Set Crushing, Fermentation, Deodorization in One of the Kitchen Waste Processor

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Abstract

This project designs a set of miniaturized kitchen waste disposal machine, which is aimed to solve the problem of kitchen waste disposal for the client. It makes use of high-temperature aerobic fermentation bacteria to produce a small biochemical processing machine with high automation degree, convenient operation and energy saving. The product uses the high temperature aerobic composting technology. The process of high temperature aerobic composting is realized on a miniaturized machine. The kitchen waste is crushed, fermented and disinfecting, and the whole process can realize deodorization function, so that it can reduce odor gas emissions and be environmentally friendly.

Keywords

Kitchen Waste; Carbon Fiber; High Temperature Aerobic Compost; Ye Guang Mud.

1. Introduction

According to 《2018 National Annual Report on Prevention and Control of Environmental Pollution by Solid Waste in Large and Medium Cities》, China produced 201.944 million tons of household waste in 2018. Meanwhile, about 108 million tons of restaurant waste were produced in China in 2018. According to data, it can be seen that about half of the domestic garbage in our country is kitchen waste, so scientific and reasonable disposal of kitchen waste is imminent. At present, there are several ways such as sanitary landfill, high temperature incineration, anaerobic fermentation technology, composting technology, insect breeding technology, heat treatment technology and bio-refining technology of high additional chemicals at home and abroad. These treatment methods are not only mostly applicable to large and medium-sized cities and enterprises, but also cannot be widely promoted due to the failure of classified treatment, the lack of effective supervision, and the lack of improvement in the construction of industrial system. And more importantly, in many processing methods listed above, there are soil, water quality, air pollution, sterilization harmless not thoroughly, long processing cycle, large covering area, relatively poor sanitary conditions and low quality of product and so on shortcomings. In addition, according to the data analysis of some urban kitchen waste, the components and physical and chemical properties of the general urban kitchen waste are as follows, which are greasy, sticky and fishy in sensory properties, and have 75-90% high moisture content. Organic matter content accounts for more than 95% of dry matter, which is easy to rot and smell, which brings great difficulty to the collection, transportation and treatment of kitchen waste, reduces work efficiency, and may even contaminate the environment in a disguised way.

Compared with the food and beverage industry's daily food and kitchen waste’s output, hundreds of households are the source of food and kitchen waste. Considering the limitation of existing eat hutch waste disposal methods, disadvantages and the pressure, and crushing waste directly into the sewer can cause resource waste and environmental pollution, we aim to design more suitable for the self-employed kitchen waste disposal device which can convert kitchen waste into organic fertilizer.

For every family, it can not only save the messy process of dumping, it can also avoid the breeding of bacteria, mosquitoes and cockroaches caused by the storage of kitchen waste, reduce the possibility of the sewer pipe being blocked and return the kitchen to a pure land. For the country, it can effectively

realize the "reduction, recycling and harmless" of restaurant kitchen waste from the source and promote the improvement of the resource utilization level of restaurant kitchen waste in China.

2. Organization of the Text

2.1 Dispose Process

The processing steps of kitchen waste processor are composed of solid-liquid separation, crushing, fermentation and deodorization. The kitchen waste is put first, through solid-liquid separation, excess water is separated out. Then redundant sewage was discharged into water pipe, then to pieces, adding a gas-bacilli blending, through high-temperature aerobic fermentation, at the same time using Ye Guang mud to deodorize. After kitchen waste decomposition fermentation is completed, falling into the storage area to store, then we can obtain the available organic fertilizer.

