Abstract: A plurality of fluid treatment devices (150, 300, 400, 500) are disclosed to treat a recirculating fluid (120) of a closed loop heat exchange system (100, 200). A fluid treatment device (150, 300, 400, 500) may include a sacrificial metallic substance (168, 360). A fluid treatment device (150, 300, 400, 500) may include a filtering member (164, 356, 370, 404, 520). A fluid treatment device (150, 300, 400, 500) may include an electronic treatment device (502, 550).
CLOSED LOOP FLUID TREATMENT SYSTEM

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Related Applications:
[0001] This application claims the benefit of US Provisional Application Serial No. 60/834,826, filed August 1, 2006, and U.S. Utility Application Serial No. 11/830,148, filed July 30, 2007, both titled "CLOSED LOOP FLUID TREATMENT SYSTEM," the disclosures each of which is expressly incorporated by reference herein.

Background

Field of the Invention

[0002] The present invention relates generally to the treatment of a fluid, such as water. More particularly, the present invention relates to the treatment of a recirculating fluid in a closed loop heat exchange system.

Prior Art

[0003] Referring to Fig. 1, a closed loop heat exchange system 10 is shown. Closed loop heat exchange system 10 includes an input 12, an output 14, piping 16 connecting a first side of input 12 to a first side of output 14, and piping 18 connecting a second side of output 14 to a second side of input 12. Closed loop heat exchange system 10 circulates a fluid from input 12, through piping 16 to output 14, and then back to input 12 through piping 18. A pump 20 pumps the fluid around closed loop heat exchange system 10.

[0004] Input 12 either heats the fluid of closed loop heat exchange system 10 or cools the fluid of closed loop heat exchange system 10. Assuming input 12 heated the recirculating fluid, output 14 then removes heat from the heated recirculating fluid. Assuming input 12 cooled the recirculating fluid, output 14 then transfers heat to the cooled recirculating fluid. A first exemplary recirculating fluid is water. A second exemplary recirculating fluid is water and glycol. A third exemplary recirculating fluid is water and one or more additional fluids.

[0005] Exemplary closed loop heat exchange systems include a heating system for a building, a cooling system for a building, and a manufacturing system to provide either heating or cooling for some manufacturing process. In an exemplary
heating system, input 12 is a hot water boiler and output 14 is a fan coil unit. In
another exemplary heating system, input 12 is a heat exchanger for part of a heat
pump loop and output 14 is a fan coil unit. In an exemplary cooling system, input 12
is a chiller and output 14 is a fan coil unit. In an exemplary manufacturing system,
input 12 is either a device to add heat to the recirculating fluid or a device to remove
heat from the recirculating fluid and output 14 is a device to add heat to the
recirculating fluid when input 12 is a device to remove heat from the recirculating
fluid or a device to remove heat from the recirculating fluid when input 12 is a device
to add heat to the recirculating fluid.

[0006] One of the problems faced in closed loop heat exchange systems is the
oxidation of the metal components of the closed loop heat exchange system 10 such
as piping 16 or 18 and the heat transfer equipment of input 12 or output 14. These
metal components are often made of steel or copper. The oxidation of the metal
components may be caused by dissolved oxygen in the water. The oxidized metal
coats the inside of the closed loop heat exchange system 10 and deteriorates valves,
seals, and other components.

[0007] A traditional way to mitigate this problem is to use a chemical
treatment in closed loop heat exchange system 10. As used herein, the phrase
"chemical treatment" means the addition of chemicals to a recirculating fluid, such as
nitrite borate or other suitable chemicals, to address corrosion and/or scale issues. As
shown in Fig. 1, chemicals may be added to the recirculating fluid of closed loop heat
exchange system 10 through a chemical pot feeder 22 in fluid communication with
piping 16 and piping 18 through piping 24 and piping 26, respectively.

[0008] The use of chemicals in a chemical treatment adds expense to the
operation of closed loop heat exchange system 10. Further, the chemicals in a
chemical treatment may coat the inside of closed loop heat exchange system 10.
Coating the surface of a heat exchanger reduces the efficiency of the heat exchanger.
Further, this may lead to the combining of oxidized metal and the coating from the
chemical treatment to form a thicker coating.

[0009] Another problem in closed loop heat exchange systems is the presence
of bacteria in the recirculating fluid of the closed loop heat exchange system. It is
known in open loop heat exchange systems, such as swimming pools, to kill bacteria
through the introduction of copper and silver to the fluid.

Summary of the Invention

[0010] The present disclosure relates to the treatment of a recirculating fluid in a closed loop heat exchange system.

[0011] In an exemplary embodiment of the present disclosure, a method for treating a recirculating fluid of a closed loop heat exchange system is provided. The method comprising the steps of: placing a first quantity of a sacrificial metallic substance in a fluid path of the recirculating fluid of the closed loop heat exchange system; filtering the recirculating fluid to remove particulate matter; and passing the recirculating fluid through an electrical treatment device. The presence of the sacrificial metallic substance resulting in a reduction in the amount of dissolved oxygen in the recirculating fluid. The electrical treatment device treating the recirculating fluid to reduce the formation of scale on the closed loop heat exchange system.

[0012] In another exemplary embodiment of the present disclosure, a system for treating a recirculating fluid of a closed loop heat exchange system is provided. The system comprising a holder supporting a first quantity of a sacrificial metallic substance for interaction with the recirculating fluid. The presence of the sacrificial metallic substance resulting in a reduction in the amount of dissolved oxygen in the recirculating fluid. The system further comprising an electrical treatment device which treats the recirculating fluid to reduce the formation of scale on the closed loop heat exchange system. The electrical treatment device including a wire wrapped around a portion of the fluid path of the recirculating fluid and a control unit which produces an electrical current in the wire. The recirculating fluid flows through the holder and the electrical treatment device. In a further exemplary embodiment of the present disclosure, a system for treating a recirculating fluid of a closed loop heat exchange system is provided. The system comprising a holder supporting a first quantity of a sacrificial metallic substance for interaction with the recirculating fluid. The presence of the sacrificial metallic substance resulting in a reduction in the amount of dissolved oxygen in the recirculating fluid. The system further comprising an electrical treatment device which treats the recirculating fluid to reduce the formation of scale on the closed loop heat exchange system. The electrical treatment
device including at least a first electrode and a second electrode in direct contact with the recirculating fluid and a control unit which provides a potential difference between the first electrode and the second electrode.

[0013] In still another exemplary embodiment of the present disclosure, a method for treating a closed loop heat exchange system is provided. The method comprising the steps of purging a first recirculating fluid from the closed loop heat exchange system, the recirculating fluid including a chemical treatment; introducing a second recirculating fluid into the closed loop heat exchange system; and placing a first quantity of a sacrificial metallic substance in a fluid path of the second recirculating fluid. The presence of the sacrificial metallic substance resulting in a level of dissolved oxygen in the second recirculating fluid being about 1 part per million.

[0014] In still a further exemplary embodiment of the present disclosure, a method for treating a recirculating fluid of a closed loop heat exchange system is provided. The method comprising the steps of placing a first quantity of a sacrificial metallic substance in a fluid path of the recirculating fluid of the closed loop heat exchange system. The presence of the sacrificial metallic substance resulting in a reduction in the amount of dissolved oxygen in the recirculating fluid to a level of about 1 part per million. The method further comprising the steps of at a spaced apart time placing a second quantity of the sacrificial metallic substance in the fluid path of the recirculating fluid to replenish a reduction in the first quantity of the sacrificial metallic substance in the fluid path.

[0015] In yet another exemplary embodiment of the present disclosure, a method of treating a recirculating fluid of a closed loop heat exchange system, the method comprising the steps of providing a fluid treatment device including a housing and a treatment fluid path at least within the housing, making a first connection to the treatment fluid path of the fluid treatment device, making a second connection to the treatment fluid path of the fluid treatment device, placing a sacrificial metallic substance in the treatment fluid path, and making a third connection to the treatment fluid path of the fluid treatment device. The first connection being in fluid communication with the closed loop heat exchange system to receive the recirculating fluid from the closed loop heat exchange system. The second connection being in fluid communication with the closed loop heat exchange
system to return the recirculating fluid to the closed loop heat exchange system. The presence of the sacrificial metallic substance in the treatment fluid path resulting in a reduction in the amount of dissolved oxygen in the recirculating fluid. The third connection being in fluid communication with a waste fluid path. At least the first connection and the third connection are configurable in an open configuration wherein the recirculating fluid is communicated and a closed configuration wherein the recirculating fluid is not communicated. The fluid treatment device being in a treatment operation when the first connection is in the open configuration and the third connection is in the closed configuration. The fluid treatment device being in a backwashing operation when the first connection is in the closed configuration and the third connection is in the open configuration.

[0016] In yet a further exemplary embodiment of the present disclosure, an apparatus for treating a recirculating fluid of a closed loop heat exchange system is provided. The apparatus comprising a housing having a treatment fluid path, a fluid inlet coupled to the housing and in fluid communication with the treatment fluid path of the housing and being adapted to couple to the fluid path of the closed loop heat exchange system to receive the recirculating fluid from the closed loop heat exchange system, and a fluid outlet coupled to the housing and in fluid communication with the treatment fluid path of the housing and being adapted to couple to the fluid path of the closed loop heat exchange system to return the recirculating fluid to the closed loop heat exchange system. The apparatus further comprising a holder supported by the housing and positioned in the treatment fluid path; and a sacrificial metallic substance held by the holder. The sacrificial metallic substance being in direct contact with the recirculating fluid flowing in the treatment fluid path. The holder being accessible to add a replenishment of the sacrificial metallic substance without physically disconnecting the housing from the fluid path of the closed loop heat exchanger system.

