Japan Patent Office

Title : Methane Fermentation Treatment Method
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Patentee :

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   - Dr. Mahyuddin K.M Nasution, MIT., Ph.D
   - Prof. Dr. Runtung, SH, M.Hum
特許証
(CERTIFICATE OF PATENT)
特許第5006424号
(PATENT NUMBER)

発明の名称
(TITLE OF THE INVENTION)
メタン発酵処理方法

特許権者
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平成24年6月1日(June 1, 2012)

特許庁長官
(COMMISSIONER, JAPAN PATENT OFFICE)

岩井良行
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特願2010-074808 (APPLICATION NUMBER)

特許権者（PATENTEE）

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ユニバーシティ・ナンバー46

国籍 インドネシア共和国

ユニバーシティー・オブ・スマトラウタラ

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特許登録番号：平成24年8月29日
特許番号：第5079834号
WIPO ASSIGNS PATENT TO METAWATER,
UNIVERSITY OF SUMATERA UTARA FOR
"METHANE FERMENTATION TREATMENT
METHOD" (JAPANESE INVENTOR)


Title of the invention: "METHANE FERMENTATION TREATMENT METHOD."

Applicants: METAWATER Co., Ltd. (JP) and University of Sumatera Utara (ID).

Inventors: Yutaka Mori (JP).

According to the abstract posted by the World Intellectual Property Organization: "Disclosed is a methane fermentation treatment method which enables the highly efficient methane fermentation treatment of an organic waste material having a low nitrogen concentration. Specifically disclosed is a methane fermentation treatment method comprising supplying an organic waste material having a ratio of the COD concentration ...

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METHANE FERMENTATION TREATMENT METHOD

Abstract: Disclosed is a methane fermentation treatment method which enables the highly efficient methane fermentation treatment of an organic waste material having a low nitrogen concentration. Specifically disclosed is a methane fermentation treatment method comprising supplying an organic waste material having a ratio of the COD concentration to the nitrogen concentration (i.e., COD/N ratio) of 50 or more to a methane fermentation vessel to cause the methane fermentation of the organic waste material, removing predetermined amounts of portions of the resulting fermentation liquor one after another from the methane fermentation vessel, separating each of the removed portions into a separated sludge and a separated solution, and redelivering at least a portion of the separated solution to the methane fermentation vessel, wherein the concentration of ammonia nitrogen in the fermentation liquor contained in the methane fermentation vessel is measured directly or indirectly and the amount of the separated sludge to be redelivered to the methane fermentation vessel is so controlled that the concentration of ammonia nitrogen exceeds a predetermined value.

Title: METHANE FERMENTATION TREATMENT METHOD

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Applicants: METAWATER Co., Ltd. [JP]; 3-1, Toranomon 4-chome, Minato-ku, Tokyo 1056029 (JP) (For All Designated States Except US), University of Sumatera Utara [ID]; Jl. Universitas No.45 Komplek USU Medan, (ID) (For All Designated States Except US), MORI Yutaka [JP]; (JP) (US Only)
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REKTOR UNIVERSITAS SUMATERA UTARA
Nomor: 840/UN5.1.R/SDM/2017

TENTANG
TIM PATEN UNIVERSITAS SUMATERA UTARA
BERDASARKAN PATEN BERSAMA ANTARA METAWATER Co.Ltd JEPANG
DENGAN TIM BIOGAS UNIVERSITAS SUMATERA UTARA

REKTOR UNIVERSITAS SUMATERA UTARA

Menimbang : a. bahwa dalam rangka dukungan pelaksanaan Tridharma Perguruan Tinggi tentang percepatan penerbitan karya ilmiah dan paten HKI serta untuk memenuhi target kinerja Universitas Sumatera Utara maka telah terbit Paten Bersama Antara Metawater Co.Ltd Jepang dengan Tim Biogas Universitas Sumatera Utara;

b. bahwa sehubungan dengan sub (a) di atas, dipandang perlu menerbitkan Keputusan Rektor Universitas Sumatera Utara tentang Tim Paten Universitas Sumatera Utara Berdasarkan Paten Bersama Antara Metawater Co.Ltd Jepang dengan Tim Biogas Universitas Sumatera Utara;