2.2 The overall design

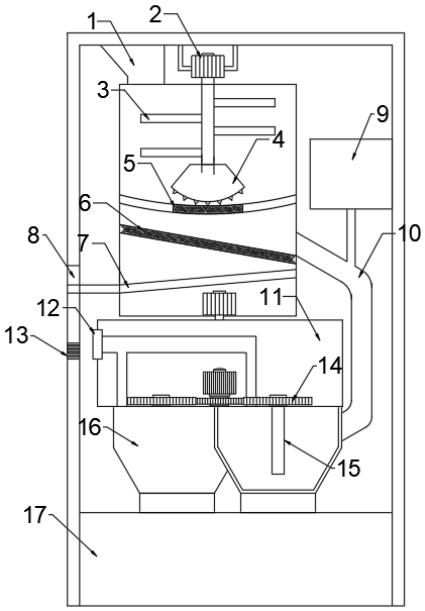

Fig. 1 Overall design

1 feed port 2 motor 3 crushing blade 4 rolling roller 5 stainless steel screen 6 stainless steel filter plate 7 plate 8 outlet 9 bacteria liquid chamber10 discharging port 11 rotary table 12 ventilation fan 13 ventilation hole 14 gear 15 mixing bar 16 fermenter 17 storage area

The overall structure is shown in Figure 1 and the design size of the overall structure is 40cm×40cm×120cm. After the kitchen waste enters the device through the feed port 1, it stands for one minute and then is crushed. The kitchen waste conforming to the pore size passes through the stainless steel screen mesh 5 at the lower part of the crushing device and falls to the stainless steel filter plate 6 in the middle of the water filter. The excess water produced by this process through the stainless steel filter plate orifice flow to the lower stainless steel plate 7, and then into the sewer. The crushed kitchen garbage enters the fermentation chamber through the discharging port 10. There are 4 fermentation chambers in the lower part of the device, and the fermentation time is about 3 days. The garbage that enters the fermentation chamber every day enters different fermentation chambers respectively (for example, the garbage that enters the first day enters the No. 1 fermentation chamber, the garbage that enters the second day enters the No. 2 fermentation chamber, and so on). The fermentation chamber that kitchen waste enters is determined by whether it is connected with the discharging port or not. There is an electric motor above the four fermentation chambers, which makes the lower four fermentation chambers rotate 90° regularly, and then the garbage can enter

different fermentation chambers every day. After garbage enters into the fermentation chamber, the bacterial fluid from bacterial fluid chamber 9 will be automatically injected into each fermentation chamber. Then it will reach appropriate fermentation temperature by heating in the fermentation room and speed up the high-temperature aerobic fermentation process by stirring and ventilation. The duct above the fermentation chamber is provided with a ventilator fan 12, and a ventilation hole 13 on the left side of the ventilator is connected with the outside world for air ventilation. On both sides of the ventilation fan and inside of the pipe wall, there are filter elements made of leaves and widely mud for deodorization. On the fourth day, the garbage in No. 4 fermentation room has been fermented and mature and the lower part of the fermentation room will automatically make the fermented kitchen waste enter the bottom storage area 17. Finally, available organic fertilizer will be obtained.

2.3 The automatic control

Automatic control by 51 single chip computer is easy to implement. 51 single-chip microcomputer has the advantages of wide application range, simple development, stable performance, small volume, strong anti-interference ability, low energy consumption and low price. There are a lot of research on 51 single chip microcomputer is applied to automatic control, the use of 51 single-chip microcomputer to realize the automatic control of this device is not difficult. And the effect is stable.

The temperature control part is combined with the PTC constant temperature heating resistance. The PTC constant temperature heating resistance has the advantages of stable performance, low cost, long service life and energy saving effect.

The control system controls the motor, electric valve, exhaust fan, electric heating wire, stirring rod motor and deodorant device used for grinding by combining PTC constant temperature heating resistance, and carries out automatic processing of all processing processes.

