

DESCRIPTION

WATER TREATMENT METHOD AND WATER TREATMENT APPARATUS

5

CROSS-REFERENCE TO RELATED APPLICATION

[0001]

This application claims priority to Japanese Patent Application No. 2014-003733, the disclosure of which is incorporated herein by reference in its entirety.

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FIELD

[0002]

The present invention relates to a water treatment method and a water treatment apparatus for anaerobically treating treatment target water containing organic matter.

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BACKGROUND

[0003]

As a water treatment method for treating treatment target water containing organic matter such as sewage, river water, or seawater, various methods have been proposed. For example, in an aerobically activated sludge process, the treatment target water is mixed with an activated sludge, thereby allowing organic matter in the treatment target water to be aerobically degraded due to the action of aerobic microorganisms in the activated sludge, so as to be removed mainly as carbon dioxide, or the like. Therefore, in the activated sludge process, mixed water in which the treatment target water and the activated sludge are mixed is aerated, in order to maintain the activity of the microorganisms in the activated sludge.

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[0004]

In such an aerobically activated sludge process, equipment such as a

blower is needed for the aeration, and thus power to operate the equipment is needed, resulting in comparatively large energy consumption. Therefore, an anaerobically activated sludge process that does not need the aeration in the degradation of organic matter is used, for example, in order to suppress the energy consumption. As such a process, an anaerobic membrane bioreactor (hereinafter, referred to also as anaerobic MBR) that combines the anaerobically activated sludge process with a membrane separation process is known. In the anaerobic MBR, the configuration is such that sludge containing anaerobic microorganisms is mixed with the treatment target water, and the mixture is placed in an anaerobic environment, thereby allowing anaerobic degradation of the organic matter in the treatment target water due to the action of anaerobic bacteria in the sludge (clarification step). Then, the mixed water after the clarification step is filtered by a separation membrane (microfiltration membrane (MF membrane) or an ultrafiltration membrane (UF membrane)) (membrane separation step), so that the treated water is obtained by separating the activated sludge. On the other hand, the separated activated sludge is returned to the clarification step so as to be reused, which prevents the outflow of the activated sludge (see Patent Literature 1).

[0005]

Meanwhile, the treatment target water that has been treated by the anaerobic MBR (hereinafter, referred to also as anaerobically treated water) is generally released into the environment (such as rivers and sea areas), as described above, but the anaerobically treated water contains nitrogen components, phosphorous components, or the like. These components are salts that are usable as fertilizers for plants, nutritional ingredients for the activated sludge, or the like, and therefore it is desired to recover such salts.

CITATION LIST

Patent Literature

[0006]

Patent Literature 1: JP 2010-17614 A

SUMMARY

Technical Problem

[0007]

5 It is therefore an object of the present invention to provide a water treatment method and a water treatment apparatus that enable efficient recovery of salts from the treatment target water that has been treated by the anaerobic MBR and effective use of such salts.

10 Solution to Problem

[0008]

 A water treatment method according to the present invention includes an anaerobic treatment step using a membrane separation activated sludge process of performing anaerobic treatment of treatment target water
15 containing organic matter and membrane separation of the treatment target water after the anaerobic treatment, the method further including: a concentration step of concentrating anaerobically treated water by bringing the anaerobically treated water composed of the treatment target water treated in the anaerobic treatment step and a draw solution into which water is
20 configured to penetrate from the anaerobically treated water via a semipermeable membrane due to osmotic pressure into contact with each other via a semipermeable membrane; and a salt recovery step of recovering salts from the anaerobically treated water concentrated in the concentration step.

[0009]

25 The draw solution is preferably composed of seawater or a liquid containing magnetic fine particles.

[0010]

 The salts are preferably at least one of nitrogen components or phosphorous components.

30 [0011]

 A water treatment apparatus according to the present invention

includes an anaerobic treatment unit using a membrane separation activated sludge process of performing anaerobic treatment of treatment target water containing organic matter and membrane separation of the treatment target water after the anaerobic treatment, the apparatus further including: a

5 concentration apparatus configured to concentrate anaerobically treated water composed of the treatment target water treated in the anaerobic treatment unit; and a salt recovery unit configured to recover salts from the anaerobically treated water concentrated in the concentration apparatus, wherein the concentration apparatus includes: a draw solution supply unit configured to be
10 supplied with a draw solution into which water penetrates from the anaerobically treated water via a semipermeable membrane due to osmotic pressure; and an anaerobically treated water supply unit configured to be supplied with the anaerobically treated water, and the concentration apparatus is configured so that the anaerobically treated water and the draw solution are
15 in contact with each other via a semipermeable membrane.

