

TITLE

CORROSIVE ANION REMOVAL DEVICE AND ANION EXCHANGE RESIN REGENERATION METHOD

INCORPORATION BY REFERENCE

[0001] This application is based on and claims the benefit of priority from Japanese Patent application No.2016-093733 filed on May 9 2016, the entire contents of which are incorporated herein by reference.

BACKGROUND

[0002] The present invention relates to a corrosive anion removal device and an anion exchange resin generation method, the device having an anion exchange resin configured to replace a corrosive anion included in water supplied in a pipeline with an anticorrosive anion.

[0003] In general, at a pipeline for air conditioning facility such as a freezer, a cool or hot water pipeline, a cooling water pipeline, or a pipeline for production process, there may be a risk in which a start point of local corrosion is generated immediately after water has been charged in the pipeline in a pipeline airtightness test or the like. The start point of the local corrosion of such type is greatly influenced by the water quality or operation state immediately after the water has been charged, and it is known that such a start point is prone to be generated at a portion at which there is no flow of the water in the pipeline or on the downstream side such as an elbow or a valve.

[0004] In order to prevent such a pipeline corrosion, nitrite-based anticorrosion agent is added in water in the pipeline; and however, in this method, there may be a risk in which environmental contamination occurs at the time of water

discharge. Therefore, conventionally, there is proposed a method of preventing a corrosion of an aqueous metal by bringing aqueous corrosive ion-containing water and an anion exchange resin configured to carry an anticorrosive anion, into contact with each other and adding a low molecular weight polymer into the aqueous corrosive ion-containing water (for example, refer to Japanese Unexamined Patent Application Publication No. Hei 6-158364).

[0005] On the other hand, at the final stage of the pipeline construction process, in order to remove a solid such as metal powder, zinc oxide, or a bonding material deposited in the pipeline at the time of pipeline construction, a flushing work of supplying water in the pipeline and washing with the water is carried out. In the conventional flushing work, replacement of the water in the pipeline is repeatedly carried out over and over again until it has become possible to visually check that there is no remaining a solid after the washing exhaust water in the pipeline has been received by a mesh of a strainer.

[0006] Incidentally, conventionally, when an anion exchange resin is caused to carry an anticorrosive anion, after pretreatment has been carried out by a sodium hydroxide (NaOH) water solution which is a poison with its strong alkalinity, in general, the sodium bicarbonate (NaHCO_3) water solution is brought into contact with the anion exchange resin. However, the sodium hydroxide (NaOH) water solution is the poison with its strong alkalinity and thus it is difficult to handle the solution. Also, it is general to dilute with pure water when sodium hydroxide (NaOH) or sodium bicarbonate (NaHCO_3) is used to make a water solution; and therefore, it is necessary to carry out installation and maintenance and management of a pure water device. By these reasons, there is a problem that it

is very difficult to use the corrosion preventing method of Japanese Unexamined Patent Application Publication No. Hei 6-158364 described above.

[0007] Further, it is experimentally verified that pH of the solution immediately after sodium bicarbonate (NaHCO_3) has been brought into contact with the anion exchange resin becomes acidic and that corrosion of the metallic material may be accelerated. In view of the foregoing description, there is a problem in a case where the corrosion preventing method of Japanese Unexamined Patent Application Publication No. Hei 6-158364 described above is used in the building site.

[0008] On the other hand, in the conventional flushing method described above, oxygen is replenished by carrying out replacement of the water in the pipeline over and over again; and therefore, there is a problem that corrosion is accelerated. Also, the microscopic particle in the water of the order of microns that cannot be removed by the mesh of the strainer is deposited in the pipeline, and there may also be a risk in which the start point of the occurrence of local corrosion is generated.

[0009] The present invention has been made in order to solve the problems described above, and it is an object of the present invention to provide a corrosive anion removal device and an anion exchange resin regeneration method, the device being capable of being easily handled and reliably preventing corrosion.

