Expanded and extruded polystyrenes distribution and impact in the marine environment

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The issue of expanded and extruded polystyrenes (EPS/XPS)

- Epanded and extruded polystyrenes have a large diversity of applications due to their numerous properties: Packaging for food and goods, maritime sector, construction sector, …
- EPS/XPS are also among most frequent litter items found on the coastline
- The OceanWise project is looking for solutions to stop EPS/XPS marine litter
- As part of OceanWise, Cedre is in charge of assessing EPS/XPS presence and impact in the marine environment

What do we know about foamed polystyrene distribution and impact in the marine environment?

EPS/XPS abundance and distribution in the Atlantic area

- Analysis of OSPAR beach litter monitoring data over 2018 to 2020
  - North East Atlantic coastline (DK, NL, DE, FR, IR, PT)
  - 100m survey sites, 4 surveys per year
  - Collection and counting of all litter > 5mm

- EPS/XPS represent **13% of litter collected**

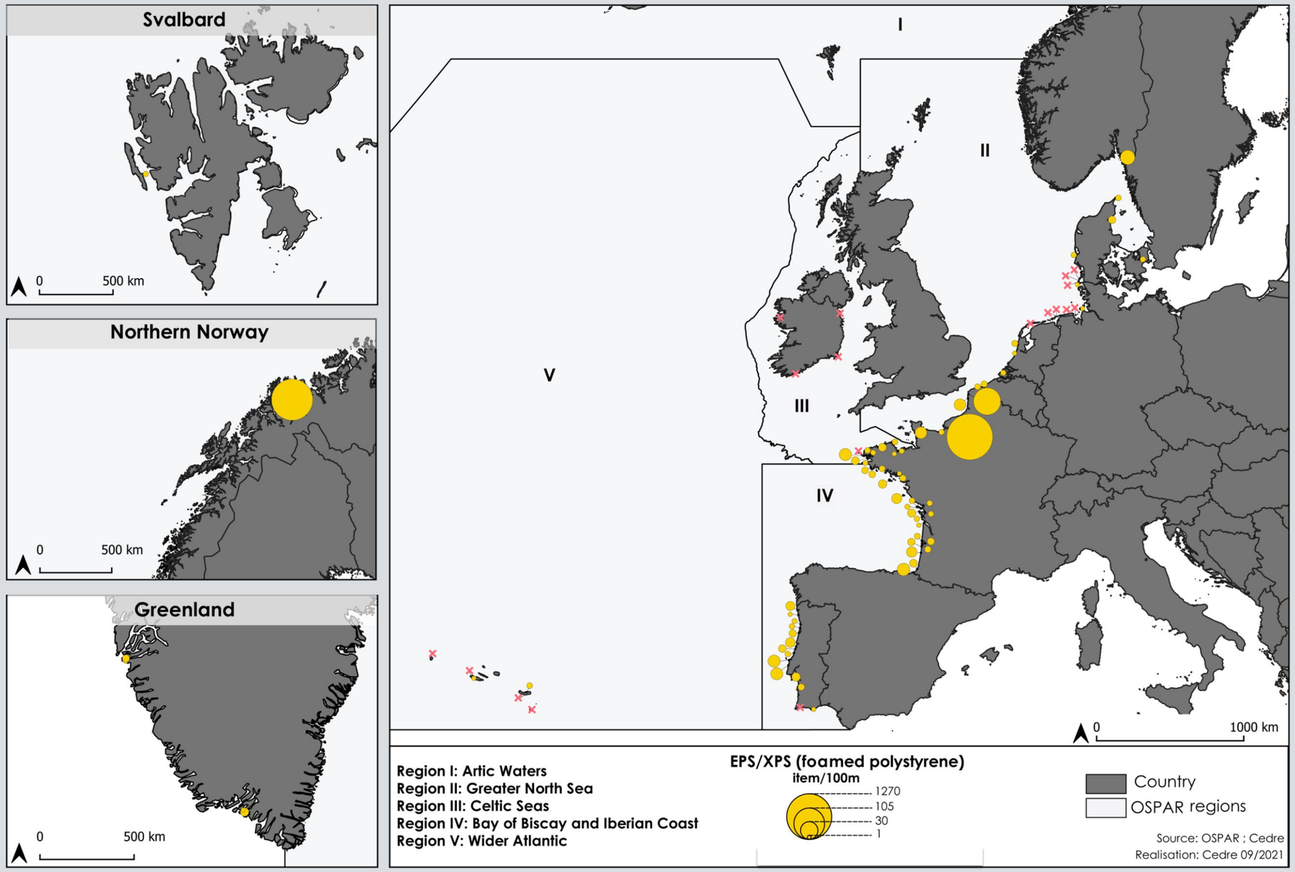
  EPS/XPS have a **heterogenous distribution**

