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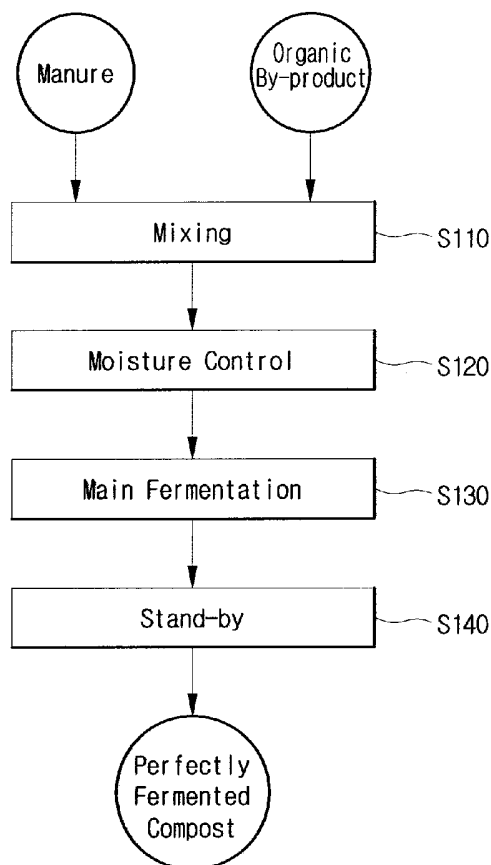
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(54) Title: PERFECTLY FERMENTED COMPOST AND METHOD FOR MANUFACTURING THEREOF



(57) Abstract: Perfectly fermented compost is provided, for which animal manures that incur intense environmental pollution are processed in large quantities, to be environmentally friendly and to allow improved productivity, as well as a method and device for manufacturing perfectly fermented compost at low costs without moving locations. One aspect of the present invention may provide a method of manufacturing perfectly fermented compost by fermenting manures and organic by-products, comprising providing the manures and the organic by-products at one end of a fermentation device and mixing the manures and organic by-products with a stirrer, preliminary fermentation of depositing the mixture with a stirrer and controlling the moisture content to be 80% or higher, main fermentation of repeatedly turning the preliminary fermented compost with a stirrer to supply air to the mixture and maintaining a moisture content of 75% or higher for natural fermentation, and final fermentation of repeatedly turning the main fermented compost with a stirrer to supply air to the main fermented compost for perfect natural fermentation, where the above operations are performed by collective stirring by the stirrer along the same line of a fermentation device.

【DESCRIPTION】**【Invention Title】**

PERFECTLY FERMENTED COMPOST AND METHOD FOR
MANUFACTURING THEREOF

5

【Technical Field】

The present invention relates to a method and device for manufacturing fermented
compost using livestock manures and to the fermented compost thus manufactured.

This application claims the benefit of Korean Patent Application No. 2005-
10 0030240 filed by the applicant on Apr. 12th, 2005. The application was registered as
Korean Patent No. 557,879 on Feb. 27th, 2006.

【Background Art】

The present invention relates to a method and device for manufacturing fermented
15 compost using livestock manures and to the fermented compost thus manufactured.

The conventional method of manufacturing compost may be divided mainly into
two steps. The first fermentation step (pre-composting) is a step of fermenting in a
stirring-type or ventilation-type fermenter for about 15 to 20 days. As less
decomposable matters still remain after the first fermentation step, the pre-composts of
20 the first fermentation step are made to undergo a second fermentation step. The second

fermentation step (post-composting) is performed by taking the pre-composts of the first fermentation step out of the fermenter and moving to the second fermentation location.

Generally in the second fermentation step, the pre-composts are piled in a suitable height to be isolated from oxygen, whereby facultative mesophiles may be used to

5 remove those factors inhibiting plant growth that may exist in the materials.

To force a supply of air for fermentation in the first fermentation step (pre-composting), the conventional method of manufacturing compost necessarily requires an expensive fermenter equipped with a blower device. Specific examples of a fermenter equipped with a blower device are disclosed in Korean Patent Application no.

10 2003-0038424 relating to a "METHOD FOR COMPOSTING FOODSTUFF WASTE BY AEROBIC FERMENTATION AND SYSTEM USING THE SAME," Korean Patent Application no. 2002-0028859 relating to an "AUTOMATIC AIR SUPPLY AND DRAINAGE SYSTEM FOR A COMPOST FERMENTER," and Korean Patent Application no. 1999-0084073 relating to a "FERMENTATION METHOD OF
15 ORGANIC FERTILIZER AND STIRRING APPARATUS AS SAME AS."

Also, in the conventional method of manufacturing compost, frequent changes in the fermentation conditions make it difficult to produce perfectly fermented compost.

This is seen in the compost products distributed in the past, in which there are odors released and fungi growing, showing that they have not undergone perfect fermentation,

20 i.e. they are imperfectly fermented compost. When such imperfectly fermented compost

is stored for long periods of time, amine or hydrogen sulphide is generated, causing decay. Also, the use of imperfectly fermented compost has lead to the problems of malodors produced due to ammonia gas generated by the decomposition of organic matter, decay in the soil producing soil pollution, and increased damages due to diseases
5 and insects which induce excessive usage of agricultural chemicals.