2.4 Mechanical parts

2.4.1 Solid-liquid separation and crushing structure design

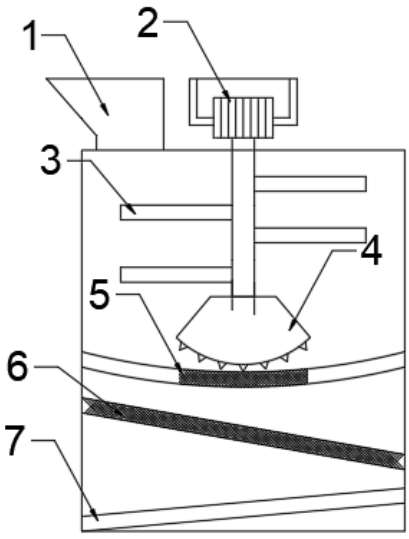

Fig. 2 Solid-liquid separation + comminution structure

1 feed port 2 motor 3 grinding blade 4 roller 5 stainless steel screen 6 stainless steel filter plate 7 plate

The solid-liquid separation and crushing structure is shown in Fig. 2. After the kitchen waste enters the crushing chamber through the feed port 1, it stands for one minute, and then it begins to crush. The crushing blade and the following roller follow the rotating shaft to crush the material. As the distance between the roller and the stainless steel screen increases from the middle to the two sides, the material is further crushed by the rotating roller when it moves to the middle under the action of

gravity. The aperture of our stainless steel screen is 20mm, so the material that can enter the next step will not exceed this diameter, so as to prevent incomplete grinding. The meal kitchen waste to be crushed is screened to the stainless steel filter plate. Then it will stop crushing and the door of the fermentation room is opened. The crushed meal kitchen waste enters the fermentation room. The water produced by this process through the stainless steel screen 5 flows to the stainless steel filter plate 6 and then flows to the lower stainless steel plate 7 through the stainless steel filter plate hole, and then into the sewer. This process will remove the excess water in the kitchen waste to meet our requirements of the initial state of the kitchen waste.

2.4.2 Fermentation structure design

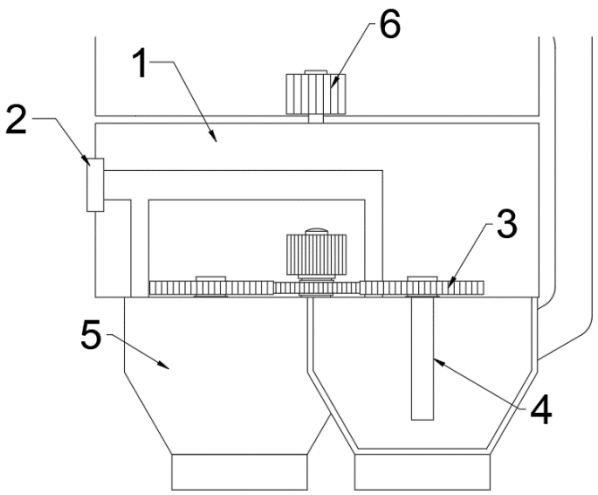

Fig. 3 Design of fermentation structure

1 turntable 2 Air vents 3 gear 4 stirring rod 5 fermenter 6 motor

The structure of the fermentation device is shown in Figure 3. The crushed garbage in the storage room enters the fermentation room after the material is discharged from the fermentation room. Our fermentation room is composed of four fermentation tanks in total. Through the interview and investigation, we found that the average amount of kitchen waste in most families is about 2kg every day, so we designed each fermentation tank to be 3L in order to prevent the storage tank from being unable to store too much kitchen waste on a certain day. When the kitchen waste enters into the fermentation tank, the bacteria liquid chamber will automatically release 10ml of bacteria liquid for the fermentation process. In theory, fermentation can be completed in 3 days. The bacteria liquid chamber is placed on the outer wall, so that users can see the remaining amount of the bacteria liquid at any time and add the bacteria liquid to the bacteria liquid chamber in time. In the process of fermentation, sensors are used to detect the temperature and humidity inside the device and they will feed back to the control system to keep the environment under the conditions of temperature and humidity suitable for microbial reproduction, so that the fermentation process is controllable and efficient. At the top of each fermenter is a blender and on the outside we combine carbon fiber to heat the fermenter. The purpose of stirring the agitator is to make the aerobic microorganisms fully contact with oxygen, so that the fermentation is more complete.

