# Research on Recycling Cost of Express Packaging Waste Under Circular Economy

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**Abstract.** Under the background of low carbon economy, the waste and pollution of express package are becoming more and more serious. Based on the perspective of circular economy, this paper takes sf express as an example, analyzes the current situation of sf express and the recycling conditions of packaging waste, establishes relevant recycling model, and discusses how sf express can recycle packaging waste through express delivery to reduce the cost of express delivery enterprises and reduce the waste of resources.

**Keywords:** Circular economy; Recycling logistics; Cost recovery.

## 1. Introduction

With the rapid development of express delivery industry, the whole industry focuses on expanding the scale of the industry and improving infrastructure, ignoring the role of recycling logistics in the recycling of express packaging waste. As a result, great waste of resources and serious environmental problems have been caused.

China's express delivery service volume reached 50.5 billion units in 2018, up 25.8 percent, data showed. We created more than 200,000 jobs, supported 6.9 trillion yuan of online retail sales, and supported more than 350 billion yuan of cross-border e-commerce trade. In 2018, the state post bureau promoted green packaging in the express delivery industry, with the usage rate of electronic waybills reaching 92 percent and the number of new-energy vehicles in the industry exceeding 12,000.The enterprise carried out the pilot application of recyclable transit bags, and developed the application of recyclable express boxes and biodegradable packaging materials. This year, the state post bureau will continue to implement the "green post" action plan, establish a statistical monitoring system, promote the implementation of green certification, and make green development an important part of its supervision of market players. It is planned that by the end of 2019, the usage rate of electronic waybill will reach 95%, and more than half of e-business express deliveries will not be re-packaged, and 10,000 postal express outlets will be set up with recycling devices for packaging waste such as plastic products and cartons. Therefore, from the perspective of circular economy, the recycling of express packaging is the trend of The Times.

## 2. The Connotation of Circular Economy

The so-called circular economy, in essence, is a kind of ecological economy, which requires the use of ecological rules rather than mechanical rules to guide the economic activities of human society. Since the 1960s, the circular economy has flourished. Compared with traditional economy, circular economy is different from traditional economy. Traditional economy is a linear economy with one-way flow of "resource -- product -- pollution emission", which is characterized by high exploitation, low utilization and high emission. Circular economy advocates an economic development model that is harmonious with the environment. It requires economic activities to be organized into a feedback process of "resource-product-renewable resources", which is characterized by low exploitation, high utilization and low emission. Circular economy emphasizes the material closed loop flow, economy and ecological economy, such as connotation, requirements, in accordance with the economic law, social law, the laws of nature, technology, ecology rule the entire process of production, consumption and waste treatment, will the current "resources - products - waste" open loop type economic system, into a "resources - products - waste -" closed loop type economic system, economic system

harmoniously integrated into the natural ecosystem material circulation process, realize resource consumption reduction in economic and social activities, product reuse and recycle use.

In China, the theory of circular economy has been applied in a wide range, covering many industries. However, because the express industry has developed rapidly in recent years, the application of circular economy theory in the field of waste recycling in the express industry is still rare. This paper attempts to apply the circular economy to the packaging recycling problem in the express industry.

## 3. Definition of Recycling Logistics

According to the logistics terms of national quality standards of the People's Republic of China, recycling logistics is defined as: "recycling logistics refers to the flow of unqualified goods from repair, return and used packaging containers to the entity of goods formed by the supplier.

### 3.1 Express Packaging Waste Recycling Significance

Express packaging waste recovery is the use of express packaging for collection activities. At present, most express packages in China are discarded at one time, which causes great waste of resources and environmental pollution. If express delivery enterprises can fully and effectively recycle packaging waste, they can not only reduce the cost of enterprises, but also reduce the waste of resources and environmental pollution, which can be said to achieve multiple goals.

### 3.2 Express Packaging Waste Recycling Difficulties

Fast recovery rate is low, there is no special recycling channel. In recent years, China's express delivery industry has not realized the importance of packaging waste recycling and has not established a special recycling channel.

