

TITLE OF THE INVENTION**A SYSTEM FOR EXTRACTING ENERGY FROM ORGANIC WASTE****FIELD OF THE INVENTION**

5 The present invention is generally related to a system for processing organic waste, and more particularly to a system for converting organic waste into biogas to generate electricity and/or for use in cooking and the like. A plurality of sinks are individually equipped with metallic stirrer for sorting out metallic materials from organic waste for waste processing.

BACKGROUND OF THE INVENTION

10 Waste disposal is a serious issue encountered by many nations across the world. In recent history, waste created by humans has primarily been disposed of in landfills, which require substantial land, engineering and environmental monitoring and management resources. Regulatory and authority bodies as well as generators of waste, are increasingly interested in reducing waste volumes, diverting wastes from landfills and incinerators while promoting the more sustainable use of waste products. It is therefore desirable to develop technologies that
15 not only reduce the amount of landfilled and incinerated waste, but also to capture and use such material for beneficial purposes.

Recently, recycling and composting of residential and commercial waste materials has become a preferred way to reduce the amount of waste materials. Currently available method of processing organic waste food is of limited commercial value, and the known techniques
20 utilizing organic materials from a municipal waste stream in an anaerobic digestion process have failed to achieve consistent. In other words, there are current exist deficiencies associated with waste processing, and, in particular, with organic waste processing.

In recent years, food wastage is a real problem in Singapore. According to National Environment agency (NEA) of Singapore, waste is one of the five largest waste streams
25 generated in Singapore, and the total waste generated in 2017 was 809,800 tonnes – an increase of over 24,000 tonnes since 2015, according to statistics published on the NEA website. Waste is generated not only within the home, but at eateries as well. As a result, methods are being proposed to tackle the problems caused by the increase of the waste.

US Patent No. 4,503,154 entitled “ Anaerobic Digestion Of Organic Waste For Biogas
30 Production” relates to a low solids aqueous suspension of organic waste being treated in at least four, e.g., six serial anaerobic zones at a temperature of less than 40° C. and under quiescent conditions to provide methane, fertilizer and a clean liquid effluent.

US Patent No. 6,824,682 discloses a process and apparatus for processing agricultural waste to make alcohol and/or biodiesel. The agricultural wastes are subjected to anaerobic digestion which produces a biogas stream containing methane, which is subsequently reformed to a syngas containing carbon monoxide and hydrogen. The syngas is converted to an alcohol which may be stored, sold, used, or fed directly to a reactor for production of biodiesel. The solids effluent from the anaerobic digester can be further utilized as slow release, organic certified fertilizer. Additionally, the wastewater from the process is acceptable for immediate reuse in agricultural operations.

US Patent Publication No. 20170158539, entitled "System And Method For Converting Organic Waste Into Methane And Other Useful Products", discloses an organic waste processing system and method for producing an organic waste slurry for the production of bio-gas, transportation fuels or chemical products, wherein the system and method produces an organic waste slurry having substantially ten to fifteen percent in total solids and high levels of COD.

US Publication No. 20100264079 discloses a waste processing system comprising: an input configured to receive a heterogeneous waste stream including biodegradable and non-biodegradable components; a pulper fluidly connected to the input, the pulper configured to mechanically de-fiber the biodegradable components of the heterogeneous waste stream to form a de-fibered biodegradable material; and an anaerobic membrane bioreactor fluidly connected downstream of the pulper.

SUMMARY OF THE INVENTION

Accordingly, one aspect of the present invention is to provide a system for extracting energy from organic waste for the production of bio-gas to produce electricity, and for the production of a filtrate for use in urban farm. The system comprises

(i) a plurality of sinks (10) each being equipped with a grinder (13) and with a metallic stirrer or the like to sort out metallic materials from organic waste for subsequent crushing process of the organic waste by the grinder (13) into tiny pieces of waste to be stored, wherein the grinder (13) speeds up digestion of the organic waste;

(ii) a centralized storage tank (20) having an inlet and an outlet, wherein the inlet is connected through piping to the grinder (13), both the inlet and the outlet are mounted with a valve to control the flow of crushed waste from the grinder (13) into the storage tank (20) and the organic waste is automatically transferred from one location to another location for processing by a pneumatic control so as to eliminate bulk point to point transfer;

(iii) a digester (30) being connected to the storage tank (20) via piping for the production of bio-gas to produce electricity, wherein the organic waste is automatically being transferred to the digester (30); and

(iv) an electric generating device being connected to the digester (30) such that the biogas
5 can be used to produce electricity.