  Maximum obtained during a survey :

  -7543 items/ 100m (>2,5 cm)

  -pieces < 2,5 cm too numerous to be counted precisely

=> EPS/XPS are common and abundant litter types



A pollution consisting mainly of fragments

EPS/XPS fragments are the most abundant polystyrene litter types, representing **97%** of the identified litter items in foamed polystyrene

This is explained by EPS/XPS brittleness

Example of EPS fragments found on the French coastline

⇒*Pollution difficult to recover*

⇒*Uncertainties regarding its origin*

A part of EPS/XPS is brought in the ocean by rivers

- Analysis of French citizen science data (“Plastique à la loupe” Programme, Fondation Tara Océan, Cedre, Observatoire de Banyuls-sur-Mer)

In France, non-negligible **riverine pollution** by EPS/XPS: **9%** of the total number of items collected

Items found are **mostly fragments**

Example of EPS fragments found on French riverbanks

Seine riverbanks

Liane riverbanks

EPS/XPS are also found in urban water systems

- Caracterisation of litter found in urban rainwater system in Brest (France)

Example of EPS/XPS found in an urban rainwater system (Brest)

=> A part of EPS/XPS comes from terrestrial sources

What about risks for the marine environment?

- Plastic materials are known to impact the marine environment in different ways

- The OceanWise consortium selected three types of foamed polystyrene:
  - An EPS fish box
  - An EPS insulation plate
  - A XPS food box

Type	fish box	insulating plate	food box
Picture			

- Several experiments were launched to study associated risks:

Toxicity testings

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Chemical analyses

©Agilent/Gerstel

9 weeks incubation in Brest marina

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3 months in a weathering equipment

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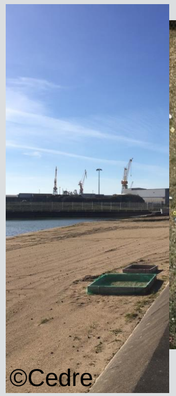
10 months weathering on Cedre artificial beach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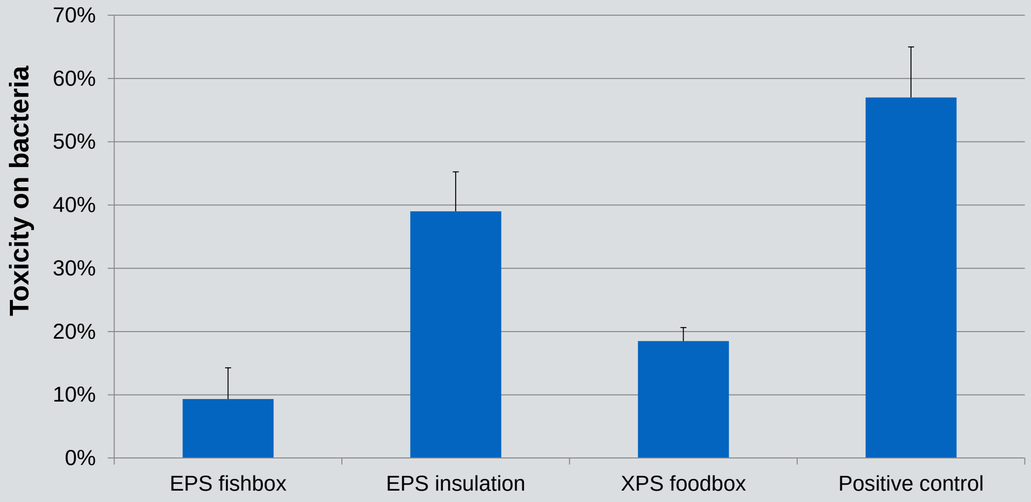
What did we learn?

