FILMTEC Membranes
System Design: Testing

For the desalination of standard waters with a defined origin and composition, system performance can be projected with sufficient accuracy by using a computer program such as ROSA. However, in some cases, testing is recommended to support the proper system design. These include:

- Unknown feed water quality
- Unknown variation of feed water quality
- Special or new applications, e.g., process or waste water effluents
- Special permeate quality requirements
- Extremely high system recoveries (>80%)
- Large plants >3.5 mgd (13,250 m^3/d)

Testing is typically carried out at different subsequent levels:

Screening Test

The goal of a screening test is to select the appropriate membrane for the desired separation and to obtain a rough idea about the flux (gfd or L/m^2-h) and rejection properties of the membrane. A small piece of flat sheet membrane is mounted in a "cell" and exposed to the test solution using the cross-flow mechanism. The method is fast, inexpensive, and requires only small quantities of test solution. However, a screening test cannot provide engineering scale-up data and long-term effects of the test solution on the membrane, nor does it provide data on fouling effects of the test solution.

Application Test

The application test provides scale-up data such as permeate flux and permeate quality as a function of feed pressure and system recovery. The test typically involves the evaluation of a 15–60 gal (50–200 L) sample solution, using a 2540 (2.5-inch x 40-inch) or 4040 (4.0-inch x 40-inch) sized element. The element is mounted in a test system with engineering features that allow adjustments to the feed flow, feed pressure, and feed temperature in the ranges of the element operating limits.

Determining Operating Pressure

The optimum operating pressure is determined by adjusting the feed pressure until the desired permeate quality and permeate flux rate are obtained (typically between 6–20 gfd (10–34 L/m^2-h)). Sufficient feed flow should be maintained to ensure a low recovery rate (<5%) as the membrane flux rate is increased. Permeate and concentrate streams are recycled back to the feed tank during this first test. The feed pressure at which the optimum permeate flux and permeate quality is obtained is the feed pressure used for the second test, determining the recovery rate.

Determining Concentration Factor/Recovery Rate

To aid in the determination of the maximum single element recovery rate (permeate flow/feed flow) the second test is run in batch mode. This is done by directing the permeate stream into a second container while returning the concentrate stream to the feed tank. Both the permeate flow and permeate quality are monitored during the test. The test is stopped when the permeate flow rate has declined to an uneconomically low value or permeate

Application Test (cont.)

quality has declined below acceptable limits. The concentration factor (CF) is then calculated by dividing the original feed volume by the remaining feed volume. The recovery rate is calculated by subtracting the remaining feed volume from the original feed volume and then dividing by the original feed volume.

Repeating the batch test will give an indication of membrane stability and fouling effects. However, long-term performance, including the assessment of cleaning procedures, can only be obtained by pilot tests.

Pilot Test

A pilot test is typically run in the field on the intended feed stream in a continuous operation mode. The pilot plant should have at least one element, 40-inch length is recommended. Preferably the arrangement of elements will be similar to that of the large-scale system. The permeate flow of the pilot plant should be at least 1% of the large-scale plant and should be run for a minimum of 30 days. The objective is to confirm the system design and to fine-tune operating parameters as well as to minimize the risk in large projects.

FILMTEC™ Membranes
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