NEWSLETTER #4
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THREADING-CO_2

Second year project results

The THREADING-CO_2 Project is entering its third year of implementation, and many are the results achieved so far! Explore this newsletter to discover the progress made by the consortium and gain insights into the upcoming milestones. Stay updated with the latest news by following THREADING-CO_2 on LinkedIn and Twitter.

Scale-up of MEG production process and set-up of pre-industrial pilot line (TRL6)

WP1 initiated at the start of Threading-CO_2 and in the second year of the project its main focus lay on task 1.3, which entails the technical implementation and experimental optimization of systems at 2kg/h MEG. As for the first part of the reaction, an up-scaled CO_2 electrolyser was tendered and is currently being designed and constructed by Hysytech in collaboration with ELCAT. Once this is delivered an extensive test campaign is planned to optimize the composition of the system and the reaction conditions to allow efficient and continuous operation. In the meantime, an up-scaled lab-scale CO_2 electrolyser (100 cm^2) stack has been constructed at ELCAT and is being used to test-run the envisaged reactor components for the pilot reactor. As for Fairbrics' achievements, the pilot line reactors for both carbonylation and hydrogenation have been successfully installed and commissioned in the Antwerp laboratory. This process included a safety analysis and extensive testing of the system to ensure its readiness for operation. Proof of concept for both hydrogenation and carbonylation processes has been successfully demonstrated at the pilot scale. In parallel, efforts have been focused on optimizing the operating conditions, particularly reducing the pressure by a factor of 4. This optimization is crucial to improving the efficiency of the processes and lowering energy consumption. Additionally, the

production capacity has been ramped up, allowing the production of several kilograms per batch. This increased capacity enables the testing of ethylene glycol in polymerization processes, a key milestone in validating the product for potential industrial applications. Once all systems are in place and tested, they will ultimately result in the completion of deliverable 1.2, which is the qualified pilot line.

Scale-up of MEG production process and set-up of industrial demo plant (TRL7)

Hydrogenation: A bibliographic benchmark on hydrogenation reactors has been conducted to identify the most suitable technology for the demo plant. In parallel, several suppliers were contacted to perform tests with bigger reactors, a crucial step in selecting the most appropriate hydrogenation technology (type, dimensions, etc.) and optimizing process conditions, including gas or liquid phase, pressure, temperature, flow rates, and catalyst characteristics (type, size, etc.). Additionally, process simulations are ongoing using dedicated software to allow for the proper sizing and optimization of the hydrogenation system at the Demo scale.

Carbonylation: A successful proof of concept for flow carbonylation was conducted, demonstrating the feasibility of this process. Several catalysts are currently being studied to enhance long-term reaction performance. Furthermore, studies have been carried out on different methods for catalyst recycling. Process simulations and calculations are underway to design the purification sequence for the carbonylation mixture at the demo plant scale, aiming to optimize efficiency and scalability.

Figure 1: Rotary Evaporator Antwerp: a device used to purify and concentrate products in the lab

Figure 2: Raw Material Virgin Pet Granules

Polymers and fibers production trials, fine tuning (w final users)

The final evaluation of the quality of a product is the application. For the ethandiol (MEG) one suitable application is to serve as monomer in the synthesis of poly (ethylene terephthalate) (PET). MEG produced by Fairbrics and based on CO_2 was applied successfully to produce PET chips in a batch process in various amounts. Beginning with smaller reaction sizes an increase in the produced polymer amounts was achieved stepwise. In parallel PET based on fossil fuel was prepared to identify possible differences in quality. Further the robustness of the monomer production was investigated by purposefully pushing the polymerization parameters to the boundaries. After successful polymer syntheses the prepared macromolecules were analyzed by various analytical means. A homogeneous quality of the products was found. Further no or minor differences were found in the comparison between PET produced from CO_2-based or fossil based MEG.

Life Cycle Sustainability Assessment

The main goal of Threading-CO_2 project is to reduce the carbon footprint of the textile industry, therefore TECNALIA is doing a full LCSA to demonstrate and quantify the improvements in terms of environmental, economic, and social impact. The first step of this analysis is to define the goal and scope and do it in a way that enables comparison with other studies in the sector since those will be later used for benchmarking. In this regard, TECNALIA has conducted a literature review focused on LCA, LCC, and S-LCA in textile and CCUS sector to identify the most common methodological approaches when defining the functional unit, system boundaries, allocation rules, etc. Up to 139 different articles have been included in this review. In addition, a materiality assessment was carried out by sending a questionnaire to project partners to gather their opinion about which impact categories, economic indicators and social topics are more relevant for this assessment, crossing this evaluation with the findings in literature and choosing the final ones that will be included in the assessment. Finally, the flow diagrams of the Threading-CO_2 process and the benchmarks to which it will be compared were defined and the inputs and outputs that need to be included were identified. All this work has been included in D4.1, which will be submitted at the end of the year.

Development of Modular Learning Resources

The development of educational tools started with identifying skill gaps on valorization of industrial CO/CO_2 emissions and studying the aspects of digital learning and their pedagogical issues. In the second year of Threading-CO_2, this information was used in the development of Massive Open Online Courses (MOOCs). Furthermore, aspects of digital learning were published as a master's thesis entitled "Development of digital teaching platform to teach CCU-application". In addition, the launching webinar of the Threading-CO_2 Academy took place in May 2024, the aim was to showcase the MOOCs and receive feedback. The first MOOC developed by LUT University was "Climate Action - The role of Digital Transformation in the Process Industry". A pilot test with it was carried out during the spring and summer of 2024 with almost two hundred university bachelor's and master's students. The results of the pilot test and the feedback from the webinar were used for its further development and the MOOC is now available to everyone worldwide via the LUT MOOC Platform, https://mooc.lut.fi/. Additionally, this pilot test resulted in a study entitled "Improving the student learning process in MOOCs through the analysis of open-ended question-based assessments using natural language processing". The results were presented at the 27th International Conference on Interactive Collaborative Learning (ICL2024) and 53rd IGIP International Conference on Engineering Pedagogy in September 2024 in Estonia, where the work received the Best Paper Award - Winner in Short Papers.

Dissemination, Communication and Exploitation

Threading-CO_2 represents a significant opportunity to reduce the environmental footprint of the clothing industry by introducing a sustainable raw material—green polyester—powered by breakthrough technology set to revolutionize the textile value chain. One of the key aspects of Threading-CO_2 is designing an exploitation strategy to ensure that the project's results can generate meaningful impact and support commercial exploitation after its completion. To advance this vision, the first exploitation workshop of the project, organized by PNO, took place in early November 2024. During the session, the overall exploitation plan was introduced, and Horizon Europe's IPR rules were outlined. The workshop also featured an interactive segment where consortium members collaboratively reviewed and refined the drafted Key Exploitable Results (KERs). This session marked a major milestone in achieving the project's exploitation objectives. With the project's KERs now defined, the next steps will involve exploring roadmaps for their exploitation and commercialization in the coming months. Thus, the exploitation activities within Threading-CO_2 not only paves the way for impactful business case scenarios in diverse sectors like clothing, automotive, and sports but also sets the stage for a strong foundation for creating tangible environmental benefits and transformative change within the clothing industry. Intrigued to learn more? Explore the THREADING-CO_2 website and watch the project videos to dive deep into the initiative!

THREADING-CO_2

Would like to join our network for collaborative Dissemination and Communication activities?

Contact our designated team below:

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Subscribe to our newsletter
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to be always updated on the latest news
and the project progress!

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