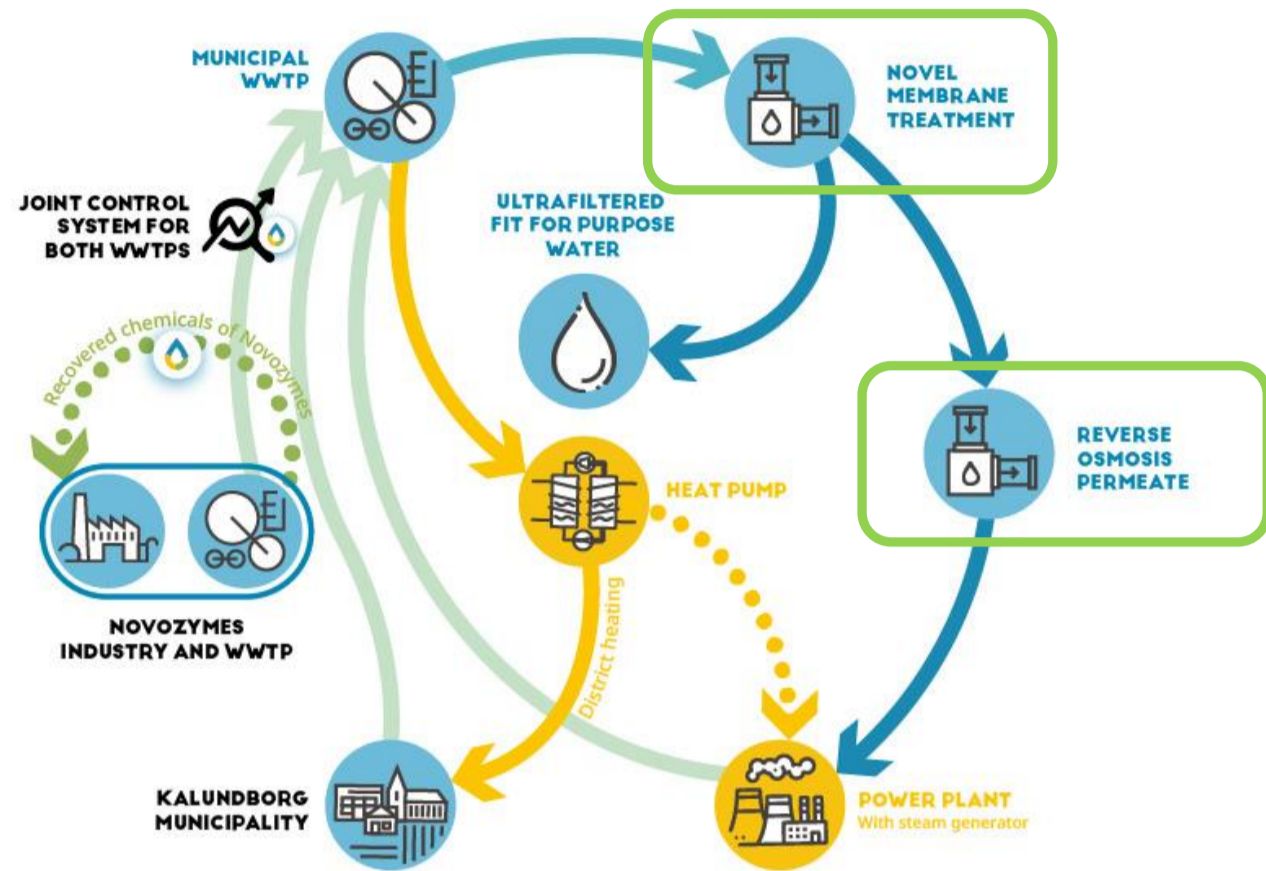


CS9 – Production of fit-for-purpose water



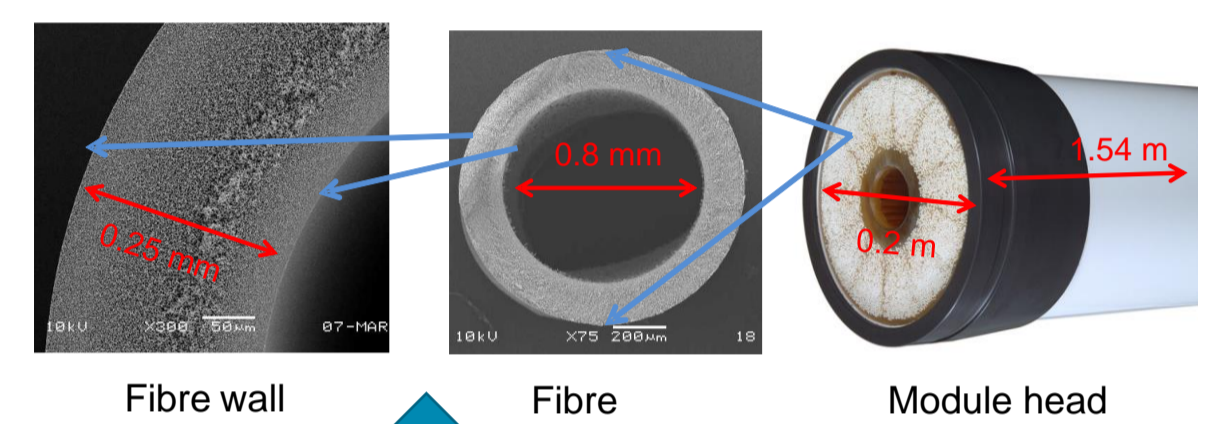
Objectives:

