National Water Week
17 - 23 October 2010

# FACT SHEET - *DESALINATION*

## OVERVIEW

Desalination is a practical way of making salty water drinkable and it is used widely around the world now, especially in very dry countries and on ships and small islands. The process is quite expensive and it uses a lot of energy. It also produces a very concentrated waste stream of brine which has to be disposed of responsibly. For these reasons, it is generally a source of last resource, implemented when all others have failed. The most common, modern methods of desalination are thermal processes and reverse osmosis (RO) although there is an increased trend to RO due to the advances in this technology in the last 10 years. For practical reasons, the most attractive desalination options are for water that does not have much salt in it to start with, ie brackish water or recycled water.

## BACKGROUND

As Australia has been severely affected by both drought conditions and changes in rainfall patterns, a great deal of attention is now focused on new sources of water to supplement traditional supplies. One of the most obvious alternative sources is desalination and it has been advocated, and seriously considered, for many applications and can provide drought proofing for water short areas. This fact sheet has been prepared to help people without expert knowledge in this area to understand how desalination works and what its potential and drawbacks are. At the end, detailed sources are listed for anyone who wishes to know more.

## TAKING SALT OUT OF WATER

Distillation: Removing salt from water is a process that has been used for a long time, in the form of distillation. The natural process evaporation from the surface of the sea, to form clouds, which then result in rain, is the most widespread distillation process. Boiling salty water and condensing the steam, or even just putting a dish of water in the sun and collecting the vapour on a clear cover are both very simple methods of distillation. Commercial desalination plants have been operating now for decades, using the distillation process. When distilling large quantities of water, say for a town supply, there are practical problems to be dealt with: firstly, the energy needed to evaporate water is quite considerable, so the process can be very expensive, unless a cheap source of electricity or heat is available. For instance, running a power station and a desalination plant together (commonly called cogeneration) can be cost effective, since the waste heat from a generator can be used, as well as cheap electricity.

Membrane processes: A more recent development, and now more widely used, relies on what is called a semi-permeable membrane to separate salt from water. Simply put, a synthetic membrane is made, with pores so tiny that water molecules can pass through it, but other molecules, especially salts, cannot. This separation doesnot happen easily, though, and it requires very high pressures to force the water through the membrane. A natural process, called osmosis, operates in all living cells, to equalise the salt concentration on either side of the membrane. Because the process for desalination is the exact opposite, it?s called reverse osmosis, or just RO. A pre-treatment step is required before RO to provide high quality water and reduce membrane fouling. The most common pre-treatment steps include coagulation and filtration or microfiltration.

Other processes: There are other ways of removing salt from water, but they are not practical for community supplies, so this fact sheet doesn?t discuss them any further.

## Considerations

Energy: One of the first things to note about desalination is that, whichever method is used, a lot of energy is needed; that is both expensive and the use of energy can create undesirable greenhouse gas emissions. It is very important to note that the amount of energy for distillation is fixed for a given volume of water, but the energy for RO depends on how salty the water is to start with. For this reason, it is much more attractive to desalinate brackish (ie slightly salty) water or treated sewage effluent than it is to deal with seawater, which has roughly 35 grams of salt in every litre of water. For RO, the energy also depends on the temperature of the water, less energy being needed for warmer water. This means that RO in Darwin would probably cost less than the same process in Hobart.