Ventilation is important in the conventional method of fermenting using aerobic microbes, so that blower devices are used to supply air, and since turning the compost materials actually hinders the fermentation, the compost is manufactured with a minimum amount of turning.

10 Moreover, in conventional compost manufacturing, unfermented supernatant and odorous leachate portions of the manure have also been included to increase production yields, and the imperfectly fermented compost has been merchandised, the matter of which has been raised as a social problem. Thus, the government has established a standard stating that the moisture content in fertilizers must be kept at 50% or lower, as
15 published in a nortification by the Rural Development Administration regarding fertilizers including compost. This has resulted in compost manufacturers drying the manufactured imperfectly fermented compost in a drying area to meet the standard moisture content, or to reduce this drying cost, has resulted in manufacturers making every effort only on reducing the moisture content from the initial fermentation stages.
20 Reducing the moisture content during the fermentation of compost makes is even more

difficult to achieve perfect fermentation, whereby there has been a greater reliance on artificial means for fermenting the compost, such as the forced injection of air and the application of artificial fermentation additives.

5 **【Disclosure】**

【Technical Problem】

 With the present invention, perfectly fermented compost is provided, for which animal manures that incur intense environmental pollution are processed in large quantities, to be environmentally friendly and to allow improved productivity, and
10 which has a moisture content of 65% or higher. Also, the invention provides a method of manufacturing perfectly fermented compost which requires neither an expensive blower device nor artificial fermentation additives, and which allows a continuous process without moving locations and provides constant fermentation conditions.

15 **【Technical Solution】**

 One aspect of the present invention may provide a method of manufacturing perfectly fermented compost by fermenting manures and organic by-products, comprising providing the manures and the organic by-products at one end of a fermentation device and mixing the manures and organic by-products with a stirrer,
20 preliminary fermentation of depositing the mixture with a stirrer and controlling the

moisture content to be 80% or higher, main fermentation of repeatedly turning the preliminary fermented compost with a stirrer to supply air to the mixture and maintaining a moisture content of 75% or higher for natural fermentation, and final fermentation of repeatedly turning the main fermented compost with a stirrer to supply
5 air to the main fermented compost for perfect natural fermentation, where the above operations are performed by collective stirring by the stirrer along the same line of a fermentation device.

Here, the organic by-products may be one or more organic by-products selected from a group consisting of straw, husks, bran, green plant material, leaves, sawdust,
10 barks, and herb residues.

In a preferred embodiment, the manures and organic by-products may be mixed in a volume ratio of 2:3 to 3:2 in the mixing operation, and the mixture or the compost undergoing fermentation may be moved by a particular distance and deposited from the direction of the preliminary fermentation towards the direction of the final fermentation
15 with every stirring action of the stirrer in the preliminary fermentation, the main fermentation, and the final fermentation operations.

Here, a particular amount of perfectly fermented compost may be obtained continuously at the other end at the final fermentation side of the fermentation device, and the time it takes for the manures and organic by-products provided at one end of the
20 fermentation device to undergo perfect natural fermentation and emerge at the other end

of the fermentation device as perfectly fermented compost is 60 to 90 days.

Another aspect of the present invention provides perfectly fermented compost manufactured by the above method of manufacturing perfectly fermented compost.

Here, the perfectly fermented compost may have a final moisture content of 65%
5 or higher.

Yet another aspect of the present invention provides a device for manufacturing perfectly fermented compost, comprising a section for providing manures and organic by-products at one end in a particular ratio and mixing the manures and organic by-products with a stirrer, a preliminary fermentation section for sedimenting the mixture
10 with a stirrer and controlling the moisture content to be 80% or higher, a main fermentation section for repeatedly turning the preliminary fermented compost with a stirrer to supply air to the mixture and maintaining a moisture content of 75% or higher for natural fermentation, and a final fermentation section for repeatedly turning the main fermented compost with a stirrer to supply air to the main fermented compost for perfect
15 natural fermentation, where the sections are positioned along the same line to allow collective stirring by the stirrer.

【Advantageous Effects】

As described above, with the perfectly fermented compost and the method of
20 manufacturing perfectly fermented compost based on the present invention, perfect

fermentation of organic matter is achieved, so that there is no ammonia gas generated and hence no malodors, and there is no decaying even when left alone for long periods of time. Also, perfectly fermented compost and a method of manufacturing perfectly fermented compost may be obtained that are environmentally friendly, as the leachate of
5 compost is also devoid of malodors and may be used as a liquid fertilizer.

The moisture content of the perfectly fermented compost based on the present invention without the leachate portion is 65% or higher, and using a mixture of soil and the perfectly fermented compost based on the present invention in a volume ratio of 7:3 allows a faster rootage compared to seedlings cultivated with bed soil for seedbeds.
10 Also, the fast rooting after rice-planting (transplantation) leads to a healthy growth of crops, with less damage due to diseases and insects than in cases where regular compost is used, to allow organic cultivation with little or no agricultural chemicals.

