



OCEAN

Oxalic acid from CO₂ using Electrochemistry At demonstration scale

Newsletter - 30th APRIL 2021



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H2020-SPIRE-2017 - GA N° 767798



Welcome from the Ocean Coordinator

Electrification of chemicals production is a major objective to use directly **renewable energy** in chemical processes and, in particular, the **electrochemical reduction of CO₂** is a key, 2nd generation technology to close the carbon cycle in energy-intensive industries. However, to assess the technological and economic feasibility of such a process at an industrial scale, a careful on-field demonstration is needed to overcome current challenges and create new applications to electrochemically produce low carbon valuable chemicals. The Ocean project fills this gap configuring as a demonstrator project to validate oxalic acid electrochemical production from CO₂ in an industrially relevant environment.



This newsletter aims to inform a wider audience about the main Ocean project achievements and the future impacts of the project results on industries and society. Stay tuned for the last developments and enjoy the newsletter reading.

I look forward to your questions or collaboration opportunities. For any question, please contact me: E-mail: perathon@unime.it

Stay Tuned!

Siglinda Perathoner - OCEAN coordinator, ERIC aisbl

The OCEAN project breakthrough

Why Ocean?



Electrification of chemical production is a major objective to use directly renewable energy in chemical processes, but a demonstration of electrochemical processes to prove the industrial and economic feasibility, as well as the development of new advanced electrochemical methodologies, is needed to overcome current challenges and create new applications for electrochemistry.



Challenges



Create **less by-product waste**, less expensive starting materials, less aggressive process conditions compared to conventional chemical processes to establish new markets



Replace polluting chemical reactions with **more environmentally friendly electrochemical reactions**



Reduction of greenhouse gases emissions using new technology based on electrical power generated from environmentally friendly production processes **like wind and solar energy**

Objectives

Proof of industrial and economic feasibility, with the development up to TRL6 of technology **to electrochemically convert CO₂ to formate**



Innovative electrochemical methodologies, by:

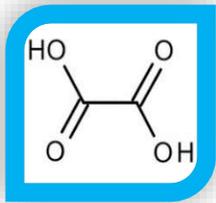
- improving the efficiency of the Demonstration cell with improved tandem operations at the anodic site;
- coupling the Demonstration cell (which produces conjugated bases as reduction products) with downstream operations (electrochemical acidification with bipolar membranes)

Development of **novel electrode materials and catalysts** along a novel pathway to produce valuable C2 products from CO₂





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Integration into industrial operations, by exploring the **full industrial value chain from C1 (formate) to C2 (oxalic acid, glycolic and glyoxylic acids, ethylene glycol)**, including aspects of new polymers from electrochemically produced monomers

Impacts



Decrease the energy use by at least 30% compared to related non-electrochemical processes



Decrease by 30% of Green House Gases emissions compared to related non-electrochemical processes



Strengthen the global position of the European process industry

CO₂ effluents from industrial processes that have 20% or greater concentrations of CO₂ (ethylene oxide synthesis, ammonia synthesis, bio-ethanol synthesis, cement manufacturing etc)

Benefit: **cost savings relative to conventional production technologies**



Environmental impact on society (reducing its CO₂ footprint) by enabling a change from fossil-based and first-generation feedstocks to what is a limitless resource

OCEAN Demonstrator

OCEAN demonstrator is a prototype electrochemical reactor with a Technological Readiness Level (TRL) of 6. TRLs are methods for understanding the technical maturity of a technology and level 6 corresponds to “Technology demonstrated in a relevant environment”: in practice, the prototype system is produced, demonstrated and verified in a simulated environment before to be implemented in a real operational environment.

The Ocean demonstrator will operate with a stack of electrochemical cells of ~0.2 m² at current densities of at least 1.5 kA/m² and it will be able to convert 250 g of CO₂ per hour into Formate at both cathode and anode side.



Figure 1 External view of the container ISO-20' in which the demo unit has been assembled at Hysytech

The engineering and scale-up has been developed by Hysytech with the Avantium support and the construction and assembly of the demonstrator were performed by Hysytech at the company facilities in Torino, Italy.



Figure 2 Ocean Demonstrator for the CO2 conversion into Formate

This is a one-of-a-kind prototype and it is the results of knowledge and lesson learned also in the previous project likes [TERRA](#) and [CELBICON](#) project in which both partners Avantium and Hysytech were involved.

The construction and the Factory Acceptant Test (FAT) of the demo plant were finalised at the beginning of April.

The unit was delivered to the Avantium facilities, which is located in Amsterdam.

Avantium will optimize and scale their electrochemical CO₂-conversion technology in an industrially relevant environment thereby moving the technology from TRL5 to TRL6.



Figure 3 Electrochemical reactor of 0.2m² of electrode area for the CO₂ conversion

The demonstration unit will be installed and validated at the site of Avantium first, followed by testing under industrial conditions at the site of RWE Company, where all relevant infrastructure for experiments on a semi pilot scale is already present. Avantium is leading the Ocean market and exploitation analysis to provide insight into the market and the activities needed for exploitation. This will result in a business case and exploitation strategy to create the first steps towards commercializing this important climate transition technology.

Project Consortium

Eight partners are part of this project, strong scientific competencies to review and update the existing technologies, high-level competencies in assessing their applications from different perspectives with a strong partnership to apply and carrying out the Demonstrator activities together with its overall assessment.

The consortium is represented in various parts of Europe and therefore the project results will have a wider impact in Europe and a higher potential for implementation outside Europe. Visit the project website [Ocean](https://www.ocean-project.eu) to know more about all the partners' skills and activities.

OCEAN EVENTS



42th Months VIRTUAL MEETING

On April 23th 2021, all Ocean partners attended the 42th Month Meeting, participating with presentations on project activities and discussions on how to achieve the best outcomes and project results. Additionally, all partners contributed to future project developments and decisions in order to complete successfully foreseen



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activities and tasks. Activities and achievements are still confidential even at M42!! Just a bit more of patience and stay tuned and visit our website

WHAT'S next?

Stay TUNED following the Project on our Social Media!

Ocean Project

Visit the Ocean project at the address – [Ocean Project](#) and follow the project on



Let us have your comments!