CLAIMS

1. An electrochemical separation device, comprising:

a first electrode;

a plurality of cell pairs wound around the first electrode to form a bundle;

each of the plurality of cell pairs comprising an ion concentrating compartment and an adjacent ion diluting compartment;

the ion concentrating compartment comprising a first spacer having a masked portion and a potted portion;

the adjacent ion diluting compartment comprising a second spacer having a masked portion and a potted portion;

the masked and potted portions of the first and second spacers being in an alternating alignment;

a concentrate stream channel extending through the masked portion of first spacer and the potted portion of the second spacer, the concentrate stream channel being in fluid communication with the ion concentrating compartment and in fluid isolation from the ion diluting compartment;

a dilute stream channel extending through the potted portion of the first spacer and the masked portion of the second spacer, the dilute stream channel being in fluid isolation from the ion concentrating compartment and in fluid communication with the ion diluting compartment; and

a second electrode surrounding the bundle.

2. The device of claim 1, further comprising a manifold block proximate to the bundle, the manifold block comprising a dilute stream port in fluid communication with the dilute stream channel.

3. The device of claim 2, wherein the manifold block further comprises a concentrate stream port in fluid communication with the concentrate stream channel.

4. The device of claim 3, wherein the dilute stream port is in fluid communication with a dilute feed source.

5. The device of claim 4, wherein the concentrate stream port is in fluid communication with a concentrate feed source.

6. The device of claim 5, wherein the dilute feed source is different from the concentrate feed source.

7. The device of claim 1, wherein the bundle has a racetrack configuration.

8. The device of claim 7, wherein the first electrode comprises a straight section with a semi-circular section at each end to define a substantially elongated S-shaped anode.

9. The device of claim 7, wherein a cross-section of the bundle has a substantially straight section and a curved section at first and second ends of the substantially straight section.

10. The device of claim 1, wherein each of the masked portions comprises a sleeve surrounding a portion of the spacer.

11. The device of claim 10, wherein the sleeve comprises a pair of impermeable films joined at a seam.

12. The device of claim 1, wherein each of the masked portions comprises a pair of impermeable films welded to the spacer.

13. The device of claim 1, further comprising a central hub, the central hub comprising a dilute port in fluid communication with the dilute stream channel and a source of dilute feed.

14. The device of claim 13, wherein the central hub further comprises a concentrate port in fluid communication with the concentrate stream channel and a source of concentrate feed.

15. The device of claim 14, wherein the source of dilute feed and the source of concentrate feed are different.

16. The device of claim 1, wherein the bundle comprises more than 20 cell pairs.

17. The device of claim 1, wherein the bundle comprises more than 50 cell pairs.

18. The device of claim 9, wherein a ratio of a length of the substantially straight section to a radius of each of the curved sections is greater than zero.

19. The device of claim 15, wherein the radius of curvature of the curved sections is not dependent on the number of cell pairs.

20. The device of claim 15, wherein the electrochemical treatment device comprises an electrodialysis treatment device.