

DESCRIPTION

Title of invention

WATER TREATMENT SYSTEM, AND METHOD FOR OPERATING WATER
TREATMENT SYSTEM

Technical Field

[0001]

This invention relates to a water treatment system and a method of operating the water treatment system.

Background of Art

[0002]

Generally, the amount of treated water discharged by a water treatment system is controlled to fall within a predetermined range. For example, as a control method for an electrodeionization water production device installed in a water treatment system, a technique is known in which the amount of concentration water is controlled by a valve to maintain the amount above a certain level in order to prevent the formation of scale due to a decrease in the amount of water supplied (e.g., see Patent Document 1).

Prior Art Documents

Patent Documents

[0003]

Patent Document 1: JP 7103467

Summary of the Invention

Problem to be Solved by the Invention

[0004]

In the technology described in Patent Document 1, the control mechanism becomes complicated when the amount of water treated by an electrodeionization water production device is reduced.

[0005]

The purpose of the present invention is to provide a water treatment system and a method for operating the water treatment system that can achieve superior power-saving effects by means of a simple and convenient control method when the amount of treated water discharged from an electrodeionization water production device is reduced.

Means for Solving the Problem

[0006]

A water treatment system of the present invention, comprising:
an electrodeionization water production device;
a pump that supplies water to be treated to the electrodeionization water production device;
a pressure gauge that measures an output pressure value of the water to be treated from the pump; and
a control unit that controls discharge pressure of the pump such that, at a predetermined timing, an output pressure value measured by the pressure gauge becomes a predetermined value.

[0007]

A method of operating a water treatment system of the present invention, comprising:
obtaining an output pressure value of water to be treated from a pump that supplies the water to be treated to an electrodeionization water production device, and
controlling discharge pressure of the pump such that the output pressure value becomes a predetermined value at a predetermined timing.

Advantageous Effects of the Invention

[0008]

In the present invention, when reducing the amount of treated water discharged from an electrodeionization water production device, a superior power-saving effect can be achieved by means of a simple and convenient control method.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

FIG. 1 is a diagram showing a first embodiment of the water treatment system of the present invention.

FIG. 2 is a flowchart for illustrating an example of the water treatment system operation method of the water treatment system shown in FIG. 1.

FIG. 3 is a diagram showing a second embodiment of the water treatment system of the present invention.

FIG. 4 is a graph illustrating an example of the relationship between the reduction rate of the output pressure value of a pump and the reduction rate of the flow rate discharged from the EDI shown in FIG. 3.

FIG. 5 is a graph illustrating an example of the relationship between the reduction rate of the output pressure value of the pump shown in FIG. 3 and the reduction rate of power consumption.

FIG. 6 is a graph illustrating an example of the relationship between the reduction rate of the output pressure value of the pump and the concentration factor in the EDI shown in FIG. 3.

FIG. 7 is a diagram showing a third embodiment of the water treatment system of the present invention.

FIG. 8 is a diagram showing a fourth embodiment of the water treatment system of the present invention.

Description of the Embodiments

[0010]

Embodiments of the invention are next described with reference to the drawings.

First Embodiment

[0011]

FIG. 1 is a diagram showing the first embodiment of the water treatment system of the present invention. As shown in FIG. 1, the water treatment system

in this embodiment has EDI (electrodeionization water production device) 100, pump 200, pressure gauge 300, control unit 400, and DC power supply device 500. In addition, flow meters 600-1 to 600-3 are provided in the paths from EDI 100. The embodiment shown in FIG. 1 may be provided in a primary pure water system within a water treatment system consisting of what may be termed a common pretreatment system, a primary pure water system, and a subsystem (secondary pure water system). Components such as a water treatment device that performs prescribed treatment of the water to be treated, conductivity meters, resistivity meters, shutoff valves, flow adjustment valves, and flow meters may be provided between pump 200 and EDI 100. Components such as conductivity meters, resistivity meters, shutoff valves, flow adjustment valves, and flow meters may also be provided to follow EDI 100. If a water treatment device that performs a prescribed treatment on the water to be treated or conductivity meters are provided between pump 200 and EDI 100, pressure gauge 300 is preferably located at a position immediately following pump 200. [0012]

