CLAIMS

1. A composition for treating a membrane in a fluid system to remediate biofilm, the composition comprising:

a surfactant;

citric acid; and

sodium bicarbonate that will react with the citric acid to produce sodium citrate;

wherein these ingredients are in amounts that when mixed with a volume of fluid in the fluid system or portion thereof containing the membrane being treated will provide concentrations of at least 0.00015 M for the surfactant, 0.001 M to 0.01M for the sodium citrate, and 0.0005 M to 0.005M for the citric acid;

wherein the fluid system is nanofiltration, ultrafiltration, microfiltration, forward osmosis, reverse osmosis, or conventional particle filtration system and the fluid comprises water.

2. The composition according to claim 1 wherein the surfactant is a sodium sulfonate compound.

3. The composition of claim 1 wherein the amount of surfactant added will provide a concentration in the range of 0.00015 M to 0.0015 M when mixed with the volume of fluid in the fluid system containing the membrane being treated and wherein the surfactant is an anionic surfactant.

4. The composition according to claim 1 wherein the composition is in solid or powder form prior to being mixed with the fluid in the fluid system containing the membrane being treated and comprises 42-43.1% citric acid, and 52.0-52.2% sodium bicarbonate.

5. The composition according to claim 1 further comprising a corrosion inhibitor and a secondary biocide.

6. The composition according to claim 5 wherein the corrosion inhibitor is a tolyltriazole compound.

7. The composition according to claim 6 wherein the corrosion inhibitor is in a concentration in the range of 2 ppm to 20 ppm based on the volume of fluid in the fluid system containing the membrane being treated.

8. The composition according to claim 5 further comprising an anti-foaming agent.

9. The composition according to claim 5 wherein the secondary biocide is hypochlorite.

10. A method of removing biofilm and treating a fluid system containing a membrane, the method comprising the steps of:

adding to the fluid system: (1) a surfactant, (2) citric acid, and (3) sodium citrate or sodium bicarbonate that will react with the citric acid to produce the sodium citrate;

removing biofilm by circulating the fluid containing the surfactant, citric acids, and added or produced sodium citrate through at least a portion of the fluid system to contact the membrane; and

monitoring the fluid system for a parameter indicating the membrane is fouled with biofilm, initiating the adding step when the monitored parameter indicates the membrane is fouled with biofilm, wherein the adding step provides concentrations when mixed with a volume of fluid in the fluid system or portion thereof containing the membrane being treated of at least 0.00015 M for the surfactant, 0.001 M to 0.01M for the added or produced sodium citrate, and 0.0005 M to 0.005M for the citric acid, and wherein the parameter is a pressure in the fluid system, a pump temperature, a fluid flow rate, a permeate flux rate, or a combination thereof; and

wherein the fluid system is nanofiltration, ultrafiltration, microfiltration, forward osmosis, reverse osmosis, or conventional particle filtration system and the fluid comprises water.

11. The method of claim 10 wherein the fluid system has a primary circulation loop for normal operations of the fluid system and a secondary circulation loop through which the surfactant, citric acid, and added or produced sodium citrate circulate to contact the membrane during treatment, the method further comprising the steps of:

circulating the fluid containing the surfactant, citric acid, and added or produced sodium citrate through the secondary circulation loop for 2 to 5 hours;

adding a corrosion inhibitor and a secondary biocide to the fluid in the secondary circulation loop; and

circulating the fluid containing the corrosion inhibitor and secondary biocide through the secondary circulation loop.

12. The method of claim 11 wherein the corrosion inhibitor is added and circulated for a period of time prior to adding the surfactant.

13. The method of claim 11 wherein the surfactant is added and circulated for a period of time prior to adding the citric acid.

14. The method of claim 11 wherein the surfactant, citric acid, and added or produced sodium citrate circulate for a period of time prior to adding the secondary biocide.

15. The method of claim 11 wherein the surfactant, the citric acid, the added or produced sodium citrate, and secondary biocide are added at the same time.

16. The method according to claim 10 wherein the surfactant is an ammonium bromide compound, an ammonium chloride compound, or a sodium sulfonate compound.

17. The method of claim 10 wherein the fluid system is a reverse osmosis system comprising the membrane, a feed line for feeding the fluid to the membrane, a concentrate line exiting the membrane and a permeate line exiting the membrane, the method further comprising the steps of:

decreasing pressure in the reverse osmosis system to temporarily cease collection of permeate through the permeate line prior to the adding step; and

wherein the circulating step comprises flowing the fluid containing the surfactant, citric acid, and added or produced sodium citrate from the feed line to the concentrate line to contact the membrane;

wherein the monitored parameter is the pressure in the fluid system; and

wherein the pressure in the fluid system is a feed pressure, a concentrate pressure, a pressure drop across the membrane or a combination thereof.

18. The method of claim 17 further comprising the steps of removing the fluid containing the surfactant, citric acid, and added or produced sodium citrate from the reverse osmosis system after the circulating step; and

rinsing the reverse osmosis system after the removing step and prior to resuming normal operations of the reverse osmosis system.

19. The method according to claim 17 wherein the amount of surfactant added will provide a concentration in the range of 0.00015 M to 0.0015 M when mixed with the volume of fluid in the reverse osmosis system being treated.

20. The method of claim 17 further comprising the step of filtering the fluid as it circulates through the reverse osmosis system to remove dislodged biofilm material.

21. The method according to claim 17 wherein the surfactant is an ammonium bromide compound, an ammonium chloride compound, or a sodium sulfonate compound.

22. The method according to claim 17 wherein the surfactant, the citric acid, and the added or produced sodium citrate are in solid form prior to being added to the fluid of the reverse osmosis system being treated.

23. The method of claim 17 wherein the adding step comprises diverting at least some fluid from the concentrate line to a treatment system comprising a feeder containing the surfactant, citric acid, and sodium citrate or sodium bicarbonate in dry or powdered form and adding the surfactant, citric acid, and sodium citrate or sodium bicarbonate to the diverted fluid.

24. The method of claim 23 wherein the circulating step further comprises returning the diverted fluid with the surfactant, citric acid, and added or produced sodium citrate to the feed line to flow from the feed line to the concentrate line to contact the membrane.

25. The method of claim 10 wherein the adding step comprises adding a solid or powder treatment composition comprising the surfactant, 42-43.1% citric acid, and 52.0-52.2% sodium bicarbonate.

26. The method of claim 10 or claim 17 wherein the surfactant is a sodium sulfonate compound.

27. The method of claim 10 or claim 17 wherein the surfactant is an anionic surfactant.