MODERNWATER | Membrane Processes

Forward Osmosis: for Evaporative Cooling

Modern Water owns, installs and operates highly innovative membrane technologies and is the world-leader in Forward Osmosis (FO) technology. Our Forward Osmosis process has been very successfully applied to the production of high quality/ low cost make-up water for evaporative cooling from feedwater sources which include seawater, brackish water and treated sewage effluent.

- 50% less operating costs compared to RO
- Low pressure system reduces energy usage when compared to other desalination methods such as RO
- Reduced chemical usage within the cooling cycle
- Osmotic agent inhibits the growth of legionella
- FO benefits apply across all feedwater sources such as brackish water and TSE

Forward Osmosis is the term used to describe the natural osmosis process whereby a solvent flows from a region of lower osmotic pressure across a selectively permeable membrane to an area of higher osmotic pressure.

Two fluids with differing osmotic pressures can be manipulated to exploit this natural process by the use of a high osmotic pressure solution known as an 'osmotic agent' or 'draw solution'. This process takes place at very low pressure (2-3 barg) especially when compared with the very high pressures (up to 82 barg) required in reverse osmosis. By applying this process to any feedwater (seawater, brackish water, treated sewage effluent) we can produce high quality make-up water at low cost for evaporative cooling processes *(See diagram 2)*.

We have already commercialised this technology for the desalination of seawater to produce drinking water and have a number of full-scale plants currently operating. In respect to make-up water for evaporative cooling we have successfully conducted full-scale and substantial trials of our patented FO process for this application.

MODERNWATER

Process explained

The osmotic agent is central to Modern Water's Forward Osmosis process. The osmotic agent draws in the pure water from the feedwater (eg seawater). The pure water and the osmotic agent are then fed to the evaporative cooling system for a number of cycles prior to blowdown.

Modern Water has developed a patented Blowdown Recovery system which effectively recovers and reuses the osmotic agent in the blowdown stream. At the same time evaporative cooling chemicals (eg scale inhibitors or biocides) are also recovered in the system for re-use. This reduces the chemical dosing requirement usually associated with traditional evaporative cooling operations, further improving economics.

Modern Water's osmotic agent is compatible with all common materials found in evaporative cooling systems.

An additional indirect benefit of Modern Water's osmotic agent is in the inhibition of the growth of the hazardous legionella pneumophila bacteria.

