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Research Article

CAD Design for Recycling and Utilization of Waste Packaging from the Perspective of Ecological Criticism

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In order to realize the value of packaging waste through recycling, detection, classification, maintenance, and reprocessing, the model construction and simulation study of logistics packaging recycling and utilization were put forward. This paper takes logistics companies as the research object, aiming at the business model of logistics companies, uses the Internet of things recycling machine for packaging recycling, and establishes a dual channel packaging recycling model. This model is intended to compare and analyze the difference between traditional packaging waste recycling channel and intelligent recycling machine of the internet of things in terms of recycling cost, profit, recovery rate, waste incineration rate, and other aspects. It is assumed that the recycling proportion of the two channels accounts for half of the packaging waste. The results of simulation analysis on recycling and utilization of dual-channel packaging waste show that in the simulated time period, the recycling rate of the intelligent recycling machine using the internet of things is higher than that of the traditional dispersed recycling vendors. Assume that when the recycling frequency = 2, when the recycling frequency is increased to 2 times a day, the recycling time of the internet of things recycling machine is further shortened, and the recycling efficiency is improved. At the same time, due to the improvement of the recycling rate of the internet of things recycling machine, the amount of waste packaging decreases, so the recycling rate of the dispersed recycling vendors decreases accordingly. The recycling revenue and net profit generated by channel 2 (internet of things recycling machine) are higher than those generated by channel 1 (decentralized recycling vendor responsible for recycling). The average profit of channel 2 is about 28,163.69 yuan, while the average profit of channel 1 is only 9,395.89 yuan. The waste recovered through channel 2 is lower than that in channel 1; the average for channel 1 is 15.58 tons. However, the average value of channel 2 is 14.58 tons. Comprehensive analysis shows that channel 2 has obvious advantages in reducing waste discharge. However, it is necessary to strengthen the research and development of recycling technology, improve the reuse efficiency, and reduce the incineration of nonreusable waste as much as possible to the minimum, which proves the robustness of this paper to the logistics packaging recycling model construction. It is proved that the robustness of this paper for logistics packaging recycling model construction provides strong support for the analysis of waste pallets and packaging recycling-related issues.

1. Introduction

With the historical progress of the industrial revolution and reform and opening up, metal packaging and plastic packaging have become the main materials of contemporary packaging [1]. Due to the special material of metal and plastic being stronger and antifouling than paper packaging, more manufacturers begin to use metal and plastic materials as product packaging materials. However, because of these tough characteristics of both, they are more difficult to degrade [2, 3]. On the other hand, some substances contained in metals and plastics can cause different degrees of damage to the soil, which makes it urgent to solve the problem of packaging recycling. With the continuous improvement of people's understanding of waste recycling, China has become more mature in the recycling of metal, glass, paper, and plastic, forming a recycling system and gaining certain experience. With the booming development of the logistics and manufacturing industry, the demand for packaging is expanding day by day [4]. The output of logistics packaging, such as plastic pallets and packaging containers, increases year by year, but China's logistics industry is still in a period of extensive development, and the loss caused by improper packaging is more than 10 billion yuan. Packaging waste is a potential urban mineral resource, but the traditional packaging recycling channel has problems such as low recovery, weak enthusiasm for recovery, and delay in recovery, which cannot adapt to the development of the logistics and packaging industry in the internet of things environment. The unsmooth recycling channel leads to a large number of packaging waste that has not been recycled efficiently and reasonably, which puts forward higher requirements for the development of packaging waste recycling activities. Pilot work such as environmental protection deposit system should be carried out. Based on the extended producer responsibility system, it should be clear that manufacturers and recyclers should take responsibility for recycling packaging waste. Figure 1 is the dual-channel packaging recycling model. Recyclers should formulate a reasonable rebate ratio according to the recovery cost and recovery profit and improve consumers' enthusiasm for packaging waste recycling by the incentive of rebates on the premise of maximizing profits. The government should establish a higher environmental tax to restrict the waste reduction responsibility of manufacturers, recyclers, incinerators, and other related subjects, and the implementation of environmental tax should be adapted to local conditions. According to the degree of environmental pollution, different environmental protection taxes should be adopted for different regions and different tax targets. At the same time, it should be realized that when the environmental protection tax is kept at a high level, the cost of package is remained at a high level too. At this time, a combination of strategies should be adopted to further reduce waste emissions through rebates or other preferential tax policies.

2. Literature Review

To address this research problem, Yang applied the SWAP computer package to help develop the decision-making process for solid waste management plans. The study analyzed the costs of transporting and treating waste, as well as the benefits of various waste recycling, providing a cost solution for networked waste management areas. Taking recyclable containers as the application example of reverse logistics [5], Guo studied the container reverse logistics system and constructed a mixed-integer programming model based on the number and location of recycling points of packaging containers [6]. Basirizadeh et al. studied the production and distribution activities and logistics network model of reusable bottled containers for a large soft drink manufacturer [7]. Petour and Assael who studied the recycling of waste carpets developed a mixed-integer programming model to support decision-making in reverse production system design. The study shows that the overall economic feasibility of recycling depends largely on the expected amount of investment in recycling infrastructure. The geographical location of processing centers affects the economics of the recycling network. An effective strategy for carpet recycling is to reduce the transportation of low-value materials [3]. Peng establishes a cost model for minimization of hazardous waste reverse logistics system considering time step and type [8]. Guo studied the problem of liquefied petroleum gas tank recovery system and established a site-allocation mixed-integer programming model [6]. Anwar et al. constructed a mixed-integer goal programming model to assist in the efficient management of waste paper recycling logistics systems [9]. Sharma et al. applied a system dynamics approach to building a solid waste model, and simulation analysis showed that there would be additional budget costs in the transition from landfill to landfill disposal. For the management planning of plastic solid waste [10], Dong et al. introduced the life cycle assessment theory into the system dynamics model so that it can carry out a related ecological and economic evaluations on the material flow, energy flow, and capital flow of the system [11]. Somarajan et al. applied system dynamics to predict the production of municipal solid waste (MSW) in a rapidly growing area [12].

