The Power Generation/Fresh Water Supply Conflict When Water is Scarce, Where Can You Look for Water for Your Power Plant?

Ovivo USA, LLC

To Review (continued)
A few facts about water and power generation

Fresh water is becoming scarce

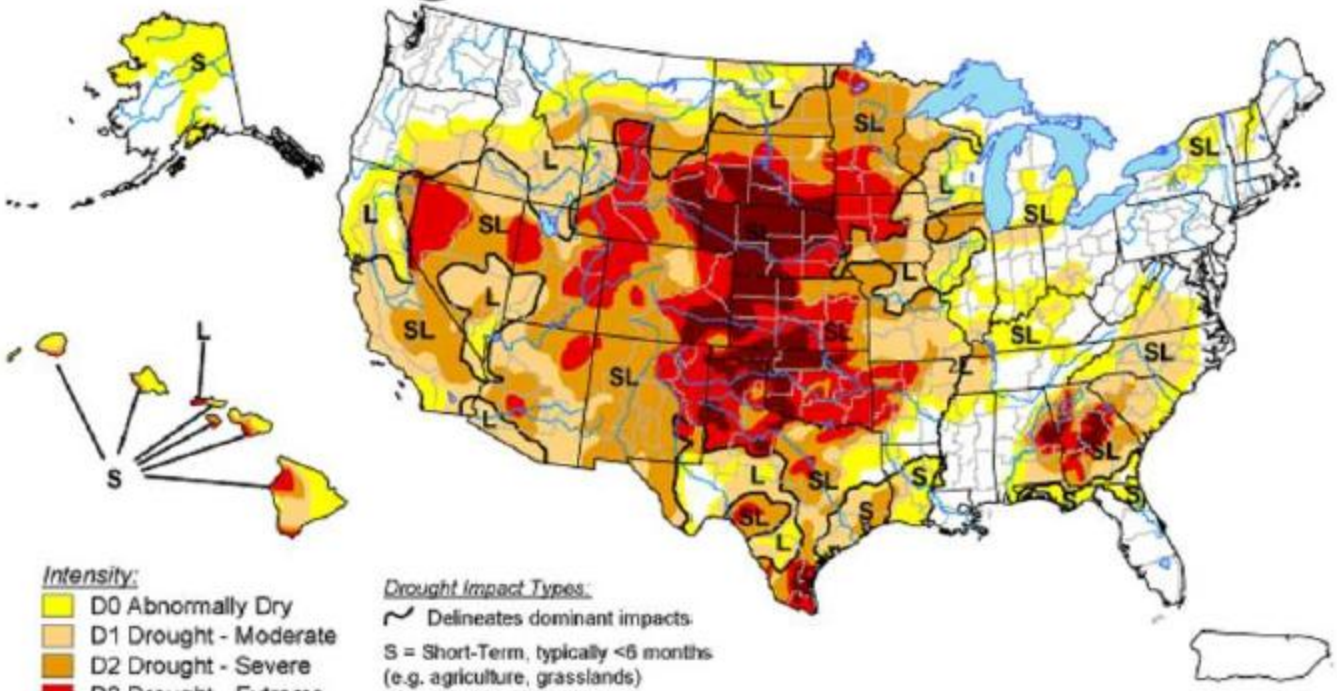
Agricultural Production (which uses a similar amount of fresh water for irrigating food crops) will increase with population growth

Power Generation will increase with population growth

As climate warms, water warms and fresh water supplies decline (Drought)

U.S. Drought Monitor

November 27, 2012
Valid 7 a.m. EST



Intensity:
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:
Delineates dominant impacts
S = Short-Term, typically <6 months (e.g. agriculture, grasslands)
L = Long-Term, typically >6 months (e.g. hydrology, ecology)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu/

USDA

Released Thursday, November 29, 2012
Author: Eric Luebehusen, U.S. Department of Agriculture

