# Seawater treatment by ultrafiltration during a coastal bloom: case of shellfish farms

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## CONTEXT

Ultrafiltration (UF) of natural seawater is confronted with water quality variations and especially coastal blooms. In this study, UF was studied to to protect shellfish farms in the case of a real bloom that appeared in seawater, in terms of hydraulic performance and pollutant removal efficiency, and was compared to commonly-used treatments used in shellfish hatcheries combining several filtration steps and UV disinfection.

## MATERIAL AND METHODS

**Membranes:** Aquasource hollow fibre PES membranes (0.02 µm), in-out configuration.
**Pilot:** Semi industrial unit, completely automated, able to treat 20 $m^3.d^{-1}$. 3 cleaning procedures to eliminate fouling: classical backwash (CB), air-backwash (AB) and chemical cleanings (CEB).

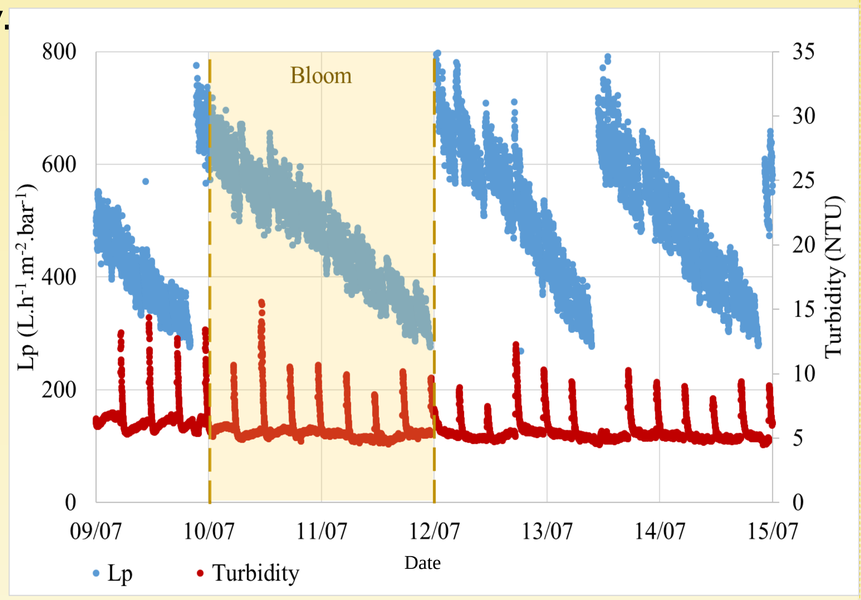
**Conditions of filtration:** **J = 60 $L.h^{-1}.m^{-2}$ and $t_{filtration}$ = 60 min**

**Seawater:** Natural seawater from Atlantic Ocean, Bourgneuf Bay (France) for marine molluscs breedings.
**UF Seawater:** settling pond + sand filtration + UF. **Control Seawater :** settling pond + sand filtration 25 µm + UV
→ Both treatment trains were confronted to **a natural bloom** that occurred in the settling ponds supplying the farms

**UF Pilot plant**

## IMPACT ON HYDRAULIC PERFORMANCES

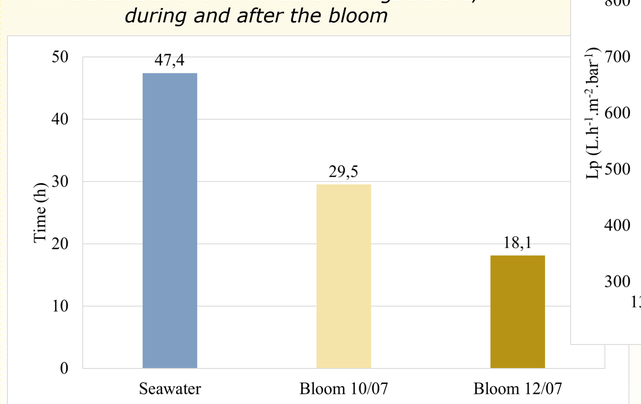
**Impact on permeability:** no significant permeability decrease was observed during the bloom, due to the retention time of pollution in the hydraulic system before UF. The impact of the bloom was found with a one-day delay.

