WASTEWATER TECHNOLOGY FACT SHEET

Biofiltration and biosorption using bivalves and bivalve shells

University of Aveiro (UAVR) technology
developed under the EU-funded NYMPHE project

PROBLEM

LACK OF TECHNOLOGY THAT COMBINES ADVANCED WASTEWATER POLISHING WITH THE CIRCULAR USE OF AQUACULTURE BYPRODUCTS IN AN ECONOMICAL AND SUSTAINABLE WAY.

Degraded wastewater pollutants:

Persistent APIs, including antibiotics, after conventional treatment.

TECHNOLOGY

System setup:

- **Biofiltration:** Live bivalves naturally filter particles and organic contaminants, potentially reducing pharmaceutical concentrations.
- **Biosorption:** Natural and pyrolyzed bivalve shells demonstrated significant adsorption capacity for pharmaceuticals. Pyrolysis enhances shell properties, increasing biosorption potential.

Operation:

Biofiltration:

- bivalves filter suspended particles and organics but show limited removal of pharmaceuticals and low survival in raw wastewater.

Biosorption:

- shells, especially after pyrolysis, adsorb pharmaceuticals; efficiency depends on contaminant type and water conditions (e.g., pH).

Function:

Shell-based biosorbents:

- Complement conventional wastewater treatment (polishing step).
- Enhance removal of residual pharmaceuticals.
- Repurpose waste → circular economy & pollution reduction.

NYMPHE

Funded by the European Union

WASTEWATER TECHNOLOGY FACT SHEET

Biofiltration and biosorption using bivalves and bivalve shells

University of Aveiro (UAVR) technology
developed under the EU-funded NYMPHE project

INNOVATION

Nature-based, circular bioremediation using biological (bivalves) and abiotic (shells) pathways.
Valorizes waste bivalve shells as biosorbents for pharmaceuticals.
Biosorption efficiency depends on water conditions (e.g., pH) and contaminant type.

TRL:
4–5 (validated in laboratory and small pilot environments).

RESULTS

- **Live bivalves:**
  Limited survival and low pharmaceutical removal in untreated wastewater.
- **Bivalve shells:**
  Pyrolyzed shells show strong biosorption; efficiency depends on surface properties and pH; optimal pyrolysis conditions identified.
- **The shells' structure and surface properties were found to play a crucial role in their efficiency.**

IMPACT

- Shell-derived biosorbents can be integrated into wastewater polishing, valorizing aquaculture waste and supporting circular economy.
- **Pilot-scale potential:**
  Significant reduction of pharmaceutical residues, lower ecotoxicity, and improved aquatic ecosystem health.

NYMPHE
Funded by the European Union