EDI 100 may also be referred to as an electro-regenerative pure water device or continuous-regenerative pure water device. EDI 100 has desalination chamber 100-1, concentration chamber 100-2, and electrode chamber 100, which are separated by a cation exchange membrane and an anion exchange membrane. Desalination chamber 100-1 is filled with at least one of a cation exchange resin and an anion exchange resin. EDI 100 is supplied with a DC current between the anode and cathode from DC power supply 500, and as ions contained in the water to be treated are removed in desalination chamber 100-1, ion exchange resin is continuously regenerated. Ions removed from the water to be treated in desalination chamber 100-1 move to concentration chamber 100-2, are contained in the concentration water, and then discharged. The treated water from which ions have been removed in desalination chamber 100-1 is discharged as desalinated water. The treated water discharged from each of desalination chamber 100-1, concentration chamber 100-2, and electrode chamber 100-3 is supplied to mutually differing demand points via different routes. Flow meter 600-1 measures the flow rate of desalinated water

discharged from desalination chamber 100-1. Flow meter 600-2 measures the flow rate of the concentration water discharged from concentration chamber 100-2. Flow meter 600-3 measures the flow rate of electrode water discharged from electrode chamber 100-3. Concentration chamber 100-2 of EDI 100 may also perform the role of electrode chamber 100-3, and electrode chamber 100-3 is not absolutely required in EDI 100. If the structure of EDI 100 is such that concentration chamber 100-2 doubles as electrode chamber 100-3, the electrode water line that passes from electrode chamber 100-3 and through flow meter 600-3 is omitted.

[0013]

Pump 200 draws the water to be treated from the outside and discharges and supplies the water to EDI 100. Pump 200 operates based on a drive signal from control unit 400. For example, pump 200 is caused to rotate by a motor at a rotation speed based on the drive signal from control unit 400, and draws and discharges the water to be treated.

[0014]

Pressure gauge 300 measures the output pressure value of the water to be treated from pump 200 at the outlet of pump 200. Pressure gauge 300 reports the measured output pressure value to control unit 400.

[0015]

Control unit 400 acquires the output pressure value measured by pressure gauge 300. Control unit 400 controls the discharge pressure of pump 200 via an inverter such that the output pressure value acquired from pressure gauge 300 becomes a predetermined value at a predetermined timing. Control unit 400 controls the discharge pressure of pump 200 such that the pressure reduction rate is from 0 to 60% when the maximum capacity value of the discharge pressure of pump 200 is 100%. This maximum capacity value may be a value determined in advance as a specification of pump 200, may be the maximum value that pump 200 can discharge in the water treatment system being used, or may be the pump discharge pressure value in a normal mode other than a power-saving mode. If pump 200 is of a construction that uses a motor, control unit 400 outputs a drive signal to pump 200 to control the motor

speed such that the output pressure value measured by pressure gauge 300 becomes the predetermined value.

[0016]

For example, when input is received from the outside indicating switching to the power-saving mode, control unit 400 acquires the output pressure value being measured by pressure gauge 300. Control unit 400 compares this acquired output pressure value with the value set as the output pressure value in the power-saving mode. Based on the results of the comparison, control unit 400 calculates the rate at which the rotational speed of the motor of pump 200 is to be reduced. Control unit 400 outputs a control signal to pump 200 according to this calculated reduction rate. The method for calculating the rate at which the rotational speed of the motor of pump 200 is to be reduced may be, for example, to beforehand associate the reduction rate of the rotational speed of the motor with the reduction rate for reducing the output pressure value to the value that is set as the output pressure value during the power-saving mode, and then to calculate the rate of reduction based on this association.

Alternatively, the method of calculating the rate at which the rotational speed of the motor of pump 200 is to be reduced may be a method in which the output pressure value is reduced at a fixed proportion and then adjusted in stages to the output pressure value that is the required flow rate. In this way, power consumption can be reduced at a desired timing.

