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CLAIMS

What is claimed is:

1. A method, comprising:
 - 5 transporting a feed solution comprising a solvent and a solute to a retentate side of a feed osmotic module such that:
 - a feed osmotic module retentate outlet stream exits the retentate side of the feed osmotic module, the feed osmotic module retentate outlet stream having a concentration of the solute that is greater than a concentration of the solute within the feed solution entering the retentate side of the feed osmotic module, and
 - 10 at least a portion of the solvent from the feed solution is transported from the retentate side of the feed osmotic module, through an osmotic membrane of the feed osmotic module, to a permeate side of the feed osmotic module where the portion of the solvent is combined with a feed osmotic module permeate inlet stream to form a feed osmotic module permeate outlet stream that is transported out of the permeate side of the feed osmotic module;
 - transporting a purification osmotic module retentate inlet stream to a retentate side of a purification osmotic module such that:
 - 20 a purification osmotic module retentate outlet stream exits the retentate side of the purification osmotic module, the purification osmotic module retentate outlet stream having an osmotic pressure that is greater than an osmotic pressure of the purification osmotic module retentate inlet stream, and
 - at least a portion of liquid from purification osmotic module retentate inlet stream is transported from the retentate side of the purification osmotic module, through an osmotic membrane of the purification osmotic module, to a permeate side of the purification osmotic module; and
 - 25 transporting an isolation osmotic module retentate inlet stream to a retentate side of an isolation osmotic module and an isolation osmotic module permeate inlet stream to a permeate side of the isolation osmotic module such that:
 - 30 an isolation osmotic module retentate outlet stream exits the retentate side of the isolation osmotic module, the isolation osmotic module retentate

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outlet stream having an osmotic pressure that is greater than an osmotic pressure of the isolation osmotic module retentate inlet stream, and

at least a portion of liquid from isolation osmotic module retentate inlet stream is transported from the retentate side of the isolation osmotic module, through an osmotic membrane of the isolation osmotic module, to a permeate side of the isolation osmotic module where the portion of the liquid is combined with the isolation osmotic module permeate inlet stream to form an isolation osmotic module permeate outlet stream that is transported out of the permeate side of the isolation osmotic module;

wherein:

the feed osmotic module permeate inlet stream comprises at least a portion of the isolation osmotic module retentate outlet stream;

the isolation osmotic module permeate inlet stream comprises at least a portion of the isolation osmotic module retentate outlet stream;

the isolation osmotic module retentate inlet stream comprises at least a portion of the purification osmotic module retentate outlet stream;

the purification osmotic module retentate inlet stream comprises at least a portion of the feed osmotic module permeate outlet stream; and

the purification osmotic module retentate inlet stream comprises at least a portion of the isolation osmotic module permeate outlet stream.

2. The method of claim 1, wherein the solute comprises solubilized ions.

3. The method of any one of claims 1-2, wherein the concentration of solubilized ions within the feed solution is at least 60,000 ppm.

4. The method of any one of claims 1-3, wherein the feed solution is an aqueous feed solution.

5. The method of any one of claims 1-4, wherein the feed solution comprises Na^+ , Mg^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} , Cl^- , carbonate anions, bicarbonate anions, sulfate anions, bisulfate anions, and/or silica.

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6. The method of any one of claims 1-5, wherein the feed osmotic module is operated as a reverse osmosis module.
7. The method of any one of claims 1-6, wherein the purification osmotic module is operated as a reverse osmosis module.
8. The method of any one of claims 1-7, wherein the isolation osmotic module is operated as a reverse osmosis module.
9. The method of any one of claims 1-8, wherein the feed osmotic module comprises a plurality of osmotic membranes.
10. The method of claim 9, wherein the plurality of osmotic membranes are connected in series.
11. The method of claim 9, wherein the plurality of osmotic membranes are connected in parallel.
12. The method of any one of claims 1-11, wherein the purification osmotic module comprises a plurality of osmotic membranes.
13. The method of claim 12, wherein the plurality of osmotic membranes are connected in series.
14. The method of claim 12, wherein the plurality of osmotic membranes are connected in parallel.
15. The method of any one of claims 1-14, wherein the isolation osmotic module comprises a plurality of osmotic membranes.
16. The method of claim 15, wherein the plurality of osmotic membranes are connected in series.

