

Design and Research of Home Automatic Kitchen Waste Composting device

Wang Na¹, Li Gang ^{1*}, Zhang Hongming²

¹ Department, DaLian JiaoTong University, Dalian, Liaoning Province ,116028, China

² Department, DaLian JiaoTong University, Dalian, Liaoning Province ,116028, China

Abstract: As a part of kitchen waste, vegetable peelings has some special features such as high water rate,high organic matter content and good biodegradability. By biological composting, such waste can be recycled, reduced, and become harmless. Based on analyzing the experimental results for the composting and fermentation of peel and vegetable leaves, an automatic composting apparatus applying for household was designed and researched. The function such as crushing pre-treatment, material transfer, fermentation and separation were realized by using the function components such as wringer blade and cross blade broken baffle,ect. The odor problem during fermentation was solved by activated carbon adsorption. Finally, solid fertilizer and fermentation broth with decontamination function were obtained.

1 Current Situation of Kitchen Waste Disposal Technology at Home and Abroad

The output of household kitchen waste is influenced by many factors, including population, economic development level, living standard and living habits. According to statistics, by the end of 2016, the annual output of our kitchen waste is about 80 million tons, and according to the annual growth rate of 8% to 10%, it is expected to increase by 7-8 times in 2030. As a major category of kitchen waste, the moisture content of peel and vegetable leaves is up to 70% to 80%, and the organic matter accounts for 93% of the dry matter. In addition, the content of nitrogen, phosphorus, potassium and other nutrients is relatively high, so the compost products can be used as organic fertilizers. However, as the producing areas of kitchen waste are scattered and the moisture content and organic matter content are high,

acidification, mildew and corruption can easily produce a variety of pathogenic microorganisms, which may cause secondary pollution to the environment in the unified recycling and transportation process. Although the individual developed cities in China have been implementing the garbage classification processing policy, the recycling of kitchen waste has not achieved the expected effect due to the policy implementation management problems and the residents' insufficient understanding of the hazards of kitchen waste and resources. In China, most of the kitchen waste is disposed by landfilling, which makes that the advantages of kitchen waste recycling cannot be well utilized. The annual output of kitchen waste and its treatment measures in other countries are shown in table 1. According to their own circumstances the different countries take different measures to recycle and reduce kitchen waste as far as possible.

Table.1 Production and disposal of foreign kitchen waste

City	Yield(10000t/a)	Main processing mode
Europe	5000	Using biochemical method turn kitchen waste into organic fertilizer and reuse resources
America	3000	Promote kitchen waste crushing processor, the broken kitchen waste with sewage treatment
England	800	Kitchen waste recycling, production of compost products or for power generation
Japan	2000	Promote the composting of waste disposal or the unified recycling of animal feed and biogas for power generation and heating
Korea	600	Adopt "from the quantity system" charging method, according to a certain standard for each kitchen waste production charge

According to the production characteristics of kitchen waste, there are two kinds of kitchen waste

disposal devices in the market at present. One is kitchen waste compost bin, which uses the principle of compost

*Corresponding author's e-mail: lg_dl@126.com

to conduct manual pretreatment and compost of kitchen waste. The other is kitchen waste pulverizer, this device containing mill blades can make kitchen waste grinding pieces back into the water pipe together with sewage treatment. The kind of kitchen waste pulverizer can reduce the amount of kitchen waste, but it cannot make kitchen waste secondary using, and it is easy to produce odor, breeding ground for germs, carry diseases, or directly pollute the environment, which increases pressure of urban sewage treatment plants.

2 Design Basis of Kitchen Waste Composter

Composting is a method in which microorganisms use organic matter in kitchen waste to ferment and degrade kitchen waste and eventually form humus for use as fertilizer. The technological parameters of composting fermentation include temperature, particle size,

composition and mixing degree. In order to meet the reasonable control parameters of the composting fermentation process by optimizing the composting structure and components, we conducted a small experiment in the laboratory to explore the optimization of the process parameters, and reported the experimental results. Through controlling the composting temperature at 37°C during fermentation, monitoring the changes of ammonia nitrogen and pH value during the composting process, it is appropriate to determine that the particle size of the composting material is 10-20mm, and the fermentation cycle is 8-12 days. According to the fuzzy comprehensive analysis method, the composting body has reached the second-level good composting state. The overall changes of the mature composting body are shown in figure 1. The overall color of the heap is dark brown, the state is loose and does not cluster, and there is a slight humus smell.