OVIVO
Bringing water to life

Bioreactor MBBR
Comparison of Typical Loading Rates

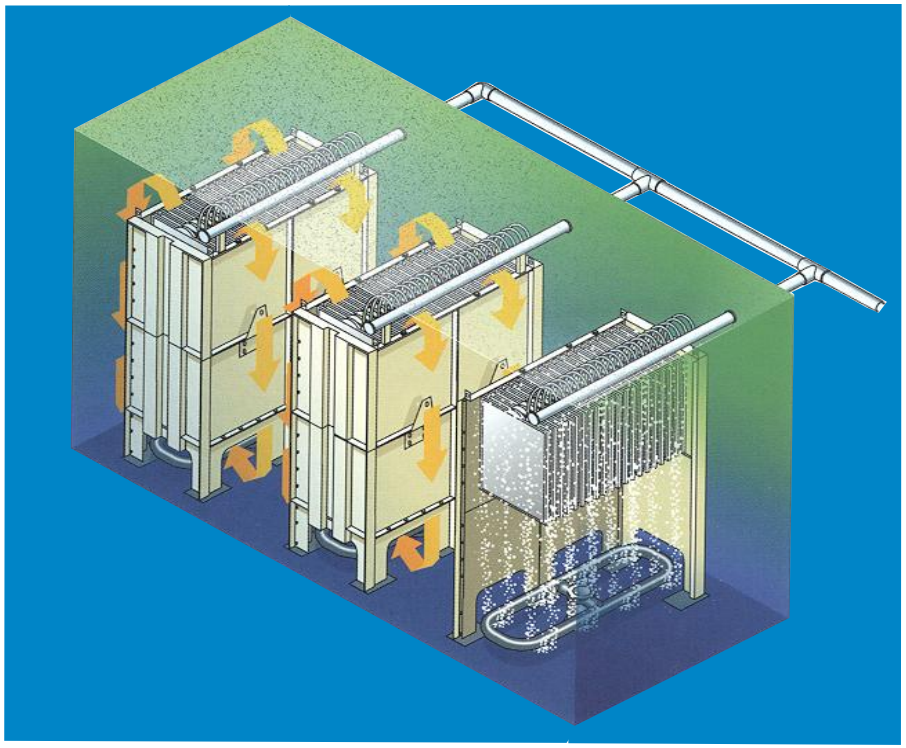
1. Activated sludge process
   - High loaded 0,6 – 1,5 kgBOD/m3 d
   - Low loaded < 0,5 kgBOD/m3 d

2. Traditional Fixed Film processes
   - High loaded 0,4 – 2,5 kgBOD/m3 d
   - Low loaded < 0,4 kgBOD/m3 d
   - Biorotor 4 – 20 gBOD/m2 d

3. FlooBed® Bioreactor
   - Volume load 2,0 – 20 kgBOD/m3 d
   - Carrier load 20 – 200 gBOD/m2 d

EWT Membrane Bioreactor (MBR)

1. A membrane bioreactor is a state of the art wastewater treatment process utilising biological treatment alongside filtration all in one common tank.
2. Kubota flat-plate membrane technology
3. Permeate suitable for water re-use



Cycle Make-up: Demineralization

Membrane based

- Ultrafiltration
- Reverse Osmosis
- Electrodeionization

Ion Exchange based

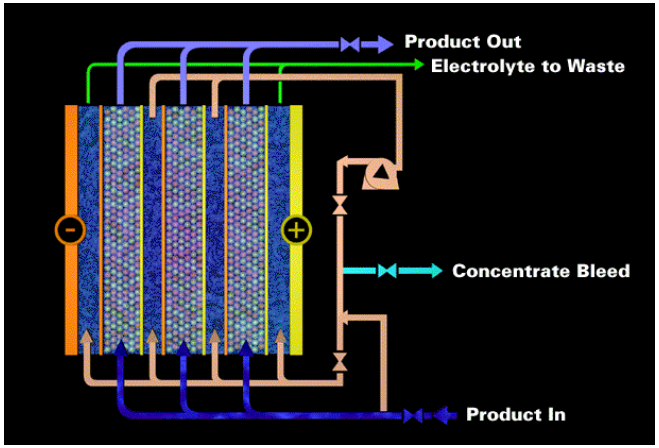
- Softening
- WAC/SAC – WBA/SBA
- Mixed Bed IX

Electrodeionisation

Advantages Chemical Free

Where Used :-

Polishing post -RO



What do you do with cooling tower blow down?

