Case study Kynar® G150 & Adheflon®51H for seawater Ultrafiltration

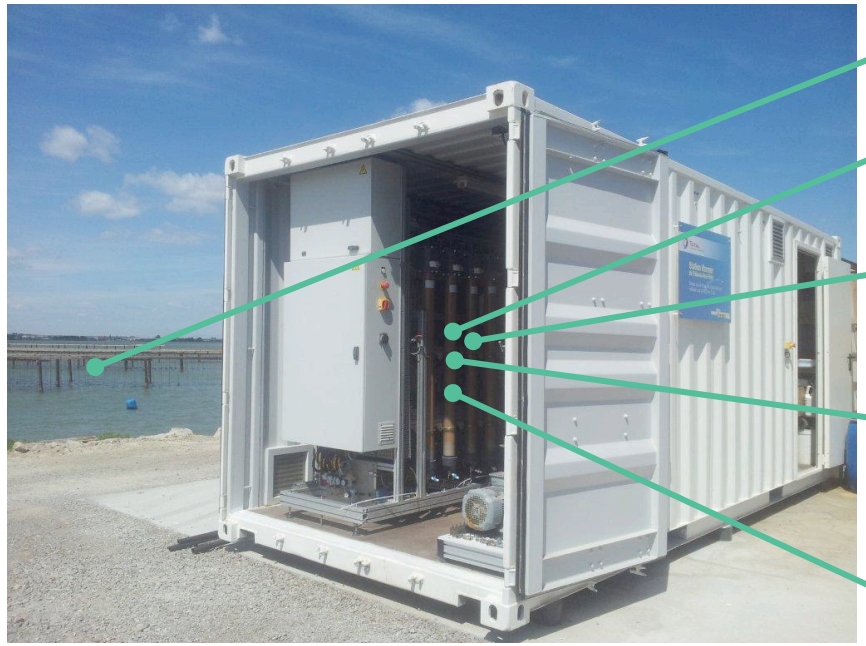
KYNAR® & Adheflon®51H For Seawater Ultrafiltration

Polymem Neophil® membrane in Palavas-les-Flots

Palavas-les-Flots, France

Key facts about Palavas-Les-Flots demonstrator

- Pilot Process: similar to offshore platform plants with 6 lines or modules working in parallel.
- The Pilot plant was installed in December 2016 and tested between for 7 months.
- In Parallel, a commercial Polysulfone (PSU) membrane was tested for comparison to Kynar® / Adheflon®51H membranes.
- Neophil® membranes show remarkable performances for use in seawater filtration, especially for NF or RO pre-treatment.
- **Permeability of Neophil® membranes based on Kynar® & Adheflon®51H remains much higher than PSU's one whatever the operating fluxes as shown in graphs below.**



Raw Seawater with a particularly poor quality

Outside/Inside mode

Filtration flux between 50 and 75 L/h.m^2

6 modules developing each 10.5m^2 of membrane filtration

KYNAR®
Adheflon®51H

Value Chain

Raw material manufacturer	Membrane manufacturer	System Integrator	End-User
ARKEMA KYNAR®	polymem A REPLIGEN COMPANY Neophil® membrane	polymem A REPLIGEN COMPANY	Undisclosed

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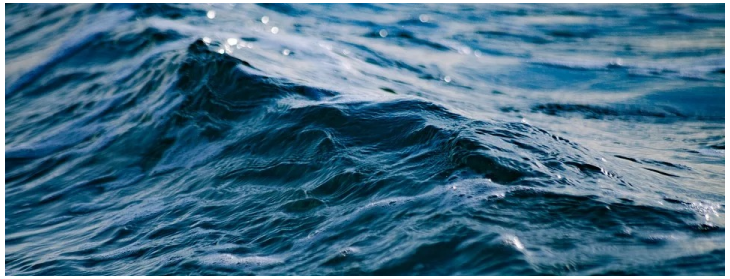

POOR QUALITY RAW SEAWATER

- Temperature: 5-25°C
- pH: 8-8.5
- Salinity: 37 500 mg/l
- Silt Density Index$_{15}$: 6.0-6.7
- Silt Density Index $_5$: 17-20

SALT CONCENTRATION IN THE SEAWATER

- Chloride: 20.1 g/L
- Iron: 18.2 µg/L
- Calcium: 390 mg/L
- Potassium: 408 mg/L
- Magnesium: 1.39 g/L
- Sodium: 11 g/L
- Sulfate: 988 mg/L
- COD HACH COD Reactor: 53 mg/L
- TOC Shimadzu TOC: 7.2 mg/L

