

A METHOD AND SYSTEM FOR TRANSFORMING ORGANIC WASTE INTO AN ORGANIC FERTILIZER

TECHNICAL FIELD

[0001] The present disclosure generally relates to organic waste recycling and more particularly to a method and a system for transforming organic waste into an organic fertilizer by a fermentation and pasteurization process using a highly efficient organic waste digester.

BACKGROUND

[0002] With the accelerating process of urbanization and population growth in many countries, more and more household, commercial and industrial waste including hazardous waste such as electronic waste, and organic waste from plant and animal farming are produced on a daily basis. Organic waste in particular, has also become a significant cause of environmental pollution that will seriously pollute our environment if there is improper disposal and/or recycling.

[0003] Organic waste comes from either plants or animals and comprises mostly vegetable and fruit debris, paper, bones, and human and animal waste. The growth of intensive animal farming such as the farming of cattle, pigs, poultry and fish at higher stocking densities in response to the ever increasing population has led to an ever increasing output of this type of organic waste. For example, the development of intensive pig and poultry farming has caused more and more soil, water and air pollution issues. The enormous amount of manure discharge not only constitutes a serious environmental pollution, but also constraints farmers' development of large-scale livestock farming. It is therefore important to convert these manure into an environmentally safe product for disposal or commercial use.

[0004] Traditionally, organic waste has been utilized by farmers as a fertilizer for their crops from ancient times, though somewhat in unhygienic ways. The need to convert the organic waste into a safe and environmentally friendly product is also necessary in view of stricter government

legislature because of environmental pollution issues. In addition, organic waste especially when sufficiently high in nutrient content has recently been recognized to possess good commercial value in providing a safe and environmentally friendly way to fertilize crops.

[0005] There are generally three methods in which to process organic waste into an organic fertilizer from intensive livestock farms and plantations. One is the degradation of aerobic composting process, which is to put the animal manure in large storage silos or composting tanks with added microbial agents. The manure is then allowed to compost for about 45 days to reach maturity into organic fertilizer. However, this method not only requires large spaces and a long process time, but the method is also prone to foul odors and breeds mosquitoes. Thus a cause of secondary pollution to the surrounding environment.

[0006] The second method is an anaerobic biogas process which converts the organic waste through anaerobic digestion into biogas. This is an anaerobic methane fermentation process which requires a relatively stable organic waste content, temperature and pH conditions. However, the fermentation time is relatively long (25-40 days) and requires a huge facility for operating the fermentation equipment resulting in very high initial investments. In addition, the biogas fermentation produces large amounts of biogas slurry and sewage, which have low nutrient content and are therefore not suitable for long-term irrigation and fertilization of farmland. These slurry and sewage may be disposed directly from the farms and may seriously pollute rivers, farmlands and surface water bodies, and therefore contributes to secondary pollution as well.

[0007] The third method is to dry the organic waste to form organic fertilizers directly using high-temperature drying equipment. However, such organic fertilizers are also low in nutrient content, and at the same time, the organic waste usually fails to totally decompose and will cause a ‘burning roots’ phenomenon when disposed on land in the long-term, thus adversely affecting the production of crops and plantation.

[0008] In view of the foregoing problems, a need remains for a method and a system for recycling organic waste into an organic fertilizer that can overcome the above-noted shortcomings. The non-limiting exemplary embodiments of this disclosure satisfy such a need by providing a method

and a system for transforming organic waste into an organic fertilizer comprising a fermentation and pasteurization process with the use of a highly efficient organic waste digester.

SUMMARY OF THE INVENTION

[0009] In view of the foregoing background, it is therefore an object of the non-limiting exemplary embodiments to provide a method and a system for transforming organic waste into an organic fertilizer comprising a fermentation and pasteurization process with the use of a highly efficient organic waste digester.

