

This Sheet Has Been Replaced



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METHOD FOR CONTROLLING A COOLING TOWER

The present invention relates to a method of
controlling a cooling tower. In particular, the present
5 invention relates to a method for controlling a cooling
tower wherein in order to prevent the generation of scale
and/or slime, circulating water for cooling which has
been treated in a water treating apparatus is controlled
by a concentration rate of the circulating water and an
10 amount of water to be treated necessary to feed the water
treating apparatus is controlled on the basis of an
amount of water to be supplied for the cooling water.

Heretofore, there has been conducted to purify
circulating water for cooling in a cooling tower by using
15 a physical/mechanical treatment to thereby suppress the
generation or proliferation of bacteria, algae or the
like whereby the deposition of scale and/or slime to a
filler and a copper coil in the cooling tower can be
prevented, or to prevent the deposition of scale and/or
20 slime in a water distribution basin.

In the above-mentioned physical/chemical treatment, there has been known to use a magnetic device for forming a magnetic field into which water to be treated for cooling is passed, or to use an electric device for feeding a current to water to be treated, or to use a device for purifying water to be treated wherein the water is passed to contact with a fluid bed in which a synthetic resin and particles of anti-biotic agent including an inorganic type anti-biotic agent as the main component is filled.

However, even in the above-mentioned water treating apparatus employing the physical/chemical treatment, control of water for cooling on the basis of numerical values was not conducted. Further, since there has been no standard for control, it was difficult to obtain a performance of 100% in the water treating apparatus, and operations for control were not effective.

Further, in the conventional method, an amount of water to be treated in the water treating apparatus was determined depending on the diameter of pipes in the pipeline for circulating water for cooling, or the amount of water to be treated was determined in a manner of trial and error in view of the performance of the water treating apparatus. Thus, since the conventional water treating apparatus was not so designed as to meet actual conditions of loads, a desired performance of treatment could not be obtained and the conventional method or the

apparatus for carrying out the method was not economical.

It is an object of the present invention to eliminate the disadvantages of the conventional technique.

In the present invention, a method for controlling a
5 cooling tower comprises circulating water for cooling
from a lower water tank through a cooling tower to the
lower water tank; taking the circulating water in the
lower water tank to feed it into a water treating
apparatus for conducting a physical-chemical treatment,
10 and feeding the circulating water for cooling treated in
the water treating apparatus to the lower water tank,
wherein the circulating water for cooling is controlled
by a concentration rate of the circulating water, while
an amount of the circulating water to be treated
15 necessary to feed to the water treating apparatus is
controlled on the basis of an amount of water to be
supplied for the cooling tower.

In drawings:

Figure 1 is a graph showing a relation between a
20 concentration rate b of water for cooling and an amount a
of organism in the water, in Example 1 of the present
invention;

Figure 2 is a graph showing a relation between a
concentration rate d which is obtained from chloride ions
25 in the water for cooling and a concentration rate c which
is obtained from the electric conductivity in Example 1
of the present invention, and

Figure 3 is a schematic diagram for explaining incoming and outgoing of circulating water for cooling in Example 2 of the present invention.

Preferred examples of the present invention will be described in more detail with reference to the drawings.

Figure 1 shows Example 1 of the present invention by means of a graph which shows a relation between a concentration rate b of water for cooling vs. an amount a of organism in the water for cooling; Figure 2 shows Example 1 of the present invention by means of a graph which indicates a relation between a concentration rate d which is obtained from the chloride ions in the water for cooling and a concentration rate c which is obtained from the electric conductivity of the water, and Figure 3 shows Example 2 of the present invention by means of a schematic diagram indicating a relation of incoming and outgoing of circulating water for cooling.

