Recovery of CT blowdown through Membrane Distillation

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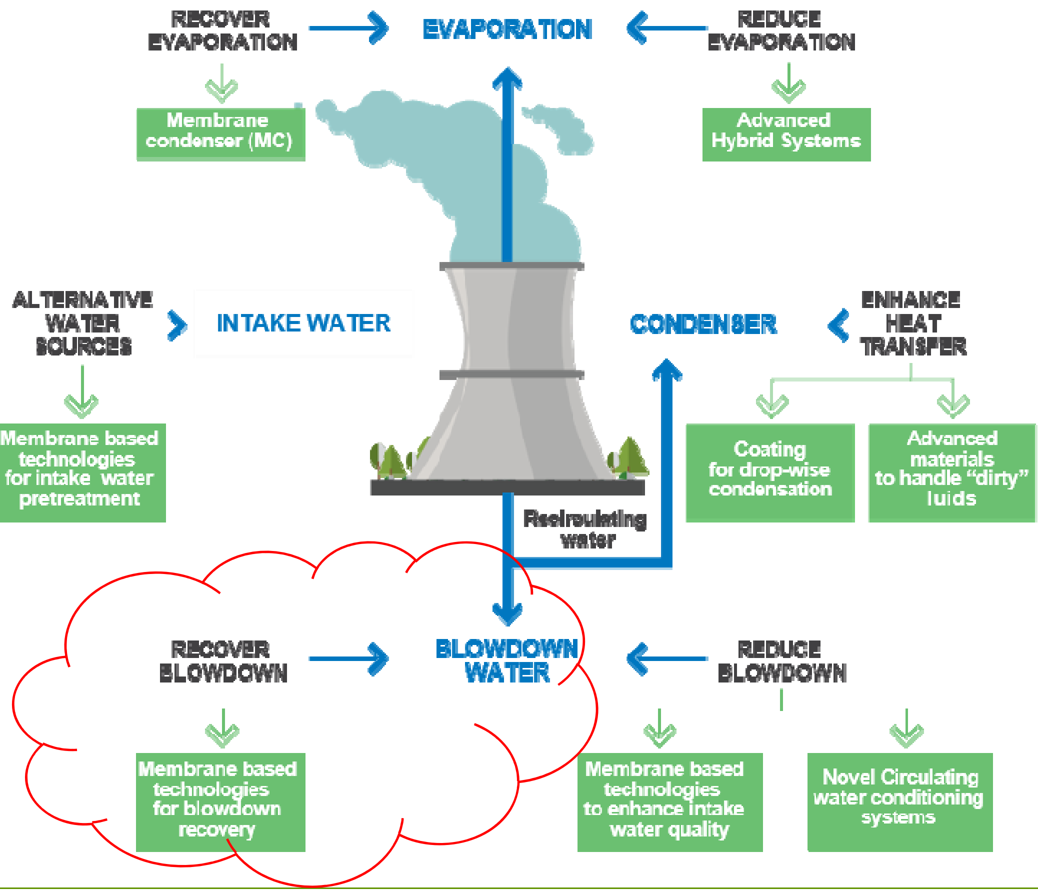
PROJECT GOAL

- **Matching** project aims to reduce the cooling water demand and to improve the performance of cooling systems in power plants.
- **Membrane Distillation** technology is being tested in As Pontes for recovering water from the cooling tower blowdown
- Water recovered can be reused as cooling system **make up water** or even other uses depending on distillate quality



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MEMBRANE DISTILLATION TEST – AS PONTES

- **Enel/Endesa As Pontes Power Plant** is located in La Coruña, Spain
- 4 coal fired power units, with a total capacity of 1400 MWe
- Closed cooling circuit with natural –draft cooling towers
- Application of **Aquastill membrane distillation pilot** for cooling tower blowdown water recovery