[0010] In the process, organic waste together with a moisture reducing agent are firstly mixed with a fermentation agent (HFA) in an organic waste digester or bio-digester comprising a fermentation/digester tank. During the fermentation process, microorganisms and enzymes from the HFA breaks down the organic waste comprising proteins, polysaccharides, fats, cellulose and starts the fermentation process. This fermentation process digest and metabolizes the large molecules in the organic waste with new enzymes by the microorganisms being further produced to maintain the digestion. The mixture is mixed thoroughly by continuous agitation of the mixture with strict control of the temperature and continuous aeration to maintain the aerobic process for about 9-12 hours. Next, a combined pasteurization and drying process of about 2.5-5 hours is provided whereby bacterial, insect eggs, seeds, fungus and other harmful organisms are destroyed at the same time that the water is removed from the fermented mixture to result in a dry organic fertilizer within an overall cycle time of less than about 22 hours, i.e. starting from the time of mixing the organic waste to the resultant dry powder organic fertilizer.

[0011] In accordance with one aspect of this disclosure, a method is disclosed for transforming organic waste to a dry organic fertilizer comprising the steps of: mixing about 80% by weight of an organic waste with about 20% by weight of an organic moisture reducing agent and about 0.1% by weight of a fermentation agent to form a mixture; fermenting the mixture at a temperature of about 70-80° C for about 9-12 hours; and simultaneously pasteurizing and drying the mixture at about 80-95°C for about 2.5-5 hours; wherein the organic waste may be transformable into an

organic fertilizer comprising organic matter of more than about 45% and an NPK value of more than about 5%. Such an organic fertilizer has a Nitrogen content that is greater than 1.5%, a Phosphorus content that is greater than 2.5%, and a Potassium content that is greater than 2.5%.

[0012] In accordance with one aspect of this disclosure, the method may further include the step of continuously agitating the mixture during the steps of mixing, fermenting, and pasteurizing and drying the mixture.

[0013] In accordance with one aspect of this disclosure, the method may further include the step of continuously aerating the mixture during the steps of mixing, fermentation, and pasteurizing and drying the mixture.

[0014] In accordance with various aspects of this disclosure: the moisture content of the animal manure may be about 70-80%; the moisture content of the food waste may be about 60-70%; the moisture content of the moisture reducing agent may be less than about 10%; the moisture content of the fermentation agent may be about 0.2%.

[0015] In accordance with one aspect of this disclosure, mixing the organic waste and the moisture reducing agent may reduce the moisture content of the mixture to about 50-60%.

[0016] In accordance with various aspects of this disclosure, the organic waste may include at least one of an animal manure, food waste, agricultural waste, plant waste and city sludge; and the moisture reducing agent may include at least one of a wood waste, saw dust and/or straw.

[0017] In accordance with one aspect of this disclosure, the fermentation agent may include thermophilic aerobic microorganisms and enzymes which are operational at the fermentation temperature of 70°-80° C.

[0018] In accordance with one aspect of this disclosure, the microorganisms may further produce enzymes during the step fermenting the mixture.

[0019] In accordance with one aspect of this disclosure, the microorganisms may include at least one or more of a microorganism such as Clostridium Stercorarium Sp, Chaetomium Thermophilum Sp, Geobacillus Sp, Actinomadura Sp, Thermomonospora Sp, Myceliophthora Thermophila Sp, Phanerochaete Chrysosporium, Aspergillus Niger, Thermoactinomyces Vulgaris Sp, Bacillus Sp, Streptomyces Thermogriseus Sp, Streptomyces Cinnamoneus, Photosynthetic bacteria and Nitrobacteria.

[0020] In accordance with one aspect of this disclosure, the enzymes may include at least one or more of a thermophilic enzyme such as Cellulase, Lipase, Pectinase, Protease, Trypsin, Amylase, Glucanase, Phytase, Hemicellulase, Laccase, Mn Peroxidase and Lignin Peroxidase.

[0021] In accordance with one aspect of this disclosure, pasteurizing the mixture at the temperature of about 80-95°C for about 2.5-5 hours exterminates harmful organisms such as E. coli, Shigella, Salmonella, Ascaris and their eggs, and weed seeds without exterminating beneficial soil organisms such as probiotics.

[0022] In accordance with another aspect of this disclosure, a system is disclosed for transforming organic waste to an organic fertilizer by a mixing, fermenting, combined pasteurizing and drying process. Such a system may include: a fermentation/digester tank having a charging port for input of the organic waste and a discharging port for output of the organic fertilizer; a mixing mechanism for mixing organic waste and a moisture reducing agent into a mixture; a heating mechanism for controlled heating and drying of the mixture; an air inlet mechanism having an air filter for inputting air into the tank and air outlet mechanism for extracting air from the tank; and a control mechanism. Such a control mechanism may include predetermined settings for time duration and temperature control of the mixing, fermenting, combined pasteurizing and drying processes.