Mengingat : 1. Undang-Undang RI No. 20 Tahun 2003 tentang Sistem Pendidikan Nasional dan No. 12 tahun 2012 tentang Pendidikan Tinggi;

2. Peraturan Pemerintah Republik Indonesia nomor 16 tahun 2014 tanggal 28 Februari 2014 tentang Statuta USU;

3. Peraturan Menteri Hukum dan Hak Asasi Manusia Republik Indonesia Nomor 8 Tahun 2016 tentang Syarat dan Tata Cara Permohonan Percatatan Perjanjian Lisensi Kekayaan Intelektual;

4. Peraturan Pemerintah RI Nomor 26 Tahun 2015 tentang Bentuk dan mekanisme Pendanaan Perguruan Tinggi Berbadan Hukum;


Memperhatikan: Surat Ketua Tim Biogas USU Dr. Eng. Ir. Irvan, M.Si tanggal 4 April 2017 tentang Penerbitan 4 buah paten milik Metawater Co.Ltd Jepang;

MEMUTUSKAN

MENETAPKAN: KEPUTUSAN REKTOR UNIVERSITAS SUMATERA UTARA TENTANG TIM PATEN UNIVERSITAS SUMATERA UTARA BERDASARKAN PATEN BERSAMA ANTARA METAWATER CO.LTD JEPANG DENGAN TIM BIOGAS UNIVERSITAS SUMATERA UTARA, yaitu:

1. Penanggungjawab: Prof. Dr. Runtuung, SH., M.Hum
   Wakil
2. Penanggungjawab: Dr. Mahyuddin K.M Nasution, MIT., Ph.D
3. Supervisor: 1. Prof. Dr. Urip Harahap, Apt
   2. Prof. Darwin Dalimunthe, Ph.D
   3. Prof. Erman Munir, M.Sc
4. Ketua: Dr. Eng. Ir. Irvan, M.Si
5. Anggota: Ir. Bambang Trisakti, M.Si

KESATU: Menjelaskan bahwa PATEN yang dihasilkan berasal dari nama-nama di atas sesuai dengan Surat Metawater Co.Ltd tanggal 7 Maret 2017;

KEDUA: Keputusan ini berlaku bulan mulai tanggal Surat Keputusan ditetapkan dengan ketentuan apabila terdapat kekeliruan dalam penetapan keputusan ini akan diadakan perbaikan sebagaimana mestinya.

Ditetapkan: di Medan
Pada Tanggal: 20 APR 2017

[Signature]
Runtuung
NIP. 195611101985031022
1. Field of the Invention

[0001] The present invention relates to a methane fermentation treatment method for an organic waste having a low nitrogen concentration.

2. Description of the Related Art

[0002] In the methane fermentation treatment, an organic waste is fermented with methanogens under an anaerobic atmosphere and converted into methane gas. With this treatment, the organic waste is decomposed to biogas and water, and hence, the organic waste can be reduced remarkably. Further, the methane fermentation treatment has an advantage of recovering methane gas to be generated as a by-product as energy.

[0003] Meanwhile, the efficiency of the methane fermentation treatment is influenced by the activity of bacteria which facilitate methane fermentation such as methanogen. One of the factors causing reduction of the activity of methanogen or the like is an increase in the inhibiting material such as ammonia. Therefore, for example, as described in Japanese Patent No. 3630165 (Claim 1), the fermentation state has been conventionally controlled so that the concentration of ammonia nitrogen in fermentation liquid falls within a predetermined concentration.

[0004] Further, it is known that, due to the decrease in alkalinity of the fermentation liquid, carbonate ions in the fermentation liquid in a methane fermentation tank cannot be buffered any more, and the pH of the fermentation liquid decreases thereby lowering methane fermentation performance. Therefore, there is employed a method of controlling the fermentation state so that the alkalinity of the fermentation liquid exceeds a predetermined
value.

[0005] For example, Japanese Patent Application Laid-open No. 2009-219960 (see Claim 3, paragraphs 0013 and 0020) discloses that, when the difference between the electrical conductivity of fermentation liquid in a methane fermentation tank and the electrical conductivity of an organic waste is at a predetermined value or less, methane fermentation is performed while increasing alkalinity of the fermentation liquid. As one of the means for increasing alkalinity, there is a method involving adding another organic waste containing a certain amount of nitrogen to an organic waste to be supplied to a methane fermentation tank to increase the concentration of nitrogen, thereby increasing the amount of ammonia nitrogen decomposed from the fermentation so as to increase the alkalinity.


