Claims

1. A system for producing a mixed aqueous halogen solution having at least two distinct halogen species, comprising:

(i) a first storage tank, the first storage tank is configured to contain an aqueous halogen solution, and wherein the aqueous halogen solution is devoid of chlorine;

(ii) a first mixing tank located downstream of the first storage tank, wherein the first mixing tank comprises a flow-impeding structure; and

(iii) an *in situ* apparatus for generating an aqueous hypochlorite solution; and

(iv) piping for transporting a stream of an aqueous hypochlorite solution to the first mixing tank.

2. The system according to Claim 1, further comprising a second storage tank for storing a pH adjusting chemical.

3. The system according to Claim 2, further comprising a static mixer for mixing the aqueous hypochlorite solution with the pH adjusting chemical before it is piped to the first mixing tank.

4. The system according to Claim 1, further comprising a first sensor suite, wherein the first sensor suite incorporates one or more sensors for measuring at least a pH of the aqueous hypochlorite solution before it is piped to the first mixing tank.

5. The system according to Claim 3, further comprising a first sensor suite, wherein the first sensor suite comprises at least a pH sensor to measure the pH of the pH adjusted aqueous hypochlorite solution before it is transported to the first mixing tank.

6. The system according to Claim 5, wherein the flow-impeding structure comprises one or more baffles,

wherein the baffles are configured to facilitate a thorough mixing of (a) the aqueous hypochlorite solution or the pH adjusted aqueous hypochlorite solution, and (b) the aqueous halogen solution devoid of chlorine to produce the mixed aqueous halogen solution having at least two distinct halogen species.

7. The system according to Claim 6, wherein the aqueous halogen solution is a bromine-containing fluid.

8. The system according to Claim 1, wherein the aqueous halogen solution includes bromine and iodine.

9. The system according to Claim 6, further comprising a second sensor suite located downstream of the first mixing tank, wherein the second sensor suite includes one or more sensors to measure one or more parameters of the mixed aqueous halogen solution.

10. The system according to Claim 9, wherein the parameters are selected from the group consisting of pH, oxidation reduction potential (ORP), UV-Vis absorption profile and combinations thereof.

11. The system according to Claim 9, further comprising a third storage tank, wherein the third storage tank is fluidically connected to the second sensor suite, and wherein the third storage tank is configured to contain a halogen stabilizing compound.

12. The system according to Claim 11, further comprising piping for transporting the mixed aqueous halogen solution and the halogen stabilizing compound to a second mixing tank.

13. The system according to Claim 12, wherein the second mixing tank includes one or more baffles and wherein the baffles are configured to facilitate a thorough mixing of (a) the mixed aqueous halogen solution, and (b) the halogen stabilizing compound to produce a stabilized mixed aqueous halogen solution having at least two distinct halogen species.

14. The system according to Claim 13, further comprising a fourth storage tank located downstream of the second mixing tank, wherein the stabilized mixed aqueous halogen solution is routed to the fourth storage tank.

15. A method for producing a mixed aqueous halogen solution having at least two distinct halogen species, comprising:

generating aqueous hypochlorite *in situ*;

pumping a stream of an aqueous hypochlorite solution to a first mixing tank;

pumping an aqueous halogen solution the first mixing tank, wherein the aqueous halogen solution is devoid of chlorine; and

facilitating a thorough mixing in the first mixing tank of the aqueous hypochlorite solution and the aqueous halogen solution devoid of chlorine to produce the mixed aqueous halogen solution having at least two distinct halogen species.

16. The method according to Claim 15, further comprising measuring:

(i) at least a pH of the aqueous hypochlorite solution before it is transported to the first mixing tank; and

(ii) one or more parameters of the mixed aqueous halogen solution, wherein the parameters are selected from the group consisting of pH, oxidation reduction potential (ORP), UV-Vis absorption profile and combinations thereof.

17. The method according to Claim 16, further comprising processing the measurements to control a flow rate of the aqueous hypochlorite solution to the first mixing tank.

18. The method according to Claim 16, further comprising processing the measurements to control a pumping rate of the aqueous hypochlorite solution and/or the aqueous halogen solution to control the reaction between hypochlorite ions and non-chloride halide ions.