CLAIMS

What is claimed is:

1. A feed diffusing system (10, 20, 30, 40, 50, 70, 80) for reducing membrane fouling in a membrane module (100, 200, 300, 400, 500) disposed in an environment, the system (10, 20, 30, 40, 50, 70, 80) comprising:

a feed inlet (11, 22, 32, 72, 82) for receiving a feed mixture;

one or more feed outlets (12, 14, 26, 36, 38, 42, 44, 52, 54, 73-76, 83-86) configured to be in fluid communication with the feed inlet (11, 22, 32, 72, 82) and for diffusing the feed mixture to a membrane disposed in an environment;

wherein the one or more feed outlets (12, 14, 26, 36, 38, 42, 44, 52, 54, 73-76, 83-86) are arranged adjacent to a membrane in a membrane module for diffusing the feed mixture to the membrane at an average feed outlet velocity, v in the range of 1 m/s to 10 m/s.

2. The system (10, 20, 30, 40, 50, 70, 80) according to claim 1, wherein each of the one or more feed outlets (12, 14, 26, 36, 38, 42, 44, 52, 54, 73-76, 83-86) is arranged at a tilting angle relative to a longitudinal axis of the membrane, wherein the tilting angle is in a range from 0 to 180 degrees.

3. The system (10, 20, 30, 40, 50, 70, 80) according to any one of the preceding claims, wherein the feed inlet (11, 22, 32, 72, 82) is characterized by an inlet cross sectional area (A_{in}), and each of the one or more feed outlets (12, 14, 26, 36, 38, 42, 44, 52, 54, 73-76, 83-86) is characterized by an outlet cross sectional area (A_{out}) wherein A_{in} is greater than or equal to A_{out}.

4. The system (10, 30, 40, 50, 70, 80) according to any one of the preceding claims wherein the system (10, 30, 40, 50, 70, 80) comprises a plurality of feed outlets (12, 14, 36, 38, 42, 44, 52, 54, 73-76, 83-86) arranged in a spaced apart arrangement adjacent to the membrane in the membrane module based on a membrane area.

5. The system (30, 80) according to claim 4, wherein the plurality of feed outlets (36, 38, 83-86) comprise a first feed outlet (36, 83) proximal to the feed inlet (32, 82) and a second feed outlet (38, 86) distal from the feed inlet (32, 82), wherein the first feed outlet (36, 83) is characterized by a first feed outlet cross sectional area (A_{out1}), wherein the second feed outlet

(38, 86) is characterized by a second feed outlet cross sectional area (A_{out2}), wherein A_{out1} is greater than or equal to A_{out2}.

6. The system (30, 80) according to any one of the preceding claims, wherein the feed mixture is selected from the group consisting of: a solid-liquid phase system, a liquid-gas phase system, a liquid-liquid system.

7. A membrane module (100, 200, 300, 400, 500) for two-phase separation of a feed mixture, wherein the system comprises:

a reservoir;

a header;

a membrane (50) disposed in the reservoir, wherein the membrane is releasably attached to the header at the top of the membrane, and the membrane comprises a bottom;

at least one feed diffusing system according to a feed diffusing system arranged in the reservoir in fluid communication with the membrane,

the feed diffusing system (10, 20, 30, 40, 50, 70, 80) comprising:

a feed inlet (11, 22, 32, 72, 82) for receiving a feed mixture;

one or more feed outlets (12, 14, 26, 36, 38, 42, 44, 52, 54, 73-76, 83-86) configured to be in fluid communication with the feed inlet (11, 22, 32, 72, 82) and for diffusing the feed mixture to the membrane;

wherein the one or more feed outlets (12, 14, 26, 36, 38, 42, 44, 52, 54, 73-76, 83-86) are arranged adjacent to the membrane for diffusing the feed mixture to the membrane at an average feed outlet velocity, v in the range of 1 m/s to 10 m/s,

wherein each of one or more the feed outlets is proximal to at least one membrane surface.

8. The module according to claim 7, further comprising a pump; and

a programmable logic controller (PLC) operably connected to the pump;

wherein the feed inlet is connected to the pump;

wherein the PLC is configured to provide a pulsed feed mixture flow in the reservoir through the feed inlet to the one or more feed outlets, such that the pulsed feed mixture flow moves past the at least one membrane surface to dislodge fouling materials therefrom.

9. The module according to any one of claims 7 to 8, wherein the at least one feed diffusing system is arranged adjacent to the bottom of the membrane.

10. The module according to any one of claims 8 to 9, wherein the at least one feed diffusing system is mounted at the header adjacent to the top of the membrane.

11. The module according to any one of claims 7 to 10, further comprising an aerator having an aeration outlet, wherein the aerator is located adjacent to the bottom of the membrane; wherein the aeration outlet is spaced apart from and opposite to the one or more feed outlets.

12. The module according to any one of claims 7 to 11, wherein the feed mixture is selected from the group consisting of: a solid-liquid phase system, a liquid-gas phase system, a liquid-liquid system.

13. A water treatment system comprising:

at least one feed diffusing system for receiving a feed mixture;

a membrane system in fluid connection with the at least one feed diffusing system for treating the feed mixture,

the feed diffusing system (10, 20, 30, 40, 50, 70, 80) comprising:

a feed inlet (11, 22, 32, 72, 82) for receiving the feed mixture;

one or more feed outlets (12, 14, 26, 36, 38, 42, 44, 52, 54, 73-76, 83-86) configured to be in fluid communication with the feed inlet (11, 22, 32, 72, 82) and for diffusing the feed mixture to a membrane of the membrane system;

wherein the one or more feed outlets (12, 14, 26, 36, 38, 42, 44, 52, 54, 73-76, 83-86) are arranged adjacent to the membrane for diffusing the feed mixture to the membrane at an average feed outlet velocity, v in the range of 1 m/s to 10 m/s,

a pump; and

a programmable logic controller (PLC) operably connected to the pump;

wherein the feed inlet is connected to the pump;

wherein the PLC is configured to provide a pulsed feed mixture flow in the reservoir through the feed inlet to the one or more feed outlets, such that the pulsed feed mixture flow moves past at least one membrane surface to dislodge fouling materials therefrom.

14. A method of reducing membrane fouling in a membrane system for phase separation of a feed mixture, the method comprising:

(a) providing a membrane system in an environment, wherein at least one surface of the membrane comprises fouling material disposed thereon;

(b) providing a feed mixture into the environment through a feed inlet; and

(c) diffusing the feed mixture through one or more feed outlets to the membrane system for reducing membrane fouling from at least one membrane surface of a membrane in the membrane system, at an average feed outlet velocity, v of 1 m/s to 10 m/s.

15. The method according to claim 14, wherein step (b) comprises providing a pulsed feed mixture in the reservoir according to the Pulsed Test Method specified within.