~~What is claimed is:~~

CLAIMS

1. A system for treating water comprising:

an electrochemical cell having an inlet and an outlet, the inlet of the electrochemical cell fluidly connectable to a source of water comprising at least one contaminant, the electrochemical cell comprising:

a cathode comprising a catalytic material for electrochemical generation of persulfate free radicals, wherein the catalytic material comprises a metal selected from the group consisting of iron, copper, nickel, cobalt, and metal alloys; and

an anode;

a source of a persulfate positioned upstream of the electrochemical cell and fluidly connectable to the source of water;

a first contaminant concentration sensor and a first water flow sensor positioned upstream of the electrochemical cell and fluidly connectable to the source of water;

a second water flow sensor positioned downstream of the electrochemical cell and fluidly connectable to the outlet of the electrochemical cell; and

a controller operatively coupled to receive ~~one or more~~ a plurality of input signals,

wherein the plurality of input signals is received from at least the first contaminant concentration sensor~~,~~ and the second water flow sensor;

wherein, based on the input signals from the first contamination concentration sensor and the second water flow sensor, the controller is operable to generate:

a first control signal that regulates at least a rate of introduction of water from the source of water~~,~~;

a second control signal that regulates at least a rate of persulfate introduction to the source of water~~,~~; and

a third control signal that regulates at least a potential applied to the electrochemical cell ~~based on the one or more input signals~~.

2. The system of claim 1, wherein the first contaminant concentration sensor comprises an organic contaminant concentration sensor.

~~3. The system of claim 1, wherein the persulfate comprises at least one of ammonium persulfate, potassium persulfate, and sodium persulfate.~~

~~4. The system of claim 1, wherein the cathode catalytic material comprises a metal selected from the group consisting of iron, copper, nickel, cobalt, and metal alloys.~~

~~5~~3. The system of claim ~~4~~1, wherein the cathode material comprises copper.

~~6~~4. The system of claim ~~4~~1, wherein the anode comprises one of platinum, a Magneli phase titanium oxide, a mixed metal oxide (MMO) coated dimensionally stable anode (DSA) material, graphite, boron doped diamond (BDD), or lead/lead oxide.

~~7. The system of claim 1, further comprising a first water flow sensor positioned upstream of the electrochemical cell and fluidly connectable to the source of water.~~

~~8~~5. The system of claim ~~7~~1,

wherein ~~the controller is further operable to receive~~ at least one input signal of the plurality of input signals is received from the first water flow sensor; and

wherein the first control signal is further based on the at least one input signal received from the first water flow sensor~~to generate a control signal that regulates at least the rate of introduction of water from the source of water~~.

~~9~~6. The system of claim 1, further comprising a current sensor coupled to the electrochemical cell.

~~10~~7. The system of claim ~~9~~6,

wherein ~~the controller is further operable to receive~~ at least one input signal of the plurality of input signals is received from the current sensor; and

wherein the third control signal is further based on the at least one input signal received from the current sensor~~to generate a control signal that regulates at least the potential applied to the electrochemical cell~~.

~~11. The system of claim 1, further comprising a persulfate concentration sensor fluidly connectable to the source of water.~~

~~12. The system of claim 11, wherein the controller is further operable to receive at least one input signal from the persulfate concentration sensor to generate a control signal that regulates at least the rate of persulfate introduction to the source of water.~~

~~13. The system of claim 1, further comprising a second water flow sensor positioned downstream of the electrochemical cell.~~

~~14. The system of claim 13, wherein the controller is further operable to receive at least one input signal from the second water flow sensor to generate a control signal that regulates at least the rate of introduction of water from the source of water, the rate of persulfate introduction to the source of water, and the potential applied to the electrochemical cell.~~

~~15~~8. The system of claim 1, further comprising a second contaminant concentration sensor positioned downstream of the outlet of the electrochemical cell and fluidly connectable to the outlet of the electrochemical cell.

~~16. The system of claim 15, wherein the controller is further operable to receive at least one input signal from the second contaminant concentration sensor to generate a control signal that regulates at least the rate of introduction of water from the source of water, the rate of persulfate introduction to the source of water, and the potential applied to the electrochemical cell.~~

~~17. The system of claim 1, further comprising a first pH sensor positioned upstream of the electrochemical cell and fluidly connectable to the source of water.~~

~~18. The system of claim 17, further comprising a first pH adjustment unit positioned upstream of the electrochemical cell and fluidly connectable to the source of water.~~

~~19. The system of claim 18, wherein the first pH adjustment unit is configured to adjust the pH of the source of water to a pH less than 7.~~

~~20. The system of claim 19, wherein the controller is further operable to receive at least one input signal from the first pH sensor to generate a control signal that regulates a rate the pH adjuster is introduced from the first pH adjustment unit to the source of water.~~

~~21. The system of claim 17, further comprising a second pH sensor positioned downstream of the outlet of the electrochemical cell.~~

