Research on Recycling and Utilization of Solid Waste in Civil Airport

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Abstract The aviation industry is embracing unprecedented prosperity together with the economic development. Building green airports resource-saving, environment-friendly and sustainable has become the inevitability of the times. The operation of airport will generate the large amount of waste every day, which certainly exposes airports and surrounding regions to waste disposal and ecological environment pressure. Waste disposal directly affects the surrounding environment of airports, which can be effectively mitigated by disposing waste into resources, i.e., sorting and recycling them into renewable materials. The development of green airport can also be promoted in this process. The article elaborates on the current methods of waste disposal adopted by airports. According to the principle of waste reduction, harmlessness, and resource recycling, a set of solid waste recycling and utilization methods suitable for airports are proposed, which can reduce the costs of waste transported to other places and landfilled. Various environmental pollution caused by landfill and other disposal methods can also be contained effectively. At the same time, resources can be fully recycled, converting waste into useful resources in an efficient and environmental-friendly way.

1. Overview

China is committed to "Innovative, Coordinated, Green, Open, and Shared" development, and the 13th Five-Year Plan for Energy Conservation and Emission Reduction of Civil Aviation also puts forward that "more than 90% waste should be disposed harmless and more than 90% of sewage treated for newly-built airports. Centralized disposal and recycling of solid waste, sewage, waste, and chemical agents in airports should be strengthened." The recycling and utilization of airport solid waste is an important measure to actively respond to the national summon and achieve green development.

2. Classification and composition of airport waste

2.1 Aviation waste

Aviation waste is the domestic waste generated by passengers during the flight, which amount is closely related to whether the airline flights are catering, the number of meals provided, and the passenger load factor. Aviation waste mainly composes newspapers, snack packaging boxes brought by passengers, a small amount of food residual, and the remaining containers for airline beverage

distribution include disposable cups, plastic bottles, cans, etc. Recyclables account for a larger proportion.

2.2 Household waste

Household waste can be divided into two categories. One is ordinary household waste, which mainly comes from waste generated by the airsides and landsides of terminal buildings, office waste generated by airport-stationed operators, and domestic waste generated in airport living areas. Ordinary household waste is complex in its composition, which components are changing largely and intermixing with each other.

The other category is air food processing waste, which is mainly produced by airport air food distribution centers during food production and processing. The composition of such waste is more complicated with organic waste generated from air food processing taking up a lion share, being mixed with and polluting other recyclable substances. As shown in Table 1.

Table 1 Composition Table for Airport Waste

Aviation waste		Household waste			
		Ordinary household waste		Air food processing waste	
Category	Proportion	Category	Proportion	Category	Proportion
Paper	27%	Paper	25%	Paper	9%
Plastic	20%	Plastic	38%	Plastic	10%
Abandoned meals	32%	Glass	0.5 %	Metal	2%
Aluminum foil lunch box	1%	Metal	1%	Abandoned meals	65%
Water	19%	Organics	20%	Water	13%
Others	1%	Water	11%	Others	1%
		Slag	3%		
		Others	1.5%		

3. Current situation of airport waste disposal

Waste generated at airport is usually handled in two ways. The first is incineration. Some airports are equipped with incinerators and other waste disposal facilities since in the early stage of their construction for waste disposal. However, incinerators are highly energy-consuming, rendering operating costs difficult to be controlled. Even worse, dust, sulfur dioxide, hydrogen chloride, and dioxins are generated during the incineration of plastics, dyes, and macromolecule organics. Contaminants such as heavy metals, after being burned at high temperatures, diffuse into the atmosphere or deposit in waste slag, impairing the air and environmental quality around airports. As requirements and standards for environmental protection tightening, the emission of waste gas, fly ash, and waste slag from waste incineration is difficult to be compliant with standards. Due to these factors, incinerators are gradually being decommissioned by airport management.