Further, it is best that the perfectly fermented compost based on the present invention be used to supply nutrition to crops, as all of the necessary nutrients form
15 chelate bonds with the perfectly fermented compost to allow a safe supply of nutrition to the crops. In particular, perfectly fermented compost based on the present invention having animal manure as an ingredient is abundant in phosphorus, and hence using only the perfectly fermented compost based on the present invention, without using chemical phosphorus fertilizers, allows a sufficient supply of phosphorus. This is the best method
20 of preventing damage due to diseases and insects.

Also, perfectly fermented compost is superior in terms of aeration and moistening, so that the soil is quickly transformed into a granular structure, to provide good physical properties. The soil with good physical properties has high fertility, so that the crops better endure rainy and draught seasons. The compost based on the present invention
5 has an adequate C:N ratio, so that crops take root well for fast rootage, while an adequate amount may be used even when cultivating crops that need a low amount of nitrogen, and nitrogen may freely be supplemented for crops that need a high amount of nitrogen, so that the amount of nitrogen may readily be adjusted according to the crop.

Crops cultivated using the perfectly fermented compost based on the present
10 invention have a good inherent taste and are also superior in terms of storage, so that the crops may be kept fresh for long periods of time. Although the amount used of the compost based on the present invention may differ according to the crop, using a large amount in the beginning and controlling the amount according to changes in the soil lead to a superior fertilizing effect.

15 Moreover, since the perfectly fermented compost based on the present invention uses animal manures, which induce intense environmental pollution, as main ingredients of the compost, animal manures may be processed in large amounts while manufacturing perfectly fermented compost throughout which a variety of nutrients are distributed. Thus, the burden may be lessened for livestock farmers of processing
20 animal manures, while crop farmers may conveniently use perfectly fermented high

quality compost.

Also, the method of manufacturing perfectly fermented compost based on the present invention does not require a fermenter equipped with an expensive blower device and hence allows the manufacture of compost at low costs. In addition, as each operation of the manufacture is performed collectively along the same line without moving pre-composts for main-fermentation, perfectly fermented compost may be obtained of a consistently uniform quality. Further, the manufacturing method is not complicated, so that little manpower is required.

10 **【Description of Drawings】**

Fig. 1 is an illustration of a fermentation device with which a method of manufacturing perfectly fermented compost may be applied according to a preferred embodiment of the present invention; and

Fig. 2 is a flowchart of a method of manufacturing perfectly fermented compost according to a preferred embodiment of the present invention.

<Legend of reference numbers for key elements>

10 : fermentation device

110 : mixing section

120 : preliminary fermentation section

130 : main fermentation section

140 : final fermentation section

111 : unit section

20 131a, 131b, 131c, 131d, 131e, 131f : unit sections of main fermentation section

141a, 141b : unit sections of final fermentation section

【Mode for Invention】

Hereinafter, preferred embodiments of perfectly fermented compost and a method
5 of manufacturing perfectly fermented compost based on the present invention will be
described in more detail with reference to the accompanying drawings. Also, before
discussing the preferred embodiments of the invention, the raw materials used in the
invention will first be described.

In the present invention, “natural fermentation” refers to such fermentation in
10 which there are no artificial control of temperature or humidity, no fermentation
accelerators or fermentation additives, and no forced injection of air such as by using a
blower device.

Also, the “final moisture content” refers to the moisture content of the perfectly
fermented compost after the method of manufacturing perfectly fermented compost
15 based on the present invention has been applied thereto.

Since the present invention relates to a fermentation technique using anaerobic
microbes, a high water content is required. This uses a different fermentation principle
from conventional fermentation which uses aerobic microbes. That is, with the present
invention that uses anaerobic microbes, many rounds of turning are required, as this
20 allows an even vertical mixing of the raw materials and keeps the fermentation

conditions constant. Also, in the present invention, changes in the fermentation conditions are kept little via a collective process from the inserting of the raw materials to the retrieving, so that the fermentation may be performed in a uniform manner. Thus, perfectly fermented compost may be obtained having a constant level of quality.

5 The raw materials for the present invention are manures and organic by-products. Examples of the manures may include human feces, cow manure, pig manure, chicken manure, and other animal manures. The organic by-products may be straw, husks, bran, green plant material, leaves, sawdust, barks, or herb residues, among which sawdust is preferable, as it is easy to obtain and may be stably supplied in large quantities. Sawdust
10 is especially preferable for the organic by-product, as it may also perform the function of adjusting the amount of moisture during the mixing operation.

Fig. 1 is an illustration of a fermentation device with which a method of manufacturing perfectly fermented compost may be applied according to a preferred embodiment of the present invention. Referring to Fig. 1, the fermentation device 10
15 may be divided into a mixing section 110, a preliminary fermentation section 120, a main fermentation section 130, and a final fermentation section 140, in correspondence to each operation of the method of manufacturing compost. Each of these sections are merely arbitrary distinctions of the fermentation device along the same line, and in practice, a collective stirring operation is performed from one end to the other of the
20 fermentation device.