In the present invention, water in a lower water tank 13, which receives water falling down from a cooling tower 1, is taken out and fed to a water treating apparatus A where the water is subjected to a physical/chemical treatment. The circulating water for cooling which has been treated in the water treating apparatus A, is controlled by a concentration rate of the circulating water, while an amount of the water to be treated necessary to feed to the water treating apparatus A is controlled on the basis of an amount of water to be

supplied to the cooling tower 1. The concentration rate of the circulating water for cooling is controlled within a range of from N1 to N2 where N1 is a concentration rate when a concentration a of organism in the circulating
5 water is small, with the progress of the concentration of the water, and N2 is a concentration rate when there is a difference between a concentration rate d of the circulating water which is obtained from the chloride ions and a concentration rate c which is obtained from
10 the electric conductivity. Further, an amount of the water to be treated necessary to feed to the water treating apparatus A is determined on the basis of the sum of load factors such as an amount E of evaporation loss of water, an amount C of drift loss of water and an
15 amount B of water of blow-down and so on, the water being discharged from the inside of the system of the cooling tower to the outside of the system.

Thus, in the cooling tower 1 provided with the water treating apparatus of the present invention, it is so
20 controlled as to maintain a range of from a concentration rate N1 wherein an amount of organism indicates the lowest value to a concentration rate N2 where no inorganic material are generated, and an amount of water to be treated necessary for circulation is determined on
25 the basis of the sum of the load factors, with the result that the deposition of scale and/or slime which is caused by organism or inorganic material can effectively be

prevented.

[EXAMPLE 1]

A water treating apparatus A in which particles of anti-biotic agent including an inorganic type anti-biotic agent as the main component was filled, was located at a side of a lower water tank 13 in a cooling tower 1 having a cooling water circulation rate of 100 RT. Water to be treated was passed in the water treating apparatus A to contact it with the particles of anti-biotic agent for purification, and the treated water was mixed with water for cooling, and the mixed water was circulated in the pipeline. An amount of adenosine triphosphate as an amount a of organism contained in the circulating water having a concentration rate (a concentration of salts in the cooling water/a concentration of salts in water to be supplied) was measured. A result as shown in the graph of Figure 1 was obtained. Namely, in a region where the concentration rate b is extremely small, an amount a of organism in the system is relatively small, since a blowing function is immediately obtained. On the other hand, in a region where the concentration rate b is 1.5 to 3.5, the concentration of organism becomes high since a time of retention of the cooling water passing through the water treating apparatus A is short in the system.

When the concentration rate b is more than 5 (N1), a time of retention of cooling water passing through the water treating apparatus A is long in the system, and the

concentration a of organism is rapidly decreased to indicate the lowest value. The value N1 is the concentration rate necessary for treating organism as a causative agent which causes slime.

5 Further, as shown in the graph of Figure 2, when concentration rates d which were obtained from chloride ions in the circulating water for cooling and concentration rates c which are obtained from the electric conductivity (or the hardness of the water) are
10 plotted, a balanced state of 1:1 is lost at the point where the concentration rate N2 becomes 9 or more with the progress of the concentration, and a difference appears between them. Namely, when the concentration rate N becomes 9 or more, there is found scale due to the
15 deposition of mineral salts which are dissolved in the circulating water. However, there is no found the scale when the concentration rate is less than 9.

In the control of the concentration rate of circulating water for the cooling tower of the present
20 invention, the relation between the concentration rate N1 where the concentration a of organism indicates the lowest value and the concentration rate N2 which indicates the limit of the deposition of mineral salts should be maintained to be $N1(5) < N2(9)$. In this case,
25 the generation of scale and/or slime which is caused by organism and/or inorganic material in the circulating water can be prevented.

[EXAMPLE 2]

Example 2 concerns a design of a water treating apparatus for purifying cooling water circulating in a cooling tower system to thereby prevent the generation and deposition of scale and/or slime. Namely, an amount of water to be treated which is fed to the water treating apparatus is determined on the basis of the sum of load factors such as an amount of evaporation water, an amount of drift loss of water, an amount of water of blow-down and so on which are discharged from the inside of the system to the outside, i.e. the amount of water to be treated is determined with reference to an amount of water to be supplied for the cooling tower.

