BRIEF SUMMARY

[0004] According to a first aspect of the present invention, there is provided a cooling tower system, comprising: a cooling tower; at least two make-up water inlet streams configured to supply water to the cooling tower; a blowdown stream configured to remove water from the cooling tower; at least one sensor monitoring water in each of the make-up water inlet streams; and a controller operably connected to the at least one sensor

wherein the cooling tower system further comprises

one or more chemical injection pumps configured to inject a chemical additive into the make-up water; and

a distributed control system operably connected to the controller and configured to activate the chemical injection pumps.

[0005] In some examples, the at least two make-up water inlet streams comprises three make-up water inlet streams.

[0006] In some examples, the at least two make-up water inlet streams are connected to a pipe that is connected to the cooling tower, and the pipe carries water from the at least two make-up water inlet streams into the cooling tower.

[0007] In some examples, the at least one sensor is a conductivity sensor.

[0008] In some examples, the at least one sensor is a flow sensor.

[0009] In some examples, each make-up water inlet stream is monitored by at least two sensors.

[0010] In some examples, the at least two sensors are a conductivity sensor and a flow sensor.

[0011] In some examples, the controller stores a conductivity set-point.

[0012] In some examples, the cooling water system further includes a distributed control system operably connected to the controller.

[0013] In some examples, the system does not include a make-up water holding tank configured to supply water to the cooling tower.

[0014] According to a second aspect of the present invention, there is provided a method of controlling cooling water treatment, comprising the steps of: receiving data from at least one sensor monitoring water in at least two make-up water inlet streams configured to supply water to a cooling tower; and creating a virtual make-up stream from the data received from the at least one sensor;

wherein the method further comprises the step of

dosing a chemical additive into the cooling tower based on properties of the virtual make-up stream.

[0015] In some examples, data is received from at least three sensors monitoring water in three make-up water inlet streams.

[0016] In some examples, the method includes dosing a chemical additive into the cooling tower based on properties of the virtual make-up stream.

[0017] In some examples, the method includes adjusting blowdown based on properties of the virtual make-up stream.

[0018] In some examples, the method includes monitoring copper and/or mild steel corrosion rate in the make-up water inlet streams.

[0019] In some examples, the chemical additive is selected from the group consisting of a scale inhibitor, a corrosion inhibitor, a biocide, a dispersant, and any combination thereof.

[0020] In some examples, the method includes adjusting a ratio of make-up water in a first stream to make-up water in a second stream.

[0021] The foregoing has outlined rather broadly the features and technical advantages of the present disclosure in order that the detailed description that follows may be better understood. Additional features and advantages of the disclosure will be described hereinafter that form the subject of the claims of this application. It should be appreciated by those skilled in the art that the conception and the specific embodiments disclosed may be readily utilized as a basis for modifying or designing other embodiments for carrying out the same purposes of the present disclosure. It should also be realized by those skilled in the art that such equivalent embodiments do not depart from the spirit and scope of the disclosure as set forth in the appended claims.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0022] A detailed description of the invention is hereafter described with specific reference being made to the drawings in which:

[0023] FIG. 1 shows inhibitor setpoint versus percent make-up source;

[0024] FIG. 2 shows mild steel corrosion rates;

[0025] FIG. 3 shows copper corrosion rates;

[0026] FIG. 4 shows cycles of concentration calculation; and

[0027] FIG. 5 shows an embodiment of a cooling tower system.

CLAIMS

What is claimed is:

1. A cooling tower system, comprising:

a cooling tower;

at least two make-up water inlet streams configured to supply water to the cooling tower;

a blowdown stream configured to remove water from the cooling tower;

at least one sensor monitoring water in each of the make-up water inlet streams; and

a controller operably connected to the at least one sensor;

wherein the cooling tower system further comprises

one or more chemical injection pumps configured to inject a chemical additive into the make-up water; and

a distributed control system operably connected to the controller and configured to activate the chemical injection pumps.

2. The system of claim 1, wherein the at least two make-up water inlet streams comprises three make-up water inlet streams.

3. The system of claim 1, wherein the at least two make-up water inlet streams are connected to a pipe that is connected to the cooling tower, and the pipe carries water from the at least two make-up water inlet streams into the cooling tower.

4. The system of claim 1, wherein the at least one sensor is a conductivity sensor.

5. The system of claim 1, wherein the at least one sensor is a flow sensor.

6. The system of claim 1, wherein each make-up water inlet stream is monitored by at least two sensors.

7. The system of claim 6, wherein the at least two sensors are a conductivity sensor and a flow sensor.

8. The system of claim 1, wherein the controller stores a conductivity set-point.

9. The system of claim 1, wherein the system does not include a make-up water holding tank configured to supply water to the cooling tower.

10. A method of controlling cooling water treatment, comprising the steps of:

receiving data from at least one sensor monitoring water in at least two make-up water inlet streams configured to supply water to a cooling tower; and

creating a virtual make-up stream from the data received from the at least one sensor;

wherein the method further comprises the step of

dosing a chemical additive into the cooling tower based on properties of the virtual make-up stream.

11. The method of claim 10, wherein the at least one sensor is a conductivity sensor.

12. The method of claim 10, wherein the at least one sensor is a flow sensor.

13. The method of claim 10, wherein data is received from at least three sensors monitoring water in three make-up water inlet streams.

14. The method of claim 10, further comprising adjusting blowdown based on properties of the virtual make-up stream.

15. The method of claim 10, further comprising monitoring copper and/or mild steel corrosion rate in the make-up water inlet streams.

16. The method of claim 10, wherein each make-up water inlet stream is monitored by at least two sensors.

17. The method of claim 10, wherein the chemical additive is selected from the group consisting of a scale inhibitor, a corrosion inhibitor, a biocide, a dispersant, and any combination thereof.

18. The method of claim 10, further comprising adjusting a ratio of make-up water in a first stream to make-up water in a second stream.