Here, each section may in turn be divided into unit sections 111 of equal lengths, where the mixing section 110 may occupy four unit sections 111, the preliminary fermentation section 120 may also occupy four unit sections 111, the main fermentation section 130 may occupy six unit sections 131a, 131b, 131c, 131d, 131e, 131f, and the
5 final fermentation section 140 may occupy two unit sections 141a, 141b. The number of unit sections represent the time it takes to pass through the corresponding section. That is, it takes the longest time to pass through the main fermentation section 150 in the fermentation device 10.

Fig. 2 is a flowchart of a method of manufacturing perfectly fermented compost
10 according to a preferred embodiment of the present invention. Referring to Fig. 2, the manures and organic by-products are mixed in a particular ratio in operation S110, and in operation S120 this mixture is deposited to be level with the height of the main fermentation section with moisture control performed thereto in the preliminary fermentation section. Operation S130 is the operation in which this moisture controlled
15 mixture is main fermented and which occupies the longest time. Finally in operation S140, perfect fermentation is completed for the main fermented compost, which stands by for sorting and packaging. Although it is not illustrated in Fig. 2, a sorting operation, for removing foreign substances and impurities that are non-decomposable, and a packaging operation, for merchandising the completed compost, may further be
20 included in operation S140.

Perfectly fermented compost and a method of manufacturing perfectly fermented compost have been described in the foregoing with reference to general illustrative drawings, and descriptions will now be given of perfectly fermented compost and a method of manufacturing perfectly fermented compost based on the present invention
5 with reference to specific examples.

1) Example 1

A fermentation device 10 according to a preferred embodiment of the present invention was manufactured to have a length of 80m, a width of 8m, and a depth of 1.5m. This fermentation device may in turn be divided into sixteen unit sections 111,
10 each unit section having a length of 5m. The time it takes (hereinafter referred to as "fermentation duration") for the raw materials, including manures and organic by-products, to be inserted at one end of the fermentation device, pass through the fermentation device for perfect fermentation, and be retrieved at the other end of the fermentation device, is about 60 days in summer and about 90 days in winter. That is,
15 the average fermentation duration is about 75 days.

At the inlet in the mixing operation, raw materials are further inserted in an amount corresponding to the amount of raw materials inserted and passing through the mixing operation to proceed to the next section, and in the final fermentation section a constant amount of perfectly fermented compost may be obtained every day. Thus, perfectly
20 fermented compost having a constant level of quality may be obtained throughout the

year. A fermentation device having such dimensions as above may produce 2500 to 3000 tons of perfectly fermented compost a year.

During the entire process, from the inserting of the raw materials into the fermentation device to obtaining perfectly fermented compost, a minimum of 50 stirring actions are performed by a stirrer, where such stirring actions are performed collectively along the same line of the fermentation device. That is, one stirring action starts at the end side of the final fermentation section of the fermentation device and finishes at the starting side of the mixing operation. A stirrer for performing such stirring actions may be a rotary type, escalate type, screw type, or pad type. With the present invention, use of the escalate type stirrer is preferred. Specific descriptions will now be given of a method of manufacturing perfectly fermented compost based on the present invention for each of the sections.

(1) Mixing Section

Pig manure and sawdust were used as raw materials. The pig manure was used without separating the supernatant and sludge, and the sawdust was used without reprocessing as obtained from a woodworker or a sawmill. The pig manure and sawdust were mixed in a volume ratio of 1:1. Here, if there is little moisture in the sawdust in the mixture, pig manure may further be added up to a volume percentage of 10%, and if there is excessive moisture, sawdust may further be added up to a volume percentage of

10%. This is for adjusting the moisture content of the mixture to be 85 to 90%. Thus, a preferable mixing ratio, by volume of pig manure to sawdust, which provides such a moisture content is 2:3 to 3:2. The stirrer operates to mix the pig manure and sawdust uniformly.

5 About 14 to 15 days will be spent in the mixing section in summer, while 22 to 23 days will be spent in winter.

(2) Preliminary Fermentation Section

10 This section deposits the mixture to be level with the height of the main fermentation section and controls the moisture content. The preferred moisture content to which the mixture is to be controlled in this section is 80% or higher. To make the height of the mixture be level with the height of the main fermentation section, there is a greater number of stirring of the stirrer than in the main fermentation section. About 14 to 15 days will be spent in this preliminary fermentation section in summer, while 22 to 15 23 days will be spent in winter. Measure values of moisture content and temperature in the preliminary fermentation section are listed in Table 2. The moisture content and C.E.C. of the mixture after passing through the preliminary fermentation section and immediately before entering the main fermentation section 131a were measured and are listed in Table 3.

