

DESCRIPTION

Title of Invention

CONTAINER FOR SOLID WATER TREATMENT AGENT, CONTAINER SET AND WATER TREATMENT METHOD

Technical Field

[0001]

The present invention relates to a container for solid water treatment agent, which is used for storing and dissolving a solid water treatment agent for suppressing corrosion, scale or generation of bacteria in cooling water in a cooling tower of an air conditioner or cooling equipment, a container set including the container, and a water treatment method using the container or the container set.

Background Art

[0002]

Cooling water in an air conditioner or cooling equipment is circulated water, and a deterioration in water quality caused by corrosion, scale, or generation of bacteria may affect an operation of the air conditioner or cooling equipment. To suppress such a deterioration in water quality, a water treatment agent has conventionally been added to cooling water.

As the water treatment agent, a liquid chemical has been mainly used, and continuously injected and added into a water system to be treated using, for example, a chemical feed pump from the viewpoint of continuing the chemical effect over a long period. However, a solid chemical is more convenient than a liquid chemical in terms of handling and cost.

[0003]

As the solid chemical to be added to cooling water, for example, PTL1 proposes a gradually soluble solid water treatment agent from which an active substance is gradually released into a water system from the viewpoint of continuing the chemical effect over a long period.

[0004]

PTL2 describes that a solid chemical placed in a container having opposed water-permeable surfaces is used so that the solid chemical can be added to both

a counterflow-type (round) cooling tower and a crossflow-type (rectangular) cooling tower.

[0005]

PTL3 describes a solid chemical dissolving apparatus in which an inner cylinder having a first water passing hole is circumferentially moved relative to an outer cylinder having a second water passing hole and into which the inner cylinder is almost tightly inserted, thereby adjusting opening of a communication hole.

Citation List

Patent Literature

[0006]

PTL1: JP 2015-93260 A

PTL2: JP 63-252597 A

PTL3: JP 3173540 U

Summary of Invention

Technical Problem

[0007]

Even if the solid chemical described in PTL1 is used, when the solid chemical is exposed and added to a cooling tower, an active substance of the solid chemical may be locally contained at high concentration in a cooling water system such that, for example, the active substance remains undissolved in the cooling tower or a dissolved solution at high concentration adheres inside the cooling tower depending on a degree of immersion in the cooling water. In such a case, some types of active substances may cause corrosion in the cooling tower.

[0008]

The container as described in PTL2 facilitates handling of a solid chemical. However, when a solid chemical soluble in water is used, an active substance cannot be gradually released over a long period. This limits types of solid chemicals that can be placed in the container and used to gradually release an active substance.

[0009]

In the apparatus as described in PTL3, the communication hole requires to be manually opened and closed by rotating the inner cylinder every time a

dissolving speed of a solid chemical is adjusted according to changes in flow amount or flow speed of water to be treated, and an operation of the apparatus is troublesome.

[0010]

The present invention is achieved in view of solving the above problems, and has an object to provide a container for solid water treatment agent used in a cooling tower, which is applicable to both a counterflow-type (round) cooling tower and a crossflow-type (rectangular) cooling tower, is capable of gradually releasing an active substance of a solid water treatment agent over a long period, and can be simply and conveniently handled, a container set including the container, and a water treatment method using the container or the container set.

Solution to Problem

[0011]

From repeated studies on a container used in a cooling tower and capable of appropriately dissolving a solid water treatment agent, it is found that a specific structure is suitably applicable to both a counterflow-type (round) cooling tower and a crossflow-type (rectangular) cooling tower. The present invention is based on such findings.

[0012]

[Container for solid water treatment agent]

A container for solid water treatment agent of the present invention is a container for solid water treatment agent arranged in a cooling tower, including: a container body; and a partition wall that partitions an inside of the container body into one or more storage chambers that store the solid water treatment agent and a non-storage chamber that does not store the solid water treatment agent, wherein the container body includes one or more container communication paths that allow cooling water to flow between an outside of the container body and the non-storage chamber, and the partition wall includes one or more partition wall communication paths that allow the cooling water to flow between the storage chamber and the non-storage chamber.

Such a container has a configuration applicable to both a counterflow-type (round) cooling tower and a crossflow-type (rectangular) cooling tower, and can appropriately dissolve the solid water treatment agent in the storage chamber.

[0013]

The partition wall that partitions the inside of the container body serves to prevent the solid water treatment agent from coming into direct contact with the cooling water flowing into the container body. The partition wall reduces a contact area of the solid water treatment agent in the storage chamber with the cooling water, and the solid water treatment agent partially comes into contact with the cooling water, thereby reducing a dissolution speed. This allows an active substance of the solid water treatment agent to be gradually released out of the container.

[0014]

The cooling water in which the solid water treatment agent is dissolved (hereinafter also referred to as a "dissolved solution") at least partially flows through the partition wall communication path into the non-storage chamber. Specifically, the dissolved solution does not totally directly flow out of the container, but is partially once retained in the non-storage chamber and then released out of the container. Thus, as compared to a case where a conventional container or apparatus for a solid chemical is used in which a solid water treatment agent is exposed and directly introduced into a cooling tower or which does not include a non-storage chamber, the active substance of the solid water treatment agent can be more gradually released into the cooling tower, an undissolved piece of the solid water treatment agent or a dissolved solution at high concentration can be prevented from coming into contact with the inside of the cooling tower, and the active substance can be more effectively diffused.