The second is the transshipment. The disposal method is to disinfect aviation waste first, and then transport it together with the airport household waste to the local urban domestic garbage dump for landfill. Aviation waste from the epidemic area is specially transported by designated professional agencies for special treatment in accordance with the requirements for handling hazardous wastes. At present, most airports in China use this method. This disposal method not only adds burden on local waste disposal sites, but also imposes great environmental risk --- once infectious diseases or other outbreaks occur, it is very difficult to control their spreading. The available resources therein are

wasted if are directly landfilled. Landfill, taking up large area of land, may cause a series of problems including groundwater and air pollution.

4. Recycling method of solid waste of airport

There are many substances that can be recycled and used in airport solid waste. If a reasonable resource disposal method is adopted, the utilization rate of waste resources will be greatly improved. Taking into account the complex composition of raw waste, it makes sense to use mechanical separation as the main method, and manual sorting as the supplementary to directly recover partial paper and metal materials as useful raw material resources. The organics are separated from the waste, and part of the leftovers, meals and other food and kitchen wastes are processed by the organics fermentation system. PE plastics are prilled, PET bottle chips are processed and part of light waste plastic and combustible materials are made into wood-plastic composite materials. The remaining part of the inorganic materials are sent to the site for sanitary landfill. The comprehensive disposal and utilization of resources can handle 90% of the waste, and only 10% of is transported to the waste plant for landfill, greatly reduceing the amount of landfilled waste. (see Figure 1).

