CLAIMS

1. A system comprising:

a module comprising:

a filtration membrane configured to extend along at least one liquid stream, the filtration membrane defining a first membrane side and a second membrane side, the first membrane side and the second membrane side being different membrane sides facing away from one another, the filtration membrane being configured to separate the at least one liquid stream into a first stream on the first membrane side of the filtration membrane and a second stream on the second membrane side of the filtration membrane;

a first electrode; and

a second electrode, the first electrode and the second electrode being at respective ones of the different membrane sides of the filtration membrane, wherein the first stream is configured to flow by the first electrode to form a first effluent stream characterized by a first alkalinity/pH, and wherein the second stream is configured to flow by the second electrode to form a second effluent stream characterized by a second alkalinity/pH, and wherein the first alkalinity/pH and the second alkalinity/pH differ from one another in response to a potential difference applied across the first electrode and the second electrode.

2. The system of claim 1, wherein the at least one liquid stream is characterized by a corresponding influent alkalinity/pH, and wherein at least one of the first effluent stream and the second effluent stream is characterized by an alkalinity/pH that is different from the corresponding influent alkalinity/pH.

3. The system of claim 1 or claim 2, wherein one of the first effluent stream and the second effluent stream has a higher alkalinity/pH than a corresponding one of the first stream and the second stream, and wherein another of the first effluent stream and the second effluent stream has a lower alkalinity/pH than another corresponding one of the first stream and the second stream.

4. The system of any one of claims 1 to 3, wherein one of the first effluent stream and the second effluent stream is an alkaline or neutral effluent stream, and wherein another one of the first effluent stream and the second effluent stream is a neutral or acidic effluent stream.

5. The system of claim 4, wherein the alkaline effluent stream is characterized by a pH in a range, and wherein the pH is greater than 7 and equal to or smaller than 13.

6. The system of claim 4, wherein the neutral or acidic effluent stream is characterized by a pH in a range of 1 to 7.

7. The system of any one of claims 1 to 6, further comprising at least one pump in a flow path connected to the module, the at least one pump being configured to controllably perform one or concurrently both of the following: (i) deliver at least one of the first stream and the second stream at a respective fluid pressure; and (ii) provide a hydraulic pressure differential across the filtration membrane between the first stream and the second stream.

8. The system of claim 7, wherein the second effluent stream comprises a permeate drawn across the filtration membrane from the first stream.

9. The system of claim 8, wherein a pressure differential between the first stream and the second stream is a result of at least one of the hydraulic pressure differential and an osmotic pressure differential between the first stream and the second stream, in which the pressure differential is configured to enable any one of the following across the filtration membrane: pressure-retarded osmosis, forward osmosis, osmotically assisted reverse osmosis, reverse osmosis, nanofiltration, ultrafiltration, and microfiltration.

10. The system of any one of claims 1 to 9, further comprising at least one recirculation flow path, wherein a respective one of the at least one recirculation flow path is

configured to recirculate at least a portion of one of the first effluent stream and the second effluent stream to a corresponding one of the first stream and the second stream.

11. The system of any one of claims 1 to 10, wherein the module further comprises:

a first spacer, the first spacer being configured to provide a first flow path for the first stream, and wherein at least one hydrodynamic parameter of the first stream is determined by the first spacer.

12. The system of claim 11, wherein the first spacer is configured as the first electrode.

13. The system of claim 11, wherein the module further comprises a second spacer, the second spacer being configured to provide a second flow path for the second stream, and wherein at least one hydrodynamic parameter of the second stream is determined by the second spacer.

14. The system of claim 13, wherein the second spacer is configured as the second electrode.

15. The system of claim 13, wherein the first spacer is disposed between and in contact with the filtration membrane and the first electrode, and wherein the second spacer is disposed between and in contact with the filtration membrane and the second electrode.

16. The system of any one of claims 1 to 10, wherein the first membrane side of the filtration membrane is configured as the first electrode.

17. The system of any one of claims 1 to 10, wherein the second membrane side of the filtration membrane is configured as the second electrode.

18. The system of any one of claims 1 to 17, wherein the filtration membrane comprises an electrically non-conductive layer, the electrically non-conductive layer being disposed between the first electrode and the second electrode.

19. The system of any one of claims 1 to 18, wherein at least one of the first alkalinity/pH and the second alkalinity/pH is variable and responsive to a change in the potential difference applied across the first electrode and the second electrode and/or a change in a current provided to the first electrode and the second electrode.

