Progress report

Institute for
Sustainable
Process Technology

Progress report (Public)

1. Acknowledgement

"Het project is uitgevoerd met Topsector Energie subsidie van het Ministerie van Economische Zaken en Klimaat, uitgevoerd door Rijksdienst voor Ondernemend Nederland. De specifieke subsidie voor dit project betreft MOOI-subsidie ronde 2020 "

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Secretary and authors	This report has been drafted by Richard Cooper (Shell), Kees Biesheuvel (Dow), Robert de Boer (TNO) Paco Rutten and John Harinck (ISPT - Secretary to the project).

2. Introduction

The e-missi0n MOOI project is part of the ongoing development of electrified cracking technology, where Shell and Dow joined forces with TNO and ISPT. The goal of this project is to research two routes that will lead to the electrification of the steam cracking process. The first route investigates how existing furnaces can be retrofitted with electrical heating, while the second route uses first principles to identify the ideal electrical furnace. This innovation, including the optimization of heat integration of the furnace section, and a study towards the system integration of the technology can potentially reduce CO_2 emissions by up to 3.4 million tons per annum.

3. Update on the project

In activity 1 the capability of specific heating concepts is tested. This has gone through the planned phases (A1.1. and A1.2.) and has successfully reached the aspired result, which is the development of an experimental unit. A unique design has been devised to allow testing of the heating concept to be conducted using water as a dense energy carrier rather than air or hydrocarbons to reduce complexity, size and cost and to improve safety. A report has been written describing in detail the unit's design. The next steps will be to test this experimental unit. In parallel, the development of a Computation Fluid Dynamics (CFD) model has started, which revolves around this experimental unit. The model will be populated with experimental data after the test program has commenced. Additionally, a calculation model (A1.7) was made for the second route concept 2 to explore the new reactor geometries which can fulfill the required cracking process conditions. The initial materials to test for the second route concept 2 are selected. (A1.9) Modification of the Lab scale Cracking Simulator (LCS) is in preparation, to allow testing and characterization of novel materials under simulated cracking process conditions.

The second activity targets efficient recovery and re-use of high temperature heat. The modelling and testing of principles has started in line with the planning. This means the construction of the experimental set-up for heat transfer testing is finished. (A2.1.) The first heat exchanger is designed, built and installed and initial functionality tests are done. Additional measurement equipment must be installed to allow performing the validation testing, to be followed by the measurement program. Furthermore, various heat recovery and re-use configurations are developed and their impact on energy efficiency improvements are calculated (A2.2). Critical success criteria are defined and will be applied to select the most promising configurations.

The cracker relies on materials that can deal with high temperatures. The following activities (A3.1. to A3.4.) revolve around the selection of high temperature materials.

Activity A3.1 has been completed. An evaluation of different heating materials was conducted, and a selection of the most promising candidate was made based on the simulated results. This material will also be used in the experimental unit in activity A1. Activities A3.2, A3.3, A3.4 and A3.5 have been started. Starting point was to define the required process conditions that the heating materials will be exposed to. In the next step, a risk register and a test plan identifying the critical chemical and mechanical properties to be tested were drafted. A literature review was initiated to identify those properties that are already known and those that need to be determined through testing. Initial testing using existing test rigs is planned to start in Q2 2022.

The last activity (A5) of the E-missi0n MOOI project aims to assess the impact of and requirements for integration of electrified cracking technology in the surrounding energy and materials systems. To better define the system, dependencies, and criteria a report has been drafted which will be shared with relevant stakeholders, such as the electricity transmission operator, in order to further define impacts of and requirements for the deployment of the technology.

4. The contribution to society

The project is strongly recognized in the innovation missions of the Climate Agreement, specifically within 'MMIP 8' innovation target 8.4.d 'development and piloting of electrification of high temperature furnaces, for

example for the manufacturing of olefins and aromatics. The topic of this project heavily contributes to the achievement of that target. Potential spin-offs and benefits that revolve outside this target are currently not yet identifiable.

5. Further information and grant acknowledgement

Results, news items and scientific articles that will be published for external use can be found on the project page of e-missi0n MOOI. This website also contains contact information for further questions.