SUMMARY

[0010] According to a first aspect of the present invention, there is provided a corrosive anion removal device having an anion exchange resin configured to replace a

corrosive anion included in water supplied in a pipeline with an anticorrosive anion and then generate an anion exchange treatment water, the device including a regeneration path configured to bring only a NaHCO_3 water solution diluted by tap water, into contact with the anion exchange resin at a time of regeneration of the anion exchange resin.

[0011] According to a second aspect of the present invention, there is provided a corrosive anion removal device including a treatment water tank configured to preserve the anion exchange treatment water and to allow NaHCO_3 to be charged therein at the time of regeneration of the anion exchange resin, wherein from the treatment water tank, the NaHCO_3 water solution diluted by tap water is supplied to the anion exchange resin through the regeneration path.

[0012] According to a third aspect of the present invention, there is provided a corrosive anion removal device including: a treatment water tank configured to preserve the anion exchange treatment water; a pH measuring instrument configured to measure pH of water in the treatment water tank; an air exposure circulating path configured to circulate the anion exchange treatment water in the treatment water tank while bringing into contact with air until the pH measured by the pH measuring instrument has become 7 or more; and a water supply path configured to supply the anion exchange treatment water in the treatment water tank into the pipeline if the pH measured by the pH measuring instrument has become 7 or more.

[0013] According to a fourth aspect of the present invention, there is provided a corrosive anion removal device including a chloride ion concentration measuring instrument configured to measure a chloride ion concentration in water in the treatment water tank, wherein the device is controlled

so as to notify a regeneration period of time of the anion exchange resin, based on the chloride ion concentration that is measured by the chloride ion concentration measuring instrument.

[0014] According to a fifth aspect of the present invention, there is provided a corrosive anion removal device including a dissolved oxygen measuring instrument configured to measure dissolved oxygen in water in the pipeline, wherein the device is controlled to output alerting in a case where the dissolved oxygen measured by the dissolved oxygen measuring instrument is 0.5 mg/L or more.

[0015] According to a sixth aspect of the present invention, there is provided a corrosive anion removal device further including a flushing facility configured to carry out flushing while the solid precipitated in water in the pipeline is removed by a filter.

[0016] According to a seventh aspect of the present invention, there is provided a corrosive anion removal device, wherein the filter has a filtration precision of 1 to 10 microns.

[0017] According to an eighth aspect of the present invention, there is provided a corrosive anion removal device including measuring instruments configured to measure pH, dissolved oxygen, and turbidity of water in the pipeline, wherein the device is controlled to stop flushing operation by the flushing facility in a case where the measured pH is 9 or more and the measured dissolved oxygen is less than 1.0 mg/L and the measured turbidity is less than 4.

[0018] According to a ninth aspect of the present

invention, there is provided an anion exchange resin regeneration method for regenerating an anion exchange resin configured to replace a corrosive anion included in water supplied into a pipeline with an anticorrosive anion and then generate anion exchange treatment water, wherein only the NaHCO_3 water solution diluted by tap water is brought into contact with the anion exchange resin.

[0019] According to the present invention, it is possible to reliably prevent corrosion and extend the service life of facilities while saving a water resource. In addition, it is possible to attain a variety of excellent advantageous effects such as an effect that a degradation state of facilities can be monitored via water quality in real time.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] FIG. 1 is a schematic view showing a corrosive anion removal device according to an embodiment of the present invention.

[0021] FIG. 2 is a schematic view showing a state in which anion exchange treatment is carried out in the corrosive anion removal device according to the embodiment of the present invention.

[0022] FIG. 3 is a schematic view showing a state in which pH adjustment is carried out in the corrosive anion removal device according to the embodiment of the present invention.

[0023] FIG. 4 is a schematic view showing a state in which anion exchange treatment water is supplied to a pipeline in the corrosive anion removal device according to the embodiment of the present invention.