Another object of the present invention is to provide a system for extracting energy from organic waste, wherein the flow of the organic wastes upon broken down into small pieces is controlled by a programmable logic controller (16) designed to transport the waste to the centralized storage tank (20) and then into the digester (30) to proceed with anaerobic
10 treatment therein.

Yet another object of the present invention is to provide a system for extracting energy from organic waste, wherein anaerobic digestion process is taking place in the digester (30) where microorganisms break down organic food materials in the absence of oxygen, and the digestate is separated into a residual solid and a liquid as filtrate for use in urban farm.

15 Still another object of the present invention is to provide a system for extracting energy from organic waste, wherein heat and biogas are generated at the digester, meaning that the heat and biogas generated will be used within the food court or hawkers centre.

A major object of the present invention is to provide a system for extracting energy from organic waste, wherein a major feature of the system is its ability to fully process all types of
20 food waste without the huge expense of separate collection systems.

A further object of the present invention is to provide a system for extracting energy from organic waste, wherein the digester is heated up using biogas which is recycled from the extracting process.

25 Still a further object of the present invention is to provide a system for extracting energy from organic waste, wherein the digester contains various micro-organism that acts like enzymes which breaks down the organic waste.

A further object of the present invention is to provide a system for extracting energy from organic waste, wherein the heat generated is being used to heat water heaters for a) the digester to an optimum temperature for the anaerobic digestion process to take place.

30 Still yet another object of the present invention is to provide a system for extracting energy from organic waste, wherein the heat generated is being used to heat up the water in

dishwashing machine for optimum dishwashing, thereby reducing the need for gas or electricity to power up the heating element of the dishwashing machine.

A further object of the present invention is to provide a system for extracting energy from organic waste, wherein the the bio gas generated powers to activate a generator which in turn
5 produces electricity to activate all the system's electromagnetic stirrer, computer vision cameras, grinders, pneumatic systems etc, and to charge on site batteries.

Still another object of the present invention to provide a system for extracting energy from organic waste, wherein the charged batteries provide electricity back to the system grid to power up mobile phone charging walls for consumers to charge their mobile phones, and to
10 power up LED lights within the food court or hawkers center, and power up common area LED lights and signages, in the process reducing overall carbon foot print.

Yet a further object of the present invention is to provide a system for extracting energy from organic waste, wherein the bio gas generated can be stored separately for usage, and the bio gas can be compressed, or is then transported back via a system of gas pipes to the individual
15 units to power up gas stoves for cooking.

Still yet another object of the present invention is to provide a system for extracting energy from organic waste, wherein the liquid of the digestion process is a nutrient rich liquid that can be used as composte/ fertilisers to irrigate urban farms.

Another further object of the present invention is to provide a system for extracting energy
20 from organic waste, wherein the nutrient rich liquid is transported via a pneumatic pipe system to the urban farm irrigation system which would then administer irrigation to the urban farm.

Still yet another object of the present invention is to provide a system for extracting energy from organic waste, wherein the operating temperature at the digester is about 40°C.

Another object of the present invention is to provide a system for extracting energy from
25 organic waste, further comprising a plurality of piping to discharge digestate generated by the digester (30) to be converted to fertilizer.

Yet a further object of the present invention is to provide a system for extracting energy from organic waste, wherein the electric generating device is an electric generator.

Still yet another object of the present invention is to provide a system for extracting energy
30 from organic waste, wherein an electro magnetic stirrer (11) is provided to the sink (10) to

sorting out metallic objects in the process of blending the organic waste food within the sink (10).