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17. The method of claim 15, wherein the plurality of osmotic membranes are connected in parallel.
18. The method of any one of claims 1-17, wherein the solute concentration in the feed osmotic module retentate outlet stream is at least 1% higher, on a mass basis, than the concentration of the solute in the feed solution.
19. The method of any one of claims 1-18, wherein, during a first period of time, the retentate side of the feed osmotic module receives at least a portion of the feed osmotic module retentate outlet stream.
20. The method of claim 19, wherein, during a second period of time that is after the first period of time, the retentate side of the feed osmotic module no longer receives any portion of the feed osmotic module retentate outlet stream or receives an amount of the feed osmotic module retentate outlet stream that is less than the amount of the feed osmotic module retentate outlet stream received by the retentate side of the feed osmotic module during the first period of time.
21. The method of claim 19, wherein, during the first period of time, the total amount of osmotic membrane surface area within the retentate side of the feed osmotic module is changed, the total amount of osmotic membrane surface area within the retentate side of the isolation osmotic module is changed, and/or the total amount of osmotic membrane surface area within the retentate side of the purification osmotic module is changed.
22. The method of any one of claims 19-21, wherein, during the first period of time, the total amount of osmotic membrane surface area within the retentate side of the feed osmotic module decreases, as a function of time, by at least 5%.
23. The method of any one of claims 19-21, wherein, during the first period of time, the total amount of osmotic membrane surface area within the retentate side of the isolation osmotic module increases, as a function of time, by at least 5%.

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24. The method of any one of claims 19-23, wherein, during the first period of time, the retentate side of the isolation osmotic module receives at least a portion of the isolation osmotic module retentate outlet stream.
- 5 25. A method, comprising:
transporting a feed solution comprising a solvent and a solute to a retentate side
of a feed osmotic module such that:
a feed osmotic module retentate outlet stream exits the retentate side of
the feed osmotic module, the feed osmotic module retentate outlet stream having
10 a concentration of the solute that is greater than a concentration of the solute
within the feed solution entering the retentate side of the feed osmotic module,
and
at least a portion of the solvent from the feed solution is transported from
the retentate side of the feed osmotic module, through an osmotic membrane of
15 the feed osmotic module, to a permeate side of the feed osmotic module where
the portion of the solvent is combined with a feed osmotic module permeate inlet
stream to form a feed osmotic module permeate outlet stream that is transported
out of the permeate side of the feed osmotic module;
wherein:
20 during a first period of time, the retentate side of the feed osmotic module
receives at least a portion of the feed osmotic module retentate outlet stream;
during a second period of time that is after the first period of time, the
retentate side of the feed osmotic module no longer receives any portion of the
feed osmotic module retentate outlet stream or receives an amount of the feed
25 osmotic module retentate outlet stream that is less than the amount of the feed
osmotic module retentate outlet stream received by the retentate side of the feed
osmotic module during the first period of time;
during both the first period of time and the second period of time, at least
a portion of an isolation osmotic module retentate inlet stream is transported to a
30 retentate side of an isolation osmotic module, and at least a portion of an isolation
osmotic module permeate inlet stream is transported to a permeate side of the
isolation osmotic module such that:

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an isolation osmotic module retentate outlet stream, having an osmotic pressure that is greater than an osmotic pressure of the isolation osmotic module retentate inlet stream, exits the retentate side of the isolation osmotic module, and

5 at least a portion of liquid from the isolation osmotic module retentate inlet stream is transported from the retentate side of the isolation osmotic module, through an osmotic membrane of the isolation osmotic module, to a permeate side of the isolation osmotic module where the portion of the liquid is combined with an isolation osmotic module permeate inlet stream to form an isolation osmotic module permeate outlet stream that is transported out of the permeate side of the isolation osmotic module;

the feed osmotic module permeate inlet stream comprises at least a portion of the isolation osmotic module retentate outlet stream; and

15 the isolation osmotic module permeate inlet stream comprises at least a portion of the isolation osmotic module retentate outlet stream.

