ROTEC
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Water Desalination

Energy & Environmental Challenges

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Methods of desalination

Thermal methods:

- MED/MSF

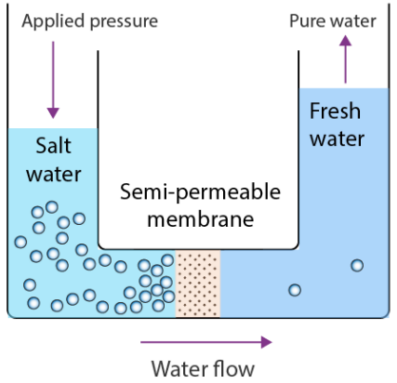
Feed>Heat > Vapor > Fresh water

- Vacuum freezing (VFVC)

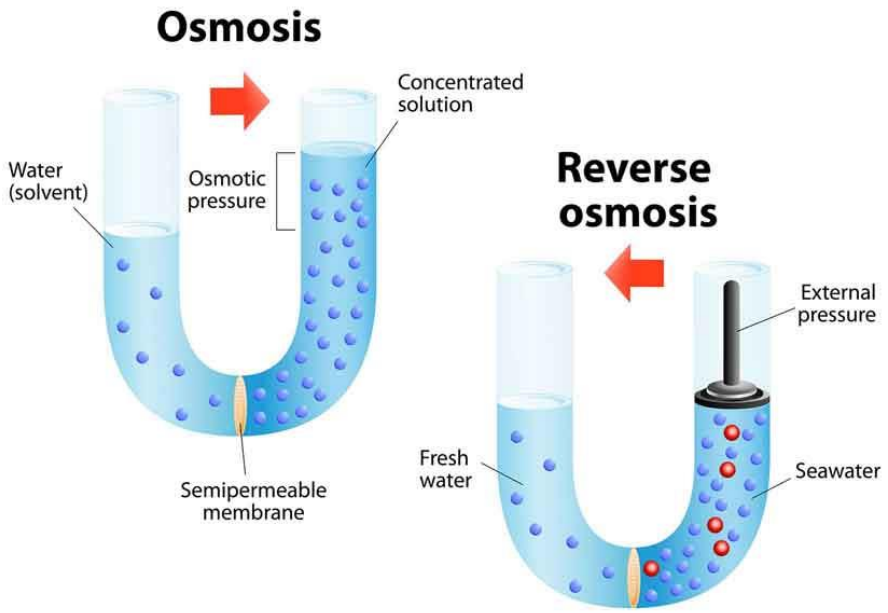
Feed>Freezing>Vacuum>Fresh water

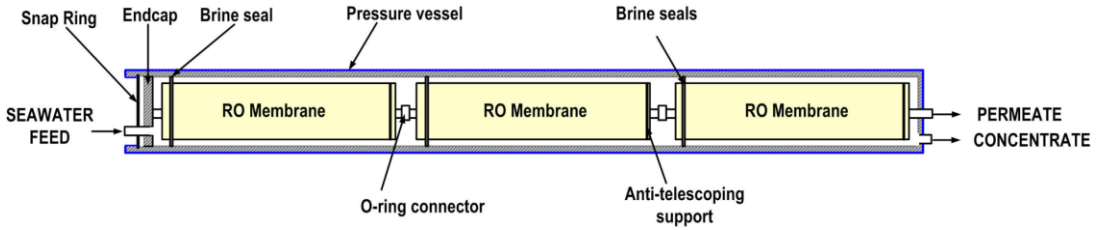
- Reverse Osmosis method:

Feed>Pressure>Fresh water

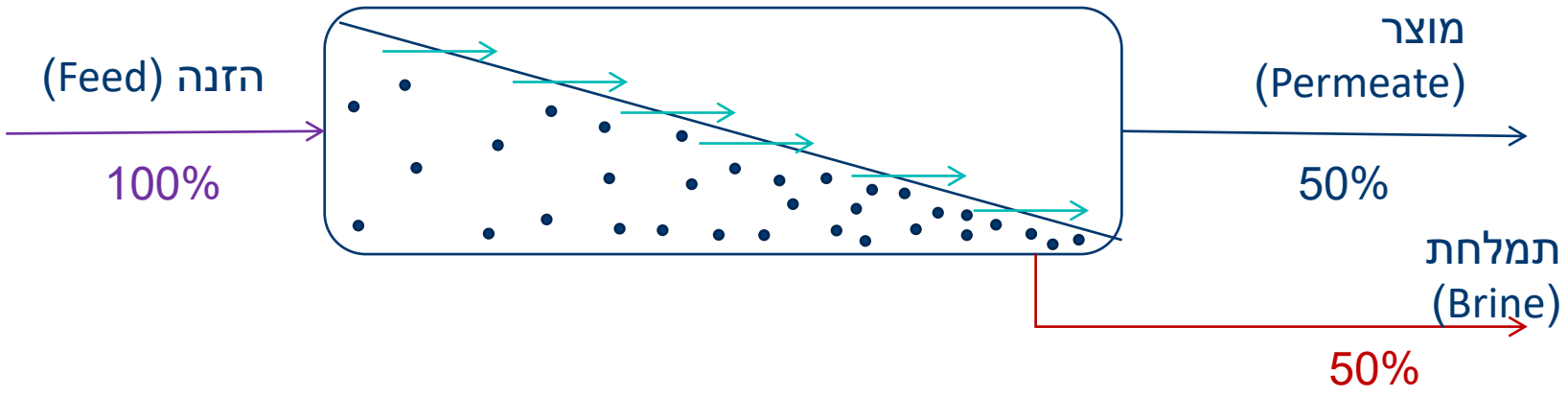


How does reverse osmosis work?





Recovery Rate



$$\%Recovery = \frac{Q_{Permeate}}{Q_{Feed}} = \frac{Q_{Permeate}}{Q_{Permeate} + Q_{Brine}}$$

Energy Challenges

- Fact:
- Large desalination facilities desalinate ~50,000 m^3/h
- ± Olympic pool every 2 minutes…

- Problems:
- How much energy it takes to evaporate that much water? (~1.15 US$ per m^3)
- How much energy it takes to pressurize that much water? (~0.63 US$ per m^3)

- Specific energy = ~3.2 kwh/m^3

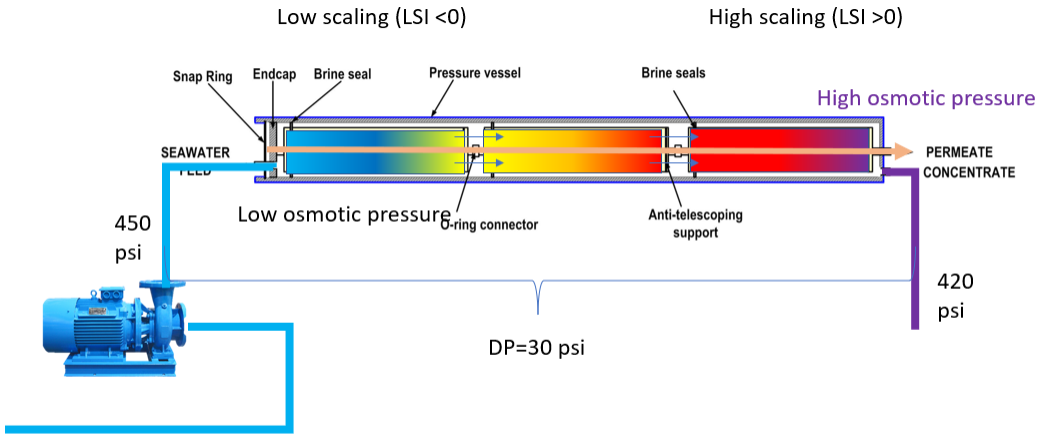
Environmental Challenges

- Fact:
- Large desalination facilities desalinate ~50,000 m^3/h
- ± Olympic pool every 2 minutes…
- 50% of the water will go back as brine

- Problems:
- Chemicals as antiscaling agents (Phosphates), flocculants (Fe2SO4) and acids must be added.

