

R&D Project PEARL

Chemical risks of elements released from offshore wind farm components

MOTIVATION & BACKGROUND

The release of chemicals from offshore wind farms raises questions about their impacts on water and sediment quality. To assess this chemical pressure, it is essential to identify the elements released by all turbine components, understand their behavior in the water column and sediments, and evaluate their ecotoxicological effects. Corrosion protection systems, such as Galvanic Anode Cathodic Protection (GACP) systems, release metals into seawater with

known ecotoxicological effects in seawater, but their interaction with sediment remains to be determined. Similarly, the elements produced by Impressed Current Cathodic Protection (ICCP) systems and their ecotoxicological effects are not fully identified. In addition, the substances released through the degradation of synthetic mooring lines used for floating wind turbines have not yet been studied.

OBJECTIVE

To enhance the assessment of environmental risks linked to emissions of chemical elements from offshore wind farms. PEARL will provide a more precise definition of environmental pressures associated with GACP and ICCP, along with an initial characterisation of pressures associated with synthetic mooring lines.

Duration: 3 years | Start: October 2025 | Total budget: €2,206K

DELIVERABLES

- Improved understanding of the production kinetics of chlorine and chlorination by-products from ICCP systems
- Enhanced knowledge of interactions between GACP elements and suspended matter, and their potential accumulation in sediments
- Improved ecotoxicological dataset for chemicals released by offshore wind activities
- Refinement of the Predicted Environmental Concentrations of elements release in the water column by cathodic protection considering inputs from OWF and other anthropic activities
- Definition of chemical specific to the discharges of OWF for water, sediment and biota matrices that could be used as tracers of OWF activities
- First characterisation of chemicals released from OWF synthetic mooring lines

WORK PLANNED

1. Production, behaviour and fate of chemical released by cathodic protection

- Study of the kinetics of chlorination by-products from ICCP systems
- Analysis of interactions between dissolved elements from GACP, suspended matter and sediment

2. Ecotoxicological assessment in controlled conditions

- Assessment of the ecotoxicological effect of the elements release by ICCP systems with chronic experimentations over different life stages
- Assessment of the ecotoxicological effect of the elements release by GACP systems with chronic and trophic experimentations
- Early toxicity evaluation of the chemical elements released from the synthetic mooring lines

3. Characterization of potential new pressures induced by synthetic mooring lines

- Development and testing of dedicated aging protocols for synthetic fibres in closed tap water
- Identification and quantifying of chemical elements that may be released during representative use

4. Environmental signatures definition and in-situ biomonitoring tests

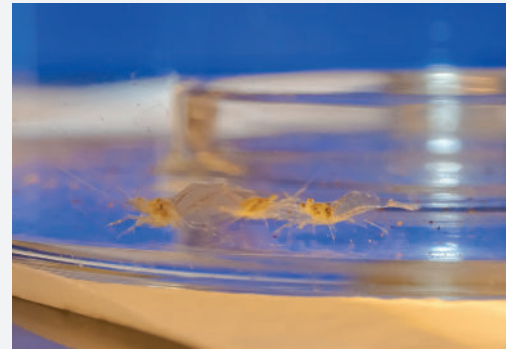
- Definition of the chemical exposome in different marine environments by measuring the concentration of several elements in contrasting environment influenced or not by wind farms
- Quantification of tracer chemicals from GACP and ICCP along vertical and horizontal gradients to study fine-scale accumulation of chemical compounds in seawater, sediment and various marine organisms
- Testing of an active biomonitoring (caging approach) adapted to offshore wind context

5. Hydrodynamic, sedimentary and trophic modelling of contamination

- Development of morphodynamic model on a theoretical wind farm to assess the dispersion of elements from the GACP systems around the foundations and anticipate the GACP concentration levels in sediments
- Prediction of environmental concentrations of GACP and ICCP elements, considering various inputs from OWF itself but also from rivers, harbours and shipping at English Channel and North Sea scale
- Improvement of a food web contamination module (ECOTRACER) for GACP context in the Gulf of Lion and adaptation to the English Channel area



Biofouling developing on a galvanic anode
Credit: ©FEM



Potential ecotoxicological of chemicals released by offshore wind farms will be investigated on different marine organisms such as shrimps. Credit: © FEM

PARTNERS

The project is led by France Energies Marines.



The project receives funding from the French government, managed by the Agence Nationale de la Recherche as part of the France 2030 investment plan. It is also supported by the Brittany, Normandy and SUD Provence-Alpes-Côte d'Azur regions, and by the Normandy channel offshore wind arm biodiversity Fund – Funded in accordance with the terms and conditions of the government's specifications for the project.