26. A method, comprising:

20 transporting, over a first period of time, a first feed solution to a retentate side of a feed osmotic module such that, during the first period of time:

 a first feed osmotic module retentate outlet stream exits the retentate side of the feed osmotic module, the first feed osmotic module retentate outlet stream having a solute concentration that is greater than a solute concentration of the first feed solution entering the retentate side of the feed osmotic module, and

25 at least a portion of the solvent from the first feed solution is transported from the retentate side of the feed osmotic module, through an osmotic membrane of the feed osmotic module, to a permeate side of the feed osmotic module where the portion of the solvent is combined with a feed osmotic module permeate inlet stream to form a first feed osmotic module permeate outlet stream that is transported out of the permeate side of the feed osmotic module; and

30 at least a portion of the first feed osmotic module retentate outlet stream is recycled back to an inlet of the retentate side of the feed osmotic module;

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transporting, over a second period of time that is after the first period of time, a second feed solution to the retentate side of the feed osmotic module such that, during the second period of time:

5 a second feed osmotic module retentate outlet stream exits the retentate side of the feed osmotic module, the second feed osmotic module retentate outlet stream having a solute concentration that is greater than a solute concentration of the second feed solution entering the retentate side of the feed osmotic module, and

10 at least a portion of the solvent from the second feed solution is transported from the retentate side of the feed osmotic module, through the osmotic membrane of the feed osmotic module, to the permeate side of the feed osmotic module where the portion of the solvent is combined with a feed osmotic module permeate inlet stream to form a second feed osmotic module permeate outlet stream that is transported out of the permeate side of the feed osmotic module; and

15 the percentage of the second feed osmotic module retentate outlet stream that is recycled back to the retentate side of the feed osmotic module is reduced by at least 10 wt%, relative to the percentage of the first feed osmotic module retentate outlet stream that is recycled back to the retentate side of the feed osmotic module during the first period of time; and

20 transporting, during both the first period of time and the second period of time, an isolation osmotic module retentate inlet stream to a retentate side of an isolation osmotic module and an isolation osmotic module permeate inlet stream to a permeate side of the isolation osmotic module such that:

25 an isolation osmotic module retentate outlet stream exits the retentate side of the isolation osmotic module, the isolation osmotic module retentate outlet stream having an osmotic pressure that is greater than an osmotic pressure of the isolation osmotic module retentate inlet stream, and

30 at least a portion of liquid from the isolation osmotic module retentate inlet stream is transported from the retentate side of the isolation osmotic module, through an osmotic membrane of the isolation osmotic module, to a permeate side of the isolation osmotic module where the portion of the liquid is combined with an isolation osmotic module permeate inlet stream to form an isolation

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osmotic module permeate outlet stream that is transported out of the permeate side of the isolation osmotic module.

27. The method of any one of claims 25-26, wherein, during the second period of
5 time, less than or equal to 90 wt% of the second feed osmotic module retentate outlet stream is recycled back to the retentate side of the feed osmotic module.

28. The method of any one of claims 25-27, wherein, during the second period of
10 time, none of the second feed osmotic module retentate outlet stream is recycled back to the retentate side of the feed osmotic module.

29. The method of any one of claims 25-28, comprising, during the first period of
time and the second period of time, transporting a purification osmotic module retentate
inlet stream to a retentate side of a purification osmotic module such that:
15 a purification osmotic module retentate outlet stream exits the retentate
side of the purification osmotic module, the purification osmotic module retentate
outlet stream having an osmotic pressure that is greater than an osmotic pressure
of the purification osmotic module retentate inlet stream, and
at least a portion of liquid from purification osmotic module retentate inlet
20 stream is transported from the retentate side of the purification osmotic module,
through an osmotic membrane of the purification osmotic module, to a permeate
side of the purification osmotic module.

