KEY POINT: In the U.S., brackish water desal accounts for 77% of total online desal capacity.

SUMMARY OF ISSUES

Global desal capacity

- Desal plants currently operate in approximately 155 countries, with seawater and brackish water desal contributing 65 and 15% of total worldwide desal capacity, respectively (Xu et. al. 2009).

- Global desal water production capacity has been increasing exponentially since 1960 (and has approximately doubled since 1995) to its current value of 42 million m³/day (11 billion gallons per day [gpd]). Of this global cumulative, approximately 10 billion gpd (37 million m³/day) is considered to be operational. Desal capacity is expected to reach close to 25 billion gpd by 2015 (NRC 2008).

- Nearly half (47%) of the current online global desal capacity is located in the Middle East. North America, Europe, and Asia each have about 15% of the global online desal capacity (NRC 2008 from GWI 2006a).

- Thermal and membrane processes are the two major desal processes in use. Thermal processes continue to dominate the Middle East. In other parts of the world, where integration of power and water generation is limited and where oil or other fossil fuels must be purchased at market prices, thermal processes are relatively expensive (NRC 2008 from GWI 2006b).

Desal in the United States

- In the U.S., RO and other membrane systems account for nearly 96% of U.S. online desal capacity and 100% of the municipal desal capacity (Mickley 2006).

- Between 2000 and 2005, the reported online desal capacity in the United States increased by around 41% (NRC 2008 from GWI 2006a). By 2005, approximately 1,100 desal plants larger than 100 m³/day (0.3 MGD) were online (or were presumed online) in the U.S. These plants have a total capacity of around 5.7 million m³/day (1,500 MGD)—less than four-tenths of a percent (0.4%) of total U.S. water use (NRC 2008).
As shown in Figure 1, the U.S. primarily uses desal technologies to treat brackish water, which accounts for 77% of total online capacity. Seawater desal reflects only a small portion (8%) of the online capacity in the U.S. (compared to about 65% globally). The remaining capacity is primarily dedicated to desalinating wastewater and providing pure water for high-quality industrial purposes (Xu et. al. 2009, NRC 2008 from GWI 2006a).

Figure 1. Percentage of total capacity of currently operating U.S. desal plants by source water. Adapted from NRC 2008, from 19th IDA Worldwide Desalting Plant Inventory, Global Water Intelligence.

- Desal plants have been built in every state in the U.S., although nearly half of these plants are small facilities built for specific industrial needs.
- Most municipal desal plants in the U.S. are located in Florida, California, and Texas. Two-thirds of the U.S. desal capacity is used for municipal water supply at roughly 300 facilities. Industry is also a sizeable user of desal in the United States, with 18% of the national desal capacity (NRC 2008).
- Figure 2 below shows the breakdown of end uses associated with seawater and brackish water desal in the U.S.
FIGURE 2. Percentage of total capacity of currently operating U.S. desal plants by end user. Adapted from NRC 2008, from 19th IDA Worldwide Desalting Plant Inventory, Global Water Intelligence.

STRATEGIES

South Florida example of brackish water desal in the U.S. (Xu et al. 2009)

Brackish water desal systems in South Florida make up the largest source of brackish water desal in the U.S. South Florida is one of the fastest growing regions in the U.S.. Water resources throughout this region of Florida are managed by the South Florida Water Management District (SFWMD). The SFWMD is not a water utility but has regulatory jurisdiction over the water resources of all or part of 16 counties, from Orlando to the Florida Keys, on behalf of 7.5 million South Floridians. Figure 3 provides a map of SFWMD’s service area.