OPERATING CONDITIONS OF THE PILOT LANT

- 6 lines or modules at a relative high pressure of 5 bars
- Transmembrane filtration pressure (TMP) varying from 0.3 to 1.2 bar
- Permeate pressure always >3.8 bars
- Periodically, the permeate produced by 5 lines is used to backwash (BW) one line
- 10.5m^2 of membrane filtration per module
- Filtration flux between 50 and 75 L/h.m^2 at 20°C
- Hollow fiber in a outside/inside mode

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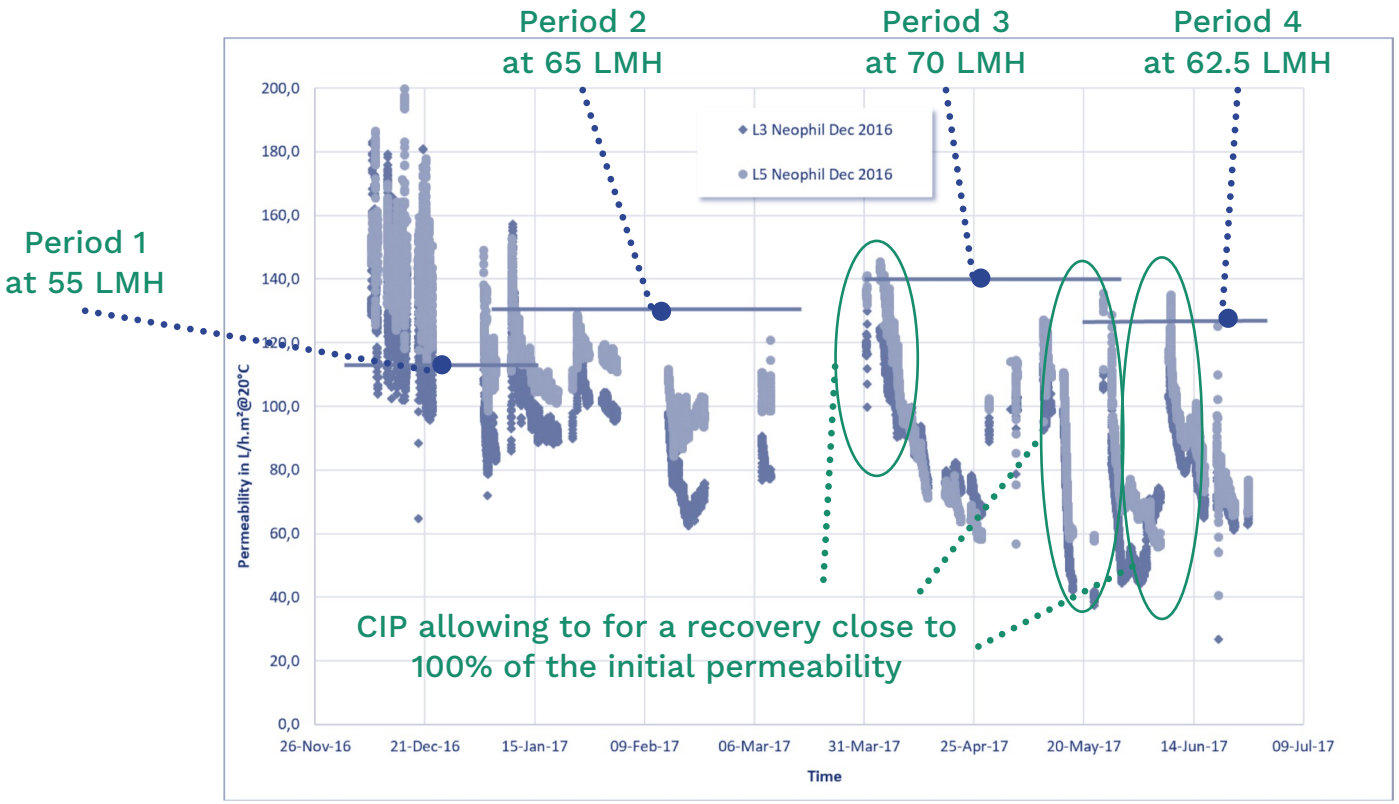
Trial campaign lasts 7 months from December 2016 to June 2017 : 4 periods of trials ~ 1.5 months each.



