Methanol based pathways towards renewable fuels

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Renewable fuels can be obtained via numerous biochemical or chemical conversion routes. The IEK-14 of the Forschungszentrum Jülich focuses hereby on the techno-economical evaluation of the chemical conversion processes of hydrogen with carbon dioxide. After concentrating on the production pathways of alcohols and ethers in last year's contribution, this presentation will highlight the methanol-to-olefins and olefins-to-hydrocarbons synthesis.

Within the field of chemical conversion of H_2 and CO_2 to renewable fuels, two pathways are predominantly discussed and investigated in the scientific literature. On the one side, there is the Fischer-Tropsch (FT) synthesis, which has the benefit of being a mature technology and delivers "drop-in" fuels after a separation and refining step. The drawback here is the need of synthesis gas instead of a CO_2/H_2 mixture. Therefore, an additional reverse water-gas-shift reactor has to be installed, which requires high temperature heat and is on a lower TRL level than the FT-Synthesis.

On the other side, there is the methanol pathway, which has the benefit of a direct conversion of CO_2 and H_2 to methanol. The drawback here is that even though the product itself is a globally traded base chemical, it is not a desired fuel for most applications. Hence, additional process steps have to be taken to reach the desired fuel. The possible fuels attainable from methanol and their individual pathways are again numerous, reaching from ethers, carbonates and higher alcohols to the hydrocarbons gasoline, diesel and kerosene. For every step taken during those pathways, a drop in efficiency and an increase of the production costs has to be taken into account. This leads to preferably short process chains, which can be attained via the reaction of methanol over zeolite catalysts. One prominent example here is the Methanol-to-Gasoline (MtG) reaction. Apart from the mature technology already applied in the 1980's, recent developments in process control, reactors and catalysts promise advantages in yield and product quality. Besides the MtG-reaction, longer hydrocarbon chains can also be obtained over a zeolite catalyst reaction. Here, short olefins are formed in a first step, followed by an oligomerization step towards diesel or kerosene chain length.

The afore mentioned product pathways towards gasoline, diesel and kerosene will be presented in this contribution and compared to the already published results of the IEK-14.

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