[0017] In yet still another exemplary embodiment of the present disclosure, a method for treating a recirculating fluid of a closed loop heat exchange system is provided. The method comprising the steps of placing a first quantity of a sacrificial metallic substance in a fluid path of the recirculating fluid of the closed loop heat exchange system; filtering the recirculating fluid to remove particulate matter; and automatically switching between a treatment operation and a backwashing operation.
The presence of the sacrificial metallic substance resulting in a reduction in the amount of dissolved oxygen in the recirculating fluid. During the treatment operation the recirculating fluid passes by the sacrificial metallic substance and the recirculating fluid is filtered. During the backwashing operation the recirculating fluid is used to dispose of the particulate matter removed during the step of filtering the recirculating fluid during the treatment operation.

[0018] In yet still a further exemplary embodiment of the present disclosure, a method of a first entity treating a recirculating fluid of a closed loop heat exchange system for a second entity is provided. The method comprising the steps of placing a first quantity of a sacrificial metallic substance in a fluid path of the recirculating fluid of the closed loop heat exchange system. The presence of the sacrificial metallic substance resulting in a reduction in the amount of dissolved oxygen in the recirculating fluid. The method further comprising the steps of filtering the recirculating fluid to remove particulate matter; passing the recirculating fluid through an electrical treatment device which treats the recirculating fluid to reduce the formation of scale on the closed loop heat exchange system; and providing a service contract between the first entity and the second entity. The service contract including a provision for the second entity to pay the first entity for at least periodically replenishing the sacrificial metallic substance.

[0019] Additional features will become apparent to those skilled in the art upon consideration of the following detailed description of the preferred embodiments.

**Brief Description of the Drawings**

[0020] The detailed description of the drawings particularly refers to the accompanying figures in which:

[0021] Fig. 1 is a representative view of a traditional closed loop heat exchange system including a chemical pot feeder through which chemicals may be added to the recirculating fluid;

[0022] Fig. 2 is a representative view of a closed loop heat exchange system including a fluid treatment device;

[0023] Fig. 2A illustrates the operation of the fluid treatment device of Fig. 2;
[0024] Fig. 3 is a representative view of an implementation of a closed loop heat exchange system including an exemplary fluid treatment device;

[0025] Fig. 4 is a top, perspective view of the exemplary fluid treatment device of Fig. 3 with a three way valve being in a first position wherein an inlet fluid conduit is in fluid communication with an interior of the fluid treatment device;

[0026] Fig. 5 is an exploded view of portions of the exemplary fluid treatment device of Fig. 3;

[0027] Fig. 6 is a top, perspective view of exemplary fluid treatment device of Fig. 3 with the three way valve in a second position connecting a drain fluid conduit in fluid communication with an interior of the fluid treatment device;

[0028] Fig. 7 is top, perspective view of the fluid treatment device of Fig. 3 with a top portion removed showing a holder for locating a plurality of magnets in an interior of the fluid treatment device along with a filtering media;

[0029] Fig. 8 shows the holder of Fig. 7 removed from the interior of the fluid treatment device;

[0030] Fig. 9 is a bottom perspective view of the top portion of the fluid treatment device of Fig. 3;

[0031] Fig. 10 is a side view of the top portion of the fluid treatment device of Fig. 9;

[0032] Fig. 11 is a representative view of a closed loop heat exchange system including a fluid treatment device;

[0033] Fig. 11A illustrates the operation of the fluid treatment device of Fig. 11;

[0034] Fig. 12 is a representative view of portions of a closed loop heat exchange system including an exemplary fluid treatment device; and

[0035] Fig. 13 is a representative view of an exemplary electronic treatment device.

Detailed Description of the Drawings

[0036] Referring to Fig. 2, a closed loop heat exchange system 100 is shown. Closed loop heat exchange system 100 includes an input 102, an output 104, piping 106 or other suitable fluid conduit connecting a first side of input 102 to a first side of output 104, and piping 108 or other suitable fluid conduit connecting a second side of
output 104 to a second side of input 102. Closed loop heat exchange system 100 circulates a fluid 120 (see Fig. 2A) from input 102, through piping 106 to output 104, and then back to input 102 through piping 108. A pump 110 pumps the recirculating fluid 120 around closed loop heat exchange system 100.

[0037] Input 102, like input 12, either heats fluid 120 of closed loop heat exchange system 100 or cools fluid 120 of closed loop heat exchange system 100. Output 104, like output 14, then either removes heat from the heated fluid 120 assuming input 102 heated fluid 120 or transfers heat to the cooled fluid 120 assuming input 102 cooled fluid 120. A first exemplary fluid 120 is water. A second exemplary fluid 120 is water and glycol. A third exemplary recirculating fluid is water and one or more additional fluids.

[0038] Exemplary closed loop heat exchange systems 100 include a heating system for a building, a cooling system for a building, and a manufacturing system to provide either heating or cooling for some manufacturing process. In an exemplary heating system, input 102 is a hot water boiler and output 104 is a fan coil unit. In another exemplary heating system, input 102 is a heat exchanger for part of a heat pump loop and output 104 is a fan coil unit. In an exemplary cooling system, input 102 is a chiller and output 104 is a fan coil unit. In an exemplary manufacturing system, input 102 is a either a device to add heat to fluid 120 or a device to remove heat from fluid 120 and output 104 is a device to add heat to fluid 120 when input 102 is a device to remove heat from fluid 120 or a device to remove heat from fluid 120 when input 102 is a device to add heat to fluid 120.

[0039] Also, shown in Fig. 2 is a fluid treatment device 150. Fluid treatment device 150 is in fluid communication with a discharge side of pump 110 through a fluid conduit 152, such as a pipe or hose, which is in fluid communication with piping 106. Fluid treatment device 150 is further in fluid communication with a suction side of pump 110 through a fluid conduit 154, such as a pipe or hose, which is in fluid communication with piping 108. Fluid treatment device 150 may also be in fluid communication with a fluid conduit 156 which passes fluid 120 in an interior of fluid treatment device 150 to a drain 158 or a receptacle, such as a bucket or barrel.

[0040] Referring to Fig. 2A, fluid treatment device 150 includes a fluid path 162 through which fluid 120 travels and is treated. As fluid 120 travels along fluid path 162, fluid 120 encounters a filtering media 164 having positioned therein one or
more magnets 166. The filtering media 164 and magnets 166 operate to remove particulate matter present in fluid 120, such as metallic particles and/or scale. Ferrous metal particles are attracted to magnets 166. Exemplary filtering media includes coal and sand. Exemplary magnets include ferrite magnets. In one embodiment, filtering media 164 filters particulate matter to less than about 0.5 microns.

[0041] The flow rate of fluid 120 entering fluid treatment device 150 is controlled to permit the particulate matter to be retained in interior region 316 of fluid treatment device 150 due to filtering media 164 and magnets 166. In one embodiment, the flow rate is in the range of about 7 gallons per minute (gpm) to about 15 gpm. In one embodiment, the flow rate is about 10 gpm.

[0042] Fluid 120 also encounters a sacrificial metal 168 as it travels along fluid path 162. Sacrificial metal 168 gradually is carried away by or reacts with fluid 120. Sacrificial metal 168 reduces the amount of dissolved oxygen present in fluid 120 through an interaction with fluid 120. The reduction in dissolved oxygen reduces the probability that additional oxidation of the internal portions of closed loop heat exchange system 100 will occur. Therefore, fluid treatment device 150 treats fluid 120 to reduce the degradation of closed loop heat exchange system 100 due to oxidation. In addition, fluid treatment device 150 removes existing iron oxide build-up in closed loop heat exchange system 100. This results in closed loop heat exchange system 100 operating more efficiently and without the need for a traditional chemical treatment, such as with nitrite borate.

[0043] In one embodiment, closed loop heat exchange system 100 further includes a chemical pot feeder to introduce a chemical into fluid 120. In one example, additional glycol may be added to fluid 120 through the chemical pot feeder for examples wherein it is desired that fluid 120 includes glycol. The chemical pot feeder may be positioned on a second bypass of closed loop heat exchange system 100 or on the same bypass as fluid treatment device 150.

[0044] An exemplary sacrificial metal 168 is aluminum. Sacrificial metal 168 may have many shapes, such as shavings, rods, ingots, blocks, tubes, and other suitable shapes. Further, sacrificial metal 168 may include multiple metals and may include one or more alloys. In one embodiment, sacrificial metal 168 includes a plurality of segments of aluminum wire. Exemplary aluminum wire is type 1100-0 Alum (heat no. 30343) having a 0.125 inch (0.318 centimeter) diameter available
from Bob Martin company located at 2209 No. Seaman Avenue, So. El Monte, California 91733.

[0045] In addition to aluminum, the applicant believes that Zinc, Magnesium, Calcium, Sodium, and Potassium or some combination thereof may be used as a sacrificial metal 168. However, Zinc, Magnesium, Calcium, Sodium, and Potassium have not been tested as a sacrificial metal 168.

