Municipal Solid Waste Treatment System—— Taking Wuhan as an Example

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Abstract. The work presented in this paper focuses on the problem of municipal solid waste in Wuhan which is becoming increasingly serious with the continuous progress of urbanization. Through literature research, we sort out and analyze the paradigms of waste treatment system of typical cities at home and abroad. By questionnaire survey, this paper makes a comprehensive analysis of current situation of municipal solid waste management in Wuhan and draws the conclusion that the waste management system is outdated and aging due to the imperfect legal system, the weak garbage sorting consciousness of residents and so on. Based on the background of Internet of things and big data, this paper puts forward some suggestions on the construction of municipal solid waste management for Wuhan.

Keywords: Municipal Solid Waste, Status Analysis, Suggestions to Management System

1. Introduction
According to statistics, the annual production of municipal solid waste in China reached 150 million tons, growing at the rate of 8-10% annually, which leads the cities of rapid development to suffer from the pain of garbage siege. Under the background of carrying out the construction of domestic waste classification demonstration area, a series of positive explorations on the management model for the classification and delivery of garbage has been conducted in various parts of the country.

Foreign studies have analyzed the influencing factors framework that needs to be considered in formulating a comprehensive and sustainable municipal solid waste management model from different perspectives, which provides a good basis for decision makers [1]. However, the management of urban living solid waste is a comprehensive problem of complexity. The current foreign research methods based on economics make the development of management mode easily and deviate from the consideration of environment and society. Since the 21th century, domestic researches have shifted from simple analysis of household waste treatment problems to in-depth studies in terms of quantitative and qualitative analysis. But most of them are limited to the single elements of management, such as treatment and disposal, fee system and so on, lacking of comprehensive system research.

This paper puts forward the improvement suggestions about diversification of source management, intelligent management of transportation and collection mode and efficient management of disposal and resource management, having the edge of comprehensive analysis.
2. Overview of Successful Domestic and Foreign Treatment Patterns

2.1. Foreign Model

2.1.1. Dual Recycling System in Germany. Germany has set up a dual recycling system. On one hand, manufacturers, packers, distributors and garbage collection departments invest in the establishment of professional recycling intermediary companies to establish a unified recycling system. On the other hand, the company organizes garbage collectors to collect consumer waste packaging and send it to the corresponding resource reuse manufacturers for recycling, and those that can be recovered directly are sent back to the manufacturers [2].

2.1.2. Japan’s Multi-subject Cooperation Model. Based on the rules of 3R, Japan’s waste management has constructed a multi-level legal system for waste management, formulated interest-driven economic policies, developed the venous industry, made the concept of garbage classification deeply popular. It has realized the mutual cooperation of multiple subjects, such as government attention, legislative support, public participation, non-profit organization practice and enterprise self-discipline [3].

2.2. Domestic Model

2.2.1. Automatic Reclassification —— Beijing Model. Since 2010, the transformed and newly built residential areas in Beijing have implemented garbage collection and promoted the recycling treatment of domestic waste. In 2012, there was a good effect on garbage classification promotion through setting up a garbage classification website. On the basis of the basic mode of garbage collection and transportation, we have taken the lead in the attempt of mechanical automatic re-classification in Xiaowuji transfer station and Majialou transfer station, and achieved good results [4].

2.2.2. Garbage Storage —— Shanghai Pudong Model. At present, there are four main forms of garbage collection and transportation system in Pudong New Area of Shanghai: the side-loading and sealing vehicle type of the bin garbage house, the compressed loading type of the second bag garbage house of the garbage collection vehicle, the container pulling-arm type of the container garbage house of the garbage collection vehicle, the small compressed garbage house container pulling-arm type of garbage collection vehicle, which serve different areas respectively. In these forms, garbage room is used to store garbage, and the environmental impact is under control [5].

3. The Status Quo of Municipal Solid Waste Treatment in Wuhan

3.1. Basic Situation
The mobile translation prediction method shows that the total amount of garbage produced every day in Hubei Province is 27394.24 tons in 2020. Wuhan, as the provincial capital, the daily output of garbage is relatively large. Although the existing urban garbage removal system in Wuhan is relatively complete, there are aging drawbacks. The outstanding problems of Wuhan municipal refuse management are as follows:

   The way of garbage collection is backward.
   The refuse transfer stations don’t meet the requirements of environmental protection completely.
   Garbage compression truck road operation and garbage dump truck caused secondary pollution.
   The construction and facilities’ level of landfill is low, and the ways of resource utilization are few.
   The standards, regulations and norms of garbage management and waste disposal need to be improved.