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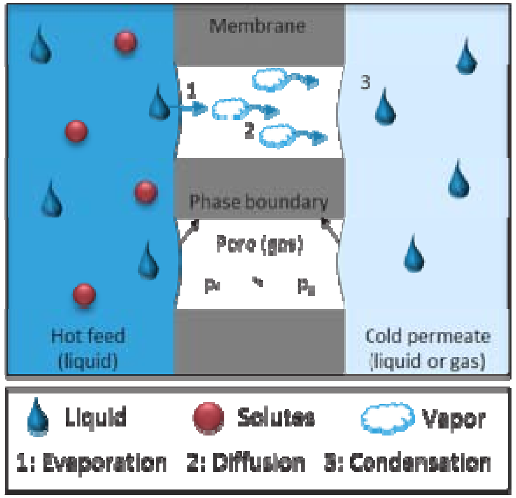
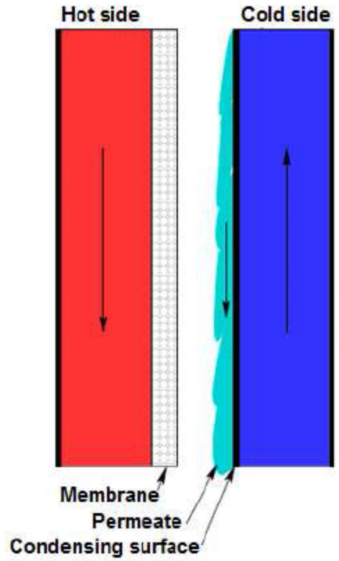


Advantages

- **Lower operation T** compared to conventional distillation
- **Waste heat driven**
- Lower operation P than RO
- Less sensitive towards fouling
- Operation window up to saturation
- Nearly 100% salt retention



- **Aquastill pilot** with **7 membrane distillation modules**
- 3 channels per module: hot brine, cold brine and distillate.
- Vacuum applied to the distillate channel → more distillate flux
- Automated operation, with control and data logging system, pressure, temperature, flow and conductivity meters.
- Heat source: auxiliary steam from the power plant

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AS PONTES TESTS

I. A first set of 9 weekly **parametric tests** performed so far:

- **Heating temperature**: 50 – 65 – 80 ºC
- **Recirculation flow**: 5 – 6.25 – 7.5 m^3/h
- Cooling temperature: 25 ºC
- Concentrate conductivity: 1600 (µS/cm) (CF~8)

II. **Long run test period** in the best condition as a result of the parametric tests.

	T hot (ºC)	T cold (ºC)	Brine Flow (m3/h)	Brine Conductivity (µS/cm)
Trial 1	50	25	5	1600
Trial 2	65	25	5	1600
Trial 3	80	25	5	1600
Trial 4	50	25	6.25	1600
Trial 5	65	25	6.25	1600
Trial 6	80	25	6.25	1600
Trial 7	50	25	7.5	1600
Trial 8	65	25	7.5	1600
Trial 9	80	25	7.5	1600

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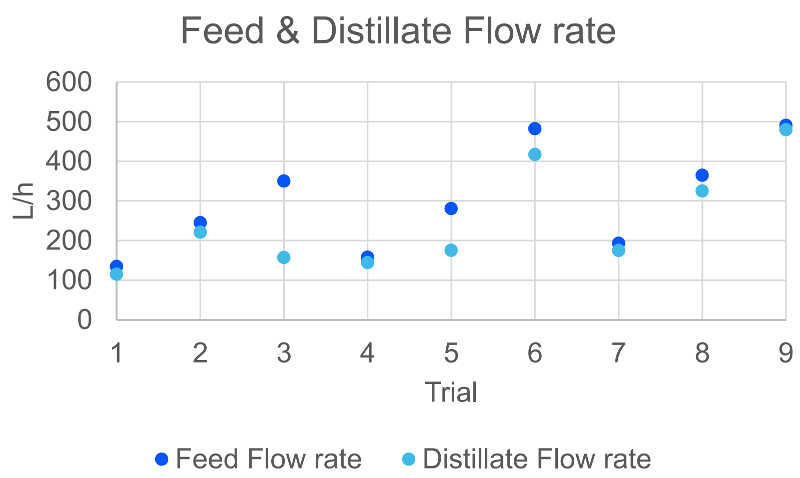
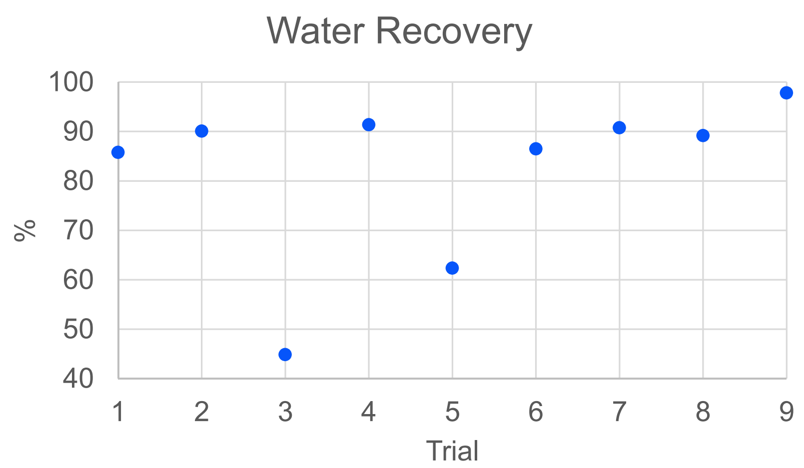
RESULTS: WATER RECOVERY