[0024] FIG. 5 is a schematic view showing a state in which regeneration of an anion exchange resin is carried out in the corrosive anion removal device according to the embodiment of the present invention.

[0025] FIG. 6 is a schematic view showing a flushing facility in the corrosive anion removal device according to the embodiment of the present invention.

DETAILED DESCRIPTION

[0026] Hereinafter, an embodiment of the present invention will be described with reference to the drawings. Incidentally, in the following description, a case in which a corrosive anion removal device according to an embodiment of the present invention is applied to a carbon steel or zinc plated steel-based pipeline for air conditioning facility will be set forth by way of example.

[0027] First, with reference to FIG. 1, a construction of a corrosive anion removal device 10 according to an embodiment of the present invention will be described. FIG. 1 is a schematic view showing the corrosive anion removal device 10.

[0028] As shown in FIG. 1, the corrosive anion removal device 10 according to the embodiment of the present invention is constructed with: an anion exchange resin 12 configured to generate anion exchange treatment water which is hardly corroded; a treatment water tank 13 configured to preserve the anion exchange treatment water generated by the anion exchange resin 12; an anion exchange treatment path 14 formed from water supply which is a replenishment water source up to the treatment water tank 13 through the anion exchange resin 12; a water supply path 15 formed from the treatment water tank 13 up to

a pipeline 11; an air exposure circulating path 16 formed to circulate the surround of the treatment water tank 13; and a regeneration path 17 formed from the treatment water tank 13 up to the anion exchange resin 12.

[0029] In addition, although the corrosive anion removal device 10 includes a flushing facility 60 configured to carry out flushing while the solid precipitated in water in the pipeline 11 is removed by a filter, this flushing facility 60 will be described later.

[0030] The anion exchange resin 12 carries out treatment to replace a corrosive anion (chloride ion or sulfuric acid ion) with an anticorrosive anion (bicarbonate ion) and then generate anion exchange treatment water in order to prevent corrosion of a metal material which may occur in the pipeline 11.

[0031] The treatment water tank 13 is an open water tank to which a pH measuring instrument 18 and a chloride ion concentration measuring instrument 19 are mounted. The pH measuring instrument 18 and the chloride ion concentration measuring instrument 19 each are electrically connected to the control device 20, and a monitor and a recording device 51 are electrically connected to a control device 20.

[0032] The anion exchange treatment path 14 is constructed with: a primary side flow path 21 formed from the replenishment water source up to the anion exchange resin 12; and a secondary side flow path 22 formed from the anion exchange resin 12 up to the treatment water tank 13. Partway of the primary side flow path 21, a first gate valve 23 is connected, and the first gate valve 23 is opened at least at the time of generation of anion exchange treatment water. To the

secondary side flow path 22, a second gate valve 23, a flowmeter 25, a third gate valve 26, and a deaerator device 27 are connected in sequential order from the upstream side, and a lower flow end 28 of the secondary side flow path 22 is connected to a top face of the treatment water tank 13. The secondary gate valve 24 and the third gate valve 26 are opened at least at the time of generation of anion exchange treatment water. Also, in the secondary side flow path 22, a drain pipe 30 branches from a portion between the anion exchange resin 12 and the secondary gate valve 24 and then extends downward. Partway of the drain pipe 30, a fourth gate valve 31 is connected, and a lower end of the drain pipe 30 is opened upward of a hopper 32. The fourth gate valve 31 is closed at the time of generation of anion exchange treatment water, and is opened at the time of generation of the anion exchange resin 12.

