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Subject Area	Energy and Environment

Implementation of a laboratory Methanol-to-Olefin test bench

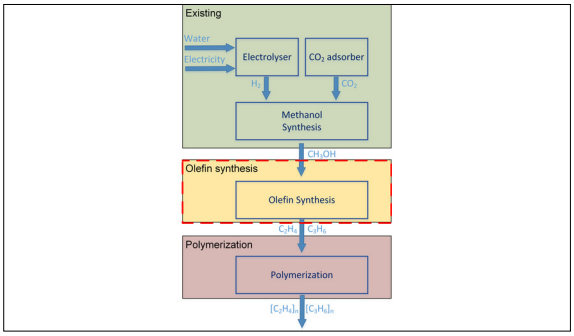

Figure 1: Power-to-Product landscape of the IET Institute of Energy Technology

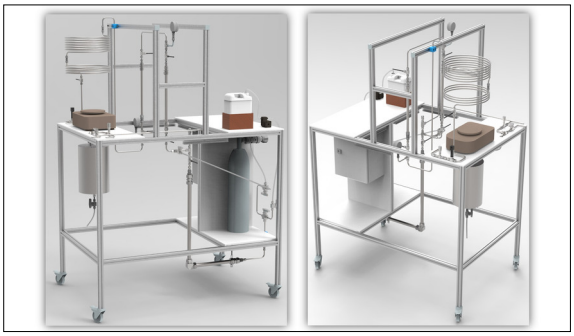

Figure 2: 3d rendering of the constructed Methanol-to-Olefin test bench

Introduction: The worldwide demand for the polyolefins polypropylene (PP) and polyethylene (PE) was 159 million tons in 2015 and continues to increase. These materials are mainly produced from fossil raw materials, which leads to a high emission of fossil carbon dioxide CO_2. One solution can be to use elementary hydrogen H_2 and carbon dioxide as feedstock. As part of a predecessor project at the IET Institute of Energy Technology at the HSR, a synthesis reactor was built to synthesize methanol (CH_3OH) from hydrogen and carbon dioxide. An electrolyser for hydrogen production and a CO_2 adsorber, which captures carbon dioxide from the ambient air, are also available. Goal of this thesis is to create the process stage olefin synthesis (as seen in Figure 1).

Procedure / Result: The procedure can be divided into the following steps:

- Research fundamentals: Research theoretical basics of plastic synthesis, comparison and evaluation of different approaches.
- Conception: Development and evaluation of various concepts. Creation of a P&ID (Figure 3) and dimensioning of system components.
- Simulation: Simulation of the process to verify calculations.
- Construction: Development of a 3d model (Figure 2) to use as construction plan.
- Implementation: Assembling of the test bench.

Result: A multifunctional test bench for the synthesis of propylene, ethylene and dimethyl ether (DME) was created. The design of the test bench was carried out both by analytic calculations and with simulations. A P&ID was developed and an operational concept created. The design contains two reactors, a DME pre-reactor loaded with a γ-Al_2O_3 catalyst and a olefin conversion reactor with either γ−Al_2O_3 bound ZSM-5 zeolite for selective on purpose propylene conversion or Sapo-34 for ethylene. The system was built but not yet commissioned.

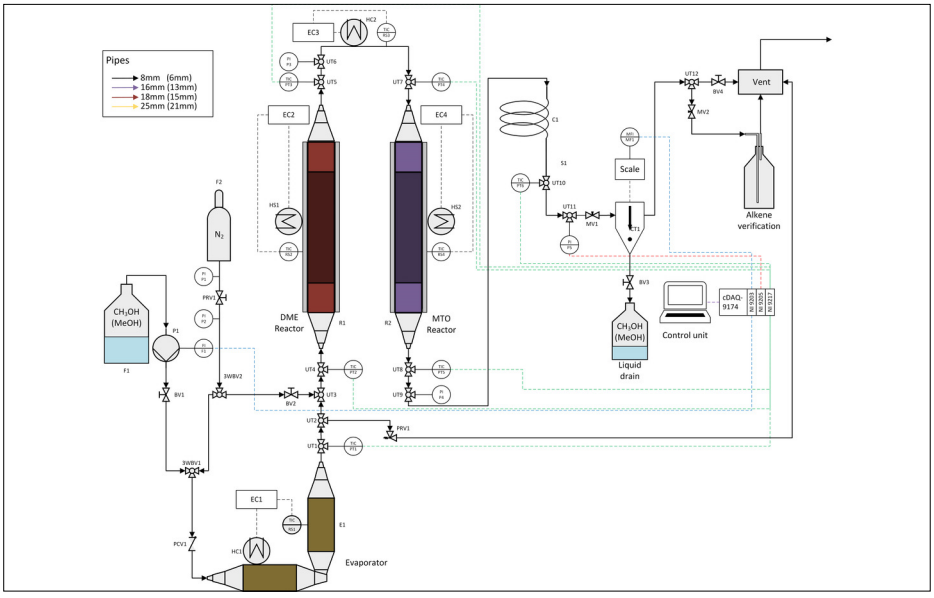

Figure 3: Detailed P&ID of the test bench