

Problems and New Countermeasures of Burning Plastic Medical Waste

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Abstract: In recent years, medical waste pollution has become increasingly prominent, seriously affecting the sustainable development of society and human survival. On this basis, we should focus on plastic medical waste, identify the types of pollution, and respond to measures to lay the environmental foundation for sustainable social development. In addition, since incineration is a common treatment method for large amounts of plastic medical waste, the environmental impact is not a problem of tomorrow but an urgent current problem. In this study, we chose plastic medical Waste treatment as the research object, and then analyzed the effective ideas and measures of its resource treatment, in order to change the traditional Waste treatment way and realize the green development of cities, realize the conversion of resources to wealth. In the research process, this work first analyzed the significance of plastic medical waste recycling, then studied the current main treatment measures, and on this basis identified the problems of plastic medical waste recycling and treatment, to seek the scientific solution measure, and proposed the suggestion to our country plastic medical waste treatment.

Keywords: Plastic Medical Waste; Incineration; Landfill; Resource Treatment

Introduction

In today's post-epidemic era, with the increasing amount of plastic medical waste, plastic medical waste has received widespread attention from the public. Recycling plastic medical waste is not an option, but a must to meet the ever-growing demands of our society.

1. Present Situation of plastic medical waste treatment in China

At the end of 2019, there were 32,000 medical and health institutions operating in the country, generating about 1,100 tonnes of plastic medical waste, according to the Chinese Ministry of Environmental Protection of the People's Republic of China. Among them, the hospital produces about 700 tons of plastic medical waste, accounting for more than half of the total amount of plastic medical waste. To ensure environmental and health safety, the Chinese government has taken a series of measures to limit and reduce the production and disposal of plastic medical waste. For example, the separation and treatment of plastic medical waste, the implementation of stringent regulatory policies, enhanced Environmental monitoring and assessment and enhanced publicity and education. Because of the space pollution and latent pollution of plastic medical waste, it is difficult to transfer and treat plastic medical waste., and the medical waste is openly burnt or incinerated without safety control devices, which results in toxic air pollution.^[1]Therefore, the research on the treatment of plastic medical waste resources has practical necessity and contemporary significance.

1.1 Source of clinical waste

Medical waste refers to them directly or indirectly infectious, toxic, and other hazardous waste generated by medical and health institutions in the course of medical treatment, prevention, health care, and other related activities.

Most of the medical waste comes from various medical institutions, usually including public and private hospitals, community hospitals, school hospitals, medical and aesthetic institutions, clinics, health centers, medical mobile vehicles, etc. A small portion comes from private use, for example, diabetes and other special patients produce daily use. Most of the medical waste in the garbage recovery has been separated for recycling treatment, and a small part of the garbage has into other areas.

1.2 Comparison of treatment methods of medical waste

Due to the diversity of the source and composition of medical waste, there may be infectious bacteria, viruses, chemical pollutants, and radioactive substances in the process of collection, transfer, and disposal of medical waste, if handled improperly, it will pollute the surrounding environment, such as soil, groundwater, and air, and form the source of spreading the virus. Therefore, according to the characteristics of medical waste, it is very important to treat medical waste scientifically and reasonably, this is related to public health security, ecological environment security, public health, and life safety. However, there is a wide variety of medical waste treatments and different regions have different policy guidelines. Due to various factors such as economic policies, we have a rough idea of the following methods for medical waste recycling. Comparison of treatment methods of medical waste.^[2]

Table1 Comparison of treatment methods of medical waste

Type	Treatment	Advantages	Shortcomings	Cost (CNY/ton)
Incineration	Burning at high temperatures	Can deal with a large number of waste, the technology is relatively mature	It's expensive, it can't be run intermittently, and it's prone to producing harmful gases	2,500-3,000
	Pyrolysis	This method does not use the auxiliary pyrolysis combustion fuel, the cost is relatively low	It's very difficult to deal with large-scale waste, and it's also very difficult to deal fully with chemical waste and pharmaceutical waste	2,500-3,000
	Steam sterilization	Implementation is more convenient, the cost is relatively low, will not cause secondary pollution	It is not suitable for dealing with radioactive, organic solvents and pathological wastes, and VOC emissions are relatively high	1,000-1,500
	Chemical disinfection	The utility model has the advantages of convenient use and relatively low cost	The presence of waste liquids and gases during the operation prevents the treatment of volatile organic compounds and radioactive wastes	1,000-1,500