[0033] An upper flow end 33 of the water supply path 15 is connected to a lower part of a side face of the treatment water tank 13. To the water supply path 15, a fifth gate valve 34, a main pump 35, and a solenoid valve 36 are connected in sequential order from the upstream side. The fifth gate valve 34 is opened at least at the time of circulation of the water in the treatment water tank 13 and at the time of supply to the pipeline 11. The solenoid valve 36 is electrically connected to the control device 20, and is controlled to open and close based on results of measurement by the pH measuring instrument 18 and the chloride ion concentration measuring instrument 19. The reason for measuring the chloride ion concentration is that it was verified through the experiment by the Inventor that the amount of chloride ion that can be exchanged with bicarbonate ion is smaller than that of sulfuric acid ion. In addition, in the water supply path 15, a main circulating path 38 branches from a first branch point 37 between the main pump 35 and the solenoid valve 36, and a lower

flow end of the main circulating path 38 is connected to the secondary side flow path 22 of the anion exchange treatment path 14 at a second branch point 39 between the third gate valve 26 and the deaerator device 27.

[0034] The air exposure circulating path 16 is constructed with: an upstream side compatible circulating path 40 from an upstream end 33 of the water supply path 15 up to the first branch point 37; the main circulating path 38; and a downstream side compatible circulating path 41 from the second branch point 39 up to the lower flow end 28 of the secondary side flow path 22 of the anion exchange treatment path 14. Partway of the main circulating path 28, a sixth gate valve 42 is connected, and the sixth gate valve 42 is opened at least at the time of circulation of the water in the treatment water tank 13. The upstream compatible circulating path 40 is made compatible by an upstream side portion of the water supply path 15, and the downstream side compatible circulating path 41 is made compatible by a downstream side portion of the secondary side flow path 22 of the anion exchange treatment path 14.

[0035] In addition, a bypass path 43 is formed in the anion exchange treatment path 14 so as to bypass the anion exchange resin 12. The bypass flow path 43 is formed to be connected to the upstream side portion of the first gate valve 23 of the primary side flow path 21 and a portion between the third gate valve 26 of the secondary side flow path 22 and the second branch point 39. Partway of the bypass flow path 43, a seventh gate valve 44 is connected, and the seventh gate valve 44 is opened when the first gate valve 23 and the second gate valve 24 are closed, etc., at the time of maintenance and inspection of the anion exchange resin 12.

[0036] The regeneration path 17 is constructed with: a main regeneration path 47 formed to couple from an upstream end 45 connected to a lower part of a side face of the treatment water tank 13 up to the third branch point 46 between the first gate valve 23 of the primary side flow path 21 of the anion exchange treatment path 14 and the anion exchange resin 12; and a compatible regenerating path 48 is formed at a portion between the third branch point 46 and the anion exchange resin 12. To the main regeneration path 47, an eighth gate valve 49 and a regeneration pump 50 are connected in sequential order from the upstream side. The eighth gate valve 49 is opened at the time of regeneration of the anion exchange resin 12. The compatible regeneration path 48 is made compatible by the lower side portion of the primary side flow path 21 of the anion exchange treatment path 21.

[0037] In addition, a dissolved oxygen measuring instrument 68 is mounted to a flushing facility 60 which will be described later, and the dissolved oxygen measuring instrument 68 is electrically connected to the control device 20. Incidentally, the dissolved oxygen measuring instrument 68 may be directly mounted to a pipeline 11.

[0038] Next, in addition to FIG. 1, with reference to FIG. 2 to FIG. 5, a function of the corrosive anion removal device 10 having the construction mentioned above will be described. FIG. 2 is a schematic view showing a state in which the corrosive anion removal device 10 carries out anion exchange treatment; FIG. 3 is a schematic view showing a state in which the corrosive anion removal device 10 carries out pH adjustment; FIG. 4 is a schematic view showing a state in which the corrosive anion removal device 10 supplies anion exchange treatment water to the pipe 11; and FIG. 5 is a schematic view showing a state in which the corrosive anion removal device 10 carries out

regeneration of the anion exchange resin 12.

[0039] As indicated by the thick line in FIG. 2, if tap water passes the anion exchange resin 12 from water supply which is a replenishment water source through the primary side flow path 21 of the anion exchange treatment path 14, the corrosive anion (chloride ion or sulfuric acid ion) in the water is replaced with anticorrosive anion (bicarbonate ion), and anion exchange treatment water is generated.