Based on the current research, this paper adopts the internet of things recycling machine for packaging recycling and establishes a dual-channel packaging recycling and utilization model. The model aims to compare the traditional packaging waste recycling channels with the intelligent recycling machine of Internet of things in terms of cost recovery, profit recovery, waste incineration rate, etc. It is assumed that these two recycling channels each account for half of the packaging waste recycling mode, and combined with the actual operation, a dual channel packaging recycling mode is constructed.

3. Method

3.1. Structure and Basic Assumptions of the Dual Channel Packaging Recycling System. The recycling model of discarded plastic pallets is aimed at the collection of packaging containers with a long service cycle and high value. However, packaging wastes such as express cartons and bottled containers, which have a short use cycle, low recycling value, and weak enthusiasm for recycling, have certain particularity, so it is necessary to conduct targeted studies separately. However, whether it is the recycling of discarded plastic trays or the recycling of double-channel packaging, they are all discussing the urban mineral resources such as logistics packaging [13]. Both are targeted discussions under the framework of an integrated logistics packaging recycling system. Although the two models are independent, they are complementary to the recycling system [14, 15]. In the packaging industry and circular economy industry, some

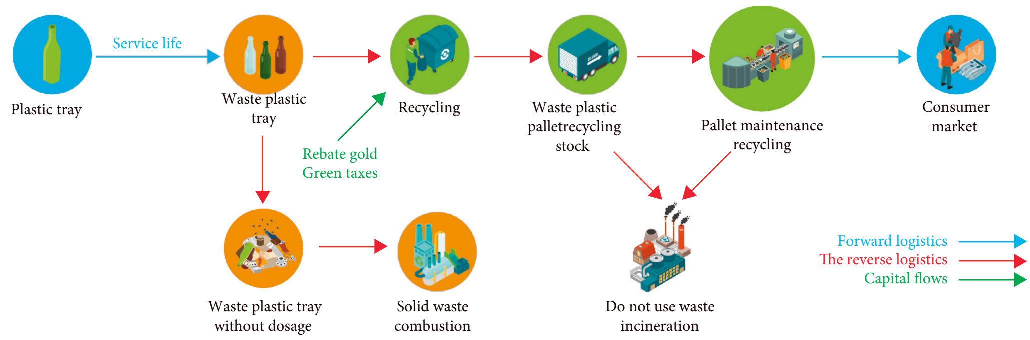

Figure 1: Structural block diagram of the recycling model of the waste plastic tray.

recycling companies have also carried out packaging waste recycling mechanisms and model exploration. For example, a certain company, Renewable Resources Recycling Co. Ltd., pioneered the advanced mode of Internet + renewable resources in China. The company is a leading operator and provider of integrated solutions for intelligent solid waste recycling machines and tools and recycling systems in China. In 2016, a company is piloting the deposit system, that is, for every piece of packaging waste recycled, consumers can get a certain percentage of cash rebate through the information platform of the recycling machine. The intelligent recycling machine of the internet of things is a new mode of packaging recycling [16]. By establishing a dual-channel packaging recycling model, the advantages and disadvantages of the new mode and the traditional packaging recycling channel are compared and analyzed. Traditional packaging waste recycling channels have problems such as low recovery efficiency and delayed recovery information, but using the internet of things recycling machine for packaging recycling can solve such problems [17]. The model analyzes the recovery cost rate, recovery profit rate and waste incineration recovery rate of the traditional packaging waste recovery channel, and the intelligent recycling machine of Internet of things. It is assumed that the two packaging waste recovery channels account for half respectively, and a dual channel packaging recovery mode is constructed in combination with the actual operation.

Channel 1 represents the traditional informal recycling channel, that is, dispersed recycling vendors are responsible for packaging waste recycling. After consumers discard the packaging, the dispersed recycling vendors collect the packaging waste from the recycling points such as street garbage cans. The recycling vendors pay the market recycling price to the mobile recycling vendors and recover the packaging waste from the recycling vendors. After recycling, the recycled packaging waste will be transformed into packaging products and re-enter the market. In the reverse supply chain of channel 1, there will be recycling cost, recycling revenue, recycling cost, nonreusable waste disposal cost, environmental protection tax, recycling revenue, and recycling profit [18, 19].

Channel 2 represents the regular recycling channel, that is, the channel through which the internet of things recycling machine is used to recycle packaging waste. Consumers take the initiative to put the packaging into the recycling machine of the internet of things and immediately get a certain percentage of rebate from the information platform of the recycling machine, and the recycled packaging continues to be put into the market after recycling processing. In the reverse supply chain of channel 2, there will be recycling cost, recycling cost, nonreusable waste disposal cost, environmental protection tax recovery income, and recycling profit. However, due to the reuse technology and detection error, a certain amount of nonreusable wastes will be generated in both channels.

The model is based on the following assumptions.

Hypothesis 1. Consider the recycling and disposal of packaging waste in a certain area [20].

Hypothesis 2. It is assumed that the production capacity of packaging, recycling capacity, recycling capacity, and waste disposal capacity are not limited. Intelligent recycling machines and decentralized recycling vendors can meet the recycling needs of waste packaging, and the production rate of packaging can meet the packaging needs of consumers.