[0007] In the case of subjecting an organic waste such as excreta and raw garbage to a methane fermentation treatment, those containing a certain amount of nitrogen components such as protein, the amount of nitrogen necessary for the activities of bacteria such as methanogen can be ensured without adding a nitrogen component from outside.

[0008] However, in the case of subjecting an organic waste having a low nitrogen concentration in some of industrial liquid waste or the like to a methane fermentation treatment with high-load operation, the amount of nitrogen necessary for the activities of bacteria may not be ensured, and the activities of bacteria decrease due to the shortage of nitrogen.

Therefore, in the case of subjecting an organic waste having a low nitrogen concentration to a methane fermentation treatment with high-load operation, it is necessary to supply nitrogen from outside to compensate for a shortage and set a longer residence time.
Japanese Patent Application Laid-open No. 2009-219960 (see Claim 3, paragraphs 0013 and 0020) discloses that another organic waste containing a certain amount of nitrogen is added to an organic waste to be supplied to a methane fermentation tank in order to increase the concentration of nitrogen, thereby increasing the amount of ammonia nitrogen decomposed from the fermentation so as to increase alkalinity.

However, in the case of performing a methane fermentation treatment as described above, it is necessary to provide, in addition to a reservoir tank for an organic waste to be treated, another reservoir tank for the organic waste containing a certain amount of nitrogen separately, which enlarges the apparatus. Furthermore, it is necessary separately to prepare to bring another organic waste containing a certain amount of nitrogen, thus the shipping cost or the like arises, resulting in an increased running cost.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a methane fermentation treatment method which is capable of subjecting an organic waste having a low nitrogen concentration to a methane fermentation treatment efficiently.

In order to achieve the above-mentioned object, the present invention provides a methane fermentation treatment method, including: supplying an organic waste to a methane fermentation tank to perform a methane fermentation treatment, the organic waste having a ratio of a chemical oxygen demand concentration to a nitrogen concentration (COD/N ratio) of 50 or more; taking out a fermentation liquid from the methane fermentation tank by predetermined amounts; separating the fermentation liquid into a separated sludge and a separated liquid; and returning at least a part of the separated sludge to the methane fermentation tank, characterized in that the method includes: measuring directly or indirectly a concentration of ammonia nitrogen in the fermentation liquid in the methane fermentation
tank; and controlling an amount of the separated sludge returned to the methane fermentation tank so that the concentration of the ammonia nitrogen exceeds a predetermined value.

[0013] In the methane fermentation treatment method of the present invention, it is preferred that the amount of the separated sludge returned to the methane fermentation tank be controlled so that the concentration of the ammonia nitrogen in the methane fermentation tank is 40 mg/L or more.

[0014] In the methane fermentation treatment method of the present invention, it is preferred that, when the amount of the ammonia nitrogen in the methane fermentation tank decreases to a predetermined value or lower, the amount of the separated sludge returned to the methane fermentation tank be increased, and in a case where the concentration of the ammonia nitrogen does not exceed the predetermined value even when the amount of the separated sludge returned to the methane fermentation tank reaches an upper limit, an ammonia nitrogen contained in the separated liquid be supplied to the methane fermentation tank.

[0015] In the methane fermentation treatment method of the present invention, it is preferred that the organic waste be a palm oil mill effluent.

[0016] In a separated sludge obtained by subjecting a fermentation liquid taken out of a methane fermentation tank to a solid-liquid separation, nitrogen derived from cadaver of bacteria such as methanogen flowing out of the methane fermentation tank, as well as ammonia generated during the methane fermentation, and the like are contained to be concentrated. An organic waste with a COD/N ratio of 50 or more has a very low nitrogen concentration, and hence, the activities of the bacteria are likely to be decreased due to the shortage of nitrogen and the fermentation efficiency is likely to decrease with time. According to the present invention, the amount of the separated sludge to be returned to the methane fermentation tank is controlled so that the concentration of ammonia nitrogen in the fermentation liquid in the methane fermentation tank exceeds a predetermined value.
Therefore, even when the methane fermentation treatment is performed with high-load operation, nitrogen derived from cadaver of bacteria, ammonia, and the like contained in the separated sludge are returned to the methane fermentation tank, which can suppress the decrease in activities of the bacteria caused by the shortage of nitrogen, and enables the methane fermentation treatment of the organic waste to be performed stably for a long period of time.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] In the accompanying drawings:

FIG. 1 is a schematic view of a treatment apparatus used in a methane fermentation treatment of the present invention; and FIG. 2 is a diagram illustrating changes with time in pH, an alkalinity, an ammonia nitrogen concentration, a volatile aliphatic acid concentration, and a hydrogen sulfide concentration of a fermentation liquid in a methane fermentation tank in Example 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] One embodiment of the methane fermentation apparatus used in the methane fermentation treatment of the present invention is described with reference to FIG. 1.

[0019] As illustrated in FIG. 1, the methane fermentation apparatus mainly includes a methane fermentation tank 1 and a solid-liquid separation tank 2.

[0020] The methane fermentation tank 1 is a treatment tank that subjects an organic liquid waste supplied to the tank to an anaerobic treatment under the function of anaerobic bacteria, such as methanogen, to decompose the liquid waste into biogas, such as methane gas. A pipe L1 extending from a supply source of an organic waste and a pipe L2 extending from a bottom portion of the solid-liquid separation tank 2 (the pipe L2 may be connected to a lower
portion of a side of the separation tank 2) are connected to the methane fermentation tank 1. Further, in the methane fermentation tank 1, a stirring device (not shown) for stirring fermentation liquid in the tank and an ammonia meter 10 are disposed. Further, a pipe L3 for taking out biogas extends from an upper portion of the methane fermentation tank 1 and is connected to a gas holder, a gas utilization facility, or the like.

[0021] There is no particular limit to the stirring device as long as the device is capable of stirring the fermentation liquid in the tank. Examples of the stirring device include a stirrer equipped with a stirring blade. Further, a mechanism in which a passage for circulating the fermentation liquid in the tank is formed to generate an upward flow or a downward flow of the fermentation liquid in the tank may be provided, and a gas stirring device for circulating generated biogas to perform blow-bubbling may be provided.

[0022] There is no particular limit to the ammonia meter 10, and any meter capable of measuring the concentration of ammonia nitrogen in the fermentation liquid can be used. Examples thereof include an electrode-type ammonia meter. Further, as described in Japanese Patent No. 3630165 and Japanese Patent Application Laid-open No. 2009-219960, and the like, it is known that the electrical conductivity of the fermentation liquid has a correlation with the concentration of ammonia nitrogen. Therefore, the ammonia meter 10 may be one that is capable of measuring the concentration of ammonia nitrogen in the fermentation liquid indirectly by measuring the electrical conductivity of the fermentation liquid.

[0023] In the latter stage of the methane fermentation tank 1, the solid-liquid separation tank 2 is disposed. The methane fermentation tank 1 and the solid-liquid separation tank 2 are connected to each other via a pipe L4.

[0024] The solid-liquid separation tank 2 is not particularly limited as long as it has a configuration capable of separating the fermentation liquid taken out of the methane
fermentation tank 1 into a separated liquid and a separated sludge by solid-liquid separation, and solid-liquid separation tanks such as a gravity sedimentation tank, a centrifugal device, and a membrane separation device can be used widely.

[0025] A pipe L5 for discharging a separated liquid extends from a side of the solid-liquid separation tank 2. Further, the pipe L2 extends from a lower portion (bottom portion in this embodiment) of the solid-liquid separation tank 2 to be connected to the methane fermentation tank 1 via a liquid sending pump P1 so that at least a part of the separated sludge can be returned to the methane fermentation tank 1.

[0026] Next, taking the case of using this methane fermentation apparatus as an example, the methane fermentation method of the present invention is described.

[0027] In the methane fermentation treatment of the present invention, an organic waste having a ratio of a chemical oxygen demand concentration to a nitrogen concentration (COD/N ratio) of 50 or more, preferably about 65 to 80, is used as a material to be treated.