Still a further object of the present invention is to provide a system for extracting energy from organic waste, wherein the digester contains anaerobic microorganisms for converting waste.

- 5 A further object of the present invention is to provide a system for extracting energy from organic waste, further comprising a biogas storage tank (40) for storing biogas generated from the digester (20).

- Still a further object of the present invention is to provide a system for extracting energy from organic waste, wherein the system is deployed within a hotel, a food court, a hawker center,
10 a cruise ship, exhibition and convention centre, and/or residential estate.

Yet still a further object of the present invention is to provide a system for extracting energy from organic waste, further comprising a plurality of computer cameras (101) to monitor the processing of organic waste.

- Still yet another object of the present invention is to provide a system for extracting energy
15 from organic waste, wherein the temperature of the digester is ranging from 28-38 degree C.

A further object of the present invention is to provide a system for extracting energy from organic waste, wherein the preferred temperature of the digester is 30° C.

- Another object of the present invention is to provide a system for extracting energy from organic waste, wherein the programmable logic controller is deployed to control a feed cycle
20 start and stop.

Still another object of the present invention is to provide a system for extracting energy from organic waste, wherein the programmable logic controller is configured to control the opening and closing of valves along the piping in communication with the storage tank to the digester, and from the digester to the bio gas storage tank.

- 25 A further yet another object of the present invention is to provide a system for extracting energy from organic waste, wherein the programmable logic controller is configured to monitor the waste food storage tank, the bio gas storage tank, and the digester.

BRIEF DESCRIPTION OF THE DRAWING

A more complete appreciation of the present invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings, wherein:

- 5 FIG. 1 is schematic view of the system for extracting energy from organic waste in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views, preferred embodiments of the present
10 invention are described.

The present invention provides a system for converting organic waste materials into energy via anaerobic digestion to produce bio-gas, which can be recycled back to food court or hawker center stall owners or the like, and a filtrate discharged from the system is used for urban farming. In accordance with the present invention, a major feature of the system is its
15 ability to fully process all types of food waste without the huge expense of separate collection system. The present system can be used from waste collected from homes, institutions or restaurants, food waste that is troublesome to most disposal systems, etc.

In accordance with the preferred embodiment of the present invention, as shown in FIG. 1, a system (100) for extracting energy from organic waste is disclosed. The system (100)
20 comprises (i) a plurality of sinks (10) each being equipped with a grinder (13) and with a metallic stirrer (14) or the like to sort out metallic materials from organic waste for subsequent crushing process of the organic waste by the grinder (13) into tiny pieces of waste to be stored, wherein the grinder (13) speeds up digestion of the organic waste; (ii) a centralized storage tank (20) having an inlet (not shown) and an outlet (not shown), wherein the inlet is connected
25 through piping to the grinder (13), both the inlet and the outlet are mounted with a valve (not shown) to control the flow of crushed waste from the grinder (13) into the storage tank (20) and the organic waste is automatically transferred from one location to another location for processing by a pneumatic control (not show) so as to eliminate bulk point to point transfer; (iii) a digester (30) being connected to the storage tank (20) via piping for the production of
30 bio-gas to be stored at a biogas storage tank (40), wherein the organic waste is automatically transferred to the digester (30); and (iv) an electric generating device (50) being connected to the biogas storage tank (40) such that the biogas can be used to produce electricity by the generating device (50).

In a food court or hawker center or the like, all the food stalls within the food court or the hawker center are equipped with a sink (10). The sink (10) is provided with an electro-magnetic stirrer (14). All the sinks (10) are linked to the centralized waste storage tank (20) via piping (15, 25). In operation, the system (100) starts by first triggering the electro-magnetic stirrer (14) to function. The organic wastes are mixed and the electro-magnetic stirrer (14) will attract any metallic waste that may be accidentally deposited into the sink (10). The electro-magnetic stirrer (14) is functioned to prevent any metallic waste from being ground or crushed which will damage the blending device and digester (20). In accordance with the present invention, the grinder (13) is provided at the waste source location which is used to speeds up digestion of the food waste at the digester (20).