[0012]

The draw solution is preferably composed of seawater or a liquid containing magnetic fine particles.

[0013]

20 The salts are preferably at least one of nitrogen components or phosphorous components.

BRIEF DESCRIPTION OF DRAWINGS

[0014]

25 Fig. 1 is a pattern diagram showing a water treatment apparatus according to this embodiment.

Fig. 2 is a schematic view showing a concentration apparatus of the water treatment apparatus according to this embodiment.

Fig. 3 is a schematic view showing a concentration apparatus of a water
30 treatment apparatus according to another embodiment.

Fig. 4 is a schematic view showing a concentration apparatus of a water

treatment apparatus according to still another embodiment.

DESCRIPTION OF EMBODIMENTS

[0015]

5 <First embodiment>

Hereinafter, a first embodiment of the present invention will be described with reference to Figs. 1 and 2. In the following drawings, the same or corresponding portions are denoted by the same reference numerals, and the description thereof is not repeated.

10 [0016]

A water treatment apparatus 1 according to this embodiment is configured to anaerobically treat treatment target water containing organic matter. Specifically, the water treatment apparatus 1 includes an anaerobic treatment unit 2 configured to anaerobically treat treatment target water supplied therein, a concentration apparatus 3 configured to concentrate the treatment target water treated in the anaerobic treatment unit 2 (hereinafter, referred to also as anaerobically treated water), and a salt recovery unit 4 configured to recover salts from the concentrated anaerobically treated water. The treatment target water is not specifically limited, but examples thereof include sewage and wastewater from food factory or the like.

[0017]

The anaerobic treatment unit 2 includes an anaerobic treatment tank 2a in which anaerobic treatment of the treatment target water is performed, and a membrane separator 2b with which membrane separation of the treatment target water after the anaerobic treatment is performed. The anaerobic treatment tank 2a is configured to be capable of degrading organic matter in the treatment target water, for example, by methane fermentation. Specifically, sludge containing anaerobic bacteria that anaerobically degrade the organic matter (hereinafter, referred to also as anaerobic sludge) is supplied into the anaerobic treatment tank 2a, and thus the anaerobic treatment tank 2a is configured so that the treatment target water and anaerobic sludge are

mixed to form a mixed solution. Then, it is configured so that the mixed water is placed in the anaerobic environment within the anaerobic treatment tank 2a, thereby allowing the anaerobic sludge to degrade the organic matter. The BOD of the treatment target water supplied into the anaerobic treatment tank 2a is not specifically limited, and may be 1000 mg/L or more and less than 2000 mg/L, or may be 2000 mg/L or more.

[0018]

In the membrane separator 2b, the anaerobic sludge is separated from the treatment target water that has been treated in the anaerobic treatment tank 2a (specifically, the mixed water discharged from the anaerobic treatment tank 2a). Specifically, the membrane separator 2b includes an internal space configured to be supplied with the mixed water, and a separation membrane (such as microfiltration membrane (MF membrane) and ultrafiltration membrane (UF membrane)) disposed in the internal space. Then, the mixed water is filtered by the separation membrane, thereby separating the treatment target water (that is, anaerobically treated water) and the anaerobic sludge from each other. The separated anaerobic sludge is returned to the anaerobic treatment tank 2a. The temperature, the pH, the flow rate, or the like, of the anaerobically treated water before being supplied to the concentration apparatus 3 may be adjusted. This can reduce fouling.

[0019]

As shown in Fig. 2, the concentration apparatus 3 includes an internal space partitioned by a semipermeable membrane 3a. Thus, the concentration apparatus 3 includes an anaerobically treated water supply unit 3b having an internal space that is supplied with the anaerobically treated water, and a draw solution supply unit 3c having an internal space configured to be supplied with a draw solution into which water penetrates from the treatment target water via the semipermeable membrane 3a due to the osmotic pressure. The concentration apparatus 3 is configured so that the treatment target water and the draw solution supplied therein are in contact with each other via the semipermeable membrane 3a. That is, the concentration apparatus 3 of this

embodiment is configured so that the internal space of the anaerobically treated water supply unit 3b and the internal space of the draw solution supply unit 3c are provided side by side via the semipermeable membrane 3a (side-stream type). The semipermeable membrane 3a is not specifically limited, and general forward osmosis membranes and reverse osmosis membranes can be used therefor.