[0023] In accordance with one aspect of this disclosure, the mixing mechanism may include a series of rotating arms or impellers for agitating, mixing and tossing the organic waste and fermenting agent within the tank.

[0024] In accordance with one aspect of this disclosure, the heating mechanism may include a

series of heating elements incorporated within or close to the interior space of the tank.

[0025] In accordance with various aspects of this disclosure, the air inlet mechanism may include an air blower and the air outlet mechanism may include an air filter.

[0026] In accordance with one aspect of this disclosure, the control mechanism may further include a programmable logic controller (PLC) programmable and sensors and switches for automatic control of the fermenting, pasteurizing and drying processes.

[0027] In accordance with another aspect of this disclosure, a method and system for obtaining an organic fertilizer from organic waste is disclosed wherein the Nitrogen content of the organic fertilizer greater than 1.5%, the Phosphorus content of the organic fertilizer is greater than 2.5%, and the Potassium content of the organic fertilizer is greater than 2.5%.

Advantages of the invention

[0028] The present invention provides the following advantageous effects:

[0029] The process greatly shortens the fermentation time of composting animal manure and other organic waste from the traditional 30-40 days to less than 22 hours. The ability of livestock waste environmental treatment and efficiency of waste recycling are therefore significantly improved.

[0030] The digester system uses a highly efficient fermentation agent to produce an organic fertilizer having a high and balanced nutrient value which is rich in organic matter having the ability to for improved soil permeability and water retention capacity.

[0031] The fermentation and drying temperature is controlled by using a Programmable Logic Controller (PLC) to control a heater which provides controlled heating within a short period of time, thereby reducing energy consumption.

[0032] The digester system uses a continuous aeration process during the fermentation process

which will not produce new malodorous gases and liquids, i.e. without causing secondary pollution.

[0033] After the aeration fermentation process, the digester system uses a combined pasteurizing and drying process to completely kill harmful bacteria, parasites and their eggs, and weed seeds, while retaining beneficial soil microorganisms. The pasteurizing and drying process improves the safety and effectiveness of the organic fertilizers.

[0034] The invention can be utilized for a wide range of feedstock, including but not limited to animal manure, plant and crop waste, food waste, municipal sludge and other organic waste.

[0035] There has thus been outlined, rather broadly, the more important features of this disclosure in order that the detailed description thereof that follows may be better understood, and in order that the present contribution to the art may be better appreciated. There are additional features of this disclosure that will be described hereinafter and which will form the subject matter of the claims appended hereto.

BRIEF DESCRIPTION OF THE DRAWINGS

[0036] Embodiments of the disclosure are described hereinafter with reference to the following drawings, in which:

[0037] Fig. 1 is a process flow diagram for converting organic waste into an organic fertilizer in accordance with the non-limiting exemplary embodiments;

[0038] Fig. 2 is a schematic block diagram showing the system for converting organic waste into an organic fertilizer using a single processing station in accordance with the non-limiting exemplary embodiments;

[0039] Fig.3 is a side elevational view showing the digester in accordance with the non-limiting

exemplary embodiments; and

[0040] Fig. 4 is a schematic view showing the automatic control mechanism utilizing a PLC in accordance with the non-limiting exemplary embodiments.

[0041] Those skilled in the art will appreciate that the figures are not intended to illustrate every embodiment of the invention. This disclosure is not limited to the exemplary embodiments depicted in the figures.

DETAILED DESCRIPTION

[0042] The non-limiting exemplary embodiments will now be fully described hereinafter with reference to the accompanying drawings, in which a preferred embodiment of the invention is shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiment set forth herein. Rather, these embodiments are provided so that this application will be thorough and complete, and will fully convey the true scope of the invention to those skilled in the art.