[0028] The organic waste has a very low nitrogen concentration, and hence, the shortage of nitrogen is likely to occur in the methane fermentation tank. In particular, the shortage of nitrogen is likely to occur during high-load operation. According to the present invention, even in the case where an organic waste having a very low nitrogen concentration is subjected to the methane fermentation treatment with high-load operation, methane fermentation occurs at satisfactory efficiency for the reasons described below, and hence, such an organic waste can be preferably used as a material to be treated. As such an organic waste, there is exemplified an organic waste having a low protein content, and specific examples thereof include palm oil mill effluent and alcohol liquid waste. The palm oil mill effluent refers to a cleaning effluent which is discharged as a result of cleaning of residues left after compressing palm fruits and recovering palm oil. The palm oil mill effluent is an organic waste having a low protein content as described in the example below.
According to the present invention, an organic waste and a separated sludge are supplied to the methane fermentation tank 1 through the pipes L1 and L2, respectively. Then, while stirring with the stirring means (not shown) continuously or intermittently so that the concentration and temperature of the sludge of the fermentation liquid in the tank become substantially uniform, the supplied organic liquid waste is retained for a predetermined period of time to be subjected to methane fermentation under the function of anaerobic bacteria such as methanogen.

The methane fermentation condition is not particularly limited, and the methane fermentation treatment is performed preferably under the conditions of an organic substance load of 5 to 25 g/l/day and a residence time of 4 to 20 days, and particularly preferably under the conditions of an organic substance load of 10 to 25 g/l/day and a residence time of 4 to 10 days. In the present invention, even when an operation is performed at such a high speed and a high load, the shortage of nitrogen does not occur in the methane fermentation tank, and the methane fermentation treatment can be performed stably.

Then, an equivalent amount of the fermentation liquid to that of the organic liquid waste supplied to the methane fermentation tank 1 is pulled out through the pipe L4 and supplied to the solid-liquid separation tank 2 in the latter stage. Further, biogas, such as methane gas generated when the organic waste is subjected to methane fermentation, is taken out of the tank through the pipe L3 and reserved in a biogas holder (not shown) or the like.

In the solid-liquid separation tank 2, the fermentation liquid taken out of the methane fermentation tank 1 is separated into a separated liquid and a separated sludge by solid-liquid separation. Then, at least a part of the separated liquid is discharged outside the tank through the pipe L5, and at least a part of the separated sludge is returned to the methane fermentation tank 1 through the pipe L2.

In the separated sludge, bacteria such as methanogen flowing out of the methane
fermentation tank, nitrogen derived from cadaver of bacteria, ammonia generated during methane fermentation, and the like are concentrated. Therefore, when the separated sludge is returned to the methane fermentation tank 1, a nitrogen component contained in the separated sludge is used as a nutrient and the like for the bacteria in the methane fermentation tank.

[0034] In the present invention, the amount of the separated sludge returned to the methane fermentation tank 1 is controlled so that the concentration of ammonia nitrogen in the methane fermentation tank 1 exceeds a previously set threshold value. In this embodiment, the amount of the separated sludge to be returned is controlled by regulating the drive of the liquid sending pump P1 so that the measured value by the ammonia meter 10 exceeds an threshold value.

[0035] It is preferred that the amount of the separated sludge to be returned be controlled by regulating the operation of the liquid sending pump P1 so that ammonia nitrogen in the methane fermentation tank 1 exceeds the detectable limit. More preferably, the operation of the liquid sending pump P1 is regulated so that the concentration of ammonia nitrogen reaches 40 mg/L or more, and particularly preferably, the operation of the liquid sending pump P1 is regulated so that the concentration of ammonia nitrogen falls between 40 and 100 mg/L.

[0036] When ammonia nitrogen is detected in the methane fermentation tank, it can be conjectured that the shortage of nitrogen has not occurred in the tank and a nitrogen component necessary for the activities of bacteria is present in the tank. If the concentration of ammonia nitrogen is 40 mg/L or more, the activity state of methanogen or the like can become particularly favorable, and a higher methane fermentation efficiency can be expected. Further, in the case where an organic waste having a COD/N ratio of 50 or more is subjected to the methane fermentation treatment, there is a low possibility that the concentration of
ammonia nitrogen increases too much. However, when the concentration of ammonia nitrogen exceeds 2,500 mg/L, the activities of methanogen may be inhibited, and hence, the upper limit of the concentration is preferably about 2,000 mg/L.

