PRODUCTS IN ACTION

Options for Inland Membrane Concentrate Disposal

By Phil Brandhuber

ARTICLE SUMMARY

Challenge: To find the best possible option for the disposal of concentrate when treating brackish/low-quality water with NF/RO membranes.

Solution: Options include disposing waste into surface water or municipal sewers, injecting it into a deep well, using an evaporation pond and employing ZLD technology.

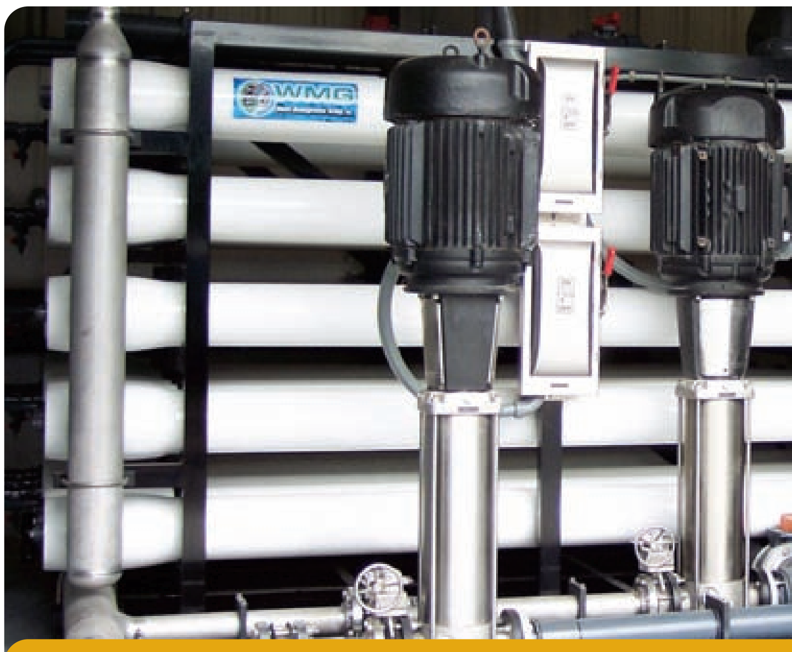
Conclusion: Each option has advantages and disadvantages and the decision will depend on a number of factors.

Increased demands for water coupled with more stringent regulations are forcing utilities to produce higher quality water using lower quality supplies.

Frequently, these lower quality sources are brackish, with elevated levels of total dissolved solids (TDS). Alternatively, the source may contain nitrate or other difficult-to-treat contaminants that must be removed to meet drinking water standards. In many cases, nanofiltration (NF) or low-pressure reverse osmosis (RO) membrane technology is likely to be the most effective treatment process.

While NF/RO membranes can remove a range of contaminants, they produce a large waste stream.

Typically, for brackish water applications, 15 to 20% of the water supplied to the membrane is wasted. This waste stream, termed the concentrate or brine, contains the contaminants and TDS rejected by the membrane. Because the concentrate contains contaminants and TDS concentrated by a five- to seven-fold factor over the raw water, its disposal can be problematic. Fortunately, several options exist for the disposal of concentrate.



Five options for waste disposal when treating brackish water

Concentrate Disposal Options

Surface Water Body. This option consists of direct disposal to surface water, including disposal to lakes, reservoirs or rivers. Disposal of membrane concentrate is regulated by the Clean Water Act and requires a permit under the National Pollution Discharge Elimination System. To obtain a permit, the discharger must demonstrate that the discharge will not impair the intended use of the water body. Given the water quality characteristics of membrane concentrate, this can be difficult to demonstrate, particularly for already impaired surface water. Also, because membranes are nonselective in concentrating contaminants, discharge to the surface water body may be limited by a contaminant, which is not the objective of the treatment.

Municipal Sewer. This option consists of disposal into the sewer. There are two advantages to this approach.

First, the concentrate can be blended with the sewer flow, reducing the concentration of TDS and other contaminants. Second, a NPDES permit is not required for the membrane system because the ultimate discharge is permitted by the wastewater treatment works.

Unless the wastewater flow is largely relative to the concentration flow, however, little dilution of the concentrate will occur and discharge standards for the receiving stream will not be met. In addition, high TDS levels in the concentrate may be detrimental to the performance of the wastewater treatment plant. Close coordination between the membrane plant and the wastewater treatment plant is required. Experience indicates that such arrangements are most effective when a single entity is responsible for the operation of both the membrane and water plants.

Deep Well Injection. This option consists of disposal by injecting the concentrate into porous subsurface rock formations. This process is highly dependent on local geology. To be effective, the receiving aquifer must have sufficient capacity to accept the total volume of concentrate produced over the life of the plant and must be isolated from other aquifers to prevent contamination of potential drinking water sources.

The Safe Drinking Water Act requires a permit to be obtained, according to the Underground Injection Control (UIC) program. Under the UIC program, there are five different classes of permits. A Class 1 permit for "Industrial and Municipal Wells that Inject Beneath the Lowermost Underground Source of Drinking Water" would be required for concentrate disposal. There are approximately 500 Class 1 permits nationwide. The bulk of the permits are in Florida and Texas where the subsurface geology is favorable for this type of disposal.

Evaporation Pond. This option consists of pumping concentrate into man-made shallow ponds where it evaporates, leaving salt to accumulate in the pond. The pond can be designed for periodic removal of the salt or such that salt continues to accumulate over the life of the pond. The pond must have an impervious liner that would consistently isolate the contents of the pond from surface or groundwater.

For this option to be feasible, a large area of low-cost flat land must be available. The climate must be warm and dry with a high rate of evaporation. Spraying the brine in the air within the pond can increase evaporation rate.

Even in desert areas, however, this option is only feasible for small volumes of concentrate. For larger systems, the required area of the pond becomes excessive. For a large-scale NF/RO plant, the concentration flow would be several million gpd and evaporation ponds on the scale of square miles would be required.

Zero Liquid Discharge (ZLD). This option refers to a class of developing technologies that process the concentrate stream to the point where there is no liquid discharge. Zero liquid discharge includes the use of evaporators, brine concentrators and crystallizers to completely separate dissolved salts from the water. All of the approaches are relatively complex and energy-intensive.

ZLD has been successfully implemented but the technology is immature when applied to drinking water treatment and it has not been implemented on a large scale. Therefore, it is a costly and technically risky disposal approach for a NF/RO system. WWD

Phil Brandhuber is a scientist for HDR, Inc. He can be reached at 303/764-1527 or by e-mail at philip.brandhuber@hdrinc.com.

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