

Environmentally friendly Formic-acid and Formaldehyde Efficient CCU Technology

Publieke samenvatting / Public summary

Aanleiding

Chemical and transport industries will still need carbon products after the coming energy transition. To make future carbon products sustainable and circular, Carbon Capture and Utilization (CCU) can play an essential role. Here, captured carbon dioxide from industry or direct air capture can be reacted with hydrogen from sustainable sources to make products. Currently, adoption barriers such as high cost and low efficiency are hindering the implementation of these novel CCU production routes. The EFFECT project is aimed at developing the CHARLIE technology where carbon capture and utilization are integrated in a single process to produce formic acid and formaldehyde. Using a process intensification methodology, the CO₂ is converted directly in the carbon capture liquid to value added products. Consequently, this integration reduces the necessary equipment & operations, the cost and improves the overall efficiency. EFFECT offers the unique opportunity to develop and optimize this next-generation CCU technology. A strong consortium of technology developers (TNO), end-consumers (Ecover & ChemCom) and future technology implementers (Fluor) enables the technology development.

Doelstelling

The primary goal of EFFECT is to advance and optimize the CHARLIE technology. CHARLIE consists of 4 main operations: 1) Absorption of CO₂, 2) Hydrogenation in the capture liquid, 3) Separation of Formic Acid product and 4) Potential conversion to

Projectinformatie / Project information

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TIND121018

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Algemene informatie / General information

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formaldehyde. Currently, the technology is researched as separate operational steps in the lab. To advance the technology, the development and optimization will focus on the integration philosophy of the operations. This will include lab scale research, where the process conditions and separation unit operations will be tuned to achieve an integrated lab-scale technology chain. In addition, the aim is to scale up the lab experiments to bench scale. Overall, this will advance the CHARLIE technology readiness level from 2/3 to 4/5, thereby paving the way for competitive next-generation CCU products. Following the EFFECT project, the technology is envisioned to progress towards demonstration under industrial relevant conditions (TRL 6/7).

Korte omschrijving

The work is divided into four work packages:

- WP1 Use Case Definition: The boundary conditions for the process and its applications are explored with the end-users.
- WP2 Proof-of-concept technology chain at lab scale: Lab-scale set-up(s) will be built in the TNO lab in Delft, after which the proof-of-concept tests are performed. The aim is to experimentally connect the four main operations of the CHARLIE concept.
- WP3 Conceptual Design & techno-economic evaluation: A conceptual design of the envisioned commercial scales (WP1 use-cases) will be made, taking into account the results delivered by the experimental work in WP2. A result of WP3 are the Capex and Opex estimates, which are used as input for WP4.
- WP4 Business case and environmental evaluation: This will combine all work in a business case-environmental analysis, assessing the sustainability of the process and its economic feasibility. The work will include sensitivity analysis on key parameters and will project levelized costs of formic acid and formaldehyde.

Resultaat

The desired result of EFFECT is a proof of concept for the CHARLIE process for both formic acid and formaldehyde by the advancement of TRL of all the sub-processes involved and the integrated process

from TRL 2-3 to TRL 4-5, providing a basis for further technological development and demonstration under relevant industrial conditions. This result is accompanied with an improved understanding of the use cases, the system boundaries, technological gaps and risks and techno-economics. Additionally, a conceptual design for a commercial scale plant will be made to better understand the costs and requirements of developing a marketable technology. After completion of the EFFECT project: • A novel strategy (to integrate capture and utilisation) for CCU will have been introduced • A novel cost-effective process (CHARLIE) producing formic acid and formaldehyde will have moved closer to the market in technology readiness level.

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in samenwerking met de Topsector Energie ontsloten.

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