

CLAIMS:

1. A method for accelerated testing of a membrane module for resistance to cyclic stresses during operation of an industrial membrane separation process comprising loading at least one membrane module into a test cell of a test plant;
- 5 conducting said industrial membrane separation process while subjecting said membrane module to cyclic stresses during a plurality of membrane operating cycles, each cycle being of significantly lesser duration than used for operation of said industrial membrane separation process in an operating plant; and testing said membrane module for component failure caused by said cyclic stresses.
- 10 2. A method of claim 1 wherein said test plant forms part of, or is connected to, an operating plant implementing said industrial membrane separation process.
3. A method of claim 1 or 2 wherein said testing allows a mean service life for the membrane module to be predicted in a much lesser timeframe than actual service life.
- 15 4. A method of claim 3 wherein frequency of membrane operating cycles applied during testing is significantly greater than the design frequency being the frequency at which stress cycles will be applied to the membrane module in normal industrial service.
5. A method of any one of the preceding claims wherein said membrane
- 20 operating cycles comprise filtration cycles; relaxation cycles; and/or pressure decay testing cycles in which the membranes of the membrane modules are tested for leaks.
6. A method of claim 5 wherein said membrane modules are only subjected to filtration and relaxation cycles; or pressure decay testing cycles.
- 25 7. A method of claim 5 wherein membrane modules are subjected to both filtration and relaxation cycles and pressure decay testing cycles.

8. A method of claim 6 or 7 wherein filtration cycles correspond with periods when pump means forming part of the test cell are turned on to apply pressure to a membrane; and relaxation cycles correspond with periods when said pump means forming part of the test cell are turned off.
- 5 9. A method of any one of the preceding claims wherein said testing plant includes a plurality of test cells.
10. A method of claim 9 wherein said test cells are operated in parallel with one test cell imposing different membrane operating cycles and a different cyclic stress regime on membrane modules than in another test cell.
- 10 11. A method of any one of claims 5 to 10 wherein the frequency of filtration and relaxation cycles to which a membrane module is subjected during testing is accelerated to be significantly greater than the frequency of any pressure decay/pressure integrity testing cycles.
- 15 12. A method of any one of the preceding claims wherein said membrane module to be tested comprises a housing accommodating a bundle of hollow fibre membrane fibres, each hollow fibre extending between two opposed pots with the opposite ends of each hollow fibre being potted and sealed within said pots and component failure is indicated when cracking of a pot occurs during testing.
- 20 13. A method of any one of the preceding claims wherein a plurality or rack of membrane modules is loaded into the test cell to enable simultaneous testing.
14. A method of any one of the preceding claims wherein each membrane module is subjected to a testing cycle having a predetermined number of stress cycles to be imposed over a predetermined period of time, said predetermined number of stress cycles corresponding with required minimum design service life.

15. A method of claim 14 wherein said minimum design service life is measured in years and said predetermined number of stress cycles is imposed in a much shorter period in the order of weeks or months.
16. A method of any one of claims 5 to 15 wherein duration of a filtration cycle is significantly shorter than during normal service.
17. A method of claim 16 wherein said significantly shorter filtration cycle duration increases filtration flux over normal service.
18. A method of claim 17 wherein filtration flux during testing is measured and compared with filtration flux during normal service.
19. A method of any one of claims 5 to 18 wherein testing is used to assess whether resistance to membrane fouling is improved by shorter filtration cycle duration.
20. A method of any one of the preceding claims including imposing chemical treatments on the membrane module at a plurality of solution strengths for varying duration.
21. A method of claim 20 wherein said chemical treatments are imposed during membrane operating cycles having duration the same as, or similar to, duration in said operating plant.
22. A method of any one of the preceding claims wherein said industrial membrane separation process requires a membrane service life of duration of a plurality of years.
23. A method of claim 22 wherein said industrial membrane separation process is a liquid treatment process, preferably a water treatment process.

24. A method of claim 23 wherein said test cell is configured to simulate a membrane bioreactor with said membrane module being submerged in mixed liquor within said test cell.

25. A method of claim 23 or 24 wherein said water treatment process is a waste water treatment process where a membrane module will be subjected to an operating temperature greater than about 25°C, or even greater than 30°C.

26. A method of any one of claims 23 to 25 where said membrane module comprises pots made of polymer material and said membrane module operating temperature is greater than the glass transition temperature of said polymer material.

27. A method of any one of claims 23 to 26 wherein said testing method is applied at different temperatures to assess dependence of membrane module service life on service operating temperature.

28. A test plant for accelerated testing of a membrane module according to any one of claims 1 to 27.