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DME from Crude Methanol

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Introduction

Hydrogen and its derivatives, such as methanol and dimethyl ether (DME), are essential for the defossilisation of the transport, industrial, and energy sectors. This is also addressed in the Hightech Agenda of the BMFTR. e-Fuels, chemicals, and energy carriers are various applications of DME, which are of significant relevance for future industrial value creation in Germany. Furthermore, Germany relies on the large-scale import of renewable energies, sustainable energy carriers, and raw materials for industry. Innovative technologies for the production of e-fuels also enhance Germany's geopolitical independence and resilience.

DME offers several advantages over other energy carriers, but there are still research gaps that need to be addressed. Fraunhofer ISE, which has long-standing expertise in the field of DME [1-7], addresses these topics. For example, Fraunhofer ISE has developed a novel process (INDIGO, patent filed) using reactive distillation, in which the thermodynamic reaction equilibrium is bypassed by coupling synthesis and distillation (see Fig. 1). INDIGO reduces energy requirements, plant complexity, and investment costs. In cooperation with our industrial partner, thyssenkrupp Uhde, the aim is to increase the technological maturity of this innovative and efficient process developed by Fraunhofer ISE for the production of DME and to prepare for its industrial implementation. We achieved the world's first DME production directly from crude methanol (Carbon2Chem pilot plant [8]).

The hydrogen carrier ammonia, frequently discussed in this context, has a lower H₂ storage capacity compared to DME and requires significant water resources in sunny countries that often suffer from water scarcity [2]. The efficient transport of hydrogen via DME allows for large-scale global use of H₂, enabling a CO₂-neutral supply to the industry, transport sector, and energy economy. Additionally, the transport of hydrogen using DME would be conducted through a non-toxic, ozone-friendly, and non-hazardous hydrogen carrier.

Furthermore, DME, as a platform molecule, offers many applications: as an intermediate for further synthesis of aviation fuels, gasoline, and other refinery products, as well as for blending with LPG (up to 20% possible without user-side adjustments).

The proposed presentation will provide an overview of the opportunities and challenges of DME and draw conclusions regarding technology and economics.



Figure 1: PN50 distillation column with a total height of 7.5 meters at Fraunhofer ISE, serving as a platform for DME and SAF process development.

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