KEY POINT: Desal concentrate can be combined with other types of industrial discharges, such as power plant cooling water, industrial or municipal wastewater, or sewage.

SUMMARY OF ISSUES

Desal concentrate can be combined with other types of industrial discharges, such as power plant cooling water, industrial or municipal wastewater, or sewage. Combined discharges can reduce the capital costs of a desal facility if it does not need to build its own discharge infrastructure (Voutchkov 2004).

- **Discharge via power-plant outfall (co-location).** Brine concentrate can be mixed with power plant cooling water at desal facilities co-located with power plants. Because the volume of power plant cooling water is large compared to the volume of desal concentrate, a large amount of mixing and dilution takes place, thereby reducing the salinity of the concentrate (Voutchkov 2004).

  The first desal facility in the U.S. to be co-located with a power station is the Tampa Bay Seawater Desalination Plant. The proposed desal facility at Carlsbad, CA, will also mix concentrate discharge with cooling water from the Encina Power Plant. In Israel, the Ashkelon desal plant uses this approach to discharge RO concentrate with the cooling water from the Ruthenberg Power Plant.

- **Discharge via blending with wastewater.** Concentrate from seawater desal plants cannot be discharged directly to the wastewater treatment plant because of its high salinity. Instead, concentrate is mixed with the wastewater effluent and discharged through the treatment plant’s outfall. Blending with treated effluent for concentrate disposal is a common practice in Florida (Mickley 2006) and is also planned by the Marin Municipal Water District (MMWD) in California (MMWD 2007).

- **Environmental considerations.** Similar to stand-alone ocean discharge of concentrate, the environmental impacts of combined concentrate discharge should be considered. For more on environmental considerations associated with combined discharge of seawater desal concentrate, see the related PIM cell discussion.
STRATEGIES

Site evaluation

The appropriateness of this discharge method will depend on location, permitting, economics, the type of combined discharge (e.g. power plant cooling water, municipal sewage, etc.), and future plans of each facility. A thorough site evaluation that assesses the environmental impacts of combined discharge should be conducted. It is important to consider the effects of both individual discharges as well as cumulative impacts of the combined discharge.

Discharge via power-plant outfall (co-location)

For co-location to be feasible and cost effective, the power plant cooling water discharge flow must be larger than the desal plant capacity and the power plant outfall configuration must be adequate to avoid entrainment and recirculation of concentrate into the desal plant intake. It is preferable that the length of the power plant outfall downstream of the desal plant discharge is adequate to achieve complete mixing prior to discharging into the sea (Voutchkov 2004).

Discharge via blending with wastewater

The advantage of blending brine with wastewater is the accelerated mixing that stems from blending the heavier high-salinity concentrate with the lighter low-salinity wastewater discharge. Depending on the volumes of the concentrate and wastewater streams and on how well the two streams mix prior to the point of discharge, the blending may reduce the size of the wastewater discharge plume and dilute some of its constituents.

Key considerations of this method are the availability and cost of wastewater outfalls, and the potential for whole effluent toxicity (WET) that may result from ion imbalance of the blended discharge. The volume of a wastewater effluent or outfall size may limit the amount of brine concentrate that can be accommodated (Xu et al., 2009).

Another concern that may restrict the discharge via blending through treated sewage outfalls is a likely reduction in the volume of sewage discharges as wastewater recycling becomes more prevalent. In general, most communities have implemented all feasible conservation and water recycling before embarking on desal. This reduces the risk of running out of wastewater for blending in the future. For example, the MMWD has a comprehensive conservation and recycling program. The treated wastewater from the CMSA that is proposed for blending with desal concentrate is not suited for landscape irrigation because of widespread saltwater intrusion into the sewer system. The most economical and practical use of this effluent in MMWD’s
setting is to use the effluent to dilute the desal concentrate (Xu et. al. 2009 communication with Bob Castle, MMWD).

BENEFITS & COSTS

Benefits

In addition to the economic benefits from avoiding construction of separate outfalls, there are numerous advantages associated with combined discharge:

Discharge combined with cooling water

- Reduced salinity discharge as a result of pre-dilution and mixing of the concentrates with the power plant discharge, which has ambient seawater salinity.
- Decreased power plant thermal loading on the aquatic environment because a portion of the discharge water is converted into drinking water.
- Faster salinity and thermal dissipation from the blending of the desal plant and the power plant discharges (Voutchkov 2005).

Discharge combined with wastewater effluents

- Co-discharge with the lighter-than-seawater wastewater effluent would also accelerate the dissipation of the saline plume by floating this plume upwards and expanding the ocean-water mixing-zone (WHO 2007).
- Desal concentrate can help to counteract the decreased salinity typical of sewage and wastewater. It therefore has a net environmental benefit by raising the salinity of the wastewater effluent to match the receiving waters (MMWD 2007).
- Blending wastewater effluent with desal concentrate can help correct the ion-imbalance problem in wastewater that is discharged into a marine environment (Xu et. al. 2009).

Costs

- Costs associated with modifying discharge infrastructure to allow for combined constituents.
Costs for conveyance of concentrate from the desal plant to the discharge outfall (likely more of a factor when blending concentrate with wastewater). These costs are typically closely related to the concentrate volume and the distance between the desal membrane plant and the discharge outfall.

Costs associated with monitoring environmental effects of concentrate discharge to surface waters may be substantial, especially if the discharge is in an environmentally sensitive area, or in areas with limited natural flushing.

KEY UNCERTAINTIES

Combined ocean disposal can be impacted or inhibited by new legislations.

- **Combined discharge with wastewater effluent.** During the 2008 session, the Florida Legislature passed laws that will result in the elimination of the six ocean outfalls that are used for effluent disposal. This legislation will make the effluent unavailable for combined discharge.

- **Combined discharge with power plant cooling water.** Phase out of once-through-cooling (OTC) system at coastal power plants is a national issue in the US. The shift from OTC systems to closed-cycle cooling systems will make cooling water not available for combined seawater discharge. As a result, the proposed co-located plants face a large degree of uncertainty about future operations. Additional intake flow may be required to reach an acceptable dilution rate of desal concentrate, which in turn will increase pumping cost, and impact of impingement and entrainment.

Maintenance or upgrade of power plant facilities: the concentrate discharge may be affected during periods of heat treatment or shutdown of the power plant facilities.

Blending different water sources may introduce new contamination or complicate the water quality of discharge. For example, the Perth Seawater Desalination Plant is co-located with the Newgen Power Station. However, the desal concentrate is not discharged with the cooling water. If warm cooling water would combined with the desal concentrate, the negative environmental impact to marine life would be intensified because the warmer cooling water would become denser and sink to the seabed (Xu et al. 2009).
ADDITIONAL RESOURCES


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