[0046] In one embodiment, fluid 120 encounters additional metal(s) 170 for treating fluid 120 as fluid 120 travels along fluid path 162. In one embodiment, copper and/or silver are also provided in fluid path 162 to reduce the level of bacteria present in fluid 120.

[0047] Referring to Figs. 3-10, an exemplary fluid treatment device 300 is shown. Fluid treatment device 300 operates in accordance with the above discussion of fluid treatment device 150. As shown in Fig. 3, fluid treatment device 300 is assembled to a closed loop heat exchange system 200. Closed loop heat exchange system 200 includes an input 102 and an output 104. Input 102 and output 104 are in fluid communication through piping 202. Fluid 120 flows from input 102 to output 104 through piping 202. Fluid 120 exits output 104 and travels through piping 204 to a pump 206. Pump 206 pumps fluid 120 through piping 208 back to input 102. The fluid in piping 208 is at an elevated pressure relative to the fluid in piping 204 due to the operation of pump 206.

[0048] Piping 208 is further in fluid communication with a fluid conduit 210 having an associated valve 212. Piping 204 is further in fluid communication with a fluid conduit 214 having an associated valve 216. In one embodiment, valves 212 and 216 are each ball valves.

[0049] As shown in Fig. 3, fluid treatment device 300 is connected to closed loop heat exchange system 200 through fluid conduits 210 and 214. An inlet fluid conduit 302 of fluid treatment device 300 is coupled to valve 212 and an outlet fluid conduit 304 of fluid treatment device 300 is coupled to valve 216. In general, during operation of fluid treatment device 300 a portion of fluid 120 flows through conduit 210, through inlet fluid conduit 302, into an interior 316 (see Fig. 7) of fluid treatment device 300, through outlet fluid conduit 304, and through conduit 214. Flow is in the direction described due to the fact that fluid 120 in piping 208 is at an elevated pressure relative to fluid 120 in piping 204 due to the operation of pump 206.
Referring to Fig. 4, fluid treatment device 300 includes a base portion 310 and a removable top portion 312. Base portion 310 includes an interior side wall 314 (see Fig. 7) which bounds an interior 316 (see Fig. 7) of fluid treatment device 300. A lower surface 318 (see Fig. 9) of top portion 312 cooperates with side surface 314 of base portion 310 and a floor (not shown) of base portion 310 to form interior space 316. A seal 322 (see Fig. 5) is disposed between a flange surface 320 of base portion 310 and lower surface 318 of removable top portion 312 to make a water tight seal between base portion 310 and top portion 312. Top portion 312 is coupled to base portion 310 through a plurality of couplers 324 (two indicated by reference numerals). In the illustrated embodiment, couplers 324 include a bolt 326 and a nut 328 along with associated washers as needed.

In one embodiment, base portion 310 and top portion 312 are made of stainless steel. In other embodiments, any suitable material may be used that is suitable for the temperature ranges of closed loop heat exchange system 200.

Referring to Fig. 4, fluid treatment device 300 may be covered in an insulating material 325 to eliminate condensation when fluid 120 is cold enough that is causes base portion 310 and/or top portion 312 to sweat (like chiller water for air conditioning).

Top portion 312 includes a fluid conduit 330 (see Fig. 10) which is covered behind a fluid permeable member 332, illustratively a screen. A valve 334 is coupled to fluid conduit 330. Inlet fluid conduit 302 is connected to valve 334. Further, a waste fluid conduit 336 is also connected to valve 334. As explained herein, fluid conduit 336 delivers fluid from the interior 316 of fluid treatment device 300 to a waste location 337 (see Fig. 3), such as a drain or a receptacle.

Referring to Fig. 6, valve 334 includes an actuator 338 which is rotatable about axis 340 in directions 342 and 344. Illustratively actuator 338 is a handle. By rotating actuator 338 an internal valve element (not shown) of valve 334 is moved. An exemplary valve is a three way valve, such as Model No. 533, available from Parker located in Otsego, Michigan.

When actuator 338 is positioned as shown in Fig. 4, inlet fluid conduit 302 is in fluid communication with interior region 316 of fluid treatment device 300 through fluid conduit 330 in top portion 312 and waste fluid conduit 336 is not in fluid communication with interior region 316 of fluid treatment device 300 through
fluid conduit 330 in top portion 312. As such, recirculating fluid 120 flows from the higher pressure inlet fluid conduit 302 through fluid treatment device 300 and into an outlet fluid conduit 304 as explained herein. The orientation of valve 334 in Fig. 4 corresponds to a treatment operation.

When handle 338 is positioned as shown in Fig. 6, waste fluid conduit 336 is in fluid communication with interior region 316 of fluid treatment device 300 through fluid conduit 330 in top portion 312 and inlet fluid conduit 302 is not in fluid communication with interior region 316 of fluid treatment device 300 through fluid conduit 330 in top portion 312. As such, recirculating fluid 120 flows from the higher pressure fluid conduit 304 through fluid treatment device 300 and into waste fluid conduit 336 as explained herein. The orientation of valve 334 in Fig. 6 corresponds to a backwashing operation.

Top portion 312 includes a fluid conduit 339 (see Fig. 10) to which fluid conduit 304 is coupled on a top side of top portion 312 as shown in Fig. 6 and to which a holder 350 is coupled on a bottom side of top portion 312 as shown in Fig. 10. Referring to Fig. 9, in the illustrated embodiment, holder 350 includes a cylindrical body 352. An interior of cylindrical body 352 is in fluid communication with fluid conduit 304 through top portion 312 and with interior region 316 through a lower end 354.

Lower end 354 of holder 350 is closed by a fluid permeable cover 356, illustratively a screen, which is held in place by a coupler 358, illustratively a band clamp. The interior region of holder 350 contains a sacrificial metallic substance 360 which treats recirculating fluid 120 as it contacts the sacrificial metallic substance 360 to reduce the level of dissolved oxygen in the recirculating fluid. An upper portion of holder 350 is also covered by a fluid permeable cover (not shown) which keeps the sacrificial metallic substance 360, such as aluminum wire, from entering fluid conduit 304.

In one embodiment, fluid treatment device 300 reduces dissolved oxygen in recirculating fluid 120 from about 3 to 8 parts per million (ppm) to less than 1 ppm in about two weeks. In general, sacrificial metallic substance 360 is replaced about every 1 to 4 years when sacrificial metallic substance 360 is aluminum wire. The time period between replacements is less if smaller pieces of aluminum are used, such as shavings.
In the illustrated embodiment, fluid permeable member 356 prevents particulate matter, such as metallic particles, of greater than about 0.5 microns from passing there through. As such, fluid permeable member 356, as well as, filtering media 370 and magnets 374 described below limit the passage of particulate matter through fluid treatment device 300. As shown in Fig. 9, fluid permeable member 332 has a greater spacing to allow larger particulate matter to enter fluid treatment device 300 during a treatment operation and to exit fluid treatment device 300 during a backwashing operation.

In one embodiment, sacrificial metallic substance 360 is aluminum. The sacrificial metallic substance 360 may be of any shape. In one embodiment, aluminum shavings are used. In another embodiment, aluminum rods, such as wire are used. The larger the surface area of sacrificial metallic substance 360 the quicker sacrificial metallic substance 360 is taken up by recirculating fluid 120. As such, the shorter the time period between replenishments of sacrificial metallic substance 360.

In one embodiment, holder 350 is not included. Rather sacrificial metallic substance 360 is mixed in with filtering media 370 in interior region 316.

Referring to Figs. 7 and 8, a filtering media 370 is positioned within interior region 316 of fluid treatment device 300. In general, filtering media 370 fills the majority of interior region 316. Exemplary filtering media includes coal and/or sand. In one embodiment, coal is used as filtering media 370. In one embodiment, #2 Anthracite coal is used as the filtering media 370.

In Fig. 7, a portion of filtering media 370 has been removed to better illustrate the placement of a holder 372. Referring to Fig. 8, holder 372 supports a plurality of magnets 374 in a spaced apart arrangement. Referring to Fig. 8, magnets 374 are ring magnets which are received by a tube 378. Magnets 364 are spaced apart with ring shaped spacers 376.

Positioners 380 are used to control the height of magnets 374 relative to tube 378. Illustratively, positioners 380 are snap rings which are received in corresponding grooves in tubes 378.

As shown in Fig. 8, holder 372 includes three tubes 378 each generally identical. Tubes 378 are held in a spaced apart relationship by a top spacer 382 and a bottom spacer 384. Illustratively, spacers 382 and 384 are made of wire. The arrangement of holder 372 in the illustrated embodiment is chosen to position
magnets 374 throughout interior region 316. In one embodiment, magnets 374 are ferrite magnets and have a Gauss strength of about 1000 gauss.

