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

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

[0010a]

In one aspect, the present disclosure provides for 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 and is a vertically extending cylinder, and

wherein at least one of the container communication paths is provided in a side periphery of the container body

[0010b]

In another aspect, the present disclosure provides for a container set for solid water treatment agent comprising:

one or more of the containers for solid water treatment agent as disclosed herein; 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.

[0010c]

In yet another aspect, the present disclosure provides for a water treatment method using the container for solid water treatment agent as disclosed herein, 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.

[0010d]

In yet another aspect, the present disclosure provides for a water treatment method using the container for solid water treatment agent as disclosed herein, 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.

[0010e]

In yet another aspect, the present disclosure provides for a water treatment method using the container set for solid water treatment agent as disclosed herein, 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.

[0010f]

In yet another aspect, the present disclosure provides for a water treatment method using the container set for solid water treatment agent as disclosed herein, 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.

[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 disclosure is based on such findings.

[0012]

[Container for solid water treatment agent]

A container for solid water treatment agent of the present disclosure 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]

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 disclosure 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 example of a water treatment method of the present disclosure 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 example of the water treatment method of the present disclosure 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 example of the water treatment method of the present disclosure 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 example of the water treatment method of the present disclosure 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 disclosure 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 disclosure 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.

# 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 and is a vertically extending cylinder, and

wherein at least one of the container communication paths is provided in a side periphery of the container body.

[Claim 2]

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

[Claim 3]

The container for solid water treatment agent according to claim 1 or 2, wherein at least one of the container communication paths is provided in a top 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 bottom of the container body.

[Claim 5]

The container for solid water treatment agent according to claim 4, wherein a leg is protruded from a bottom outer wall of the container body.

[Claim 6]

The container for solid water treatment agent according to any one of claims 1 to 5, wherein the solid water treatment agent is a tablet.

[Claim 7]

The container for solid water treatment agent according to any one of claims 1 to 6, wherein the container body and the partition wall are transparent.

[Claim 8]

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 7; 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 9]

The container set for solid water treatment agent according to claim 8, 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 10]

A water treatment method using the container for solid water treatment agent according to any one of claims 1 to 7, 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 11]

The water treatment method according to claim 10, wherein a sound absorbing mat is arranged in the cooling tower and the container is placed on the sound absorbing mat.

[Claim 12]

A water treatment method using the container for solid water treatment agent according to any one of claims 1 to 7, 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 13]

A water treatment method using the container set for solid water treatment agent according to claim 8 or 9, 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 14]

The water treatment method according to claim 13, wherein a sound absorbing mat is arranged in the cooling tower and the container set is placed on the sound absorbing mat.

[claim 15]

A water treatment method using the container set for solid water treatment agent according to claim 9, 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 16]

The water treatment method according to any one of claims 10 to 12, 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 17]

The water treatment method according to claim 16, 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 18]

The water treatment method according to any one of claims 13 to 15, 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 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.