

Pathogen removal by ultrafiltration for shellfish productions

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CONTEXT

Ultrafiltration (UF) process was tested to treat inlet water of shellfish hatcheries and nurseries. The aim of the study was to protect oysters from pathogens linked to mass mortalities in shellfish culture. Two pathogens were targeted, a bacterium, *Vibrio aestuarianus* and a virus, OsHV-1, with the objective to produce high quality water from natural seawater. The retention of those microorganisms by ultrafiltration was evaluated at laboratory and industrial scales for *Vibrio* bacteria.

MATERIAL AND METHODS

Membranes: Aquasource hollow fibre PES, UF membranes (0.02 µm), in-out configuration.

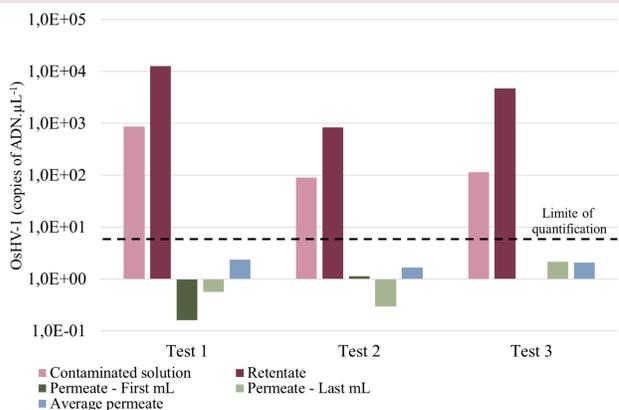
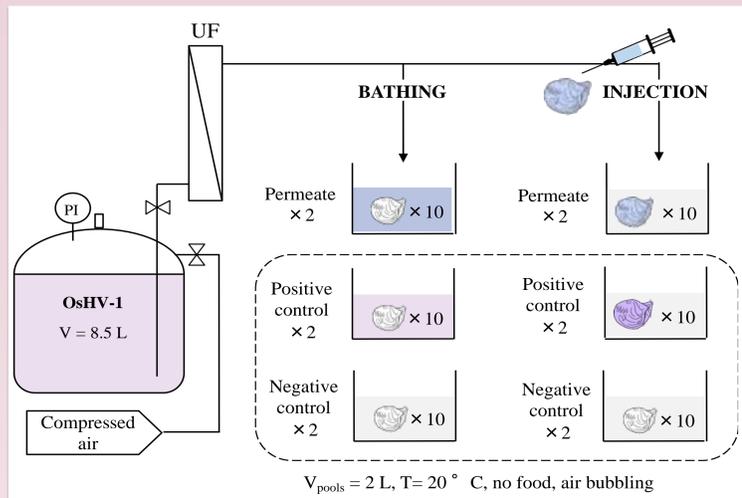
Semi industrial unit: area of 8 m², volumic concentration factor (VCF) of 267, completely automated, able to treat 20 m³.d⁻¹.

Lab scale pilot: area of 0.138 m², VCF of 267

VIRUS OSHV-1

The efficiency of treatment was evaluated with qPCR analysis of UF contaminated water and *in vivo* experiments.

Treatment of OsHV-1
- *In vivo* test of bathing and injection
- **Pink:** contaminated solution with OsHV-1;
- **Blue:** treated water (=permeate)
- **Grey:** disinfected seawater [TMP = 0.3 bar]



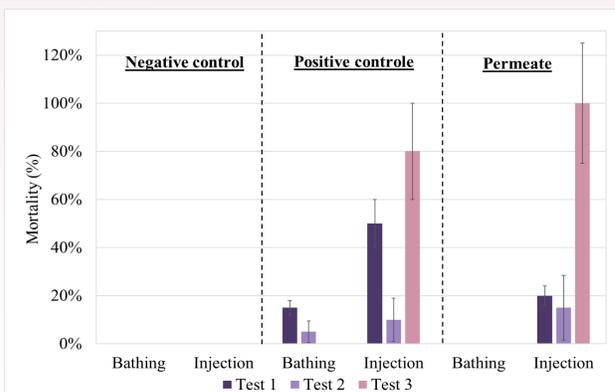
Virus concentration of the analysed samples for the 3 tests

The virus detected is sufficient to kill oysters when the permeate is injected directly inside the body, but **insufficient to kill oysters in bathing** over 7 days.