(3) Main Fermentation Section

This is the section in which the moisture controlled mixture undergoes main fermentation. With the present invention, fermentation occurs under natural conditions, even without artificially controlling moisture or temperature. As listed in Table 1, as the fermentation occurs for manures and organic by-products, i.e. as heat is generated due to the decomposition, a temperature condition suitable for fermentation is created. Also, as the moisture content of the moisture controlled mixture exceeds 80%, and the moisture content is maintained at 75% or higher in the main fermentation section, there is a sufficient amount of moisture for main fermentation. Hence, it is not necessary to artificially control the moisture or temperature. Measure values of moisture content and temperature in the main fermentation section are listed in Table 2 for each unit section.

Table 1. Decomposition Rate and Generated Decomposition Heat of Raw Materials⁽¹⁾

	Decomposition Rate per day	Decomposition Heat generated per kg
Chicken Manure	about 2%	4,800 kcal
Pig Manure	about 1.7 to 2.0%	4,800 kcal
Cow Manure	about 1.5%	4,500 kcal
Sawdust	about 0.7%	4,500 kcal

Ground Husks	about 0.5%	3,000 kcal
Plain Husks	about 0.2 to 0.3%	3,000 kcal

(¹) the decomposition rate is an averaged value from the beginning of fermentation to 20-25 days; livestock testing site, Ministry of Agriculture and Forestry of Japan)

Also, fermentation occurs even without forced injection of air with a blower device.

- 5 This is because air is supplied into the mixture as the stirrer advances and turns the mixture in which fermentation has not yet started.

Also, no fermentation accelerators or artificial fermentation additives were used, besides compost.

- The number of such stirring actions may be determined by examining the state of fermentation, and in summer when fermentation occurs more actively this number would be greater, while in winter when fermentation occurs less actively this number would be reduced. Preferably, the stirrer may be operated every day in summer, three to four times a week in spring and autumn, and about twice a week in winter, with four repetitions per operation. Setting the stirrer so that the stirred depth is 1.35m may prevent the stirrer from colliding with the bottom of the fermentation device while turning and depositing the entirety of the compost in the same section.
- 10
15

As the stirrer operates in a particular direction, i.e. from the direction of the final fermentation section towards the direction of the preliminary fermentation section, the

compost undergoing fermentation is slowly moved 1.7m and deposited in a direction opposite to the advancing direction of the stirrer, i.e. from the direction of the preliminary fermentation section towards the direction of the final fermentation section, with every round of operation of the stirrer. Thus, the compost undergoing fermentation
5 is moved at the same time it is fermented. About 22 to 23 days are spent in the main fermentation section in summer, and about 33 to 35 days are spent in winter.

The moisture content of the compost passing through the main fermentation section is maintained at 75% or higher. The compost was sampled between main fermentation sections 131d and 131e, and the moisture content and C.E.C. were
10 measured. The results are listed in Table 3.

(4) Final Fermentation Section

The main fermented compost was fermented about 90%, and in the final fermentation section, the compost undergoes perfect natural fermentation and stands by
15 for the optional post-processing operations of sorting and packaging. Stirring actions are performed for this section also, where the stirring actions are performed collectively with the main fermentation section. The stirring conditions are equal to the stirring conditions of the main fermentation section. The main fermentation section and the perfect fermentation section are merely arbitrary distinctions for convenient description,
20 and in an actual manufacturing process, the perfect fermentation section is continued

from the main fermentation section through a continuous process. The measured values of moisture content and temperature of the perfect fermentation section are listed in Table 2.

About 7 to 8 days are spent in the final fermentation section in summer, and about 5 11 to 12 days are spent in winter. The final moisture content of the perfectly fermented compost is 65% or higher.

When the moisture content of perfectly fermented compost is 65 to 70%, the moistening rate of the perfectly fermented compost itself is superior, so that there is no separate leachate discharged. When the moisture content of perfectly fermented 10 compost is 70% or higher, leachate is separated and discharged, but as the discharged leachate is also a perfectly fermented by-product, it has no odors and contains nitrogen and organics suitable for use as a liquid fertilizer.

The perfectly fermented compost that has passed through the final fermentation section was sampled, and the moisture content and C.E.C. were measured, which are 15 listed in Table 3. Also, nitrogen, phosphorus, and potassium contents, which are the most important elements for a fertilizer, were measured in the leachate discharged from this section and are listed in Table 4.

Table 2. Moisture Content and Temperature for Each Section of the Fermentation

	Mixing Section	Preliminary Fermentation Section	Main Fermentation Section						Final Fermentation Section		Sorting Stand- by
			131a	131b	131c	131d	131e	131f	141a	141b	
Moisture Content (%)	85 to 90	85 to 80	80 to 77	77 to 75	75 to 70				70 to 67		67
Temperature (°C)	Normal Temp.	Normal Temp.	40 to 60	70 to 80	55 to 60				30 to 40		Normal Temp.