[0043] In the present disclosure, the use of “/” in a figure or associated text is understood to mean “and/or” unless otherwise indicated. The recitation of a particular numerical value or value range herein is understood to include or be a recitation of an approximate numerical value or value range, for instance, to within +/- 10%, +/- 5%, +/-2.5% or +/-1% of a particular numerical value or value range under consideration as will be understood by one of ordinary skill in the relevant art.

[0044] Embodiments of this disclosure relate to a method and a system for transforming organic waste into an organic fertilizer comprising fermentation, pasteurization and drying processes utilizing a highly efficient organic waste digester. The method and system efficiently transform organic waste into a high quality organic fertilizer with the use of a fermentation agent in a controlled heated and aerated environment. The embodiments further help to protect the environment by reducing the usage of chemical fertilizers, and to promote an eco-environmentally

friendly agricultural development.

[0045] Embodiments of this disclosure utilize a thermophilic aerobic fermentation process coupled with kinetic energy and efficient combination of microbial and enzyme catalytic action at a high temperature to efficiently transform organic waste into a high-quality organic fertilizer in less than 22 hours. The method and system not only improves the efficiency of converting organic waste into an organic fertilizer, but in addition, saves energy and protects the environment by reducing secondary pollution. It is not only an eco-friendly microbial digesting technology for treatment of intensive livestock farm organic waste and food waste, but also an eco-friendly organic waste renewable technology for converting animal manure, food and other types of organic waste into organic fertilizer.

Process Description

[0046] Fig. 1 is a process flow diagram for converting organic waste into an organic fertilizer in accordance with the non-limiting exemplary embodiments.

[0047] The process 100 include first mixing an amount of organic waste with an organic moisture reducing agent and a fermentation agent to form a mixture in a digester as shown in step 110. The mixture is next subjected to a fermentation process under a predetermined fermentation temperature after which the fermented mixture is further subjected to a pasteurizing and drying process which is performed simultaneously under another predetermined pasteurizing/drying temperature for a predetermined duration of time in the same digester. Such a method of (i) mixing, (ii) fermenting and (iii) simultaneously pasteurizing and drying is conducted while aerating and agitating or stirring/tossing the mixture in the same digester advantageously transform the organic waste into dry organic fertilizer comprising organic matter of more than 45% and an NPK value of more than 5% in a single continuous process within less than 22 hours. Time is saved by eliminating the need to transfer the mixture in between the fermenting, pasteurizing and drying processes from station to station. Subsequent processes may include processing the dry organic fertilizer into granules or other suitable forms using granulating machines or the like as desired by users.

[0048] In one embodiment of the present disclosure, fresh animal manure comprising about 80% manure by weight of total mixture and about 20% of a moisture reducing agent, for example, wood waste, saw dust or straw by weight of total mixture are mixed together in a digester as shown in step 110a. The moisture content of the animal manure may be about 70-80% which is typically the moisture content that one can find in fresh animal manure. It is envisaged that the naturally occurring moisture content of the moisture reducing agent is less than 10% as it is preferred that the moisture reducing agent be as dry as possible. As an example, if about 4 tons of manure comprising about 70-80% moisture is introduced into the fermentation/digester tank, about 1 ton of moisture reducing agent comprising less than about 10% moisture will be introduced. The combination of the animal manure and the moisture reducing agent thus results in a moisture content of about 50-60% in the organic waste mixture.

[0049] In an alternative embodiment of the present disclosure as shown in step 110a, fresh food waste comprising about 80% manure by weight of total mixture and about 20% of a moisture reducing agent, for example, wood waste, saw dust or straw by weight of total mixture are mixed together in the digester as shown in step 110. The moisture content of the food waste may typically be about 60-70%. It is envisaged that the naturally occurring moisture content of the moisture reducing agent is less than 10% as it is preferred that the moisture reducing agent be as dry as possible. For example, if 4 tons of food waste comprising about 60-70% moisture is introduced into the fermentation/digester tank, about 1 ton of the moisture reducing agent with less than about 10% moisture content will be introduced. The combination of the food waste and the moisture reducing agent thus results in a moisture content of about 50-60% in the organic waste mixture.