On the wall of the fermentation, we installed the structure of ventilation and deodorization. At the top of each fermenter there is a duct leading to the main duct leading to the ventilator. The ventilation hole on the left side of the ventilation fan is connected with the outside world so as to pass air. The walls of these pipes are arranged with Ye Guang mud and the filter elements made of Ye Guang mud are arranged on both sides of the ventilation fan. Ye Guang mud is a material with very good deodorization effect. Through the adsorption and locking of Ye Guang mud, the gas discharged and entered into air is non-toxic, odorless and pollution-free.

The working process of fermentation chamber is as follows:

Since the fermentation cycle of kitchen waste is three days, the four fermenters meet the requirements, and the numbers of the four fermenters are No.1, No.2, No.3 and No.4 respectively. Fermentation tank No. 1 is under the discharge port of the filter plate. When the first time material enters into No. 1, the bacteria liquid chamber will automatically release 10ml of bacteria liquid. The kitchen waste of one day enters into the fermentation tank after crushing., motor starts and drives the fermentation chamber rotate 90 ° until 12 PM. At this time, No. 2 fermentation tank has reached the position of the original No. 1, and No. 3 goes to No. 2, and along the way No. 1 goes to No. 4, and No. 1 starts its first day of actual fermentation. Then fermentation Tank No. 2 is the same as that of Fermentation Tank No. 1. One day later, at 12 o 'clock in the evening, the motor takes the fermentation chamber to rotate 90° again and Fermentation Tank No. 3 reaches the discharge acceptance port of filter plate. In this way, when No. 4 fermenter in the filter plate outlet to undertake a day of kitchen waste, by 12 o 'clock in the evening, No. 1 fermenter has been fermented for three days, so the fermentation is complete. Therefore, No. 1 Fermentation tank discharges the material and then the motor rotates 90° again. At this time, the empty No. 1 Fermentation tank returns to the bottom of the discharge port of the filter plate, waiting for a new round of feeding and fermentation. The associated machinery structures such as the agitator and the ventilation deodorizer are also kept on during the process.

2.4.3 Discharge structure design

The storage chamber is a fixed structure at the bottom of the fermentation chamber, where pipes are connected to the position where fermentation is completed. Since the structure of the vertebra is adopted at the bottom of the fermentation tank, the baffle at the bottom of the fermentation tank is opened when the material is discharged, and the material enters into the storage chamber through the vertebra structure and pipes.

3. Working principle and performance analysis

1) The crushing device. First put the kitchen waste into the feed port,

The first step after the garbage enters into the entrance is to be crushed by the pulverizer into fermented particles, which are then moved to the next step.

2) Fermentation device. After garbage enters into the fermentation device,

After the waste enters into the fermentation device, it is fermented by aerobic microorganisms. The temperature and humidity inside the device are detected by sensors and they will feed back to the control system to keep the environment under the temperature and humidity conditions suitable for microbial reproduction, so that the fermentation process is controllable and efficient. There is a stirrer in the fermentation device, so that aerobic microorganisms can fully contact with oxygen and the fermentation is more complete. When the raw material is fermented into standard organic fertilizer, it enters the next step.

3) Deodorization and ventilation device. Because the fermentation will produce hydrogen sulfide odor and other harmful gases, we placed the Ye Guang mud to purify it in the fermentation device. Through the adsorption, locking and decomposition of Ye Guang mud, the gas we discharge is non-toxic, harmless and pollution-free. Finally, it is discharged through the exhaust pipe.

4) Termentation principle——high-temperature aerobic fermentation principle.

For the small biochemical processor we designed, high-temperature aerobic fermentation with thermophilic bacteria species is a feasible way to achieve it. According to research, 40℃ is the optimal growth temperature for a thermophilic bacteria species, so we controlled the temperature in the fermentation room at about 40℃.

4. Conclusions

After our investigation, the small biochemical processor of kitchen waste facing the client in our country has not been widely used due to the high energy consumption and high price. Our small

biochemical processor of kitchen waste has reduced the energy consumption of the machine, which makes the machine be used in more places and is more likely to be popularized.

5. References

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