Hypothesis 3. Considering the recovery cost, we have to consider the disposal cost of nonrecyclable waste and the recovery profit of environmental tax rebate. Regardless of transportation route planning, transportation costs, and administrative expenses, recycled packaging can continue to be sold at the price of recycled materials.

3.2. Dynamic Equation of the Double-Channel Packaging Recovery System.

$$\text{Non}-\text{reusable waste disposal cost (channel1)} = \text{incineration rate of non}-\text{reusable waste after recycling (channel1)} {}^{*}\text{incineration time} {}^{*}\text{Unit incineration cost, Units : YUAN}$$

$$\text{Non}-\text{reusable waste disposal cost (channel2)} = \text{Incineration rate of unrecyclable waste after recycling (channel2)} {}^{*}\text{Incineration time}{}^{*}\text{Unit incineration cost, Units : Yuan}$$

$$\text{Per capita packaging demand} = \text{RANDOM NORMAL}(\{\text{min}\}, \{\text{max}\}, \{\text{mean}\}, \{\text{stdev}\}, \{\text{seed}\}), \text{Units : piece/person}$$

$$\text{Recycling stock (channel2)} = \text{INTEG}\begin{pmatrix}\text{Recycling rate (channel2)} \\ -\text{Sales rate (channel2), 0}\end{pmatrix}, \text{Units : piece}$$

$$\text{Recycling cost (channel2)} = \text{Recycling rate (channel2)} {}^{*}\text{Recycling time}{}^{*}\text{Unit regeneration cost}{}^{*} \text{Average packaging weight} + \text{Recycling stock (Channel2)} {}^{*}\text{Average packaging weight}{}^{*}\text{unit storage cost, Units : Yuan}$$

$$\text{Regeneration benefit (channel1)} = \text{Sales Rate (Channel1)}{}^{*}\text{Average package weight} {}^{*}\text{Sales price of recycled materials}{}^{*}\text{Sales time, Units : Yuan}$$

$$\text{Regeneration Income (channel2)} = \text{Sales Rate (Channel2)} {}^{*}\text{Timeof sale}{}^{*}\text{average weight of packaging} {}^{*}\text{Sales price of recycled materials,} \text{Units : first}$$

$$\text{Sales price of recycled materials} = \text{INTEGER}\left(\text{RANDOM NORMAL}\begin{pmatrix}\{\text{min}\}, \{\text{max}\}, \{\text{mean}\}, \\ \{\text{stdev}\}, \{\text{seed}\}\end{pmatrix}\right), \text{Units : Yuan/ton}$$

$$\text{Recycling rate (channel1)} = \text{Recovery stock (channel1)}{}^{*}\text{Recycling/regeneration time, Units : piece / Day}$$

$$\text{Recycling rate (Channel2)} = \text{Recovery stock (Channel2)} {}^{*}\text{Reavailability/regeneration time, Units : piece / Day}$$

$$\text{Recovery rate of the dispersed recycling vendors} = \begin{pmatrix}\text{SMOOTH (waste packaging stock}{}^{*}\text{ recovery ratio, smoothing time)} \\ {}^{*}\begin{pmatrix}\text{Recovery rate} + \text{recovery rate}{}^{*} \\ \text{Effect of receiving price on recovery rate factor} + \text{recovery rate} \\ {}^{*}\text{Impact factor of environmental tax on recovery rate}\end{pmatrix}\end{pmatrix} \text{(Recovery time} + \text{smoothing time), Units : piece/Day}$$

$$\text{Number of dispersed recycling vendors} = \text{INTEGER} \begin{pmatrix}\text{Waste packaging stock}{}^{*} \\ \text{recycling ratio/average recycling capacity}\end{pmatrix}, \text{Units : People}$$

$$\begin{aligned}
\text{Stock of the packaged finished products} &= \text{INTEG} \\
&\quad (\text{Packaging production rate} - \text{waste rate}, 0), \text{Units : piece} \\
\text{Packing recovery price} &= \text{INTEGER (RANDOM NORMAL} \\
&\quad (\{\min\}, \{\max\}, \{\text{mean}\}, \{\text{stdev}\}, \{\text{eed}\}), \text{Units : Yuan/ton} \\
\text{Generation rate of packaging waste (channel1)} &= (\text{Recovery rate}^{*} \text{ recovery time of waste packaging stock}) \\
&\quad {}^{*}\text{Package average weight/generation time, Units : ton/Day} \\
\text{Generation rate of packaging waste (channel 2)} & \\
&= \left(\begin{array}{c} \text{Waste packaging stock} \\ -\text{Recovery rate of Internet of Things} \\ \text{recovery machine}^{*}\text{Recovery time} \end{array} \right) \\
&\quad {}^{*}\text{Package average weight/ generation time, Units : ton/Day} \\
&\quad \text{Packaging waste without unused (channel1)} \\
&= \text{INTEG} \left(\begin{array}{c} \text{Generation rate of packaging waste storage (channel 1)} \\ -\text{Incineration rate of packaging waste storage} \\ \text{without consumption (channel1)}, 0 \end{array} \right) \\
&\quad \text{Units : ton} \\
&\quad \text{Packaging waste without unused (channel 2)} \\
&= \text{INTEG} \left(\begin{array}{c} \text{generation rate of packaging waste storage (channel 2)} \\ -\text{Incineration rate of packaging waste storage} \\ \text{without consumption (channel 2)}, 0 \end{array} \right) \\
&\quad \text{Units : ton} \\
\text{Total packaging requirements} &= \text{INTEGER} \\
&\quad (\text{Per capita packaging demand}^{*} \text{Regional total population}), \text{Units : parts} \\
\text{Packaging production rate} &= \text{SMOOTH} \\
&\quad (\text{Total packaging requirements, smoothing time}) \\
&\quad \text{Production time, Units : Parts / Day.}
\end{aligned} \tag{1}$$

3.3. Correlation Test of the Model

3.3.1. Range Test. The scope test is to test whether the structural variable equation of the model is consistent with the described research problem, the actual situation, and the established conceptual model. The SD models established in this paper are all based on the real situation and system structure, and the CheckModel function in VensimPLE is used to detect that the model established in this paper has no structural problems, and the expected effect is achieved.