South Florida’s population is projected to increase from 7.4 million in 2005 to approximately 10.6 million by 2025. Accordingly, raw water demand is anticipated to increase from 3,124 mgd (11.82 million m³/d) in 2005 to 4,136 mgd (15.64 million m³/d) in 2025 (SFWMD 2007). Due to population growth and projected water needs, maximized development of traditional fresh water supplies, and meeting the water needs of the environment, the SFWMD is increasing efforts to promote both demand management (i.e., water conservation practices) and supply management (e.g., development of new alternative water sources through seawater and brackish water desal).
The Floridan Aquifer is the primary source of fresh water in the Kissimmee Basin Planning Area (Orlando-Kissimmee). However, in most of the other areas in the District, the Floridan Aquifer is considered an alternative source because its water quality is brackish and requires desal treatment or blending with a freshwater sources prior to treatment or use. The Floridan Aquifer System (FAS) is the deepest of the aquifers used for water supply in the SFWMD. Water quality in the FAS decreases substantially from Orlando to Miami or Naples in terms of hardness and salinity.

In 2003, more than 25 water utilities in south Florida were using RO to treat brackish water from the Floridan Aquifer to meet potable water demands. Between 2003 and 2008, utilities expanded their supplies from the brackish Floridan Aquifer sources. Of the 31 current regional desal facilities for public water supply, 20 were constructed or are under construction since 2000 (Xu et. al. 2009 from Akpoji 2007). A number of golf courses in south Florida have tapped the Floridan Aquifer including several that installed on-site reverse osmosis plants to meet irrigation needs.

However, the implementation of desal in Florida is challenged by product water efficiency, cost and environmental concerns. Depending upon water quality, the typical water recovery of brackish RO is between 60 and 85%. Approximately 15 to 40 % of the feed water is wasted as concentrate. This water loss affects permitting of desal facilities in Florida because raw water withdrawal volumes and concentrate disposal are the key factors in permitting.

Due to geological conditions, most desal plants in Florida employ deep well injection for concentrate disposal. One reason for the large scale usage of deep well injection in Southwest
Florida is the occurrence of naturally occurring radioactive material (NORMS) in the concentrate - which prohibits discharge to a surface water. Leakage has been monitored in some Class I injection wells. Regulatory agencies may not renew the disposal permits for these wells, and in general, disposal permits will be more difficult to obtain in the future (Xu et. al. 2009 from Akpoji 2007a). In addition, deep well injection is very costly, approximately $5.5 million per well in South Florida.

Finally, the cost of desal is currently about 50 to 100% higher than traditional water sources in South Florida, which makes desal not as willingly accepted by the public.

**BENEFITS & COSTS**

**Benefits**

In the California Desalination Planning Handbook (2008), the California Department of Water Resources (CDWR) provides a summary of the various values and benefits of desal. The following benefits apply to inland facilities:

- Providing additional water supply to meet existing and projected demands
- Reducing reliance on imported water supplies
- Enhancing water reliability (especially during drought)
- Restoring use of brackish or polluted groundwater
- Replacing water that can be used for sustaining or restoring river and stream ecosystems

More specialized benefits, limited to specific situations, were also identified:

- Providing improved water quality for disadvantaged communities
- Providing for additional groundwater storage (in coastal and inland areas dependent on groundwater)
Costs

Challenges and potential impediments associated with developing desal facilities include (CDWR 2008):

- Environmental and ecological impacts associated with concentrate discharge
- Economic and energy cost constraints
- Land use and siting impacts
- Cumulative impacts from increased numbers of desal facilities, and
- Facility ownership.

While these have been identified as potential substantive impediments, process impediments were also identified:

- Lack of effective public involvement
- Lack of effective, ongoing interaction with permitting agencies
- Steep learning curve and limited capabilities to support developing large-scale desal facilities.

As perceived by proponents of desal facilities, another obstacle that currently exists but will likely diminish over time is that of regulatory uncertainty and differing requirements among regulatory agencies.

KEY UNCERTAINTIES

In response to water shortages, decreasing costs, and due to its high product water quality, desal is receiving renewed interest as a viable source of water supply. However, as noted above, and throughout related PIM cell discussions, various challenges and possible impediments to the widespread use of desal have been identified. As detailed in the California Desalination Planning Handbook, some are related specifically to desal whereas others are related to nearly any attempts to generate new sources of water.
ADDITIONAL RESOURCES


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