CLAIMS

What is claimed is:

1. A filter element, comprising:

a closed membrane structure wrapped about a core in reciprocating clockwise and counterclockwise directions forming semicircular folds of membrane about the core, the semicircular folds of membrane having opposingly situated apical ends separated by a gap, wherein the closed membrane structure has an interior portion defining at least one feed channel and an exterior portion defining at least one permeate channel, and the gap defines a radial permeate discharge path.

2. The filter element of Claim 1, further comprising a sealant applied to a first end and a second end of the filter element, the sealant preventing feed that is entering the filter element, retentate that is exiting the filter element, or a combination thereof, from entering the radial permeate discharge path and the at least one permeate channel.

3. The filter element of Claim 1 or 2, wherein the sealant is a urethane, epoxy, glue, tape, or thermoplastic bonding material.

4. The filter element of any one of Claims 1-3, further comprising a feed spacer within the at least one feed channel.

5. The filter element of any one of Claims 1-4, wherein the closed membrane structure comprises one or more membrane sheets arranged in a closed loop.

6. The filter element of any one of Claims 1-5, further comprising a permeate spacer located within the radial permeate discharge path.

7. The filter element of any one of Claims 1-5, further comprising a radial path support located within the radial permeate discharge path.

8. The filter element of any one of Claims 1-7, further comprising a permeate spacer located within the at least one permeate channel.

9. The filter element of any one of Claims 1-8, further comprising a permeate collection tube disposed within the core.

10. The filter element of any one of Claims 1-9, wherein the wound closed membrane structure is disposed within a housing, a sleeve, or a liner.

11. The filter element of any one of Claims 1-10, wherein the closed membrane structure comprises at least one ultrafiltration membrane.

12. The filter element of any one of Claims 1-10, wherein the closed membrane structure comprises at least one microfiltration membrane.

13. The filter element of any one of Claims 1-10, wherein the closed membrane structure comprises at least one nanofiltration membrane.

14. A tangential flow filtration (TFF) system comprising the filter element of any one of Claims 1-13.

15. The TFF system of Claim 14, wherein the TFF system is a single pass system.

16. A method of creating a filter element, comprising:

forming a stack of folded membrane by pleating a closed membrane structure;

wrapping the stack of folded membrane about a core, the stack of folded membrane forming semicircular folds of membrane about the core, the semicircular folds of membrane having apical ends;

providing a gap by opposingly situating the apical ends, the gap forming a radial permeate discharge path;

providing at least one feed channel formed from an interior portion of the closed membrane structure; and

providing at least one permeate channel formed from an exterior portion of the closed membrane structure.

17. The method of Claim 16, further comprising applying a sealant to a first end and a second end of the filter element, the sealant preventing feed that is entering the filter element, retentate that is exiting the filter element, or a combination thereof, from entering the radial permeate discharge path and the at least one permeate channel.

18. The method of Claim 16 or Claim 17, further comprising placing a feed spacer within the at least one feed channel.

19. The method of any one of Claims 16-18, further comprising placing a permeate spacer within the at least one permeate channel.

20. The method of any one of Claims 16-19, further comprising placing a permeate collection tube within the core.

21. The method of any one of Claims 16-20, further comprising placing the semicircular folds of membrane within a housing, a sleeve, or a liner.

22. A method of filtering a liquid feed, comprising:

providing the filter element of Claim 1; and

introducing a liquid feed to the at least one feed channel of the filter element, the liquid feed travelling through a flowpath defined by the closed membrane structure, the liquid feed separating into permeate and retentate as the feed passes through the filter element, the permeate arriving at the radial permeate discharge path, thereby filtering the liquid feed.

23. The method of Claim 22, further comprising recovering the permeate and at least a portion of the retentate from the filter element.

24. The filter element of Claim 1, wherein the at least one feed channel and the at least one permeate channel are isolated from each other.