

[DESCRIPTION]

[TITLE OF INVENTION]

HYPOCHLOROUS ACID SUPPLY DEVICE AND BOILER WASTE-WATER
TREATMENT METHOD

5 [Technical Field]

[0001]

The present invention relates to a hypochlorous acid supply device and a boiler
waste-water treatment method for supplying a liquid containing hypochlorous acid
generated from seawater to facilities utilizing hypochlorous acid and boiler waste-water
10 containing ammonia.

Priority is claimed on Japanese Patent Application No. 2015-085221, filed April
17, 2015, and Japanese Patent Application No. 2015-202052, filed October 13, 2015, the
content of which are incorporated herein by reference.

[Background Art]

15 [0002]

For example, in a thermal power plant, hydrazine used for removing oxygen
which causes corrosion is evaluated as “a chemical substance in which mutagenesis is
recognized.” Therefore, in recent years, water treatment with a safer oxygen scavenger
or without using the oxygen scavenger has been employed.

20 As an oxygen scavenger not using hydrazine, ammonia having a large hydrogen
ion exponent (pH) value (for example, pH 7 to pH 10.5) is known. However, the use of
ammonia as an oxygen scavenger is estimated to increase ammonia concentration in
waste-water from plants in the future (see Non-Patent Literature 1, for example). On
the other hand, the reduction of nitrogen is also required by waste-water regulations and
25 thus an urgent response is desired.

[0003]

In Patent Literature 1, a system for decomposing ammonia by chlorine treatment using sodium hypochlorite obtained by electrolyzing seawater is disclosed. In this system, boiler waste-water which is ammonia-containing waste-water is introduced into a reaction tank, hypochlorous acid is added to the reaction tank, and thereby ammonia present in the boiler waste-water and the hypochlorous acid are subjected to a solution reaction and decomposed to nitrogen gas.

[Citation List]

[Patent Literature]

10 [0004]

[Patent Literature 1]

Japanese Unexamined Patent Application, First Publication No. 2014-563

[Non-Patent Literature]

[0005]

15 [Non-Patent Literature 1]

“Aspects on Non-Toxic Oxygen Scavenger in Power Plant Cycle Chemistry”,

[online], Mitsubishi Heavy Industries TECHNICAL REVIEW Vol. 46 No. 2 (2009),

[Search on March 30, 2012,], Internet <URL:

<http://www.mhi.co.jp/technology/review/pdf/462/462055.pdf> >

20 [Summary of Invention]

[Technical Problem]

[0006]

In the system described in Patent Literature 1, a treatment liquid treated in the reaction tank is discharged after a concentration of hypochlorous acid and pH in the

25 treatment liquid are decreased to waste-water standards. In the system described above,

for example, sodium hypochlorite is neutralized using sodium thiosulfate and pH is adjusted using caustic soda (sodium hydroxide).

[0007]

However, since treating the treatment liquid with chemicals requires a great deal
 5 of chemical cost, a hypochlorous acid supply device capable of treating ammonia contained in boiler waste-water at a lower cost is desired.

【 0 0 0 1 】【0008】

An object of the present invention is to provide a hypochlorous acid supply
 device and boiler waste-water treatment method capable of treating ammonia contained
 10 in boiler waste-water at a lower cost.

[Solution to Problem]

[0009]

According to a first aspect of the present invention, a hypochlorous acid supply
 device includes a storage tank which stores seawater, an electrolysis device which
 15 electrolyzes the seawater taken in from the storage tank to generate a hypochlorous acid-containing liquid and returns the hypochlorous acid-containing liquid to the storage tank, a supply line through which the hypochlorous acid-containing liquid stored in the storage tank is introduced, a reaction tank in which the hypochlorous acid-containing liquid supplied via the supply line is reacted with ammonia-containing boiler waste-water,
 20 and a feed line through which a mixed liquid in which a treatment liquid reacted in the reaction tank and the hypochlorous acid-containing liquid stored in the storage tank are mixed is fed to a hypochlorous acid utilization facility.

[0010]

According to such a configuration, since the treatment liquid stored in the

reaction tank is fed to a hypochlorous acid utilization facility without being discharged, the treatment liquid does not need to be treated with chemicals to satisfy waste-water standards and the treatment cost of ammonia can be reduced.

[0011]

5 The hypochlorous acid supply device described above may include a first feed line through which the hypochlorous acid-containing liquid stored in the storage tank is discharged and a second feed line through which the treatment liquid stored in the reaction tank is discharged, wherein the feed line may be formed by connecting the first feed line and the second feed line.