Table 3. Sample Analysis for Each Section of Example 1

Category	Between Preliminary Fermentation Section 120 and Main Fermentation Section 131a	Main Fermentation Section (Between 131d and 131e)	Final Fermentation Section 141b	Stand-by for Packaging after Sorting
Moisture Content (%) ⁽²⁾	80.47	77.81	71.86	66.71
C.E.C. (me/100g) ⁽³⁾	6.08	7.30	10.42	10.93

Here, ⁽²⁾ moisture content (%) : according to wet sample weight equation

$$\frac{\text{Total weight of wet sample(kg)} - \text{Total weight of dry sample(kg)}}{\text{Total weight of wet sample(kg)}} \times 100$$

(³) C.E.C (cation exchange capacity): the ability to adsorb cations by the action of a soil colloid is referred to cation exchange capacity or base exchange capacity, which represents the equivalent amount for the total amount of exchangeable ions contained in a particular amount of soil, and is equal to the number of sites available, i.e. the number of negative charges, for hydrogen ions to be exchanged with cations per 100g of soil, and is represented in mg-equivalent weight.

Table 4. Leachate Analysis Results (⁴)

Category	Nitrogen (%)	Phosphorus (%)	Potassium (%)
Test Results	0.039	0.035	0.263

(⁴) follows fertilizer analysis method of the Rural Development Administration)

(5) Perfectly Fermented Compost

Perfectly fermented compost obtained in a preferred embodiment of the present invention was sampled after the sorting operation and during stand-by for packaging, and the moisture content and C.E.C. were measured. The measurements are listed in Table 3. As seen also in the analysis results, the moisture content of perfectly fermented

compost is 65% or higher. Table 5 shows the results of three times analyzing the components of perfectly fermented compost obtained by Example 1. A comparison between Results 1 and 3 show that the analysis results are almost constant for the resulting products obtained during a period of over 1 year by the method such as

5 described in Example 1. Thus, it is seen that perfectly fermented compost may be manufactured stably by the manufacturing method based on the present invention. Table 6 represent the results of toxicity testing from the livestock farming laboratory at the National Agricultural Cooperative Federation. Hazardous germs such as Salmonella, Listeria monocytogenes, or Staphylococcus aureus were not detected.

10

Table 5. Analysis Results of Perfectly Fermented Compost ⁽⁵⁾

Category	Standard	Result 1 ⁽⁷⁾	Result 2 ⁽⁸⁾	Result 3 ⁽⁹⁾
Nitrogen (%)	-	0.85	0.98	1.02
Phosphorus (%)	-	2.13	2.32	1.92
Potassium (%)	-	0.90	0.65	0.97
Organics (%)	25 or higher	42.34	43.69	41.10
Organic to Nitrogen Ratio	50 or lower	49.81	44.58	40.29
Arsenic (mg/kg)	50 or less	0.81	0.63	traces
Cadmium (mg/kg)	5 or less	0.27	0.23	traces

Mercury (mg/kg)	2 or less	traces	traces	traces
Lead (mg/kg)	150 or less	13.82	11.76	11.71
Chromium (mg/kg)	300 or less	8.00	6.59	traces
Copper (mg/kg)	300 or less	100.79	92.73	124.94
Nickel (mg/kg)	50 or less	3.24	4.26	traces
Zinc (mg/kg)	900 or less	418.70	368.17	traces
pH ⁽⁶⁾	-	8.01	6.84	-
Electrical Conductivity (ms) ⁽⁶⁾	-	1.87	2.31	-
Moisture Content (%)	50 or lower	46.76	45.00	47.91
Salinity (%)	1 or lower	0.15	0.14	0.53

⁽⁵⁾ analysis method: follows fertilizer analysis method posted by the Rural Development Administration

⁽⁶⁾ pH, electrical conductivity: diluted 1:10

5 ⁽⁷⁾ received test result notification dated Aug. 31, 2004, from A and F Corporation (Korea)

⁽⁸⁾ received test result notification dated May 9, 2005, from A and F Corporation (Korea)

⁽⁹⁾ received fertilizer component analysis grades dated Dec. 15, 2005, from the
10 National Institute of Agricultural Science and Technology (Korea)

Table 6. Toxicity Test of Perfectly Fermented Compost ⁽¹⁰⁾

Analyzed Component	Result
Tetracyclines	Not Found
Sulfonamides	Not Found
Aminoglycosides	Not Found
Microlides	Not Found
Penicillin	Not Found
Ecoli (CFU/g)	6.0×10^3
Salmonella spp	Negative
Listeria monocytogenes	Negative
Staphylococcus aureus	Negative
Aflatoxin (ppb)	6.9

⁽¹⁰⁾ analysis results of the livestock farming laboratory of the Korean National

5 Agricultural Cooperative Federation, dated Dec. 14, 2005

2) Example 2

The fermentation device 10 was manufactured to have a length of 120m, a width of 10m, and a depth of 1.8m. With this fermentation device, the output may roughly be

doubled compared to Example 1, and may produce 5000 to 6000 tons of perfectly fermented compost a year. Although the fermentation duration is the same as in Example 1, the area of the overall fermentation device is greater, so that when raw materials are inserted and pass through the fermentation device to be retrieved as perfectly fermented compost, the unit output is doubled. The specific processes for each section are the same as in Example 1, with the exception that the stirring depth during the stirring actions is 1.5m to 1.65m.