[0015]

The partition wall is preferably a vertically extending cylinder. The partition wall having such a shape allows the solid water treatment agent to be easy to be stored and additionally replenished in the storage chamber.

At least one of the partition wall communication paths preferably extends to a bottom surface of the container body. The partition wall communication path provided near the bottom surface of the container body ensures that the cooling water and the dissolved solution flow between the storage chamber and the non-storage chamber even if a level of the cooling water flowing into the container body is low.

[0016]

At least one of the container communication paths is preferably provided in a top of the container body. The container communication path provided in the

top of the container body allows the cooling water distributed in the cooling tower and dropping from above to be easily guided into the container body.

At least one of the container communication paths is preferably provided in a bottom of the container body. The container communication path provided in the bottom of the container body ensures that the dissolved solution is released to an underside of the container, and prevents the dissolved solution from being retained in the container during a stop of an operation of the cooling tower. In this case, a leg is preferably protruded from a bottom outer wall of the container body. The leg provided as such prevents the container communication path in the bottom of the container body from being closed even if the container is placed somewhere.

At least one of the container communication paths may be provided in a side periphery of the container body.

[0017]

The solid water treatment agent is preferably a tablet. The tablet is easily handled when the solid water treatment agent is stored in the storage chamber. The tablet is also preferable from the viewpoint of reducing the dissolution speed of the solid water treatment agent.

[0018]

The container body and the partition wall are preferably transparent. The transparent container body and partition wall allow a state of the solid water treatment agent in the container to be visually checked from outside the container.

[0019]

[Container set for solid water treatment agent]

A container set for solid water treatment agent of the present invention is a container set for a solid water treatment agent including: one or more of the containers for solid water treatment agent described above; and a frame having a through hole in which the container can be individually fitted and held, wherein the frame is formed to expose the container communication path of the container held in the frame.

The frame facilitates carrying and handling of the container. Particularly for a plurality of the containers, the frame makes it possible to integrally handle the plurality of the containers, and also prevent falling of the containers.

Thus the container set for a solid water treatment agent is excellent in convenience.

[0020]

The frame is preferably formed of a member capable of floating and holding the container on a water surface so that at least a top outer wall of the container is exposed on the water surface. Since the frame serves as a "float", the container can be used in a form of floating on cooling water in a cooling water pit or the like.

[0021]

[Water treatment method]

An aspect of a water treatment method of the present invention is a water treatment method using the above container for solid water treatment agent, including: the container that stores the solid water treatment agent in the storage chamber being arranged in a cooling tower so that dropping cooling water hits a top outer wall of the container; the cooling water flowing through the container communication path into the non-storage chamber, and then flowing from the non-storage chamber through the partition wall communication path into the storage chamber; the solid water treatment agent in contact with the cooling water having flowed into the storage chamber being dissolved; and the cooling water in which the solid water treatment agent has been dissolved flowing out of the container through the container communication path, to water-treat the cooling water in the cooling tower.

With such a method, the cooling water distributed in the cooling tower and dropping from above can flow into the container body and then be guided into the storage chamber to come into contact with the solid water treatment agent. This allows an active substance of the solid water treatment agent to be gradually released and diffused out of the container.

[0022]

In the water treatment method, it is preferable that a sound absorbing mat is arranged in the cooling tower and the container is placed on the sound absorbing mat. Placing the container on the sound absorbing mat that the cooling water distributed in the cooling tower and dropping from above is likely to hit allows the cooling water to flow into the container body with the container being stable.

[0023]

Another aspect of the water treatment method of the present invention is a water treatment method using the above container for solid water treatment agent, including: the container that stores the solid water treatment agent in the storage chamber being floated on a water surface of cooling water in a cooling water pit in a cooling tower so as to expose at least a top outer wall of the container on the water surface; the cooling water flowing through the container communication path into the non-storage chamber, and then flowing from the non-storage chamber through the partition wall communication path into the storage chamber; the solid water treatment agent in contact with the cooling water having flowed into the storage chamber being dissolved; and the cooling water in which the solid water treatment agent has been dissolved flowing out of the container through the container communication path, to water-treat the cooling water in the cooling tower.

When the container can be floated on the water surface, the container can be floated in the cooling water pit, and the cooling water in the cooling water pit can flow into the container body and then be guided into the storage chamber to come into contact with the solid water treatment agent. This allows an active substance of the solid water treatment agent to be gradually released and diffused out of the container.

[0024]

A further aspect of the water treatment method of the present invention is a water treatment method using the above container set for solid water treatment agent, including: the container set that stores the solid water treatment agent in the storage chamber being arranged in a cooling tower so that dropping cooling water hits a top outer wall of the container; the cooling water flowing through the container communication path into the non-storage chamber, and then flowing from the non-storage chamber through the partition wall communication path into the storage chamber; the solid water treatment agent in contact with the cooling water having flowed into the storage chamber being dissolved; and the cooling water in which the solid water treatment agent has been dissolved flowing out of the container through the container communication path, to water-treat the cooling water in the cooling tower.

Using the container set facilitates carrying and handling the container as compared to the above method using only the container. Particularly for a plurality of the containers, a frame makes it possible to integrally handle the

plurality of the containers, and also prevent falling of the containers. Thus the container set for a solid water treatment agent is excellent in convenience.

Particularly when two or more types of solid water treatment agents reactive to each other are used in combination, the solid water treatment agents can be stored in separate containers and dissolved in the cooling water in the cooling tower with a space being ensured between the agents, which is preferable in terms of safety.

