Membrane Performance Factors

Temperature Correction

Temperature of the feed water and the net driving pressure across the element must be taken into account before comparing or evaluating the performance of a membrane element or a reverse osmosis system.

Temperature Correction Factor

The water temperature is one of the key factors in the performance of the reverse osmosis membrane element. The higher the temperature, the more the product flow, and vice versa.
All reverse osmosis membrane elements and systems are rated at 77º Fahrenheit (25º Celsius).
To find the membrane permeate rate at a different temperature, follow these steps:

Find the temperature correction factor (TCF) from the below table. Divide the rated permeate flow at 77º Fahrenheit by the temperature correction factor. The result is the permeate flow at the desired temperature.

Rated Permeate Flow ÷ TCF = Temperature Correct Flow

Example

QUESTION: For a thin-film membrane permeate rated at 1800 gallons per day at 77º Fahrenheit, what is the actual permeate rate at 59º Fahrenheit?

ANSWER: Temperature correction factor (from below table) for 59ºF = 1.422
Permeate flow at 59 degrees Fahrenheit = 1800 ÷ 1.422 = 1266 gallons/day

Feed Water Temperature		TCF for Thin Film
°C	°F	
10.0	50	1.711
10.5	50.9	1.679
11.0	51.8	1.648
11.5	52.7	1.618
12.0	53.6	1.588
12.5	54.5	1.558
13.0	55.4	1.530
13.5	56.3	1.502
14.0	57.2	1.475
14.5	58.1	1.448
15.0	59	1.422
15.5	59.9	1.396
16.0	60.8	1.371
16.5	61.7	1.347
17.0	62.6	1.323
17.5	63.5	1.299
18.0	64.4	1.276
18.5	65.3	1.254
19.0	66.2	1.232
19.5	67.1	1.210

Feed Water Temperature		TCF for Thin Film
°C	°F	
20	68	1.189
20.5	68.9	1.168
21.0	69.8	1.148
21.5	70.7	1.128
22.0	71.6	1.109
22.5	72.5	1.090
23.0	73.4	1.071
23.5	74.3	1.053
24.0	75.2	1.035
24.5	76.1	1.017
25.0	77	1.000
25.5	77.9	0.985
26.0	78.8	0.971
26.5	79.7	0.957
27.0	80.6	0.943
27.5	81.5	0.929
28.0	82.4	0.915
28.5	83.3	0.902
29.0	84.2	0.889
29.5	85.1	0.877

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Membrane Performance Factors

Net Pressure Correction

Net Pressure Correction

The higher the net pressure on a membrane element, the higher the permeate rate. A rough value of osmotic pressure of water can be calculated roughly by the following rule:

Osmotic pressure (PSI) = Total Dissolved Solids ÷ 100

To estimate the effect of net pressure, follow these steps:

1. Calculate the net pressure under operating conditions (P_{op})
   P_{op} = Average applied pressure - Average osmotic pressure of the feed water

2. Calculate the net pressure at which the membrane element is rated (P_r)
   P_r = Rated pressure - Osmotic pressure of test solution

3. Expected permeate flow at operating conditions = **Rated permeate flow × P_{op} / (P_r)**

Example

QUESTION:
For a thin-film 4 × 40" membrane element, using a 2000 ppm, sodium chloride solution at 225 psi and 77 degrees Fahrenheit, the permeate rate is 1800 gallons/day. What is the permeate rate at 150 psi, feed water with 1000 TDS and temperature of 59 degrees Fahrenheit?

ANSWER:
Follow the below steps to come to your answer:

1. Temperature correction: Using the Temperature correction factor for 59°F (1.422) from the table: 1800 gpd Rated Flow ÷ 1.422 = **1266 gpd**

2. Osmotic Pressure: TDS of 1,000 ÷ 100 = **10 psi**

3. Applied Net Pressure: 150 psi feed pressure – 10 psi osmotic pressure = **140 net pressure (P_{op})**

4. Rated net Pressure:
   a. Osmotic pressure of the membrane pressure is 2000 ÷ 100 = **20**
   b. 225 psi feed pressure – 20 psi osmotic pressure = **205 psi rated net pressure (P_r)**

Using the numbers found in the 4 steps above, our calculation [Rated permeate flow × P_{op} / (P_r)] will be:

1266 × 140 ÷ 205 = **865 gpd**

Note:
When designing a system additional detailed calculations are necessary to take into account the effect of pressure drop and variation in total dissolved solids (TDS) throughout the system. Please contact us if you require further information.

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