CLAIMS

What is claimed is:

1. A method of operating an electrochemical cell, the method comprising:

introducing an aqueous solution into an electrochemical cell between an anode and a cathode of the electrochemical cell;

applying a current across the anode and the cathode at a voltage sufficient to generate a product compound from the aqueous solution in the electrochemical cell;

monitoring at least one parameter selected from the group consisting of a concentration of dissolved hydrogen in a product solution generated in the electrochemical cell and a condition of the aqueous solution associated with hydrogen gas production; and

reversing polarity of the anode and the cathode responsive to the at least one parameter being outside of a predetermined range.

2. The method of claim 1, wherein the condition of the aqueous solution is selected from the group consisting of flow rate, dissolved oxygen concentration, dissolved hydrogen concentration, pH, ORP, and temperature of the aqueous solution being introduced into the electrochemical cell.

3. The method of claim 2, further comprising controlling a magnitude of the current applied across the anode and the cathode based on the condition of the aqueous solution.

4. The method of claim 2, further comprising controlling a rate of introduction of the aqueous solution based on the condition of the aqueous solution.

5. The method of claim 1, further comprising selecting the predetermined range to be sufficient to prevent generation of hydrogen gas in the electrochemical cell.

6. The method of claim 1, further comprising controlling a magnitude of the current applied across the anode and the cathode based on at least one of a flow rate of the aqueous solution, voltage applied across the anode and the cathode, and the concentration of dissolved hydrogen in the product solution.

7. The method of claim 1, further comprising controlling a rate of introduction of the aqueous solution into the electrochemical cell based at least on one or more of a flow rate of the product solution out of the electrochemical cell, a concentration of the product compound in the product solution, and a concentration of chloride in the aqueous solution.

8. The method of claim 1, further comprising introducing an oxidizing agent into the aqueous solution upstream of the electrochemical cell.

9. The method of claim 8, wherein introducing the oxidizing agent into the aqueous solution comprises introducing one or more of gaseous oxygen, ozone, air, oxygen-enriched air, and hydrogen peroxide into the aqueous solution.

10. A method of suppressing accumulation of hydrogen gas in an electrochlorination cell, the method comprising:

introducing a liquid electrolyte into an electrochlorination cell between an anode and a cathode of the electrochlorination cell;

monitoring at least one parameter selected from the group consisting of a voltage applied across the anode and the cathode, a concentration of dissolved hydrogen in a product solution generated in the electrochlorination cell, and a condition of the liquid electrolyte selected from the group consisting of flow rate, dissolved oxygen concentration, dissolved hydrogen concentration, pH, ORP, and temperature of the liquid electrolyte being introduced into the electrochlorination cell; and

reversing polarity of the anode and the cathode in the electrochlorination cell responsive to the at least one parameter being outside of a range sufficient to prevent generation of hydrogen gas within the electrochlorination cell.

11. An electrochemical system comprising:

an electrochemical cell including a housing having an inlet, an outlet, an anode, and a cathode disposed within the housing;

a source of an aqueous solution having an outlet fluidly connectable to the inlet of the electrochemical cell;

a first sensor constructed and arranged to measure a concentration of dissolved hydrogen in a product solution generated in the electrochemical cell; and

a controller electrically connectable to the first sensor and configured to cause the anode and the cathode to reverse polarity responsive to the dissolved hydrogen concentration exceeding a predetermined threshold.

12. The electrochemical system of claim 11, further comprising a second sensor constructed and arranged to measure a condition of the aqueous solution selected from the group consisting of flow rate, dissolved oxygen concentration, dissolved hydrogen concentration, pH, ORP, and temperature of the aqueous solution.

13. The electrochemical system of claim 12, wherein the controller is electrically connectable to the second sensor and configured to cause the anode and the cathode to reverse polarity responsive to the condition of the aqueous solution being outside of a predetermined range.

14. The electrochemical system of claim 12, further comprising a flow controller electrically connectable to the second sensor and configured to regulate a rate of introduction of the aqueous solution into the electrochemical cell based on the condition of the aqueous solution.

15. The electrochemical system of claim 11, wherein the controller is configured to cause the anode and the cathode to reverse polarity responsive to the dissolved hydrogen concentration in the product solution being outside of a predetermined range sufficient to cause accumulation of hydrogen at the cathode during operation of the electrochemical cell.

16. The system of claim 11, wherein the controller is configured to regulate the current applied across the anode and the cathode based on at least one of a flow rate of the aqueous solution, voltage applied across the anode and the cathode, a concentration of oxygen dissolved in the aqueous solution, and a concentration of hydrogen dissolved in the aqueous solution.

17. The electrochemical system of claim 11, further comprising a source of an oxidizing agent fluidly connectable to the source of the aqueous solution upstream of the electrochemical cell.

18. The electrochemical system of claim 17, wherein the source of the oxidizing agent is constructed and arranged to deliver hydrogen peroxide to the source of the aqueous solution from the outlet of the electrochemical cell.

19. The electrochemical system of claim 17, further comprising a flow controller configured to regulate a rate of introduction of the oxidizing agent into the aqueous solution based at least on one of an amount of hydrogen gas present in the electrochemical cell, a concentration of hydrogen dissolved in the aqueous solution, a concentration of oxygen dissolved in the aqueous solution, and a concentration of oxygen dissolved in the product solution.

20. The electrochemical system of claim 11, further comprising a third sensor constructed and arranged to measure a condition of the product solution selected from the group consisting of flow rate, pH, ORP, temperature, and concentration of a product compound in the product solution.

21. The electrochemical system of claim 20, further comprising a flow controller electrically connectable to the third sensor and configured to regulate a rate of introduction of the aqueous solution into the electrochemical cell based on the condition of the product solution.

22. The electrochemical system of claim 11, wherein the source of the aqueous solution comprises at least one of seawater, brackish water, or brine.

23. A method of facilitating operation of an electrochemical cell, the method comprising:

providing an electrochemical system comprising:

an electrochemical cell including a housing having an inlet, an outlet, an anode, and a cathode disposed within the housing;

a first sensor constructed and arranged to measure a concentration of dissolved hydrogen in a product solution generated in the electrochemical cell;

a second sensor constructed and arranged to measure a condition of a liquid electrolyte fluidly connectable to the inlet of the electrochemical cell,

the condition selected from the group consisting of flow rate, dissolved oxygen concentration, dissolved hydrogen concentration, pH, ORP, and temperature of the liquid electrolyte; and

a controller electrically connectable to one or more of the first sensor and the second sensor, the controller configured to cause the anode and the cathode to reverse polarity responsive to at least one of the concentration of dissolved hydrogen in the product solution, and the condition of the liquid electrolyte being outside of a predetermined range;

providing instructions for connecting a liquid electrolyte to the inlet of the electrochemical cell; and

providing instructions for connecting the outlet of the electrochemical cell to a point of use.

24. The method of claim 23, wherein providing the electrochemical system comprising the electrochemical cell comprises providing and electrochemical system comprising an electrochlorination cell, and providing instructions for connecting the liquid electrolyte to the inlet of the electrochemical cell comprises providing instructions for connecting a chloride-containing aqueous solution to the inlet of the electrochemical cell.

25. The system of claim 11, further comprising a fourth sensor configured to measure voltage applied across the anode and the cathode, the fourth sensor being electrically connectable to the controller.