3) Comparative Example 1

The moisture content and degree of decay of imperfectly fermented compost produced by conventional pre-composting and post-composting were measured and are listed in Table 7. The criteria for the degree of decay are odor and the degree of fly attraction, with observations performed for a pile at normal temperature every two weeks.

Table 7

	Moisture Content Excluding Leachate (%)	Odor		Fly Attraction	
		after 2 weeks	after 4 weeks	after 2 weeks	after 4 weeks

Example 1 (Stand-by for Sorting)	66.71%	None	None	None	None
Comparative Example 1	45 %	Slight Malodors	Significant Malodors	Few	Several Tens per m ²

It is to be appreciated that the present invention is not limited to the foregoing embodiments and that various changes may be made by those skilled in the art without departing from the spirit of the invention.

【CLAIMS】**【Claim 1】**

A method of manufacturing perfectly fermented compost by fermenting manures and organic by-products, the method comprising:

5 providing the manures and the organic by-products at one end of a fermentation device and mixing the manures and organic by-products with a stirrer;

preliminary fermentation, of depositing the mixture with a stirrer and controlling the moisture content to be 80% or higher;

main fermentation, of repeatedly turning the preliminary fermented compost with a stirrer to supply air to the mixture, and maintaining a moisture content of 75% or higher
10 for natural fermentation; and

final fermentation, of repeatedly turning the main fermented compost with a stirrer to supply air to the main fermented compost for perfect natural fermentation,

wherein the above operations are performed by collective stirring by the stirrer
15 along the same line of a fermentation device.

【Claim 2】

The method of claim 1, wherein the organic by-products are one or more organic by-products selected from a group consisting of straw, husks, bran, green plant material,
20 leaves, sawdust, barks, and herb residues.

【Claim 3】

The method of claim 1, wherein in the mixing operation, the manures and organic by-products are mixed in a volume ratio of 2:3 to 3:2.

5

【Claim 4】

The method of claim 1, wherein in the preliminary fermentation, the main fermentation, and the final fermentation operations, the mixture or the compost undergoing fermentation is moved by a particular distance and deposited from the direction of the preliminary fermentation towards the direction of the final fermentation, with every stirring action of the stirrer.

10

【Claim 5】

The method of claim 1, wherein at the other end at the final fermentation side of the fermentation device, a particular amount of perfectly fermented compost is obtained continuously.

15

【Claim 6】

The method of claim 1, wherein the time it takes for the manures and organic by-products provided at one end of the fermentation device to undergo perfect natural fermentation and emerge at the other end of the fermentation device as perfectly

20

fermented compost is 60 to 90 days.

【Claim 7】

The perfectly fermented compost manufactured by the method of claim 1.

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【Claim 8】

The perfectly fermented compost of claim 7, wherein the perfectly fermented compost has a final moisture content of 65% or higher.

10

【Claim 9】

A device for manufacturing perfectly fermented compost, the device comprising:

a section for providing manures and organic by-products at one end in a particular ratio and mixing the manures and organic by-products with a stirrer;

a preliminary fermentation section for depositing the mixture with a stirrer and

15 controlling the moisture content to be 80% or higher;

a main fermentation section for repeatedly turning the preliminary fermented compost with a stirrer to supply air to the mixture, and maintaining a moisture content of 75% or higher for natural fermentation; and

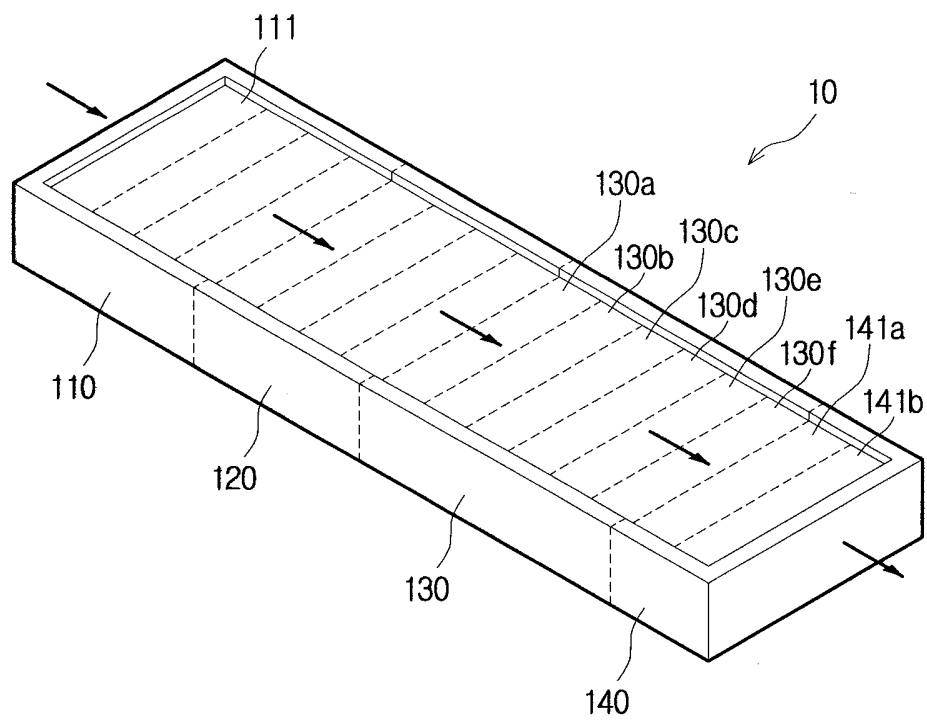
a final fermentation section for repeatedly turning the main fermented compost