In one embodiment, the existing recirculating fluid 120 is not purged from closed loop heat exchange system 200 prior to installation of fluid treatment device 300. In another embodiment, the existing recirculating fluid is purged from closed loop heat exchange system 200 prior to installing fluid treatment device 300. In one example, the existing recirculating fluid is removed through a drain valve 203 (alternatively valve 216 prior to connection of fluid treatment device 300) at a rate of about 2 gpm. Higher or lower rates of removal may be used. At the same time additional recirculating fluid, such as water or water and glycol, may be provided to closed loop heat exchange system 200 through a make-up supply 201, as is known in the art. The pressure in system 200 should maintain a required pressure level during the removal process due to the additional recirculating fluid provided by make-up supply 201. In addition, the flow rate of the removal process should be chosen to maintain the temperature of fluid 120 within an acceptable level. Once the recirculating fluid 120 has been generally drained through drain valve 203 and has been generally replaced by the recirculating fluid 120 from the make-up device 201 fluid treatment device 300 may be installed. In one embodiment, fluid treatment device 300 may be installed prior to purging of fluid 120.

Fluid treatment device 300 is installed as follows. Fluid conduit 302 is coupled to fluid conduit 210. Fluid conduit 304 is coupled to fluid conduit 214. An air vent 390 is opened on fluid treatment device 300 to permit air to exit from interior 316. Air vent 390 (see Fig. 4) is in fluid communication with interior 316 through fluid conduit 394 (see Fig. 9). As shown in Fig. 4, air vent 390 includes a screw 392 which may be loosened to bring interior 316 into fluid communication with atmosphere.

With air vent 390 open, valve 212 is partially opened to permit fluid 120 to flow from fluid conduit 210 into fluid conduit 302. Air will exit air vent 390 as fluid 120 fills interior 316. When interior 316 is generally full of fluid 120, valve 216 is partially opened. Finally, valves 212 and 216 are fully opened. Further, air vent 390 is closed. Fluid treatment device 300 is now treating the fluid 120 of closed loop heat exchange system 200.
In general, the concentration of dissolved oxygen in recirculating fluid should reduce over time. However, dissolved oxygen concentrations may periodically rise due to the removal of iron oxide from the piping and heat transfer surfaces.

Further, as time progresses the sacrificial metallic substances reduces in quantity. As such, at spaced apart intervals valves 212 and 216 are closed to stop the flow of fluid 120 through fluid treatment device 300 and top portion 312 is separated from bottom portion 310. However, fluid conduits 302, 304, and 336 remain connected to top potion 312. Additional sacrificial metallic substance 360 is added to holder 350 and top portion 312 is again coupled to based portion 310. Finally, valves 212 and 216 are reopened to permit the flow of fluid 120 through fluid treatment device 300.

Over time iron oxides and other particulate matter become collected in interior 316 due to the presence of filtering media 370 and magnets 374. This collection of particulate matter, should be removed during a backwashing operation. To initiate a backwashing operation, valve 334 on fluid treatment device 300 is moved to the position shown in Fig. 6; thereby placing fluid conduit 336 in fluid communication with interior region 316 and fluid conduit 302 not in fluid communication with interior region 316. Since fluid conduit 336 empties in a waste location 337, such as a drain or a receptacle, which is generally at atmospheric pressure, the direction of flow of fluid 120 through fluid treatment device 300 is reversed. Fluid 120 enters fluid treatment device 300 through fluid conduit 304, flows through interior region 316, out through fluid conduit 330, and through waste fluid conduit 336 to waste location 337. Waste location 337 may correspond to a receptacle, such as a barrel. This is useful when fluid 120 contains glycol, so that as the particulate matter settles in the receptacle, clean glycol may be obtained and reused.

The flow rate of fluid 120 through fluid treatment device 300 should be selected to cause particulate matter to dislodge from filtering media 370 and the attraction to magnets 374 and exit through fluid conduit 336. In one embodiment, the flow rate of fluid should be at least 10 gpm. Over time the fluid exiting fluid conduit 336 will become lighter due to the majority of particulate matter having already been washed out of interior 316. Once the fluid returns to a generally normal or clean
color, valve 334 may again be moved to the position shown in Fig. 4 which corresponds to a treatment operation.

[0074] Based on the position of valve 334, fluid treatment device 300 is either in a treatment operation (Fig. 4) or a backwashing operation (Fig. 6). In one embodiment, valve 334 is a motorized valve and a controller controls the operation of the motorized valve. In one embodiment, the controller operates the motorized valve in response to a timer which specifies a first time period between backwashing operations and a second time period for the length of a backwashing operation.

[0075] In operation, once a treatment operation is commenced, the timer initiates the first time period. Once the first time period has expired, the controller moves the motorized valve to initiate a backwashing operation and initiates the second time period. Once the second time period has expired, the controller moves the motorized valve to initiate a treatment operation.

[0076] In one embodiment, fluid conduit 302 has a smaller cross section than fluid conduit 304, thus fluid conduit 302 acts as a restricting orifice and restricts the flow into fluid treatment device 300. In one example during a treatment operation, the pressure in inlet fluid conduit 302 is about 40 psi and the pressure in outlet fluid conduit 304 is about 10 psi to about 20 psi. During a backwashing operation, the pressure in fluid conduit 304 is about 10 to about 20 psi (fluid conduit 304 is now the inlet) and the pressure in fluid conduit 336 (which is larger than fluid conduit 304) is generally at atmosphere.

[0077] In one embodiment, an entity doing business in the treatment of a recirculating fluid in a closed loop heat exchange system may establish the following process. The entity would establish a service contract between the entity and a customer, the customer desiring to have a closed loop heat exchange system treated to reduce a level of the dissolved oxygen in the recirculating fluid. The service contract including the performance of: installing a fluid treatment device to receive the recirculating fluid from the closed loop heat exchange system, periodically replenishing the sacrificial metallic substance in the fluid treatment device, and billing the customer for at least one of the installation of the fluid treatment device and the periodic replenishing of the sacrificial metallic substance. The fluid treatment device includes, in addition to a sacrificial metallic substance, one or more of a filtering media including at least one of a loose filtering media and a filter membrane,
magnets, and an electrical treatment device including at least one of electrodes in direct contact with the recirculating fluid and a wire wrapped around a conduit of the fluid treatment device or other portion of the closed loop heat exchange system.

[0078] In one embodiment, wherein the closed loop heat exchange system has scale forming on one or more components, an electrical treatment device is included to treat fluid 120 for mineral scale. Scale in a closed loop system may be a side effect of the system having a leak. In such a situation, additional fluid is added to the fluid of the closed loop system to make up for fluid lost due to the leak. The lost fluid often leaves behind particles that form scale and the additional fluid introduces additional such particles. The electrical treatment device may be used in combination with treatment device 300, in combination with fluid treatment device 400 (see Fig. 11), be incorporated into treatment device 300, be incorporated into fluid treatment device 400, or used independent of treatment device 300 and fluid treatment device 400. Exemplary electrical treatment devices 400 include a device having electrodes in direct contact with the recirculating fluid and a device having a wire wrapped around a conduit.

[0079] In one embodiment, the addition of an electrical treatment device may be desired in closed loop systems which do not have a problem with scale formation. In such systems, as well as in leaky systems, it is believed that the treatment with an electrical treatment device breaks up molecular clusters in the fluid, thereby reducing the surface tension of the fluid. This has been observed in that pockets of air in a given closed loop system are eliminated over time when the fluid of the closed loop system is treated with an electrical treatment device.

[0080] An exemplary wrap electrical treatment device is a Series E treatment system available from Freje Treatment Systems located at 7435 E. 86th Street in Indianapolis, Indiana which may be installed on any of the fluid conduits of the closed loop heat exchange piping or the fluid treatment device. The Series E treatment system includes a wire wrapped around an exterior of the fluid conduit and a control unit. The control unit passes a current through the wire which treats the fluid for mineral scale. In one embodiment, the electrical treatment device applies an alternating current in the frequency range of about 1 kilo-hertz (kHz) to about 9kHz.

[0081] Referring to Fig. 11, a fluid treatment device 400 is presented. Fluid treatment device 400 is in fluid communication with a discharge side of pump 110.
through a fluid conduit 152, such as a pipe or hose, which is in fluid communication with piping 106. Fluid treatment device 400 is further in fluid communication with a suction side of pump 110 through a fluid conduit 154, such as a pipe or hose, which is in fluid communication with piping 104. Fluid treatment device 400 may also be in fluid communication with a fluid conduit 156 which passes fluid 120 in an interior of fluid treatment device 400 to a drain 158 or a receptacle, such as a bucket or barrel.

Referring to Fig. 11A, fluid treatment device 400 includes a fluid path 402 through which fluid 120 travels to be treated. As fluid 120 travels along fluid path 402, fluid 120 encounters a filtering media 404 such as a bag or other suitable membrane. The filtering media 404 operates to remove particulate matter present in fluid 120, such as metallic particles and/or scale. Exemplary filtering media includes one or more filter bags used in a bag filter device. In one embodiment, filtering media 404 filters particulate matter to less than about 0.5 microns.

Fluid 120 also encounters a sacrificial metal 168 as it travels along fluid path 402 to treat fluid 120 to reduce the degradation of closed loop heat exchange system 100 due to oxidation. In addition, fluid treatment device 400 removes existing iron oxide build-up in closed loop heat exchange system 100 or 200. This results in closed loop heat exchange system 100 or 200 operating more efficiently and without the need for a traditional chemical treatment, such as with nitrite borate.

In one embodiment, closed loop heat exchange system 100 further includes a chemical pot feeder to introduce a chemical into fluid 120. In one example, additional glycol may be added to fluid 120 through the chemical pot feeder. The chemical pot feeder may be positioned on a second bypass of closed loop heat exchange system 100 or on the same bypass as fluid treatment device 400.