10 [0012]

 The hypochlorous acid supply device described above may include a first feed line through which the hypochlorous acid-containing liquid stored in the storage tank is discharged and a second feed line through which the treatment liquid stored in the reaction tank is discharged, wherein the second feed line may be connected to the storage
15 tank.

[0013]

 The hypochlorous acid supply device described above may include a control device, wherein the control device may adjust a flow rate of the hypochlorous acid-containing liquid supplied to the reaction tank and a flow rate of the
20 ammonia-containing boiler waste-water supplied to the reaction tank to such an extent that ammonia remains in the treatment liquid.

[0014]

 According to such a configuration, generation of a trihalomethane due to a reaction of hypochlorous acid and organic matter derived from the seawater can be
25 suppressed in the storage tank. That is, since ammonia is preferentially subjected to

oxidization by hypochlorous acid, the organic matter cannot easily be oxidized and thus generation of the trihalomethane can be suppressed.

[0015]

The hypochlorous acid supply device described above may include a discharge
5 line which discharges part of the treatment liquid flowing through the second feed line and an activated carbon treatment device provided on the discharge line.

[0016]

According to such a configuration, unreacted or excess hypochlorous acid
(residual chlorine) is subjected to reduction, and nitrate ions and trihalomethanes
10 (generated by a reaction of organic matter in the seawater and hypochlorous acid) can be adsorbed and removed.

[0017]

According to a second aspect of the present invention, a boiler waste-water
treatment method includes an electrolysis process of electrolyzing seawater to generate a
15 hypochlorous acid-containing liquid, a reaction process of reacting the hypochlorous acid-containing liquid with ammonia-containing boiler waste-water to generate a treatment liquid, and a feeding process of feeding a mixed liquid in which the treatment liquid and the hypochlorous acid-containing liquid are mixed to a hypochlorous acid utilization facility.

20 [Advantageous Effects of the Invention]

[0018]

According to the present invention, since the treatment liquid stored in the
reaction tank is fed to a hypochlorous acid utilization facility without being discharged,
the treatment liquid does not need to be treated with chemicals to satisfy waste-water
25 standards and the treatment cost of ammonia can be reduced.

[Brief Description of Drawings]

[0019]

Fig. 1 is a schematic configuration view of a combined cycle power plant including a hypochlorous acid supply device of a first embodiment of the present invention.

Fig. 2 is a schematic configuration view of a combined cycle power plant including a hypochlorous acid supply device of a second embodiment of the present invention.

Fig. 3 is a schematic configuration view of a combined cycle power plant including a hypochlorous acid supply device of a third embodiment of the present invention.

[Description of Embodiments]

[0020]

[First Embodiment]

Hereinafter, a hypochlorous acid supply device 1 and a boiler waste-water treatment method according to a first embodiment of the present invention will be described in detail with reference to the drawings.

Fig. 1 is a schematic configuration view of a combined cycle power plant P including a hypochlorous acid supply device 1 of the first embodiment of the present invention. The hypochlorous acid supply device 1 of the present embodiment is a device for supplying a liquid containing sodium hypochlorite (sodium hypochlorite) generated by a seawater electrolysis device 2 to a hypochlorous acid utilization facility, for example, a water intake port 3 of seawater or the like, and for treating waste-water containing ammonia (ammonia-containing boiler waste-water. Hereinafter, referred to as boiler waste-water) discharged from a waste heat recovery boiler B of the combined

cycle power plant P.

[0021]

As illustrated in Fig. 1, the hypochlorous acid supply device 1 includes a storage tank 5 for storing seawater M, the seawater electrolysis device 2 for generating a liquid E containing sodium hypochlorite (hereinafter, referred to as a hypochlorous acid-containing liquid E), a waste-water tank 6 in which boiler waste-water W discharged from the waste heat recovery boiler B (hereinafter, referred to as a boiler B) of the combined cycle power plant P (hereinafter, referred to as a plant P) is stored, a reaction tank 7 provided downstream from the waste-water tank 6, and a supply line 17 for supplying the hypochlorous acid-containing liquid E to the reaction tank 7.

The plant P includes a gas turbine (not illustrated), a boiler to which an exhaust gas from the gas turbine is sent, a steam turbine (not illustrated), a power generator (not illustrated) driven by a rotational driving force of the gas turbine and the steam turbine to generate electric power.