3.3.2. Dimension Consistency. It mainly tests whether the dimensionality of variables in the model is consistent. Dimensionality inconsistency will lead to problems such as model failure or operation error and unreasonable output results. In system dynamics, the dimensional inconsistency of the model is not allowed. The unit of the model in this paper is set based on the actual situation and literature and detected by the UnitsCheck function in Vensim. The dimensions of the model constructed in this paper are all consistent and conform to the practical significance.

3.3.3. Test of Extreme Conditions. The purpose of testing the robustness of the model is to check whether the variables of the model under extreme conditions are still meaningful and conform to social reality.

The conditions for recycling and utilization of waste plastic pallets should be checked more strictly.

It is assumed that the parameters of the recycling and utilization model of discarded plastic pallets are as follows: recovery rate = 0.1, reuse rate = 0, and the extreme conditions of the model are tested.

The detection results are shown in Figures 2 and 3, which are obvious: when the recycling rate is 0, it indicates that the recycling enterprise stops production and shuts down, and the revenue of recycling is 0. If the recycling activity continues, the related cost of recycling will be generated, making the recycling profit appear continuous loss. At the same time, because recycling cannot be carried out, the recycled packaging waste is incinerated as nonreusable waste, and the incineration rate of nonreusable waste continues to increase. The extreme condition test conforms to reality and passes the test.

3.3.4. Inspection of Extreme Conditions of Double-Channel Packaging Recycling. It is assumed that the parameters of the dual-channel packaging recycling model are as follows: recovery rate = 0.3, reuse rate = 0, and the model was tested under extreme conditions. The test results are shown in Figure 4. When the recycling rate is 0, it indicates that the recycling enterprise stops production and the recycling income is 0. If the recycling activities continue, the recycling profit will continue to decline, and the recycling chamber will have sustained losses. Figure 5 shows that if no regeneration processing is carried out, the recycled packaging waste can only be incinerated as nonreusable waste, and the incineration rate will continue to rise, which conforms to the actual operation mechanism and passes the test under extreme conditions.

3.3.5. Behavior Anomaly Test. When some preset conditions and parameters in the model change, the model will have abnormal behavior, that is, does not conform to the actual system. If abnormal behavior occurs, the equations and variables in the model need to be re-examined to see if they are in line with the actual situation. In the long-term repeatability test process, the model established in this paper has passed through cyclic simulation to find problems, analyze the model, adjust the simulation process, and finally achieved the expected effect, no abnormal conditions have been found, and has strong stability.

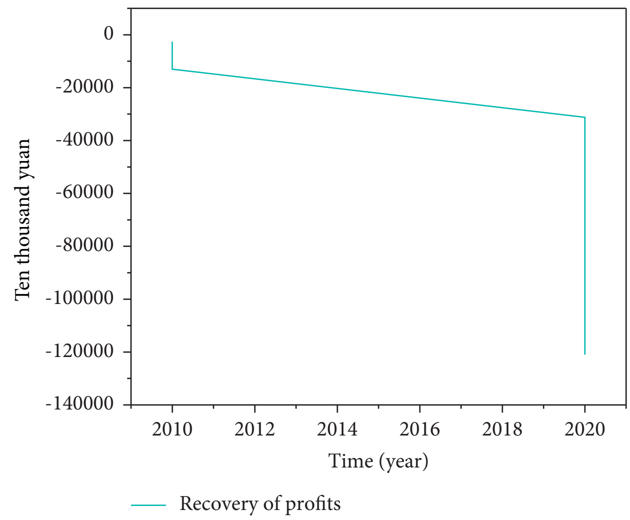

Figure 2: Waste plastic tray recycling profit.

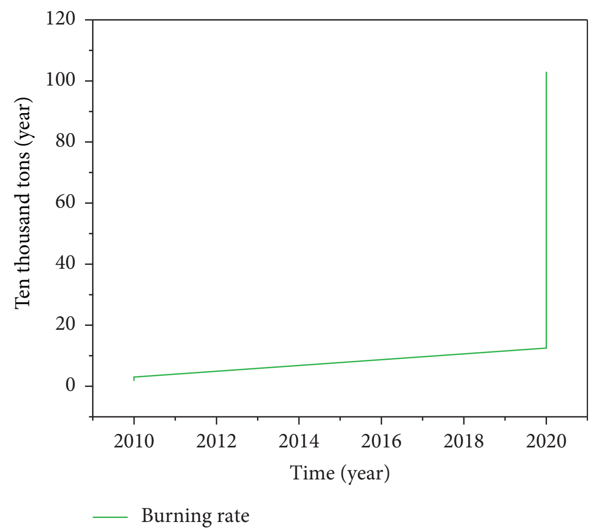

Figure 3: Waste incineration rate cannot be reused.