In one embodiment, fluid 120 encounters additional metal(s) 170 for treating fluid 120 as fluid 120 travels along fluid path 402. In one embodiment, copper and/or silver are also provided in fluid path 162 to reduce the level of bacteria present in fluid 120.

Referring to Fig. 12, a fluid treatment device 500 is shown. Fluid treatment device 500 operates in accordance with the description of fluid treatment device 400. Fluid treatment device 500 is coupled to fluid conduit 210 and fluid conduit 214 of closed loop heat exchange system 200 through valves valve 212 and
valve 216, respectively. Fluid treatment device 500 includes an electrical treatment
device 502, a bag filter device 504, and a sacrificial metal holder 506. Electrical
treatment device 502 treats fluid 120 to reduce the formation of scale in fluid 120.
Bag filter device 504 includes a membrane 520, such as one or more bags, which
prevents the passage of particulate matter, such as metallic particles or scale greater
than a given particle size. An exemplary particle size is about 10 microns. Sacrificial
metal holder 506 holds the sacrificial metal 168 which contacts fluid 120.

[0087] Electrical treatment device 502 is shown as a wire 510 wrapped around
a conduit 512. Wire 510 is coupled to a control unit 514 which provides an electrical
signal to wire 510 that induces a magnetic field in fluid 120. An exemplary wire
treatment device is a Series E treatment system available from Freije Treatment
Systems located at 7435 E. 86th Street in Indianapolis, Indiana.

[0088] Control unit 514 regulates the power provided to wire 510. In one
embodiment, an alternating current is provided to wire 510 by control unit 514. Fluid
120 leaving electrical treatment device 502 passes through conduit 516 and enters an
inlet 518 of bag filter device 504. Bag filter device 504 includes in its interior one,
two or more filter membranes 520 through which fluid 120 passes to reach an outlet
522. Exemplary filter membranes include filter bags and cartridge filters. Exemplary
frequencies of alternating current are in the range of about 1 kHz to about 9 kHz.

[0089] Exemplary bag filter devices 504 and filter membranes 520 are
available from Rosedale Products Inc. located at 3730 West Liberty Road in Ann
Arbor, Michigan 48106. Exemplary bag filter devices 504 are described in US
patents 4,419,240; 4,496,459; 4,574,047; 4,651,570; 4,701,259; 4,966,697;
4,970,004; 5,128,032; 5,176,826; and 5,462,678, the disclosures of which are
expressly incorporated by reference herein. In one embodiment, bag filter device 504
is a Model No. NC08-30-2P-1-150-S-B-PB available from Rosedale Products Inc.
located at 3730 West Liberty Road in Ann Arbor, Michigan 48106.

[0090] Fluid 120 which passes through filter membranes 520 exits bag filter
device 504 through outlet 522 and enters conduit 524. Conduit 524 is in fluid
communication with sacrificial metal holder 506 which holds sacrificial metal 168. In
one embodiment, sacrificial metal 168 is held within a region 528 of sacrificial metal
holder 506 between fluid permeable covers 530 and 532. In one embodiment, fluid
permeable covers 530 and 532 are screens. Over time sacrificial metal 168 is
gradually carried away by or reacts with fluid 120. The fluid 120 exits sacrificial metal holder 506 and travels through a conduit 534 in fluid communication with fluid conduit 214 through valve 216.

In operation fluid enters fluid treatment device 500 through valve 212 and passes through fluid treatment device 500 and onto fluid conduit 214 through valve 216. Over time, the amount of particulate matter within bag filter device 504 increases. To clean bag filter device 504, valves 212 and 216 are closed. A top 538 of bag filter device 504 is opened and filter membrane 520 is removed. The particulate matter is removed from filter membrane 520 and filter membrane 520 is returned to bag filter device 504 or replaced with another filter membrane 520. In one embodiment, two or more bag filter device 504 are provided in parallel, such that when one bag filter device 504 is being serviced the other bag filter device 504 continues to treat fluid 120.

In a similar fashion, when sacrificial metal 168 needs replenished valves 212 and 216 are closed and sacrificial metal holder 506 is removed. Sacrificial metal holder 506 is coupled to fluid conduits 524 and 534 through unions 540 and 542, respectively. Region 528 is again populated with sacrificial metal 168 and sacrificial metal holder 506 is again placed in fluid communication with conduit 524 and conduit 534.

In one embodiment, fluid treatment device 500 is used in closed loop heat exchange systems wherein fluid 120 contains glycol since fluid treatment device 500 does not remove particulate matter through a flushing operation like fluid treatment device 300. In fluid treatment device 500 the filtering membrane 520 may be removed and cleaned without flushing the recirculation fluid.

In one embodiment, electrical treatment device 502 is an electrical treatment device having electrodes in direct contact with the fluid. An exemplary electrical treatment device 550 is shown in Fig. 13. Electrical treatment device 550 includes a first electrode 552 and a second electrode 554 both of which are positioned to directly contact fluid 120. A control unit 556 is coupled to first electrode 552 and second electrode 554 and provides a potential difference between the first electrode 552 and the second electrode 554. In one embodiment, the potential difference is an alternating potential difference. Exemplary frequencies of alternating current are in the range of about 1 kHz to about 9 kHz.
Paragraph A. In an exemplary embodiment of the present disclosure, a method for treating a closed loop heat exchange system is provided. The method comprising the steps of: purging a first recirculating fluid from the closed loop heat exchange system, the recirculating fluid including a chemical treatment; introducing a second recirculating fluid into the closed loop heat exchange system; and placing a first quantity of a sacrificial metallic substance in a fluid path of the second recirculating fluid. The presence of the sacrificial metallic substance resulting in a reduction in the amount of dissolved oxygen in the second recirculating fluid.

Paragraph B. In another exemplary embodiment of the present disclosure, the method of Paragraph A further comprises the step of at a spaced apart time placing a second quantity of the sacrificial metallic substance in a fluid path of the second recirculating fluid to replenish a reduction in the first quantity of the sacrificial metallic substance in a fluid path.

Paragraph C. In another exemplary embodiment of the present disclosure, in the method of Paragraph A the step of purging a first recirculating fluid includes the step of draining the first recirculating fluid from the closed loop heat exchange system and wherein the second recirculating fluid is introduced simultaneously.

Paragraph D. In another exemplary embodiment of the present disclosure, in the method of Paragraph A the step of placing a first quantity of a sacrificial metallic substance in a fluid path of the second recirculating fluid includes the step of coupling a fluid treatment device to a first fluid connection of a treatment loop of the closed loop heat exchange system and a second fluid connection of the treatment loop of the closed loop heat exchange system. The treatment loop of the closed loop heat exchange system being in parallel with a main loop of the closed loop heat exchange system. The fluid treatment device including an interior having a treatment fluid path in fluid communication with the first fluid connection of the treatment loop to receive the second recirculating fluid and with the second connection of the treatment loop to return the second recirculating fluid. The step of placing a first quantity of a sacrificial metallic substance in a fluid path of the second recirculating fluid further includes placing the sacrificial metallic substance in the interior of the fluid treatment device such that the second recirculating fluid flowing in the treatment fluid path contacts the sacrificial metallic substance.
[0099] Paragraph E. In another exemplary embodiment of the present disclosure, in the method of Paragraph D the fluid treatment device includes a first portion and a second portion separatable from the first portion. The second portion being coupled to the first fluid connection and the second fluid connection.

[00100] Paragraph F. In another exemplary embodiment of the present disclosure, in the method of Paragraph E the step of placing the sacrificial metallic substance in the interior of the fluid treatment device includes the steps of: separating the second portion from the first portion; and placing the sacrificial metallic substance in a holder of fluid treatment device.

[00101] Paragraph G. In another exemplary embodiment of the present disclosure, in the method of Paragraph E the holder is coupled to the second portion. Further, the step of placing the sacrificial metallic substance in a holder includes the steps of: opening a cover of the holder relative to a body portion of the holder; placing the sacrificial metallic substance within an interior of the body portion of the holder; and closing the cover of the holder relative to the body portion of the holder.

[00102] Paragraph H. In another exemplary embodiment of the present disclosure, in the method of Paragraph G the cover of the holder includes openings to permit the second recirculating fluid to pass there through.

[00103] Paragraph I. In another exemplary embodiment of the present disclosure, any of the methods of Paragraphs A-E, further includes the steps of: placing a filtering media in the interior of the fluid treatment device; and placing at least one magnetic substance in the interior of the fluid treatment device. The at least one magnetic substance attracting metallic particles in the second recirculating fluid.

[00104] Paragraph J. In another exemplary embodiment of the present disclosure, in the method of Paragraph I the metallic particles are removed from the interior of the fluid treatment device by a backwashing operation. In one embodiment, the backwashing operation includes the steps of: preventing the flow of the second recirculating fluid into the treatment fluid path from the first connection of the treatment loop; and opening a waste fluid path from the interior of the fluid treatment device. The waste fluid path being at a lower pressure than the second connection to the treatment loop resulting in the second recirculating fluid flowing in the second connection through the filtering media in the interior of the fluid treatment
device and out through the waste fluid path. The fluid flowing out the waste fluid path including the metallic particles.

