

SPECIFICATION

TITLE OF THE INVENTION

5 DESALINATION SYSTEM AND DESALINATION METHOD

TECHNICAL FIELD

[0001]

10 The present invention relates to a desalination system for desalinating sewage water and sea-water and a desalination method.

BACKGROUND ART

[0002]

15 Recently, due to the global growth of population and the broad industrial developments including emerging countries, the fresh-water-generation demands of the drinking water and the industrial water in the desert areas or the like have become definite.

 Formerly, there has been a desalination system S100 shown in FIG. 7, as a system for desalinating the sea-water and the sewage water.

20 The production of the product water s101 (the industrial water) utilizing the sewage water in the desalination system S100 is executed as following. Incidentally, the salinity concentration of the sewage water is approximately 0.1%.

[0003]

25 The sewage water is water-supplied by the pump p101 to the MBR (Membrane Bioreactor) 101 to which the membrane separation activated sludge method is applied, and the activated sludge or the like of the solid contents in the sewage water is removed by the MBR 101, then the MBR permeate water which has permeated the MBR 101 is water-supplied to the low-pressure RO membrane (Reverse Osmosis Membrane: reverse osmosis membrane) 102 by the pump p102.

30 Incidentally, the MBR permeate water which has permeated the MBR 101 has the salinity concentration of approximately 0.1% which is low, therefore, as the low-pressure RO membrane 102, the RO membrane of the low-pressure of

approximately 1 to 2 MPa (mega-pascal) is utilized.

[0004]

The MBR permeate water water-supplied by the pump p102 is desalinated by permeating the low-pressure RO membrane 102, and almost a half is produced as the product water s101 (the industrial water) and the remaining half is separated and removed as the concentrated-water s104 including the impurities of the salinity or the like.

[0005]

To the contrary, the concentrated-water s104 which includes the impurities of the salinity or the like removed by the low-pressure RO membrane 102 and is approximately 1/2 in volume of the sewage water concentrated in the salinity concentration of approximately 0.2%, is water-supplied from the low-pressure RO membrane 102 to the stirring-vessel 104.

[0006]

The production of the product water s102 (the industrial water) from the sea-water in the desalination system S100 is executed as following. Incidentally, the salinity concentration of the sea-water is 3 to 4% approximately.

The sea-water is water-supplied to the UF membrane (Ultrafiltration Membrane) 103 by the pump p103, and water-supplied to the stirring-vessel 104, removing particles by the UF membrane 103. In the stirring-vessel 104, the UF membrane permeation sea-water which has permeated this UF membrane 103 and the concentrated-water s104 which is approximately 1/2 in volume of the sewage water concentrated from the sewage water by the aforementioned low-pressure RO membrane 102 are stirred, and the generated mixture water s103 is water-supplied to the intermediate-pressure RO membrane 105 by the pump p104.

[0007]

The UF membrane permeation sea-water which has permeated the UF membrane 103 has the salinity concentration of 3 to 4%, however, it is diluted by the concentrated-water s104 of the salinity concentration of approximately 0.2%, accordingly, as the intermediate-pressure RO membrane 105, the RO membrane (reverse osmosis membrane) of approximately 3 to 5 MPa of the intermediate-pressure is utilized.

The mixture water s103 which has been water-supplied from the stirring-vessel 104 to the intermediate-pressure RO membrane 105 by the pump p104, by permeating the intermediate-pressure RO membrane 105, is desalinated, and approximately 1/2 is produced as the desalinated product water s102 (the industrial water) and the remaining approximately 1/2 is separated and removed as the brine water s105 including the impurities of the salinity or the like. In other words, the product water s102 (the industrial water) is produced as 1/2 of the sea-water plus approximately 1/4 of the sewage water in volume.

[0008]

The brine water s105 is separated and drained as 1/2 of the sea-water plus approximately 1/4 of the sewage water in volume.

Incidentally, the pressure energy of the brine water s105 is recovered as the rotational energy by the power recovery apparatus 106, and utilized as the power source (energy source) of the pressure-transfer to the intermediate-pressure RO membrane 10 of a part of the mixture water s103 which has by-passed the pump p104.

[0009]

As another conventional desalination system, there is a desalination system S200 shown in FIG. 8.

The desalination system S200 doesn't water-supply the concentrated-water s104 of the sewage water in the desalination system S100 of FIG. 7 to the stirring-vessel 204, and constitutes the desalination of the sewage water and the desalination of the sea-water independently.

[0010]

In the desalination system S200, in the sea-water, particles are removed by the UF membrane 203, however, not diluted by the water-supply (the concentrated-water s104 of sewage water in FIG. 7) from the sewage water in the stirring-vessel 204, accordingly, the salinity concentration is approximately 3 to 4%, which is high. Therefore, the high-pressure RO membrane 205 which is an RO membrane (reverse osmosis membrane) of the high-pressure of approximately 6 to 8 MPa, is utilized.