3.4. Key Parameters of the Dual-Channel Packaging Recycling Model

3.4.1. Set Parameters Related to Packaging Demand and Price. The simulation duration is set to 0 days for the initial time, 365 days for the final time, and 1 day for the time step. That is, the simulation period is 365 days, and 1 day is a step. Based on the actual situation, this paper assumes that in channel 1, the dispersed recycling vendors are responsible for recycling packaging waste, and the recycling vendors have a delay in the recycling information of packaging waste. In channel 2, recycling is carried out through the intelligent recycling machine of the internet of things in the region, and there is no information delay. Combined with the actual situation, this paper assumes that the average weight of the packaging is 0.0002 tons per piece and that the market demand for packaging products follows the random normal distribution function. Per capital packaging demand = RANDOMNORMAL(1, 3, 2, 1, 1), unit: piece per person. In order to simulate the trend of market price changes, assuming that the market price follows the normal distribution function, the sales price of recycled materials = INTEGER(RANDOMNORMAL (5,000,6,000, 5,500, 50, 5,000)), unit: yuan per ton. Packaging recycling price = INTEGER(RANDOMNORMAL (1,500, 2,000, 1,750, 50, 1,500), unit: yuan per ton. The main parameters involved in the memory flow diagram are listed in Tables 1, 2.

4. Results and Analysis

4.1. Simulation Analysis of Recycling and Utilization of Dual-Channel Packaging Waste. Compared with developed countries that carry out packaging recycling activities earlier, the recycling rate of paper products packaging waste in China is lower at 30.2%. For the convenience of calculation, it is assumed that the recovery rate of paper packaging is taken as the recovery rate of packaging waste in the model, that is, the rebate ratio = 0.1 and the recovery rate = 0.3. Other parameters in Tables 1 and 2 remain unchanged to

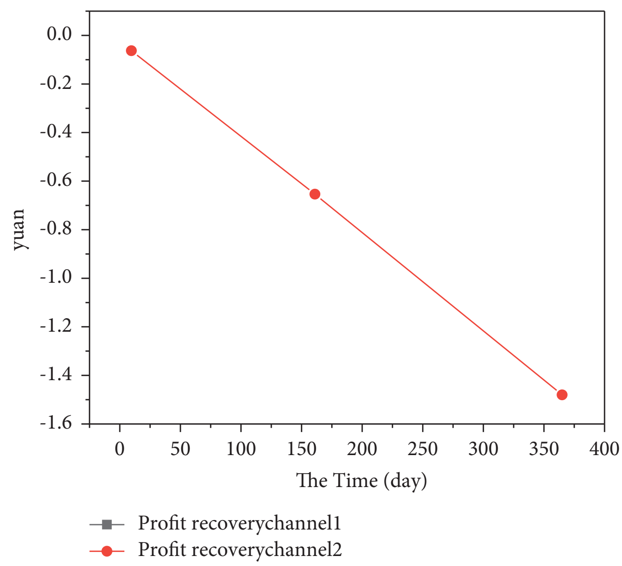

Figure 4: Double-channel packaging recycling profit comparison.

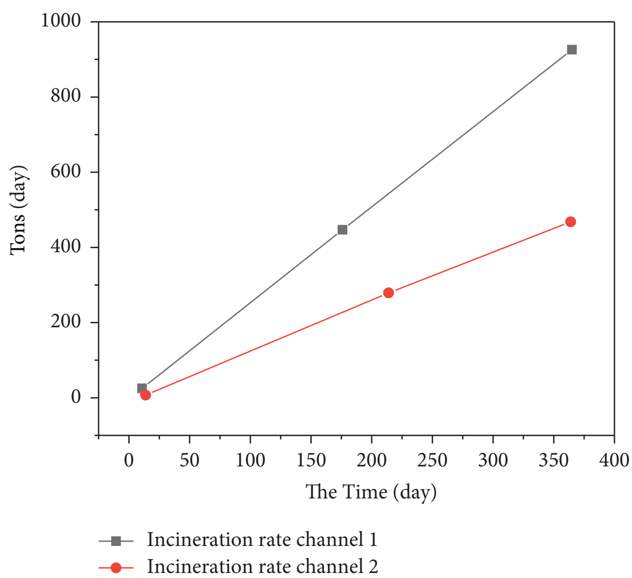

Figure 5: Nonreusable waste incineration rate comparison.

simulate the dual-channel packaging waste recycling and utilization model.

4.1.1. Comparison of Recycling Rate of Double-Channel Packaging Waste. The analysis of Figure 6 shows that the recycling rate of intelligent recycling machines using the internet of things is higher than that of traditional dispersed recycling vendors in the simulated time period. As intelligent recycling machines of the internet of things are widely distributed in the region, consumers can proactively deliver waste packaging in time, and there is no delay in recycling information, so they can respond quickly to the recycling objects and targets. However, the traditional recycling vendors are not fixed, and consumers cannot timely and actively contact the recycling vendors. Therefore, there is information delay in the recycling of packaging waste, making the recycling rate lower than that of intelligent recycling machines in the internet of things.

The intelligent recycling machine of the internet of things can further improve the recycling efficiency by improving the recycling frequency (the cleaning frequency of the intelligent recycling machine every day). This paper further simulates the recycling rate of dual-channel packaging waste. Assuming that the recycling frequency is 2, the simulation results are shown in Figure 7. When the recycling frequency is increased to 2 times per day, the recycling time of the internet of things recycling machine is further shortened, and the recycling efficiency is improved. At the same time, due to the improvement of the recycling rate of the internet of things recycling machine, the amount of waste packaging decreases, so the recycling rate of the dispersed recycling vendors decreases accordingly.

4.1.2. Double-Channel Packaging Waste Recycling Cost Comparison. Figures 8–11 shows the comparison of related costs under dual-channel recovery. According to the four simulation graphs, the recycling cost of channel 2 is higher

Table 1: Related parameters of double-beam-channel packaging recycling model simulation 1.