Diagram 1

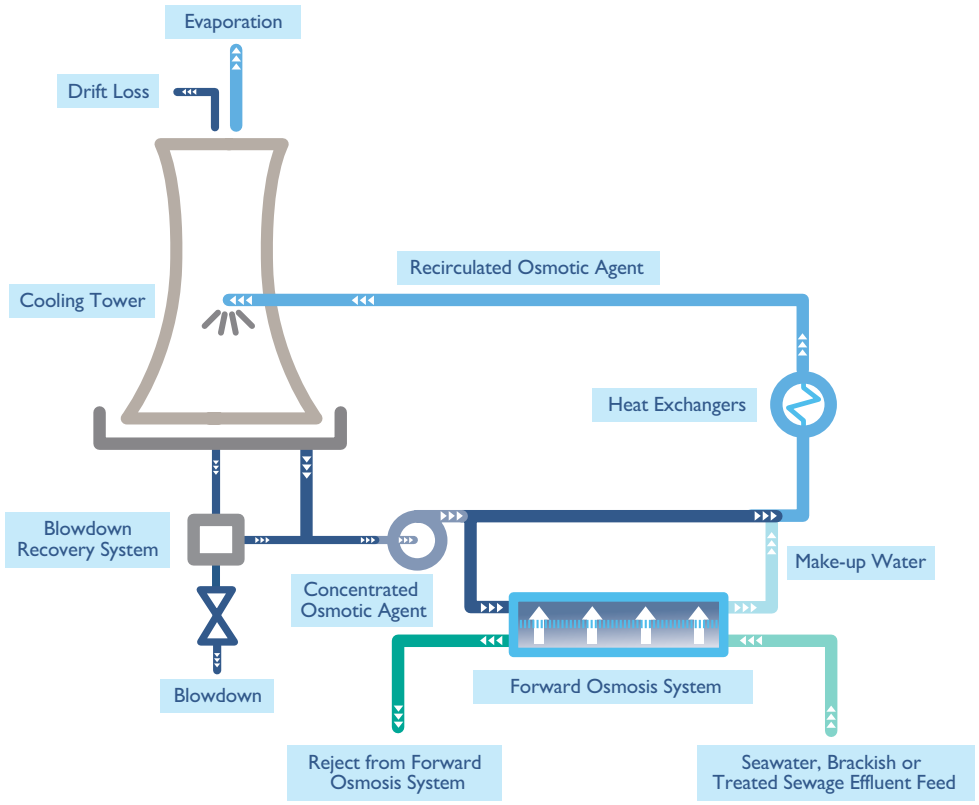
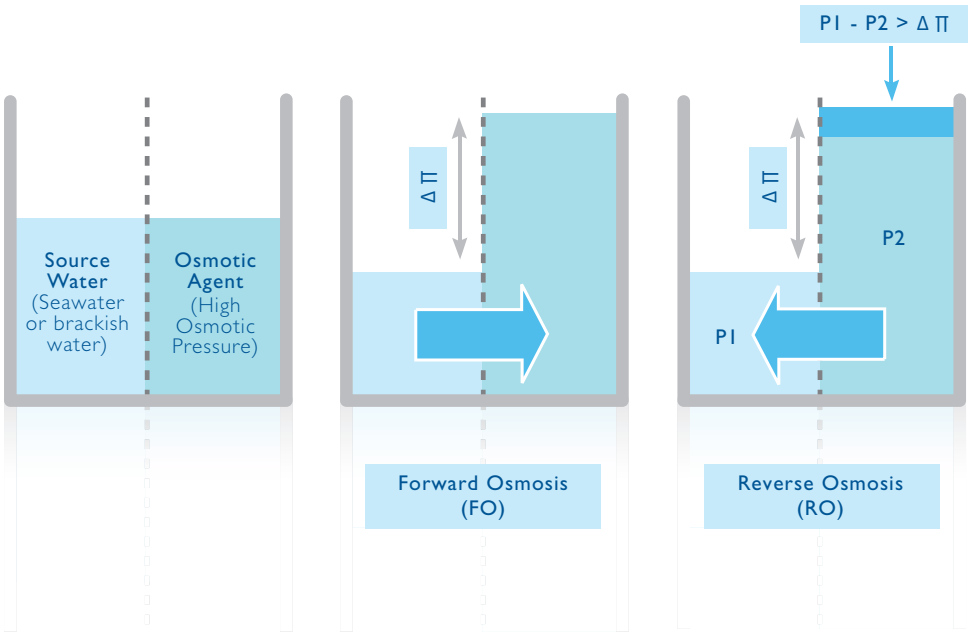


Diagram 2



FO EVAPORATIVE COOLING PROCESS VS OTHER MAKE-UP WATER ALTERNATIVES

	Current Make-up Water Options			
	Potable/ Desalinated Water	Seawater	Treated Sewage Effluent	**Forward Osmosis**
Feed water availability	Scarce and valuable resource	Unlimited availability, but requires proximity to the sea	Limited availability, transport of effluent to the point of use, subject to seasonal and population effects	**Unlimited but requires a source of feed water (seawater, brackish water, treated sewage effluent)**
Cycles of concentration	4 - 6	1.2 - 1.5	2.0 - 2.5	**4 - 5**
Materials	No special materials required for heat transfer surfaces	Special materials required for pipework, heat transfer surfaces (titanium, cupro-nickel etc)	No special materials required for heat transfer surfaces	**No special materials required for heat transfer surfaces**
Chemicals	Requires corrosion inhibitors, oxidising and non oxidising biocides, as with all cooling towers but are lost via blowdown	Requires significant quantities of chemicals including continuous use of oxidising biocides	Careful monitoring required to ensure biological and corrosion controls remain in place, due to wide variability of incoming sewage effluent	**Small loss of Osmotic Agent in drift and blowdown, but significantly less 'other' chemicals required due to patented blowdown recovery system**
Drift	No detrimental affects to surrounding structures, flora and fauna	Salt laden drift requires careful selection of the site, can cause corrosion damage to surrounding structures and may affect local flora and fauna	Public perception issues associated with airborne treated sewage water	**No detrimental affects to surrounding structures, flora and fauna**
Other Issues	Expensive from a desalinated water source	Introduction of solids and biological materials from the marine environment, with potential detrimental effects on heat transfer and tower fill materials.	Public perception. Disposal of blowdown due to high phosphates and nitrates. Membranes prone to fouling.	**Membranes not prone to fouling.**

To find out how we can help you please contact us on:

UK: +44 (0)1483 696 000

OMAN: +968 (0)24491833

EMAIL: info@modernwater.co.uk

MODERNWATER

www.modernwater.com