

SPECIFICATION

WATER PURIFYING MATERIAL, WATER PURIFYING MEMBER, WATER PURIFYING APPARATUS AND WATER CIRCULATION UTILIZING SYSTEM

Field of the Invention

The present invention relates to a water purifying material for purifying water to be utilized through circulation and also relates to a water purifying member with the water purifying material mixed in it, a water purifying apparatus to accommodate the water purifying member, and a water circulation utilizing system.

Background Art

In swimming pools and bathing facilities, water or hot water is circulated and used. In such a system, filters and sterilizers are adopted. These apparatuses are required for the facilities where unspecific number of persons are supposed to use.

Also, in a cooling tower to cool down the circulating cooling water in a large size air-conditioning system, water is brought into direct contact with the air, and the water is often contaminated.

In using hot water, when distributed to a plurality of places, hot water at elevated temperature is first stored in a hot water tank. It is thus, often difficult to maintain the hot water in the hot water tank in clean and non-contaminated condition.

Fig. 1 shows an arrangement of a water circulating system generally used in a swimming pool or in hot water bathing facilities.

In the circulating system, reference numeral 1 represents a water receiving

tank; numeral 2 a circulating water utilizing unit such as a swimming pool or a bath; numeral 3 a discharge outlet for the circulating water; 4 an overflow water collecting channel; 5 a circulating water collecting tank; 6 an overflow water collecting tank; 7 a hair-catcher in the circulating water; 8 a hair-catcher in the overflow water; 9 a circulating water pump; 10 an overflow water pump; 11 a circulating water filter; and 12 an overflow water filter.

Further, coagulant injectors 13 and 14; automatic chlorine injectors 15 and 16; and valves 17 and 18 are used.

The circulating water, after being discharged from the outlet 3 of the circulating water utilizing unit 2, flows into the circulating water collecting tank 5. After passing through the hair-catcher 7 and the circulating water filter 11, the water is circulated and flows into the circulating water utilizing unit 2. During this process, coagulant to coagulate stains and contaminants is injected from the coagulant injector 13. Coagulated contaminants are removed by the circulating water filter 11, and chlorine for sterilizing is injected by the automatic chlorine injector 15.

This circulation is carried out by means of the circulating water pump 9 and the valve 17.

Overflow water from the circulating water utilizing unit 2 flows into the overflow water collecting tank 6 via the overflow water collecting channel 4. After passing through the hair-catcher 8 and the overflow water filter 12, the overflow water flows into the unit 2. During this process, coagulant to coagulate stains and contaminants is injected from the coagulant injector 14 and coagulated stains and contaminants are removed by the overflow water filter 12, and chlorine for sterilizing is injected by the automatic chlorine injector 16.

The circulation is controlled by the pump 9 and the valve 17.

In addition to the above, a water receiving tank 1 is used to replenish the water, which has been consumed and discharged outside. New water is supplied from the water receiving tank 1 to the circulating water collecting tank 5.

As a circulating system using the circulating water similar to swimming pools, bathing facilities, etc., a cooling system using a cooling tower is known.

Fig. 2 shows a conventional type cooling system using the cooling tower.

In the circulating system in Fig. 2, reference numeral 41 represents a cooling water tank; numeral 42 a cooling tower; 43 a sprinkling box; 44 a filling material; 45 a water tank; 46 a fan; 47 a cooling water circulating pump; 48 a heat exchanger; 49 a place to be cooled; and 50 a water supply.

Further, valves 51 and 52 are used.

Water is sprinkled to the filling material 44 from the sprinkling box 43 in the cooling tower 42, and the water is mixed with the air, which is sucked from the side of the filling material 44 by the fan 46 when the water flows down through the filling material 44. Then, water is cooled down as it loses latent heat of vaporization, and it goes down into the water tank 45 and flows into the cooling water tank 41 via the valve 51.

The cooling water is then sent to the heat exchanger 48 by the cooling water circulating pump 47. The inflowing cooling water receives heat from the water, which has been warmed up at the place 49 such as a building, a factory, etc. and which is then, cooled down. On the contrary, the cooling water itself is warmed up by the heat and is circulated to the cooling tower 42.