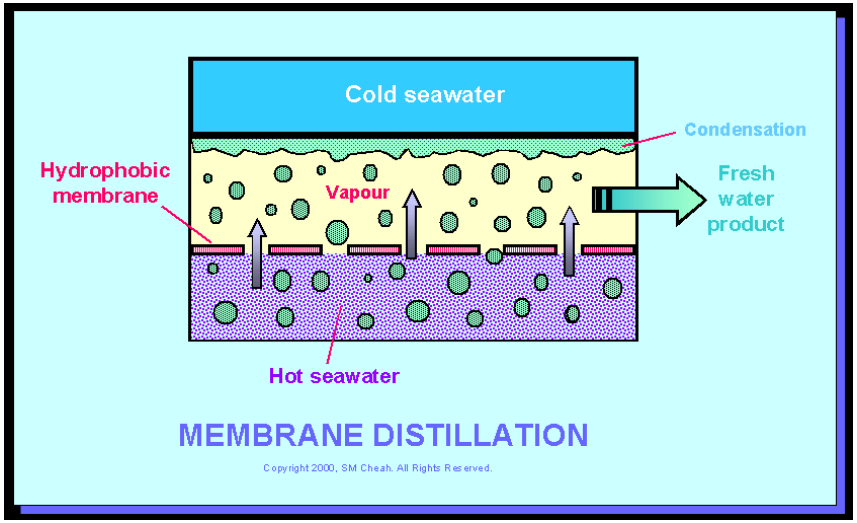
Can be returned to sewage treatment plant if within permitted discharge limits

Can be sent to immediate sidestream recycle/reuse treatment system consisting of CLS and membranes for make up to the cooling tower

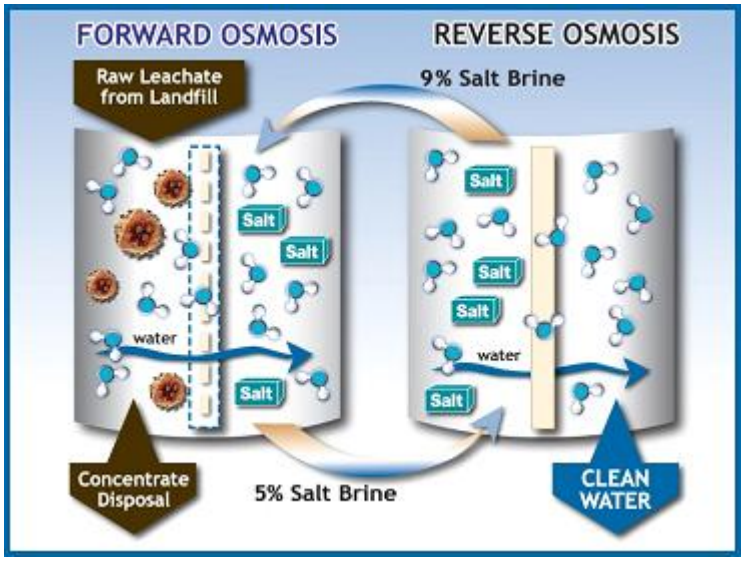
Can be sent to on-site irrigation if suitable for soil application and where sufficient land is available on site

Future Technologies that may have an impact on ZLD

Membrane Distillation



Forward Osmosis



Conclusions

Power Generation is competing with agricultural use. Population growth fuels both growth in power generation and demand for food.

Again only 1% of all fresh water is accessible for use.

Drought can impact water supply and temperature of the water can affect power plant efficiency, availability, and reliability

Coal, Nuclear, and IGCC's draw more water than combined cycle natural gas fired power generators

Combined cycle growth and older coal plant retirements are temporarily easing the stress on fresh water supplies, but power plants are built to last 40 years but will sufficient water be available to operate for 40 years?

Once through cooling conversions to wet cooling will also ease water stress

Hybrid cooling schemes using air cooling/wet cooling will also ease stress.