Dynamic Methanol Synthesis: CO2 Utilization under fluctuating operation conditions

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The main focus of this research is a.) Investigating industrially applied catalyst in CO2-rich feed gas and b.) The adaption of the industrially applied methanol production to intermitting operation scenarios. Our approach focuses on the utilization of biogenic CO_2 and green hydrogen. Due to the fluctuating regenerative energy, the supply with hydrogen gained by electrolysis, the operation conditions and the methanol production are dynamic as well. The deactivation behaviour of industrially relevant catalysts under static conditions is well understood. Here, we show a first comparison of industrially applied catalysts under different, static and dynamic, operation conditions in the first part of the presentation.

Accurate knowledge of catalyst behaviour and accurate modelling of the reaction kinetics is additionally essential for the design of the entire process structure. Based on this reaction model the optimal temperature profile needs to be found along the tube reactor followed by the generation of the entire process design mainly for the methanol synthesis and the distillation unit downstream.
Hence, the following part of this presentation will be the illustration of significant steps of developing concepts for process design and control handling of the dynamic process behaviour caused by fluctuations of hydrogen feed by extensive simulation studies with Aspen Plus and Aspen Dynamics. Those concepts should consider the dependence on different site conditions such as composition of CO_2-stream and options for heat recovery. For optimizing the economic viability a detailed concept for heat integration has to be developed as well. And as for the fluctuations of hydrogen supply the impact on the dynamic behaviour of all process units is to be analysed as a base for dynamic process control strategy.