The system (100) is equipped with a plurality of cameras (not shown) which capture the type of organic wastes being thrown into the sink (10), the volume of the organic waste, or metallic waste, and a report can be prepared based on these data. The report can be used as a guide for the stall operator to track the volume of organic wastage, the type of organic wastage to prevent future wastage, and the data collected can provide further insights that the systemic level which helps to monitor waste and provide a model of predictive analysis on volume per day, and provide each units organic waste cycling volume readings and proportionately provide the electricity of bio-gas created to the system (100).

Grinding of the waste begins at each of the stall in the food court or the hawker centre by operating the sink (10) and the grinder (13). The organic waste is broken down into small pieces of waste which are then mixed with water and are transported by a system of piping (15, 25) to the centralized storage tank (20), and from the storage tank (20) to the digester (30). The breaking of the waste is by meant of the grinder (13) equipped with a metallic stirrer (14) to the sink (10). The transportation of waste through the pipes can be done via an air vacuum system or the usage of a pneumatic system. With such a system, the need for a point to point transfer of organic waste from a point to another organic digester can be reduced. This will provide a better operational process and labour efficiency, and reduces the disincentive of organic waste sorting by the operation, and there is no leakage of organic waste due to transportation. Further, the grinding of the organic waste speeds up the digestion process as organic wastes have been broken into smaller particles, hence the speed and yield of digestion process are increased.

In the present preferred embodiment, the organic waste is transported to the centralised storage tank (20), the organic waste from the tank (10) is then fed into the digester (30). The digester (30) contains various micro-organism that acts like enzymes which breaks down the organic waste further. The chemical process in the digester (30) is anaerobic and heat and

bio-gas are generated. The heat the generated is used to heat water heaters for the devices used in the food court or hawker center, such as dishwashing, etc. Thus, energy is conserved via this process. The bio gas generated will power a generator which in turn produces electricity. The electricity can be used in many ways. The temperature of the digester (30) is ranging from 28-38 degree C, and the preferred temperature of the digester (30) is 30° C.

Alternatively, the bio gas generated can be stored in a biogas storage tank (40) separately for usage. The bio gas can be compressed and transported to the stalls for gas stoves or the like devices.

The filtrate or digestate (22) of the digestion process in the digester (30) is a nutrient rich liquid than can be used a composite fertilizer to irrigate urban farms. The nutrient rich liquid is transported via the pneumatic pipe system to the urban farm for irrigation which could then administer irrigation to the on site urban farm.

In accordance with the present invention, the system (100) is being implemented by having a piping system which operated via pneumatic controls, to transport organic waste matter, and them the conversion of organic waste into useful bio gas, electricity and nutrient rich fluids from the digester (30) and is then transported back to the stall or an urban farm. The system reduces carbon food print by (a) using less conventional electricity to power lighting devices, water heaters, mobile phones, etc; (b) the need to transport waste from source to disposal point; and (c) reduces consumption of LPG for cooking as biogas generated by the system is used instead.

The system provides automated point to point transfer of organic waste from one source to the location of the digester (30), which eliminates the need for bulk point to point transfer. Thus, the system provides better efficiencies, yield, and reduces carbon emissions as a result of gas operated vehicles.

In the present invention, a computer vision analytics (not shown) and a volume flow meter (81) can be mounted at the sinks (10) to analyse the organic waste volume and inorganic waste. In addition, an automated display counter that calculates carbon emission reduction based on volume of organic waste digested is provided.

The system of the present invention employs the programmable logic controller to control a feed cycle start and stop. The programmable logic controller is also used to monitor the waste food storage tank, the bio gas storage tank, and the digester. The programmable logic controller is fitted to the pneumatic control system for controlling the discharge of waste to be discharged. The programmable logic controller is configured to control the opening and

closing of valves along the piping in communication with the storage tank (20) to the digester (30), and from the digester (30) to the bio gas storage tank (40).

5 The system (100) of the present invention is a close loop, and is a convenient system for the users to increase of organic waste recycling. Conventional method of organic waste recycling requires too many points to points transfer which discourages the stall owners to recycle the waste.