A part of water is lost due to the causes such as evaporation when mixed

with the air at the cooling tower. New water is supplied through the water supply 50 via the valve 52.

In the water circulating systems as described above, rusting occurs in the apparatuses and pipes. Inorganic substances in the water are deposited in the apparatuses and pipes, and scales gather. Also, algae often develop. Further, bacteria gather in the slimes, which are sticky substances caused by bacteria in the water, and bacteria are also present in algae and slimes. It is an important problem to sterilize and remove these substances and bacteria (in particular, *Legionella pneumophila*, which may cause severe pneumonia).

In the water circulating system in such as swimming pools or bathing facilities where water comes into direct contact with human bodies, mineral materials such as sand and pebbles; fibrous materials such as vegetable fiber; and porous synthetic resin have been conventionally used as a filter material for the circulating water filter 11 and the overflow water filter 12 for the purpose of purifying the water. Also, coagulant for coagulating the contaminants is injected from the coagulant injector 14 and chlorine for sterilizing is injected from the automatic chlorine injector 16.

On the other hand, in the cooling system using the cooling tower, it has been supposed that water is not brought into direct contact with human bodies, and the treatment by using chemical drugs is adopted.

In recent years, attention has been focused on the relaxing and refreshing effects caused by minus ions. The minus ion comprises oxygen ion O_2^- surrounded by a plurality of water molecules (H_2O), and it is expressed as $[O_2^- (H_2O)_n]$.

Together with the minus ions, plus ions are also generated in the same amount, which comprise hydrogen ion H^+ surrounded by a plurality of water

molecules (H_2O), and this plus ion is expressed as $[\text{H}^+ (\text{H}_2\text{O})_m]$.

These minus ions and plus ions are generated in the same amount, and the mixture of these ions is called plasma cluster ions.

It has been confirmed that minus ions not only have relaxing and refreshing effects on the human body but also have favorable effects on hair.

Further, in addition to the favorable effects on human bodies, it has been demonstrated that minus ions result reducing water evaporation and discoloring for vegetables in a refrigerator.

It is considered as desirable that water molecule clusters associated with minus ions are as small as possible.

The plasma cluster ions change the structure of protein hemagglutinin on the surface of influenza viruses. It is confirmed that the plasma cluster ions stop the functions of viruses and have the effects to prevent influenza infection by inactivating virus function (See Nikkei Electronics, October 21, 2002, page 63).

It is also confirmed that the plasma cluster ions have effects to reduce gathering mold.

It is already known that these minus ions and plus ions can be generated by electric discharge or through collision of water drops against each other. As the simplest method, discharging method has been frequently used. However, ozone may be generated during the discharge, and there are problems in that ozone has offensive odor and strong oxidizing action.

In addition, mineral substances are used for generating minus ions and plus ions. As the mineral substances, natural mineral substances such as tourmaline,

amphibole, and granite porphyry are used, and artificial mineral substances such as ceramic balls are used.

Disclosure of the Invention

To overcome the above problems, it is an object of the present invention to provide water purifying member for generating minus ions, plus ions, and plasma cluster ions, and also to provide a water purifying apparatus and a water purifying system by using it.

In the water purifying member according to the present invention, a material which ceramic powder is kneaded with a plastic material with low specific gravity, is formed in such a manner that the water purifying member has large surface area and high void ratio, and does not entangle with each other.

In the water purifying member according to the present invention, ceramic powder mixed in it generates minus ions, plus ions, and plasma cluster ions and makes the size of water molecule cluster smaller.

In the water purifying apparatus according to the present invention, the water purifying member is accommodated in a water-passing container made of corrosion-resistant metal and is filled up to about 70% of the internal container volume. The shape of the container can be adequately adjusted depending on the place where it is used.

In the water purifying apparatus according to the present invention, the water purifying member filled in the container up to about 70% of the internal volume is stirred up by the flow of the water to be purified, which passes through the water purifying apparatus. As a result, the water purifying member is brought into good contact with the water to be purified and the functions of the water purifying member can be fulfilled to the utmost extent.