In the water treatment method using such a container set, similarly to the above method using only the container, it is preferable that a sound absorbing mat is arranged in the cooling tower and the container set is placed on the sound absorbing mat.

[0025]

A further aspect of the water treatment method of the present invention is a water treatment method using the above container set for solid water treatment agent, including: the container set that stores the solid water treatment agent in the storage chamber being floated on a water surface of cooling water in a cooling water pit in a cooling tower so as to expose at least a top outer wall of the container on the water surface; the cooling water flowing through the container communication path into the non-storage chamber, and then flowing from the non-storage chamber through the partition wall communication path into the storage chamber; the solid water treatment agent in contact with the cooling water having flowed into the storage chamber being dissolved; and the cooling water in which the solid water treatment agent has been dissolved flowing out of the container through the container communication path to water-treat the cooling water in the cooling tower.

When a frame is used, formed of a member capable of floating and holding the container on the water surface so as to expose at least the top outer wall of the container above the water surface, even a plurality of the containers can be integrally floated as the container set in the cooling water pit. Then, similarly to the above method using only the container, the cooling water in the cooling water pit can flow into the container body and then be guided into the storage chamber to come into contact with the solid water treatment agent. This allows an active substance of the solid water treatment agent to be gradually released and diffused out of the container.

Particularly when two or more types of solid water treatment agents reactive to each other are used in combination, the solid water treatment agents can be stored in separate containers and dissolved in the cooling water in the cooling tower with a space being ensured between the agents, which is preferable in terms of safety.

[0026]

In the above water treatment method, one or more of the containers for solid water treatment agent that store a solid agent (A) of a halogen-based oxidant as a solid water treatment agent, and one or more of the containers for solid water treatment agent that store a solid agent (B) containing organic bactericide reactive to the halogen-based oxidant as a solid water treatment agent are preferably used in combination.

The water treatment method of the present invention is suitable for using such two types of chemicals reactive to each other as solid water treatment agents from the viewpoint of exhibiting a continuous effect of bactericidal activity of the cooling water in the cooling tower.

For the solid water treatment agents, it is preferable that the halogen-based oxidant contains 1-bromo-3-chloro-5,5-dimethylhydantoin as an active substance, and the organic bactericide contains 5-chloro-2-methyl-4-isothiazolin-3-one as an active substance from the viewpoint of bactericidal activity, particularly bactericidal activity against *Legionella* species.

Advantageous Effects of Invention

[0027]

The container for solid water treatment agent and the container set including the container of the present invention are applicable to both a counterflow-type (round) cooling tower and a crossflow-type (rectangular) cooling tower, and capable of gradually releasing the active substance of the solid water treatment agent over a long period. The container and the container set have a simple configuration and can be easily and conveniently handled.

Thus, with the water treatment method using the container for solid water treatment agent or the container set including the container, the cooling water in the cooling tower can be easily treated. Also, an effect of a chemical of the solid water treatment agent can be continued over a long period.

Brief Description of Drawings

[0028]

[Fig. 1] Fig. 1 is a perspective view schematically showing a container for solid water treatment agent according to a first embodiment of the present invention.

[Fig. 2] Fig. 2 is a vertical sectional view of the container shown in Fig. 1.

[Fig. 3] Fig. 3 is a perspective view schematically showing a container for solid water treatment agent according to a second embodiment of the present invention.

[Fig. 4] Fig. 4 is a vertical sectional view of the container shown in Fig. 3.

[Fig. 5] Fig. 5 is a perspective view schematically showing a container set for solid water treatment agent according to an embodiment of the present invention.

[Fig. 6] Fig. 6 is a vertical sectional view of the container set shown in Fig. 5 being set.

[Fig. 7] Fig. 7 is a vertical sectional view for illustrating a water treatment method according to a first embodiment of the present invention using a container 10.

[Fig. 8] Fig. 8 is a vertical sectional view for illustrating a water treatment method according to a second embodiment of the present invention using the container 10.

Description of Embodiments

[0029]

Now, embodiments of the present invention will be described in detail with reference to the drawings. However, the present invention is not limited to the embodiments described below.

[0030]

[Container for solid water treatment agent]

<First embodiment>

Figs. 1 and 2 schematically show a container for solid water treatment agent according to a first embodiment of the present invention. Fig. 1 is a perspective view of the container according to the first embodiment, and Fig. 2 is a vertical sectional view of the container. A container 10 shown in Fig. 1 includes a substantially cylindrical container body 11, and a partition wall 12 that partitions an inside of the container body 11. As shown in Fig. 2, the cylindrical partition wall 12 with an open at a lower end partitions the inside of

the container body 11 into a storage chamber 13 that stores a solid water treatment agent S1 and a non-storage chamber 14 that does not store the solid water treatment agent.

[0031]

(Container body 11)

The container body 11 is configured so that an upper member 11a fits in a lower member 11b. The container body can be preferably dividable and easily integrated from the viewpoint of the solid water treatment agent being easily stored and additionally replenished in the storage chamber.

A shape and size of the container body are not limited, but may be appropriately determined from the viewpoint of storing the solid water treatment agent and from the viewpoint of considering a size of a cooling tower or carrying and handling of the container. For example, the container body may have a cylindrical shape with a round, elliptical or polygonal section, or a shape with a generally rounded outer surface. The container body is preferably of such a size as to be lifted by one hand for easy handling.

The lower member 11b has a flange 18 at an upper opening for convenience of use as a container set described later.