30. The method of claim 29, wherein the isolation osmotic module retentate inlet
25 stream comprises at least a portion of the purification osmotic module retentate outlet stream.

31. The method of any one of claims 29-30, wherein the purification osmotic module
retentate inlet stream comprises at least a portion of the isolation osmotic module
30 permeate outlet stream.

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32. The method of any one of claims 29-31, wherein the purification osmotic module retentate inlet stream comprises at least a portion of the feed osmotic module permeate outlet stream.
- 5 33. The method of any one of claims 25-32, wherein the solute comprises solubilized ions.
34. The method of any one of claims 25-33, wherein the concentration of solubilized ions within the feed solution is at least 60,000 ppm.
- 10 35. The method of any one of claims 25-34, wherein the feed solution is an aqueous feed solution.
36. The method of any one of claims 25-35, wherein the feed solution comprises Na^+ ,
15 Mg^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} , Cl^- , carbonate anions, bicarbonate anions, sulfate anions, bisulfate anions, and/or silica.
37. The method of any one of claims 25-36, wherein the feed osmotic module is operated as a reverse osmosis module.
- 20 38. The method of any one of claims 29-37, wherein the purification osmotic module is operated as a reverse osmosis module.
39. The method of any one of claims 25-38, wherein the isolation osmotic module is
25 operated as a reverse osmosis module.
40. The method of any one of claims 25-39, wherein the feed osmotic module comprises a plurality of osmotic membranes.
- 30 41. The method of claim 40, wherein the plurality of osmotic membranes are connected in series.

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42. The method of claim 40, wherein the plurality of osmotic membranes are connected in parallel.
43. The method of any one of claims 29-42, wherein the purification osmotic module
5 comprises a plurality of osmotic membranes.
44. The method of claim 43, wherein the plurality of osmotic membranes are connected in series.
- 10 45. The method of claim 43, wherein the plurality of osmotic membranes are connected in parallel.
46. The method of any one of claims 25-45, wherein the isolation osmotic module comprises a plurality of osmotic membranes.
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47. The method of claim 46, wherein the plurality of osmotic membranes are connected in series.
48. The method of claim 46, wherein the plurality of osmotic membranes are
20 connected in parallel.
49. The method of any one of claims 25-48, wherein the solute concentration in the feed osmotic module retentate outlet stream is at least 1% higher, on a mass basis, than the concentration of the solute in the feed solution.
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50. The method of any one of claims 25-49, wherein, during the first period of time, the total amount of osmotic membrane surface area within the retentate side of the feed osmotic module is changed, the total amount of osmotic membrane surface area within the retentate side of the isolation osmotic module is changed, and/or the total amount of
30 osmotic membrane surface area within the retentate side of the purification osmotic module is changed.

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51. The method of any one of claims 25-50, wherein, during the first period of time, the total amount of osmotic membrane surface area within the retentate side of the feed osmotic module decreases, as a function of time, by at least 5%.
- 5 52. The method of any one of claims 25-51, wherein, during the first period of time, the total amount of osmotic membrane surface area within the retentate side of the isolation osmotic module increases, as a function of time, by at least 5%.
53. The method of any one of claims 25-52, wherein, during the first period of time,
10 the retentate side of the isolation osmotic module receives at least a portion of the isolation osmotic module retentate outlet stream.
54. A method, comprising:
operating a feed osmotic module to produce a feed osmotic module retentate
15 outlet stream having a solute concentration that is greater than a solute concentration of a feed solution entering a retentate side of the feed osmotic module;
operating an isolation osmotic module to produce an isolation osmotic module retentate outlet stream having an osmotic pressure that is greater than an osmotic pressure of an isolation osmotic module retentate inlet stream;
20 wherein:
during a first period of time, the retentate side of the feed osmotic module receives at least a portion of the feed osmotic module retentate outlet stream; and
during a second period of time, the retentate side of the feed osmotic module no longer receives any portion of the feed osmotic module retentate outlet stream or
25 receives an amount of the feed osmotic module retentate outlet stream that is less than the amount of the feed osmotic module retentate outlet stream received by the retentate side of the feed osmotic module during the first period of time.
55. The method of claim 54, further comprising transporting a first portion of the
30 isolation osmotic module retentate outlet stream to the permeate side of the feed osmotic module.

