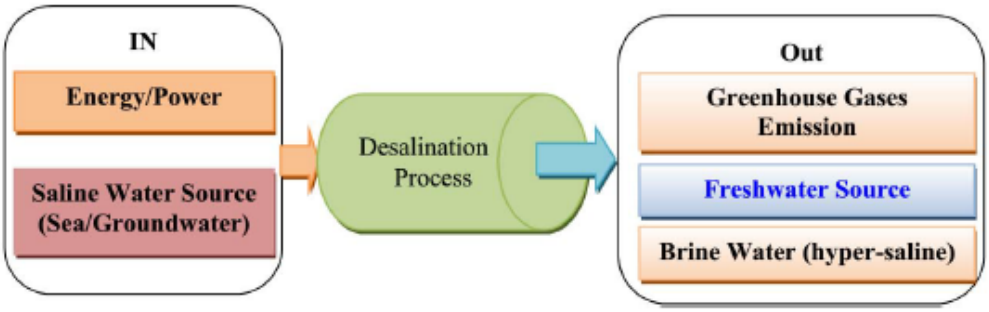
NEW MEXICO DESALINATION ASSOCIATION

WHAT IS DESALINATION?

Water desalination is a process used to separate dissolved salts and other minerals from water. Desalination feed water sources can include brackish ground water, sea water, brackish surface waters (rivers, streams, lakes), wastewater, irrigation water return flows, and industrial feed and process waters. Separation of the dissolved salts and minerals from water requires thermal, mechanical, or electrical energy to create the temperature, pressure (applied and vapor), or electric potential needed to drive a desalination process. As such, desalination is often more energy intensive than developing easily accessible fresh water resources, and research is continually evolving to improve the efficiency and reduce the energy consumption of desalination approaches. But in areas where fresh water supplies are limited, or are becoming limited, improvements over the past four decades in desalination technology have made the use of locally available brackish ground water or sea water much



more affordable.

For example, seawater desalination has the potential to reliably and cost-effectively produce enough potable water to support large populations located near the coast. Numerous seawater desalination plants are currently in water-stressed regions, such as the Middle East, Australia, and on the eastern coast of the United States in Florida and South Carolina. And many more sea water desalination plants are either under construction or are being planned up and down California's parched coast, with a new 50 million gallon per day (mgd) plant in Carlsbad, California starting operation in late 2016.

Likewise, a significant number of brackish ground water desalination plants, designed to utilize locally available brackish ground water resources, are being planned and developed. In the U.S., there are currently over 200 brackish ground water desalination plants in operation in almost 40 states. Often surprising to many, the two largest brackish ground water desalination plants in the world are the 30 mgd Kay Bailey Hutchinson Desalination Plant in El Paso, Texas, which opened in 2010, and the 35 mgd San Antonio Water Authority desalination plant currently under construction.

COMMON DESALINATION PROCESSES

As mentioned, there are several types of desalination processes, including thermal, membrane, and electrical or electro-chemical approaches. While the thermal distillation process is well understood and 30-40 years ago was the major desalination process, most of the newer desalination plants are utilizing membrane or electrical separation approaches. But efforts to utilize waste heat to improve desalination energy efficiency and reduce costs has water treatment professionals reevaluating thermal desalination processes such as Multiple Effects Distillation (MED) and Multi-stage Flash (MSF) distillation in combination with advanced corrosion and scaling resistant materials.

Reverse osmosis (RO) and Nanofiltration (NF) are the leading pressure driven membrane processes. Membrane configurations include spiral wound, hollow fiber, and sheet systems, with spiral being the most widely used. Contemporary membranes are primarily polymeric materials with cellulose acetate still used to a much lesser degree. Operating pressures for RO and NF are in the range of 50 to 1,000 psig (3.4 to 68 bar, 345 to 6896 kPa).

Electrodialysis (ED) and Electrodialysis Reversal (EDR) processes are driven by direct current (DC) in which ions (as opposed to water in pressure driven processes) flow through ion selective membranes to electrodes of opposite charge. In EDR systems, the polarity of the electrodes is reversed periodically. Ion-transfer (perm-selective) anion and cation membranes separate the ions in the feed water. These systems are used primarily in waters with low total dissolved solids (TDS).

Forward osmosis (FO) is a relatively new commercial desalting process in which a salt concentration gradient (osmotic pressure) is the driving force through a synthetic membrane. The feed (such as seawater) is on one side of the semi permeable membrane and a higher osmotic pressure "draw" solution is on the other side. Without applying any external pressure, the water from the feed solution will naturally migrate through the membrane to the draw solution. The diluted solution is then processed to separate the product from the reusable draw solution.

Membrane Distillation (MD) is a water desalination membrane process currently in limited commercial use. MD is a hybrid process of RO and distillation in which a hydrophobic synthetic membrane is used to permit the flow of water vapor through the membrane pores, but not the solution itself. The driving force for MD is the difference in vapor pressure of the liquid across the membrane, with some system using waste heat and vacuum to improve system cost and performance.

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