[0011]

In the desalination system S200, the sewage water permeates the low-pressure RO membrane 202 and is desalinated, and the product water s201 (the industrial water)

of approximately a half of the sewage water can be acquired. To the contrary, the particles are removed by the UF membrane 203, and the sea-water permeates the high-pressure RO membrane 205 and is desalinated, then the product water s202 (the drinking water) of a 1/2 amount of the sea-water can be acquired.

5 [0012]

The other configuration is similar to the desalination system S100 of FIG. 7, accordingly, the components of the desalination system S100 are shown with references in the two-hundred range and the in-depth descriptions are omitted.

Incidentally, there is Patent Literature 1 as a prior art reference in respect of
10 the present invention.

PRIOR ART REFERENCE

Patent Literature

[0013]

15 [Patent Literature 1] JP 4481345 A

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0014]

20 Incidentally, the conventional desalination systems S100, S200 have following problems.

Firstly, in the case of a great amount of needs for each of the industrial water and the drinking water, it is difficult to correspond. For example, in the desalination system S100 of FIG. 7, it is possible to water-increase the industrial use, however,
25 impossible to water-take the drinking water, because the concentrated-water s104 is water-supplied to the stirring-vessel 104 in the desalination process of the sea-water.

To the contrary, in the desalination system S200 of FIG. 8, it is possible to water-take the drinking water (the product water s202), however, in order to water-increase the industrial water, the water-intake amount of the sewage water needs
30 to be increased. Therefore, in the areas with the limited amount of the sewage water, it becomes difficult to water-increase the industrial water.

[0015]

Secondly, in the case that both of the desalination systems S100, S200 show a great amount of the variation of the inflow amount of the sewage water, the configuration is not made to correspond to the variation of the inflow amount of the sewage water. Therefore, it is impossible to correspond to the variation of the inflow amount of the sewage water.

[0016]

Thirdly, the fresh-water-generation cost is more inexpensive when the sewage water is desalinated, however, the configuration is not made to be capable of utilizing the sewage water effectively, accordingly, the fresh-water-generation cost of the entire system easily increases.

For example, in the desalination system S200 of FIG. 8, a half of the water-taken sewage water becomes the product water s201 (the industrial water), however, a half is discharged to the exterior of the system as the brine water. To the contrary, in the desalination system S100 of FIG. 7, a half of the sewage water becomes the product water s101 (the industrial water), and out of the concentrated-water s104 of a half of the sewage water, the half becomes the product water s102 (the industrial water), however, a half of the concentrated-water s104 is discharged to the exterior of the system as the brine water.

As a result, $\frac{3}{4}$ of the sewage water is utilized as the industrial water, however, even in the desalination system S100, the sewage water is not utilized as effective as possible.

[0017]

To the contrary, it costs to increase the water-intake amount of the sea-water in place of the sewage water, therefore, the increase of the water-intake amount of the sea-water causes the fresh-water-generation cost increase of the entire system.

[0018]

An object of the present invention is, in respect of the aforementioned actual condition, to provide a desalination system and a desalination method which are possible to utilize the sewage water as effective as possible and also to decrease the fresh-water-generation cost of the entire system.

MEANS FOR SOLVING THE PROBLEM

[0019]

In order to achieve the aforementioned purpose, a desalination system in claim 1 is a desalination system for desalinating sewage water and sea-water, comprising: a purification apparatus for purifying by permeating the sewage water; a first RO membrane for permeating permeate water which permeated the purification apparatus; and including and removing salinity thereof in first concentrated-water and also generating industrial water; a first pretreatment apparatus for performing pretreatment of at least either of concentration filtration or NF membrane filtration to the first concentrated-water; and a second RO membrane for permeating first water to be treated to which pretreatment was performed by the first pretreatment apparatus; and including and removing salinity thereof in second concentrated-water and also generating industrial water.

[0020]

A desalination method in claim 6 of the present invention is a method to realize a desalination system in claim 1.

[0021]

A desalination system in claim 3 is desalination system for desalinating sewage water and sea-water, comprising: a purification apparatus for purifying by permeating the sewage water; a plurality of RO membranes for permeating permeate water which permeated the purification apparatus; and including and removing salinity thereof in concentrated-water and also generating industrial water; and a single of or a plurality of pretreatment apparatuses for performing pretreatment of at least either of concentration filtration or NF membrane filtration to concentrated-water which was removed by either of a plurality of the RO membranes.

[0022]

A desalination method in claim 8 is a method to realize a desalination system in claim 3.

EFFECT OF THE INVENTION

[0023]

The desalination system and the desalination method of the present invention can realize the desalination system and the desalination method which are capable of

utilizing the sewage water as effective as possible and also to decrease the fresh-water-generation cost of the entire system.