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56. The method of any one of claims 54-55, further comprising transporting a second portion of the isolation osmotic module retentate outlet stream to a permeate side of the isolation osmotic module.
- 5 57. The method of any one of claims 54-56, further comprising operating a purification osmotic module to produce a purification osmotic module permeate outlet stream having an osmotic pressure that is lower than an osmotic pressure of the feed solution entering the feed osmotic module.
- 10 58. The method of any one of claims 54-57, wherein the feed osmotic module permeate inlet stream comprises at least a portion of the isolation osmotic module retentate outlet stream.
59. The method of any one of claims 54-58, wherein the isolation osmotic module
15 permeate inlet stream comprises at least a portion of the isolation osmotic module retentate outlet stream.
60. The method of any one of claims 54-59, wherein the isolation osmotic module retentate inlet stream comprises at least a portion of the purification osmotic module
20 retentate outlet stream.
61. The method of any one of claims 54-60, wherein the purification osmotic module retentate inlet stream comprises at least a portion of the feed osmotic module permeate outlet stream.
25
62. The method of any one of claims 54-61, wherein the purification osmotic module retentate inlet stream comprises at least a portion of the isolation osmotic module permeate outlet stream.
- 30 63. The method of any one of claims 54-62, wherein, during the second period of time, less than or equal to 90 wt% of the feed osmotic module retentate outlet stream is recycled back to the retentate side of the feed osmotic module.

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64. The method of any one of claims 54-63, wherein, during the second period of time, none of the feed osmotic module retentate outlet stream is recycled back to the retentate side of the feed osmotic module.
- 5 65. The method of any one of claims 54-64, wherein the solute comprises solubilized ions.
66. The method of any one of claims 54-65, wherein the concentration of solubilized ions within the feed solution is at least 60,000 ppm.
- 10 67. The method of any one of claims 54-66, wherein the feed solution is an aqueous feed solution.
68. The method of any one of claims 54-67, wherein the feed solution comprises Na^+ ,
15 Mg^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} , Cl^- , carbonate anions, bicarbonate anions, sulfate anions, bisulfate anions, and/or silica.
69. The method of any one of claims 54-68, wherein the feed osmotic module is operated as a reverse osmosis module.
- 20 70. The method of any one of claims 55-69, wherein the purification osmotic module is operated as a reverse osmosis module.
71. The method of any one of claims 54-70, wherein the isolation osmotic module is
25 operated as a reverse osmosis module.
72. The method of any one of claims 54-71, wherein the feed osmotic module comprises a plurality of osmotic membranes.
- 30 73. The method of claim 72, wherein the plurality of osmotic membranes are connected in series.

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74. The method of claim 72, wherein the plurality of osmotic membranes are connected in parallel.

75. The method of any one of claims 55-74, wherein the purification osmotic module
5 comprises a plurality of osmotic membranes.

76. The method of claim 75, wherein the plurality of osmotic membranes are connected in series.

10 77. The method of claim 75, wherein the plurality of osmotic membranes are connected in parallel.

78. The method of any one of claims 54-77, wherein the isolation osmotic module comprises a plurality of osmotic membranes.
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79. The method of claim 78, wherein the plurality of osmotic membranes are connected in series.