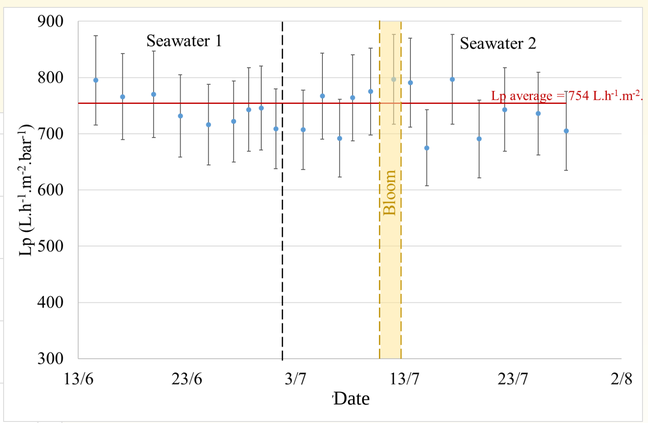



*Evolution of permeability and turbidity of the pilot feed vs. time*

**Impact on CEB frequency:** when the pilot is fed with seawater, more than 47 h were needed for this permeability loss, and shorter time durations were obtained during and after the bloom but this frequency is superior to 12 h, **the conditions are then sustainable.**

*Time between two chemical cleanings before, during and after the bloom*



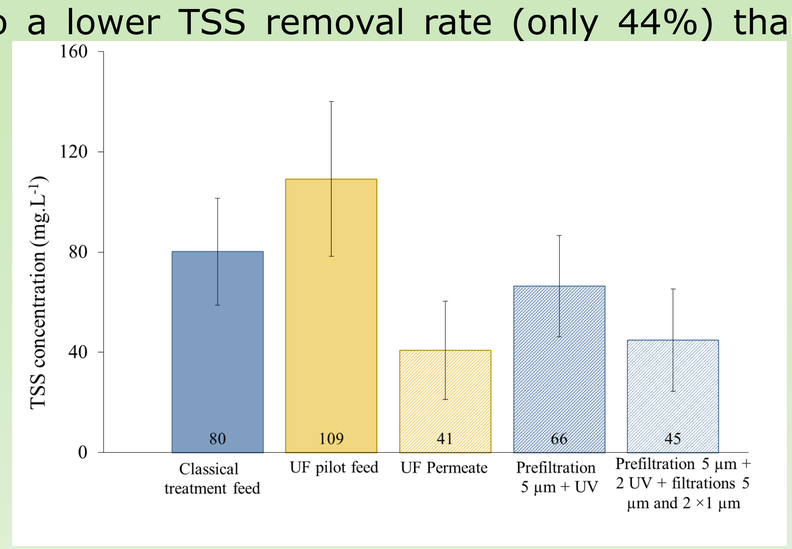

*Permeability after each CEB in the two-month period*

CEB led to a permeability around 750 $L.h^{-1}.m^{-2}.bar^{-1}$. This cleaning procedure eliminates resistant fouling even in the case of the bloom with high concentrations of TSS and plankton inside membranes. **The stability of the permeability and the resistance of the process were confirmed.**

## QUALITY OF THE TREATED WATER

**Total Suspended Solids (TSS):** the treatment was able to effectively eliminate more than 60% of the inlet TSS. the succession of treatments led to a lower TSS removal rate (only 44%) than UF alone.

*TSS concentrations as the function of the water treatments during the bloom*




**Bacterial concentrations:** a better control of total bacteria is obtained by UF process, with the concentration of the total bacteria lower than the detection limit, which corresponded to a retention rate over 99.76%.

*Bacterial concentrations before and after the two treatment trains (D.L.: detection limit)*

| | Settling pond | Pilot feed | UF Permeate | Filtrations + UV |
|---|---|---|---|---|
| **Total bacteria** | 3.6 $10^3$ | 8.22 $10^3$ | **< D. L.** | **1.2 $10^3$** |
| ***Vibrio*** | - | 307 | **< D. L.** | **< D. L.** |

**Microscopic observations:** parasites were observed in every samples from control water used to supply oyster breedings. The presence of TSS impact UV efficiency and limit microorganism's inactivation that is normally obtained with this process.

*Microscopic observations of samples from UV treated water (×100)*

## CONCLUSION

UF was the only process able to deliver water with a low TSS concentration and free from living phytoplankton, zooplankton, *Vibrio*, and total bacteria. Hydraulic performance of the UF process in the case of blooms was impacted with a higher CEB frequency but lower to the limit interval of CEBs of sustainable condition. The permeability is recovered efficiently through CEB confirming the resistance of the UF process. **These results confirmed the ability of the UF process to treat natural seawater and produce water with constant quality even in the case of a bloom.**

*Member of cfm Club Français des Membranes