Non-incineration	Microwave disinfection	It is more convenient to use, does not cause greater environmental pollution, and has a higher volume reduction	Because of its high cost, it is not suitable for pathological waste treatment	2,500-3,000
	High temperature dry heat disinfection	The cost of sterilization is relatively low	Heat conduction rate is relatively slow, easy to produce odor	1,000-1,500
	Safe Landfill	Easy to use and relatively low in cost	Harmful substances are easy to leak, can not be treated as a separate way	500-800

1.3 Hazards of clinical waste

As one of the national hazardous wastes, the impact of medical waste on human beings and the environment can not be underestimated. Only proper recycling of medical waste can prevent injury, and cross-contamination and reduce the risk of infection and infectious disease. Currently, in most countries around the world, most medical waste is collected and the primary medical waste treatment method is incineration. This is the most common way, but it also releases a lot of pollutants, it has produced high pollution in the atmosphere and other human living environments, reduces the air quality, and poses a severe threat to human beings and the environment.

Our country has strict supervision over medical wastes which are directly related to people's health and environmental safety and carries out classification and centralized harmless disposal of medical wastes, it is prohibited for any unit or individual to transfer or trade medical waste.

2. The pollution of the burning of the plastic medical waste to the atmosphere and its consequence

The main ways of air pollution by plastic combustion include the emission of carbon dioxide, the emission of harmful gases, and the production of particulate matter. Considering the infectious diseases caused by environmental pollution and the urgent need to develop a healthier ecosystem, the burning of plastic medical waste should be strictly controlled and effective environmental protection measures should be taken, reduce the use of plastic and strengthen the recycling of plastic medical waste to protect human health and sustainable development of the environment. Plastic medical waste contains potential toxins and micro-organisms that can be a source of disease transmission and pollution by harmful substances [3], if not properly managed, can infect healthy populations and cause large-scale infectious diseases, building eco-friendly medical systems can provide better ecosystems and may have long-term benefits for human health.

2.1 Carbon dioxide emissions

Plastics are made up of elements such as carbon, hydrogen, and oxygen. Burning them releases large amounts of carbon dioxide, which in part creates more nutrients for plants, but what's even more remarkable is that it's exacerbating the greenhouse effect, causing global climate change, causing global temperatures to rise, directly causing climate change, sea level rise, ocean acidification, more frequent forest fires, and so on, and it will further increase mortality from infectious diseases, particularly tropical ones such as malaria. It also indirectly affects the growth of marine crustaceans, drives plants to migrate to higher altitudes, and makes plants and animals smaller, shaking the concept of biome. Penga et al.[4] predicted

that 193 countries worldwide would generate additional 8.4 million tons of plastic waste due to COVID-19-related activities, a 10% increase from the baseline since the World Health Organization (WHO) declared the disease a global pandemic in March 2020. This alarming statistic is our warning sign.

2.2 Releases harmful gases

When Plastic Burns, it also releases harmful gases such as sulfur dioxide, nitrogen oxide, and carbon monoxide. These harmful gases will not only lead to the deterioration of air quality but will cause serious harm to human beings and other organisms. For example, sulfur dioxide can cause acid rain, seriously affecting air quality; carbon monoxide is a toxic gas, that can affect human health, there will be sudden chest tightness, headache and vomiting, and other symptoms; Benzene and other organic substances and small particulate matter can affect respiratory health, leading to respiratory diseases. In addition, nitrogen oxide from burning plastics is also important to air pollutants, forming photochemical smog and causing damage to vegetation and buildings.

2.3 Production of particulate matter

In the process of burning plastic, a large number of particulate matter can be produced, including PM10 and PM2.5 and other fine particulate matter PM10 can enter the upper respiratory tract, and some can be excreted through sputum and other body, it is also blocked by hairs in the nasal cavity. However, the diameter of PM2.5 is less than 1/20 of the width of human hair. Due to its small size and relatively large surface area, PM2.5 can easily carry heavy metals, microbes, and other harmful substances, and in the atmosphere for a long time, with long transport distance, easy to enter the human alveoli and deposition down. When PM2.5 deposits on the alveoli, it can interfere with gas exchange in the lungs, damage the alveoli and mucous membranes, and cause bronchitis, emphysema, and cor pulmonale. It may also aggravate a series of diseases such as asthma, even PM2.5 can enter the blood through the bronchi and alveoli, where harmful gases, heavy metals and other dissolved in the blood, causing adverse effects on human tissues and organs. Even more frightening, PM2.5 particles are too small to be effectively separated from air purifiers by ordinary masks. As a result, PM2.5 is even more harmful to the human body. At the same time, it will directly cause a large number of haze weather, reduces visibility, and shadow people's daily life, the impact on transport and tourism is particularly significant.

