and polystyrene, although providing a certain degree of shock absorption and cushioning while protecting the product, have gradually caused concern and worry due to their non-degradability and serious pollution to the environment. Therefore, the search for a material that has both excellent packaging protection performance and meets the environmental requirements has become one of the important issues in the current packaging industry.

As a rich and renewable resource, straw is widely found in agricultural production. However, the traditional way of straw treatment is often based on incineration or composting, which is easy to cause environmental pollution and waste of resources. Therefore, it is of great significance to convert straw into high value-added products. This study aims to explore a new type of packaging design



that utilises compressed straw natural materials to achieve effective protection for fragile products by adjusting their density distribution.

PURPOSE

This study will deeply explore the physical properties, engineering applicability and its impact on the environment of eco-packaging materials, and provide new ideas and technical support for material innovation in the field of eco-packaging. In terms of application, the research will help reduce the reliance on environmentally unfriendly materials such as traditional plastics and promote the development of the packaging industry in a more environmentally friendly and sustainable direction. By promoting the development and popularising the application of eco-packaging, the sustainability goals of the packaging industry can be realised, the carbon footprint can be reduced, plastic pollution can be minimised, and a positive contribution can be made to building a green and low-carbon social environment.

RESULTS AND DISCUSSION

This research explores the characteristics of compressed straw natural materials in the fields of function, art and environmental protection, with the aim of designing a shock-absorbing cushioning packaging structure using compressed straw natural materials, which provides a feasible solution for eco-packaging design.

From the aspect of packaging function, straw as a packaging material has good shock absorption and cushioning properties, and can be compressed and processed to form materials with different densities, thus providing effective packaging protection. Its porousness and elasticity enable it to absorb the impact force and protect the fragile products inside the package from damage. In addition, straw material also has a certain sealing performance, can effectively prevent the external dust, moisture and other impact on the product, to ensure the quality and safety of the product.

From the aspect of ecological art: as a natural material, straw has a unique texture, color and form, which can bring a sense of natural aesthetics to packaging design. By skillfully using the characteristics of straw to design unique packaging works, it can not only show the beauty of nature, but also reflect the expression of a specific culture and region. Art designers can take advantage of the plasticity and creativity of straw to incorporate it into packaging design, creating unique and artistic works that add unique eco-artistic value to the product.

From the aspect of sustainable development: as a renewable resource, straw has rich potential for recycling. Using straw as packaging material helps to reduce the reliance on environmentally unfriendly materials such as traditional plastics, and reduces resource consumption and energy consumption. Meanwhile, straw materials have good biodegradability and can decompose quickly after use, reducing the negative impact on the environment. Choosing straw as packaging material not only conveys respect for the natural environment, but also guides people to pay attention to ecological protection and sustainable lifestyles, and promotes the packaging industry to develop in a more environmentally friendly and sustainable direction.



This packaging design makes use of the different densities of the different straw layers, which gradually increase from the inner layer to the outer layer, forming a hierarchical structure (see Fig.1).

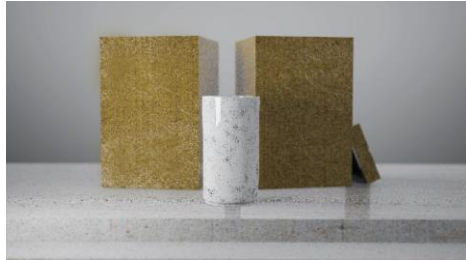


Fig. 1. Ecological Packaging Design

The inner layer of straw has a lower density, fluffy and good elasticity, which can effectively absorb and mitigate external shocks, providing a reliable shockproof cushioning protection and protecting the product from damage. The outer layer of straw gradually increases in density and becomes harder, which can protect the box from deformation and resist external impacts, thus ensuring the integrity of the product (see Fig. 2).

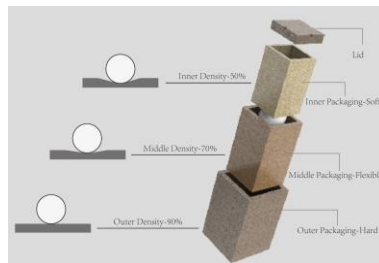


Fig. 2. Hierarchical structure

As the whole packaging material is made of the same straw material, it makes the packaging easier to separate, recycle, degrade or reuse, which is in line with the concept of sustainable development. In addition, the appearance of the packaging was designed with aesthetic and tactile considerations in mind. The closeness to the natural environment makes the overall design more attractive and enhances the brand image of the product and the communication of sustainability.

CONCLUSIONS

This research is dedicated to exploring a new type of environmentally friendly packaging design. Based on the characteristics and plasticity of straw material, a packaging structure with distinct layers and gradually increasing density from the inside to the outside is designed. By laying out the layers of straw with



different densities, the design aims to achieve effective protection of the internal products and structural stability of the packaging. The results of the study show that the packaging design has a significant effect in shockproof buffer protection, which can protect the products from external impacts. At the same time, based on the biodegradability and recyclability of straw material, the design has the characteristics of environmental protection and sustainability, which meets the needs of contemporary society for environmentally friendly packaging. In addition, the eco-art elements incorporated in the design make the appearance of the packaging more aesthetically pleasing and compatible with the natural environment, which enhances the user experience and brand image. Overall, this study provides new ideas and methods for the field of environmental protection packaging design, and makes a positive contribution to promoting the packaging industry to a more environmentally friendly and sustainable direction.

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ЕКОЛОГІЧНА УПАКОВКА: ІННОВАЦІЇ ТА ДИЗАЙН НАТУРАЛЬНИХ МАТЕРІАЛІВ ТА БАГАТОШАРОВИХ СТРУКТУР

У роботі досліджується новий тип екологічно чистого дизайну упаковки зі структурою з поступовим збільшенням щільності з використанням природних матеріалів зі спресованої соломи для досягнення ефективного захисту крихких продуктів. Результати дослідження показують, що дизайн може ефективно захищати продукт від зовнішніх впливів і водночас має характеристики захисту навколишнього середовища та стійкості, що відповідає нагальним потребам сучасного суспільства в екологічно чистій упаковці. У той же час художня естетика дизайну та природна близькість додають неповторного шарму досвіду користувача та іміджу бренду.

Ключові слова: дизайн упаковки, екологічна упаковка, природні матеріали, багатошарові структури.