[0050] It is envisaged that no additional water needs to be added to the fresh organic waste mixture as the resultant moisture content is typically higher than about 60%. In this way, the addition of an organic moisture reducing agent such as dry wood waste, saw dust or straw with less than 10% moisture will typically yield a moisture content of about 50-65% in the organic waste mixture. It will be easily understood by individuals of ordinary skill in the art that adding wood waste, sawdust or straw which comprises substantially dry organic material as organic moisture reducing agents serves to reduce the level of mixture moisture and to raise the Carbon/Nitrogen (C/N) ratio of the

feedstock to provide a more efficient fermentation process.

[0051] In other alternative embodiments of the present disclosure as shown in step 110b, the organic waste/ mixtures may include a mixture of more than two types of organic waste such as for example, 40% animal manure, 40% food waste and 20% moisture reducing agent. However, the combination of the organic waste and the moisture reducing agent should be prepared to meet the required moisture content of about 50-60% in the organic waste mixture prior to the fermentation process. The proportions of the different types of organic waste may be adjusted in accordance with the formulation of the resultant organic fertilizer as will be easily understood by an individual skilled in the art.

[0052] Next, simultaneously or at about the same time or following the step of mixing the organic waste and moisture reducing agent together, about 0.1% of a complex fermentation agent known as HFA having about 0.2% moisture may be added to the resultant mixture in the digester as shown in step 115. As an example, if 5 tons of organic waste/moisture reducing agent mixture is mixed together in the fermentation/digester tank, 5kg of HFA will be added. It is envisaged that the HFA will be in the form of a dry powder. It is also envisaged that the moisture content of the feedstock/moisture reducing agent/fermentation can be reduced to about 50-65% by continuously agitating the moisture in the digester while organic waste and HFA are being added. As shown in step 130, the temperature in the digester can be gradually raised to the fermentation temperature of about 70° - 80° C. At about the same time or simultaneous with the raising of the temperature to about 70° - 80° C, the mixture is agitated to provide maximum exposure to the heat and incoming air flow. Agitation can be by stirring, turning, tossing motions to ensure exposure of all the contents in the mixture to effect maximum aeration and heating.

[0053] The HFA may include microorganisms and enzymes selected using samples of multiple microorganisms which have undergone acclimatization to obtain those having the highest survivability and fermentation rates that can operate in the high fermentation temperature of the digester. The selected microorganisms may be cultivated to obtain the various types that produces the enzymes to aid in the fermentation process. The HFA may next be formulated to obtain the most efficient microorganisms and enzymes through using different proportions of the

microorganisms, enzymes and supplements such as microorganism protection agents.

[0054] The thermophilic aerobic micro-organisms may include at least one or more of the following micro-organisms such as *Clostridium stercorarium* sp, *Chaetomium thermophilum* sp, *Geobacillus* sp, *Actinomadura* sp, *Thermomonospora* sp, *Myceliophthora Thermophila* sp, *Phanerochaete chrysosporium*, *Aspergillus niger*, *Thermoactinomyces vulgaris* sp, *Bacillus* sp, *Streptomyces thermogriseus* sp, and *Streptomyces cinnamoneus*, Photosynthetic bacteria and Nitrobacteria.

[0055] The microorganisms digest the organic waste by decomposing the organic macromolecules and secrete enzymes at the same time thereby converting the organic waste mixture into organic fertilizer and further degrade the organic waste directly. The thermophilic enzymes may further include one or more of the following enzymes such as Cellulase, Lipase, Pectinase, Protease, trypsin, amylase, Glucanase, Phytase, Hemicellulase, Laccase, Mn Peroxidase and Lignin Peroxidase. One skilled in the art will understand that such types of enzymes may be produced during the fermentation process or added to the mixture as necessary.

[0056] The mixture remains in the fermentation/digester tank where the temperature is set at about 70° - 80° C for about 9-12 hours for optimum enzyme catalysis as shown in step 140. The resultant fermented composition is envisaged to yield a Carbon/Nitrogen (C/N) ratio of about 20-28:1 which can be derived from the proportions of the organic waste mixture and is the best range for such type of microbial fermentation within the desired fermentation duration of 9-12 hours. One of ordinary skill in the art will understand that the C/N ratio depends on the type of organic waste utilized and the resultant C/N ratio can be derived based on the ratio of the different organic waste utilized in the process.