Control variable	Value	Unit
Rebate ratio	0.1~0.9	Dmnl
Recovery	0.1~0.9	Dmnl
Recovery ratio	0.5	Dmnl
Recycling frequency	1	Dmnl
a	0.01	Dmnl
Reuse rate	0.9	Dmnl
Pollution current value	0.9	Dmnl
Production time/production time/recycling time/ smooth time/incineration time recovery time	1	Day
Waste of time/time for selling	3	Day
The life cycle of the recycling machine	365	Day

Table 2: Related parameters of double-beam-channel packaging recycling model simulation 2.

Control variable	Value	Unit
Unit storage cost	10	Yuan/ton
Cost per unit of recycling/ incineration cost per unit	500	Yuan/ton
The environmental protection tax	1,200	Yuan/ton
Regional total population	10,000	Person
Average packing weight	0.0002	ton/piece
Average recovery capacity	500	Piece/person
Recovery cost per person per day	100	Yuan/person
Price of recycling machine	10,000	Yuan/unit
Average recovery capacity	500	Piece/unit
Rent for each recycling machine per day	100	Yuan/(unit*day)

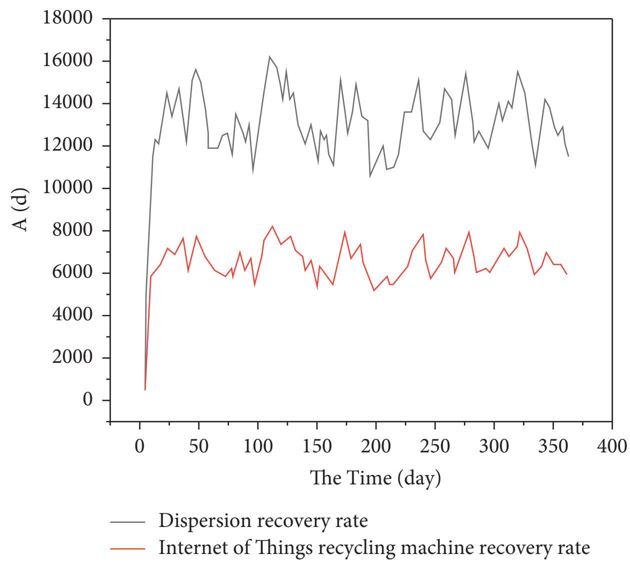

Figure 6: Comparison of the recycling rate of double-channel packaging waste.

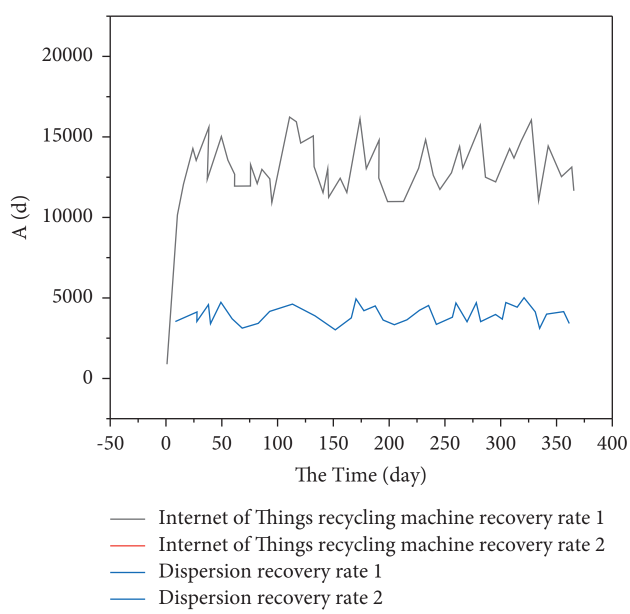

Figure 7: Influence of recovery frequency variation on the recovery rate.

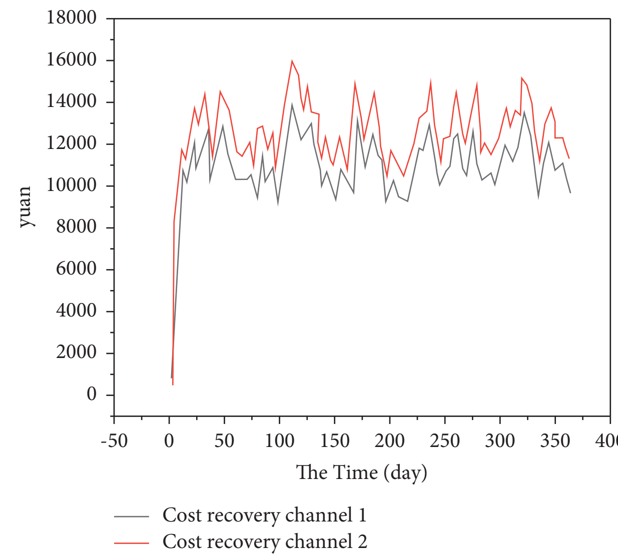

Figure 8: Cost recovering.