BRIEF DESCRIPTION OF THE DRAWINGS

5 [0024]

FIG. 1 is a conceptual configuration diagram of the desalination system of the embodiment 1 with reference to the present invention;

FIG. 2 is a conceptual configuration diagram of the desalination system of the variation of the embodiment 1;

10 FIG. 3 is a conceptual configuration diagram of the desalination system of the embodiment 2;

FIG. 4 is a conceptual configuration diagram of the desalination system of the variation of the embodiment 2;

15 FIG. 5 is a conceptual configuration diagram of the desalination system of the embodiment 3;

FIG. 6 is a conceptual configuration diagram of the desalination system of the variation of the embodiment 3;

FIG. 7 is a conceptual configuration diagram showing the conventional desalination system; and

20 FIG. 8 is a conceptual configuration diagram showing the other conventional desalination system.

MODES FOR CARRYING OUT THE INVENTION

[0025]

25 Hereinafter, the embodiments of the present invention are described with reference to the attached drawings.

<<Embodiment 1>>

FIG. 1 is a conceptual configuration diagram of the desalination system of the embodiment 1 with reference to the present invention.

30 The desalination system S of the embodiment 1 comprises an industrial water fresh-water-generation system Sa for fresh-water-generating the industrial water s1, s2 from the sewage water and a drinking water fresh-water-generation system Sb for

fresh-water-generating the drinking water s3 from the sea-water.

[0026]

The industrial water fresh-water-generation system Sa of the desalination system S comprises an MBR (Membrane Bioreactor) 1 for removing the solid contents and bacteria or the like and purifying by permeating the sewage water, and a first low-pressure RO membrane (Reverse Osmosis Membrane) 2 for removing the impurities of the salinity, ions or the like included in the sewage water and desalinating by permeating the sewage water, in order to generate the industrial water s1.

[0027]

Furthermore, the industrial water fresh-water-generation system Sa comprises a pretreatment apparatus 3 for permeating the sewage water concentrated-water s6a separated by the first low-pressure RO membrane 2 and performing the coagulation filtration and/or NF-treatment, and a second low-pressure RO membrane (Reverse Osmosis Membrane) 4 for permeating the water to be treated s7a pretreated by the pretreatment apparatus 3, removing the impurities of the salinity, ions or the like included in the water to be treated s7a, and desalinating, in order to generate the industrial water s2.

[0028]

The MBR 1 performs the solid-liquid separation, removes the solid contents, bacteria or the like from the sewage water, and purifies.

The RO membrane (reverse osmosis membrane) is a semipermeable membrane to pass water, however, hardly to pass low molecular substances of the salinity or the like and ions. The first low-pressure RO membrane 2 is a low-pressure RO membrane for removing the salinity or the like by permeating (filtering) the sewage water, by the permeation pressure of approximately 1 to 2 MPa (mega-pascal) which is relatively low, since the salinity concentration of the sewage water is low of 0.1% approximately.

[0029]

The pretreatment apparatus 3 has a functionality of the coagulation filtration and/or the NF-treatment.

The coagulation filtration of the pretreatment apparatus 3 reduces the scales by coagulation-filtering the sewage water concentrated-water s6a, and removes the

toxic substances of cyanide (CN) or the like, and the heavy metals of chromium or the like.

The NF-treatment of the pretreatment apparatus 3 is a process to utilize the NF membrane. The NF membrane (Nanofiltration Membrane: nanofiltration membrane) has the selectivity to the elements and ions, and eliminates the low molecular impurities of toxic cyanide (CN) or the like or microorganisms, by permeating (filtering) the sewage water.

[0030]

The second low-pressure RO membrane 4 is a low-pressure RO membrane for removing the salinity or the like by permeating (filtering) the sewage water, by the permeation pressure of approximately 1 to 2 MPa (mega-pascal) which is relatively low, since the salinity concentration of the water to be treated s7a is low of 0.2% approximately.

[0031]

To the contrary, in the desalination system S, the drinking water fresh-water-generation system Sb for fresh-water-generating the drinking water comprises a following configuration.

The drinking water fresh-water-generation system Sb comprises a UF membrane (Ultrafiltration Membrane) 5 for removing the particles included in the sea-water by permeating the sea-water, a stirring-vessel 6 for permeating the UF membrane 5 and stirring the sea-water the particles of which were removed to be uniform, and a high-pressure RO membrane 7 for removing the impurities of the salinity, ions or the like included in the sea-water the particles of which were removed and made uniform, and desalinating.

[0032]

The UF membrane (ultrafiltration membrane) 5, by permeating (filtering) the sea-water, performs the screening in the molecule levels depending on the pore size of the membrane and the size of the molecule of the to-be-excluded substances in the sea-water, and removes the particles in the sea-water.

The high-pressure RO membrane 7 is a high-pressure RO membrane (reverse osmosis membrane) for removing the salinity or the like of the sea-water by permeating (filtering) the sea-water by the permeation pressure of approximately 6 to 8

MPa (mega-pascal) which is a relatively high permeation pressure of the sea-water, since the salinity concentration of the sea-water is 3 to 4% approximately.

[0033]

Subsequently, the process for fresh-water-generating the industrial water s1, s2 from the sewage water in the industrial water fresh-water-generation system Sa of the desalination system S, is described.

The sewage water is fed-under-pressure to the interior of the industrial water fresh-water-generation system Sa by the pump p1, and water-supplied to the MBR 1. The sewage water permeates the MBR 1, and activated sludge flocks, bacteria and the like are removed, thereby.