[0057] The temperature of the fermentation/digester tank is next raised to about 80-95° C whereby the fermented mixture is subjected to this temperature for about 2.5-5 hours for the pasteurization and drying process as shown in step 150. Such a pasteurization/drying temperature and process is well known in the art and harmful organisms such as *E. coli*, *Shigella*, *Salmonella*, *Ascaris* eggs, weed seeds and the like are killed. It should be noted that organisms beneficial to the soil such as

probiotics necessary for plant growth are not killed at this temperature and heating duration. The pasteurizing and drying processes are performed simultaneously or at about the same time. In this way, the method reduces the time and effort taken to produce the dry organic fertilizer as well as conserve energy consumption. The combined pasteurization/drying process results in a dry organic fertilizer which may typically be in powder form. It should be well understood by individuals skilled in the art that if necessary and depending on the amount and quantity of the mixture, the temperature and the duration of the heating can be adjusted to ensure that the harmful organisms can be thoroughly killed.

[0058] As shown in steps 110-160, the fermentation and pasteurization/drying is performed while the mixture is being continuously agitated while a continuous flow of air is drawn into the digester to provide the aeration. Such a combination of kinetic energy during the thermophilic aerobic fermentation process, efficient combination of microbial and enzyme catalytic action at a high temperature effectively transforms the organic waste into a high-quality organic fertilizer in less than 22 hours as shown in step 160. The agitation serves to evenly distribute and expose the contents of the mixture to the temperatures necessary for fermentation to take place and to kill the harmful organisms while ensuring that the good organisms are not destroyed at the same time during the pasteurization/drying processes. The process of stirring and aerating the mixture is thus performed until the mixture is transformed into the substantially powdered form of the resultant organic fertilizer as will be readily understood by one skilled in the relevant art.

[0059] Lastly, the dried organic fertilizer may be transferred to a granulation machine to be granulated if desired as shown in step 170. The granulation machines may include conventional machines well known in the art to process the powdered fertilizers into granules, for example with less than 30% moisture thereby fulfilling the requirements of fertilizer products. It will be appreciated that one skilled in the art will be able to utilize suitable granulation machines for such a purpose, such as using a centrifugal formula granulation system to convert the dried mixture into granules for example.

System Description

[0060] Figure 2 is a schematic block diagram showing the system for converting organic waste into an organic fertilizer using a single processing station in accordance with the non-limiting exemplary embodiments.

[0061] The system 10 may include a suitable utensil 12 suitable for transporting, transferring the organic waste 40 from a source such as a plantation or animal farm to the facility wherein the digester 14 is located. The system 10 is simple and convenient in structure whereby the organic waste/moisture reducing agent/HFA mixture 50 is subjected to the mixing, fermentation, pasteurizing/drying processes in a single station which includes the digester 14 equipped with heating and aeration mechanisms as detailed below. The resultant organic fertilizer 60 is easily discharged from the digester 14 upon completion of the transformation process.

[0062] As shown in Figures 3 and 4, the digester 14 which may be fully automatic is capable of performing the fermentation, pasteurization/drying processes all within a single station. The digester may include a tank 20 made from one or both of stainless steel 304 and stainless steel 316. The tank 20 may be designed according to user specified shapes, sizes and dimensions suitable for the amount and/or type of organic waste to be processed and include a charging port 21 and a discharging port 23 for inputting the organic waste 40 into the digester 14 and outputting the resultant organic fertilizer 60 from the digester 14 respectively. It is envisaged that the interior of the tank 20 may include a mixing mechanism 22 such as a series of rotating arms or impellers suitable at least for performing the task of mixing, agitating including stirring and tossing the organic waste mixture and HFA materials within the tank 20. Such a mixing mechanism 22 may be suitably coupled to a rotating mechanism such as an electrical motor 25 as shown in Fig. 3. A heating mechanism 24 may be incorporated within or close to the interior volume of the tank 20 for heating and drying of the mixture 50. An air intake mechanism 26 such as a blower may further be affixed to a top portion of the tank 20 or any other suitable location of the digester 14 together with an air outlet mechanism 28 having an air filter (not shown) for the aeration process.