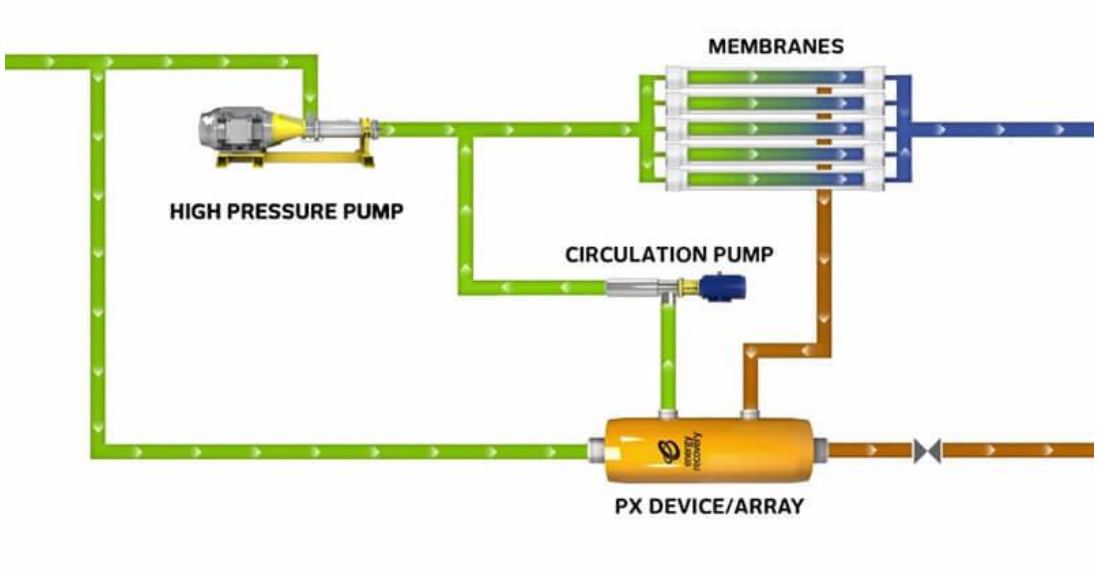
Why won’t we work in higher recovery?

- Membrane scaling
- Higher concentration of brine stream
- Higher energy consumption