[0034]

The MBR permeate water s5a of the sewage water which permeated the MBR 1 is water-supplied to the first low-pressure RO membrane 2 by the pump p2, and by permeating the first low-pressure RO membrane 2, the sewage water concentrated-water s6a including the impurities of the salinity, ions or the like is removed and desalinated, then the industrial water s1 is produced.

For the industrial water s1, while approximately 1/2 of the sewage water can be acquired, the remainder of the sewage water, that is to say, approximately 1/2 of the sewage water is removed as the sewage water concentrated-water s6 including the impurities of the salinity, ions or the like.

[0035]

The sewage water concentrated-water s6a separated by the first low-pressure RO membrane 2 is sent to the pretreatment apparatus 3, and in the pretreatment apparatus 3, the coagulation filtration and/or the NF-treatment is performed to remove the scales, cyanides or the like. The water to be treated s7a, with the sewage water concentrated-water s6a being pretreated by the pretreatment apparatus 3, is water-supplied to the second low-pressure RO membrane 4 by the pump p3, and by permeating the second low-pressure RO membrane 4, the treated-concentrated-water s6b including the impurities of the salinity, ions or the like is removed and desalinated, then the industrial water s2 is produced.

[0036]

For the industrial water s2, while approximately 1/2 of the sewage water concentrated-water s6a can be acquired, the remainder of the sewage water, that is to say, approximately 1/2 of the sewage water concentrated-water s6a is removed as the treated-concentrated-water s6b including the impurities of the salinity, ions or the like.

5 The sewage water concentrated-water s6a is approximately 1/2 of the sewage water, therefore, the industrial water s2 of approximately 1/4 of the sewage water can be acquired.

As a result, the industrial water s1 of approximately 1/2 of the sewage water can be acquired and the industrial water s2 of approximately 1/4 of the sewage water
10 can be acquired, therefore, it is possible to water-take the industrial water of approximately 3/4 of the sewage water in volume.

[0037]

Subsequently, the process for fresh-water-generating the drinking water s3 from the sea-water, in the drinking water fresh-water-generation system Sb of the
15 desalination system S, is described.

The sea-water is fed-under-pressure to the interior of the drinking water fresh-water-generation system Sb by the pump p4, and water-supplied to the UF membrane 5. The sea-water permeates the UF membrane 5, and the particles in the sea-water are removed thereby. The UF membrane permeation sea-water s5b of the
20 sea-water the particles of which are removed by the UF membrane 5, is stirred in the stirring-vessel 6 to be uniform.

[0038]

Thereafter, the stirred UF membrane permeation sea-water s5b is water-supplied to the high-pressure RO membrane 7 by the pump p5. The UF
25 membrane permeation sea-water s5b permeates the high-pressure RO membrane 7, and almost a half is removed as the brine water s8 including the impurities of the salinity, ions or the like, and the remaining half is produced as the desalinated drinking water s3, thereby.

Therefore, it is possible to water-take the drinking water s3 of approximately a
30 half amount of the sea-water.

[0039]

In the desalination system S of the embodiment 1, by the industrial water

fresh-water-generation system Sa, it is possible to water-take the industrial water of approximately 3/4 amount of the sewage water, and also, it is possible to water-increase the drinking water by increasing the water-take amount of the inexhaustible sea-water, by the drinking water fresh-water-generation system Sb.

5 Therefore, in the case of a great amount of needs for each of the industrial water and the drinking water, it is possible to conform.

[0040]

Moreover, even in the case of a great amount of the variation of the inflow amount of the sewage water, the industrial water of approximately 3/4 amount of the
10 sewage water can be water-taken, accordingly, it is possible to correspond, by pooling the industrial water which has been water-taken. Furthermore, even in the case of a small amount of the sewage water, the industrial water of approximately 3/4 amount of the sewage water can be water-taken, accordingly, it is possible to water-take a great amount of the industrial water by utilizing the small amount of sewage water
15 effectively. Therefore, the re-utilization ratio of the sewage water can be raised.

[0041]

Furthermore, the sewage water concentrated-water s6a performs the coagulation filtration and/or the NF-treatment by the pretreatment apparatus 3 before permeating the second low-pressure RO membrane 4, therefore, the clogging caused
20 by the second low-pressure RO membrane 4 in the latter stage is prevented, beforehand.

[0042]

Incidentally, the embodiment 1 has been described by exemplifying the case that the desalination system S comprises the industrial water fresh-water-generation system Sa and the drinking water fresh-water-generation system Sb, however, as
25 shown in FIG. 2, the configuration may comprise only the industrial water fresh-water-generation system Sa in the desalination system S'.

[0043]

<<Embodiment 2>>

FIG. 3 is a conceptual configuration diagram showing the desalination system
30 of the embodiment 2;

The desalination system 2S of the embodiment 2 adds the second pretreatment apparatus 3a and one further stage of the third low-pressure RO membrane 4a to the

industrial water fresh-water-generation system Sa of the desalination system S of the embodiment 1, constitutes the low-pressure RO membrane in three stages, and constitutes the pretreatment apparatus in two stages.