20. The system of claim 19, further comprising: a controller, the controller being configured to:

acquire at least one measured alkalinity/pH measured from one or both of the first effluent stream and the second effluent stream; and

in response to the at least one measured alkalinity/pH, change the potential difference applied across the first electrode and the second electrode and/or change the current provided to the first electrode and the second electrode.

21. The system of any one of claims 1 to 20, wherein the filtration membrane is a non-ion exchange membrane selected from the following: a reverse osmosis (RO) membrane, a nanofiltration (NF) membrane, an ultrafiltration (UF) membrane, a microfiltration (MF) membrane, a forward osmosis (FO) membrane, a pressure-retarded osmosis (PRO) membrane, and a porous filtration paper.

22. The system of any one of claims 1 to 21, wherein the module is configured as one of: a spiral wound membrane filtration module, a plate and frame membrane filtration module, a hollow fiber membrane filtration module, and a tubular membrane module.

23. A method comprising:

providing a liquid stream to flow by a filtration membrane, the filtration membrane defining a first membrane side and a second membrane side, the first membrane side and the second membrane side being different membrane sides

facing away from one another, the filtration membrane being configured to separate the liquid stream into a first stream on the first membrane side of the filtration membrane and a second stream on the second membrane side of the filtration membrane; and

applying a potential difference across a first electrode and a second electrode, the first electrode and the second electrode being at respective ones of the different membrane sides of the filtration membrane, wherein the first stream is configured to flow by the first electrode to form a first effluent stream characterized by a first alkalinity/pH, and wherein the second stream is configured to flow by the second electrode to form a second effluent stream characterized by a second alkalinity/pH, and wherein the first alkalinity/pH and the second alkalinity/pH differ from one another.

24. The method of claim 23, wherein the liquid stream is characterized by a corresponding influent alkalinity/pH, and wherein at least one of the first effluent stream and the second effluent stream is characterized by an alkalinity/pH that is different from the corresponding influent alkalinity/pH.

25. The method of claim 23 or claim 24, wherein one of the first effluent stream and the second effluent stream has a higher alkalinity/pH than the liquid stream, and wherein another one of the first effluent stream and the second effluent stream has a lower alkalinity/pH than the liquid stream.

26. The method of any one of claims 23 to 25, further comprising applying a pressure differential across the filtration membrane.

27. The method of claim 26, wherein the second effluent stream comprises a permeate drawn across the filtration membrane from the first stream.

28. The method of claim 27, wherein the pressure differential is a result of at least one of a hydraulic pressure differential and an osmotic pressure differential between the first stream and the second stream, and wherein the pressure differential is

configured to enable any one of the following across the filtration membrane: pressure-retarded osmosis, forward osmosis, osmotically assisted reverse osmosis, reverse osmosis, nanofiltration, ultrafiltration, and microfiltration.

29. The method of any one of claims 23 to 28, further comprising recirculating at least one or both of a portion of the second effluent stream to the second stream and a portion of the first effluent stream to the first stream.

30. The method of any one of claims 23 to 29, wherein the first stream is configured to flow through a first spacer, and wherein the first spacer is configured to determine at least one hydrodynamic parameter of the first stream.

31. The method of claim 30, wherein the first electrode is configured as the first spacer.

32. The method of claim 30 or claim 31, wherein the second stream is configured to flow through a second spacer, and wherein the second spacer is configured to determine at least one hydrodynamic parameter of the second stream.

33. The method of claim 32, wherein the second electrode is configured as the second spacer.

34. The method of claim 32, wherein the first spacer is disposed between and in contact with the filtration membrane and the first electrode, and wherein the second spacer is disposed between and in contact with the filtration membrane and the second electrode.

35. The method of any one of claims 23 to 29, wherein the first membrane side of the filtration membrane is configured as the first electrode.

36. The method of any one of claims 23 to 29, wherein the second membrane side of the filtration membrane is configured as the second electrode.

37. The method of any one of claims 23 to 36, wherein the filtration membrane comprises an electrically non-conductive layer, the electrically non-conductive layer being disposed between the first electrode and the second electrode.

38. The method of any one of claims 23 to 37, wherein at least one of the first alkalinity/pH and the second alkalinity/pH is variable and responsive to a change in the potential difference applied across the first electrode and the second electrode and/or a change in a current provided to the first electrode and the second electrode.

39. The method of claim 38, further comprising, in response to at least one measured alkalinity/pH measured from one or both of the first effluent stream and the second effluent stream, changing the potential difference applied across the first electrode and the second electrode and/or changing the current provided to the first electrode and the second electrode.