15 [0022]

The seawater M taken in from the water intake port 3 of seawater is introduced into the plant P via a first seawater supply line 4 and is used, for example, for cooling or the like. A seawater supply pump (not illustrated) for sending the seawater M and a seawater flow rate adjusting valve (not illustrated) for adjusting a flow rate of the seawater M are provided in the first seawater supply line 4.

In the boiler waste-water W of the boiler, ammonia is used as an oxygen scavenger for removing oxygen which causes corrosion. Therefore, the boiler waste-water W discharged from the boiler is ammoniacal nitrogen-containing waste-water (ammonia-containing boiler waste-water) that contains ammoniacal nitrogen such ammonia (NH₃) and the ammonium ion (NH₄⁺).

[0023]

The boiler waste-water W discharged from the boiler B is stored in the waste-water tank 6. The reaction tank 7 is provided downstream from the waste-water tank 6. The waste-water tank 6 and the reaction tank 7 are connected via a drainage line 8. The boiler waste-water W stored in the waste-water tank 6 is introduced into the reaction tank 7 via the drainage line 8. A waste-water supply pump 9 for sending the boiler waste-water W stored in the waste-water tank 6 to the reaction tank 7 is provided in the drainage line 8.

[0024]

The storage tank 5 is a tank for storing the seawater M and the hypochlorous acid-containing liquid E generated by the seawater electrolysis device 2. The seawater M is introduced into the storage tank 5 from the water intake port 3 via a second seawater supply line 11. A seawater supply pump 12 for sending the seawater M and a seawater flow rate adjusting valve (not illustrated) for adjusting a flow rate of the seawater M are provided in the second seawater supply line 11.

[0025]

The seawater electrolysis device 2 is a device which electrolyzes the seawater M taken in from the storage tank 5 to generate the hypochlorous acid-containing liquid E containing sodium hypochlorite and return the hypochlorous acid-containing liquid E to the storage tank 5. The seawater electrolysis device 2 includes an electrolysis tank 14, a direct current (DC) power supply 15, and a circulation line 16 for circulating the hypochlorous acid-containing liquid E from the electrolysis tank 14 to the storage tank 5, and from the storage tank 5 to the electrolysis tank 14. The electrolysis tank 14 includes a plurality of electrodes (not illustrated).

[0026]

The DC power supply 15 is a device for supplying a current to be used for electrolysis of the seawater M and can employ a configuration in which a DC power supply and a constant current control circuit are included, for example. The DC power supply is a power supply that outputs DC power and may have a configuration in which alternating current (AC) power output from an AC power supply is rectified to output DC power.

[0027]

The seawater electrolysis device 2 of the present embodiment is a recycling method in which the seawater M is circulated by the circulation line 16 connecting a downstream side of the electrolysis tank 14 (an outlet of the electrolysis tank 14) and an upstream side of the electrolysis tank 14 (an inlet of the electrolysis tank 14). As the seawater electrolysis device 2, a one-pass method in which the seawater passes through the electrolysis tank only once may be employed in addition to the recycling method described above. That is, the seawater electrolysis device 2 may be of any type as long as it can generate hypochlorous acid using seawater.

[0028]

The supply line 17, for supplying the hypochlorous acid-containing liquid E stored in the storage tank 5 to the drainage line 8, is connected to the storage tank 5. A first feed line 21, for feeding the hypochlorous acid-containing liquid E stored in the storage tank 5 to the water intake port 3 serving as a hypochlorous acid utilization facility, is connected to the storage tank 5. Since the hypochlorous acid-containing liquid E is fed to the water intake port 3, it is possible to suppress adhesion of marine organisms to the water intake port 3.

A line mixer 19, for promoting mixing of the boiler waste-water W and the hypochlorous acid-containing liquid E, is provided on a downstream side (on the reaction

tank 7 side) of a junction 18 of the supply line 17 and the drainage line 8.

[0029]

A second feed line 22, for introducing a treatment liquid T reacted in the reaction tank 7 into the first feed line 21, is connected to the reaction tank 7 of the present embodiment. The treatment liquid T of the reaction tank 7 is fed to the water intake port 3 via the second feed line 22 and the first feed line 21. The first feed line 21 and the second feed line 22 are used to feed a mixed liquid, in which the treatment liquid T reacted in the reaction tank 7 and the hypochlorous acid-containing liquid E stored in the storage tank 5 are mixed, to the water intake port 3.