[0040] The anion exchange treatment water that has been generated in the anion exchange resin 12 is supplied into the treatment water tank 13 from a top face of the treatment water tank 13 through the secondary side flow path 22 of the anion exchange treatment path 14. At this time, a flow rate of the anion exchange treatment water that have passed through the secondary side flow path 22 of the anion exchange treatment path 14 is measured by a flowmeter 25, and carbon dioxide included in oversaturation in the anion exchange treatment water is removed by the deaerator device 27.

[0041] With respect to the anion exchange treatment water that has been supplied to the treatment water tank 13, its related pH is measured by the pH measuring instrument 18. Then, as indicated by the thick line in FIG. 3, the anion exchange treatment water in the treatment water tank 13 circulates the air exposure circulating path 16 while being in contact with the air in the treatment water tank 13 until the pH measured by the pH measuring instrument 18 has becomes 7 or more.

[0042] Afterwards, if it is determined by the control device 20 that the pH of the anion exchange treatment water in the treatment water tank 13 measured by the pH measuring instrument 18 has been 7 or more, and that the chloride ion

concentration measured by the chloride ion concentration measuring instrument 19 has become 1.0 mg/L or less, the solenoid valve 36 is opened, and as indicated by the thick line in FIG. 4, the anion exchange treatment water in the treatment water tank 13 is supplied to the pipeline 11 system through the water supply path 15.

[0043] In general, a variety of ions such as chloride ion, sulfuric acid ion, and bicarbonate ion are included in the tap water to be supplied to the anion exchange resin 12, the chloride ion and the sulfuric acid ion promote corrosion, and the bicarbonate ion prevents corrosion. Therefore, the chloride ion and the sulfuric acid ion are replaced with the bicarbonate ion by using the anion exchange resin 12, and advancement of corrosion can be thereby prevented.

[0044] While the anion exchange treatment water is thus supplied to the pipeline 11 system through the water supply path 15, the concentration of chloride ion in the anion exchange treatment water in the treatment water tank 13 is always measured by the chloride ion concentration measuring instrument 19. The result of the measurement is transmitted to the monitor and the recording device 51 via the control device 20 and then is always monitored, and in a case where the concentration of chloride ion exceeds a predetermined value (1.0 mg/L), regeneration treatment of the anion exchange resin 12 is carried out.

[0045] In the regeneration treatment of the anion exchange resin 12, sodium bicarbonate (NaHCO_3) as a regenerating agent is charged in the treatment water tank 13, and as indicated by the thick line in FIG. 5, the NaHCO_3 water solution that has been diluted by tap water is supplied from the treatment water tank 13 to the anion exchange resin 12 through the

regeneration path 17. It is the most preferable that the concentration of the NaHCO_3 water solution in this case be of the order of 8%. In general, the amount of decomposition of sodium bicarbonate in water is approximately of the order of 10% in an environment of room temperature, and the larger amount of decomposition is, the easier regeneration treatment of the anion exchange resin 12 is. On the other hand, if a regenerating agent remains in the treatment water tank 13, there may be a risk in which a scale trouble of calcium carbonate or the like occurs; and therefore, there is a need to avoid excessively adding such a kind of chemical. According to the present invention, it was determined that the order of 8% is the easiest manageable concentration as a result of experimental verification while such a circumstance is taken into consideration.

[0046] At the time of such regeneration of the anion exchange resin 12, only the NaHCO_3 water solution that has been diluted by tap water is brought into contact with the anion exchange resin 12, whereby even if adjustment of reagent is not carried out through the pretreatment by sodium hydroxide (NaOH) which is a poison with its strong alkalinity or by pure water, local corrosion in the pipeline 11 can be prevented. Therefore, the present invention can be easily used in the building site.