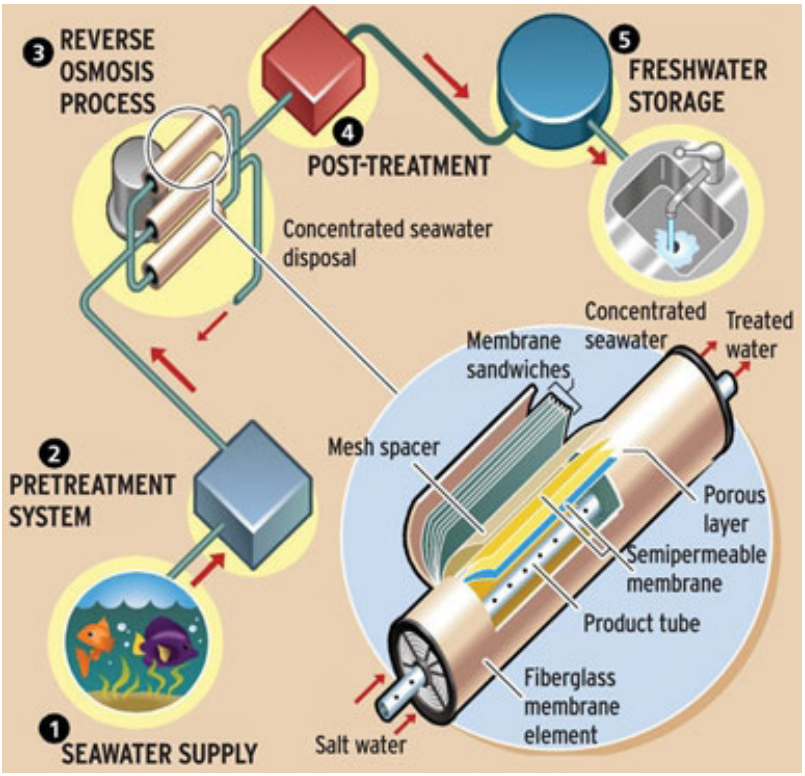
Cost: A significant part of the cost equation for desalination is owing to the high energy consumption, but desalination plants are sophisticated pieces of equipment with high capital costs and quite significant maintenance requirements too. Desalination plants do not last as long as traditional water treatment plants, so the capital cost has to be amortised over a relatively short life, which also adds to the cost. The actual cost for a given plant is very site specific and also dependent on the size of the plant. To give a very rough idea, it is now possible to produce desalinated water from seawater for slightly more than A$1 per kilolitre, if the plant is large, say 100 megalitres per day (serving, say, a medium-sized city). For smaller plants and less favourable conditions, the cost could be $4 per kL or more.

Environmental Impacts: It is not possible to use desalination as a water source and to assume that it has no environmental impact. As mentioned earlier, the high energy consumption leads to greenhouse gas production and the salt that has been extracted has to go somewhere. Depending on the process, the salt concentration in the waste stream could be anywhere from double that of the source water, up to a solid salt product (although that would seldom happen in practice). Managing that salt stream is not a trivial problem and even in a coastal community, the environmental management issues associated with the brine disposal have to be carefully managed. In an inland community, of course, there is no easy disposal route, so dedicated brine ponds may be needed. There have been proposals to link gourmet salt manufacturing to desalination, but that is not a common occurrence.

Maintenance and Operation: A desalination plant is complex and has serious challenges in terms of corrosion and fouling, regardless of the specific process being used. While it is possible to design a small RO plant, say, for rugged conditions, it is not feasible to expect a large desalination plant of any sort to operate reliably without expert operational and maintenance support. This means that implementing desalination in small, remote communities has to be dealt with carefully, if significant breakdowns are to be avoided.

## Treatment Plants

There has been an exponential growth in desalination plants worldwide with the reduction in capital and operating costs and improvements in energy efficiency of RO systems. The Middle East is still the largest user of desalination and seawater desalination plants of capacity over 300 ML/d are being constructed there (e.g. Ashkelon plant in Israel). There is increasing use in Europe in countries such as Spain and in North America with plants of over 100ML/d capacity in the Caribbean.




## Other Sources of Information

International Desalination Association (IDA) http://www.idadesal.org - Journal - The International Desalination and Water Reuse Quarterly
Australasian Desalination Association (ADA) - http://www.ceic.unsw.edu.au/ada/ - publishes regular newsletters for members.
European Desalination Society (EDS) http://www.edsoc.com