In the water purifying system according to the present invention, the water purifying apparatus as described above is arranged at an adequate position in the water purifying system.

In the water purifying system according to the present invention, the water purifying apparatus is arranged at the adequate position, and optimal water purifying process can be carried out.

Brief Description of the Drawings

Fig. 1 is a schematic drawing of a conventional type water circulation utilizing system;

Fig. 2 is a schematic drawing of a conventional type cooling system using a cooling tower;

Fig. 3 shows an example of configuration of a water purifying member according to the present invention;

Fig. 4 shows an example of a container to accommodate the water purifying member according to the present invention;

Fig. 5 (a) to Fig. 5 (d) show other examples of the container to accommodate the water purifying member according to the present invention; and

Fig. 6 shows an example of a water purifying apparatus according to the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

Description will be given below on embodiments of the present invention.

Fig. 3 shows an example of configuration of a water purifying member 20 according to the invention, which comprises polyethylene or ethylene- α -olefin copolymer with specific gravity lower than 1 and mixed with calcined ceramic powder at the mixing ratio of $10\% \pm 5\%$. Its specific gravity is about 1.01 ± 0.02 . This specific gravity can be adjusted to an adequate value of about 1.4 by changing the mixing ratio of the ceramic powder.

This water purifying member can be obtained by the following procedure:

- (1) Ceramic-mixed plastics are molded in a cylindrical shape.
- (2) The ceramic-mixed plastics in the cylindrical shape are cut hellically and thin along its radius so that a helical material is obtained.
- (3) The helical material thus obtained is formed into a form of a saddle along the central axis of the cylinder.
- (4) The helical material formed into the form of the saddle is twisted in winding direction or in reverse direction for each turn of the helix.

The water purifying member 20 thus formed has a large surface area and has a sufficiently large contact surface in contact with the water to be purified. Thus, good contact can be kept between the water to be purified and the water purifying member 20. Because it has the high void ratio, the water to be purified contacts satisfactorily with the surface of the water purifying member 20. Also, ends of the water purifying member 20 are not exposed to the surface, and this prevents entangling or interlocking between the water purifying members.

As a result, the water to be purified is always kept in good contact with the water purifying member 20, accordingly, minus ions, plus ions, and plasma cluster ions are generated. This contributes to the reduction of the size of water molecule cluster, which otherwise tends to be larger.

As the cylinder to be cut into the helical material, a cylinder with diameter of about 10 - 35 mm is generally used. Its shape may not be cylindrical and may be in form of a prism with polygonal cross-section. The cylinder made by kneading the ceramic powder is hard and slippery on the surface, and it is not very easy to cut it into the helical shape by holding the ends and by rotating it. However, if the prism with polygonal cross-section is adopted, it is easier to cut.

Fig. 4 shows an example of a container 21 for accommodating the water

purifying member according to the present invention.

The water purifying member container 21 shown in Fig. 4 comprises a cylinder 22 made of corrosion-resistant perforated-metal such as stainless steel, with a bottom 23 and a top 24 both made of corrosion-resistant perforated-metal similar to the cylinder 22 such as stainless steel, and the water purifying member 20 is accommodated therein.

Each of holes 25 perforated on the perforated-metal is in such a size that does not allow the water purifying member 20 to pass through, so that the water purifying member 20 is filled up to about 70% of the total internal volume of the water purifying member container 21.

Fig. 6 shows an example of a water purifying apparatus, in which the water purifying member container 21 in the cylindrical shape as shown in Fig. 4 is accommodated.

The water purifying apparatus 26 shown in Fig. 6 has a main body 27 designed in a cylindrical shape, provided an inlet 28 for the water to be purified at lower portion of the side of 27 and an outlet 29 for the purified water at upper portion of the side of 27. In the present embodiment, the water purifying apparatus 26 is comprised in the circulating water filter 11 and in the overflow water filter 12.

The positional relation of the inlet 28 and the outlet 29 may be reversed. Also, these may be arranged on upper and lower portions of the apparatus instead of its side, e.g., on the bottom 30 and the top 31. These positions can be adequately selected depending on the conditions of use.