[0047] In addition, after anion exchange treatment water has been supplied into the pipeline 11 by the corrosive anion removal device 10, while in operation of the air conditioning facility, the dissolved oxygen in the pipeline 11 is always monitored by the dissolved oxygen measuring instrument 68 to thereby keep track of an environment of corrosion. Then, alerting is output in a case where the control device 20 determines that the value of the dissolved oxygen measured by the dissolved oxygen measuring instrument 68 has become 0.5

mg/L or more.

[0048] In an environment of neutral freshwater such as tap water, a main cause of corrosion is the dissolved oxygen. In general, in an environment of closed circulating water, the dissolved oxygen in the water is managed so as to be retained to be less than 1 mg/L. However, due to a deficiency in adjustment of a pump or a change of a facility or the like, the water in the pipeline 11 is discharged and then the water including the dissolved oxygen is replenished, and advancement of corrosion may be thereby accelerated. The concentration of the dissolved oxygen in the water is determined by an oxygen partial pressure and a temperature in accordance with Henry's law, and under an atmospheric pressure, the concentration of the dissolved oxygen rises due to lowering of the temperature.

[0049] According to the result of experimentation by the Inventor et al., it was found that the effect of anticorrosion is not significant unless the amount of the oxygen is reduced up to 0.5 mg/L or less. Therefore, in the embodiment, in order to ensure the extended service life of the facility, it has been determined that the dissolved oxygen in the water in the pipeline 11 is always monitored, and when the amount of the dissolved oxygen is 0.5 mg/L or more, alerting is output.

[0050] According to estimation by the Inventor et al., even if oxygen is supplied to water, it has found that the corrosion velocity of carbon steel can be prevented to 1/60 or less and the corrosion velocity of zinc can be prevented to 1/2 or less by using the corrosive anion removal device 10 according to the embodiment of the present invention described above.

[0051] In addition, in the corrosive anion removal device 10 according to the embodiment of the present invention, at the

time of estimation of costs per amount of treatment water taken when the anion exchange resin 12 is regenerated by sodium bicarbonate (NaHCO_3), it becomes 0.3 yen/L. This is about 1/2 of the costs taken in nitrite-based anticorrosion treatment having been conventionally carried out; and therefore, according to the present invention, it is found that the costs taken in regeneration treatment can be remarkably reduced.

[0052] Further, with the corrosive anion removal device 10 according to the embodiment of the present invention, there is no need to use a poison and thus the device can be easily used in the building site as well. Therefore, it is possible to reliably prevent corrosion immediately after water charging in the pipeline 11 while taking an environment into consideration. In addition, a start point of local corrosion cannot be generated; and therefore, corrosion may not occur to an extent such that a water leakage occurs in several years. Further, by using the device with a flushing facility 60 which will be described later, the effect of preventing corrosion can be remarkably improved.

[0053] Next, with reference to FIG. 6, the flushing facility 60 of the corrosive anion removal device 10 according to the embodiment of the present invention will be described. FIG. 6 is a schematic view showing the flushing facility 60 of the corrosive anion removal device 10.

[0054] The corrosive anion removal device 10 includes the flushing facility 60 configured to carry out flushing while removing the foreign matter that is precipitated in the water in the pipeline 11. The pipeline 11 in this case is a pipeline for air conditioning facility, and partway of the pipeline 11, a freezer 52, a primary pump 53, headers 54, 55, a secondary pump 56, an air conditioning machine 57, a gate valve 68 or

the like are mounted.

[0055] The flushing facility 60 includes a filtration circulating path 61 which is branched from two portions 59a, 59b on the upstream side and the downstream side of the gate valve 58 of the pipeline 11. To the filtration circulating path 61, a first gate valve 62, a second gate valve 63, a first pressure gauge 64, a filter 65, a second pressure gauge 66, a third gate valve 67, a dissolved oxygen measuring instrument 68, a flowmeter 69, and a fourth gate valve 70 each are connected in sequential order from the upstream side. It is preferable that the filter have the filtration precision of 1 to 10 microns.

