KEY POINT: In the U.S. and many other locations, thermal desal is virtually unused for municipal water treatment.

SUMMARY OF ISSUES

- Thermal processes for seawater desal include:
  - Multiple effect distillation (MED)
  - Multi-stage flash distillation (MSF)
  - Mechanical vapor compression (MVC)

- Thermal processes utilize principles of thermodynamics to distill saline water and subsequently condense the distillate, leaving behind a concentrate stream. Because water is distilled in thermal processes, they are considered barrier technologies for the purpose of removing pathogenic microorganisms.

- MED and MSF processes demand both thermal energy (typically steam) and electrical energy.

- MED and MSF processes have electrical requirements that approximate or exceed SWRO plants while MVC plants usually have electrical requirements more than four times higher than SWRO plants.

- MVC plants are limited to practical total production capacities of 10,000 m3/d.

- Thermal processes are most economical within the context of power plant co-generation. (i.e., with the availability of waste heat and inexpensive power).

- In the US, almost all seawater desal applications utilize RO membrane technology. Thermal desal is virtually unused in the municipal treatment market. This trend is largely driven by the lower capital and operating costs of RO relative to thermal processes (USBR 2003). In addition, RO also has a smaller footprint, which can be advantageous in coastal areas with more expensive real estate.
STRATEGIES

- Large MSF distillers are commonplace in the Middle East largely because of cogeneration. With cogeneration, desal plants are built along with power plants and use the low-temperature steam exhausted from the power plant steam turbines. This approach combines water production with the generation of electric power (using the same fuel), thereby improving the energy efficiency of the desal process.

  Co-generation also allows for shared intake and outfall structures. With cooling water requirements that may be more than seven times higher than plant production capacities, MED and MSF plants require much larger seawater intakes than an equivalent capacity membrane plant.

- Thermal desal plants generally require little or no pretreatment beyond the intake screens and the chemical conditioning with an antifoam/antiscalant agent.

- Thermal processes achieve very high rejection of TDS, producing water that is close to de-ionized quality.

- Unlike membrane processes, the energy required to accomplish desal via thermal processes does not vary substantially with TDS concentration. Therefore, thermal processes are much less energy efficient for lower-TDS brackish water desal than membrane processes.

BENEFITS & COSTS

Thermal processes are most economical within the context of power plant co-generation. (i.e., with the availability of waste heat and inexpensive power).

Thermal processes have a larger footprint, require more feedwater, and have higher capital and operating costs than membrane plants. Thermal plants are only economically justifiable when designed and constructed in conjunction with an electric power plant employing once-thorough cooling, and/or where a large quantity of low TDS (<25 mg/L water is required. Thus, thermal processes are virtually unused in the United States for municipal desal.
KEY UNCERTAINTIES

As discussed above, thermal seawater desal plants are best–suited for co–location at steam electric power plants equipped with once–through cooling (OTC) systems. To be economically viable, the desal plant must be integrated within the steam cycle of the power plant at the time of its design. Current environmental requirements that severely limit the use of OTC power plants mean that thermal desal technology is unlikely to be employed in the United States.

ADDITIONAL RESOURCES