3.2. Governance Policy and Management System
The governance policy of Wuhan city on municipal household garbage can be traced back to the measures of Wuhan municipal household garbage management issued in 1998. Along with the
continuous improvement of the legal system and the further development of urbanization, Wuhan has issued a series of specific policy systems around the source reduction of domestic waste, garbage collection, garbage classification, such as “the regulations on the management of city appearance”. Nowadays, one-third of Wuhan's regions have implemented garbage classification, but the legislative work of "Wuhan municipal solid waste classification management measures" is still in progress, and the relevant process system needs to be improved.

3.3. Participation of the Public in Sorting and Recycling

According to the Chutian Metropolis Daily news reports, the kitchen waste can be properly disposed of in the pilot district of Wuhan City. The elderly had more sense of classification, contrary to the low participation of young people. In non-experimental district, all kinds of garbage mixed and residents’ awareness of garbage classification is relatively weak. In public places, citizens have little sense of classification, and some supporting facilities are defective. Although the government encourages citizens to carry out garbage sorting spontaneously through propaganda and education guidance, the garbage sorting work in Wuhan has never achieved the expected result due to the lack of binding force.

In order to understand the participation of the classified citizens of Wuhan municipal solid waste, this paper conducted a questionnaire survey on the residents of Jiangxia District and received a total of 504 valid questionnaires. According to the survey, 56 people, or 11% of the total number of people carry out routine simple garbage sorting, including 9 students, 12 salaried staff, 27 retired staff and 8 others.

The results show that there are four main reasons why residents do less garbage sorting. As shown in the figure below, 43% of the respondents do not understand the knowledge of garbage sorting, which is much higher than expected.

![Figure 1. The reason why residents do less garbage sorting](image)

4. Wuhan Municipal Solid Waste Treatment Model

According to the principle of comprehensive and periodic management, the treatment of municipal solid waste is gradually separated from the stage of disposal of municipal solid waste as waste only. Now the treatment of municipal solid waste covers the whole process from generation, collection, storage, transportation to final disposal. Generally, it can be divided into three phases.

![Figure 2. General municipal waste management model](image)

4.1. Diversification in Source Management
4.1.1. Legislation Improvement and Economic Incentives. During the process of municipal solid waste treatment, the government can better understand the changes of domestic waste and judge the category and quantity of renewable resources in garbage by data analysis, so as to formulate a more perfect system of classified garbage collection according to local conditions. Economic incentive policies should be established to reward enterprises that implement recycling mechanism, in reverse, warn and punish enterprises and individuals who violate the law of garbage treatment [6].

4.1.2. Producers’ Obligations. Production enterprises are suggested to abide by the principle of “reduction, reuse and recycling” in production to achieve source reduction of house-hold waste. It’s critical to consider the construction of product recovery system involving prolonging the service life of products, using environmentally friendly materials, adopting “green packaging” and so on at the beginning when the product is designed.

4.1.3. Intelligent Classification and Recycling. Internet can be occupied in the treatment of municipal solid waste to promote the exchange-type intelligent garbage recycling box, which has various functions, including opening, closing, weighing and settlement by scanning a code[7]. Residents will get bonus points that can be converted into some commodities or service by the amount of garbage they classify. It will help to enhance residents’ understanding of garbage classification knowledge and arouse the sense of responsibility and participation consciousness.

4.2. Intelligent Transportation Management
With the arising of big data, urban garbage transportation will gradually enter the stage of information intelligent transportation and collection. The whole collection and transportation system is connected into a whole to achieve intelligent management of the collection and transportation system through specific data processing and model optimization [8]. The design of intelligent transportation and collection management platform is shown in figure 3.

Figure 3. Intelligent collection management platform design

4.3. Treatment and Resource Management
EMBT technology, which means mechanical biological ablation technology, can overcome the disadvantages of the traditional treatment methods. EMBT technology refers to the recycling of materials and energy from waste by mechanical screening and biological treatment [9]. Mechanical parts of EMBT mainly use sorting and screening equipment to undertake the separation of high value and high combustion value in garbage, and biological treatment depends on biological anaerobic process to minimize the disposal of subsequent solid waste to recover more energy substances.

5. Conclusion
In the context of fast development of social economy and urbanization, the phenomenon of garbage siege or improper handling relatively equal to be aging of the city, which will affect the vitality of the cities [10]. It should be noted that we are supposed to take full use of Internet of things sensing, mathematical model and big data analysis technology to improve the municipal solid waste classification, transportation and treatment. We should stress the significance of taking municipal solid waste treatment as a whole so as to achieve the participation of multiple subjects, forming a virtuous circle of municipal solid waste classification and recycling system.

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