Design of Express Recyclable Packaging Bag Based on Green Environmental Packaging Material

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Abstract. With the increasing number of parcels in China's express industry, how to make express packaging Green has become a critical issue for the development of the express industry. This paper analysed the current situation of express packaging materials, PEST analysis and SWOT analysis were carried out on the use of Green Express packaging materials, and a green shared express packaging bag was designed, which provided a way for the "green development" of express packaging materials.

1. Introduction

In recent years, with the explosive development of e-commerce industry and the rapid rise of express delivery service industry, it has become an important economic form and service industry in China. According to the statistics of State Post Bureau of the People's republic of China, the business volume of express service enterprises in China totaled 50.71 billion pieces in 2018, an increase of 26.6% over the same period of last year. By 2020, Chinese express business will reach 50 billion pieces [1]. With the rapid development of express delivery industry, the pollution caused by express packaging bags has gradually emerged. In 2018, the express delivery industry consumed 10 billion plastic express bags, 5 billion packaging boxes, 5.2 billion woven bags and 535 million rolls of tape. Restricted by the selection of raw materials, structural design, sealing and opening methods, the recovery and destruction of express bags are far from meeting the requirements of society. Abandoned express bags are eroding previously healthy land and environment, and the number is growing at a rate of 45%.

By the end of 2017, ten government departments, such as State Post Bureau of the people’s republic of China, jointly issued the Guiding Opinions on Cooperative Promotion of Green Packaging in Express Industry, which clearly defined the three major objectives of green packaging in Express Industry during the 13th Five-Year Plan period: greening, reduction and recycling [2]. By 2020, the application of degradable packaging materials will be increased to 50%. Heavy metals and other special materials will be basically eliminated, and a special express packaging recycling system will be basically established [3].

Therefore, the development of green, environmentally friendly and recyclable packaging materials for express delivery industry is urgent.
2. Current Situation Analysis of Express Packaging Material

According to the data of the National Bureau of Statistics, the annual total amount of garbage disposal and transportation in China has increased from 148,413,000 tons to 203,620,000 tons in the past ten years [4]. Among them, express parcels contribute a lot of garbage. In Chinese mega-cities, the increment of express packaging garbage has accounted for 93% of the increment of domestic garbage, while in some large cities it is 85% to 90%. Paper and plastic are the main components of these packaging garbage, and most of the raw materials come from wood and oil. According to industry estimates, 17 ten-year-old trees need to be cut down to produce a ton of paper, and a ton of plastic bags needs to consume more than 3 tons of oil. According to the annual measurement of tens of billions of parcels in our country, the amount of wood and oil consumed by express delivery industry every year is very astonishing [5].

The usual destructive way of bagging and sticking waybill in express delivery enterprises leads to the millions of tons of packaging waste, and the recovery rate is less than 10% [6]. Moreover, the main raw materials of transparent tape, plastic bags and other materials commonly used in express packaging are polyvinyl chloride, which is buried in the soil and needs hundreds of years to degrade, causing irreversible damage to the environment.

The pollution caused by express packaging materials has received widespread attention from the society. Green and reduced express packaging materials have become the public welfare consensus of the industry. In August 2014, Dangdang launched biodegradable plastic bags, but because of its thin material and insufficient toughness, it stopped using after 3 months. In June 2016, at the Global Intelligent Logistics Summit, 32 partners jointly launched "Green Action" to reduce carbon emissions and pollution from packaging, distribution and recycling. In December of the same year, Tianmao, Suning, No. 1 Shop and other e-commerce enterprises launched environmental protection actions to reward package recycling with points, but failed to achieve a sustainable and effective model.

3. Environmental Analysis of Green Shared Express Packaging Material Design

3.1. PEST analysis

3.1.1. Political Environment Analysis. The publication of "Guiding Opinions on Cooperative Promotion of Green Packaging Work in Express Industry" has pointed out the green, reduced and recyclable development direction for the green packaging industry in express industry. China Express Association has jointly established China Express Green Packaging Industry Alliance with dozens of express and packaging enterprises, many industry organizations and e-commerce platforms. It has made continuous efforts in promoting the application of scientific and technological environmental protection packaging materials, recycling of express packaging materials, simplification of express packaging, etc. It has guided the whole society to attach importance to the implementation of environmental protection concept and realize the green development of express packaging.

3.1.2. Economic Environment Analysis. Due to raw materials, production processes and processes, the cost of green shared express packaging materials is slightly higher than that of Ordinary Express bags, but because of its green environmental protection, it is decomposed into plant nutrients, which really comes from nature and is also natural. With the improvement of people's awareness of environmental protection and the attention paid by the state to environmental issues, the vast majority of businesses and consumers are willing to pay for environmental protection.
3.1.3. **Social Environment Analysis.** The environmental problems caused by express packaging are currently a hot topic. Due to the traditional usage habits, the problem of plastic pollution still needs to be solved urgently. Therefore, accelerating the transformation and upgrading of bio-based and biodegradable plastics is the only way.

3.1.4. **Technical Environment Analysis.** Shared Green Express bags are mainly composed of PBAT (petroleum-based degradable plastics). It accounts for 80%-90%, PLA (biodegradable plastics) and corn starch. There are no plasticizers, flame retardants and other harmful substances. The temperature control and machine performance of raw materials in film blowing and bag making are highly demanded. In laboratory settings, 180 days can be converted into carbon dioxide and water; in nature, April-May can be decomposed into carbon dioxide and water.

3.2. **SWOT analysis**

3.2.1. **Strength.** Sharing Green Express bags from raw materials to destruction is zero pollution and can be recycled and shared. And the express bag abandons the traditional paper waybill, uses electronic waybill, reduces paper consumption, and saves 5 billion yuan per year for express enterprises.