In vivo tests results - Oyster spat mortalities after 7 days in contact by bathing and injection with negative, positive controls and permeate

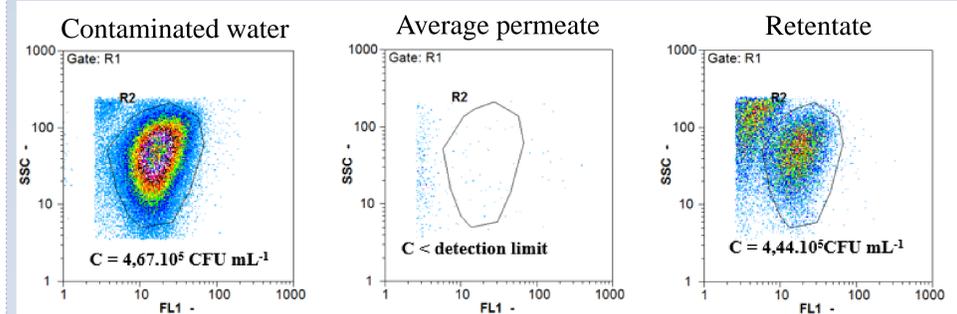
Results confirmed with bath tests were carried out with oyster larvae 8 days old, life stage more sensitive than spat

Ultrafiltration provides protection of oysters towards OsHV-1 at the spat stage in real production conditions

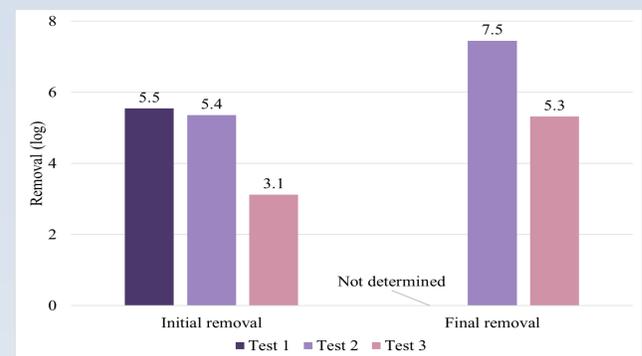


VIBRIO AESTUARIANUS

The contaminated solutions were ultrafiltered and the treatment efficiency was validated with flow cytometry and seeding on Petri dish with and without filtration 0.02 µm.



Virus concentration of the analysed samples for the 3 tests



Removal of *Vibrio aestuarianus* calculated from direct seeding results

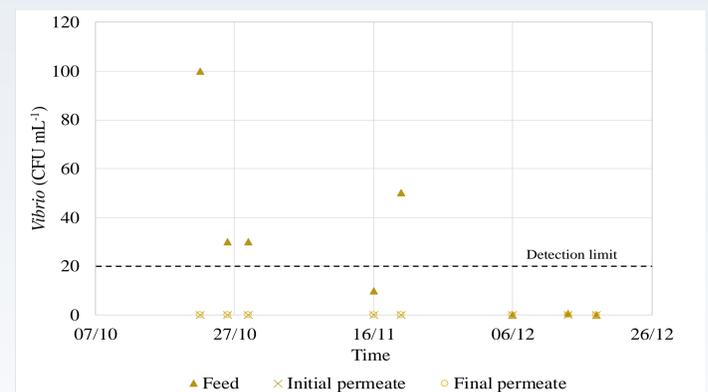
V. aestuarianus concentration in the permeate < detection limit, whatever the analytical method used

Concentration in permeate at least 300 times < minimum infective dose (Travers *et al.* 2017)

The effectiveness of the process to protect oyster production from *V. aestuarianus* is validated

SEMI-INDUSTRIAL SCALE

The retention by ultrafiltration of the total flora and *Vibrio* bacteria naturally present in water entering the hatchery / nursery was monitored over **several months at industrial scale**.



Evolution of *Vibrio* concentration vs. time - Before (feed) and after (permeate) filtration

No bacteria detected in permeate, whatever the quality of the seawater treated

The treatment performances are validated at semi-industrial scale

CONCLUSION

For OsHV-1, the virus found in the permeate did not generate mortality using bathing. For *Vibrio aestuarianus*, the permeate reach the limits of detection regardless of the analytical quality and the bacteria concentration upstream of the membrane. Moreover, **the resistance of the process was confirmed**. In terms of retention and resistance, **ultrafiltration process was validated for the treatment of seawater with the aim of biosecuring shellfish productions**.