ECOCAP Newsletter

Issue N°2 - August 2022

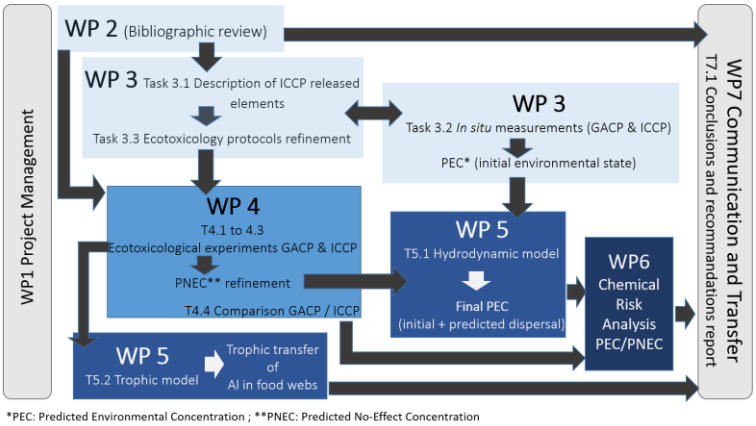
ECOCAP

Ecotoxicology analysis of cathodic protections to assess the chemical risk of elements released from galvanic anode and impressed current on the marine environment and its food webs

Quick resume

ECOCAP project main objective is to produce a knowledge base of the potential environmental impacts of anticorrosion protections commonly used in the offshore renewable energy industry, including galvanic anodes cathodic protections (GACP), impressed current cathodic protections (ICCP) and anticorrosion coatings. The project Work Packages' flow is shown in the figure.

ECOCAP online: https://www.france-energies-marines.org/en/projects/ecocap/



*PEC: Predicted Environmental Concentration ; **PNEC: Predicted No-Effect Concentration

ECOCAP Highlights

May 2022

- Set-up of the experimental devices (first season of ecotoxicological studies)
- Arrival of M. Dussauze (Postdoc position in WP4)
- DGT and chemcatcher sampling at Mistral site

June 2022

- ECOCAP official progress meeting on June 8
- Institut de la corrosion in Marseille for experimental set-up of ICCP device at LCE laboratory

July 2022

- Water sampling at the mistral site for additional information on ecosystem initial state (and natural variability)

Science

Conducting an experimental study on ICCP elements' release (FEM/AMU- LCE) :

In the lab, a set-up with an electric generator, an inert anode, one reference electrode and steel plates are used to simulate the conditions used offshore (Figure 1). These conditions (including current density) are representative of those used by manufacturers to protect against steel corrosion. A water tank and pumps were acquired and installed in the lab. The electric set-up was installed on June 14th at LCE (Laboratoire de Chimie de l'Environnement) by Charles Leballeur from Institut de la Corrosion and experiments are now going on. Filling seawater of the tank is collected on beaches of Marseille and kept at 4 °C before use. Samples are collected regularly and characterized before applying an electrical current. Generation of by-products chlorinated, brominated and iodinated compounds are followed by GC-ECD at regular intervals of time, along with following of main physical-chemical parameters (pH, O2, redox potential). Additionally, in September, a simulating chamber will be used to identify volatile molecules in a controlled environment (hygrometry, temperature, …). In the next months, kinetics of formation and volatilization (transfer to the gas phase) will be determined in addition to half lifetime of the formed compounds by hydrolysis and photolysis under solar simulator). Also, mechanisms of formation of new formed products will be explored.

Gaël Martin, *Postdoctoral fellowship progression*

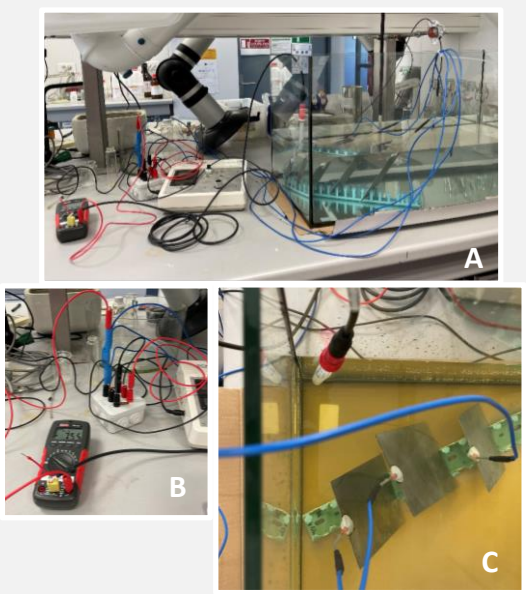


Figure 1: *Images of the experimental set-up to study ICCP elements released. A- Global view of the set-up ; B- Focus on the electric generator, connection cables, multimeter to take measurements (potential, current) ; C- Focus on the steel plates and the reference electrode for the measurements*

Science

Conducting acute toxicity tests on microalgae (UniCaen-BOREA) :

Validation of the experimental protocols to simulate galvanic anodes (GACP) systems:

To advance the knowledge of the elements released into the seawater by the GACP systems, this first part involves in situ measurements of all studied elements (i.e. aluminum and the metal cocktail of the GACP system) to focus on the protocols that will be applied for the ecotoxicological studies. We first defined the aluminum concentration (AlCl3,6 H20 and the GACP element cocktail) of the stock solution in order to prepare a selected concentration range of soluble Al. The results of this part put in evidence the stability of the soluble concentration of Al which reached the limit of solubility of 500 µg L^{-1} (Figure 2). The purpose of this task will be to define conditions compatible for medium production and stability of exposure.