The extent and uncertainty of where waste is dumped. Due to the wide distribution of the final customers, most of the packaging waste needs to be concentrated in various scattered points and collected many times before it is possible to carry out subsequent recycling treatment.

Express packaging for disposable use. Due to the poor production materials and quality of some express packaging materials, the lack of unified specifications or the customers' random unpacking and damage of express packaging, the recycling cost of express packaging is high and the recycling value is lost.

Lack of awareness of recycling logistics and related regulations constraints. Customers lack the awareness of recycling express packaging waste, and most packaging waste is usually thrown away in the household garbage. China has not formulated relevant regulations on waste packaging recycling and reproduction, and lacks relevant laws and regulations to restrain the behavior of express delivery industry and regulate the recycling of express packaging waste.

## 4. Sf Express for Packaging Waste Recycling Ideas

### 4.1 Sf Express Packaging Waste Recycling Process Ideas

Along abundant express packages for customization of a unified specification of recycled materials, mainly can be divided into three categories: cartons, polystyrene, polyethylene, the cost is about 4.3 yuan/kg, respectively 17 yuan/kg, 9 yuan/kg, according to the Courier about 90% carton packaging, 7% polyethylene, polystyrene, 3% express the packaging cost per kilogram is about: C express the packaging cost 4.3 + 7% = 90% 3% 9 + 17 = 5.01 yuan/kg. Because sf currently has no reasonable recycling process, most of the final packaging waste is recycled and incinerated, resulting in a great waste of resources and environmental pollution. Therefore, the author designed the following process for the recycling and reuse of express packaging of sf express:
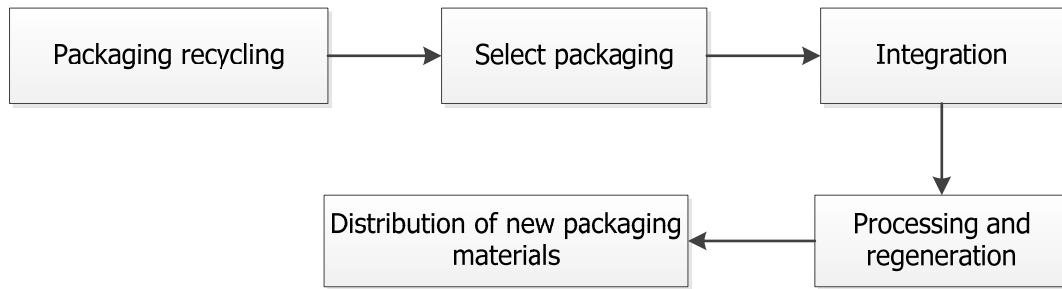
Fig 1. Express packaging recycling process

Packaging recycling: the express packaging is recovered from customers by means of outlet recycling, delivery recycling, fixed-point recycling, deposit recovery and other ways.

Select packaging: each agency selects the packaging waste recovered from the lower agency or local customers, and preserves the complete packaging waste that can be directly used for reuse. Packaging waste that cannot be used directly is transported with the cargo to the next level distribution center.

Integration: the accumulation of packaging waste that cannot be directly used at each level of agency is integrated and transported to the recycling plant after simple classification.

Processing and regeneration: after the processing and regeneration of the recycling plant, the new packaging materials are sent to the integration department for sorting and classification.

Distribution of new packaging materials: new packaging materials processed and regenerated will be distributed to each agency of sf step by step along with the transport vehicles arriving at the integration department.

**4.2 The Cost Model of Recycling and Reproduction of Packaging Waste of Sf Express**

According to the process design, the recycling and reproduction cost model of sf express packaging waste is divided into two parts.