10 [0030]

Next, an operation of the hypochlorous acid supply device 1 of the present embodiment will be described.

First, as a plant cooling process, the seawater M is supplied to the plant P via the first seawater supply line 4. The boiler waste-water W discharged from the boiler B of the plant P is stored in the waste-water tank 6. The boiler waste-water W stored in the waste-water tank 6 is introduced into the reaction tank 7 via the drainage line 8.

[0031]

On the other hand, as an electrolysis process, the seawater M is introduced into the storage tank 5 via the second seawater supply line 11, and the hypochlorous acid-containing liquid E is generated by the seawater electrolysis device 2. The hypochlorous acid-containing liquid E is introduced into the reaction tank 7 via the supply line 17. The hypochlorous acid-containing liquid E is fed to the water intake port 3 via the first feed line 21.

Further, a flow rate of the hypochlorous acid-containing liquid E being fed is adjusted by a control device (not illustrated) controlling a flow rate adjusting valve (not

illustrated) provided in the first feed line 21. The control device performs adjustment of the flow rate of the hypochlorous acid-containing liquid E so that it returns to the original seawater M by causing almost all of the hypochlorous acid to be consumed in the water intake port 3.

5 [0032]

Next, as a reaction process, ammonia present in the boiler waste-water W and hypochlorous acid contained in the hypochlorous acid-containing liquid E are subjected to a solution reaction in the reaction tank 7 and decomposed to nitrogen gas (N₂). In the reaction tank 7, ammonia is treated and the treatment liquid T is stored in the reaction tank 7.

[0033]

Here, the hypochlorous acid used for decomposition of the ammonia may remain in the treatment liquid T. The pH (hydrogen ion exponent) of the treatment liquid T may deviate from waste-water standards. Thus, the treatment liquid T cannot be discharged to the sea, for example, unless the treatment liquid T is treated with chemicals or the like.

[0034]

Next, as a feeding process, the treatment liquid T stored in the reaction tank 7 is introduced into the first feed line 21 and is mixed with the hypochlorous acid-containing liquid E. The treatment liquid T in the reaction tank 7 is introduced into the first feed line 21 via the second feed line 22.

The mixed liquid of the treatment liquid T in the reaction tank 7 and the hypochlorous acid-containing liquid E in the storage tank 5 is fed to the water intake port 3. The boiler waste-water W treated with ammonia in the reaction tank 7 is fed to the water intake port 3 without being discharged to the sea directly.

[0035]

According to the embodiment described above, ammonia contained in the boiler waste-water W can be decomposed by adding the hypochlorous acid-containing liquid E containing the hypochlorous acid to the boiler waste-water W which is waste-water
5 containing ammoniacal nitrogen.

Since the treatment liquid T stored in the reaction tank 7 is fed to the water intake port 3 serving as a hypochlorous acid utilization facility without being discharged to the sea directly, the treatment liquid T does not need to be treated with chemicals to satisfy waste-water standards and the treatment cost of ammonia can be reduced.

10 [0036]

Also, the hypochlorous acid-containing liquid E generated in the seawater electrolysis device 2 is fed to the water intake port 3 of the seawater M via the first feed line 21. Since the hypochlorous acid-containing liquid E is fed to the water intake port 3, it is possible to suppress adhesion of marine organisms to the water intake port 3.

15 [0037]

[Second embodiment]

Hereinafter, a hypochlorous acid supply device 1B according to a second embodiment of the present invention will be described on the basis of the accompanying drawings. The present embodiment will be described mainly focusing on differences
20 from the first embodiment described above, and description on similar portions will be omitted.

[0038]

As illustrated in Fig. 2, a second feed line 22 of the hypochlorous acid supply device 1B of the present embodiment is connected to a storage tank 5. A treatment
25 liquid T in a reaction tank 7 is introduced into the storage tank 5.

A first flow rate adjusting valve 23 which adjusts a flow rate of a boiler waste-water W flowing through a drainage line 8 is provided in the drainage line 8 of the present embodiment. Also, a second flow rate adjusting valve 24 which adjusts a flow rate of a hypochlorous acid-containing liquid E flowing through a supply line 17 is provided in the supply line 17 of the present embodiment.

[0039]

An ammonia concentration measuring device 25, for measuring the ammonia concentration of the treatment liquid T stored in the reaction tank 7, is provided in the reaction tank 7 of the hypochlorous acid supply device 1 of the present embodiment.