80. The method of claim 78, wherein the plurality of osmotic membranes are
20 connected in parallel.

81. The method of any one of claims 54-80, wherein the solute concentration in the feed osmotic module retentate outlet stream is at least 1% higher, on a mass basis, than the concentration of the solute in the feed solution.
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82. The method of any one of claims 54-81, wherein, during the first period of time, the total amount of osmotic membrane surface area within the retentate side of the feed osmotic module is changed, the total amount of osmotic membrane surface area within the retentate side of the isolation osmotic module is changed, and/or the total amount of
30 osmotic membrane surface area within the retentate side of the purification osmotic module is changed.

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83. The method of any one of claims 54-82, wherein, during the first period of time, the total amount of osmotic membrane surface area within the retentate side of the feed osmotic module decreases, as a function of time, by at least 5%.
- 5 84. The method of any one of claims 54-83, wherein, during the first period of time, the total amount of osmotic membrane surface area within the retentate side of the isolation osmotic module increases, as a function of time, by at least 5%.
85. The method of any one of claims 54-84, wherein, during the first period of time,
10 the retentate side of the isolation osmotic module receives at least a portion of the isolation osmotic module retentate outlet stream.
86. A method, comprising:
operating a feed osmotic module to produce a feed osmotic module retentate
15 outlet stream having a solute concentration that is greater than a solute concentration of a feed solution entering a retentate side of the feed osmotic module;
operating an isolation osmotic module to produce an isolation osmotic module retentate outlet stream having an osmotic pressure that is greater than an osmotic pressure of an isolation osmotic module retentate inlet stream;
20 transporting a first portion of the isolation osmotic module retentate outlet stream to the permeate side of the feed osmotic module; and
transporting a second portion of the isolation osmotic module retentate outlet stream to a permeate side of the isolation osmotic module.
- 25 87. The method of claim 86, further comprising operating a purification osmotic module to produce a purification osmotic module permeate outlet stream having an osmotic pressure that is lower than an osmotic pressure of the feed solution entering the feed osmotic module.
- 30 88. The method of any one of claims 86-87, wherein the feed osmotic module permeate inlet stream comprises at least a portion of the isolation osmotic module retentate outlet stream.

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89. The method of any one of claims 86-88, wherein the isolation osmotic module permeate inlet stream comprises at least a portion of the isolation osmotic module retentate outlet stream.
- 5 90. The method of any one of claims 86-89, wherein the isolation osmotic module retentate inlet stream comprises at least a portion of the purification osmotic module retentate outlet stream.
91. The method of any one of claims 86-90, wherein the purification osmotic module
10 retentate inlet stream comprises at least a portion of the feed osmotic module permeate outlet stream.
92. The method of any one of claims 86-91, wherein the purification osmotic module retentate inlet stream comprises at least a portion of the isolation osmotic module
15 permeate outlet stream.
93. The method of any one of claims 86-92, wherein, during the second period of time, less than or equal to 90 wt% of the feed osmotic module retentate outlet stream is recycled back to the retentate side of the feed osmotic module.
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94. The method of any one of claims 86-93, wherein, during the second period of time, none of the feed osmotic module retentate outlet stream is recycled back to the retentate side of the feed osmotic module.
- 25 95. The method of any one of claims 86-94, wherein the solute comprises solubilized ions.
96. The method of any one of claims 86-95, wherein the concentration of solubilized ions within the feed solution is at least 60,000 ppm.
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97. The method of any one of claims 86-96, wherein the feed solution is an aqueous feed solution.

