transference into the deaerated liquid via the light transference medium is obtained or maintained. The distance (d) is defined by the formula: $d = (a + 0.5*n) * \lambda$, wherein λ = the wavelength of the ultrasonic energy, a is a constant ranging from about 0.2 to about 0.2, and n is an integer ranging from 1 to 30.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

[0005] FIG. 1 illustrates an embodiment of a system capable of performing at least one inventive method described herein;

[0006] FIG. 2 illustrates a variation of the illustrative embodiment shown in FIG. 1;

[0007] FIG. 3 illustrates an embodiment of a system capable of performing at least one inventive method described herein;

[0008] FIG. 4 illustrates an embodiment of a system capable of performing at least one inventive method described herein;

[0009] FIG. 5A illustrates an embodiment of a system incorporating a sleeve as described herein;

[0010] FIG. 5B illustrates an embodiment of a system incorporating a lossy surface;

[0011] FIG. 6 is a plot of experimental data collected during the execution of Example 1;

[0012] FIG. 7 is a plot of experimental data collected during the execution of Example 2; and

[0013] FIG. 8 is a plot of experimental data collected during the execution of Example 3.

DETAILED DESCRIPTION

[0014] While embodiments encompassing the general inventive concepts may take various forms, there is shown in the drawings and will hereinafter be described various illustrative and preferred embodiments with the understanding that the present disclosure is to be considered an exemplification and is not intended to be limited to the specific embodiments.

[0015] A method of maintaining optical transference into deaerated (*e.g.*, degassed) liquid in contact with a light transference medium. The method includes applying ultrasonic energy into the deaerated liquid so as to contact the light transference medium at a particular locus of points suitable for obtaining, or for maintaining, reliability in a system comprising an optical sensor. In certain embodiments, liquid is deaerated prior to being utilized in a heating application (*e.g.*, a boiler). Liquid is generally deaerated in an

Claims

1. A method of obtaining or maintaining optical transference into deaerated liquid in contact with a light transference medium, the method comprising:

applying ultrasonic energy at a wavelength (λ) into deaerated liquid in contact with a light transference medium, the ultrasonic energy at wavelength (λ) originating at a distance (d) from an optical signal transmitted into the light transference medium to obtain or maintain optical transference into the deaerated liquid via the light transference medium,

wherein the distance (d) defined by the formula:

$$d = (a + 0.5*n) * \lambda$$

wherein λ = the wavelength of the ultrasonic energy, a is a constant ranging from about -0.2 to about 0.2, and n is an integer ranging from 1 to 30.

2. The method of claim 1, further comprising measuring a parameter of the deaerated liquid in contact with the light transference medium by transmitting the optical signal into the deaerated liquid via the light transference medium, and detecting a response.

3. The method of claim 2, further comprising controlling treatment of the deaerated liquid by utilizing the measured parameter in a control scheme.

4. The method of claim 3, wherein the method is performed during operation of a system utilizing the deaerated liquid.

5. The method of claim 1, wherein the optical transference through the light transference medium is obstructed prior to the application of the ultrasonic energy to the light transference medium.

6. The method of claim 1, wherein the deaerated liquid is at least one of deaerated boiler make-up feedwater, boiler condensate, and boiler blowdown liquid.

7. The method of claim 1, wherein the light transference medium is obstructed by deposition of a chemical species selected from the group consisting of iron, copper, manganese, titanium, chromium, nickel, calcium, magnesium, oxide, phosphate, carbonate, silicate, and combinations thereof.

8. The method of claim 1, wherein the light transference medium is obstructed by scale comprising a chemical species selected from the group consisting of calcium, magnesium, phosphate, carbonate, silicate, and combinations thereof.

9. The method of claim 1, wherein the ultrasonic energy is applied in a manner selected from the group consisting of: continuous, intermittent, as-needed, and combinations thereof.

10. The method of claim 1, wherein the ultrasonic energy is applied at a rate of from about 1 $W/cm^2/sec$ to about 400 $W/cm^2/sec$.

11. The method of claim 1, wherein the ultrasonic energy is applied at a frequency of from about 20 kHz to about 200 kHz.

12. The method of claim 1, wherein the light transference medium is selected from the group consisting of: a flow cell, an optical window, and a reflective surface.

13. The method of claim 1, wherein the light transference medium has a Mohs scale hardness of at least about 7.

14. The method of claim 1, wherein the light transference medium is constructed of a material selected from the group consisting of quartz, sapphire, diamond, boron nitride, and derivatives thereof.

15. The method of claim 1, wherein the light transference medium is a quartz flow cell coated with at least one of diamond, titanium diboride, boron nitride, and derivatives thereof.

16. The method of claim 1, wherein method is a clean-in-place method.

17. The method of claim 1, wherein an enhancer protects at least a portion of the light transference medium from the ultrasonic energy source.

18. The method of claim 17, wherein the enhancer comprises at least one of a sleeve and a lossy surface.

19. The method of claim 1, wherein the deaerated liquid contacts the light transference medium at a pressure of from about 5 psig to about 100 psig, and at a temperature of from about 20°F to about 200°F.