[0037] In the case where the concentration of ammonia nitrogen in the methane fermentation tank 1 does not exceed a threshold value even if the amount of the separated sludge to be returned reaches the upper limit, it is preferred that the ammonia nitrogen contained in the separated liquid be separated and recovered by a method, such as ammonia stripping or an ion exchange membrane method, and returned to the methane fermentation tank 1.

[0038] Thus, according to the present invention, the amount of the separated sludge to be returned to the methane fermentation tank is controlled so that the concentration of ammonia nitrogen in the fermentation liquid in the methane fermentation tank 1 exceeds a threshold value. Therefore, even when the methane fermentation treatment is performed with high-load operation, nitrogen derived from cadaver of bacteria, ammonia, and the like contained in the separated sludge are returned to the methane fermentation tank so that the amount of nitrogen necessary for the activities of the bacteria can be supplied. Therefore, without setting a longer residence time; or without adding a nitrogen-containing compound such as ammonium carbonate, which may be converted into a nitrogen component, an organic waste having high protein content such as raw garbage and excreta, or the like, an organic waste can be subjected to the methane fermentation treatment at a high speed and a high load over a long period of time while suppressing the decrease in the activities of bacteria caused by the shortage of nitrogen. In addition, there is no need separately to prepare to bring a nitrogen-containing compound such as ammonium carbonate, which may be converted into a nitrogen component, as well as an organic waste having high protein content such as raw garbage and excreta. Therefore, the cost for storage facilities of those materials; the
shipping cost; the cost for materials as they are; and the like can be avoided, and the operational cost can be reduced.

Example

(Example 1)

A methane fermentation treatment by an apparatus illustrated in FIG. 1 was performed under the condition of a residence time of 10 days, with the use of a palm oil mill effluent (COD/N ratio = 72) having a composition shown in the following Table 1. As the methane fermentation tank 1, a tank with a capacity of 5 L was used. As the solid-liquid separation tank 2, a gravity sedimentation tank 3 with a capacity of 0.5 L was used.

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It should be noted that the TS concentration was measured in accordance with a
sewage test method-2.2.9. More specifically, the TS concentration of the sample liquid was obtained by dividing the amount of the remaining solid after drying at 110°C by the original volume of the sample liquid. Further, the VS concentration of the sample was obtained by subtracting the ash concentration, obtained by dividing the mass of the remaining solid (ash) after heating at 600°C±25°C by the original volume of the sample, from the TS concentration obtained above. Further, the COD/N ratio was calculated from CODcr/Kj-N (Kjeldahl nitrogen) in Table 1.

[0042] To the methane fermentation tank 1, 1,500 mL of palm oil mill effluent was charged per day, and 125 mL of separated sludge (total solid (TS) concentration: 66,000 mg/L, non-volatile organic substance (VS) concentration: 46,000 mg/L) was returned from the solid-liquid separation tank 2. Further, the same amount (625 mL) of the fermentation liquid was pulled out of the methane fermentation tank 1 and introduced into the solid-liquid separation tank 2. The pH, the alkalinity (M-alk), the concentration of ammonia nitrogen (NH4-N), the concentration of volatile fatty acid (VFA), and the concentration of hydrogen sulfide (H2S) of the fermentation liquid in the methane fermentation tank 1 were measured. FIG. 2 illustrates the results.

[0043] As illustrated in FIG. 2, during the methane fermentation treatment, the concentration of ammonia nitrogen of the fermentation liquid was 94 mg/L on average. There was no fluctuation in the pH, the alkalinity, the concentration of volatile aliphatic acid, and the concentration of hydrogen sulfide, and thus, the fermentation state was stable.

Further, the VS concentration of the fermentation liquid in the methane fermentation tank, after the elapse of 31 days from reaching the condition of the residence time of 10 days on the organic waste charged into the methane fermentation tank 1, was measured to be 17,000 mg/L, and the decomposition ratio of the VS was 69%.