[0056] In addition, to the filtration circulating path 61, a bypass flow path 71 configured to bypass the filter 65 is connected, and to the bypass flow path 71, a fifth gate valve 72 is connected. The fifth gate valve 72 is opened when the second gate valve 63 and the third gate valve 67 are closed, etc., at the time of maintenance and inspection of the filter 65 or the like.

[0057] Further, in the filtration circulating path 61, a drain pipe 73 is formed so as to branch from a portion between the second gate valve 63 and the first pressure gauge 64. Partway of the drain pipe 73, a sixth gate valve 74, a pH measuring instrument 75, and a turbidity measuring instrument 76 are connected in sequential order from the upstream side, and a lower end of the drain pipe 73 is opened upward of a hopper 77. The pH measuring instrument 75 and the turbidity measuring instrument 76 each are electrically connected to the control device 20. The sixth gate valve 74 is opened when the pH or turbidity of the water in the pipeline is measured by the pH measuring instrument 75 or the turbidity measuring instrument

76 (timing with which water of which amount is of the order of 3 times of the amount of preserved water has passed through the filter 65 at the time of flushing and every one to several hours thereafter; reference to the end of flushing; and any time until the pH of 9.0 or more and the turbidity of less than 4 has been met). Incidentally, the pH and turbidity cannot be directly measured in a closed pipeline system as in the embodiment because of a problem associated with the withstanding pressure of the sensor; and therefore, these values are measured while the sixth gate valve 74 is opened and then water is flushed; and however, the amount of water to be discarded at this time is only 0.1% or less of the entire amount of the water that is preserved in the pipeline.

[0058] In the flushing facility 60 having the construction described above, a flushing operation is executed so that the water of which amount is 3 times of the amount of the water that is preserved in the pipeline 11 is circulated in the pipeline 11 and the filtration circulating path 61 and then at the time of construction of the pipeline 11, the foreign matter such as metal powder, zinc oxide, or a bonding material that is deposited in the pipeline 11 is removed by the filter 6. Then, while flushing is carried out by the flushing facility 60, in consideration of the water quality chemistry and preventing corrosion of a pipeline-based metal material, the values of the dissolved oxygen, pH, and turbidity are always measured by the dissolved oxygen measuring instrument 68, the pH measuring instrument 75, and the turbidity measuring instrument 76, and these values are always monitored by the monitor and the recording device 51 and then the control device 20 determines whether or not to stop the flushing operation. Then, if the control device 2 determines that the amount of the dissolved oxygen has become less than 1.0 mg/L and the pH has become 9.0 or more and the turbidity has become less than

4 degrees, the flushing operation by the flushing facility 60 is stopped.

[0059] In general, a problem with flushing of the pipeline 11 made of a carbon steel or a zinc-plated steel pipe is a corroded product of zinc and iron which is eluted from an interior face of the pipeline 11. With respect to the corroded product of these metals, due to a phenomenon in which free radical carbonate included in the water replenished in the pipeline 11 is released in circulating operation and then the pH thereby rises, the major part is precipitated and exists as microscopic particle. The size of the particle is of the order of several microns (of the order of 1 to 10 microns) and thus all of the particle can be removed through the filtration by the filter 65. That is, according to the flushing facility 60 described above, flushing can be carried out through the filtration by the filter 65 without a need to discard a large amount of water. Therefore, the flushing facility is capable of reliably preventing corrosion of the pipeline 11 while contributing to conservation of a global environment by saving a water resource and it is possible to ensure the extended service life of the facility as well. In addition, the timing of the completion of flushing can be quantitatively evaluated; and hence, the water of which water quality is stable can be supplied into the pipeline 11.

[0060] Incidentally, although in the foregoing description of the embodiment of the present invention, a descriptive matter was furnished with respect to a case in which the present invention is applied to a carbon steel pipes or galvanized steel pipes for air conditioning facility, this is merely illustrative, and the present invention is applicable to a pipeline for another usage such as a pipeline for production process as well.