[0063] It is envisaged that the mixing mechanism 22 and the heating mechanism 24 may be adjustably controlled by a control mechanism 30, such as a programmable logic controller (PLC) which can be programmed to automatically control and manage the processes described hereinabove. An individual skilled in the art will understand that the PLC may utilize various electronic components to control the functions of the mechanisms 22, 24 such as the rate of agitating, temperature control, aerating air flow, and operations of the essential mechanisms such as sensors 32 and switches 34 of the digester 14 at least. The data from these electronic components (not shown) may further be communicated wirelessly to the control mechanism 30 thereby allowing for remote control of the system 10 and processes if necessary.

[0064] In an alternative embodiment, the system 10 may include a continuous production system for the fermentation/pasteurizing/drying process as opposed to the batch production system as described and depicted in the figures of the present disclosure. In a continuous production system, the mixture 50 may be processed such that the input of the organic waste 40 and the output of the organic fertilizer 60 can be subjected to a controlled flow arrangement from a 1st end (input) to a 2nd end (output) as will be well understood by individuals skilled in the art. However, it will be envisaged that individuals skilled in the art will understand that the essential mechanisms of the system 10 in such a continuous production system will still be necessary as disclosed.

[0065] The automated processes provided by such a system 10 serve to reduce the overall duration or time taken to convert the raw organic waste 40 into a dry organic fertilizer 60 without undue handling of the mixture 50. However, such an automated system 10 should not deter one skilled in the art to design alternative semi-automatic or manual mechanisms to operate the processes explained herein above without departing from the essence of this disclosure. In alternative embodiments, the system 10 for example, may include separate receptacles for mixing, fermentation and drying of the mixture. Conveying/transfer mechanisms may additionally be incorporated to transfer the mixture 40 to the different stations for processing. Manual mechanism may also be utilized in such processes, for example, at remote locations where it may not be feasible to include automation mechanism to operate the processes.

Composition Description

[0066] The following experimental results show that the present disclosure efficiently transforms organic waste into a high-quality organic fertilizer within less than 22 hours:

[0067] Using chicken manure as feedstock and wood sawdust according to a carbon and nitrogen ratio of 20-30: 1, and using the aforementioned process steps for 12, 18 and 22 hours respectively, the results show that the organic fertilizer achieved a high organic matter content ratio and is rich in the main nutrient value, i.e. Nitrogen, Phosphorus and Potassium (NPK value).

[0068] Table 1 shows the % of the NPK nutrients in tests using the aforementioned processes conducted by the Agri-Food and Veterinary Authority of Singapore (AVA) and Malaysian Agricultural Research and Development Institute (MARDI) respectively.

Table 1

Duration (Hours)	Organic Matter (%)	N %	P (As P ₂ O ₅) %	K (As K ₂ O) %	Remarks / Test conducted by
12	50.3	1.77	3.21	2.82	AVA, Singapore
18	48.1	1.61	2.82	3.26	MARDI, Malaysia
22	47.5	1.75	2.82	3.12	MARDI, Malaysia
12-22	47.5-50.3	1.61-1.77	2.82-3.21	2.82-3.26	Average Results

[0069] The system and process is able to yield a resultant organic fertilizer comprising organic matter of more than 45% as the main ingredients to enrich and promote healthy soil at the desired NPK (Nitrogen, Phosphorus, potassium) value of more than 5%. However, any desired NPK value higher than this disclosure can be augmented by the addition of formula organic materials if desired.

[0070] While the invention has been described with respect to a certain specific embodiment, it will be appreciated that many modifications and changes may be made by those skilled in the art without departing from the spirit of the invention. It is intended, therefore, by the appended claims

to cover all such modifications and changes as fall within the true spirit and scope of the invention. In particular, with respect to the above description, it is to be realized that the optimum dimensional relationships for the parts of the non-limiting exemplary embodiments may include variations in size, materials, shape, form, function and manner of operation.