3.2.2. **Weakness.** This product is the first attempt. There are technical, management, promotion and financial risks. It needs the full support of express industry and enterprises. It also needs time to coordinate the promotion of products.

3.2.3. **Opportunity.** In "Several Opinions on Promoting the Development of Express Industry", the government regards "Green Energy Conservation" as its development goal. In the "Implementing Plan for Promoting Green Packaging in Express Industry", it is required to basically eliminate toxic and harmful substances in excess of standard packaging materials by 2020, and basically build a socialized express packaging recycling system.

3.2.4. **Threat.** At present, there are enterprises producing green express packaging materials on the market. Although the products have not been widely promoted, they have formed a potential competitive relationship.

4. **Introduction of Green Shared Express Packaging Material**

This product is based on green environmental protection materials. It combines environmental protection with science and technology in a unique way of design. It increases the income of express bags by advertising and reduces the investment of logistics enterprises.

It is made of biodegradable material PBAT and PLA modified with plant starch as raw material. It is non-toxic, odorless, harmless to human body, safer to use and recyclable express bags.

Reasonable recycling of express bags can reduce their usage, save enterprise costs and reduce environmental pollution. In the delivery link, users are encouraged to share the use. After the recipient picks up the items, they are placed in a designated location. The express bags are in good condition for lower use. Express manufacturers actively recycle the damaged express bags for degradation treatment. Where used and placed according to the regulations, the deposit can be refunded after the completion of the mail, and the corresponding integrals can be obtained. The integrals can be used in the integral mall. Express bag compost can be degraded into carbon dioxide, water and organic fertilizer, without causing "white pollution”.

4.1. **Raw materials for products**

The raw materials used in the product are 70-100 parts of high density polyethylene, 25-45 parts of starch, 10-25 parts of Polyethylene Grafted with maleic anhydride, 7-15 parts of polylactic acid, 2-7
parts of polyoxyethylene laurate, 2-3 parts of coupling agent and 0.2-1.5 parts of additives. The product is based on high density polyethylene and synergistic reaction of high density polyethylene, starch, Polyethylene Grafted with maleic anhydride, polylactic acid, polyoxyethylene laurate and coupling agent to form a degradable express bag material with high toughness. The express bag made of this degradable express bag material has excellent toughness and tensile resistance, good anti-static performance and is not easy to stick dust.

4.2. Product Brief

4.2.1. *The product structure diagram (front, side and bottom) is shown below.*

![Figure 1. Product Structure Diagram (Front)](image1)

![Figure 2. Product Structure Diagram (side)](image2)

![Figure 3. Product Structure Diagram (bottom)](image3)
4.2.2. Schematic diagram of the structure of the utility model embodiment

Figure 4. Schematic diagram of the structure of the utility model embodiment

1. Bag body: 1A - bottom of bag body, 2. Zippers, 3. Seals, 4. Information storage, 5. Handle, 6. Buckling rings, 7. Fasteners

4.2.3. Functional description of product structure. The bag mouth of express bags used by express delivery industry has a bonding place. After the goods to be sent are stuffed into the express bags, the package goods can be sent by using the bonding part to bond the bag mouth to complete the packaging. Using express bags to transport goods can protect the goods from damage to a certain extent. However, the adhesive part of the bag mouth is relatively strong. The adhesive part of the express bag can only be used once. Users often need to tear the express bag hard to get the goods out. In this way, after taking out the goods, the express bags are artificially damaged and cannot be directly used to encapsulate the goods again.

The green shared express packaging bag designed in this project can be folded and unfolded to form a body. The bottom end of the bag body is rectangular, and the top of the bag body has a long strip opening. The zipper is arranged at the top of the bag body for closing or opening the opening. The zipper includes the first zipper part and the second zipper part which cooperate with each other, and the zipper head which is used to bond or separate the first zipper part and the second zipper part. The disposable sealing part includes a viscous adhesive part and a radio frequency tag in the viscous part. After closing the opening, the sealing part is adhered to the first zipper part and the second zipper part. The zipper piece is covered with a zipper head to prevent the zipper piece from being opened, and the information storage piece is made of transparent material and is arranged near the lower end of the bag body.

4.3. Indicators of detection

| Project                                      | Index                                      |
|----------------------------------------------|--------------------------------------------|
| Thickness / mm                               | 0.06±10%                                   |
| Tensile Strength (Longitudinal and Transverse)/Mpa | ≥20                                         |
| Heat and strength                            | ≥6.0N/15mm                                 |
| The quality of falling darts is 300g         | No Breakage Number (≥9)                    |
| Transmittance                               | ≤5%                                        |
| Puncture strength                            | ≥1N                                        |
4.4. **Product advantage**

Under normal service condition, it has good toughness and tensile resistance, and is not easy to be damaged. The whole biomaterial PBAT and plant starch are non-toxic, tasteless, harmless to human body, good degradability and not easy to cause secondary pollution.

When discarded in soil or microbial-rich areas, the express bag has good biodegradability and photodegradation performance, and can be degraded to carbon dioxide, water and organic fertilizer, without causing "white pollution" and promoting the growth of crops.

The packaging material is low static electricity, easy to open bags, convenient and fast. The self-sealing water-proof zipper seal design has changed the traditional destructive opening method, and the shape and function of the bag body after opening has not been damaged, which will not affect the next use. It can be reused in half a year.

5. **Conclusion**

This product design won the gold medal in the 2nd National "Internet +" Express College Students Innovation and Entrepreneurship Competition. Express bags based on green environmental protection materials are a new concept developed under the traditional packaging. They are harmless to the ecological environment and human health, reusable and renewable, and consistent with sustainable development. It is the inevitable choice to solve the serious environmental pollution and will be the trend of packaging materials in the future.

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