Specific gravity of the water purifying member 20 accommodated in the water purifying member container 21 placed in the water purifying apparatus 26 is about

1.10 $\pm$ 0.02, and this is higher than the specific gravity of water. Thus, in the still water, the water purifying member stays at lower portion of the water purifying member container 21.

The water to be purified flows in through the inlet 28 of the water purifying apparatus 26 under the above arrangement, and the purified water flows out through the outlet 29. The inflowing water flows upward from the lower portion inside the water purifying apparatus 26. Together with this water, the water purifying member 20 is pushed upward to the upper portion in the water purifying member container 21. As a result, the water purifying member 20 is stirred up inside the water purifying member container 21.

As described above, the water purifying member 20 has a large contact surface with the water to be purified, and it is stirred up in the water to be purified, it contacts satisfactorily with the water to be purified. As a result, minus ions, plus ions, and plasma cluster ions are generated. By the actions of these ions, the size of water molecule cluster is to be smaller. Surface active effect caused by the smaller size of the water molecule cluster is activated. And then, slime and algae, which cause bacteria gathering, are removed, and purified water with good quality can be obtained. Also, rusting and scales gathering are suppressed. Further, contaminant materials in the water to be purified are stuck in the water purifying member 20 and are removed.

To the purified water thus obtained, chlorine is injected by automatic chlorine injectors 15 and 16 respectively to comply with the regulations on the residual chlorine concentration. Finally, the water is sent back to the circulating water utilizing facilities such as a swimming pool or a bath.

In addition to the method to obtain the water purifying member 20 as described above, JP-A-7-75712 discloses another method.

The configuration of the water purifying member container 21 according to the present invention can be adequately selected to suit the shape of the water purifying apparatus, which accommodates the water purifying member container 21. The configuration may be, in addition to the cylindrical shape as shown in Fig. 4, a conical shape; a rectangular parallelepiped as shown in Fig. 5 (a); a truncated conical shape as shown in Fig. 5 (b); a pyramidal shape as shown in Fig. 5 (c); or a truncated pyramidal shape as shown in Fig. 5 (d).

Further, the water purifying member container 21 may be provided as a water purifying apparatus in the circulating water passage, independently from the circulating water collecting tank 5, the overflow water collecting tank 6, the circulating water filter 11, and the overflow water filter 12.

In addition, the water purifying member container 21 may be arranged on the wall surface of the circulating water utilizing unit 2, on the circulating water discharge outlet 3, or on the overflow water collecting channel 4 without placing it in the water purifying apparatus 26.

In case of the cooling system using the cooling tower as shown in Fig. 2, the water purifying apparatus according to the present invention is arranged on the water sprinkling box 43, the water tank 45 and the cooling water tank 41. If necessary, it may also be provided on the passage of the water, which circulates the place to be cooled 49.

In a case where there is provided an apparatus for storing hot water in a hot water supply system or in a hot water heating system, the water purifying apparatus according to the present invention is arranged in the hot water storage apparatus.

WHAT IS CLAIMED IS:

1. A water purifying material for generating minus ions, plus ions, and plasma cluster ions, said material containing SiO_2 in an amount of $73 \pm 4\%$, Al_2O_3 in an amount of $15 \pm 4\%$, Li_2O in an amount of $3 \pm 4\%$, and CoO_3 in an amount of $3 \pm 0.5\%$, and the remainder being MgO , K_2O and CaO .
2. A water purifying member for generating minus ions, plus ions, and plasma cluster ions, wherein ceramic powder, containing SiO_2 in an amount of $73 \pm 4\%$, Al_2O_3 in an amount of $15 \pm 4\%$, Li_2O in an amount of $3 \pm 4\%$, and CoO_3 in an amount of $3 \pm 0.5\%$, and the remainder being MgO , K_2O and CaO , is mixed in polyethylene with the mixing ratio being $10 \pm 5\%$ for the ceramic powder, and $90 \pm 5\%$ for the polyethylene.
3. A water purifying member according to claim 2, wherein specific gravity of said water purifying member is 1.01 ± 0.02 .
4. A water purifying member for generating minus ions, plus ions, and plasma cluster ions, wherein ceramic powder, containing SiO_2 in an amount of $73 \pm 4\%$, Al_2O_3 in an amount of $15 \pm 4\%$, Li_2O in an amount of $3 \pm 4\%$, and CoO_3 in an amount of $3 \pm 0.5\%$, and the remainder being MgO , K_2O and CaO , is mixed in ethylene- α -olefin copolymer with mixing ratio being $10 \pm 5\%$ for the ceramic powder and $90 \pm 5\%$ for the ethylene- α -olefin copolymer.
5. A water purifying member according to claim 4, wherein specific gravity of said water purifying member is 1.01 ± 0.02 .
6. A water purifying member accommodating container comprising a perforated-metal with holes, each of said holes being in such a size that the water purifying member cannot pass through.
7. A water purifying member accommodating container according to claim 6,