[00105] Paragraph K. In another exemplary embodiment of the present disclosure, in the method of any of Paragraphs A-J the sacrificial metallic substance is aluminum.

[00106] Paragraph L. In another exemplary embodiment of the present disclosure, a method for treating a closed loop heat exchange system is provided. The method including the step of placing a first quantity of a sacrificial metallic substance in a fluid path of a recirculating fluid of the closed loop heat exchanger system. The presence of the sacrificial metallic substance resulting in a reduction in the amount of dissolved oxygen in the recirculating fluid. The method further including the step of at a spaced apart time placing a second quantity of the sacrificial metallic substance in a fluid path of the recirculating fluid to replenish a reduction in the first quantity of the sacrificial metallic substance in the fluid path.

[00107] Paragraph M. In another exemplary embodiment of the present disclosure, in the method of Paragraph L the step of placing a first quantity of a sacrificial metallic substance in a fluid path of the recirculating fluid includes the step of coupling a fluid treatment device to a first fluid connection of a treatment loop of the closed loop heat exchange system and a second fluid connection of the treatment loop of the closed loop heat exchange system. The treatment loop of the closed loop heat exchange system being in parallel with a main loop of the closed loop heat exchange system. The fluid treatment device including an interior having a treatment fluid path in fluid communication with the first fluid connection of the treatment loop to receive the recirculating fluid and with the second connection of the treatment loop to return the recirculating fluid. The step of placing a first quantity of a sacrificial metallic substance in a fluid path of the recirculating fluid further includes the step of placing the sacrificial metallic substance in the interior of the fluid treatment device such that the recirculating fluid flowing in the treatment fluid path contacts the sacrificial metallic substance.

[00108] Paragraph N. In another exemplary embodiment of the present disclosure, in the method of Paragraph M the fluid treatment device includes a first portion and a second portion separatable from the first portion. The second portion being coupled to the first fluid connection and the second fluid connection.
[00109] Paragraph O. In another exemplary embodiment of the present disclosure, in the method of Paragraph N the step of placing the sacrificial metallic substance in the interior of the fluid treatment device includes the steps of separating the second portion from the first portion and placing the sacrificial metallic substance in a holder of fluid treatment device.

[00110] Paragraph P. In another exemplary embodiment of the present disclosure, in the method of Paragraph O the holder is coupled to the second portion. Further, the step of placing the sacrificial metallic substance in a holder includes the steps of: opening a cover of the holder relative to a body portion of the holder; placing the sacrificial metallic substance within an interior of the body portion of the holder and closing the cover of the holder relative to the body portion of the holder.

[00111] Paragraph Q. In another exemplary embodiment of the present disclosure, in the method of Paragraph P the cover of the holder includes openings to permit the recirculating fluid to pass there through.

[00112] Paragraph R. In another exemplary embodiment of the present disclosure, the method of any of Paragraphs L-Q, further including the steps of: placing a filtering media in the interior of the fluid treatment device and placing at least one magnetic substance in the interior of the fluid treatment device. The at least one magnetic substance attracting metallic particles in the recirculating fluid.

[00113] Paragraph S. In another exemplary embodiment of the present disclosure, in the method of Paragraph R the metallic particles are removed from the interior of the fluid treatment device by a backwashing operation comprising the steps of: preventing the flow of recirculating fluid into the treatment fluid path from the first connection of the treatment loop and opening a waste fluid path from the interior of the fluid treatment device. The waste fluid path being at a lower pressure than the second connection to the treatment loop resulting in the recirculating fluid flowing in the second connection through the filtering media in the interior of the fluid treatment device and out through the waste fluid path. The fluid flowing out the waste fluid path including the metallic particles.

[00114] Paragraph T. In another exemplary embodiment of the present disclosure, in the method of Paragraph S the waste fluid path and the first connection to the treatment loop are each connected to a first valve in fluid communication with the treatment fluid path of the fluid treatment device. The first valve having a first
position wherein the first connection to the treatment loop is in fluid communication with the treatment fluid path of the fluid treatment device and the waste fluid path is not in fluid communication with the treatment fluid path of the fluid treatment device and the first valve having a second position wherein the first connection to the treatment loop is not in fluid communication with the treatment fluid path of the fluid treatment device and the waste fluid path is in fluid communication with the treatment fluid path of the fluid treatment device.

[00115] Paragraph U. In another exemplary embodiment of the present disclosure, in the method of any of Paragraphs L-T the sacrificial metallic substance is aluminum.

[00116] Paragraph V. In another exemplary embodiment of the present disclosure, a method of treating a closed loop heat exchange system. The method comprising the steps of providing a fluid treatment device including a housing and a treatment fluid path at least within the housing; making a first connection to the treatment fluid path of the fluid treatment device, the first connection being in fluid communication with the closed loop heat exchange system to receive a recirculating fluid from the closed loop heat exchange system; making a second connection to the treatment fluid path of the fluid treatment device, the second connection being in fluid communication with the closed loop heat exchange system to return the recirculating fluid to the closed loop heat exchange system; placing a sacrificial metallic substance in the treatment fluid path, the presence of the sacrificial metallic substance in the treatment fluid path resulting in a reduction in the amount of dissolved oxygen in the recirculating fluid; making a third connection to the treatment fluid path of the fluid treatment device, the third connection being in fluid communication with a waste fluid path. At least the first connection and the third connection being configured in an open configuration wherein the recirculating fluid is communicated and a closed configuration wherein the recirculating fluid is not communicated. The fluid treatment device being in a treatment operation when the first connection is in the open configuration and the third connection is in the closed configuration. The fluid treatment device being in a backwashing operation when the first connection is in the closed configuration and the third connection is in the open configuration.

[00117] Paragraph W. In another exemplary embodiment of the present disclosure, in the method of Paragraph V the first connection and the third connection
are made through a three-way valve coupled to the fluid treatment device. The three
way valve having a first orientation wherein the first connection is in fluid
communication with the treatment path of the fluid treatment device and the third
connection is not in fluid communication with the treatment path of the fluid
treatment device and a second orientation wherein the first connection is not in fluid
communication with the treatment path of the fluid treatment device and the third
connection is in fluid communication with the treatment path of the fluid treatment
device.

[00118] Paragraph X. In another exemplary embodiment of the present
disclosure, in the method of Paragraph V the fluid treatment device includes a first
portion and a second portion separatable from the first portion. The second portion
including the first connection, the second connection, and the third connection.

[00119] Paragraph Y. In another exemplary embodiment of the present
disclosure, in the method of Paragraph X the step of placing the sacrificial metallic
substance in the interior of the fluid treatment device includes the steps of: separating
the second portion from the first portion and placing the sacrificial metallic substance
in a holder of fluid treatment device.

[00120] Paragraph Z. In another exemplary embodiment of the present
disclosure, in the method of Paragraph Y the holder is coupled to the second portion.
Further, the step of placing the sacrificial metallic substance in a holder includes the
steps of: opening a cover of the holder relative to a body portion of the holder; placing
the sacrificial metallic substance within an interior of the body portion of the holder;
and closing the cover of the holder relative to the body portion of the holder.

[00121] Paragraph AA. In another exemplary embodiment of the present
disclosure, in the method of Paragraph Z the cover of the holder includes openings to
permit the recirculating fluid to pass there through.

[00122] Paragraph BB. In another exemplary embodiment of the present
disclosure, in the method of any of Paragraphs V-AA, further includes the steps of:
placing a filtering media in the interior of the fluid treatment device and placing at
least one magnetic substance in the interior of the fluid treatment device. The at least
one magnetic substance attracting metallic particles in the recirculating fluid.
[00123] Paragraph CC. In another exemplary embodiment of the present disclosure, in the method of Paragraph BB the metallic particles are removed from the interior of the fluid treatment device by the backwashing operation.

[00124] Paragraph DD. In another exemplary embodiment of the present disclosure, the method of any of Paragraphs V-CC, further includes the step of replenishing the sacrificial metallic substance.

[00125] Paragraph EE. In another exemplary embodiment of the present disclosure, in the method of any of Paragraphs V-DD the sacrificial metallic substance is aluminum.

[00126] Paragraph FF. In another exemplary embodiment of the present disclosure, the method of any of Paragraphs V-EE, further includes the step of placing an anti-bacterial substance to reduce the amount of bacteria in the recirculating fluid in the fluid treatment path of the fluid treatment device.

[00127] Paragraph GG. In another exemplary embodiment of the present disclosure, in the method of Paragraph FF, the anti-bacterial substance includes at least one of copper and silver.

[00128] Paragraph HH. In another exemplary embodiment of the present disclosure, a method of treating a closed loop heat exchange system is provided. The method comprising the steps of: providing a fluid treatment device including a housing and a treatment fluid path at least within the housing; making a first connection to the treatment fluid path of the fluid treatment device, the first connection being in fluid communication with the closed loop heat exchange system to receive a recirculating fluid from the closed loop heat exchange system; making a second connection to the treatment fluid path of the fluid treatment device, the second connection being in fluid communication with the closed loop heat exchange system to return the recirculating fluid to the closed loop heat exchange system; and placing a sacrificial aluminum substance in the treatment fluid path. The presence of the sacrificial aluminum metallic substance in the treatment fluid path resulting in a reduction in the amount of dissolved oxygen in the recirculating fluid.