10 Although specific embodiment of the invention has been shown and described above for the purpose of enabling a person skilled in the art to make and use the invention, it will be appreciated that the invention is not limited thereto. Accordingly, any modifications, variations or equivalent arrangements within the scope of the attached claims should be considered to be within the scope of the invention.

CLAIMS

1. A system for extracting energy from organic waste comprising
 - (i) a plurality of sinks (10) each being equipped with a grinder (13) and with a metallic stirrer (14) or the like to sort out metallic materials from organic waste for subsequent crushing process of the organic waste by the grinder (13) into tiny pieces of waste to be stored, wherein the grinder (13) speeds up digestion of the organic waste;
 - (ii) a centralized storage tank (20) having an inlet and an outlet, wherein the inlet is connected through piping to the grinder (13), both the inlet and the outlet are mounted with a valve to control the flow of crushed waste from the grinder (13) into the storage tank (20) and the organic waste is automatically transferred from one location to another location for processing by a pneumatic control so as to eliminate bulk point to point transfer ;
 - (iii) a digester (30) being connected to the storage tank (20) via piping for the production of bio-gas to be stored in a bio gas storage tank (40) to produce electricity , wherein the organic waste is automatically transferred to the digester (30); and
 - (iv) an electric generating device (50) being connected to the digester (30) such that the biogas can be used to produce electricity.
2. The system for extracting energy from organic waste as set forth in Claim 1, further comprising a computer vision analytics and a volume flow meter (81) at the sinks (10) to analyse the organic waste volume and inorganic waste.
3. The system for extracting energy from organic waste as set forth in Claim 1, further comprising an automated display counter (82) that calculates carbon emission reduction based on volume of organic waste digested.
4. The system for extracting energy from organic waste as set forth in Claim 1, further comprising a plurality of piping to discharge digestate (22) generated by the digester (30) to be converted to fertilizer.
5. The system for extracting energy from organic waste as set forth in Claim 1, wherein the electric generating device is an electric generator.

6. The system for extracting energy from organic waste as set forth in Claim 1, wherein metallic objects in the organic waste is sorted out by the magnetic stirrer (14) in the process of blending the organic waste food in each sink (10).
- 5 7. The system for extracting energy from organic waste as set forth in Claim 1, wherein the digester (30) contains anaerobic microorganisms for converting waste.
8. The system for extracting energy from organic waste as set forth in Claim 1, further comprising a biogas storage tank (40) for storing biogas generated from the digester (20).
- 10 9. The system for extracting energy from organic waste as set forth in Claim 1, wherein the system is deployed within a hotel, a food court, a hawker center, a cruise ship, exhibition and convention centre, and/or residential estate.
10. The system for extracting energy from organic waste as set forth in Claim 1, further comprising a plurality of computer cameras to monitor the processing of organic waste.
- 15 11. The system for extracting energy from organic waste as set forth in Claim 1, further comprising a pneumatic control system to handle the waste food until bio gas is generated to produce electricity.
12. The system for extracting energy from organic waste as set forth in Claim 1, wherein the temperature of the digester is ranging from 28-38 degree C.
- 20 13. The system for extracting energy from organic waste as set forth in Claim 10, wherein the preferred temperature of the digester is 30° C.
14. The system for extracting energy from organic waste as set forth in Claim 9, wherein a programmable logic controller is fitted to the pneumatic control system for controlling the discharge of waste to be discharged.
- 25 15. The system for extracting energy from organic waste as set forth in Claim 12, wherein the programmable logic controller is deployed to control a feed cycle start and stop.
16. The system for extracting energy from organic waste as set forth in Claim 13, wherein the programmable logic controller is configured to control the opening and closing of valves along the piping in communication with the storage tank to the digester, and from the digester to the bio gas storage tank.

17. The system for extracting energy from organic waste as set forth in Claim 14, wherein the programmable logic controller is configured to monitor the waste food storage tank, the bio gas storage tank, and the digester.