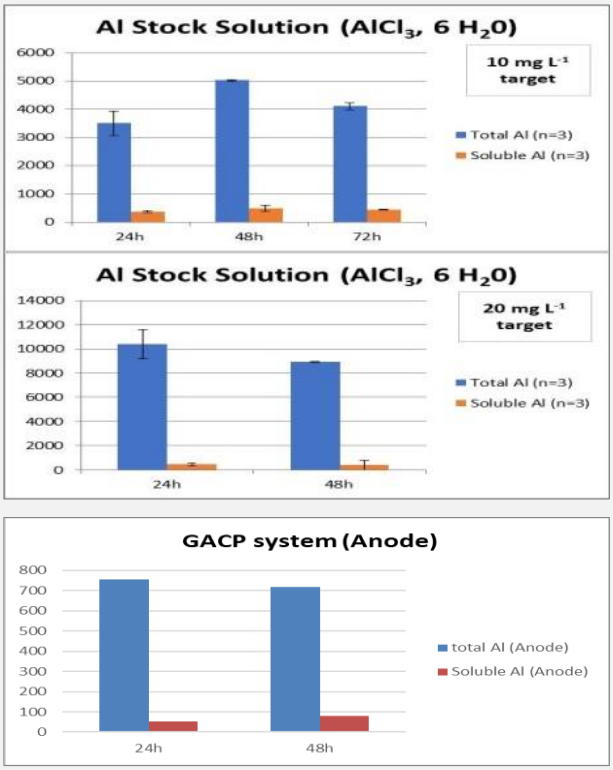


Figure 2: *Aluminum concentrations (total and soluble aluminum) reached in stock solutions after 24 to 72 hours either using $AlCl_3$, $6H_2O$ or a direct production from GACP system (galvanic anode).*

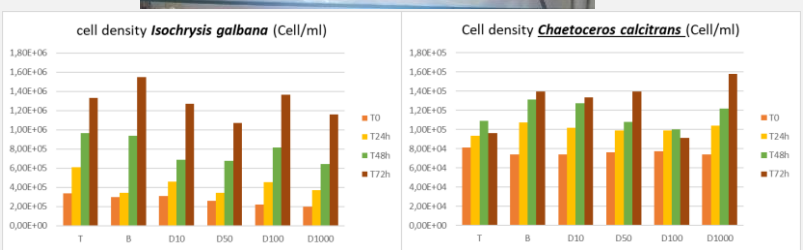
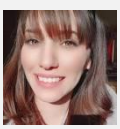


Figure 3: *Cellular densities of Isochrysis and Chaetoceros under increasing concentrations of aluminum using $AlCl_3$, $6H_2O$ (4 to 1835 µg/L) and increasing incubation periods (24 to 72 h).*

Define experimental protocols for the ecotoxicological study including testing aluminum, metal cocktail from GACP elements' cocktails:

Afterwards, laboratory experiments are developed on the effect of Al and metals resulting from the dissolution of aluminum galvanic anodes on the growth of three microalgae species, *Isochrysis galbana*, *Chaetoceros calcitrans* and *Tetraselmis sp*. under acute exposure (72h). The preliminary results are shown in figure 3.



Nesrine Zitouni, *Postdoctoral fellowship progression*

Science

Conducting acute toxicity tests on the shrimp *Palaemon elegans* (FEM/CEDRE/UBS) :

Preliminary studies are currently being carried out at Cedre on the shrimp *Palaemon elegans* in order to assess the feasibility of using the different stages (embryo, larvae and adult) of this model for future experimentations in the ECOCAP project.
In order to refine future experimental protocols, a preliminary exposure to GACPs and aluminum salts (AlCl3) was carried out on the adult stages for a period of 120 hours using the Cedre facilities (Figure 4). First findings will enable us to propose a relevant protocol for future acute toxicity experimentations on adult individuals (WP4: task4.1).