- Insufficient cooling on Trial 3 and Trial 5 → Low distillate

- Water recovery = (distillate flow / feed flow) x 100
- **Water recoveries around 90 %** in most of the cases

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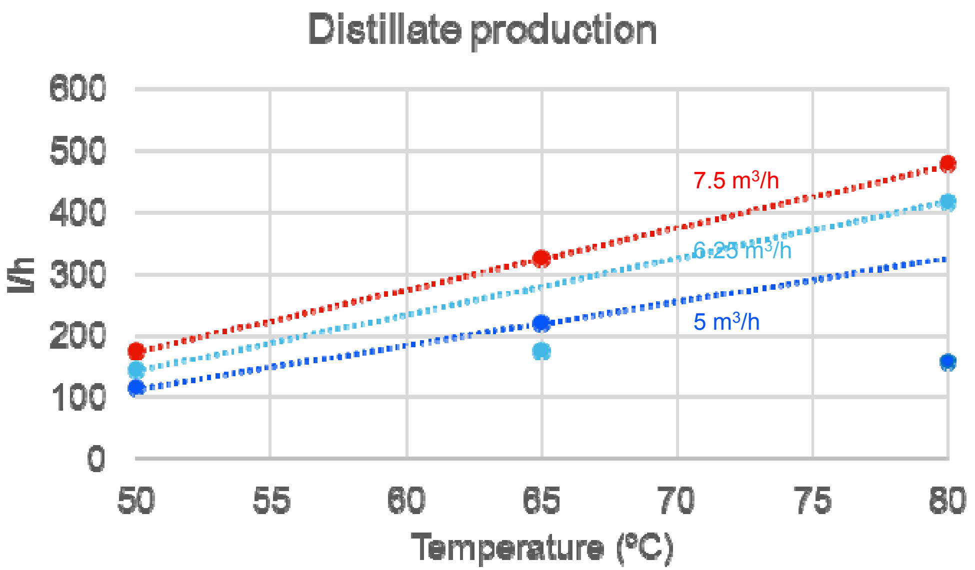
RESULTS: DISTILLATE PRODUCTION



Distillate production is **proportional to heating temperature** and brine **recirculation flow**.

The **impact of** increasing the **heating temperature is bigger** than the effect of increasing the recirculation flow inside the membranes