[0017]

Alternatively, for example, control unit 400 acquires the output pressure value being measured by pressure gauge 300. Control unit 400 compares this acquired output pressure value with the pressure value that corresponds to the required flow rate in the system downstream of EDI 100. Based on the results of the comparison, control unit 400 calculates the rate for reducing the rotational speed of the motor of pump 200. Control unit 400 outputs to pump 200 a control signal that accords with the calculated reduction rate. The pressure value that accords with the required flow rate at this time is obtained from the correspondence between the required flow rate and the pressure value that was set in advance. The method for calculating the rate for reducing the rotational

speed of the motor of pump 200 may also be, for example, to associate beforehand the reduction rate of the rotational speed of the motor with the reduction rate for reducing the output pressure value to the pressure value that accords with the demanded flow rate, and then to calculate the rate based on this correspondence. Alternatively, the method of calculating the rate for reducing the rotational speed of the motor of pump 200 may also be a method in which the output pressure value is reduced by a fixed portion and then adjusting in stages to arrive at the output pressure value that is the required flow rate. In this way, the output of pump 200 is controlled to achieve the output pressure value appropriate for the demand from the downstream system. A reduction of power consumption can thus be achieved without excessive water production.

[0018]

For example, at a time for operation in the power-saving mode, which is set for nighttime or holidays in a preset schedule, control unit 400 acquires the output pressure value being measured by pressure gauge 300. Control unit 400 compares this acquired output pressure value with the value set as the output pressure value during the power-saving mode. Based on the results of the comparison, control unit 400 calculates the rate for reducing the rotation speed of the motor speed of pump 200. Control unit 400 outputs to pump 200 a control signal that accords with the calculated rate of reduction. The method of calculating the rate for reducing the rotational speed of the motor of pump 200 at this time can also be the same method as described above. When returning from the power-saving mode to the normal mode, control unit 400 acquires the output pressure value being measured by pressure gauge 300, compares the acquired output pressure value with the value set as the output pressure value in the normal mode, and based on the result of this comparison, calculates the rate for increasing the rotational speed of the motor of pump 200 and outputs to pump 200 a control signal that accords with the calculated rate of increase. In this way, control unit 400 controls the output of pump 200 to be an output pressure value that accords with the operation mode. Power consumption can thus be reduced according to a schedule for reducing power consumption.

[0019]

For example, control unit 400 may effect control based on the operating status of systems downstream of EDI 100 (e.g., the number of systems in operation). Control unit 400 acquires the output pressure value being measured by pressure gauge 300. Control unit 400 compares this acquired output pressure value with the pressure value that accords with the operating status. Based on the results of the comparison, control unit 400 calculates the rate for reducing the rotational speed of the motor of pump 200. The control unit 400 outputs to pump 200 a control signal that accords with the calculated reduction rate. The pressure value that accords with the operating status at this time is obtained from the correspondence between operating status and pressure value that was set in advance. The method for calculating the rate for reducing the rotational speed of the motor of pump 200 may also be, for example, to associate beforehand the reduction rate of the rotational speed of the motor with reduction rates for reducing the output pressure value to a pressure value that accord with the operating status, and then to calculate the rate based on this correspondence. Alternatively, the method of calculating the rate for reducing the rotational speed of the motor of pump 200 may also be a method in which the output pressure value is reduced by a fixed portion and then adjusted in stages to the output pressure value that corresponds to the operating status. In this way, control unit 400 controls the output of pump 200 to an output pressure value that is suitable for the operating status of the downstream system. Power consumption can thus be reduced without excessive water production.

