Claims

1. A process for treating an aqueous composition, the process comprising:

converting at least a portion of chloride ions in the aqueous composition to hypochlorite ions or hypochlorous acid by passing an electric current through at least a portion of the aqueous composition under anaerobic conditions, where the aqueous composition through which the electric current is passed includes the chloride ions, iron (II) compounds, and one or more organic compounds;

reacting at least a portion of the iron (II) compounds of the aqueous composition with the hypochlorite or hypochlorous acid to produce iron (III) ions; and

coagulating the one or more organic compounds with the iron (III) ions to produce a plurality of insoluble solid particles in a treated aqueous composition.

2. The process of claim 1 where the electric current has a voltage of greater than or equal to 1.5 volts (V) and a current density of from 1 millimapere per square centimeter to 1 ampere per square centimeter.

3. The process of either of claims 1 or 2 where the aqueous composition comprises a composition of an oilfield produced water and has a pH of from 2.5 to 8.5 or a pH of from 10.5 to 12.5.

4. The process of any one of the preceding claims where the electric current is passed through the aqueous composition with non-sacrificial electrodes, where the non-

sacrificial electrodes have an outer surface comprising one or more of zirconium, molybdenum, gold, silver, tantalum, tungsten, chromium, carbon, sulfur, silicon, or oxides of these materials.

5. The process of claim 4 further comprising alternating polarities of the non-sacrificial electrodes, where the polarities of the non-sacrificial electrodes are alternated by an electrode polarity alternator comprising a waveform generator.

6. The process of either of claims 4 or 5 further comprising rotating the non-sacrificial electrodes relative to the aqueous composition.

7. The system of claim 6 where the non-sacrificial electrodes are rotated by an electrode rotation system comprising a shaft coupled to each of the non-sacrificial electrodes and a drive operatively coupled to the shaft, the drive operable to rotate the shaft and the non-sacrificial electrodes relative to the aqueous composition.

8. The process of any one of the preceding claims further comprising:

measuring a property of the aqueous composition or the treated aqueous composition; and

controlling a voltage or a current density of the electric current passing through the aqueous composition in response to the measured property.

9. The process of claim 8 where the property comprises an oxidation-reduction potential.

10. The process of any one of the preceding claims where all of the aqueous composition is subjected to the electric current.

11. The process of any one of claims 1 through 9 further comprising:

separating the aqueous composition into a first portion and a second portion;

converting at least a portion of the chloride ions in the first portion of the aqueous composition to hypochlorite or hypochlorous acid by passing an electric current through the first portion of the aqueous composition under anaerobic conditions; and

combining the first portion of the aqueous composition with the second portion of the aqueous composition after converting of the chloride ions in the first portion to hypochlorite or hypochlorous acid.

12. The process of claim 11 further comprising:

measuring a property of the first portion of the aqueous solution, the second portion of the aqueous composition, or the treated aqueous composition; and

adjusting a ratio of the first portion to the second portion of the aqueous composition based on the measured property.

13. The process of any of the preceding claims where:

the aqueous composition comprises phenolic compounds and the treated aqueous composition comprises less than 0.01 parts per million by weight phenolic compounds, after treatment;

the aqueous composition includes greater than or equal to 0.1 weight percent crude oil and the treated aqueous composition comprises less than 50 milligrams per liter crude oil, after treatment; or

the aqueous composition comprises hydrogen sulfide and the treated aqueous composition comprises a concentration of hydrogen sulfide less than a concentration of hydrogen sulfide in the aqueous composition.

14. A system for treating an aqueous composition, the system comprising:

an electro-chlorination system that includes a vessel and a plurality of electrodes disposed within the vessel, the electro-chlorination system operable to convert at least a portion of chloride ions in the aqueous composition into hypochlorite or hypochlorous acid by passing an electric current through the aqueous composition disposed in the vessel with the plurality of electrodes, where the electrodes each comprise non-sacrificial electrodes having an outer surface that includes one or more of zirconium, molybdenum, gold, silver, tantalum, tungsten, chromium, carbon, sulfur, silicon, or oxides of these materials and the plurality of electrodes are operable to pass the electric current with a current potential greater than 1.5 V through the aqueous composition disposed within the vessel; and

a coagulation vessel downstream of the electro-chlorination system.

15. The system of claim 14 further comprising:

a bypass line operable to pass at least a portion of the aqueous composition around the electro-chlorination system and directly to the coagulation vessel; and

a control valve disposed in the bypass line, wherein the control valve is operable to control a flow rate of a portion of an aqueous composition into the electro-chlorination vessel in response to a measured property determined by a property sensor position in the electro-chlorination vessel or downstream of the electro-chlorination vessel.