~~22. The system of claim 21, further comprising a second pH adjustment unit positioned downstream of the outlet of the electrochemical cell.~~

~~23. The system of claim 1, further comprising a conductivity sensor positioned upstream of the electrochemical cell and fluidly connectable to the source of water.~~

~~24. The system of claim 23, further comprising a conductivity adjustment unit fluidly connectable to the electrochemical cell.~~

~~25. The system of claim 24, wherein the controller is further operable to receive at least one input signal from the conductivity sensor to generate a control signal that regulates a rate the conductivity adjuster is introduced from the conductivity adjustment unit to the source of water.~~

~~26. The system of claim 1, wherein the electrochemical cell further comprises a reference electrode.~~

~~27. The system of claim 1, further comprising a plurality of electrochemical cells.~~

~~28. The system of claim 1, further comprising a treatment vessel positioned downstream of the electrochemical cell and fluidly connectable to the outlet of the electrochemical cell.~~

~~29. A method of treating water, comprising:~~

~~providing water from a source of water comprising at least one contaminant;~~

~~measuring a concentration of at least one contaminant in the water from the source of water;~~

~~introducing a persulfate to the water at a concentration based on a signal representative of at least the measured concentration of the at least one contaminant in the water to produce a first treated water;~~

~~introducing the first treated water to an inlet of an electrochemical cell; and~~

electrochemically generating persulfate free radicals from the persulfate in the electrochemical cell at an electrode comprising a catalytic material to produce a second treated water.

30. The method of claim 29, further comprising adjusting the concentration of the persulfate introduced to the water based on at least a signal generated from a measured concentration of the at least one contaminant in the second treated water.

31. The method of claim 30, further comprising adjusting a potential applied to the electrochemical cell based on at least a signal generated from the measured concentration of the at least one contaminant in the second treated water.

32. The method of claim 31, further comprising adjusting a rate of introduction of water from the source of water based on at least a signal generated from the measured concentration of the at least one contaminant in the second treated water.

33. The method of claim 29, wherein the persulfate comprises at least one of ammonium persulfate, sodium persulfate, and potassium persulfate.

34. The method of claim 29, wherein the persulfate free radicals are generated at a cathode in the electrochemical cell.

35. The method of claim 29, wherein the at least one contaminant comprises an organic contaminant.

36. The method of claim 29, further comprising introducing a pH adjuster to the water from the source of water.

37. The method of claim 36, further comprising adjusting the pH of the water from the source of water to a value of less than 7.

38. The method of claim 29, further comprising introducing a conductivity adjuster to the water from the source of water.

39. The method of claim 29, further comprising introducing the second treated water from the electrochemical cell into a treatment vessel positioned downstream of the electrochemical cell.

40. The method of claim 39, further comprising adjusting the pH of the second treated water.

41. A method of facilitating water treatment, comprising:

providing a water treatment system, the system comprising an electrochemical cell configured to electrochemically activate a persulfate introduced to a source of water comprising at least one contaminant at an electrode comprising a catalytic material for electrochemical generation of persulfate free radicals;

providing at least one of a first contaminant concentration sensor, a first water flow sensor, a current sensor, and a persulfate concentration sensor;

providing a controller configured to regulate at least the introduction of water from the source of water, an amount of the persulfate introduced, and a potential applied to electrochemical cell responsive to at least a measured contaminant concentration of the water;

instructing a user to fluidly connect the electrochemical cell to the source of water; and

instructing a user to connect the water treatment system to the controller.

42. The method of claim 41, further comprising providing the persulfate.

43. The method of claim 41, wherein the controller is further responsive to a measured water flow rate.

44. The method of claim 41, wherein the controller is further responsive to a measured persulfate concentration.

45. The method of claim 41, wherein the controller is further responsive to a measured current of the electrochemical cell.

~~46. A method of retrofitting a water treatment system comprising an advanced oxidation process (AOP) in fluid communication with a source of water comprising at least one contaminant, comprising:~~

~~providing an electrochemical cell including a cathode comprising a catalytic material for electrochemical generation of persulfate free radicals;~~

~~fluidly connecting the electrochemical cell to the source of water; and~~

~~providing instructions to operate the electrochemical cell to activate a persulfate introduced into the source of water to produce a treated water.~~

~~47. The method of claim 46, further comprising replacing an ultraviolet (UV) AOP from the water treatment system.~~

~~48. The method of claim 46, wherein the electrochemical cell is provided with a cathode that comprises a metal selected from the group consisting of iron, copper, nickel, cobalt, and alloys thereof.~~

~~49. The method of claim 48, wherein the electrochemical cell is provided with an anode that comprises one of platinum, a Magneli phase titanium oxide, a MMO coated DSA material, graphite, BDD, or lead/lead oxide.~~

~~50. The method of claim 49, further comprising providing the persulfate.~~

~~51. The method of claim 46, further comprising providing a controller configured to regulate at least a rate of introduction of water from the source of water, a rate the persulfate is introduced to the source of water, and a potential applied to the electrochemical cell.~~