An inner wall of a top of the storage chamber 13, that is, a top inner wall of the upper member 11a may have a rib-like protrusion. This can prevent the solid water treatment agent as a tablet from adhering to the top inner wall, and increase strength of the container body.

[0032]

In the top of the upper member 11a, near a bottom of a side periphery of the lower member 11b, and in a bottom of the lower member 11b, container communication paths 15a, 15b, and 15c are provided, respectively, which allow the cooling water to flow between an outside of the container body 11 and the non-storage chamber 14.

A shape, size, layout, and the number of the container communication paths are not limited, but may be appropriately determined according to a desired flow amount of the cooling water as long as the cooling water can flow through the container communication path. The container communication path may be in the shape of, for example, a round hole, a rectangular hole, a slit, a mesh, or the like. In the container body 11 (the lower member 11b in this embodiment), "near a bottom" may be a position less than 1/3 of a height of the

container body 11 from the bottom when the container communication path is provided near the bottom of the side periphery.

In this embodiment, the top outer wall of the upper member 11a is recessed so that a portion having the container communication path 15a formed thereon is lower than an outer peripheral edge for dropping cooling water to easily flows into the container communication path 15a.

The container communication path 15a is arranged above the non-storage chamber 14, and provides communication between the non-storage chamber 14 and the outside of the container 10.

[0033]

A ring-shaped leg 17 is protruded from a bottom outer side of the lower member 11b.

A shape and size of the leg is not limited, but may be determined so that with the container being placed on a surface, the container communication path 15c in the bottom of the lower member 11b is not closed by the surface. The leg preferably has such a shape that the container can be stably placed. The leg may be in the shape of, for example, a ring, a ring with a through hole, a ring with a slit, a plurality of small cylindrical protrusions, or radial protrusions.

[0034]

(Partition wall 12)

The partition wall 12 is a cylinder and suspended from the top inner wall of the upper member 11a. In the container body 11 including the upper member 11a fitting in the lower member 11b, the storage chamber 13 is located inside the cylindrical partition wall 12 and the non-storage chamber 14 is located outside the partition wall 12.

The partition wall may be provided in contact with a side peripheral inner wall or a bottom inner wall of the container body according to the shape of the container body. The partition wall may not be necessarily in contact with the container body, but may be formed to partition the inside of the container body into the storage chamber and the non-storage chamber via a support member or the like. A shape and thickness of the partition wall are not limited as long as a space of the storage chamber and the non-storage chamber can be kept during use of the container. The partition wall may have, for example, a cylindrical shape with a round, elliptical or polygonal section, or a shape with a generally rounded outer surface as a whole shape.

However, the storage chamber is preferably provided so that its center of gravity is around a center of the bottom of the container with the storage chamber storing the solid water treatment agent from the viewpoint of preventing the container from falling down.

[0035]

The shape, size, and layout of the partition wall 12 are determined by adapting to an outer peripheral shape of the solid water treatment agent S1 so that the solid water treatment agent S1 as a tablet can be stored with allowance (play) from the viewpoint of facility of storage and additional replenishment of the solid water treatment agent S1 in the storage chamber 13. Similarly, for example, a vertical rib-like protrusion or the like may be provided on the partition wall on the side of the storage chamber. Such a protrusion or the like also serves to prevent the solid water treatment agent from adhering to the partition wall.

A type of the solid water treatment agent stored and used in the container of the present invention is not limited, but the solid water treatment agent may be a solid chemical usable as a water treatment agent for cooling water in the cooling tower. The solid water treatment agent may be easily dissolved when coming into contact with water. A form of the solid water treatment agent is not limited, but the solid water treatment agent is preferably a tablet in the form of a pellet or a pill, or granules, from the viewpoint of easy adjustment of an amount used, easy handling, and the like. A tablet is more preferable from the viewpoint of facility of storage and additional replenishment in the storage chamber and a reduction in dissolution speed.

[0036]

The partition wall 12 is arranged in non-contact with a bottom surface of the lower member 11b. A clearance between a lower end of the cylindrical partition wall 12 and the bottom surface of the lower member 11b facing the lower end forms a partition wall communication path 16 that allows the cooling water to flow between the storage chamber 13 and the non-storage chamber 14.

A shape, size, layout, and the number of the partition wall communication paths are not limited, but may be appropriately determined according to a desired flow amount of the cooling water as long as the cooling water can flow through the partition wall communication path. The partition wall communication path may be in the shape of, for example, a round hole, a

rectangular hole, a slit, a mesh, or the like. When the partition wall is a cylinder, the lower end of the cylinder is in contact with the bottom surface of the container body facing the lower end, and the partition wall communication path may be formed in such a manner that a clearance is created at least partially between the cylinder and the bottom surface of the container body.

However, at least one of the partition wall communication paths preferably extends to the bottom surface of the container body from the viewpoint of better ensuring that the cooling water flows between the storage chamber and the non-storage chamber, even if a level of the cooling water having flowed into the non-storage chamber is low.

[0037]

The container 10 is made of translucent polypropylene.

The container body and the partition wall are preferably transparent from the viewpoint that a state of the solid water treatment agent in the container can be easily visually checked from outside the container. Since used in the cooling tower, the container is preferably made of plastic from the viewpoint of easy handling and water resistance.