[0020]

The anaerobically treated water supply unit 3b is fluidically connected to the anaerobic treatment unit 2. Specifically, the anaerobically treated water supply unit 3b includes an anaerobically treated water introducing unit 31b fluidically connected to the membrane separator 2b to introduce the anaerobically treated water into the anaerobically treated water supply unit 3b, and an anaerobically treated water discharging unit 32b fluidically connected to the salt recovery unit 4 to discharge the treatment target water from the inside of the anaerobically treated water supply unit 3b.

[0021]

The draw solution supply unit 3c includes a draw solution introducing unit 31c fluidically connected to the supply source of the draw solution to introduce the draw solution into the draw solution supply unit 3c, and a draw solution discharging unit 32c fluidically connected to the discharge destination of the draw solution to discharge the draw solution from the inside of the draw solution supply unit 3c.

[0022]

The draw solution is not specifically limited, and seawater is used in this embodiment. That is, in this embodiment, ocean S can be used as the supply source and the discharge destination of the draw solution.

[0023]

The salt recovery unit 4 is fluidically connected to the concentration apparatus 3 to be supplied with the concentrated anaerobically treated water. Such anaerobically treated water contains salts (specifically, nutrient salts such as nitrogen components and phosphorous components), and therefore the

salt recovery unit 4 is configured to recover the salts (specifically, nutrient salts) from the concentrated anaerobically treated water.

[0024]

Next, a method for treating the treatment target water using the water treatment apparatus 1 configured as above will be described.

[0025]

The treatment target water (raw water) is supplied to the anaerobic treatment unit 2. Specifically, the treatment target water is supplied to the anaerobic treatment tank 2a. In the anaerobic treatment tank 2a, the treatment target water and an anaerobic sludge are mixed together to form mixed water. Then, the mixed water is maintained under conditions (specifically, such as pH and temperature) suitable for anaerobic treatment (methane fermentation). This allows organic matter in the treatment target water to be anaerobically treated so as to be degraded, so that methane gas is generated (anaerobic treatment step). The generated methane gas is discharged from the anaerobic treatment tank 2a so as to be recovered, and thus can be used as fuels or raw materials. On the other hand, the mixed water in the anaerobic treatment tank 2a is discharged from the anaerobic treatment tank 2a and is supplied to the membrane separator 2b.

[0026]

In the membrane separator 2b, the mixed water is filtered by the separation membrane, thereby separating the treatment target water in which the organic matter has been degraded (that is, anaerobically treated water) and the anaerobic sludge from each other. At least a part of the separated anaerobic sludge is returned to the anaerobic treatment tank 2a. The anaerobically treated water is discharged from the anaerobic treatment unit 2 (specifically, the membrane separator 2b) to be supplied to the concentration apparatus 3 (specifically, the anaerobically treated water supply unit 3b).

Following this, seawater is supplied to the concentration apparatus 3

(specifically, the draw solution supply unit 3c) as the draw solution.

[0027]

In this way, the anaerobically treated water is supplied to the anaerobically treated water supply unit 3b, and seawater is supplied to the draw solution supply unit 3c as the draw solution, thereby allowing the treatment target water and seawater to be in contact with each other via the semipermeable membrane 3a within the concentration apparatus 3 and allowing the water in the anaerobically treated water to permeate through the semipermeable membrane 3a due to osmotic pressure so as to penetrate into the seawater side (forward osmosis). This causes the anaerobically treated water to be concentrated within the anaerobically treated water supply unit 3b, thereby increasing the concentration of salts (specifically, nutrient salts) (concentration step). On the other hand, seawater is diluted due to the penetration of the water in the anaerobically treated water within the draw solution supply unit 3c.

[0028]

In this embodiment, the anaerobically treated water discharging unit 32b and the draw solution discharging unit 32c are provided in the vicinity of the semipermeable membrane 3a, and the treatment target water and the draw solution are supplied to the concentration apparatus 3 at an appropriate flow rate, so that the anaerobically treated water in the vicinity of the semipermeable membrane 3a (that is, the concentrated anaerobically treated water) and seawater (that is, the diluted seawater) are rapidly discharged out of the concentration apparatus 3. This allows the anaerobically treated water and seawater to remain in the vicinity of the semipermeable membrane 3a to prevent a reduction in penetration efficiency. Then, the concentrated anaerobically treated water is supplied to the salt recovery unit 4. On the other hand, the diluted seawater can be released into the environment such as rivers and the ocean S without further water treatment as long as its water quality allows the release into the environment, but the diluted seawater may be released into the environment after being subjected to further water treatment so as to have desired water quality.