The other configuration is similar to the embodiment 1, therefore, the identical components are shown with identical references to the embodiment 1, and the in-depth description is omitted.

[0044]

The desalination system 2S comprises the industrial water fresh-water-generation system 2Sa including the three stages of the low-pressure RO membrane and two stages of the pretreatment apparatus, for fresh-water-generating the industrial water s1, s2, s2a from the sewage water. Furthermore, the desalination system 2S comprises the drinking water fresh-water-generation system Sb for fresh-water-generating the drinking water s3 from the sea-water, similarly to the embodiment 1.

[0045]

The industrial water fresh-water-generation system 2Sa of the desalination system 2S further comprises the second pretreatment apparatus 3a for pretreating the treated-concentrated-water s6b removed by the second low-pressure RO membrane 4 and the third low-pressure RO membrane 4a for permeating the second treated-concentrated-water s7b pretreated by the second pretreatment apparatus 3a, in the industrial water fresh-water-generation system Sa of the embodiment 1.

[0046]

The second pretreatment apparatus 3a is an apparatus for performing the coagulation filtration and/or the NF-treatment, similar to the pretreatment apparatus 3.

The coagulation filtration of the second pretreatment apparatus 3a, as aforementioned, reduces the scales by coagulation-filtering the treated-concentrated-water s6b, and removes the toxic substances of cyanides (CN) or the like, and the heavy metals of chromium or the like.

[0047]

The NF-treatment of the second pretreatment apparatus 3a is a process to utilize the NF membrane as aforementioned, and eliminates the low molecular impurities of cyanides (CN) or the like or microorganisms, by making the

treated-concentrated-water s6b permeate the NF membrane.

The third low-pressure RO membrane 4a is a low-pressure RO membrane for removing the salinity or the like by permeating (filtering) the sewage water by the permeation pressure of approximately 1 to 2 MPa (mega-pascal) which is relatively low, since the salinity concentration of the sewage water is low of 0.4% approximately. [0048]

Subsequently, the process for fresh-water-generating the industrial water s1, s2, s2a from the sewage water in the industrial water fresh-water-generation system 2Sa of the desalination system 2S shown in FIG. 3, is described.

The sewage water is fed-under-pressure to the interior of the industrial water fresh-water-generation system 2Sa by the pump p1, and water-supplied to the MBR 1. The sewage water permeates (is filtered by) the MBR 1, and the activated sludge flocks, bacteria and the like are removed, thereby. [0049]

The MBR permeate water s5a of the sewage water which has permeated the MBR 1 is water-supplied to the first low-pressure RO membrane 2 by the pump p2, and by permeating the first low-pressure RO membrane 2, the sewage water concentrated-water s6a including the impurities of the salinity, ions or the like is removed and desalinated, then, the industrial water s1 is produced (generated).

For the industrial water s1, while approximately 1/2 of the sewage water can be acquired, the remainder of the sewage water, that is to say, approximately 1/2 of the sewage water is removed as the sewage water concentrated-water s6a including the impurities of the salinity, ions or the like. [0050]

The sewage water concentrated-water s6a separated by the first low-pressure RO membrane 2 is sent to the pretreatment apparatus 3 and, and in the pretreatment apparatus 3, the coagulation filtration and/or the NF-treatment is performed to remove the scales, cyanides or the like. The water to be treated s7a which is the sewage water concentrated-water s6a being pretreated by the pretreatment apparatus 3, is water-supplied to the second low-pressure RO membrane 4 by the pump p3, and by permeating the second low-pressure RO membrane 4, the treated-concentrated-water s6b including the impurities of the salinity, ions or the like is removed and desalinated,

then the industrial water s2 is produced (generated).

[0051]

For the industrial water s2, while approximately 1/2 of the water to be treated s7a can be acquired, the remainder of the water to be treated s7a, that is to say, approximately 1/2 of the water to be treated s7a is removed as the treated-concentrated-water s6b including the impurities of the salinity, ions or the like.

The water to be treated s7a is approximately 1/2 of the sewage water, therefore, the industrial water s2 of approximately 1/4 of the sewage water can be acquired.

[0052]

The treated-concentrated-water s6b removed by the second low-pressure RO membrane 4 is sent to the second pretreatment apparatus 3a, and in the second pretreatment apparatus 3a, the coagulation filtration and/or the NF-treatment is performed to remove the scales, cyanides or the like. The second water to be treated s7b which is the treated-concentrated-water s6b being pretreated by the second pretreatment apparatus 3a, is water-supplied to the third low-pressure RO membrane 4a by the pump p3a, and by permeating the third low-pressure RO membrane 4a, the second treated-concentrated-water s6c including the impurities of the salinity, ions or the like is removed and desalinated, then the industrial water s2a is produced (generated).

