Freeze-casting as a technique to enhance the encapsulation of bacteria for biodegradation applications

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Pollutants in European aquifer:

- Heavy metals: 37% 
- Mineral oils: 34% 
- PAH (polycyclique Aromatic Hydrocarbons) & BTEX (Aromatic hydrocarbons): 19%

Proportion of bathing waters with excellent quality in European countries in 2019

Adapté de European Environmental Agency
**Biodegradation:** Natural response against pollutant accumulation
**Bioattenuation**: Natural response of microorganisms already present, against pollutant accumulation

If too slow, we may help:

- **Biostimulation** → Stimulation of species already present by adding nutrients and other compounds
- **Bioaugmentation** → Introduction of *exogenous microorganisms* specifically degrading the targeted pollutants
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- Protection of exogenous microorganisms
- Limiting their release into the environment
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Shapping strategy:
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Freeze-casting process
Shapping strategy:

Heating coil

Thermocouple

Polymer solution

Ice nucleation

Cooled plate

Liquid N₂

Thermocouple

Cooled plate

Liquid N₂

Thermocouple

Cooled plate

Liquid N₂

-80°C

Ice growth phase segregation

Ice growth phase segregation

Ice growth phase segregation

Heating coil
Shapping strategy:

Freeze-casting process

Polymer and bacteria solution → Freeze-casting → Topotactic Cross-linking → Bacteria encapsulated in alginate structured hydrogel
Depollution strategy:
Thank you!

Poster 9

How bacteria survive to these low temperatures?

What's about depollution?

Are bacteria surviving to all process?

How to stabilize matrices to use them in water?