[0029]

In the salt recovery unit 4, salts are recovered from the concentrated anaerobically treated water. The method for recovering salts is not specifically limited, but ammonia stripping in which the ammonium nitrogen in the anaerobically treated water is recovered as ammonia gas by introducing air or steam into the concentrated anaerobically treated water, for example, can be employed, as a method for recovering nitrogen components that are nutrient salts. Further, as a method for recovering phosphorous components that are nutrient salts, a recovery method by adding aluminum salts (such as sulfuric acid band and PAC) to the concentrated anaerobically treated water, thereby allowing phosphorous components to aggregate and precipitate, for example, can be employed. Alternatively, a recovery method by pelletizing the phosphorous components in the concentrated anaerobically treated water as magnesium ammonium phosphate (MAP) can be employed. The recovered nutrient salts are discharged out of the system, and the water other than the nutrient salts is returned to the line of the treatment target water after the membrane separator 2b. Further, though not shown in the drawings, the water also can be returned to the line of the treatment target water that is supplied to the anaerobic treatment unit 2 (specifically, the anaerobic treatment tank 2a).

[0030]

As described above, the water treatment method and the water treatment apparatus of the present invention enable salts to be efficiently recovered from the treatment target water treated by anaerobic MBR, and enable the salts to be effectively used.

[0031]

That is, in the concentration apparatus 3 (concentration step) of the above-described water treatment apparatus 1, the water penetrates from the anaerobically treated water to the draw solution side via the semipermeable membrane 3a due to osmotic pressure (forward osmosis). This allows the water content in the anaerobically treated water to be reduced and the anaerobically treated water to be concentrated in the concentration apparatus

3 without applying a pressure as in inverse penetration or using power to
reduce the pressure. Then, the concentrated anaerobically treated water
(hereinafter, referred to also as concentrated water) contains salts at higher
concentration than before the concentration, and therefore the salts can be
5 efficiently recovered from the concentrated water in the salt recovery unit 4
(salt recovery step). In the case where the recovered salts are nutrient salts
such as nitrogen components and phosphorous components, the nutrient salts
contained in the anaerobically treated water can be effectively used by using
them as fertilizers for plants.

10 [0032]

Further, in the case where the draw solution is seawater, only the water
moves from the anaerobically treated water to the draw solution side, and other
solutes are prevented from moving to the draw solution side by the
semipermeable membrane to remain on the concentrated side (that is, the
15 anaerobically treated water side). Therefore, the draw solution into which the
water has penetrated from the anaerobically treated water means diluted
seawater. Therefore, there is no need for treatment (such as pH adjustment
and removal of unnecessary components) to drain the draw solution released
from the concentration apparatus 3 (draw solution after the concentration step)
20 into the environment, and the draw solution released from the concentration
apparatus 3 (draw solution after the concentration step) can be directly
released into the ocean.

[0033]

<Second embodiment>

25 Next, a second embodiment of the present invention will be described
with reference to Fig. 3. The water treatment method and the water
treatment apparatus according to the second embodiment are mainly different
from the water treatment method and the water treatment apparatus 1
according to the first embodiment in configuration of a concentration apparatus
30 300. Specifically, the concentration apparatus 300 is mainly different from the
concentration apparatus 3 according to the first embodiment in configurations

of an anaerobically treated water supply unit 300b and a draw solution supply unit 300c. Accordingly, features different from the first embodiment are mainly described below, the same configurations are denoted by the same reference numerals, and the description thereof is omitted.

5 [0034]

The concentration apparatus 300 is constituted by arranging the anaerobically treated water supply unit 300b in an internal space of the draw solution supply unit 300c configured to be supplied with the draw solution. The anaerobically treated water supply unit 300b includes an internal space
10 configured to be supplied with the anaerobically treated water, and the internal space is separated from the internal space of the draw solution supply unit 300c by the semipermeable membrane 3a. That is, at least a part of the anaerobically treated water supply unit 300b is constituted by the semipermeable membrane 3a, and at least the part constituted by the
15 semipermeable membrane 3a is located in the internal space of the anaerobically treated water supply unit 300b. Note that, the draw solution supply unit 300c does not include the draw solution discharging unit 32c as in the standalone type.