CLAIMS

1. A method for transforming organic waste to a dry organic fertilizer comprising the steps of:
 - (i) mixing 80% by weight of an organic waste with 20% by weight of an organic moisture reducing agent and 0.1% by weight of a fermentation agent to form a mixture;
 - (ii) fermenting the mixture at a temperature of 70-80° C for 9-12 hours;
 - (iii) simultaneously pasteurizing and drying the mixture at 80-95°C for 4-5 hours;wherein the organic waste is transformable into an organic fertilizer comprising organic matter of more than 45% and an NPK value of more than 5%.
2. The method of claim 1, wherein the organic fertilizer has a Nitrogen content that is greater than 1.5%, a Phosphorus content that is greater than 2.5%, and a Potassium content that is greater than 2.5%.
3. The method of claim 1, further comprising the step of continuously agitating the mixture during the steps of (i) mixing, (ii) fermenting, and (iii) pasteurizing and drying the mixture.
4. The method of claim 1, further comprising the step of continuously aerating the mixture during the steps of (i) mixing, (ii) fermentation, and (iii) pasteurizing and drying the mixture.
5. The method of claim 1, wherein the moisture content of the animal manure is 70-80%.
6. The method of claim 1, wherein the moisture content of the food waste is 60-70%.
7. The method of claim 1, wherein the moisture content of the moisture reducing agent is less than 10%.
8. The method of claim 1, wherein the moisture content of the fermentation agent is 0.2%.
9. The method of claim 1, wherein mixing the organic waste and the moisture reducing agent reduces the moisture content of the mixture to 50-60%.

10. The method of claim 1, wherein the organic waste comprises at least one of an animal manure, food waste, agricultural waste, plant waste and city sludge.
11. The method of claim 1, wherein the moisture reducing agent comprises at least one of a wood waste, saw dust and/or straw.
12. The method of claim 1, wherein the fermentation agent comprises thermophilic aerobic microorganisms and enzymes.
13. The method of claim 12, wherein the microorganisms further produce enzymes during the step fermenting the mixture.
14. The method of claim 12, wherein the microorganisms comprises at least one or more of a microorganism such as *Clostridium Stercorarium* Sp, *Chaetomium Thermophilum* Sp, *Geobacillus* Sp, *Actinomadura* Sp, *Thermomonospora* Sp, *Myceliophthora Thermophila* Sp, *Phanerochaete Chrysosporium*, *Aspergillus Niger*, *Thermoactinomyces Vulgaris* Sp, *Bacillus* Sp, *Streptomyces Thermogriseus* Sp, *Streptomyces Cinnamoneus*, Photosynthetic bacteria and Nitrobacteria.
15. The method of claim 13, wherein the enzymes comprises at least one or more of a thermophilic enzyme such as Cellulase, Lipase, Pectinase, Protease, Trypsin, Amylase, Glucanase, Phytase, Hemicellulase, Laccase, Mn Peroxidase and Lignin Peroxidase.
16. The method of claim 12, wherein the microorganisms and enzymes are operational at the fermentation temperature of 70°-80° C.
17. The method of claim 1, wherein pasteurizing the mixture at the temperature of 80-95°C for 4-5 hours exterminates harmful organisms such as *E. coli*, *Shigella*, *Salmonella*, *Ascaris* and their eggs, and weed seeds without exterminating beneficial soil organisms such as probiotics.

18. A system for transforming organic waste to an organic fertilizer by a mixing, fermenting, combined pasteurizing and drying process comprising:
a fermentation/digester tank having a charging port for input of the organic waste and a discharging port for output of the organic fertilizer;
a mixing means for mixing organic waste and a moisture reducing agent into a mixture;
a heating means for controlled heating and drying of the mixture;
an air inlet means having an air filter for inputting air into the tank and air outlet means for extracting air from the tank; and
a control means;
wherein the control means comprises predetermined settings for time duration and temperature control of the mixing, fermenting, combined pasteurizing and drying processes.
19. The system of claim 18, wherein the mixing means comprises a series of rotating arms or impellers for agitating, mixing and tossing the organic waste and fermenting agent within the tank.
20. The system of claim 18, wherein the heating means comprises a series of heating elements incorporated within or close to the interior space of the tank.
21. The system of claim 18, wherein the air inlet means comprises an air blower.
22. The system of claim 18, wherein the air outlet means comprises an air filter.
23. The system of claim 18, wherein the control means further comprises a programmable logic controller (PLC) programmable, and a plurality of sensors and switches for automatic control of the fermenting, pasteurizing and drying processes.