CLAIMS

1. A filtration system for batch or semi-batch hyperfiltration comprising:

(a) a recirculation loop,

(b) a pump providing pressurized feed solution to the recirculation loop,

(c) a waste outlet conduit,

(d) a valve separating the recirculation loop from a waste outlet conduit suitable to provide a discontinuous flow of a concentrated fluid from the recirculation loop,

(d) a control device suitable to actuate said valve,

(e) a membrane pressure vessel within said recirculation loop comprising a feed port, concentrate port and a permeate port, and containing two or more hyperfiltration elements aligned in an axial direction, including an end hyperfiltration element located nearest a fluid port, wherein the fluid port is selected from one of said inlet port and said outlet port, and said end hyperfiltration element has a length in the axial direction, and a first distance between said fluid port and said end hyperfiltration element which is at least one third of said length,

(f) a flow distributor located between said end hyperfiltration element and said fluid port;

(g) wherein the flow distributor is comprised of a proximal surface nearest the end hyperfiltration element and a distal surface nearest said fluid port, and

(h) an axial positioner within said vessel that locates said distal surface of said flow distributor a second distance from said end hyperfiltration element, wherein said second distance is at least 50% of said first distance.

2. The filtration system of claim 1, wherein said flow distributor is suitable to provide: (i) a velocity profile across a cross section of said pressure vessel, wherein said velocity profile has a coefficient of variation of less than 0.1, or (ii) a flow resistance of between 10 and 200 kPa·sec·m^{-1} wherein flow resistance (R) is defined as:

$$R = \frac{\Delta P}{v}$$

wherein ΔP is pressure drop across the flow distributor, *v* is the average velocity and R is measured using pure water at 25°C and an average velocity of 5 cm/sec.

3. The filtration system of claim 1 or claim 2, in which said end hyperfiltration element has a length in the axial direction and said second distance is greater than one third of said length.

4. The filtration system of any of claims 1, 2, or 3 in which said flow distributor comprises: (i) a flow plate having at least one opening, wherein total area of said at least one opening is from 1 to 50% of total area of the flow plate; (ii) sintered porous media; (iii) a mesh, a screen or a fabric; or (iv) a set of parallel or concentric tubes.

5. The filtration system of any preceding claim in which the flow plate has a central opening to accommodate a permeate tube and remaining area of the flow plate has at least one additional opening, wherein total area of said at least one additional opening is from 2 to 10% of said remaining area of the flow plate.

6. A flow distributor assembly for use in a batch or semi-batch hyperfiltration system pressure vessel comprising:

(a) a flow distributor preferably having an outer circular surface,

(b) an axial positioner, and

(c) a radial positioner.

7. The flow distributor assembly of claim 6, wherein said flow distributor is suitable to provide: (i) a velocity profile across a cross section of said pressure vessel, wherein said velocity profile has a coefficient of variation of less than 0.1, or (ii) a flow resistance of between 10 and 200 kPa·sec·m^{-1} wherein resistance (R) is defined as:

$$R = \frac{\Delta P}{v}$$

wherein ΔP is pressure drop across the flow distributor, v is the average velocity and R is measured using pure water at 25°C and an average velocity of 5 cm/sec.

8. The flow distributor assembly of claim 6 or claim 7 in which the flow distributor comprises: (i) a flow plate having at least one opening, wherein total area of said at least one opening is from 1 to 50% of total area of the flow plate; (ii) a porous plate; (iii) a mesh, a screen or a fabric; or (iv) a set of parallel or concentric tubes.

9. The flow distributor assembly of any of claims 6, 7, or 8 in which the flow distributor comprises a flow plate which has a central opening to accommodate a permeate tube and the remaining area of the flow plate has at least one additional opening, wherein total area of said at least one additional opening is from 2 to 10% of said remaining area of the flow plate.

10. A flow distributor assembly for insertion into a pressure vessel for use in a batch or semi-batch reverse osmosis or nanofiltration system, comprising:

(a) a flow distributor,

(b) an axial positioner, and

(c) a radial positioner.

11. The flow distributor assembly of claim 10, wherein said flow distributor comprises: (i) a flow plate having at least one opening, wherein total area of said at least one opening is from 1 to 50% of total area of the flow plate; (ii) a porous plate; (iii) a mesh, a screen or a fabric; or (iv) a set of parallel or concentric tubes.

12. The flow distributor assembly of claim 10 or claim 11 in which the flow distributor comprises a flow plate having at least one opening, wherein total area of said at least one opening is from 1 to 50% of total area of the flow plate.

13. The flow distributor assembly of any of claims 10, 11 or 12 in which the flow plate has a central opening to accommodate a permeate tube and remaining area of the flow plate has at least one additional opening, wherein total area of said at least one additional opening is from 2 to 10% of said remaining area of the flow plate.

14. The flow distributor assembly of any of claims 10 through 13 wherein the axial distributor comprises a plurality of hollow tubes which may have different axes parallel to the axial positioner or which may be concentric.

15. The flow distributor assembly of any of claims 10 through 14 wherein the flow resistance of the flow distributor is between 10 and 200 kPa·sec·m^{-1} ; said flow resistance (R) defined as:

$$R = \frac{\Delta P}{v}$$

wherein ΔP is pressure drop across the flow distributor, *v* is the average velocity and R is when measured using pure water at 25°C and an average linear velocity of 5 cm/sec.

16. A pressure vessel assembly comprising the flow distributor assembly of any of claims 6 through 15.

17. A hyperfiltration system comprising the pressure vessel assembly of claim 16.