[0053]

For the industrial water s2a, while approximately 1/2 of the second water to be treated s7b can be acquired, the remainder of the second water to be treated s7b, that is to say, approximately 1/2 of the second water to be treated s7b is removed as the second treated-concentrated-water s6c including the impurities of the salinity, ions or the like.

The second water to be treated s7b is approximately 1/4 of the sewage water, therefore, the industrial water s2a of approximately 1/8 of the sewage water can be acquired.

[0054]

As a result, the industrial water s1 of approximately 1/2 of the sewage water can be acquired, and the industrial water s2 of approximately 1/4 of the sewage water

can be acquired, and the industrial water s2a of approximately 1/8 of the sewage water can be acquired, therefore, it is possible to water-take the industrial water of approximately 7/8 of the sewage water in volume.

[0055]

5 According to the embodiment 2, the pretreatment apparatus is made in two stages and the low-pressure RO membrane is constituted in three stages, therefore, it is possible to acquire a volume of approximately 7/8 of the sewage water which is water-taken for the industrial water, and to produce a greater amount of the industrial water from the sewage water.

10 The other embodiment 1 gives the action effects similarly.

[0056]

Incidentally, in the embodiment 2, the case to comprise the industrial water fresh-water-generation system 2Sa and the drinking water fresh-water-generation system Sb in the desalination system 2S has been exemplified, however, as shown in
15 FIG. 4, the desalination system 2S' may be configured to comprise only the industrial water fresh-water-generation system 2Sa.

Furthermore, in the embodiment 2, the case to constitute the pretreatment apparatus in two stages and the low-pressure RO membrane in three stages has been exemplified, however, the configuration may be made similar to the embodiment 2
20 with the pretreatment apparatus in equal to or more than three stages and the low-pressure RO membrane in equal to or more than four stages. Due to this, it is possible to produce (generate) a greater amount of the industrial water from the sewage water.

[0057]

25 <<Embodiment 3>>

FIG. 5 is a conceptual configuration diagram showing the desalination system of the embodiment 3.

The desalination system 3S of the embodiment 3 is configured to provide the industrial water amount switching means (the switching means) for switching a
30 plurality of stages of the pretreatment apparatus, and a plurality of stages of the low-pressure RO membrane described in the embodiment 1, 2, in the arbitrary number of stages.

The other configuration is similar to the desalination system S, 2S of the embodiment 1, 2, therefore, the identical components are shown with identical references to the embodiment 1, and the in-depth description is omitted.

[0058]

5 The desalination system 3S comprises the industrial water fresh-water-generation system 3Sa including a plurality of stages of the low-pressure RO membrane, a plurality of stages of the pretreatment apparatus, the industrial water amount switching means or the like for fresh-water-generating the industrial water s1, s2, s2a, s2b,... from the sewage water, and the drinking water fresh-water-generation
10 system Sb for fresh-water-generating the drinking water s3 from the sea-water.

[0059]

The first, second, third, fourth low-pressure RO membrane 2, 4, 4a, 4b,... are low-pressure RO membranes for removing the salinity or the like, by permeating (filtering) the sewage water by the permeation pressure of approximately 1 to 2 MPa
15 (mega-pascal) which is relatively low, since the salinity concentration of the sewage water is low of 0.1%, 0.2%, 0.4%, 0.8%,... approximately, respectively.

[0060]

Each of the pretreatment apparatus 3, the second pretreatment apparatus 3a, the third pretreatment apparatus 3b,... is the apparatus for performing the coagulation
20 filtration and/or the NF-treatment. The coagulation filtration, as aforementioned, reduces the scales and removes the toxic substances of cyanides (CN) or the like and the heavy metals of chromium or the like, by coagulation-filtering the brine water (the concentrated-water). The NF-treatment, as aforementioned, eliminates the low molecular impurities of cyanides (CN) or the like or microorganisms, by making the
25 brine water (the concentrated-water) permeate (filter) the NF membrane.

[0061]

The industrial water amount switching means comprises the switching control apparatus 9 for switching the valve v1, v2,... and the flow-channel of the valve v1, v2, v3,....

30 The valve v1, v2, v3,... are three-way valves and switch to drain the brine water (the concentrated-water) from the first low-pressure RO membrane 2, the second low-pressure RO membrane 4, the third low-pressure RO membrane 4a, the fourth

low-pressure RO membrane 4b,..., or to flow to the pretreatment apparatus 3, the second pretreatment apparatus 3a, the third pretreatment apparatus 3b...of the subsequent stage, respectively. Incidentally, for the valve v1, v2,..., the normal condition is preferably set to the longer duration one, the drainage or the flow to the pretreatment apparatus of the down-stream.

[0062]

The switching control apparatus 9 is a control apparatus to control the switching of the valve v1, v2, v3,..., and controls the switching to drain the brine water from the first low-pressure RO membrane 2, the second low-pressure RO membrane 4, the third low-pressure RO membrane 4a,..., or to flow to the pretreatment apparatus 3, the second pretreatment apparatus 3a, the third pretreatment apparatus 3b,... of the subsequent stage by the valve v1, v2, v3,..., respectively.