10 [0040]

Next, an operation of the hypochlorous acid supply device 1B of the present embodiment will be described.

A control device 26 adjusts the flow rate of the boiler waste-water W and the flow rate of the hypochlorous acid-containing liquid E which are introduced into the reaction tank 7 by controlling the first flow rate adjusting valve 23 and the second flow rate adjusting valve 24. The control device 26 performs adjustment of the flow rate of the boiler waste-water and the flow rate of the hypochlorous acid-containing liquid E to such an extent that ammonia remains in the treatment liquid T stored in the reaction tank 7. In the hypochlorous acid supply device 1 of the present embodiment, the ammonia present in the boiler waste-water W is not completely decomposed, and some is left in the treatment liquid T in the reaction tank 7.

[0041]

If it is possible to leave ammonia in the treatment liquid T, it is not necessary to adjust both flow rates of the hypochlorous acid-containing liquid E and the boiler waste-water W, and ammonia may be left in the treatment liquid T by adjusting the flow

rate of either one.

Specifically, the control device 26 adjusts at least one flow rate of the hypochlorous acid-containing liquid E and the boiler waste-water W such that ammonia remains in the treatment liquid T.

5 [0042]

As a feeding process, the treatment liquid T containing ammonia is introduced into the storage tank 5 via the second feed line 22. That is, the treatment liquid T is fed to the storage tank 5 without being discharged to the sea. Thereby, ammonia is added to the seawater M and the hypochlorous acid-containing liquid E which are stored in the
10 storage tank 5.

[0043]

According to the embodiment described above, generation of a trihalomethane due to the reaction of hypochlorous acid and organic matter derived from the seawater M can be suppressed in the storage tank 5. That is, since ammonia introduced into the
15 storage tank 5 together with the treatment liquid T is preferentially subjected to oxidization by the hypochlorous acid, the organic matter cannot easily be oxidized. Thus, generation of a trihalomethane can be suppressed.

[0044]

[Third embodiment]

20 Hereinafter, a hypochlorous acid supply device 1C according to a third embodiment of the present invention will be described on the basis of the accompanying drawings. The present embodiment will be described mainly focusing on differences from the first embodiment described above, and description on similar portions will be omitted.

25 As illustrated in Fig. 3, a discharge line 27, for discharging part of a treatment

liquid T flowing through a second feed line 22, is connected to the second feed line 22 of the hypochlorous acid supply device 1C of the present embodiment. Part of the treatment liquid T flowing through the second feed line 22 is discharged to the sea via the discharge line 27.

5 [0045]

An activated carbon treatment device 28 is provided in the discharge line 27. The activated carbon treatment device 28 is a device that performs an activated carbon treatment by passing the treatment liquid T through activated carbon.

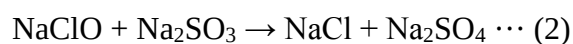
Also, a flow rate adjusting valve 29 for adjusting a flow rate of the treatment
10 liquid T flowing through the discharge line 27 is provided in the discharge line 27.

In the activated carbon treatment device 28, excess residual chlorine is decomposed by a decomposition reaction as expressed in Expression (1). Here, an amount of activated carbon used per kg of NaClO is about 0.08 kg.



15 [0046]

On the other hand, when excess residual chlorine is decomposed by a reaction using a chemical such as sodium thiosulfate (Na_2SO_3) as expressed in Expression (2), an amount of sodium thiosulfate used per kg of NaClO is about 1.7 kg.



20 [0047]

According to the embodiment described above, by providing the activated carbon treatment device 28 on the discharge line 27, unreacted or excess hypochlorous acid (residual chlorine) is subjected to reduction, and nitrate ions and trihalomethanes (generated by the reaction of organic matter in the seawater and hypochlorous acid) can
25 be adsorbed and removed.

In addition, the treatment liquid T discharged from the reaction tank 7 is treated to have properties to be permitted to that enable discharge under the low or the standard. Therefore, when a concentration of chloride ions of the seawater is low or the like and in a case in which the treatment liquid T diluted by mixing with the boiler waste-water is introduced into the water intake port 3 to cause a concentration of the chloride ions to be further decreased, a decrease in the concentration of the chloride ions can be suppressed by discharging the treatment liquid T treated by the activated carbon treatment device to the outside.

The flow rate of the treatment liquid T discharged from the discharge line 27 can be adjusted by using the flow rate adjusting valve 29.