[00129] Paragraph II. In another exemplary embodiment of the present disclosure, an apparatus for treating a closed loop heat exchange system is provided. The apparatus comprising: a housing having a treatment fluid path, a fluid inlet coupled to the housing and in fluid communication with the treatment fluid path of the
housing and being adapted to couple to the fluid path of the closed loop heat exchange system to receive a recirculating fluid from the closed loop heat exchange system, and a fluid outlet coupled to the housing and in fluid communication with the treatment fluid path of the housing and being adapted to couple to the fluid path of the closed loop heat exchange system to return the recirculating fluid to the closed loop heat exchange system; a holder supported by the housing and positioned in the treatment fluid path; and a sacrificial metallic substance held by the holder. The sacrificial metallic substance being in direct contact with the recirculating fluid flowing in the treatment fluid path. The holder is accessible to add a replenishment of the sacrificial metallic substance without physically disconnecting the housing from the fluid path of the closed loop heat exchanger system.

[00130] Paragraph JJ. In another exemplary embodiment of the present disclosure, in the apparatus of Paragraph II further includes a filter media disposed in the treatment fluid path.

[00131] Paragraph KK. In another exemplary embodiment of the present disclosure, in the apparatus of Paragraph II further includes a plurality of magnets positioned in the treatment fluid path. The magnets attracting metallic particles in the recirculating fluid.

[00132] Paragraph LL. In another exemplary embodiment of the present disclosure, in the apparatus of Paragraph KK further includes a filter media disposed in the treatment fluid path. The filter media being disposed about the plurality of magnets.

[00133] Paragraph MM. In another exemplary embodiment of the present disclosure, in the apparatus of Paragraph LL, the plurality of magnets are arranged such that at least a first magnet and a second magnet are spaced apart. The plurality of magnets being coupled to a magnet holder.

[00134] Although the present invention has been described in detail with reference to preferred embodiments, variations and modifications exist within the scope and spirit of the present invention as described and defined in the following claims.
Claims:

We claim:

1. A method for treating a recirculating fluid of a closed loop heat exchange system, the method comprising the steps of:
   - placing a first quantity of a sacrificial metallic substance in a fluid path of the recirculating fluid of the closed loop heat exchange system, the presence of the sacrificial metallic substance resulting in a reduction in the amount of dissolved oxygen in the recirculating fluid;
   - filtering the recirculating fluid to remove particulate matter; and
   - passing the recirculating fluid through an electrical treatment device which treats the recirculating fluid to reduce the formation of scale on the closed loop heat exchange system.

2. The method of claim 1, wherein the step of passing the recirculating fluid through an electrical treatment device includes the steps of:
   - contacting the recirculating fluid with a first electrode and a second electrode; and
   - providing a potential difference between the first electrode and the second electrode.

3. The method of claim 2, wherein the potential difference is an alternating potential difference.

4. The method of claim 1, wherein the step of passing the recirculating fluid through an electrical treatment device includes the step of passing the recirculating fluid through a loop carrying an electrical current.

5. The method of claim 4, wherein the electrical current is an alternating electrical current.

6. The method of claim 1, wherein the step of placing a first quantity of a sacrificial metallic substance in a fluid path of the recirculating fluid of the closed loop heat exchange system includes the steps of:
   - providing a holder;
   - placing the first quantity of the sacrificial metallic substance in the holder; and
   - passing the recirculating fluid through the holder.

7. The method of claim 1, wherein the first quantity of sacrificial metallic substance includes aluminum.
8. The method of claim 1, wherein the step of filtering the recirculating fluid to remove particulate matter, includes the steps of:
   providing a loose filtering media in a holder;
   providing a plurality of magnets in the holder for attracting metallic particles in the particulate matter; and
   passing the recirculating fluid through the holder.
9. The method of claim 8, further comprising the step of washing the loose filtering media to remove the particulate matter deposited in the loose filtering media or attracted to the plurality of magnets.
10. The method of claim 1, wherein the step of filtering the recirculating fluid to remove particulate matter, includes the steps of:
    providing a filtering media in a holder, the filtering media being a membrane; and
    passing the recirculating fluid through the membrane, the membrane being configured to prevent particulate matter of at least a first size from passing through the membrane.
11. The method of claim 10, wherein the holder is at least one filter bag unit and the membrane is at least one filter bag.
12. A system for treating a recirculating fluid of a closed loop heat exchange system, the system comprising:
    an holder supporting a first quantity of a sacrificial metallic substance for interaction with the recirculating fluid, the presence of the sacrificial metallic substance resulting in a reduction in the amount of dissolved oxygen in the recirculating fluid;
    an electrical treatment device which treats the recirculating fluid to reduce the formation of scale on the closed loop heat exchange system, the electrical treatment device including a wire wrapped around a portion of the fluid path of the recirculating fluid and a control unit which produces an electrical current in the wire, wherein the recirculating fluid flows through the holder and the electrical treatment device.
13. The system of claim 12, further comprising a filtering media which filters particulate matter from the recirculating fluid, wherein the recirculating fluid flows through the holder, the filtering media, and the electrical treatment device.
14. The system of claim 13, wherein the holder and the filtering media are positioned within a second holder, the recirculating fluid passing through both the holder and the second holder.

15. The system of claim 13, wherein the filtering media is supported in a second holder, the filtering media including a membrane configured to prevent particulate matter of at least a first size from passing through the membrane.

16. The system of claim 15, wherein the second holder is at least one filter bag unit and the membrane is at least one filter bag.

17. A system for treating a recirculating fluid of a closed loop heat exchange system, the system comprising:

   a holder supporting a first quantity of a sacrificial metallic substance for interaction with the recirculating fluid, the presence of the sacrificial metallic substance resulting in a reduction in the amount of dissolved oxygen in the recirculating fluid;

   an electrical treatment device which treats the recirculating fluid to reduce the formation of scale on the closed loop heat exchange system, the electrical treatment device including at least a first electrode and a second electrode in direct contact with the recirculating fluid and a control unit which provides a potential difference between the first electrode and the second electrode.

18. The system of claim 17, further comprising a filtering media which filters particulate matter from the recirculating fluid, wherein the recirculating fluid flows through the holder, the filtering media, and the electrical treatment device.

19. The system of claim 18, wherein the holder and the filtering media are positioned within a second holder, the recirculating fluid passing through both the holder and the second holder.

20. The system of claim 18, wherein the filtering media is supported in a second holder, the filtering media including a membrane configured to prevent particulate matter of at least a first size from passing through the membrane.

21. The system of claim 20, wherein the second holder is at least one filter bag unit and the membrane is at least one filter bag.

22. The system of claim 17, wherein the control unit provides an alternating potential difference between the first electrode and the second electrode.
23. A method for treating a closed loop heat exchange system, the method comprising the steps of:
   purging a first recirculating fluid from the closed loop heat exchange system, the recirculating fluid including a chemical treatment;
   introducing a second recirculating fluid into the closed loop heat exchange system; and
   placing a first quantity of a sacrificial metallic substance in a fluid path of the second recirculating fluid, the presence of the sacrificial metallic substance resulting in a level of dissolved oxygen in the second recirculating fluid being about 1 part per million.
24. The method of claim 23, further comprising the step of at a spaced apart time placing a second quantity of the sacrificial metallic substance in the fluid path of the second recirculating fluid to replenish a reduction in the first quantity of the sacrificial metallic substance.
25. The method of claim 23, wherein the step of purging a first recirculating fluid includes the step of draining the first recirculating fluid from the closed loop heat exchange system and wherein the second recirculating fluid is introduced simultaneously.
26. The method of claim 23, wherein the step of placing a first quantity of a sacrificial metallic substance in a fluid path of the second recirculating fluid includes the steps of:
   coupling a fluid treatment device to a first fluid connection of a treatment loop of the closed loop heat exchange system and a second fluid connection of the treatment loop of the closed loop heat exchange system, the treatment loop of the closed loop heat exchange system being in parallel with a main loop of the closed loop heat exchange system, the fluid treatment device including an interior having a treatment fluid path in fluid communication with the first fluid connection of the treatment loop to receive the second recirculating fluid and with the second connection of the treatment loop to return the second recirculating fluid; and
   placing the sacrificial metallic substance in the interior of the fluid treatment device such that the second recirculating fluid flowing in the treatment fluid path contacts the sacrificial metallic substance.
27. The method of claim 26, wherein the fluid treatment device includes a first portion and a second portion separatable from the first portion, the second portion being coupled to the first fluid connection and the second fluid connection.

28. The method of claim 27, wherein the step of placing the sacrificial metallic substance in the interior of the fluid treatment device includes the steps of:
   separating the second portion from the first portion; and
   placing the sacrificial metallic substance in a holder of the fluid treatment device.

29. The method of claim 27, wherein the holder is coupled to the second portion and the step of placing the sacrificial metallic substance in a holder includes the steps of:
   opening a cover of the holder relative to a body portion of the holder;
   placing the sacrificial metallic substance within an interior of the body portion of the holder; and
   closing the cover of the holder relative to the body portion of the holder.

30. The method of claim 29, wherein the cover of the holder includes openings to permit the second recirculating fluid to pass there through.

31. The method of claims 23, further comprising the step of placing a filtering media in the fluid path of the second recirculating fluid.