**4.2.1 Packaging Waste Recovery Cost Model**

$$Ct1 = \sum k \sum i \sum j \, Tij(k,l) + \sum i \sum j \, [Sij(l) + Pij(m) + Tij(l,m) + Mij(t1)] \tag{1}$$

C t1 is the total cost of packaging waste recovery; Tij (l, m) is the transportation cost of packaging waste from customer k to l level distribution center that cannot be directly reused for batch j of category I;Sij (l) refers to the storage cost of packaging waste in the l-level distribution center, which cannot be directly reused for batch j of class I. Pij (m) is the sorting cost of batch j of class I that packaging waste cannot be directly reused in integration section m; Tij (l, m) is the transportation cost from the l-level distribution center to the integration department m. Mij (t1) is the management cost in the recycling process of packaging waste.

**4.2.2 Packaging Waste Reproduction Cost Model**

$$C\,t2 = \sum i \sum j \, [P\,ij(t2) + T\,ij(m,n) + M\,ij(t2)] \tag{2}$$

C t2 is the total cost of reproduction of packaging waste that cannot be directly reused; P ij (t2) is the treatment cost of packaging waste in the recycling plant, which cannot be directly reused. T ij (m, n) is the transportation cost of packaging waste that cannot be directly reused from the integration department m to the recycling plant. Mij(t2) is the management cost of packaging waste that cannotbe directly reused in the treatmen tplant:

$$C = Ct1 + Ct2 \tag{3}$$

C is the total cost of recycling and reproduction of packaging waste that cannot be directly reused.

### 4.2.3 Analysis of Example

It is assumed that sf recycled and remanufactured A batch of damaged express packaging waste in area C, city B, A province (about 80% of express packaging waste).

First, the type and proportion of packaging waste and the average cost of sf express from customers: Paper packaging materials account for about 90% of the total packaging waste, and its recycling cost is about 0.5 yuan /kg. Polyethylene packaging material accounts for about 7% of the total packaging waste, and its recovery cost is about 0.7 yuan /kg. Polystyrene packaging material accounts for about 3% of the total packaging waste, and its recovery cost is about 0.7 yuan /kg.

Second, the average transport cost of packaging waste between all levels of distribution centers: The average transportation costs of paper packaging, polyethylene packaging and polystyrene packaging are about 0.42 yuan /kg, 0.91 yuan /kg and 0.95 yuan/kg respectively. The average transportation cost of paper packaging, polyethylene packaging and polystyrene packaging is about 0.32 yuan /kg, 0.92 yuan /kg and 0.97yuan/kg respectively from the distribution center of B city to the distribution center of A province. The average transportation cost of paper packaging, polyethylene packaging and polystyrene packaging is about 0.32 yuan /kg, 0.90 yuan /kg and 0.97 yuan /kg respectively. The average transportation cost of paper packaging, polyethylene packaging and polystyrene packaging is about 0.24 yuan /kg, 0.75 yuan /kg and 0.78 yuan /kg respectively.

Third, the average storage cost of packaging waste at all levels of distribution centers: C. The average storage cost of paper packaging, polyethylene packaging and polystyrene packaging is about 0.35 yuan /kg, 0.93 yuan /kg and 0.94 yuan /kg, respectively. The average storage cost of paper packaging, polyethylene packaging and polystyrene packaging in the distribution center of B city is about 0.37 yuan /kg, 0.95 yuan /kg and 0.97 yuan /kg respectively. In the distribution center of A province, the average storage cost of paper packaging, polyethylene packaging and polystyrene packaging is about 0.36 yuan /kg, 0.92 yuan /kg and 0.94 yuan /kg respectively.

Fourth, the sorting cost of packaging waste in the integration department: In the integration department, the average sorting cost of paper packaging, polyethylene packaging and polystyrene packaging is about 0.42 yuan /kg, 0.46 yuan /kg and 0.42 yuan /kg respectively.

Fifth, the management cost of packaging waste in the recycling process: In the recycling process, the average management cost of paper packaging, polyethylene packaging and polystyrene packaging is about 0.75 yuan /kg, 0.72 yuan /kg and 0.76 yuan /kg, respectively.