<u>4 different periods of trials at different flux levels:</u>

- Period 1 at 55 LMH
- Period 2 at 65 LMH
- Period 3 at 70 LMH
- Period 4 at 62.5 LMH

- Temperature range from 8°C to 28°C
- 2 Neophil® membranes based on Kynar® Adheflon® 51H tested

<u>Permeability behavior:</u>

- Permeability goes from 140 L/h.m².bar at 20°C when the membrane is clean to 40 when the membrane is fouled

- CIPs (**C**leaning **I**n **P**lace) allow for a recovery close to 100% of the initial permeability

The membrane shows a durable anti-fouling performance as the CIPs allow for a recovery close to 100% of the initial permeability, even after some very poor raw seawater quality goes through the membrane

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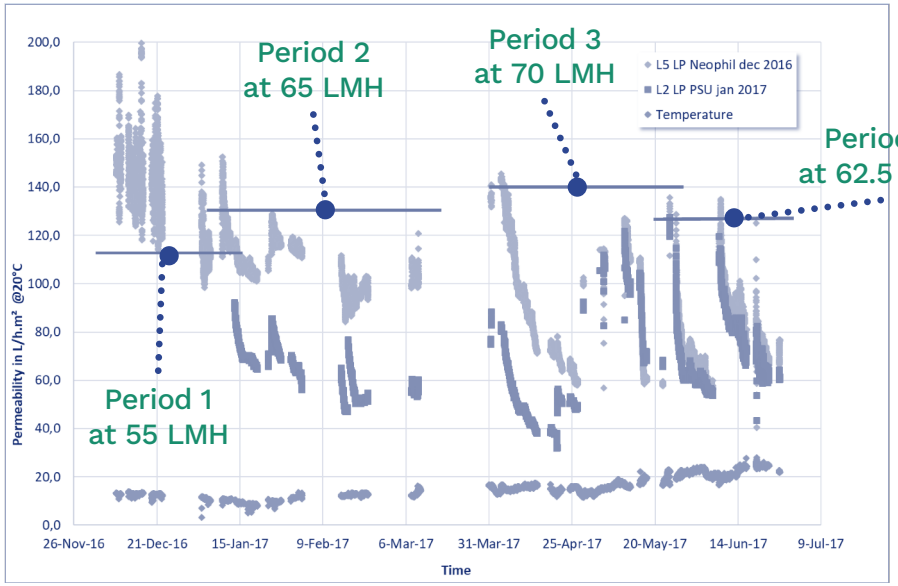
Polymem Neophil® membrane in Palavas-les-Flots

Neophil® membranes based on Kynar® Adheflon®51H VS PSU Membranes

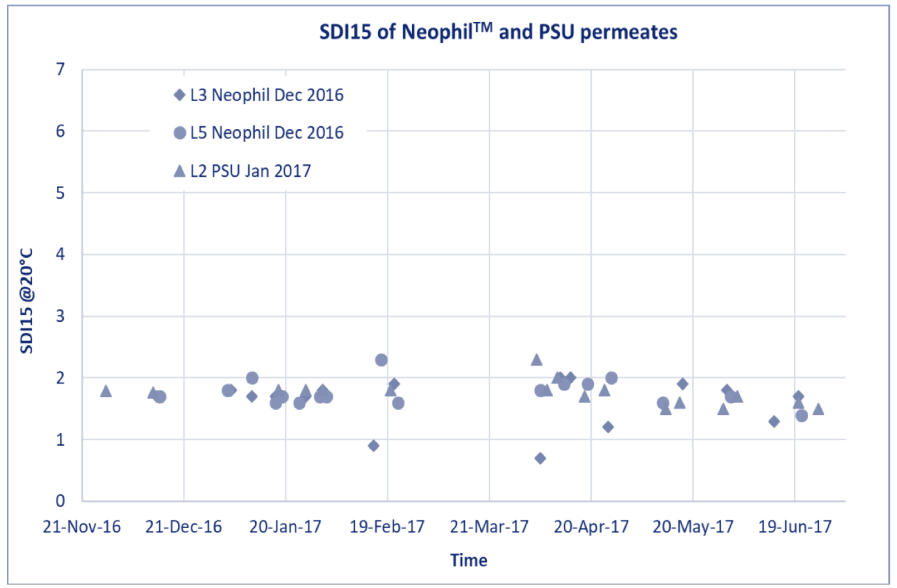
Operating flux of the membranes:

- Neophil® membranes based on Kynar® & Adheflon® 51H: 55-70 LMH
- PSU Membranes: 50-55 LMH (recommended operating conditions)

Fouling index (SDI_{15}) is followed to evaluate membranes performances. The **SDI of the raw seawater is very high and much higher than the one encountered in off-shore exploitations; this represents very challenging conditions** for the trials.



Permeability of Neophil® membranes based on Kynar® & Adheflon®51H remains much higher than PSU's one whatever the operating fluxes. The flux can be up to 40% higher.



SDI15 of both membranes permeate were very low (< 3), whatever the quality of the raw seawater. Neophil® membranes performs well for raw seawater treatment