[0038]

<Second embodiment>

Figs. 3 and 4 schematically show a container for solid water treatment agent according to a second embodiment of the present invention. Fig. 3 is a perspective view of the container according to the second embodiment, and Fig. 4 is a vertical sectional view of the container. A container 20 shown in Fig. 3 includes a cylindrical container body 21 having a cocoon-shaped section. As shown in Fig. 4, a cylindrical partition wall 22 with an open at a lower end partitions an inside of the container body 21 into two storage chambers 23 that store a solid water treatment agent S2 and a non-storage chamber 24 that does not store the solid water treatment agent.

Similarly to the container body 11 of the container 10 described above, the container body 21 is configured so that an upper member 21a fits in a lower member 21b. As in the container 10 described above, the lower member 21b also has a flange 28 at an upper opening for convenience of use as a container set described later.

In a top of the upper member 21a, near a bottom of a side periphery of the lower member 21b, and in a bottom of the lower member 21b, container

communication paths 25a, 25b, and 25c are provided, respectively, which allow the cooling water to flow between an outside of the container body 21 and the non-storage chamber 24. A total sectional area of the container communication paths 25b and 25c is smaller than that of the container communication paths 15b and 15c. Thus, the container 20 has a structure more suitable for reducing a dissolution speed of the solid water treatment agent than the container 10.

A ring-shaped leg 27 is provided on a bottom outer side of the lower member 21b.

Other configurations are the same as those of the container 10 described above.

[0039]

[Container set for solid water treatment agent]

Figs. 5 and 6 schematically show a container set for solid water treatment agent according to an embodiment of the present invention. A container set 40 for solid water treatment agent shown in Fig. 5 includes the container 10 shown in Figs. 1 and 2 and the container 20 shown in Figs. 3 and 4 that are fitted in a frame 30 and integrated. The containers 10 and 20 are held so as not to fall off the frame 30 by the flanges 18 and 28 of the containers being locked on inner walls of through holes in the frame 30 in which the containers are fitted, and so that the legs 17 and 27 of the containers 10 and 20 can be supported on the same plane. The container communication paths of the containers 10 and 20 are not covered with the frame 30 but are exposed.

[0040]

The container set may include only one container or two or more containers being set. For two or more containers, the solid water treatment agent stored in each of the containers may be the same type, or may be different types for each of the containers. The container being set is the container for solid water treatment agent according to the present invention, and in this embodiment, two of the containers 10 and one of the container 20 are used. However, a specific form, layout, and the number of the containers may be appropriately chosen according to a dissolution speed or an effect of a chemical of the solid water treatment agent stored in the containers.

[0041]

The frame 30 is made of styrene foam, and the containers 10 and 20 together with the frame 30 can be floated on the water surface so that at least the top outer walls of the containers are exposed on the water surface.

The frame is preferably made of a material light in weight and resistant to water from the viewpoint that the container set can be floated on water. The frame may be made of, for example, lightweight plastic or styrene foam from the viewpoint of handling, cost and the like.

The frame 30 has a grip 31 on an outer periphery. Such a grip or a handle facilitates carrying and handling the container set.

A form of the frame is not limited as long as the frame can separately hold the containers and does not cover the container communication paths of the containers. The frame may be formed of one member or two or more members in combination.

[0042]

[Water treatment method]

<First embodiment>

With reference to Fig. 7, a water treatment method according to a first embodiment of the present invention for water-treating cooling water in the cooling tower using the container 10 will be described. Arrows in Fig. 7 show flow directions of the cooling water.

In the first embodiment, the container 10 that stores the solid water treatment agent S1 in the storage chamber 13 is arranged in the cooling tower so that dropping cooling water hits the top outer wall of the container 10.

In a counterflow-type (round) cooling tower including a sound absorbing mat, the container 10 is preferably placed on the sound absorbing mat. The container 10 may be placed on a water distribution plate or the like. The container 10 may be arranged in the cooling tower using a support member such as a strap or a mount.

In a crossflow-type (rectangular) cooling tower, a portion for placing the container 10 may be provided in the cooling tower, for example, near a louver on a side periphery of the cooling tower, and the container 10 may be arranged on the portion. In such a case, for example, a trough is preferably provided so as to guide the cooling water from a filler in the cooling tower to the top of the container 10.

[0043]

The cooling water flows through the container communication path 15a into the non-storage chamber 14, and flows from the non-storage chamber 14 through the partition wall communication path 16 into the storage chamber 13. The solid water treatment agent S1 in the storage chamber 13 comes into contact with the cooling water having flowed into the storage chamber 13 and is dissolved. The cooling water in which the solid water treatment agent S1 is dissolved (dissolved solution) flows out of the container 10 through the container communication paths 15b and 15c. With such a flow of the cooling water, the solid water treatment agent is used to water-treat the cooling water in the cooling tower.

The amount of cooling water retained in the non-storage chamber changes depending on a size of the non-storage chamber or a flow-in speed and a flow-out speed of the cooling water. The larger an amount of retained cooling water is, the further a dissolution speed of the solid water treatment agent can be reduced. [0044]

In such an embodiment, when the cooling water flowing through the container communication path 15a drops, waterdrops are likely to splash and be diffused in the container 10. However, the partition wall 12 prevents the cooling water from hitting the solid water treatment agent S1 in a portion surrounded by the partition wall 12, thereby reducing the dissolution speed of the solid water treatment agent S1.

