



GreenPebble Technologies

Your Water and Energy Solutions

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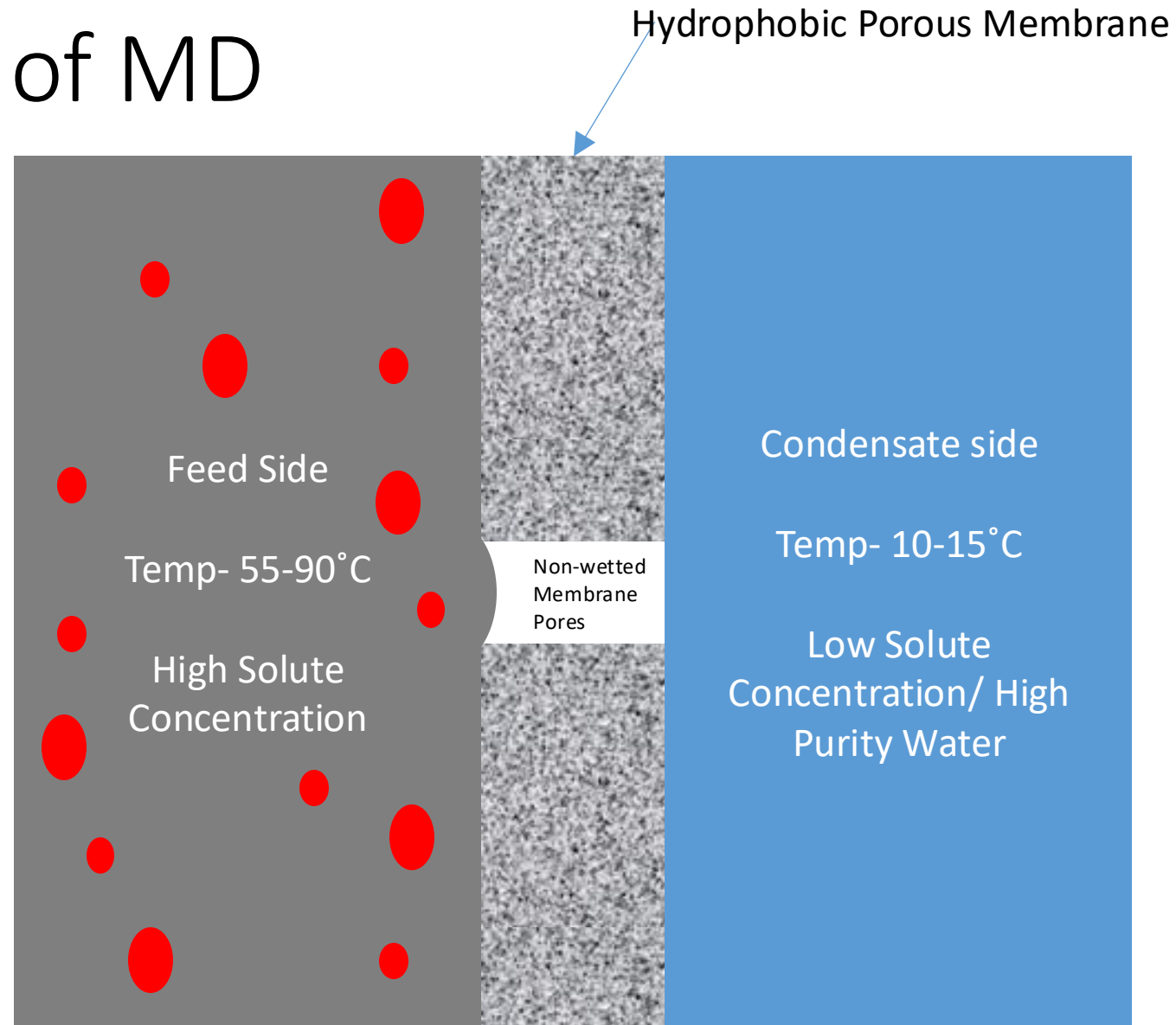
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Principle of MD



- Thermally-driven membrane-based distillation process exploiting hydrophobic nature of the membrane for selective recovery of water vapor giving- excellent product water quality and high feed solute concentrations

