Subproject L-II

DYNAMIC METHANOL PRODUCTION FROM METALLURGICAL GASES

Project content

for the period 2020 to 2024

Carbon2Chem®

PROJECT AIMS

In order to be able to use metallurgical gases to produce methanol, it must first be shown that conventional methods are suitable for the new raw material or how these may need to be altered to suit the properties of the metallurgical gases. One area of focus in the first phase of the joint project lay, among other things, in the assessment of the scalability of the observed effects and in the creation and analysis of methanol samples to examine the formation of byproducts with different compositions of the feed gas. The relocation and integration into the Carbon2Chem® technical center in Duisburg with two testing plants was already conducted in the first phase in order to enable the very important long-term operation with real purified metallurgical gases in the second phase.

PROJECT CONTENT

To process the tasks, subproject L-II consists of various work packages on different technical and scientific questions. A work package involves the optimization of overall process concepts and economic benchmarks. The aim is to validate the dynamic simulation with data from the operation of the real systems. As part of mini engineering, a process description, an equipment list, a set of flow charts, a heat and material balance, and a costing should be created for multiple run cases. In another work package, tests take place on long-term measurement at the Carbon2Chem® technical center in Duisburg. In order to minimize the economic and technical risk of this scale increase, several thousand operating hours are necessary under realistic conditions at the Duisburg site. The various mini plant/pilot plant systems are perfectly suited to this task due to their scale, process concept, and their high level of automation. The long-term operation should demonstrate that methanol synthesis from metallurgical gases is possible.

Another work package focuses on the deactivation speed of the industrial catalyst as a function of various factors (temperature, pressure, catalyst mass, catalyst poison concentration and type) and the optimization of selectivity and productivity.

The aim of the laborious long-term studies is to create a broad kinetic database, which should be used for modelling and the preparation of potency estimates. The implementation of a digital twin at the pilot plant, the optimization of the process while taking into account economic and ecological aspects, and the scale-up of the digital twin are the content of a further work package. The last work package involves the groundwork for a complete life-cycle assessment.

MILESTONES

- Creation of block flow charts and mass balance calculations for all process concepts
- The compilation of the business case for selected process concepts exists.
- There is a detailed list of poisoning mechanisms and an identification of new catalyst phases and catalyst poisons.
- Establishment of kinetic models for reversible and irreversible poisoning and identification of the centers for the carbon monoxide steam conversion reaction and alkene hydrogenation
- Implementation of a digital twin
- Interfaces for the use of methanol in the fuel sector are defined and various business models determined for the use of methanol.
- The environmental effects are quantified for the coordinated scenarios.

PROJECT PARTNERS

- Nouryon Industrial Chemicals GmbH (coordinator)
- thyssenkrupp AG
- Clariant Produkte (Deutschland) GmbH
- Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT
- Fraunhofer Institute for Solar Energy Systems ISE
- Ruhr University Bochum