[0063]

The switching control apparatus 9 is enclosed in the controller (not shown) for controlling the entire desalination system 3S. More specifically, the switching control apparatus 9 comprises the microcomputers (microcomputers), the interface circuits such as the A/C·D/C converters or the like, the current control circuits or the like for switching the operations of the valve v1, v2, v3,... The switching operations of the valve v1, v2, v3,... are described in the control program stored in the ROM (Read Only Memory) of the microcomputers.

[0064]

The control of the switching control apparatus 9 is performed as following.

For the first mode, the valve v1 is switched to the drainage side. The other valve v2, v3,... may be switched to either side, since the sewage water concentrated-water s6a is drained in the valve v1 of the upper-stream.

Due to this, the industrial water s1 being the MBR permeate water s5a which has permeated the first low-pressure RO membrane 2, can be acquired, from the sewage water.

[0065]

For the second mode, while only the valve v1 is opened to the flow-channel to the second low-pressure RO membrane 4, the valve v2 is switched to the drainage side. The other valve v3,... may be switched to either side, since the

treated-concentrated-water s6b is drained in the valve v2 of the upper-stream.

Due to this, the industrial water s1 being the MBR permeate water s5a which has permeated the first low-pressure RO membrane 2 and the industrial water s2 being the water to be treated s7a pretreated by the pretreatment apparatus 3 which has permeated the second low-pressure RO membrane 4, can be acquired, from the sewage water.

[0066]

For the third mode, while the valve v1, v2 are opened to the flow-channels to the second low-pressure RO membrane 4, and the third low-pressure RO membrane 4a respectively, the valve v3 is switched to the drainage side. The other valves may be switched to either side, since the treated-concentrated-water s6c is drained in the valve v3 of the upper-stream.

Due to this, the industrial water s1 being the MBR permeate water s5a which has permeated the first low-pressure RO membrane 2, the industrial water s2 being the water to be treated s7a pretreated by the pretreatment apparatus 3 which has permeated the second low-pressure RO membrane 4, and the industrial water s2a being the second water to be treated s7b pretreated by the second pretreatment apparatus 3a which has permeated the second low-pressure RO membrane 4a, can be acquired, from the sewage water.

[0067]

For the fourth mode, while the valve v1, v2, v3 are opened to the flow-channels to the second low-pressure RO membrane 4, and the third low-pressure RO membrane 4a respectively, the other valves are switched to the drainage side.

Due to this, the industrial water s1 being the MBR permeate water s5a which has permeated the first low-pressure RO membrane 2, the industrial water s2 being the water to be treated s7a pretreated by the pretreatment apparatus 3 which has permeated the second low-pressure RO membrane 4, the industrial water s2a being the second water to be treated s7b pretreated by the second pretreatment apparatus 3a which has permeated the second low-pressure RO membrane 4a, and the industrial water s2a being the third water to be treated s7c pretreated by the third pretreatment apparatus 3b which has permeated the fourth low-pressure RO membrane 4b, can be acquired, from the sewage water. Incidentally, in the fourth low-pressure RO

membrane 4b, the third treated-concentrated-water s6d is removed.

Hereinafter, by opening an arbitrary number of valves to the low-pressure RO membrane side similarly, it is possible to water-increase the industrial water.

[0068]

5 According to the embodiment 3, a plurality of stages of the low-pressure RO membrane, a plurality of stages of the pretreatment apparatus, the valve v1, v2, v3,... for switching to flow the brine water (the concentrated-water) to the low-pressure RO membrane of the subsequent stage or to drain, and a switching control apparatus 9 for controlling the switching of the valve are provided, therefore, it is possible to flexibly
10 modify the industrial water amount to be water-taken, depending on the demand amount of the industrial water, and the more or less of the sewage water amount.

The embodiments 1, 2 give the other action effects similarly.

[0069]

 Incidentally, in the embodiment 3, the case to comprise the industrial water
15 fresh-water-generation system 3Sa and the drinking water fresh-water-generation system Sb in the desalination system 3S, has been exemplified, however, as shown in FIG. 6, the desalination system 3S' may be configured to comprise only the industrial water fresh-water-generation system 3Sa.

[0070]

20 Moreover, in the industrial water amount switching means described in the embodiment 3, the case to configure the pretreatment apparatus in two stages and the low-pressure RO membrane in three stages, has been exemplified, however, the configuration may be made similar to the embodiment 2 with the pretreatment apparatus in equal to or more than three stages and the low-pressure RO membrane in
25 equal to or more than four stages. Due to this, it is possible to produce a greater amount of the industrial water, from the sewage water.

[0071]

 Incidentally, needless to say, it is possible to apply the configuration of the industrial water amount switching means (the switching means) (valve v1, v2, v3,...,
30 the switching control apparatus 9) described in the embodiment 3, also to the embodiment 1, 2.

[0072]

Moreover, in the aforementioned embodiment 1, 2, the MBR 1 has been exemplified as the purification apparatus for purifying the sewage water, however, the purification apparatus which is different from the MBR, such as the plain sedimentation method, the sand filtration, the disinfection or the like may be applied.