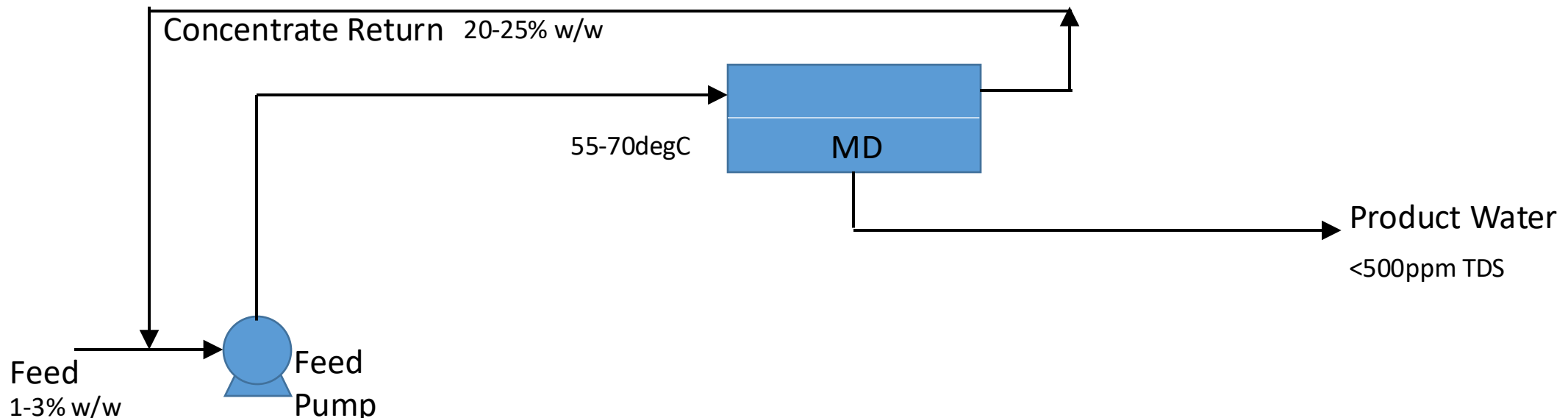
Four Configurations of MD

- Direct Contact Membrane Distillation
- Vacuum Membrane Distillation
- Sweeping Gas Membrane Distillation
- Air Gap Membrane Distillation

➤ Multiple MD configurations can be devised to achieve MD targets and to match available resources

GPT's Membrane Distillation

- GPT designs and manufactures its proprietary membrane distillation process that separates, fractionates and concentrates solutes or organic constituents while separating water using porous hydrophobic membrane
- Hydrophobic membrane only allows water vapor to pass through
- Concentrated feed does not wet membrane and stays at feed section



➤ GPT owns proprietary know-how of MD membrane fabrication and system integration

Advantages :: Membrane Distillation

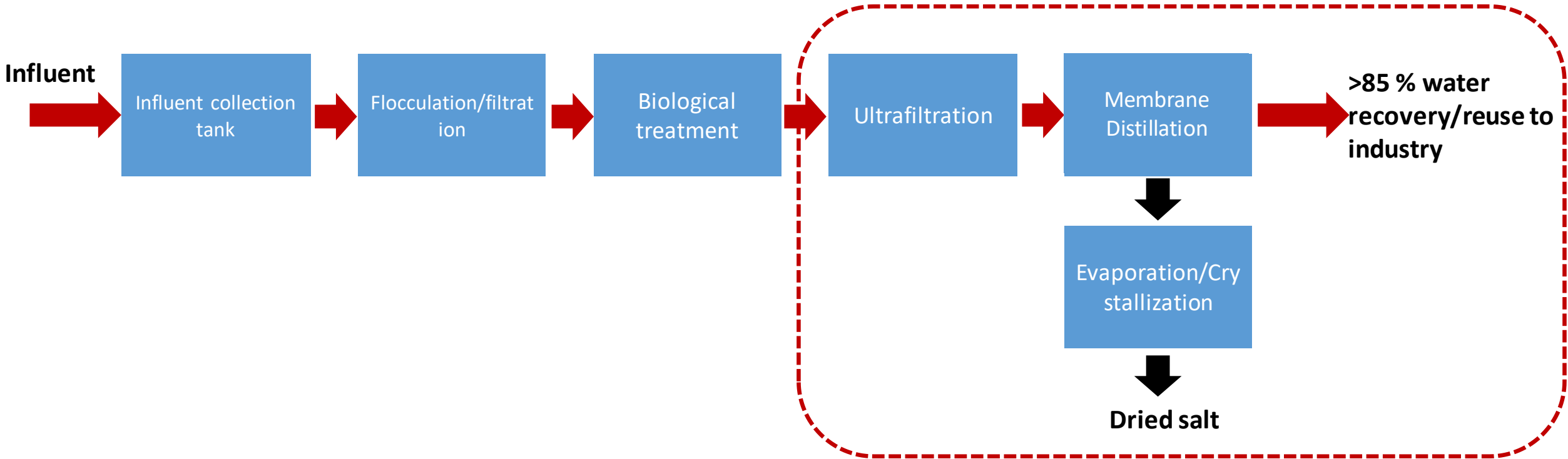
- High purity water production
- 100% rejection of non-volatile electrolytes
- Feasibility for temperature sensitive applications- food, biotech, pharma etc.
- High concentrate requirement
- Low temp operation
- Hazardous chemical waste treatment
- No pressure limitations