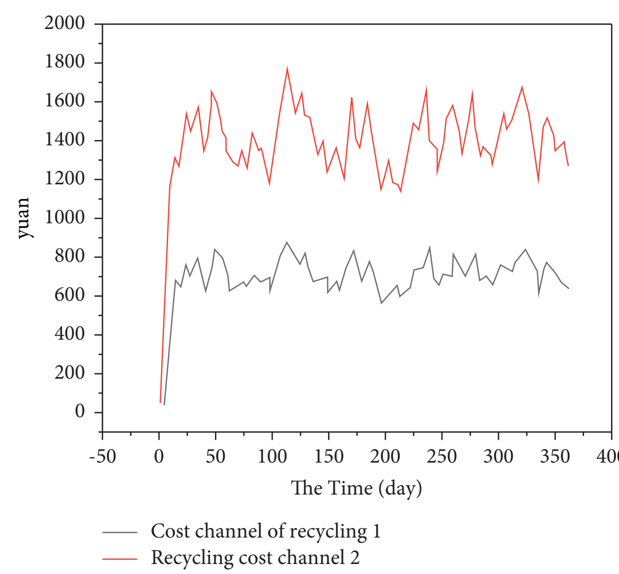

Figure 9: Cost of recycling.

than that of channel 1, indicating that the packaging recycling by intelligent recycling machine of internet of things will pay more recycling cost compared with the recycling channel of traditional dispersed recycling vendors, including the investment cost of equipment and the land lease cost of the recovered site. At the same time, the cost of recycling in channel 2 is also higher than that in channel 1. This is because the recycling rate of the internet of things recycling machine is higher than that of the dispersed recycling vendors, so the recycling stock is increased compared with channel 1, and the cost of recycling processing, the final waste disposal cost, and environmental protection tax also increase.

4.1.3. Double-Channel Packaging Waste Recycling Income and Profit Comparison. From an economic perspective, it can be seen from Figures 12 and 13 that the recycling revenue and net profit generated by channel 2 (internet of things recycling machine) are higher than those generated by channel 1 (decentralized recycling vendor responsible for recycling). The average profit of channel 2 is about 28,163.69 yuan, while the average profit of channel 1 is only 9,395.89 yuan.

According to Table 3, channel 2 became profitable on the 7th day of the simulation, while channel 1 became profitable on the 10th day of simulation. Although the recycling cost of channel 2 is higher than that of channel 1, the loss of channel 2 is more serious than that of channel 1 on the 2nd, 3rd, and 4th days of simulation. This is because the initial facility investment cost of channel 2 is significantly higher than that

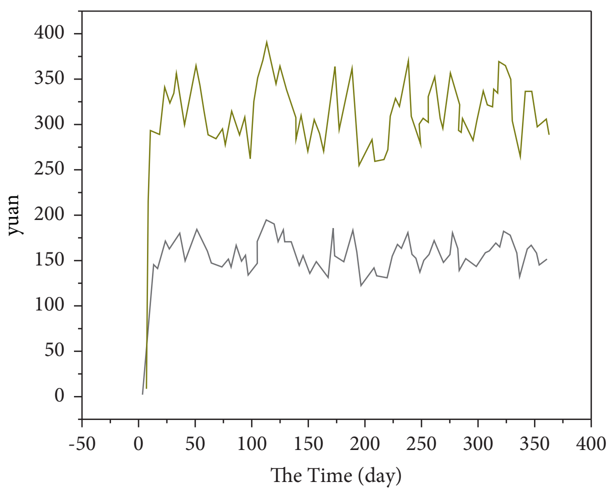

Figure 10: Environmental tariff.

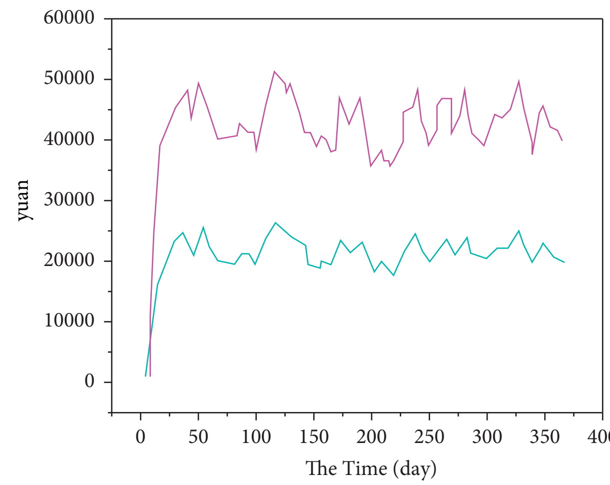

Figure 12: Comparison of the benefits of recycling.

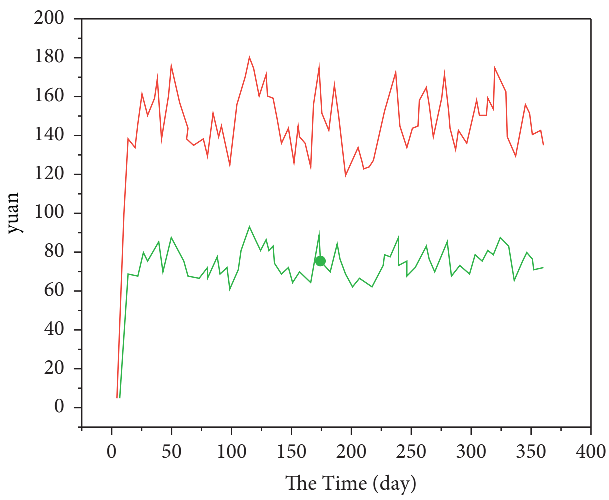

Figure 11: Waste disposal costs cannot be reused.

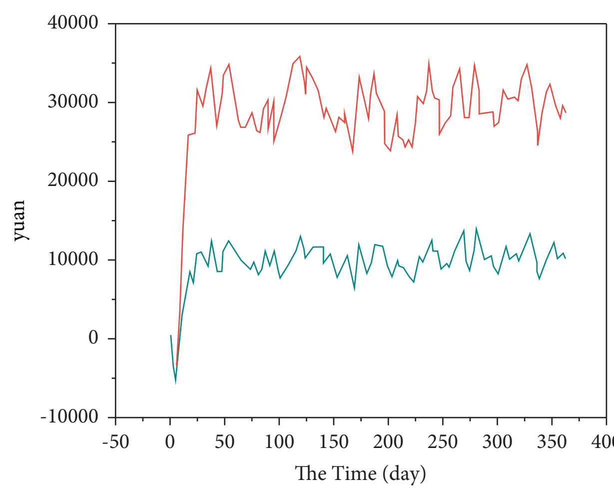

Figure 13: Recovery profit comparison.

of channel 1. However, the loss situation has been reversed since the 6th day, and the recovered profit of channel 2 continues to rise [21]. From the 5th day, in the simulation period, the recycling profit of channel 2 is significantly higher than that of channel 1. Therefore, the recycling benefit of channel 2 through the internet of things recycling machine is better than that of the traditional recycling channel.