In addition, in the case in which part of the treatment liquid T is discharged, an amount of chemicals used can be reduced as compared with the case in which decomposition is performed using sodium thiosulfate. In addition, it is unnecessary to control a feeding amount of chemicals required in performing the decomposition using the sodium thiosulfate.

[0048]

The technical scope of the present invention is not limited to the above embodiments, and various modifications can be added to the scope of the present invention without departing from the spirit of the present invention.

For example, although the supply line 17 of the hypochlorous acid-containing liquid E of the embodiments described above is connected to the drainage line 8 through which the boiler waste-water W flows, the supply line 17 may be directly connected to the reaction tank 7.

In addition, although the supply line 17 and the first feed line 21 of the embodiments described above are respectively connected to the storage tank 5, the first

feed line 21 may be branched off from the supply line 17 and connected to the water intake port 3.

Further, the discharge line 27 of the third embodiment may be provided in the hypochlorous acid supply device 1B of the second embodiment.

5 [Reference Signs List]

[0049]

	1, 1B	Hypochlorous acid supply device
	2	Seawater electrolysis device
	3	Water intake port (hypochlorous acid utilization facility)
10	4	First seawater supply line
	5	Storage tank
	6	Waste-water tank
	7	Reaction tank
	8	Drainage line
15	9	Waste-water supply pump
	10	pH measuring device
	11	Second seawater supply line
	12	Seawater supply pump
	14	Electrolysis tank
20	15	DC power supply
	16	Circulation line
	17	Supply line
	18	Junction
	19	Line mixer
25	21	First feed line

	22	Second feed line
	23	First flow rate adjusting valve
	24	Second flow rate adjusting valve
	25	Ammonia concentration measuring device
5	26	Control device
	27	Discharge line
	28	Activated carbon treatment device
	29	Flow rate adjusting valve
	B	Waste heat recovery boiler
10	E	Hypochlorous acid-containing liquid
	M	Seawater
	P	Plant
	T	Treatment liquid
	W	Boiler waste-water

[CLAIMS]

[Claim 1]

A hypochlorous acid supply device comprising:

a storage tank which stores seawater;

5 an electrolysis device which electrolyzes the seawater taken in from the storage tank to generate a hypochlorous acid-containing liquid and returns the hypochlorous acid-containing liquid to the storage tank;

a supply line through which the hypochlorous acid-containing liquid stored in the storage tank is introduced;

10 a reaction tank in which the hypochlorous acid-containing liquid supplied via the supply line is reacted with ammonia-containing boiler waste-water;

a feed line through which a mixed liquid in which a treatment liquid reacted in the reaction tank and the hypochlorous acid-containing liquid stored in the storage tank are mixed is fed to a water intake port of a plant;

15 a first feed line through which the hypochlorous acid-containing liquid stored in the storage tank is discharged; and

a second feed line through which the treatment liquid stored in the reaction tank is discharged, wherein

the feed line is formed by connecting the first feed line and the second feed line.

20 [Claim 2]

A hypochlorous acid supply device comprising:

a storage tank which stores seawater;

an electrolysis device which electrolyzes the seawater taken in from the storage tank to generate a hypochlorous acid-containing liquid and returns the hypochlorous acid-containing liquid to the storage tank;

25

a supply line through which the hypochlorous acid-containing liquid stored in the storage tank is introduced;

a reaction tank in which the hypochlorous acid-containing liquid supplied via the supply line is reacted with ammonia-containing boiler waste-water; and

5 a feed line through which a mixed liquid in which a treatment liquid reacted in the reaction tank and the hypochlorous acid-containing liquid stored in the storage tank are mixed is fed to a water intake port of a plant;

a first feed line through which the hypochlorous acid-containing liquid stored in the storage tank is discharged; and

10 a second feed line through which the treatment liquid stored in the reaction tank is discharged, wherein

the second feed line is connected to the storage tank.

[Claim 3]

The hypochlorous acid supply device according to claim 2, comprising:

15 a control device, wherein

the control device adjusts a flow rate of the hypochlorous acid-containing liquid supplied to the reaction tank and a flow rate of the ammonia-containing boiler waste-water supplied to the reaction tank to such an extent that ammonia remains in the treatment liquid.

20 [Claim 4]

The hypochlorous acid supply device according to any one of claims 1 to 3, comprising:

a discharge line which discharges part of the treatment liquid flowing through the second feed line; and

25 an activated carbon treatment device provided on the discharge line.