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98. The method of any one of claims 86-97, wherein the feed solution comprises Na^+ , Mg^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} , Cl^- , carbonate anions, bicarbonate anions, sulfate anions, bisulfate anions, and/or silica.
- 5 99. The method of any one of claims 86-98, wherein the feed osmotic module is operated as a reverse osmosis module.
100. The method of any one of claims 87-99, wherein the purification osmotic module is operated as a reverse osmosis module.
- 10 101. The method of any one of claims 86-100, wherein the isolation osmotic module is operated as a reverse osmosis module.
102. The method of any one of claims 86-101, wherein the feed osmotic module
- 15 comprises a plurality of osmotic membranes.
103. The method of claim 102, wherein the plurality of osmotic membranes are connected in series.
- 20 104. The method of claim 102, wherein the plurality of osmotic membranes are connected in parallel.
105. The method of any one of claims 87-104, wherein the purification osmotic module comprises a plurality of osmotic membranes.
- 25 106. The method of claim 105, wherein the plurality of osmotic membranes are connected in series.
107. The method of claim 105, wherein the plurality of osmotic membranes are
- 30 connected in parallel.
108. The method of any one of claims 86-107, wherein the isolation osmotic module comprises a plurality of osmotic membranes.

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109. The method of claim 108, wherein the plurality of osmotic membranes are connected in series.

5 110. The method of claim 108, wherein the plurality of osmotic membranes are connected in parallel.

111. The method of any one of claims 86-110, wherein the solute concentration in the feed osmotic module retentate outlet stream is at least 1% higher, on a mass basis, than
10 the concentration of the solute in the feed solution.

112. The method of any one of claims 86-111, wherein, during a first period of time, the retentate side of the feed osmotic module receives at least a portion of the feed osmotic module retentate outlet stream.

15 113. The method of claim 112, wherein, during a second period of time that is after the first period of time, the retentate side of the feed osmotic module no longer receives any portion of the feed osmotic module retentate outlet stream or receives an amount of the feed osmotic module retentate outlet stream that is less than the amount of the feed
20 osmotic module retentate outlet stream received by the retentate side of the feed osmotic module during the first period of time.

114. The method of any one of claims 112-113, wherein, during the first period of time, the total amount of osmotic membrane surface area within the retentate side of the
25 feed osmotic module is changed, the total amount of osmotic membrane surface area within the retentate side of the isolation osmotic module is changed, and/or the total amount of osmotic membrane surface area within the retentate side of the purification osmotic module is changed.

30 115. The method of any one of claims 112-114, wherein, during the first period of time, the total amount of osmotic membrane surface area within the retentate side of the feed osmotic module decreases, as a function of time, by at least 5%.

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116. The method of any one of claims 112-115, wherein, during the first period of time, the total amount of osmotic membrane surface area within the retentate side of the isolation osmotic module increases, as a function of time, by at least 5%.
- 5 117. The method of any one of claims 112-116, wherein, during the first period of time, the retentate side of the isolation osmotic module receives at least a portion of the isolation osmotic module retentate outlet stream.
118. An osmotic system, comprising:
- 10 a feed osmotic module comprising a first side, a second side, and at least one osmotic membrane between the first side and the second side;
- a purification osmotic module comprising a first side, a second side, and at least one osmotic membrane between the first side and the second side; and
- an isolation osmotic module comprising a first side, a second side, and at least
- 15 one osmotic membrane between the first side and the second side;
- wherein:
- the second side of the feed osmotic module is fluidically connected to the first side of the purification osmotic module;
- the second side of the feed osmotic module is fluidically connected to the
- 20 first side of the isolation osmotic module;
- the first side of the purification osmotic module is fluidically connected to the first side of the isolation osmotic module;
- the second side of the isolation osmotic module is fluidically connected to the first side of the isolation osmotic module; and
- 25 the second side of the isolation osmotic module is fluidically connected to the first side of the purification osmotic module.
119. The osmotic system of claim 118, further comprising a recycle stream connecting an outlet of the first side of the feed osmotic module to an inlet of the first side of the
- 30 feed osmotic module.
120. The osmotic system of any one of claims 118-119, wherein the feed osmotic module is configured to be operated as a reverse osmosis module.

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121. The osmotic system of any one of claims 118-120, wherein the purification osmotic module is operated as a reverse osmosis module.

