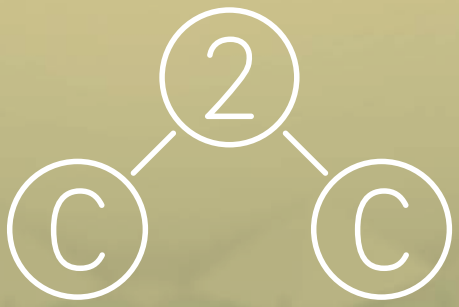
Subproject L-IV

C_{2+} ALCOHOLS, C_{2+} OLEFINS, SYNTHETIC FUEL COMPONENTS

Project content
for the period 2020 to 2024



Carbon2Chem®

PROJECT AIMS

The aim is to develop a catalytic process for the use of a syngas consisting of purified metallurgical gases from a steelworks and sustainably produced hydrogen to create short-chain alcohols, olefins and/or synthetic fuels. The use of the alcohols and olefins as fuel and for other chemical components reduces the use of fossil raw materials. The fixation of carbon in recyclable products reduces carbon dioxide emissions from the steelworks. A large reduction in CO_2 results from the large-volume markets for the products addressed by subproject L-IV. With technological adjustments to gas purification, the syngas-based manufacturing of higher alcohols or olefins offers opportunities to transfer to other industrial process gases or CO_2 sources (e.g. from the cement and lime industry or waste incineration) and use renewable raw materials and plastic waste.

PROJECT CONTENT

The optimization of the catalyst and reactor design for real gas operation is determined by the envisaged product mix (alcohols vs. olefins, chain lengths). Market analyses in the mobility/transport and petrochemistry sectors serve to identify market-appropriate product mixes. Product treatment takes into consideration fractionating olefins and alcohols and marketing them separately. Olefins should be hydrated/hydroformylated and the alcohol mix that arises should be marketed as a fuel component after further processing. Alcohols should be dehydrated and the olefins marketed separately after their fractionation. The CO_2 saving is additionally supported by the development of processes in which CO_2 is converted into hemiacetals with C_2-C_4 alcohols or CO_2-based methanol into iso alcohols with C-C alcohols using the Guerbet reaction. The aim is to demonstrate the process step that uses syngas while making use of the existing Carbon2Chem® infrastructure.

MILESTONES

- Milestone 1 after 24 months:
  Catalyst is available on a commercial scale, duration > 2,000 hours; productivity > 150 g/mL/h; selectivity > 55 %.
- Milestone 2 after 18 months:
  Catalyst is assessed with regard to the implementation of syngas containing CO_2.
- Milestone 3 after 20 months:
  A kinetic model describes the range of operating conditions.
- Milestone 4 after 36 months:
  The reactor model delivers realistic predictions.
- Milestone 5 after 18 months:
  A market-compatible product composition is identified and a process concept developed.
- Milestone 6 after 42 months:
  An economical procedure is developed, for which an LCA is conducted.
- Milestone 7 after 40 months:
  Demonstration of a concept to refine the product mix, CO_2 saving, process concept (continuous) exists.
- Milestone 8 after 20 months:
  The concept for renovating the methanol demonstration plant is ready.
- Milestone 9 after 48 months:
  The demonstration plant has been started up with the catalyst prototype and the developed process conditions. The feasibility of the process has been demonstrated on a larger scale.

PROJECT PARTNERS

- Evonik Operations GmbH (coordinator)
- thyssenkrupp AG
- Ruhr University Bochum
- Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT
- RWTH Aachen University