Introduction

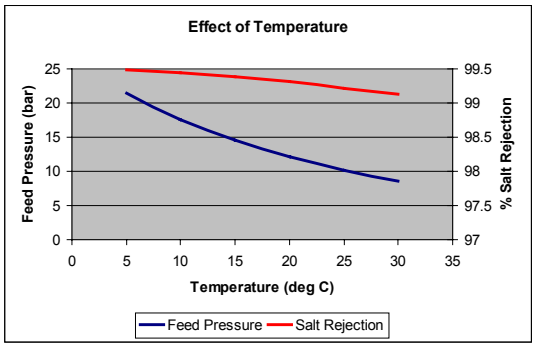
The best way to ensure successful operation of a membrane system is to implement a program of data normalisation. Implicit in a program of this nature is a well-maintained instrument calibration program and accurate data collection. The purpose of normalisation is to reduce the daily operating data to a standard set of conditions, thereby allowing detection of trends in operating performance in the membrane system. The trends will allow plant cleaning and optimisation work to be scheduled.

It is natural for membranes to change in performance with time. However, once the system has stabilised, these changes should occur slowly, There are a number of variables which also affect the performance of membranes such as temperature, pressure, recovery, water chemistry, etc. Since these may vary on a day to day basis, it is often difficult to determine whether a change is to be expected or if the observed change is indicative of a problem. For example; a feed temperature drop of 4'C will cause a permeate flow decrease of 10%. This is a normal system response. Some of these variables are under the operator's control, others are not.

Normalisation refers to calculations that adjust recorded performance values to a common reference by accounting for variations in feed water temperature, feed water TDS, feed and permeate flowrates and the system pressures. The following paragraphs detail the effect of change to these parameters. The reference performance may be the designed performance or the measured initial, (start up), performance. Normalisation with reference to the designed, or warranted, system performance is useful to verify that the plant gives the specified, or warranted, performance. Normalisation with reference to the initial, or start up, performance is useful to show up any performance changes between day one and the actual date.

Feed Water Temperature

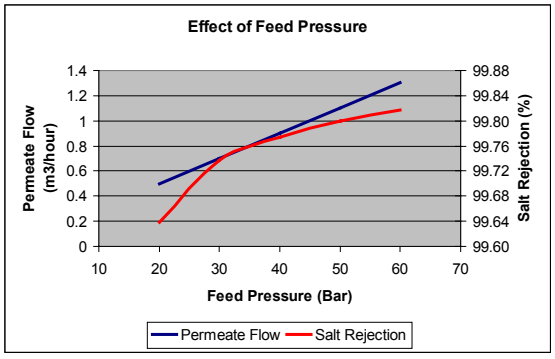
As the temperature of the feed water increases, the viscosity of the water decreases and the rate of permeation through the membrane increases. Typical



figures for temperature are 1.5-2.5% change per degree Celsius. The rate of salt passage through the membrane is also higher at increased temperatures.

System Pressures

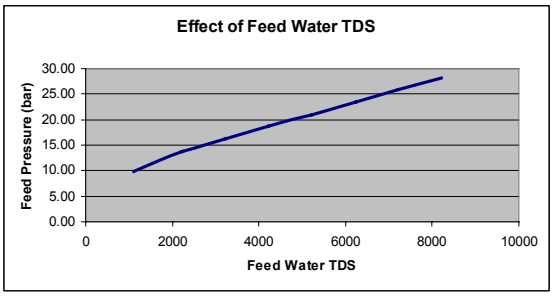
Increased pressure results in an increase in the amount of permeate produced, as the applied pressure is the driving force for moving the solution through the membrane.



This increased permeate production has the effect of diluting the salt which has passed the membrane, and therefore there is an increase in salt rejection at higher pressures.

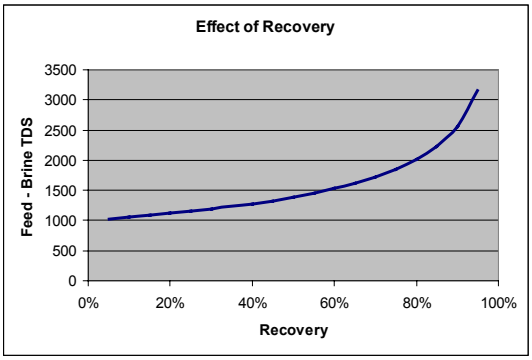
Feed Water TDS

Pressure applied has to overcome the osmotic pressure of the feed water. This is proportional to the total dissolved solids present in the water, and therefore any change in the feed water TDS will cause a change in the performance of the membrane system.



Flowrates & Recovery

The ratio of permeate produced to feed water applied (i.e. the percentage recovery) affects the average feed - concentrate salt concentration, and this affects the osmotic pressure.



By its very nature data normalisation for a system is not an exact science. It is necessary to make a number of assumptions for such things as pressure drop, boundary layer, etc., and to treat a system from an average point of view. The objective is to correct the data for temperature, concentration and net driving pressure, thereby adjusting all the day to day variations of known factors that effect a system's performance.

As a matter of routine the calculations for normalisation are complex and time consuming making the task unsuitable for evaluation by hand. Computer software is available for this purpose, or a membrane support company can provide assistance.

Summary

The data collected from the system cannot be used directly to determine overall membrane performance. The number of variables makes it difficult to compare one data set with another without recourse to a means of bringing the data to a comparable level. Normalisation provides the method of interpreting day to day system performance using a common set of values. By monitoring the trends in the three key indicators of membrane performance; flux, rejection, pressure drop, the ability to detect problems is presented. Once detected, the problem can be identified and the appropriate corrective action initiated.

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