Desalination Supplements Fresh Water?

Water desalination has been practiced around the world, though 60% of the output capacity is located in the Middle East; the scarcity of ground water in this region has driven many nations, including Saudi Arabia, to implement large-scale desalination. In recent years however, many coastal municipalities in the US have evaluated desalination as a means of providing a sustainable water source for an ever-expanding population. While there are many methods of desalinating water, the two technologies that have been considered the most practical for large-scale use are reverse osmosis and distillation.

In reverse osmosis (RO), the feed water is pumped at high pressure through a collection of permeable membranes, separating salts from the water. Distillation, on the other hand, heats the feed water and uses evaporation and subsequent re-condensation to extract the water, while leaving the salts and minerals. While these technologies may sound straightforward to the layman, they are rife with technical and economic drawbacks that prevent widespread implementation. Some of the major issues that contribute to this are energy use, mineral scale (mineral and salt build-up) on equipment and environmental disposal of the extracted minerals.

If one evaluates energy use, distillation can consume 7.6 to 21 megawatt-hours (MWh) of electrical energy per million gallons of water processed and RO can use 17.8 – 36.8 MWh for the same amount. When that is evaluated in the context of 80-100 gallons per person, per day (a typical water use pattern in the United States) it becomes obvious why more communities have not invested in this technology. Even if the energy costs of large-scale water desalination were tolerable at the residential level, the cost to agriculture would most likely be unbearable because of the tremendous amount of water that would be needed. For example, in America, agriculture accounts for over 80 percent of consumptive water use.

A second issue that complicates the water desalination process is scale build up on equipment. Even with additives to reduce scaling, it is common for RO facilities to be taken offline several times per year. The RO membranes must be cleaned approximately four times a year and must be replaced every three to five years. Because of the heat used in the evaporative process of distillation, scale forms at a higher rate, requiring these facilities to shut down for maintenance of tube bundles and transport pipes.

Obviously fresh water is the resulting output from the desalination process; what is not always obvious is that the salts and minerals that were extracted are also produced. As an example, the City of Santa Barbara's desalination facility can produce 6.7 million gallons per day of fresh water, generating 8.2 million gallons per day of waste brine. The waste water has a salinity approximately 1.8 times that of seawater. An additional 1.7 million gallons per day of brine was generated from filter backwash. It is estimated that this amounts to approximately 1.7 to 5.1 cubic yards of solids per day.

One might ask why even bother to worry about the problems of desalination in the Americas; it might be assumed that there is an abundance of fresh water and it is

inexpensively piped to communities. To counter that, consider that even today there are regular calls for water conservation in communities each summer. A relatively fixed number of reservoirs and well-fields are supporting a growing population and a growing agricultural base that feeds it. Projecting the trend into the future, it would be wise to plan for a day when the renewable ground water can still be used to support agriculture and desalination facilities will ease the water-demand burden in the coastal areas.

One option to consider in the short term is a shift in focus to desalinating brackish water vs. seawater. Brackish water has a lower salt and mineral concentration than seawater and therefore takes less energy to remove those minerals. Additionally a lower mass of waste products result from this conversion process. Long term, however, serious evaluation of new technologies and new materials must occur to make desalination an attractive alternative in the quest to meet the world's fresh water needs. It is plausible that thermoplastic and thermoset composite materials can address some of the scale and maintenance issues , and inventive solutions to tackle the energy and waste problems are currently being explored at the experimental level . Continued support of these efforts now is critical to avert a water crisis in the future.