As shown in Figure 3, circulating water L is flown down from a water distribution basin 11 through a filler 12 to a lower water tank 13. The circulating water having an inlet water temperature T1 is pumped-up from the lower water tank by means of a pump P, and is circulated through a circulating pipe 14 to a heat exchanger 2 during which the water becomes cooling water having an outlet water temperature T2. On the other hand, there is a loss of water such as an amount B of blow-down from the lower water tank 13, an amount E for evaporation of water and an amount of C of drift loss of water by the operations of a ventilation fan 15 during the circulation of the cooling water. Then, it is necessary to supply an additional amount of water M to

the lower water tank 13.

For this purpose, in the present invention, a water treating apparatus A is provided at a side of the cooling tower 1, and an amount of water to be treated necessary for circulating from the water treating apparatus A to the cooling tower 1 is determined on the basis of an amount M of water to be supplied. The amount M of water to be supplied is expressed as an amount E of evaporation water + an amount C of drift loss of water + an amount D of blow-down water. Since the amount E of evaporation water is expressed as {(an outlet water temperature T2 - an inlet water temperature T1)/latent heat of evaporation × an amount L of circulation water}, the amount M of water to be supplied through the water treating apparatus A is $(T2-T1)/580 \times L + C + B$.

In conditions for designing in the Example 2, when $T2-T1 = 5^{\circ}\text{C}$; C (an amount of drift loss of water) = $0.001 (0.1\%) \times L$, and B (an amount of blow-down water) = $0.002 (0.2\%) \times L$, then, M (an amount of water to be supplied) = $(5/580 \times L) + (0.001 \times L) + (0.002 \times L) = 0.0116 \times L$. Accordingly, an amount M of water to be supplied to the cooling tower 1 can be obtained when an amount L for the circulating water is determined under the conditions of designing described above. Therefore, an amount of water to be treated necessary for circulating to the cooling tower 1 can be determined on the basis of an amount M of water to be supplied.

As described above, in accordance with the method for controlling a cooling tower provided with a water treating apparatus A, a range between a concentration rate N1 indicating the lowest value in an amount a of
5 organism in the cooling water and a concentration rate N2 indicating that there is no generation of inorganic material is maintained, and an amount of water to be treated necessary for circulating is determined on the basis of the sum of load factors, whereby the generation
10 and deposition of scale and/or slime which are caused by the organism or inorganic material can effectively be prevented.

CLAIMS:

1. A method for controlling a cooling tower comprising;
circulating water for cooling from a lower water tank
through a cooling tower to the lower water tank;
5 taking the circulating water in the lower water tank
to feed it into a water treating apparatus for conducting
a physical-chemical treatment, and
feeding the circulating water for cooling treated in
the water treating apparatus to the lower water tank,
10 wherein the circulating water for cooling is controlled
by a concentration rate of the circulating water, while
an amount of the circulating water to be treated
necessary to feed to the water treating apparatus is
controlled on the basis of an amount of water to be
15 supplied for the cooling tower.
2. The method for controlling a cooling tower according
to Claim 1, wherein the concentration rate of the
circulating water is controlled within a range of from N1
to N2 where N1 is a concentration rate when a
20 concentration of organism in the circulating water is
small with the progress of the concentration of the
water, and N2 is a concentration rate when there is a
difference between a concentration rate of the
circulating water which is obtained from the chloride
25 ions and a concentration rate of the circulating water
which is obtained from the electric conductivity.
3. The method for controlling a cooling tower according



to Claim 1, wherein the amount of water to be treated
necessary to feed to the water treating apparatus is
determined on the basis of the sum of load factors such
as an amount of evaporation water, an amount of drift
5 loss of water, an amount of water of blow-down and so on
which are discharged from the inside of the system to the
outside of the system of the cooling tower.