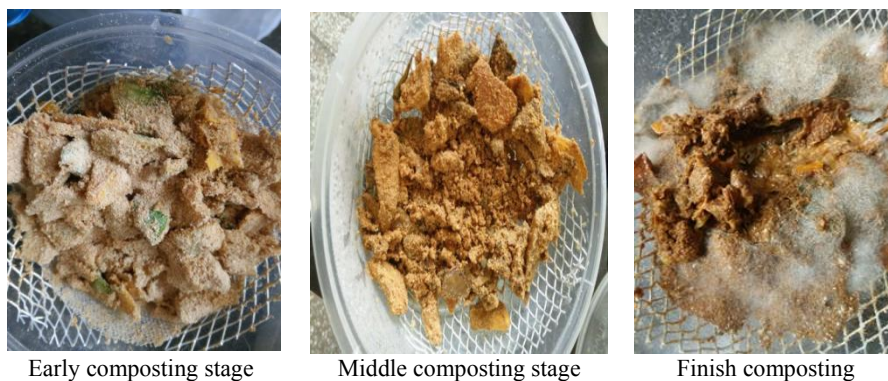


Figure.1 Constant temperature composting at 37degrees Celsius

3 Design of Household Automatic Kitchen Waste Composter

The household automatic kitchen waste composter consists of various functional components,as shown in Figure 2.The part1- plug is designed as a stretchable type,which is convenient for connecting the device to the power supply according to the distance between the room and the power supply,and the part2-control switch is the power suooly button of the composter. Through the collection of the vegetable peelings from the daily domestic kitchen waste, the pretreatment of garbage is realized through the 3-7 way entry device, the 6-shaft belt whee, 7-belt connection, 5-FM low-speed motor and the 8-stranded dragon. According to the quantity of kitchen waste,the rotation speed of the skeins can be adjusted by 4 rotation switches to control the broken time of 9-cross blade to kitchen waste,in the process of crushing,10 baffle gap filter function is used to control the particle size of composting materials in the range of

10mm to 20mm,materials meeting the condition of broken particle size enter the left 11 main fermentation chamber through blocking publishing pores for constant temperature composting,the odor produced during composting is absorbed by 15-odor treatment devices,which are full of activated carbon with strong adsorption,thus avoiding the pollution to the indoor environment.The fermentation chamber is designed as a pull-out,which is convenient to take out the leavening residue as fertilizer for green planting.The produced solution is fed into the 13-fermentation broth storage room through 12-hole partition board,the lower end of the storage room is provided with a 14- fermentation liquor discharge valve to facilitate broth for other purposes.The device is a cuboid structure,whose length width and height are 519mm,20mm and 467mm, respectively .The device is provided with 16 safety universal wheels at the bottom of the installation,which makes the device flexible and to move easily.The device is shown in Figure 3.

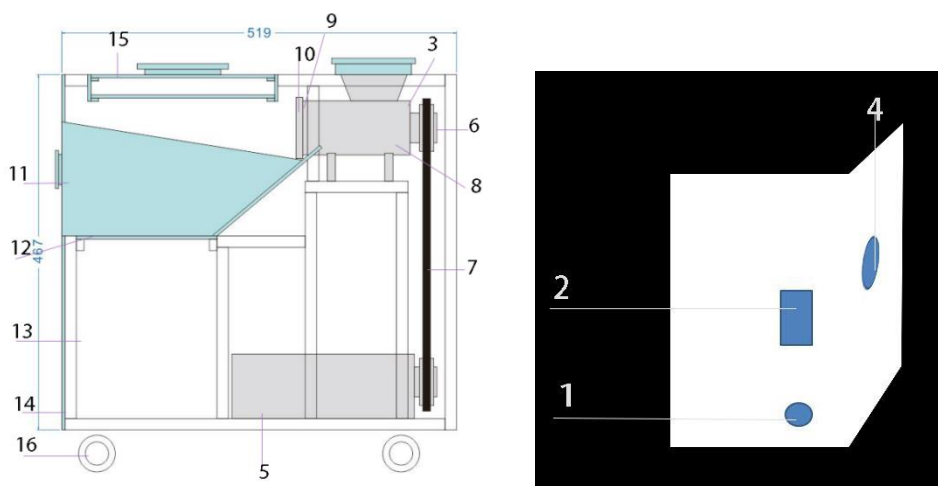


Figure.2 Component diagram of design device for household automatic kitchen waste composer

Part1-plug outlet; Part2-control switch; Part3-seven character; Part4-rotary adjusting switch; Part5-FM low speed motor; Part6-shaft pulley; Part7-belt; Part8-wring dragon ; Part9-cross blade; Part10-baffle plate;

Part11-main fermentation room; Part12-porous partition; Part13-fermentation liquid storage room; Part14-fermentation liquid contact; Part15-odor treatment unit; Part16-safety universal wheel

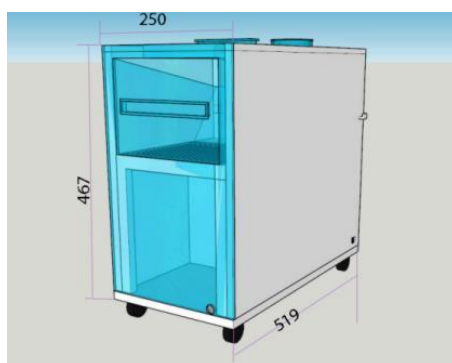


Figure.3 Physical and dimensional charts of composer

4 Conclusion and Outlook

In this paper, the results of small scale experiment on composting and fermentation of pericarpal wastes from kitchen waste were analyzed, based on the optimization of the structure of the composter, a small household composter is designed, which is composed of crushing pretreatment and composting fermentation in one unit. By controlling the particle size of composting materials and optimizing the composting conditions of the kitchen waste, this device can reduce and recycle the domestic litter. Some problems could be solved very well, for example, kitchen waste was scattered and it was difficult to collect and deal in a centralized way, the concept of green living for resident was advocated.

The types of kitchen waste are very various, the designed device in this research is only suitable for the processing of vegetable leaf litter, so the disposal of other kitchen waste is not satisfied. In the following research and design, through the continue updating and improvement of functional components, a multifunctional kitchen waste disposer will be designed to meet full coverage of kitchen waste disposal and to solve the

environmental pollution of kitchen waste from household cited material.

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