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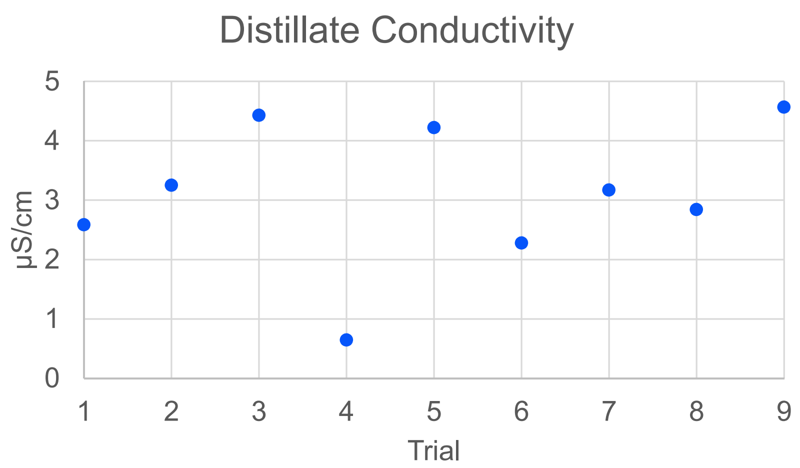
RESULTS: DISTILLATE QUALITY



Distillate conductivity < 5 µS/cm in all cases

Very good quality of produced water !

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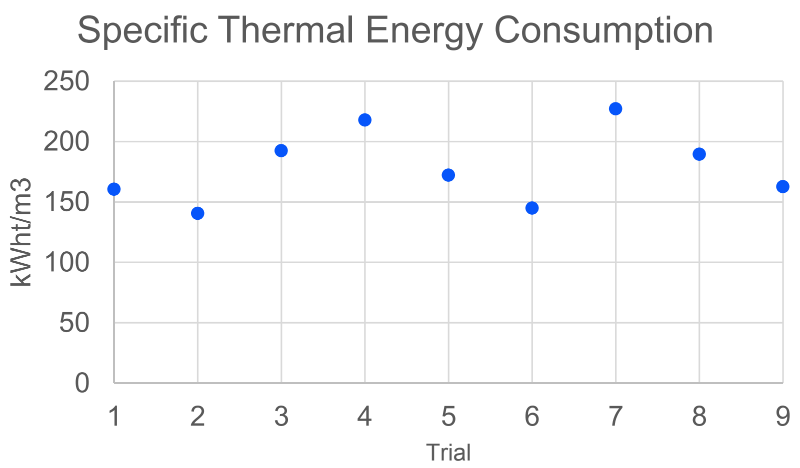
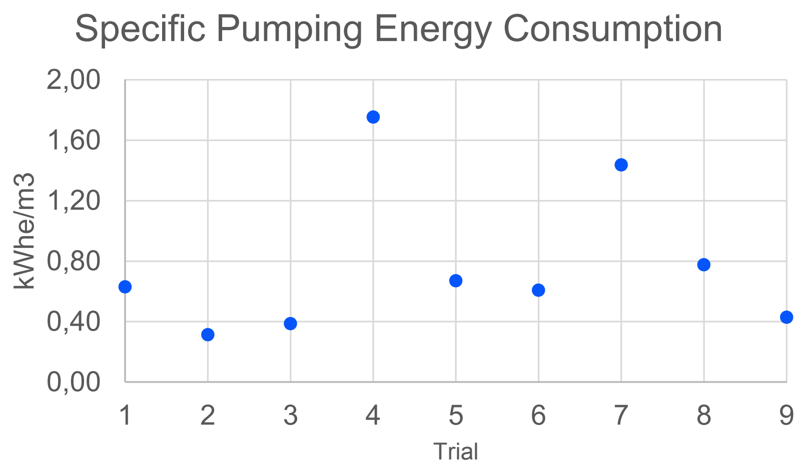
RESULTS: ENERGY CONSUMPTION





Minimum STEC in Trial 2 and 6 (~ 150 kWht/m^3 distillate)

Pumping energy (electricity) negligible compared to thermal energy

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CONCLUSIONS:

The distillation membranes have demonstrated **very good results** in terms of **water recovery** and **distillate quality** for all conditions tested. Thus, this water can be reused as cooling tower make up but also with other uses where high quality water is required (demi water).

Higher distillation temperature (80ºC) leads to **higher production rate** and **lower specific energy consumption**

Lower distillation temperature (50ºC) also produces good quality water while **increasing the chances** of finding a source of **waste heat**

NEXT STEP:

Long run test ongoing to evaluate other O&M points related to membrane degradation, cleaning frequency, influence of environmental conditions, etc.

Thank you