[0044] (Comparative Example 1)
An organic waste, in which 100 mg/L of ammonia nitrogen was added to a palm oil mill effluent (COD/N ratio = 78) having a composition shown in Table 2, was subjected to a methane fermentation treatment under the condition of a residence time of 8 days. It is conjectured that the concentration of ammonia nitrogen of the organic waste was 144 mg/L.

<table>
<thead>
<tr>
<th></th>
<th>mg/L</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TS</td>
<td>46,400</td>
<td></td>
</tr>
<tr>
<td>VS</td>
<td>40,200</td>
<td></td>
</tr>
<tr>
<td>BOD</td>
<td>33,000</td>
<td></td>
</tr>
<tr>
<td>CODcr</td>
<td>56,000</td>
<td></td>
</tr>
<tr>
<td>TOD</td>
<td>62,540</td>
<td></td>
</tr>
<tr>
<td>Kj-N</td>
<td>720</td>
<td></td>
</tr>
<tr>
<td>NH₄-N</td>
<td>44</td>
<td></td>
</tr>
<tr>
<td>oil and Grease</td>
<td>7,900</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>49.2</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>7.04</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>1.71</td>
<td></td>
</tr>
<tr>
<td>COD/N</td>
<td>78</td>
<td></td>
</tr>
</tbody>
</table>

After the elapse of 40 days of operation, the concentration of ammonia nitrogen of the fermentation liquid in the methane fermentation tank was measured to be 60 mg/L on average.

It is conjectured from the above result that, if ammonia nitrogen was not added, ammonia nitrogen was not detected in the fermentation tank caused by the shortage of nitrogen.
WHAT IS CLAIMED IS:

1. A methane fermentation treatment method, comprising:

   supplying an organic waste to a methane fermentation tank to perform a methane fermentation treatment, the organic waste having a ratio of a chemical oxygen demand concentration to a nitrogen concentration (COD/N ratio) of 50 or more;

   taking out a fermentation liquid from the methane fermentation tank by predetermined amounts;

   separating the fermentation liquid into a separated sludge and a separated liquid; and

   returning at least a part of the separated sludge to the methane fermentation tank, characterized in that the method comprises:

   measuring directly or indirectly a concentration of ammonia nitrogen in the fermentation liquid in the methane fermentation tank; and

   controlling an amount of the separated sludge returned to the methane fermentation tank so that the concentration of the ammonia nitrogen exceeds a predetermined value.

2. A methane fermentation treatment method according to claim 1, wherein the amount of the separated sludge returned to the methane fermentation tank is controlled so that the concentration of the ammonia nitrogen in the methane fermentation tank is 40 mg/L or more.

3. A methane fermentation treatment method according to claim 1 or 2, wherein when the amount of the ammonia nitrogen in the methane fermentation tank decreases to a predetermined value or lower, the amount of the separated sludge returned to the methane fermentation tank is increased, and in a case where the concentration of the ammonia nitrogen does not exceed the predetermined value even when the amount of the separated sludge
returned to the methane fermentation tank reaches an upper limit, an ammonia nitrogen contained in the separated liquid is supplied to the methane fermentation tank.

4. A methane fermentation treatment method according to any one of claims 1 to 3, wherein the organic waste is a palm oil mill effluent.
ABSTRACT OF THE DISCLOSURE

Provided is a methane fermentation treatment method which is capable of subjecting an organic waste having a low nitrogen concentration to a methane fermentation treatment efficiently. The methane fermentation treatment method includes: supplying an organic waste to a methane fermentation tank to perform a methane fermentation treatment, the organic waste having a ratio of a chemical oxygen demand concentration to a nitrogen concentration (COD/N ratio) of 50 or more; taking out a fermentation liquid from the methane fermentation tank by predetermined amounts; separating the fermentation liquid into a separated sludge and a separated liquid; and returning at least a part of the separated sludge to the methane fermentation tank, characterized in that the method includes: measuring directly or indirectly a concentration of ammonia nitrogen in the fermentation liquid in the methane fermentation tank; and controlling an amount of the separated sludge returned to the methane fermentation tank so that the concentration of the ammonia nitrogen exceeds a predetermined value.
FIG. 1

TAKEOUT OF BIOGAS

ORGANIC WASTE

L1

L3

10

SEPARATED LIQUID

L4

L5

SEPARATED SLUDGE

P1

L2