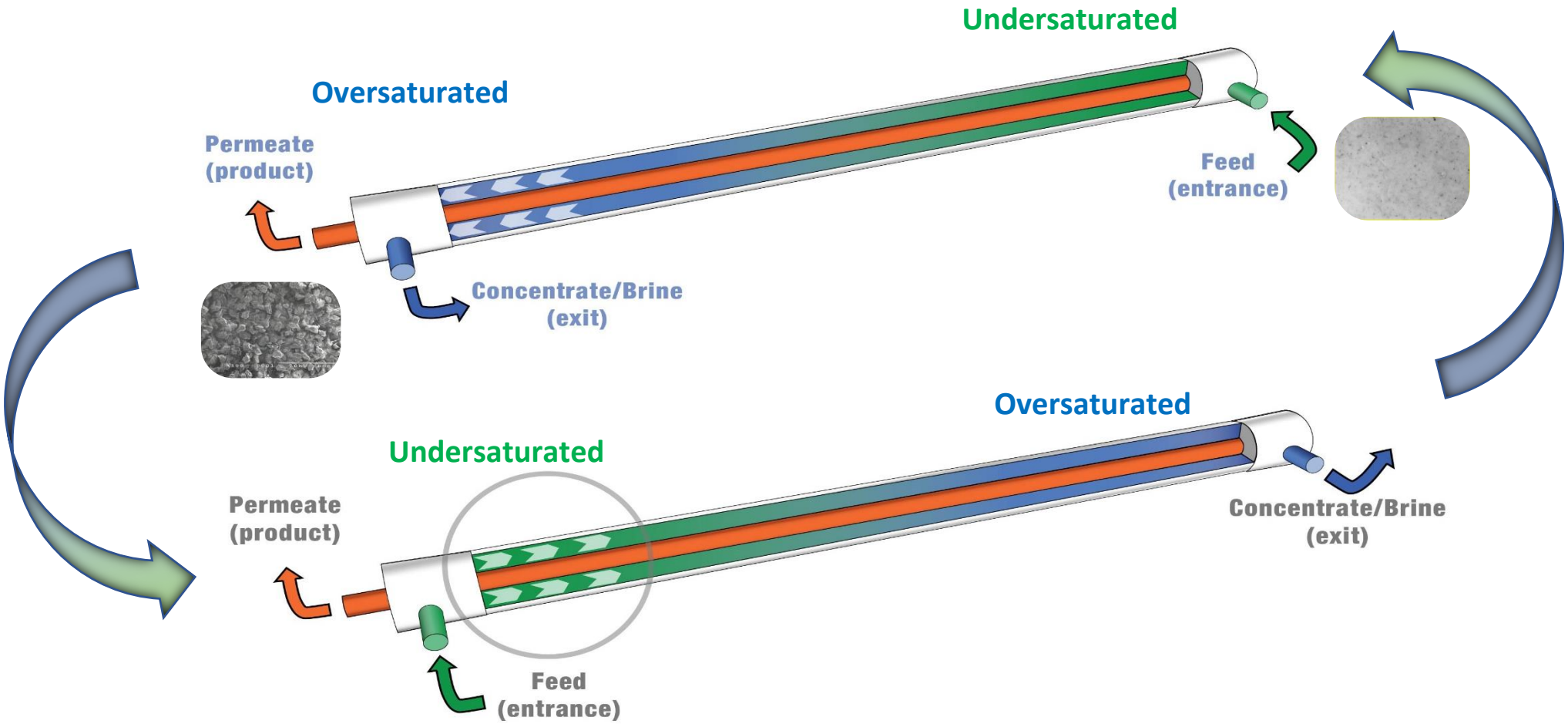


Energy Recovery

- Using the pressure from brine side to help pressurize inlet stream.
- 1) High pressure brine IN
- 2) Low pressure feed IN
- 3) High pressure feed OUT
- 4) Low pressure brine OUT



Extreme High Recovery without Scaling



ZLD / MLD

- Extreme high recovery can be used before evaporators / crystallizers and filter press in order to achieve Zero Liquid Discharge
- Still today require very high CAPEX and even higher OPEX
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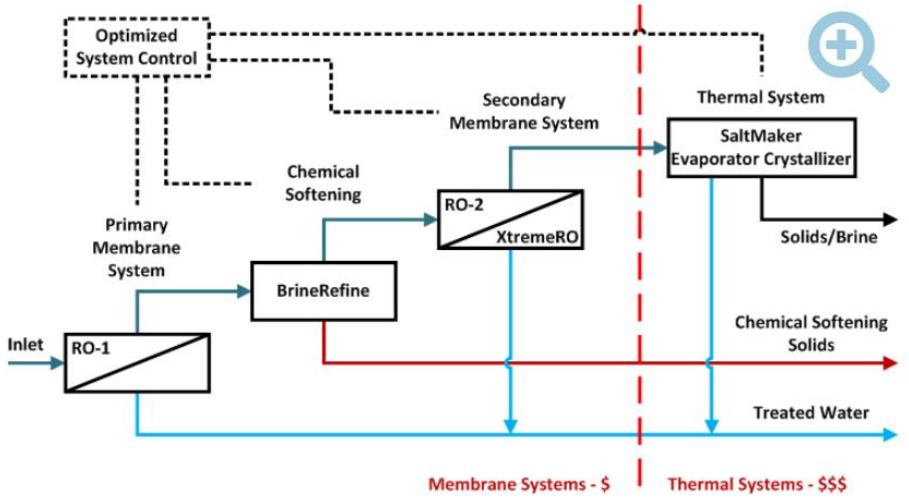

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Thank You!