[0061] In addition, the foregoing description of the embodiment of the present invention sets forth the preferred embodiment in the corrosive anion removal device according to the present invention; and therefore, there may be a case in which a variety of technically preferred limitations such as materials, dimensions or structures are made; and however, the technical scope of the present invention is not limited to these aspects unless there is a descriptive matter to limit the present invention in particular. That is, the constituent elements in the foregoing embodiment of the present invention can be appropriately substituted by the existing constituent elements or the like, and diversified variations including a combination of other existing constituent elements are possible, and the subject matters of the invention set forth in the claims are not limited by the foregoing description of the embodiment of the present invention.

CLAIMS

WHAT IS CLAIMED IS:

1. A corrosive anion removal device having an anion exchange resin configured to replace a corrosive anion included in water supplied in a pipeline with an anticorrosive anion and then generate an anion exchange treatment water, the device comprising:

a treatment water tank configured to preserve the anion exchange treatment water;

a pH measuring instrument configured to measure pH of water in the treatment water tank;

an air exposure circulating path configured to circulate the anion exchange treatment water in the treatment water tank while bringing into contact with air until the pH measured by the pH measuring instrument has become 7 or more;

a water supply path configured to supply the anion exchange treatment water in the treatment water tank into the pipeline if the pH measured by the pH measuring instrument has become 7 or more; and

a regeneration path configured to bring only a NaHCO_3 water solution diluted by tap water, into contact with the anion exchange resin at a time of regeneration of the anion exchange resin.

2. The corrosive anion removal device according to claim 1, comprising a treatment water tank configured to preserve the anion exchange treatment water and to allow NaHCO_3 to be charged therein at the time of regeneration of the anion exchange resin, wherein from the treatment water tank, only the NaHCO_3 water solution diluted by the

tap water is supplied to the anion exchange resin through the regeneration path.

3. The corrosive anion removal device according to claim 1 or claim 2, comprising a chloride ion concentration measuring instrument configured to measure a chloride ion concentration in water in the treatment water tank, wherein the device is controlled so as to notify a regeneration period of time of the anion exchange resin, based on the chloride ion concentration that is measured by the chloride ion concentration measuring instrument.

4. The corrosive anion removal device according to any one of claims 1 to 3, comprising a dissolved oxygen measuring instrument configured to measure dissolved oxygen in water in the pipeline, wherein the device is controlled so as to output alerting in a case where the dissolved oxygen measured by the dissolved oxygen measuring instrument is 0.5 mg/L or more.

5. The corrosive anion removal device according to any one of claims 1 to 4, further comprising a flushing facility configured to carries out flushing while the solid precipitated in water in the pipeline is removed by a filter.

6. The corrosive anion removal device according to claim 5, wherein the filter has a filtration precision of 1 to 10 microns.

7. The corrosive anion removal device according to claim 5 or claim 6, comprising at least one measuring

instrument configured to measure pH, dissolved oxygen, and turbidity of water in the pipeline, wherein the device is controlled to stop flushing operation by the flushing facility in a case where the pH measured by the at least one measuring instrument is 9 or more, the measured dissolved oxygen is less than 1.0 mg/L, and the measured turbidity is less than 4.

8. An anion exchange resin regeneration method for regenerating an anion exchange resin configured to replace a corrosive anion included in water supplied into a pipeline with an anticorrosive anion and then generate anion exchange treatment water, the method comprising:

circulating the anion exchange treatment water in the treatment water tank while bringing into contact with air until the pH of water in a treatment water tank configured to preserve the anion exchange treatment water has become 7 or more;

supplying the anion exchange treatment water in the treatment water tank into the pipeline if the pH has become 7 or more; and

being brought only the NaHCO_3 water solution diluted by tap water into contact with the anion exchange resin when regenerating the anion exchange resin.