System Operation

Initial Start-Up

Start-Up Sequence

Proper start-up of reverse osmosis (RO) and nanofiltration (NF) water treatment systems is essential to prepare the membranes for operating service and to prevent membrane damage due to excessive pressure/flow or hydraulic shock. Following the proper start-up sequence also helps ensure that system operating parameters conform to design conditions so that water quality and productivity goals can be achieved. Measurement of initial system performance is an important part of the start-up process. Documented results of this evaluation serve as benchmarks against which ongoing system operating performance can be measured.

Typical Start-Up Sequence

Following is the recommended RO system start-up sequence:

1. Before initiating the start-up sequence, thoroughly rinse the pretreatment section to flush out debris and other contaminants without letting the feed enter the elements.

Check all valves to ensure that settings are correct. The feed pressure control and concentrate control valves should be fully open. 3. Use low-pressure water at a low flowrate to flush the air out of the elements and pressure vessels. Flush at a gauge pressure of 30 – 60 psi (0.2 – 0.4 MPa). All permeate and concentrate flows should be directed to an appropriate waste collection drain during flushing.

Note: Air remaining in the elements and/or in the pressure vessels may lead to excessive forces on the element in flow direction or in radial direction and causing fiberglass shell cracking, if the feed pressure is ramped up too quickly

4. During the flushing operation, check all pipe connections and valves for leaks. Tighten connections where necessary.

5. After the system has been flushed for a minimum of 30 minutes, close the feed pressure control valve. 6. Ensure that the concentrate control valve is open.

Note: Starting against a closed or almost closed concentrate valve could cause the recovery to be exceeded which may lead to scaling.

7. Slowly crack open the feed pressure control valve (feed pressure should be less than 60 psi (0.4 MPa).

8. Start the high-pressure pump.

9. Slowly open the feed pressure control valve, increasing the feed pressure and feed flowrate to the membrane elements until the design concentrate flow is reached. The feed pressure increase to the elements should be less than 10 psi (0.07 MPa) per second to achieve a soft start. Continue to send all permeate and concentrate flows to an appropriate waste collection drain.

Note: If the feed pressure and/or the feed flowrate are ramped up too quickly, the housing of the elements may be damaged by excessive forces in flow direction and/or in radial direction - especially if air is in the system - leading to telescoping and/or fiberglass shell cracking.

10. Slowly close the concentrate control valve until the ratio of permeate flow to concentrate flow approaches, but does not exceed, the design ratio (recovery). Continue to check the system pressure to ensure that it does not exceed the upper design limit.

11. Repeat steps "9" and "10" until the design permeate and concentrate flows are obtained.

12. Calculate the system recovery and compare it to the system's design value.

13. Check the addition of pretreatment chemicals (acid, scale inhibitor and sodium metabisulfite if used). Measure feedwater pH.

14. Check the Langelier Saturation Index (LSI) or the Stiff & Davis Stability Index (S&DSI) of the concentrate by measuring pH, conductivity, calcium hardness, and alkalinity levels and then making the necessary calculations.

15. Allow the system to run for one hour. Note: Permeate obtained from first hour of operation should be discarded.

16. Take the first reading of all operating parameters.

17. Check the permeate conductivity from each pressure vessel to verify that all vessels conform to performance expectations (e.g., vessels with leaking O-rings or other evidence of malfunction to be identified for corrective action).

18. After 24 – 48 hours of operation, review all recorded plant operating data such as feed pressure, differential pressure, temperature, flows, recovery and conductivity readings. At the same time draw samples of feedwater, concentrate and permeate for analysis of constituents.

19. Compare system performance to design values.

20. Confirm proper operation of mechanical and instrumental safety devices.

21. Switch the permeate flow from drain to the normal service position.

22. Lock the system into automatic operation.

23. Use the initial system performance information obtained in steps "16" through "18" as a reference for evaluating future system performance. Measure system performance regularly during the first week of operation to check for proper performance during this critical initial stage.

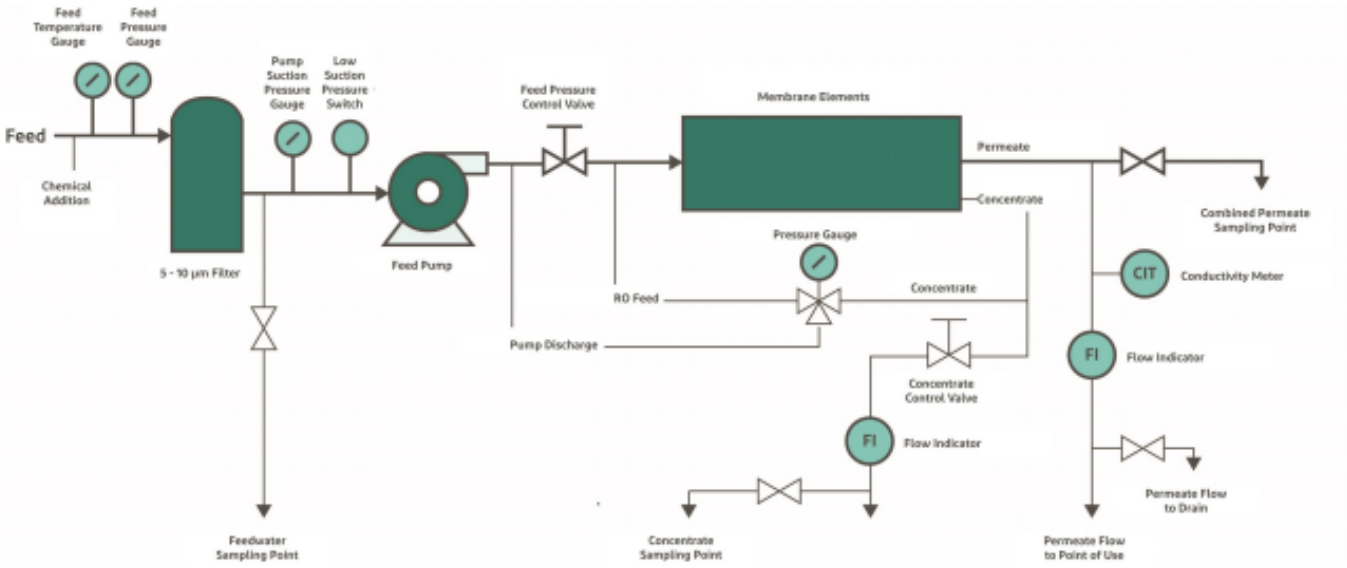

Figure 1: Typical RO/NF system

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