3. New Treatment Methods - Recycling Treatment of plastic medical Waste

Disposable plastic is one of the chief items in medical waste. High-density polyethylene and Polypropylene is the main component of several PMWs. These plastics have a higher latent as hydrocarbon sources for the chemical industry. Pyrolysis of PMW was accomplished at a temperature range of 200–300 °C in a batch reactor made up of stainless steel. The chemical and physical properties of the pyrolysis liquid were much closer to the commercial fuel like diesel, petrol, etc. The density is 840 kg/m³, the gross calorific value is 4.13·10⁴ kJ/kg flash point is 39 °C in producing pyrolytic oil. This liquid can be used as an alternative source of fuel.^[5]At the same time, in the United States and Canada, the vast majority of medical waste is disposed of or incinerated after strict disinfection. But the third option, recycling, is also accelerating. As one example, Triumvirate Environmental Inc. The company has successfully converted medical waste into plastic building materials. The company is planning to extend its proven process across the United States. The 30-year-old company has an annual turnover of about \$120 million and focuses on hazardous and medical waste management. With years of experience in the industry, the company has built a plant in Jeanette, Pennsylvania, to recycle high-plastic medical waste and process it into plastic building materials, sold under the Best Plus brand. The development of recycling technology for medical plastic waste will not only reduce the environmental pollution caused by medical plastic waste but also bring more profits and jobs to related industries, which is One Stone Two Birds.

4. Measures and methods to improve air quality

When plastic medical waste pollutes the air inevitably, we need to take measures to keep the air quality stable and optimize the air quality as much as possible. The measures and methods for improving air quality can be divided into three types in nature: physical remediation, chemical remediation, and biological remediation, This paper will put forward two long-term and multi-functional measures from the perspective of urban management.

4.1 Enhance urban greening

Urban greening can fix and reduce carbon dioxide, so that carbon dioxide becomes plant nourishment, and release oxygen, but also can purify the harmful gas in the air, and play the role of windbreak and sand fixation. Strengthening urban greening and increasing vegetation coverage is one of the most effective ways to improve air quality, along with improving the city's aesthetic functions.

4.2 Planning the layout of the city properly

The urban layout should be reasonably planned to avoid excessive proximity of pollution sources to residents' living areas and transportation hubs and to reduce the pollution of plastic medical waste to a certain extent.

5. Conclusions

The treatment and recovery of plastic medical waste are more difficult than other solid waste. However, due to the particularities of geographical location and climatic conditions, a consensus has been reached to reduce the sources of plastic medical waste and to optimize treatment technologies in order to address the shortage of land resources and high transport costs, increasing the total amount and technical deficiencies. China has also carried out a lot of exploration in the resource treatment of plastic medical waste, and achieved outstanding results. It also seems logical that healthcare providers should generally use products that minimize infection while treating patients. There are more cost-effective ways to reduce medical waste in healthcare facilities, such as proper separation of waste releases, and promoting the use of high-temperature/high-pressure and chemical processes used to sterilize medical equipment and materials. The next phase of research should focus on improving the efficiency and quality of resource disposal to truly address the problem of plastic medical Waste treatment.

References

- [1] Bolan S, Padhye LP, Kumar M, Antoniadis V, et al. Review on distribution, fate, and management of potentially toxic elements in incinerated medical wastes[J]. *Environmental Pollution*, 2023, 321.
- [2] Attrah M, Elmanadely A, Akter D, Rene ER. A Review on Medical Waste Management: Treatment, Recycling, and Disposal Options[J]. *Environments*, 2022, 9(11).
- [3] Penga Y, Wua P, Schartup A, Zhang Y. Plastic Waste Release Caused by COVID-19 and Its Fate in the Global Ocean. *Proc.Natl. Acad. Sci. USA* 2021, 118, e2111530118. [CrossRef] [PubMed]
- [4] Lee SM., Lee DH. Effective Medical Waste Management for Sustainable Green Healthcare[J]. *International Journal of Environmental Research and Public Health*, 2022, 19(22).
- [5] Som U, Rahman F, Hossain S. Recovery of Pyrolytic Oil from Thermal Pyrolysis of Medical Waste[J]. *Journal of engineering sciences*, 2018, 5(2).