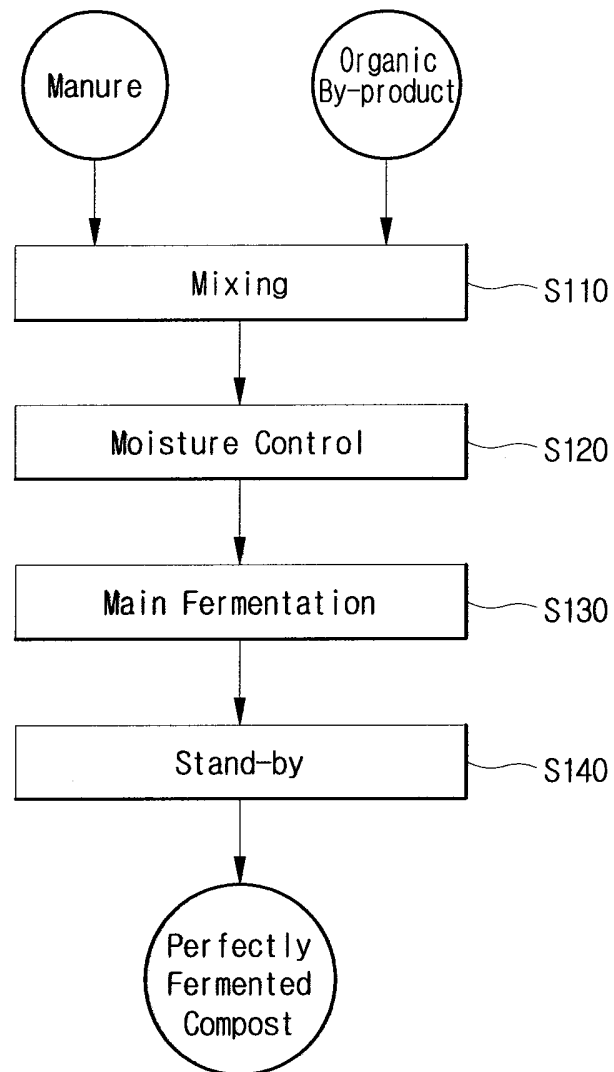
20 with a stirrer to supply air to the main fermented compost for perfect natural

fermentation,

wherein the sections are positioned along the same line to allow collective stirring
by the stirrer.

1/2
FIG. 1



2/2
FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2006/001309**A. CLASSIFICATION OF SUBJECT MATTER*****C05F 17/00(2006.01)i***

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 8 C05F 17/00, 9/04, 3/06, 17/02, 11/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Patents and applications for inventions since 1975

Korean Utility models and applications for Utility models since 1975

Japanese Utility models and applications for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,401,291A (Inoue) 28 March 1995 See Abstract, col 1. line 36-61, col 2. line 39-45	7-8
A	JP 2000-1387A (SATO YOTONJO:KK) 7 January 2000 See [0016]-[0017], [0047]-[0049], Fig. 3	1-8
A	JP 2001-302380A (CHIKYU KANKYO KAIZEN SYSTEM:KK , NAKASAKU:KK) 31 October 2001 See Abstract, [0018], Fig. 1-3	1-8
A	JP 07-133177A (HASAKA MASARU) 23 May 1995 See Abstract, [0016], Claim 1, Fig. 1	1-8
A	KR 1996-7514A (BoEung Lee) 22 March 1996 See Claim 1, Fig. 1	1-8



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

24 JULY 2006 (24.07.2006)

Date of mailing of the international search report

24 JULY 2006 (24.07.2006)

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2006/001309

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 9
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

The claim is unclear, since it is limited functionally rather than describing the matter essential to the invention. The functional statements do not enable the skilled person to determine which technical features are necessary to perform the stated function.
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2006/001309

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US5401291A	28.03.1995	DK489158T3 EP0489158A1 EP0654457A1 EP489158B1 EP654457A1 JP02167878 JP2167878A2 JP2610176B2 US05401291 US5401291A US5591637A W09200259A1	16.12.1996 10.06.1992 24.05.1995 27.11.1996 24.05.1995 28.06.1990 28.06.1990 14.05.1997 28.03.1995 28.03.1995 07.01.1997 09.01.1992
JP12001387	07.01.2000	NONE	
JP13302380	31.10.2001	NONE	
JP07133177	23.05.1995	NONE	
KR1996-7514A	22.03.1996	NONE	