5 Incidentally, the numerical values utilized in the description of the aforementioned embodiments have shown one example, and these numerical values are not to be limited to.

EXPLANATION OF REFERENCES

10 [0073]
 1 MBR (purification apparatus)
 2 first low-pressure RO membrane (first RO membrane, RO membrane)
 3 pretreatment apparatus (first pretreatment apparatus, pretreatment apparatus)
 3a second pretreatment apparatus (second pretreatment apparatus, pretreatment
 15 apparatus)
 3b third pretreatment apparatus (first pretreatment apparatus, pretreatment apparatus)
 4 second low-pressure RO membrane (second RO membrane, RO membrane)
 4a third low-pressure RO membrane (third RO membrane, RO membrane)
 4b fourth low-pressure RO membrane (fourth RO membrane, RO membrane)
 20 5 UF membrane
 7 high-pressure RO membrane (RO membrane)
 9 switching control apparatus (switching means)
 S, 2S, 3S, S', 2S', 3S' desalination system
 s1, s2, s2a, s2b industrial water
 25 s3 drinking water
 s5a MBR permeate water (permeate water)
 s5b UF membrane permeation sea-water (water to be treated)
 s6a sewage water concentrated-water (first concentrated-water, concentrated-water)
 s6b treated-concentrated-water (second concentrated-water, concentrated-water)
 30 s6c second treated-concentrated-water (third concentrated-water, concentrated-water)
 s6d third treated-concentrated-water (concentrated-water)
 s7a water to be treated (first water to be treated)

s7b second water to be treated (second water to be treated)

v1, v2, v3 valve (switching means)

CLAIMS

1. A desalination system for desalinating sewage water and sea-water, comprising:

- 5 a purification apparatus for purifying by permeating the sewage water;
a first RO membrane for
permeating permeate water which permeated the purification
apparatus; and
including and removing salinity thereof in first concentrated-water
10 and also generating industrial water;
a first pretreatment apparatus for performing pretreatment of at least either of
concentration filtration or NF membrane filtration to the first concentrated-water; and
a second RO membrane for
permeating first water to be treated to which pretreatment was
15 performed by the first pretreatment apparatus; and
including and removing salinity thereof in second concentrated-water
and also generating industrial water.

2. A desalination system according to claim 1, comprising:

- 20 a second pretreatment apparatus for performing pretreatment of at least either
of concentration filtration or NF membrane filtration to the second concentrated-water;
and
a third RO membrane for
permeating second water to be treated to which pretreatment was
25 performed by the second pretreatment apparatus; and
including and removing salinity thereof in third concentrated-water
and also generating industrial water.

3. A desalination system for desalinating sewage water and sea-water, comprising:

- 30 a purification apparatus for purifying by permeating the sewage water;
a plurality of RO membranes for

permeating permeate water which permeated the purification
apparatus; and

including and removing salinity thereof in concentrated-water and
also generating industrial water; and

5 a single of or a plurality of pretreatment apparatuses for performing
pretreatment of at least either of concentration filtration or NF membrane filtration to
concentrated-water which was removed by either of a plurality of the RO membranes.

4. A desalination system according to either one of the claim 1 to 3,
10 comprising a switching means for switching to drain the concentrated-water or to flow
the concentrated-water to the pretreatment apparatus of down-stream, in down-stream
of concentrated-water side removed by the RO membrane.

5. A desalination system according to either one of the claim 1 to 4,
15 comprising:

a UF membrane for removing particles in the sea-water by permeating the
sea-water; and

an RO membrane for

permeating water to be treated which permeated the UF membrane;

20 and

including and removing salinity of the water to be treated and
also generating drinking water.

6. A desalination method for desalinating sewage water and sea-water,
25 generating industrial water by making the sewage water permeate purification
apparatus and first RO membrane; and

generating industrial water by making first concentrated-water which was
removed by the first RO membrane permeate second RO membrane, after at least
either pretreatment of concentration filtration or NF membrane filtration is performed.

30

7. A desalination method according to claim 6, for generating industrial
water by permeating third RO membrane, after second concentrated-water removed by

the second RO membrane performs at least either pretreatments of concentration filtration or NF membrane filtration.

5 8. A desalination method for desalinating sewage water and sea-water,
 purifying the sewage water by permeating purification apparatus; and
 repeating
 a process to generate industrial water by making permeate water
 which permeated the purification apparatus permeate RO membrane; and
 a process to perform at least either pretreatments of concentration
10 filtration or NF membrane filtration to concentrated-water removed by the RO
 membrane.

 9. A desalination method according to either one of the claim 6 to 8,
 switching to drain the concentrated-water or to flow the concentrated-water to the
15 pretreatment performed in down-stream, in down-stream of concentrated-water side
 removed by the RO membrane.

 10. A desalination method according to either one of the claim 6 to 9, for
 generating drinking water by making the sea-water permeate UF membrane and RO
20 membrane.