- Treatment of wastewater with a high fraction of non-degradable organic matter with a high fouling potential
- Novel ultra-tight ultrafiltration (UF) membrane shall prevent the reverse osmosis (RO) membrane better from fouling than a conventional UF
→ Lower demand for chemical enhanced cleanings & cleaning in place of RO
- Production of fit-for-purpose water for cooling and/or as feed water for boilers



Novel tight ultrafiltration membrane

Molecular weight cut offs: 1 and 4 kDa TRL: 9 and 5 → 7



Conventional ultrafiltration membrane

Molecular weight cut off: 150 kDa

First results – secondary effluent of mWWTP as influent to pilot

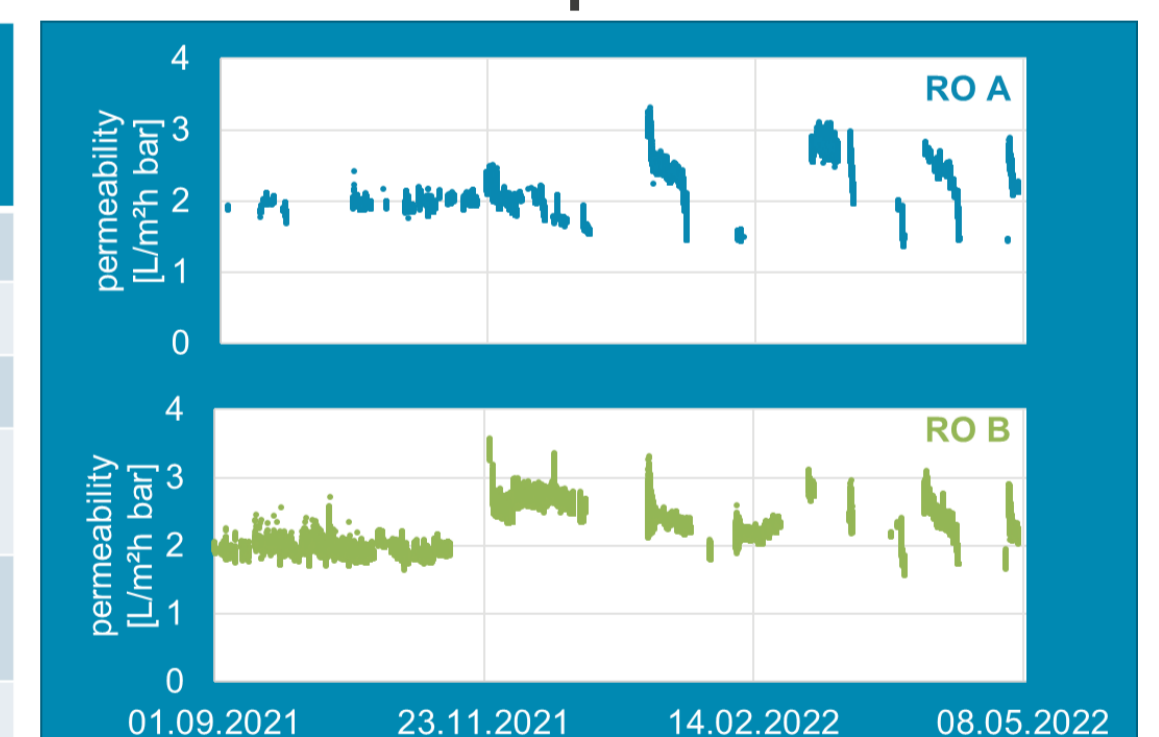
- For this type of wastewater: management of UF fouling and pre-filtration is challenging → many downtimes
- The novel membrane with 4 kDa performs better with less downtimes than the conventional UF with 150 kDa.
- Currently, a nanofiltration membrane with only 1 kDa is tested (data not shown), that requires more energy than the 4kDa-membrane, but might be even better for the effective protection of the RO from fouling.

Fit-for-purpose water qualities

Parameter	Unit	Thresholds for cooling water	UF B (4 kDa) permeate	RO B permeate
Hardness tot.	°dH	<20	10-36 n=2	<0.1-0.3 n=4
El. conductivity	µS/cm	<3000	5200-5500 n=3	32-150 n=6
pH	-	7-8.5	8.1-8.5 n=2	6-7.4 n=6
Chloride	mg/L	<250	1100 n=1	9.9-40 n=5
Sulphate	mg/L	<600	390-570 n=5	0.3-5 n=4
TDS	mg/L	<1800	3400 n=1	100 n=1
TSS	mg/L	<5	<0.5 n=1	<0.5 n=1

RO combined with tighter UF membrane shows a longer operation time than RO with conventional UF membrane as pre-treatment

Parameter	Unit	RO A with UF (150 kDa) as pre-treatment	RO B with novel UF (4 kDa) as pre-treatment
Membrane area	m ²	8	8
Flux	L/(m ² *h)	22.3	22.3
Recovery	%	40	40
Recirculation flow	L/h	1200	1200
Membrane replacement	per 10 months	3	3
Operation time	%	28	55



Lessons learned from the construction and start-up

- Unexpected high demand for maintenance at the beginning with 16-20 h/week
- "Simple" technologies such as pre-filters may cause headaches.
- Comprehensive analyses are crucial to accelerate the start-up.
- Still low UF performance hinders continuous operation of RO.

What is crucial in terms of replication of the technology?

- Depending on the chemical composition of the feed stream, a pre-treatment might be beneficial.
- Therefore, a comprehensive characterisation of the feed stream will reveal the requirements for a suitable treatment train.
- Especially for wastewaters with high fouling potential, pre-tests are required and on site piloting is recommended.

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