[0020]

Alternatively, for example, control unit 400 may effect control based on the amount of water produced upstream of EDI 100. Control unit 400 acquires the output pressure value being measured by pressure gauge 300. Control unit 400 compares this acquired output pressure value with the pressure value that corresponds to the amount of water produced upstream. Based on the results of this comparison, control unit 400 calculates the rate for reducing the rotational speed of the motor of pump 200. Control unit 400 then outputs to pump 200 a

control signal that accords with the calculated rate of reduction. The pressure value that accords with the amount of water being produced upstream at this time is obtained from a correspondence that was set in advance between the amount of water produced upstream and the pressure value. Alternatively, the method for calculating the rate for reducing the rotational speed of the motor of pump 200 may also be, for example, to associate in advance reduction rates of the rotational speed of the motor with the rate for reducing the output pressure value to the pressure value that corresponds to the amount of water being produced upstream, and then to calculate the rate based on this correspondence. Alternatively, the method of calculating the rate for reducing the rotational speed of the motor of pump 200 may also be a method in which the output pressure value is reduced by a fixed portion and adjusted in stages to the output pressure value that corresponds to the amount of water being produced upstream. In this way, control unit 400 controls the output of pump 200 to be an output pressure value suitable for the amount of water being produced upstream. Power consumption can thus be reduced without excessive water production.

[0021]

The method of operating the water treatment system in the water treatment system shown in FIG. 1 is next described. FIG. 2 is a flowchart for illustrating an example of an operation method of the water treatment system in the water treatment system shown in FIG. 1. The following description pertains to an example of the process at a time for operation in power-saving mode in a predetermined schedule.

[0022]

Control unit 400 first determines whether or not the current time is for the power-saving mode (Step S1). This determination is made based on a predetermined schedule and the date and time indicated by a clock. The schedule includes settings indicating for each time period and day (e.g., day of the week, season, etc.) whether the water treatment system is to be operated in the normal mode or in a power-saving mode which saves power.

[0023]

Upon determining that the current time is the timing for a power-saving mode, control unit 400 acquires the output pressure value of pump 200 that is being measured by pressure gauge 300 (Step S2). Control unit 400 then compares this acquired output pressure value with the value set in advance as the output pressure value in the power-saving mode. Based on the result of the comparison, control unit 400 calculates the rate for reducing the rotational speed of the motor of pump 200 (Step S3). At this time, control unit 400 may calculate the rate for reducing the rotational speed of the motor of pump 200 according to the preset target pressure value. Control unit 400 outputs to pump 200 a control signal that accords with the calculated reduction rate to control the discharge pressure of pump 200 (Step S4).

[0024]

In this way, control unit 400 controls the discharge pressure of pump 200 such that the output pressure value of pump 200 reaches a predetermined value as measured by pressure gauge 300 installed at the discharge port of pump 200 that supplies water to be treated to EDI 100. The timing of this control may be based on an external request, the operating status of the downstream system, the amount of water supplied from the upstream system, or a schedule for set modes of operation. Therefore, when the discharge of treated water from the electrodeionization water production device is to be reduced to provide an appropriate amount of treated water, the power consumption of pump 200 can be kept low, resulting in greater power savings. According to common practice, circulation operations in a system are performed to reduce the discharge of treated water from an electrodeionization water production device when, for example, there is no external demand for water procurement from the outside, such as from supply destinations. In such cases, the water temperature rises due to input of pump heat. The boron removal performance of an EDI is known to deteriorate when water temperature rises. In this embodiment, however, control is performed to decrease the rotational speed of the motor of pump 200 to reduce the amount of treated water discharged from the electrodeionization water production device. This control continues operation in the normal temperature range without causing a rise in the water temperature due to heat

input to the pump during circulation and thus can prevent a decrease in the boron removal rate.

Second Embodiment

[0025]

FIG. 3 is a diagram showing the second embodiment of the water treatment system of the present invention. As shown in FIG. 3, the water treatment system in this embodiment has, in addition to the components of the first embodiment shown in FIG. 1, additional branched paths 700 and flow control valves 800-1 to 800-3.

[0026]

Branched paths 700 are three paths that branch from pump 200 to desalination chamber 100-1, concentration chamber 100-2, and electrode chamber 100-3, respectively, of EDI 100. The branch point from which the paths 700 branch is located closer to EDI 100 than to the point at which pressure gauge 300 measures the output pressure value of pump 200. The water to be treated discharged from pump 200 is supplied via branch paths 700 to each of desalination chamber 100-1, concentration chamber 100-2, and electrode chamber 100-3. If the structure of EDI 100 is such that concentration chamber 100-2 also serves as electrode chamber 100-3, the electrode water line that passes from flow control valve 800-3, through electrode chamber 100-3, and to flow meter 600-3 is omitted.