When the dissolution speed of the solid water treatment agent S1 is to be increased, a cooling water flow-in path may be provided in a position where the cooling water dropping in the cooling tower directly flows from outside the container body 11 into the storage chamber 13, that is, near a center of the top of the container 10 according to a desired dissolution speed. [0045]

<Second embodiment>

With reference to Fig. 8, a water treatment method according to a second embodiment of the present invention for water-treating cooling water in the cooling tower using the container 10 will be described. Arrows in Fig. 8 show flow directions of the cooling water.

In the second embodiment, the container 10 that stores the solid water treatment agent S1 in the storage chamber 13 is floated on a water surface of the cooling water in the cooling water pit in the cooling tower so as to expose at least

the top outer wall of the container 10 on the water surface. The cooling water pit may be an upper pit that stores the distributed cooling water or a lower pit.

In this embodiment, a material and form of the container need to be such that the container floats on the water surface. If it is difficult for the container only to float, the container set used in combination with the frame that serves as a "float" as described above can be used to float the container.

To prevent the container from floating in a broad range, a fence or the like may be provided for anchoring the container or fixing a floating range.

[0046]

The cooling water flows through the container communication paths 15b and 15c into the non-storage chamber 14, and flows from the non-storage chamber 14 through the partition wall communication path 16 into the storage chamber 13. The solid water treatment agent S1 in the storage chamber 13 comes into contact with the cooling water having flowed into the storage chamber 13 and is dissolved. The cooling water in which the solid water treatment agent S1 is dissolved (dissolved solution) flows out of the container 10 through the container communication paths 15b and 15c. With such a flow of the cooling water, the solid water treatment agent is used to water-treat the cooling water in the cooling tower.

In this embodiment, the container communication path 15a serves as a vent. However, if dropping cooling water hits the top outer wall of the container 10, the cooling water may also flow through the container communication path 15a into the non-storage chamber 14.

[0047]

Also when using the container 20 and the container for solid water treatment agent according to other embodiments of the present invention, the water treatment method of the present invention may be performed in the same manner as in the first and second embodiments described above.

[0048]

<Third embodiment>

A water treatment method according to a third embodiment of the present invention is performed using the container set for solid water treatment agent according to the embodiment described above. The water treatment method of the present invention may be performed in the same manner as in the first

embodiment except that the container 10 used in the first embodiment is replaced by a container set 40.

With such a container set, for water treatment using not only one type of solid water treatment agent but also two or more types of solid water treatment agents, containers that store the solid water treatment agents can be integrally handled, and falling of the containers can be prevented, which is very convenient.
[0049]

In this embodiment, the container 20 stores, as a solid water treatment agent S2, a solid agent (A) containing 1-bromo-3-chloro-5,5-dimethylhydantoin as an active substance, and the two containers 10 store, as a solid water treatment agent S1, a solid agent (B) containing 5-chloro-2-methyl-4-isothiazolin-3-one as an active substance. These two types of chemicals are suitably used in combination from the viewpoint of bactericidal activity against Legionella species in the cooling water.

Since the solid agent (A) is more likely to be dissolved than the solid agent (B) when coming into contact with water, the containers 10 store the solid agent (B) and the container 20, which is more likely to reduce a dissolution speed, stores the solid agent (A) from the viewpoint of controlling the dissolution speeds of the solid agents (A) and (B).

The solid agent (A) is a halogen-based oxidant, and the solid agent (B) is organic bactericide reactive to the halogen-based oxidant. Water treatment performed with the solid agent (A) being in contact with the solid agent (B) generates a chlorine gas. In this respect, this embodiment can ensure that the solid agent (A) and the solid agent (B) are kept in non-contact with each other, thereby allowing safe and effective water treatment.

[0050]

<Fourth embodiment>

A water treatment method according to a fourth embodiment of the present invention is performed also using the container set for solid water treatment agent according to the embodiment described above. The water treatment method of the present invention may be performed in the same manner as in the second embodiment except that the container 10 used in the second embodiment is replaced by a container set 40.

For water treatment with the container being floated in the cooling water pit, using the container set including the frame formed of a member capable of

floating and holding the container on the water surface prevents overturning of the container as compared to the case where the container only is floated, which is preferable from the viewpoint of safety of the container.

Examples

[0051]

Now, the present invention will be described in detail with reference to Example, but the present invention is not limited to Example below.

[0052]

(Example 1)

A container for solid water treatment agent made of polypropylene and storing a solid water treatment agent was placed on a sound absorbing mat in a counterflow-type (round) open cooling tower (refrigeration capacity of 20 USRT, operated for 8 hours/day, cooling water temperature of 30°C), and a continuity evaluation test was performed.

The continuity evaluation test was performed in such a manner that the solid water treatment agent remaining in the container was taken out every predetermined number of days, and a weight of the remaining solid water treatment agent was measured to check changes in the weight of the remaining solid water treatment agent with the lapse of days.

Details of the container and the solid water treatment agent used are as described below.

<Container>

Container including two storage chambers as shown in Figs. 3 and 4

- Overall size: major diameter of 12.7 cm, minor diameter of 8.0 cm, height of 7.0 cm
- Container communication path in a top of an upper member 21a: eight round holes with a diameter of 5.5 mm, total hole area of 1.9 cm²
- Container communication path near a bottom of a side periphery of a lower member 21b: six round holes with a diameter of 5 mm, central positions of the round holes at a height of 12 mm from a bottom inner surface of the lower member 21b
- Container communication path in a bottom of the lower member 21b: two round holes with a diameter of 2.5 mm

- Partition wall communication path: clearance of 7 mm between a lower end of a cylindrical partition wall 22 and the bottom inner surface of the lower member 21b

<Solid water treatment agent>

1-bromo-3-chloro-5,5-dimethylhydantoin (solid agent (A)); round tablet with a diameter of 31 mm, a height of 17.5 mm, 20 g; three tablets stacked per storage chamber

[0053]

(Comparative example 1)

A container as described below was used as a container for solid water treatment agent, and three stacked tablets of the solid water treatment agent as in Example 1 were placed in two rows in the container. A continuity evaluation test was performed in the same manner as in Example 1 except using the container described below that stores the solid water treatment agent.