5 122. The osmotic system of any one of claims 118-121, wherein the isolation osmotic module is operated as a reverse osmosis module.

123. The osmotic system of any one of claims 118-122, wherein the feed osmotic module comprises a plurality of osmotic membranes.

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124. The osmotic system of claim 123, wherein the plurality of osmotic membranes are connected in series.

125. The osmotic system of claim 123, wherein the plurality of osmotic membranes
15 are connected in parallel.

126. The osmotic system of any one of claims 118-125, wherein the purification osmotic module comprises a plurality of osmotic membranes.

20 127. The osmotic system of claim 126, wherein the plurality of osmotic membranes are connected in series.

128. The osmotic system of claim 126, wherein the plurality of osmotic membranes are connected in parallel.

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129. The osmotic system of any one of claims 118-128, wherein the isolation osmotic module comprises a plurality of osmotic membranes.

130. The osmotic system of claim 129, wherein the plurality of osmotic membranes
30 are connected in series.

131. The osmotic system of claim 129, wherein the plurality of osmotic membranes are connected in parallel.

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132. The osmotic system of any one of claims 118-131, further comprising a recycle stream connecting an outlet of the first side of the isolation osmotic module to an inlet of the first side of the isolation osmotic module.

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133. An osmotic system, comprising:

a feed osmotic module comprising a first side, a second side, and at least one osmotic membrane between the first side and the second side; and

10 an isolation osmotic module comprising a first side, a second side, and at least one osmotic membrane between the first side and the second side;

wherein:

the second side of the feed osmotic module is fluidically connected to the first side of the isolation osmotic module; and

15 the second side of the isolation osmotic module is fluidically connected to the first side of the isolation osmotic module.

134. The osmotic system of claim 133, further comprising an purification osmotic module comprising a first side, a second side, and at least one osmotic membrane between the first side and the second side.

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135. The osmotic system of claim 134, wherein the second side of the feed osmotic module is fluidically connected to the first side of the purification osmotic module.

25 136. The osmotic system of any one of claims 134-135, wherein the first side of the purification osmotic module is fluidically connected to the first side of the isolation osmotic module;

30 137. The osmotic system of any one of claims 134-136, wherein the second side of the isolation osmotic module is fluidically connected to the first side of the purification osmotic module.

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138. The osmotic system of any one of claims 133-137, further comprising a recycle stream connecting an outlet of the first side of the feed osmotic module to an inlet of the first side of the feed osmotic module.
- 5 139. The osmotic system of any one of claims 133-138, wherein the feed osmotic module is configured to be operated as a reverse osmosis module.
140. The osmotic system of any one of claims 133-139, wherein the purification osmotic module is operated as a reverse osmosis module.
- 10 141. The osmotic system of any one of claims 133-140, wherein the isolation osmotic module is operated as a reverse osmosis module.
142. The osmotic system of any one of claims 133-141, wherein the feed osmotic
15 module comprises a plurality of osmotic membranes.
143. The osmotic system of claim 142, wherein the plurality of osmotic membranes are connected in series.
- 20 144. The osmotic system of claim 142, wherein the plurality of osmotic membranes are connected in parallel.
145. The osmotic system of any one of claims 133-144, wherein the purification osmotic module comprises a plurality of osmotic membranes.
- 25 146. The osmotic system of claim 145, wherein the plurality of osmotic membranes are connected in series.
147. The osmotic system of claim 145, wherein the plurality of osmotic membranes
30 are connected in parallel.
148. The osmotic system of any one of claims 133-147, wherein the isolation osmotic module comprises a plurality of osmotic membranes.

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149. The osmotic system of claim 148, wherein the plurality of osmotic membranes are connected in series.
- 5 150. The osmotic system of claim 148, wherein the plurality of osmotic membranes are connected in parallel.
151. The osmotic system of any one of claims 133-150, further comprising a recycle stream connecting an outlet of the first side of the isolation osmotic module to an inlet of
- 10 the first side of the isolation osmotic module.