Applications :: Membrane Distillation

- Zero (or Minimum) Liquid Discharge (Water Treatment)
- Brine Concentration (Chlore-Alkali, ETP, ZLD)
- Dehydration of solvents (ethanol, butanol, NMP etc.)
- High Purity Water Production (<10 ppm TDS)
- Concentration of non-volatile acids (H₂SO₄, HF etc)
- Recovery of trace volatiles from aqueous streams (ethanol)
- Acid recovery from metal pickling (HCl, HNO₃ etc)

Application : : For ZLD/MLD

Our Technological and Business Propositions



Sustainable technologies such as MD gives energy-efficient, low-cost and high water recovery system at significantly lower O&M costs



Technology Comparison- MD vs RO

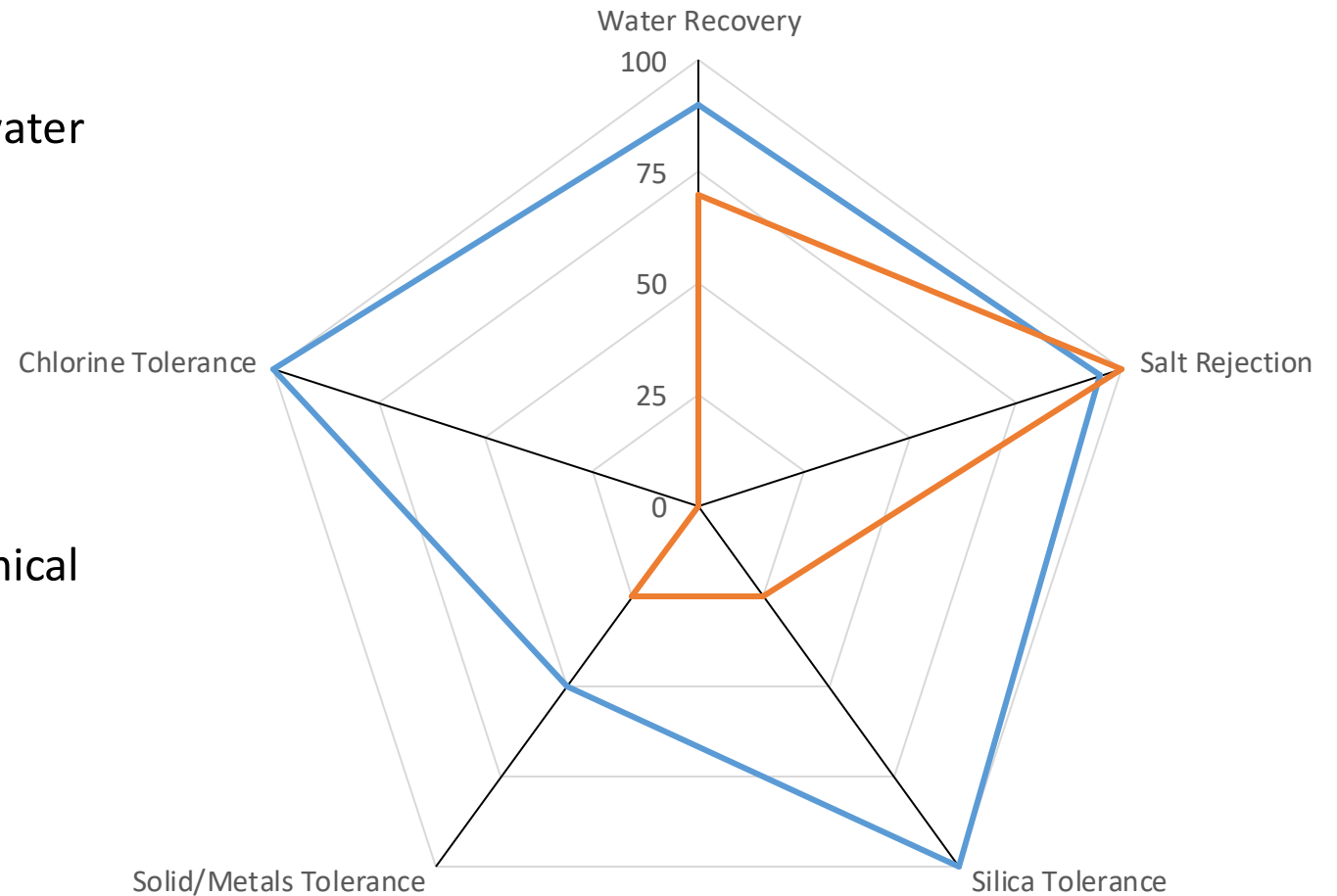
Criteria	Membrane Distillation	RO
Feed TDS (ppm)	500-70000	100-25000
Salt Removal Efficiency	>99%	90-99%
Mode of Operation	Continuous, moderate start-up issues	Continuous, difficult start-up
Water Recovery Efficiency	70-90%	30-50%
Feed Water Turbidity	SDI ₅ <3	SDI ₁₅ <5
Continuous Feed Free Cl ₂	0.5 ppm	0 ppm (TFC)
Operating Pressure	<3 bars	>25 bars
Power Consumption	Electric: 0.5-1 kWh/m ³ Thermal Heat: 150-170 MJ/m ³ (mainly in the form of waste heat source)	4-15 kWh/m ³
Membrane life	7-10 years	1-3 years
Maintenance	Moderate	Significant
Chemical Usage	Moderate	Significant
Silica removal	100%	90-97%
Silica in concentrate	As feed	100 ppm

➤ MD is better technology than RO to treat and recover highly saline feed source



Membrane Distillation Value Propositions