[0027]

Flow control valve 800-1 is provided in the branch path of branch paths 700 that supplies water to be treated to desalination chamber 100-1. Flow control valve 800-1 is a valve for adjusting the flow rate of the water to be treated that is supplied to desalination chamber 100-1. Flow control valve 800-1 may also be provided at the outlet of desalination chamber 100-1. Flow control valve 800-2 is provided in the branch path of branch paths 700 that supplies the water to be treated to concentration chamber 100-2. Flow control valve 800-2 is a valve for adjusting the flow rate of the water to be treated that is supplied to concentration chamber 100-2. Flow control valve 800-2 may also be provided at

the outlet of concentration chamber 100-2. Flow control valve 800-3 is provided in the branch path of branch paths 700 that supplies the water to be treated to electrode chamber 100-3. Flow control valve 800-3 is a valve for adjusting the flow rate of the water to be treated that is supplied to electrode chamber 100-3. Flow control valve 800-3 may also be provided at the outlet of electrode chamber 100-3.

[0028]

FIG. 4 is a graph illustrating an example of the relationship between the reduction rate of the output pressure value of pump 200 and the reduction rate of the flow rate discharged from EDI 100 shown in FIG. 3. FIG. 4 shows that the rate of decrease of each of the flow rate of desalinated water discharged from desalination chamber 100-1 that is measured by flow meter 600-1 and the flow rate of concentration water discharged from concentration chamber 100-2 that is measured by flow meter 600-2 declines according to the reduction rate of the output pressure value of pump 200. This result was obtained through experimentation. As shown in FIG. 4, as the reduction rate of the output pressure value of pump 200 increases, the reduction rate of the flow rate of desalinated water and concentration water also increases. The ratio of increase in the reduction rate of the flow rate to increase in the reduction rate of the output pressure value of pump 200 for desalinated water differs from the ratio for concentration water. The reduction rate of the flow rate of discharge of desalinated water, which is most sensitive to the flow rate of the water to be treated that is supplied to EDI 100, is lower than the reduction rate of the output pressure value of pump 200. As a result, the flow rate of treated water discharged from EDI 100 can be controlled without monitoring as long as the pressure value reduction does not exceed 60% of the maximum capacity value of pump 200 in this water treatment system.

[0029]

FIG. 5 is a graph illustrating an example of the relationship between the reduction rate of the output pressure value of pump 200 shown in FIG. 3 and the reduction rate of power consumption. As shown in FIG. 5, as the reduction rate of the output pressure value of pump 200 increases, the reduction rate of

power consumption of pump 200 also increases. The reduction rate of the power consumption of pump 200 can be seen to be higher than the reduction rate of the output pressure value of pump 200. This relationship indicates that reducing the output pressure value of pump 200 has a significant power-saving effect.

[0030]

FIG. 6 is a graph illustrating an example of the relationship between the reduction rate of the output pressure value of pump 200 and the concentration factor in EDI 100 of FIG. 3. The concentration factor is the ratio of the inlet water volume in EDI 100 to the concentration water volume. As shown in FIG. 6, as the reduction rate of the output pressure value of pump 200 increases, the concentration factor does not increase, but rather, remains constant or decreases. This result was obtained through experimentation. The system can therefore be operated in such a way that the concentration factor in EDI 100 is maintained or reduced without any need to use flow control valves 800-1 through 800-3 to control the supply of the water to be treated to EDI 100. Monitoring the pump discharge pressure and reducing the pump output can mitigate the risk of problems (such as scale and slime) caused by an increase in the concentration factor.