[0035]

20 In the concentration apparatus 300 with such a configuration, the draw solution is supplied to the draw solution supply unit 300c (specifically, from equipment X configured to supply the draw solution), thereby allowing the anaerobically treated water supply unit 300b (specifically, the part constituted by the semipermeable membrane 3a) to be immersed in the draw solution
25 (immersion type). Then, the anaerobically treated water is supplied to the anaerobically treated water supply unit 300b, thereby allowing the anaerobically treated water and the draw solution to be in contact with each other via the semipermeable membrane 3a to cause the water to penetrate from the anaerobically treated water into the draw solution. According to such a
30 configuration, the anaerobically treated water supply unit 300b is immersed in the draw solution, and therefore the water that has penetrated to the draw

solution side is easily diffused in the draw solution supply unit 300c.

Therefore, the difficulty in generation of osmotic pressure due to the reduction in concentration difference between the anaerobically treated water side and the draw solution side in the vicinity of the semipermeable membrane 3a is

5 prevented. This allows efficient water penetration from the treatment target water into the draw solution and thus enables efficient concentration of the anaerobically treated water. The draw solution in the draw solution supply unit 300c is discharged from the draw solution supply unit 300c by overflow.

Further, in order to efficiently bring the draw solution and the anaerobically
10 treated water into contact with each other via the semipermeable membrane 3a (in other words, into contact with the semipermeable membrane 3a), the inside of the draw solution supply unit 300c may be stirred using a stirrer or the like (not shown) to adjust the flow rate (discharge amount of the draw solution from the draw solution supply unit 300c).

15 [0036]

The water treatment method and the water treatment apparatus according to the present invention are not limited to the above-described embodiments, and various modifications can be made without departing from the gist of the present invention. Further, the configurations, methods, or the
20 like, of the above-described plurality of embodiments may be optionally employed and combined (configuration, method, or the like, of one embodiment may be applied to configuration, method, or the like, of another embodiment). Further, it is also a matter of course that configurations and methods according to various modifications described below may be optionally selected to be
25 employed as the configurations and methods according to the aforementioned embodiments.

[0037]

For example, in the concentration apparatus 3 of the first embodiment, the flow directions of the anaerobically treated water and the draw solution are
30 configured to be parallel, but there is no limitation to this. For example, the flow directions may be configured to be reversed. Specifically, the flow

directions may be configured to be reversed by introducing the anaerobically treated water from the anaerobically treated water introducing unit 31b (or the anaerobically treated water discharging unit 32b) into the anaerobically treated water supply unit 3b and discharging it from the anaerobically treated water discharging unit 32b (or the anaerobically treated water introducing unit 31b), and introducing the draw solution from the draw solution discharging unit 32c (or the draw solution introducing unit 31c) into the draw solution supply unit 3c and discharging it from the draw solution introducing unit 31c (or the draw solution discharging unit 32c).

[0038]

Further, in the second embodiment, the draw solution is configured to be discharged from the draw solution supply unit 300c by overflow, but there is no limitation to this. The configuration may be such that the draw solution supply unit 300c includes the draw solution discharging unit 32c, and the draw solution is discharged from the draw solution discharging unit 32c.

[0039]

Further, instead of the concentration apparatuses 3 and 300 of the above-described embodiments, a concentration apparatus 301 having the configuration shown in Fig. 4 may be employed. The concentration apparatus 301 is mainly different from the concentration apparatuses 3 and 300 of the above-described embodiments in configurations of an anaerobically treated water supply unit 301b and a draw solution supply unit 301c. Accordingly, features different from the above-described embodiments are mainly described below, the same configurations are denoted by the same reference numerals, and the description thereof is omitted.

[0040]

As shown in Fig. 4, the concentration apparatus 301 is constituted by arranging a plurality of draw solution supply units 301c to pass through an anaerobically treated water supply unit 301b. A draw solution supply unit 301c has a tubular shape extending in one direction. A region of the draw solution supply unit 301c that is located in the internal space of the

anaerobically treated water supply unit 301b is formed using the semipermeable membrane 3a, and the draw solution introducing unit 31c and the draw solution discharging unit 32c are formed by the outer region of the internal space.

5 [0041]

In the concentration apparatus 301 with such a configuration, the internal space of the draw solution supply unit 301c is filled with the draw solution, and the anaerobically treated water is supplied to the anaerobically treated water supply unit 301b so that the entire region of the draw solution supply unit 301c that is formed using the semipermeable membrane 3a is
10 immersed in the anaerobically treated water. This allows the anaerobically treated water and the draw solution to be in contact with each other via the semipermeable membrane 3a.