wherein the water purifying member is accommodated inside.

8. A water purifying member accommodating container according to claim 7, wherein the water purifying member is placed in the water purifying member container up to about 70% of the total internal container volume.

9. A water purifying apparatus comprising a perforated-metal, for accommodating a water purifying member,

wherein said member comprises ceramic powder, containing SiO_2 in an amount of $73 \pm 4\%$, Al_2O_3 in an amount of $15 \pm 4\%$, Li_2O in an amount of $3 \pm 4\%$, and CoO_3 in an amount of $3 \pm 0.5\%$, and the remainder being MgO , K_2O and CaO , being mixed with polyethylene, with the mixing ratio being $10 \pm 5\%$ for the ceramic powder, and $90 \pm 5\%$ for the polyethylene.

10. A water purifying apparatus comprising a perforated-metal for accommodating a water purifying member,

wherein said member comprises ceramic powder, containing SiO_2 in an amount of $73 \pm 4\%$, Al_2O_3 in an amount of $15 \pm 4\%$, Li_2O in an amount of $3 \pm 4\%$, and CoO_3 in an amount of $3 \pm 0.5\%$, and the remainder being MgO , K_2O and CaO , being mixed with ethylene- α -olefin copolymer with the mixing ratio being $10 \pm 5\%$ for the ceramic powder, and $90 \pm 5\%$ for the ethylene- α -olefin copolymer.

11. A water circulation utilizing system, using a water purifying member therein for a filter comprised of a perforated-metal,

wherein said member comprises ceramic powder, containing SiO_2 in an amount of $73 \pm 4\%$, Al_2O_3 in an amount of $15 \pm 4\%$, Li_2O in an amount of $3 \pm 4\%$, and CoO_3 in an amount of $3 \pm 0.5\%$, and the remainder being MgO , K_2O and CaO , being mixed with polyethylene with the mixing ratio being $10 \pm 5\%$ for the ceramic powder, and $90 \pm 5\%$ for the polyethylene.

12. A water circulation utilizing system according to claim 11, wherein said

system is a water circulating swimming pool system.

13. A water circulation utilizing system according to claim 11, wherein said system is a hot water circulating bathing system.

14. A water circulation utilizing system according to claim 11, wherein said system is a circulating cooling system.

15. A water circulation utilizing system, using a water purifying member therein for a filter, comprising a perforated-metal,

wherein said member comprises ceramic powder, containing SiO_2 in an amount of $73 \pm 4\%$, Al_2O_3 in an amount of $15 \pm 4\%$, Li_2O in an amount of $3 \pm 4\%$, and CoO_3 in an amount of $3 \pm 0.5\%$, and the remainder being MgO , K_2O and CaO , being mixed with ethylene- α -olefin copolymer with the mixing ratio being $10 \pm 5\%$ for the ceramic powder, and $90 \pm 5\%$ for the ethylene- α -olefin copolymer.

16. A water circulation utilizing system according to claim 15, wherein said system is a water circulating swimming pool system.

17. A water circulation utilizing system according to claim 15, wherein said system is a hot water circulating bathing system.

18. A water circulation utilizing system according to claim 15, wherein said system is a water circulating cooling system.