[0031]

In this way, the water to be treated from pump 200 to EDI 100 is diverted from the main path to the branch paths and supplied to desalination chamber 100-1, concentration chamber 100-2, and electrode chamber 100-3 via each of the branch paths. If flow control valves 800-1 to 800-3 provided in the respective branch paths are used in advance to adjust the amount of water supplied to desalination chamber 100-1, concentration chamber 100-2, and electrode chamber 100-3, simply controlling the output pressure value of pump 200 can subsequently change (decrease) the amount of water to be treated supplied to EDI 100 without significantly changing the ratio of desalinated water to concentration water, and moreover, while reducing the concentration factor.

Third Embodiment

[0032]

FIG. 7 is a diagram showing the third embodiment of a water treatment system of the present invention. As shown in FIG. 7, the water treatment system in this embodiment is a system in which, of the components of the second embodiment shown in FIG. 3, control unit 400 is replaced by control unit 401.

[0033]

In addition to the functions of control unit 400 shown in FIG. 1 or FIG. 3, control unit 401 has a function of calculating the reduction rate for reducing the value of the current supplied by DC power supply unit 500 to EDI 100 based on the reduction rate of the output pressure value of pump 200. This calculation method may involve calculating in advance the correlation between the reduction rate of the output pressure value of pump 200 and the reduction rate of the value of the current supplied by DC power supply 500 to EDI 100 (e.g., a relational formula or an algorithm for deriving one from the other), and then using the calculated correlation to calculate the reduction rate of the value of the current supplied by DC power supply 500 to EDI 100. Alternatively, this calculation method may involve associating (placing conditions on) in advance the reduction rate of the output pressure value of pump 200 and the reduction rate of the value of the current supplied by DC power supply 500 to EDI 100, and then calculating the reduction rate of the value of the current supplied by DC power supply 500 to EDI 100 based on this association. The timing at which control unit 401 effects control at the calculated current reduction rate may be the timing of receiving input from the outside to switch to the power-saving mode. Alternatively, the timing at which control unit 401 effects control at the calculated current reduction rate may be the timing of switching to the power-saving mode according to a preset schedule. Alternatively, the timing at which control unit 401 effects control at the calculated current reduction rate may be the same as or different from the timing at which the output pressure value of pump 200 is reduced.

[0034]

In this way, control unit 401 both reduces the output pressure value of pump 200 and, according to this reduction rate, reduces the value of the current

supplied by DC power supply 500 to EDI 100, whereby a greater power-saving effect can be achieved. Control unit 401 of this embodiment may also be applied to EDI 100 of the first embodiment.

Fourth Embodiment

[0035]

FIG. 8 is a diagram showing the fourth embodiment of a water treatment system of the present invention. As shown in FIG. 8, the water treatment system in this embodiment has three sets of EDIs 100 shown in FIG. 3, these sets being connected in parallel.

[0036]

The water to be treated from pump 200 is supplied to three EDIs 100 to 102. In addition, DC current is supplied from DC power supply devices 500 to 502 to EDIs 100 to 102, respectively. Desalination chamber 100-1, concentration chamber 100-2, and electrode chamber 100-3 of EDI 100 are supplied with water to be treated from pump 200 via flow control valves 800-1 to 800-3, respectively, these flow control valves being installed in respective branch paths 700. Desalination chamber 101-1, concentration chamber 101-2, and electrode chamber 101-3 of EDI 101 are supplied with water to be treated from pump 200 via flow control valves 801-1 to 801-3, respectively, these flow control valves being installed in respective branch paths 700. Desalination chamber 102-1, concentration chamber 102-2, and electrode chamber 102-3 of EDI 102 are supplied with water to be treated from pump 200 via flow control valves 802-1 to 802-3, respectively, these flow control valves being installed in respective branch paths 700. The treated water discharged from each of desalination chamber 100-1 of EDI 100, desalination chamber 101-1 of EDI 101, and desalination chamber 102-1 of EDI 102 is combined and supplied downstream as desalinated water. The treated water discharged from each of concentration chamber 100-2 of EDI 100, concentration chamber 101-2 of EDI 101, and concentration chamber 102-2 of EDI 102 is combined and supplied downstream as concentration water. The treated water discharged from each of electrode chamber 100-3 of EDI 100, electrode chamber 101-3 of EDI 101, and