<Container>

A container made of polypropylene having an outline similar to that of the container in Example 1 and including no partition wall in a container body

- Sixteen round holes with a diameter of 3.7 mm in the entire top of an upper member 21a, total hole area of 1.7 cm²
- Sixteen round holes with a diameter of 3.7 mm in the entire bottom of a lower member 21b

[0054]

(Comparative example 2)

A container as described below was used as a container for solid water treatment agent, and three stacked tablets of the solid water treatment agent as in Example 1 were placed in two rows in the container. A continuity evaluation test was performed in the same manner as in Example 1 except using the container described below that stores the solid water treatment agent.

<Container>

A container made of polypropylene having an outline similar to that of the container in Example 1 and including no partition wall in a container body

- Sixteen round holes with a diameter of 2.5 mm in the entire top of an upper member 21a, total hole area of 0.8 cm²
- Sixteen round holes with a diameter of 2.5 mm in the entire bottom of a lower member 21b

[0055]

(Comparative example 3)

A container as described below was used as a container for solid water treatment agent, and three stacked tablets of the solid water treatment agent as in Example 1 were placed in two rows in the container. A continuity evaluation test was performed in the same manner as in Example 1 except using the container described below that stores the solid water treatment agent.

<Container>

A container made of polypropylene having an outline similar to that of the container in Example 1 and including no partition wall in a container body

- Sixteen round holes with a diameter of 2.5 mm in the entire top of an upper member 21a, total hole area of 0.8 cm²
- Sixteen round holes with a diameter of 3.7 mm near a bottom of a side periphery of a lower member 21b, central positions of the round holes: at a height of 7 mm from a bottom inner surface of the lower member 21b
- Two round holes with a diameter of 2.5 mm in the entire bottom of the lower member 21b
- To prevent cooling water flowing through the round holes in the top of the upper member 21a into the container from directly hitting upper surfaces of the three stacked tablets of the solid water treatment agent in two rows, a shield plate was mounted to an inner lower surface of the upper member 21a so as to be located above the solid water treatment agent.

[0056]

(Comparative example 4)

A container as described below was used as a container for solid water treatment agent, and three stacked tablets of the solid water treatment agent as in Example 1 were placed in two rows in the container. A continuity evaluation test was performed in the same manner as in Example 1 except using the container described below that stores the solid water treatment agent.

<Container>

A container made of polypropylene having an outline similar to that of the container in Example 1 and including no partition wall in a container body

- Sixteen round holes with a diameter of 2.5 mm in an outer periphery of a top of an upper member 21a (other than immediately above the three stacked tablets of the solid water treatment agent in two rows), total hole area of 0.8 cm²

- Sixteen round holes with a diameter of 3.7 mm near a bottom of a side periphery of a lower member 21b, central positions of the round holes: at a height of 7 mm from a bottom inner surface of the lower member 21b
- Two round holes with a diameter of 2.5 mm in the entire bottom of the lower member 21b

[0057]

From the results of the continuity evaluation tests of Example and Comparative examples described above, the solid water treatment agent in the container was completely dissolved for about five days in Comparative example 1, for about 12 days in Comparative example 2, for about 26 days in Comparative example 3, and for about 25 days in Comparative example 4.

On the other hand, in Example 1, it was recognized that the solid water treatment agent was gradually dissolved for about three months. This allows an active substance of the solid water treatment agent to be stably supplied to the cooling water with time, and eliminates the need for replacement of the container or additional replenishment of the solid water treatment agent for one season (three months), thereby reducing work burden in the water treatment of the cooling water in the cooling tower.

Reference Signs List

[0058]

- | | |
|------------------------------|---|
| 10, 20 | Container for solid water treatment agent |
| 11, 21 | Container body |
| 12, 22 | Partition wall |
| 13, 23 | Storage chamber |
| 14, 24 | Non-storage chamber |
| 15a, 15b, 15c, 25a, 25b, 25c | Container communication path |
| 16, 26 | Partition wall communication path |
| 17, 27 | Leg |
| 18, 28 | Flange |
| 30 | Frame |
| 31 | Grip |
| 40 | Container set for solid water treatment agent |
| S1, S2 | Solid water treatment agent |

CLAIMS

[Claim 1]

A container for solid water treatment agent arranged in a cooling tower, comprising:

a container body; and

a partition wall that partitions an inside of the container body into one or more storage chambers that store a solid water treatment agent and a non-storage chamber that does not store the solid water treatment agent,

wherein the container body comprises one or more container communication paths that allow cooling water to flow between an outside of the container body and the non-storage chamber, and

the partition wall comprises one or more partition wall communication paths that allow the cooling water to flow between the storage chamber and the non-storage chamber.

[Claim 2]

The container for solid water treatment agent according to claim 1, wherein the partition wall is a vertically extending cylinder.

[Claim 3]

The container for solid water treatment agent according to claim 1 or 2, wherein at least one of the partition wall communication paths extends to a bottom surface of the container body.