Sixth, the management cost of packaging waste in the treatment process: In the process, the average management cost of paper packaging, polyethylene packaging and polystyrene packaging is about 0.64 yuan /kg, 0.57 yuan /kg and 0.67 yuan /kg, respectively.

Seventh, the disposal cost of packaging waste in the recycling plant: In the recycling plant, the average processing cost of paper packaging, polyethylene packaging and polystyrene packaging is about 0.78 yuan /kg, 0.96 yuan /kg and 0.97 yuan /kg, respectively.

According to formula (1), $C_{t1}$ paper =3.81 yuan /kg;

$C_{t1}$ polyethylene =7.41 yuan /kg; $C_{t1}$ polybenzene =7.62 yuan /kg

According to formula (2), $C_{t2}$ paper =1.66 yuan /kg;

$C_{t2}$ polyethylene =2.28 yuan /kg; $C_{t2}$ polybenzene =2.42 yuan /kg

According to formula (3), C paper =$C_{t1}$ paper +$C_{t2}$ paper =5.47 yuan /kg;

C poly (b) =$C_{t1}$ poly (b) +$C_{t2}$ poly (b) =9.69 yuan /kg; C polybenzene =$C_{t1}$ polybenzene +$C_{t2}$ polybenzene =10.04 yuan /kg

C damaged packaging waste recovery and reproduction =90%C paper +7%C polyethylene+3%C polybenzene =90%5.47+7%9.69+3%10.04=5.90 yuan /kg

Because damaged packaging waste accounts for about 80% of packaging waste, the rest20% can be reused directly at negligible cost. So packaging waste the recycling cost is: C packaging waste recycling =80%C damaged packaging waste recycling; Reproduction =4.72 yuan /kg

It can be seen from the calculation example that according to the envisioned recycling process, the cost of recycling a batch of damaged express packaging is about 4.722 yuan /kg. Compared with the

cost of 5.01 yuan /kg of express packaging purchased by sf express, sf express can directly reduce its cost and improve its profit by recycling express packaging waste.

### 4.2.4 Sf Express for Packaging Waste Recycling Advantages and Recycling Methods

Speed advantage. Sf express is the largest private express company in China, with excellent service, safe and fast delivery of goods, easy recovery of packaging waste and quick response to recycling.

Management advantage. Sf express has the guarantee of direct sales under unified management. All the staff and branches are managed and planned by sf headquarters and head office; Part of the package waste can be recovered on the spot.

Packaging advantage.

Sf-express packaging is specially customized and has a unified standard. The logo of sf-express on the packaging has a clear distinction, which is convenient for recycling.

Network advantage.

Sf has a very complete nationwide distribution network. The transportation and distribution of goods are radiated from the headquarters to all provinces in China, and all links are closely linked. For the successful implementation of packaging waste recovery provides the premise and guarantee. The recycling methods of package waste of sf express are mainly recycling and recycling. The recycling methods can be as follows:

Express outlet recycling. After customers sign for the delivery of goods at the delivery point, they can directly recycle the packaging waste on the spot at the delivery point.

Recall on delivery. When the deliveryman delivers the goods to the customer, he can communicate with the customer to recycle the packaging waste.

Point recovery. Sf can carry out fixed-point recycling in centralized areas such as schools, hospitals and government offices. Packaging waste that can be reused directly can be distributed to nearby sf branches. It cannot be directly reused and collected for recycling.

Deposit recovery. Customers should pay a certain deposit when sending the goods, and return part or all of the deposit to customers according to whether the packaging is recycled or recycled after the goods are signed.

## 5. Conclusion

Based on circular economy as the research background, this paper through recycling logistics development situation in our country, analyzes the present situation of China's express delivery industry to recycling of packaging waste and difficulties, combined with the advantages for its motion design of packaging waste recycling processes, recycling cost model, and through the example analysis and comparison along abundant express Courier packaging waste recycling cost and buy the cost of packaging. On the one hand, the recycling and reuse of express packaging waste reduces the cost of sf; on the other hand, it improves the recycling utilization rate of resources and reduces the waste of resources to protect the environment.

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