electrode chamber 102-3 of EDI 102 is combined and supplied downstream as electrode water. The location of flow control valves 800-1 to 800-3 is not limited to upstream of EDI 100. For example, flow control valve 800-1 may be provided at the outlet of desalination chamber 100-1, flow control valve 800-2 may be provided at the outlet of concentration chamber 100-2, and flow control valve 800-3 may be provided at the outlet of electrode chamber 100-3. Alternatively, instead of flow control valves 800-1 to 800-3, a flow control valve may be provided upstream of branch paths 700 (preceding the branching point) or flow control valves may be provided downstream of branch paths 700 (at points of confluence). If the structure of EDI 100 is such that concentration chamber 100-2 also serves as electrode chamber 100-3, the electrode water line that passes from flow control valve 800-3, through electrode chamber 100-3, and then to flow meter 600-3 is omitted.

[0037]

Thus, even in a system having multiple EDIs connected in parallel, control unit 400, by simply controlling pump 200 in the first to third embodiments, is able to change (reduce) the amount of treated water being supplied to the EDIs without significantly changing the ratio of desalinated water and concentration water discharged from each of the multiple EDIs, and moreover, while reducing the concentration factor. This method can eliminate excessive water production and reduce power consumption even in systems in which multiple EDIs are connected in parallel or in series. It goes without saying that control can be realized even in embodiments in which multiple EDIs 100 in the first embodiment and EDIs 100 in the second embodiment are arranged in parallel as in EDIs 100 to 102 in the third embodiment.

[0038]

While the present invention has been described above with reference to embodiments, the present invention is not limited to the above embodiments. Various changes within the scope of the present invention that will be understood by those skilled in the art can be made in the configuration and details of the present invention.

[0039]

This application claims priority based on JP 2023-216824, filed December 22, 2023, and incorporates herein all of the disclosures of that application.

CLAIMS

[Claim 1] A water treatment system, comprising:
 an electrodeionization water production device;
 a pump that supplies water to be treated to the electrodeionization water production device;
 a pressure gauge that measures an output pressure value of the water to be treated from the pump; and
 a control unit that controls discharge pressure of the pump such that, at a predetermined timing, an output pressure value measured by the pressure gauge becomes a predetermined value.

[Claim 2] The water treatment system according to claim 1, further comprising:
 branch paths that branch off from a path from the pump to each of a desalination chamber and a concentration chamber equipped in the electrodeionization water production device; and
 a flow control valve that is provided in at least one of the branch paths, wherein
 the pressure gauge is provided closer to the pump than a branch point where the path branches into the branch paths.

[Claim 3] The water treatment system according to claim 1 or 2, wherein
 the control unit controls discharge pressure of the pump such that, when a predetermined input is received from outside, output pressure value measured by the pressure gauge becomes a predetermined value.

[Claim 4] The water treatment system according to claim 1 or 2, wherein
 the control unit controls discharge pressure of the pump such that the output pressure value measured by the pressure gauge becomes a value predetermined based on at least one of required flow rate in a system downstream of the electrodeionized water production device, the amount of

water produced upstream of the electrodeionized water production device, and the operating status of a system downstream of the electrodeionized water production device.

[Claim 5] The water treatment system according to claim 1 or 2, wherein the control unit controls discharge pressure of the pump such that the output pressure value measured by the pressure gauge becomes a predetermined value based on a predetermined schedule.

[Claim 6] The water treatment system according to claim 1 or 2, wherein the control unit controls discharge pressure of the pump such that the pressure reduction rate is 0 to 60% when the value of the maximum capacity of the discharge pressure is 100%.

[Claim 7] The water treatment system according to claim 1 or 2, further comprising:
 a plurality of the electrodeionization water production devices that are connected to each other in parallel or in series.

[Claim 8] A method of operating a water treatment system, comprising:
 obtaining an output pressure value of water to be treated from a pump that supplies the water to be treated to an electrodeionization water production device, and
 controlling discharge pressure of the pump such that the output pressure value becomes a predetermined value at a predetermined timing.