Case Example

Texas Instruments Incorporated: Raising Water Efficiency to Ninety Percent in Water Production Plants

Inexpensive plant modifications may be possible to increase reverse-osmosis (RO) system water efficiency well above the nominal 75 percent; success is dependent on the incoming city water quality and availability of equipment at an existing ultra pure water (UPW) production plant. At three primary UPW plants, Texas Instruments (TI) succeeded in raising water efficiency from 75 percent to approximately 90 percent by configuring each plant's backup RO array as an additional operating unit.

TI's largest deionized water (DI) plant had a very common RO configuration that readily allowed about 77 percent recovery (product to feed flow ratio). The improvement as conceived and implemented required the collection of the brine reject from the normal production RO arrays, the removal of CO2 (alkalinity) by acidification with sulfuric acid injection and aeration in a new induced draft packed stripping column. The treated water was then pressurized and processed through a backup RO unit. Using an inexpensive piping change and new stripping column, approximately 66 percent of the "normal/traditional RO brine to sewer" was reclaimed and sent to the plant's feed water tank. The reconfigured brine array allows it to perform as a brine recovery array, but in an "emergency" it can be re-converted by valve status changes into a regular production RO array. The recovery method performed uses existing, normally redundant RO equipment. This has the decisive advantage of decreasing the project cost, installation difficulties, and increasing the payback rate even where water rates are low. At this large UPW plant, approximately 210 gallons per minute of RO brine was recovered at the startup, displacing incoming city water.

A second UPW plant had vacuum deaeration located prior to the production reverse osmosis system so significant carbonate loading could be shed by simply lowering the city water pH feeding the UPW plant. The calcium fluoride concentrations exceeded the published solubility limits, but practical experience indicated that no actual problems should occur. The brine recovery array was equipped with used reverse osmosis modules, as a lowered rejection is not a problem since there was a completely redundant array. The product water produced by the brine recovery array goes to the make up tank. The recovery array turns 66 percent of production array brine into a product water superior to city water. The array is an existing unit and the motive force is the residual brine pressure of the production arrays. About 40-50 GPM of would be waste brine is recovered as plant feed stock.

A third system located on a different water source was also modified with an RO brine recovery system. In the late 1990's, the manufacturing area was experiencing large increases in production rates, and UPW capacity was installed in the form of a 4th RO unit which by the end of 2001 was not needed. The design of the 4th RO included plumbing and valving for a future 5th RO unit as well as conversion capability to a brine recovery unit. With some minor plumbing modifications (small RO brine storage tank installation, pump header replumbing), the 4th RO unit was converted to an RO brine recovery system. Since the city water contained negligible calcium levels, a decarbonation and acid feed system (similar to the other two plants) was deemed unnecessary except for slight lowering of the feed pH. The system modifications were simple and straightforward and completed by the plant's facility organization