[Claim 4]

The container for solid water treatment agent according to any one of claims 1 to 3, wherein at least one of the container communication paths is provided in a top of the container body.

[Claim 5]

The container for solid water treatment agent according to any one of claims 1 to 4, wherein at least one of the container communication paths is provided in a side periphery of the container body.

[claim 6]

The container for solid water treatment agent according to any one of claims 1 to 5, wherein at least one of the container communication paths is provided in a bottom of the container body.

[Claim 7]

The container for solid water treatment agent according to claim 6, wherein a leg is protruded from a bottom outer wall of the container body.
[Claim 8]

The container for solid water treatment agent according to any one of claims 1 to 7, wherein the solid water treatment agent is a tablet.
[Claim 9]

The container for solid water treatment agent according to any one of claims 1 to 8, wherein the container body and the partition wall are transparent.
[Claim 10]

A container set for solid water treatment agent comprising:
one or more of the containers for solid water treatment agent according to any one of claims 1 to 9; and
a frame having a through hole in which the container can be individually fitted and held,
wherein the frame is formed to expose the container communication path of the container held in the frame.
[Claim 11]

The container set for solid water treatment agent according to claim 10, wherein the frame is formed of a member capable of floating and holding the container on a water surface so that at least a top outer wall of the container is exposed on the water surface.
[Claim 12]

A water treatment method using the container for solid water treatment agent according to any one of claims 1 to 9, comprising:

the container that stores the solid water treatment agent in the storage chamber being arranged in a cooling tower so that dropping cooling water hits a top outer wall of the container;

the cooling water flowing through the container communication path into the non-storage chamber, and then flowing from the non-storage chamber through the partition wall communication path into the storage chamber;

the solid water treatment agent in contact with the cooling water having flowed into the storage chamber being dissolved; and

the cooling water in which the solid water treatment agent has been dissolved flowing out of the container through the container communication path, to water-treat the cooling water in the cooling tower.

[Claim 13]

The water treatment method according to claim 12, wherein a sound absorbing mat is arranged in the cooling tower and the container is placed on the sound absorbing mat.

[Claim 14]

A water treatment method using the container for solid water treatment agent according to any one of claims 1 to 9, comprising:

the container that stores the solid water treatment agent in the storage chamber being floated on a water surface of cooling water in a cooling water pit in a cooling tower so as to expose at least a top outer wall of the container on the water surface;

the cooling water flowing through the container communication path into the non-storage chamber, and then flowing from the non-storage chamber through the partition wall communication path into the storage chamber;

the solid water treatment agent in contact with the cooling water having flowed into the storage chamber being dissolved; and

the cooling water in which the solid water treatment agent has been dissolved flowing out of the container through the container communication path to water-treat the cooling water in the cooling tower.

[Claim 15]

A water treatment method using the container set for solid water treatment agent according to claim 10 or 11, comprising:

the container set that stores the solid water treatment agent in the storage chamber being arranged in a cooling tower so that dropping cooling water hits a top outer wall of the container;

the cooling water flowing through the container communication path into the non-storage chamber, and then flowing from the non-storage chamber through the partition wall communication path into the storage chamber;

the solid water treatment agent in contact with the cooling water having flowed into the storage chamber being dissolved; and

the cooling water in which the solid water treatment agent has been dissolved flowing out of the container through the container communication path to water-treat the cooling water in the cooling tower.

[Claim 16]

The water treatment method according to claim 15, wherein a sound absorbing mat is arranged in the cooling tower and the container set is placed on the sound absorbing mat.

[claim 17]

A water treatment method using the container set for solid water treatment agent according to claim 11, comprising:

the container set that stores the solid water treatment agent in the storage chamber being floated on a water surface of cooling water in a cooling water pit in a cooling tower so as to expose at least a top outer wall of the container on the water surface;

the cooling water flowing through the container communication path into the non-storage chamber, and then flowing from the non-storage chamber through the partition wall communication path into the storage chamber;

the solid water treatment agent in contact with the cooling water having flowed into the storage chamber being dissolved; and

the cooling water in which the solid water treatment agent has been dissolved flowing out of the container through the container communication path to water-treat the cooling water in the cooling tower.

[Claim 18]

The water treatment method according to any one of claims 12 to 14, wherein one or more of the containers for solid water treatment agent that store a solid agent (A) of a halogen-based oxidant as a solid water treatment agent, and one or more of the containers for solid water treatment agent that store a solid agent (B) containing organic bactericide reactive to the halogen-based oxidant as a solid water treatment agent are used in combination.

[Claim 19]

The water treatment method according to claim 18, wherein the halogen-based oxidant contains 1-bromo-3-chloro-5,5-dimethylhydantoin as an active substance, and the organic bactericide contains 5-chloro-2-methyl-4-isothiazolin-3-one as an active substance.

[Claim 20]

The water treatment method according to any one of claims 15 to 17, wherein the method uses a container set for solid water treatment agent comprising one or more of the containers for solid water treatment agent that store a solid agent (A) of a halogen-based oxidant as a solid water treatment

agent, and one or more of the containers for solid water treatment agent that store a solid agent (B) containing organic bactericide reactive to the halogen-based oxidant as a solid water treatment agent.

[Claim 21]

The water treatment method according to claim 20, wherein the halogen-based oxidant contains 1-bromo-3-chloro-5,5-dimethylhydantoin as an active substance, and the organic bactericide contains 5-chloro-2-methyl-4-isothiazolin-3-one as an active substance.