- Lower pretreatment requirements
- High reliability and low maintenance costs to treat water
- Highest water recovery reduces need for complex evaporation/crystallization-based processes
- Reduces burden on valuable natural resources
- Durable membranes allowing use of aggressive chemical cleaning, chlorine tolerance and physical cleaning
- Low waste disposal cost



MD Capabilities

	Description
Capacity Range	20-100 KL/day (varied by feed stream, recovery and membranes)
Pretreatment	Membrane filtration coupled with bag, cartridge filter and GAC
Removal Efficiency	99+% removal eff. For ionic constituents 99% removal efficiency of nitrates 99+% removal efficiency of heavy metals 99.99% microbial removal efficiency
TDS	<500 ppm with feed TDS 5000-70000 ppm
SDI	>20
Turbidity	<5 NTU
pH	6-8
BOD	<100 ppm
COD	<500 ppm
Recovery rate	>90% for feed of 10000 ppm TDS
Antiscalent	No need
Power Supply	3-Phase



Standard Plant Configuration



- All pumps have auto start/stop that is controlled by system pressures and tank levels to provide complete integration between systems



- Automatic safety shutdown process to protect system components



- Low pressure switches to protect pumps



- High pressure switches to protect membranes and housings



- All parameters are user defined



- Real time system performance displayed on user interface screens



- Automatic system performance data logging



Innovations for Sustainable Tomorrow

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