32. The method of claim 31, wherein the filtering media is at least one filter bag supported in at least one filter bag unit.

33. The method of claims 26, further comprising the steps of:
   placing a filtering media in the fluid path of the second recirculating fluid; and
   placing at least one magnetic substance in the interior of the fluid treatment device, the at least one magnetic substance attracting metallic particles in the second recirculating fluid.

34. The method of claim 33, wherein the metallic particles are removed from the interior of the fluid treatment device by a backwashing operation comprising the steps of:
   preventing the flow of the second recirculating fluid into the treatment fluid path from the first fluid connection of the treatment loop; and
   opening a waste fluid path from the interior of the fluid treatment device, the waste fluid path being at a lower pressure than the second connection to the treatment loop resulting in the second recirculating fluid flowing in the second connection.
through the filtering media in the interior of the fluid treatment device and out through the waste fluid path, the fluid flowing out the waste fluid path including the metallic particles.

35. The method of claim 23, wherein the sacrificial metallic substance is aluminum.

36. A method for treating a recirculating fluid of a closed loop heat exchange system, the method comprising the steps of:

   placing a first quantity of a sacrificial metallic substance in a fluid path of the recirculating fluid of the closed loop heat exchange system, the presence of the sacrificial metallic substance resulting in a reduction in the amount of dissolved oxygen in the recirculating fluid to a level of about 1 part per million; and

   at a spaced apart time placing a second quantity of the sacrificial metallic substance in the fluid path of the recirculating fluid to replenish a reduction in the first quantity of the sacrificial metallic substance in the fluid path.

37. The method of claim 36, wherein the step of placing a first quantity of a sacrificial metallic substance in a fluid path of the recirculating fluid includes the steps of:

   coupling a fluid treatment device to a first fluid connection of a treatment loop of the closed loop heat exchange system and a second fluid connection of the treatment loop of the closed loop heat exchange system, the treatment loop of the closed loop heat exchange system being in parallel with a main loop of the closed loop heat exchange system, the fluid treatment device including an interior having a treatment fluid path in fluid communication with the first fluid connection of the treatment loop to receive the recirculating fluid and with the second connection of the treatment loop to return the recirculating fluid; and

   placing the sacrificial metallic substance in the interior of the fluid treatment device such that the recirculating fluid flowing in the treatment fluid path contacts the sacrificial metallic substance.

38. The method of claim 37, wherein the fluid treatment device includes a first portion and a second portion separable from the first portion, the second portion being coupled to the first fluid connection and the second fluid connection.

39. The method of claim 38, wherein the step of placing the sacrificial metallic substance in the interior of the fluid treatment device includes the steps of:

   separating the second portion from the first portion; and
placing the sacrificial metallic substance in a holder of fluid treatment device.

40. The method of claims 36, further comprising the step of placing a filtering media in the fluid path of the recirculating fluid.

41. The method of claim 40, wherein the filtering media is at least one filter bag supported in at least one filter bag unit.

42. The method of claim 40, further comprising the step of placing at least one magnetic substance in the interior of the fluid treatment device, the at least one magnetic substance attracting metallic particles in the second recirculating fluid.

43. A method of treating a recirculating fluid of a closed loop heat exchange system, the method comprising the steps of:

- providing a fluid treatment device including a housing and a treatment fluid path at least within the housing;
- making a first connection to the treatment fluid path of the fluid treatment device, the first connection being in fluid communication with the closed loop heat exchange system to receive the recirculating fluid from the closed loop heat exchange system;
- making a second connection to the treatment fluid path of the fluid treatment device, the second connection being in fluid communication with the closed loop heat exchange system to return the recirculating fluid to the closed loop heat exchange system;
- placing a sacrificial metallic substance in the treatment fluid path, the presence of the sacrificial metallic substance in the treatment fluid path resulting in a reduction in the amount of dissolved oxygen in the recirculating fluid; and
- making a third connection to the treatment fluid path of the fluid treatment device, the third connection being in fluid communication with a waste fluid path, wherein at least the first connection and the third connection are configured in an open configuration wherein the recirculating fluid is communicated and a closed configuration wherein the recirculating fluid is not communicated, the fluid treatment device being in a treatment operation when the first connection is in the open configuration and the third connection is in the closed configuration and the fluid treatment device being in a backwashing operation when the first connection is in the open configuration and the third connection is in the open configuration.
44. The method of claim 43, wherein the first connection and the third connection are made through a three-way valve coupled to the fluid treatment device, the three way valve having a first orientation wherein the first connection is in fluid communication with the treatment path of the fluid treatment device and the third connection is not in fluid communication with the treatment path of the fluid treatment device and a second orientation wherein the first connection is not in fluid communication with the treatment path of the fluid treatment device and the third connection is in fluid communication with the treatment path of the fluid treatment device.

45. The method of claim 43, wherein the fluid treatment device includes a first portion and a second portion separatable from the first portion, the second portion including the first connection, the second connection, and the third connection.

46. The method of claim 45, wherein the step of placing the sacrificial metallic substance in the interior of the fluid treatment device includes the steps of:
   separating the second portion from the first portion; and
   placing the sacrificial metallic substance in a holder of fluid treatment device.

47. The method of claims 43, further comprising the step of placing a filtering media in the fluid path of the recirculating fluid.

48. The method of claim 47, wherein the filtering media is at least one filter bag supported in at least one filter bag unit.

49. The method of claims 43, further comprising the steps of:
   placing a filtering media in the fluid path of the recirculating fluid; and
   placing at least one magnetic substance in the interior of the fluid treatment device, the at least one magnetic substance attracting metallic particles in the second recirculating fluid.

50. The method of claim 43, further comprising the step of placing an anti-bacterial substance to reduce the amount of bacteria in the recirculating fluid in the fluid treatment path of the fluid treatment device.

51. The method of claim 50, wherein the anti-bacterial substance includes at least one of copper and silver.

52. An apparatus for treating a recirculating fluid of a closed loop heat exchange system, the apparatus comprising:
   a housing having a treatment fluid path, a fluid inlet coupled to the housing and in fluid communication with the treatment fluid path of the housing and being
adapted to couple to the fluid path of the closed loop heat exchange system to receive
the recirculating fluid from the closed loop heat exchange system, and a fluid outlet
coupled to the housing and in fluid communication with the treatment fluid path of the
housing and being adapted to couple to the fluid path of the closed loop heat exchange
system to return the recirculating fluid to the closed loop heat exchange system;

a holder supported by the housing and positioned in the treatment fluid path; and

a sacrificial metallic substance held by the holder, the sacrificial metallic
substance being in direct contact with the recirculating fluid flowing in the treatment
fluid path, wherein the holder is accessible to add a replenishment of the sacrificial
metallic substance without physically disconnecting the housing from the fluid path of
the closed loop heat exchanger system.

53. The apparatus of claim 52, further comprising a filter media disposed in the
treatment fluid path.
54. The apparatus of claim 52, further comprising a plurality of magnets positioned in
the treatment fluid path, the magnets attracting metallic particles in the recirculating
fluid.
55. The apparatus of claim 54, further comprising a filter media disposed in the
treatment fluid path, the filter media being disposed about the plurality of magnets.
56. The apparatus of 55, wherein the plurality of magnets are arranged such that at
least a first magnet and a second magnet are spaced apart, the plurality of magnets
being coupled to a magnet holder.
57. A method for treating a recirculating fluid of a closed loop heat exchange system,
the method comprising the steps of:

placing a first quantity of a sacrificial metallic substance in a fluid path of the
recirculating fluid of the closed loop heat exchange system, the presence of the
sacrificial metallic substance resulting in a reduction in the amount of dissolved
oxygen in the recirculating fluid;

filtering the recirculating fluid to remove particulate matter; and

automatically switching between a treatment operation and a backwashing
operation, during the treatment operation passing the recirculating fluid by the
sacrificial metallic substance and filtering the recirculating fluid and during the
backwashing operation using the recirculating fluid to dispose of the particulate
matter removed during the step of filtering the recirculating fluid during the treatment operation.

58. The method of claim 57, wherein the step of automatically switching between a treatment operation and a backwashing operation is controlled by a controller having at least a first timer corresponding to a first time period between successive backwashing operations.

59. The method of claim 58, wherein the controller operates a motorized valve.

60. The method of claim 58, wherein the controller includes a second timer corresponding to a duration of a backwashing operation.

61. The method of claim 57, further comprising the step of passing the recirculating fluid through an electrical treatment device which treats the recirculating fluid to reduce the formation of scale on the closed loop heat exchange system.

62. A method of a first entity treating a recirculating fluid of a closed loop heat exchange system for a second entity, the method comprising the steps of:

- placing a first quantity of a sacrificial metallic substance in a fluid path of the recirculating fluid of the closed loop heat exchange system, the presence of the sacrificial metallic substance resulting in a reduction in the amount of dissolved oxygen in the recirculating fluid;
- filtering the recirculating fluid to remove particulate matter;
- passing the recirculating fluid through an electrical treatment device which treats the recirculating fluid to reduce the formation of scale on the closed loop heat exchange system; and
- providing a service contract between the first entity and the second entity, the service contract including a provision for the second entity to pay the first entity for at least periodically replenishing the sacrificial metallic substance.
Fig. 1
(PriorArt)
Fig. 6
Fig. 7