4.1.4. Comparison of Incineration Rates of Double-Channel Packaging Waste. Figure 14 shows that the incineration rate of nonreusable waste in channel 2 is higher than that in channel 1, but the difference is small. The average value of channel 1 is 0.14 tons, while that of channel 2 is 0.29 tons. If the recycling technology cannot achieve 100% recycling, the waste discharge generated in the recycling process will increase with the increase of the recycling rate. Figure 15 shows

Table 3: Simulation of part of the time recovery profit comparison.

Time (day)	Profit recovery channel 1	Profit recovery channel 2
1	0	0
2	−400	−579.397
3	−1,606.59	−2,220.78
4	−3,439.87	−3,938.83
5	−5,044.88	−4,057.04
6	−5,278.74	−1,696.97
7	−4,326.35	2,224.22
8	−2,679.84	5,782.99
9	−987.758	9,315.68
10	216.276	11,679.9

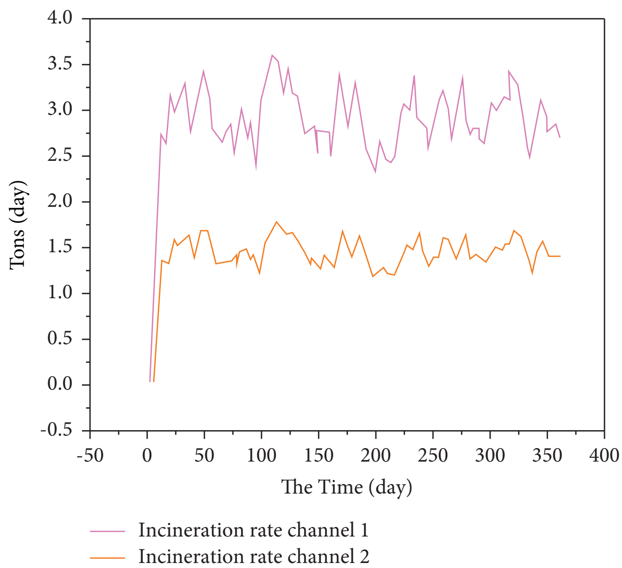

FIGURE 14: Comparison of incineration rates of nonreusable wastes.

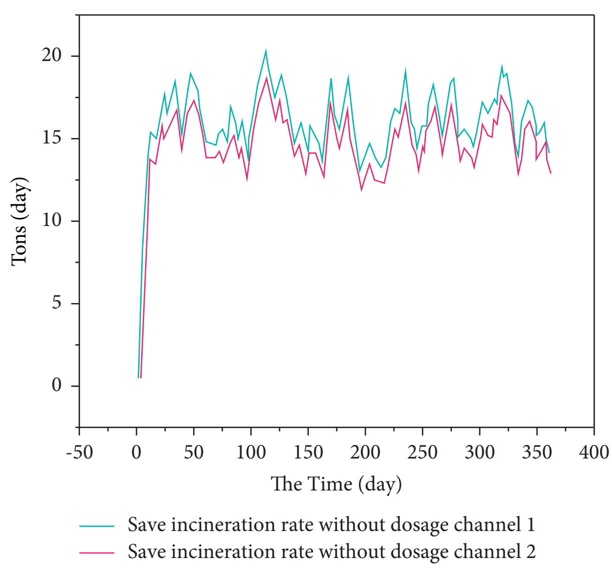

FIGURE 15: Comparison of incineration rates without storage.

that the waste recovered through channel 2 is lower than that of channel 1, and the average value of channel 1 is 15.89 tons. However, the average value of channel 2 is 14.58 tons. Comprehensive analysis shows that channel 2 has obvious advantages in reducing waste discharge. However, it is necessary to strengthen the research and development of recycling technology, improve the reuse rate, and minimize the incineration of nonreusable waste as much as possible [22, 23].

5. Conclusion

This paper proposes a CAD design for recycling and utilization of waste packaging based on the perspective of ecological criticism. Firstly, the variables and equations related to the system block diagram and flow diagram of the dual-channel packaging waste recycling and utilization model are constructed. The range dimensional extreme condition behavior anomaly of the model is tested. The model is built in the process of long-term repeated tests and debugging and has strong robustness, which provides strong support for analyzing the related problems of waste pallets and packaging recycling. Then this paper introduces the parameters of the dual-channel packaging waste recycling model and makes a detailed simulation analysis of the two models based on the hypothesis parameters. The content includes the cost-benefit recovery rate and the incineration rate of dual-channel packaging recycling simulation analysis. The simulation results provide some help and reference for the solution of logistics packaging recycling. In terms of data selection, given the large scale and variety of plastic trays, it is difficult to obtain actual data. Therefore, this model simulation has some limitations. It only analyzes the overall trend of recycling waste plastic pallets without considering the influence of constraint factors on the model, and the model needs to be further improved and expanded in the future.

Data Availability

The labeled datasets used to support the findings of this study are available from the author upon request.

Conflicts of Interest

The author declares that there are no conflicts of interest.

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