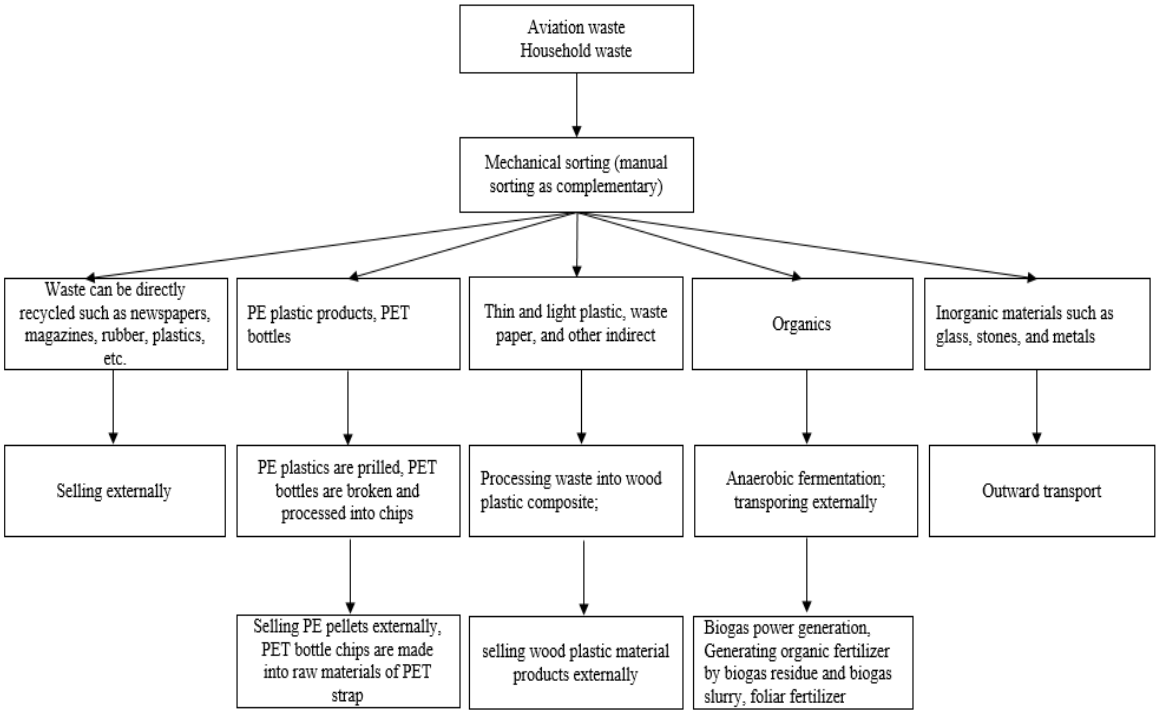

Figure 1 Flow Chart of Solid Waste Disposal in Airport

4.1 Waste sorting

This is the first step in the processing and utilization of waste resources. The first thing to do after the waste being disinfected and weighed is to break bags. Since waste is mostly wrapped, it is necessary to use a bag breaking machine to tear the plastic bag wrapped outside, so that the waste can scatter out, which will be transported by belt conveyors to the roller screen for mechanical sorting. Due to the different gravity and particle size of substances in the waste, paper, plastic and other substances are screened out, which then are transported by the belt conveyor to the crusher. Partial separated kitchen waste and other waste, rich in fine particles of organic substances, are transported to the organic dry anaerobic fermentation system, and the remaining parts are transported externally. Manul sorting is also deployed as supplementary to the mechanical sorting. Lightweight plastics such as PE and PET plastic bottles are hand-picked and sent by the belt conveyor to the plastic processing area for centralized disposal. Recyclable materials such as paper and magazines are collected and recycled. Metals can be sorted and recycled through the preceding magnetic separation process and the

subsequent non-ferrous sorting process. Lightweight plastics and some combustibles are passed to the wood-plastic composite production system, and the remaining part is buried in the sanitary landfill.

4.2. Recycling of renewable resources

Many substances in waste can be recycled after being specially processed. Making plastic products by using PE recycled materials can save resources and reduce solid waste pollution. After sorting, plastic products such as thin films and plastic bottle caps are broken and then processed using plastic granulation technology, which can be used as raw materials for other plastic products. PET plastic bottles, after being washed, broken and logo removed, are changed into raw materials of chemical fiber factory. Plastic cups, plastic cutlery, etc., evolve into raw materials for other plastic products after being washed and broken. Combustibles can be used as raw materials for making wood-plastic composites. Metals and some newspapers, magazines, etc. can be recycled directly and then sold.

4.3 Organics high-temperature dry anaerobic fermentation

Organics in waste can be processed by the organics high-temperature dry anaerobic fermentation method. The biogas generated in the anaerobic fermentation can be used for combined heat and power generation, the biogas residue can be made into humus, and the biogas can be used as the leaf fertilizer. Crushed waste is sent to a mixing device, where the waste is mixed with the refluxed biogas residue. And then it is sent to the anaerobic fermentation system and is subjected to biodegradation in a closed environment. About 25 days of anaerobic fermentation will biodegrade some of the organics with biogas being generated. The biogas is sent to the biogas pretreatment unit for processing through the pipeline. The residue after anaerobic fermentation is fermented biogas residue, which is processed by the biogas residue dewatering equipment via fermentation tank discharge device. The desulfurized and purified biogas is sent to the biogas storage and utilization units. Dehydrated biogas residue has been treated by anaerobic fermentation. Generally, stable humus can be produced with two to three weeks' stabilization. Hot water required for the anaerobic fermentation system is provided by the heat energy generated by the biogas generator and no additional heating is required.

5. Conclusions and Suggestions

Disposal of airport solid waste through a combination of harmless treatment and comprehensive utilization of resources can maximize the recovery and utilization of waste resources, which can not only obtain respectable economic benefits, but also reduce environmental risks and achieve obvious comprehensive benefits in society, economy and environment. Waste recycling conforms to the national policy of the sustainable use of resources and meets the requirements for the construction of green airports. It can provide reference for other airports, play a model and demonstration role, and has a good application prospect. At the same time, it is necessary to better manage waste classification. The relevant administrative departments should improve the rules and regulations for waste separation, guarantee their implementation with mandatory measures, standardize the disposal process of the recycling of domestic garbage, and lay a solid foundation for the treatment of waste resources at airports and cities at large.

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