[0042]

15 Further, in the above-described embodiments, seawater is used as the draw solution, but the draw solution is not specifically limited as long as it allows water to penetrate therein from the treatment target water due to osmotic pressure. For example, a draw solution containing any one of inorganic salts, sugar, water-soluble low-boiling-point gases, magnetic fine
20 particles, organic solvents, or the like, as a solute can be used as the draw solution. Further, seawater and another solute may be combined as the draw solution, such as a combination of seawater and magnetic fine particles. In the case of using such a draw solution, the draw solution cannot be directly released into the environment after use, as seawater, and therefore the solute
25 needs to be removed from the draw solution after the use. Therefore, a solute that is easily separable from water is preferably selected as the solute of the draw solution. In such a case, the solute separated from the draw solution can be used as a component of the draw solution again by being recovered. Specifically, in the case where the draw solution is composed of a liquid
30 containing magnetic fine particles, the magnetic fine particles can be separated from the draw solution by magnetic force. Therefore, the draw solution (draw

solution after the concentration step) discharged from the concentration apparatuses 3, 300, and 301 can be easily released into the environment by being subjected to a step of removing magnetic fine particles.

[0043]

5 Further, in the above-described embodiments, the anaerobically treated water concentrated in the concentration apparatus 3 is supplied to the salt recovery unit 4, but there is no limitation to this. The anaerobically treated water may be partially or entirely supplied again to the concentration apparatus 3. Alternatively, the anaerobically treated water may be
10 concentrated stepwisely by using the concentration apparatus 3 a plurality of times, or using a concentration apparatus different from the concentration apparatus 3 at least one of before and after the concentration apparatus 3.

REFERENCE SIGNS LIST

15 [0044]

1: Water treatment apparatus

2: Anaerobic treatment unit

2a: Anaerobic treatment tank

2b: Membrane separator

20 3, 300, 301: Concentration apparatus

3a: Semipermeable membrane

3b, 300b, 301b: Anaerobically treated water supply unit

3c, 300c, 301c: Draw solution supply unit

4: Salt recovery unit

25 31b: Anaerobically treated water introducing unit

31c: Draw solution introducing unit

32b: Anaerobically treated water discharging unit

32c: Draw solution discharging unit

S: Ocean

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CLAIMS

1. A water treatment method comprising an anaerobic treatment step using a membrane separation activated sludge process of performing anaerobic treatment of treatment target water containing organic matter and membrane separation of the treatment target water after the anaerobic treatment, the method further comprising:

a concentration step of concentrating anaerobically treated water by bringing the anaerobically treated water composed of the treatment target water treated in the anaerobic treatment step and a draw solution into which water is configured to penetrate from the anaerobically treated water via a semipermeable membrane due to osmotic pressure into contact with each other via a semipermeable membrane; and

a salt recovery step of recovering salts from the anaerobically treated water concentrated in the concentration step.

2. The water treatment method according to claim 1, wherein the draw solution is composed of seawater or a liquid containing magnetic fine particles.

3. The water treatment method according to claim 1 or 2, wherein the salts are at least one of nitrogen components or phosphorous components.

4. A water treatment apparatus comprising an anaerobic treatment unit using a membrane separation activated sludge process of performing anaerobic treatment of treatment target water containing organic matter and membrane separation of the treatment target water after the anaerobic treatment, the apparatus further comprising:

a concentration apparatus configured to concentrate anaerobically treated water composed of the treatment target water treated in the anaerobic

treatment unit; and

a salt recovery unit configured to recover salts from the anaerobically treated water concentrated in the concentration apparatus, wherein

the concentration apparatus comprises:

5 a draw solution supply unit configured to be supplied with a draw solution into which water penetrates from the anaerobically treated water via a semipermeable membrane due to osmotic pressure; and

an anaerobically treated water supply unit configured to be supplied with the anaerobically treated water, and

10 the concentration apparatus is configured so that the anaerobically treated water and the draw solution are in contact with each other via a semipermeable membrane.

5. The water treatment apparatus according to claim 4, wherein

15 the draw solution is composed of seawater or a liquid containing magnetic fine particles.

6. The water treatment apparatus according to claim 4 or 5, wherein the salts are at least one of nitrogen components or phosphorous

20 components.