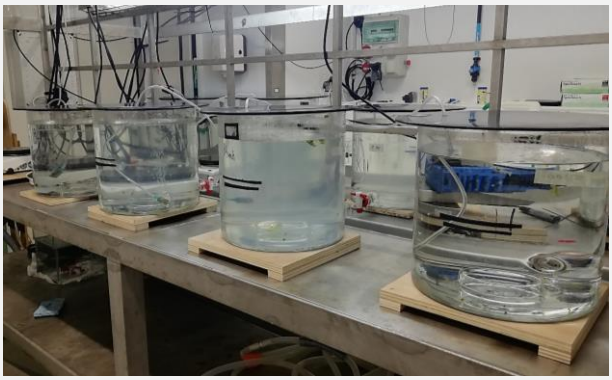


Figure 4: *Ecotoxicology facilities of Cedre including these different exposure tanks (volume of 16 liters).*

Figure 5: *Ovigerous female of the species Palaemon elegans. Eggs are present in large numbers under its abdomen.*

Preliminary studies are also underway on early stages (embryo and larvae) of *Palaemon elegans* with the aim of validating experimental protocols for future chronic exposures (WP4: task2). To do this, ovigerous females (Figure 5) were sampled in the Bay of Brest, allowing us to obtain eggs and larvae. Thus, evaluations of embryonic development (based on the work of Fisher and Foss (1993) and Rayburn and Aladdin (2003)) as well as survival tests of larval stages (based on van Dam et al., 2018) are in progress.

Matthieu Dussauze, *Postdoctoral fellowship progression*

Fisher and Foss (1993) : doi.org/10.1016/0025-326X(93)90186-N
Rayburn and Aladdin (2003) : doi.org/10.1007/s00128-003-8741-0
van Dam et al., 2018 : doi.org/10.1016/j.ecoenv.2018.09.025

Back to the Consortium

Two recruitment positions are now open for ECOCAP :

The first position is a temporary contract for 12 months for a postdoc that will be working with INRAE at Palavas-les-flots. The postdoc will investigate the potential ecotoxicological impacts of aluminum and metals' cocktail of Galvanic Anode Cathodic Protections on a fish species, the medaka *Oryzias melastigma*. More details of the postdoc missions are available on the following link: https://www.france-energies-marines.org/nous-rejoindre/chercheur-postdoctoral-en-ecotoxicologie-marine-sur-les-molecules-liberees-des-systemes-de-protection-cathodique-en-milieu-marin-offshore-f-h/

The second position is a permanent position for a researcher in Trophic modeling applied to the development of ORE in the Gulf of Lion. The recruited researcher will work in a first place on two main projects, ECOCAP (WP5-Task 5.2) and NESTORE (a new project from CORED 2022 that will be launched in November 2022 and that focuses on cumulative impact assessment). At longer term, the researcher will have as a main mission to develop research projects that investigate the ecosystem approach applied to environmental and socio-economic stakes that are specific for the Mediterranean context with the floating offshore windfarms that are foreseen in this French façade. For more details to this position, please refer to the full position description at this link: https://www.france-energies-marines.org/en/join-us/researcher-in-trophic-modeling-applied-to-the-development-of-ore-in-the-gulf-of-lion-f-m/

Agenda & upcoming events

- July 2022: A second water sampling has been conducted at the MISTRAL site. An offshore mission to the MISTRAL site was organized by the ABIOP+ project consortium in July. FEM and Ifremer took advantage of this mission to collect an additional water sample from that site. This water sample will be an additional one to what has been already collected on that site in May (i.e. DGT, chemcatcher and water sampling). This second sample collected in July will give an indication of the metals' concentration variability in the area (initial state).

- September 2022: Recruitment commissions. The two recruitment positions will be finalized in September with two commissions that will be held to select the candidates. Both recruited persons should start working on ECOCAP by October/November 2022.

- October 2022 : Second *in situ* measurement mission (WP3) at Courseulles sur mer offshore wind site. FEM, Ifremer, AMU-LCE and EDF-Renewable are currently investigating the possibility to conduct an *in situ measurement* at the Courseulles sur mer offshore wind parc. The deployment of the passive sampling devices (i.e. DGT and chemcatchers) would be fixed to an acoustic receiver system (see figure 6) that is already deployed at Courseulles sur mer site in the context of FISHOWF project.

- November 2022: The 12 months progress meeting of ECOCAP should be held in presence of the consortium partners. The logistics of this meeting will be organized starting in September 2022.

- Scientific and technical Tribune of FEM 2022:
Two tribune are foreseen for 2022, one in Brest and a second in Marseille. Register to and discover more on it following this link: https://www.france-energies-marines.org/nos-actualites/articles/tribune-2022/

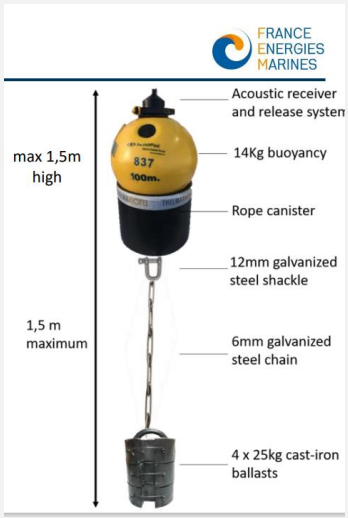


Figure 6: *An* acoustic receiver system that is deployed at Courseulles sur mer site in the context of FISHOWF project.