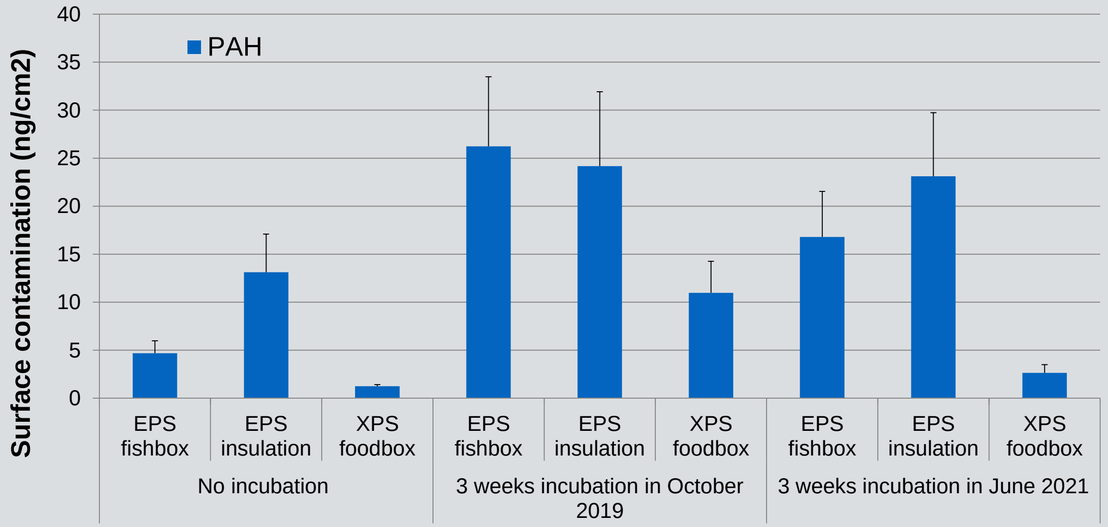
EPS/XPS:

- contain molecules, which can be released in seawater and exhibit some toxicity
- can adsorb environmental contaminants

Toxicity of seawater leachates



Adsorption of environmental contaminants in Brest marina



What did we learn?

- Species can develop on their surface

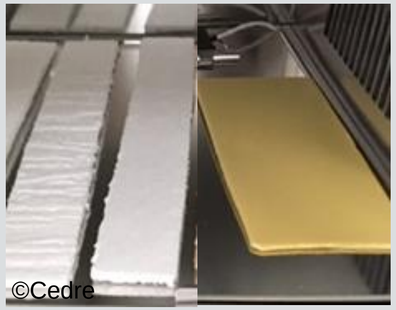
Materials after 9 weeks in Brest marina

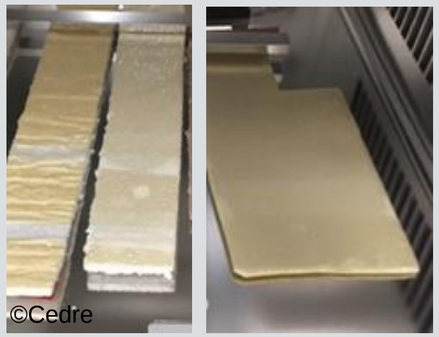
EPS insulation plate

XPS foodbox

- They can weather (photo-oxidation) once in the environment

Unweathered materials





Artificially weathered
(14 days)

Other risks

In addition:

- They can degrade and produce microplastics
- They can be ingested by fauna
- They are very light and buoyant, they can drift with winds and currents and be disseminated over long distances

What about alternative materials?

- Methodologies selected are also being applied on three materials identified as interesting alternatives for fishboxes by the OceanWise consortium:
  - a foamed PLA
  - a foamed PLA+PBAT
  - a foamed PHBH
- Results obtained for the three alternatives will be compared to the ones obtained for foamed polystyrenes
- The methodologies selected in the project could be used to predict risks for the marine environment of new materials put on the market

Take-home messages

- EPS/XPS are abundant

  Due to their brittleness and lightness, they break down and disseminate in the marine environment

- EPS/XPS can impact the marine environment in different ways

It appears essential to work on solutions to reduce the presence of EPS/XPS products in the marine environment

And for that we need … you!

Thank you for your attention