Potential of Dimethylether as a large-scale chemical hydrogen carrier

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Abstract

A recent study by Schühle et al.[1] investigated the potential of DME as an energy carrier for intercontinental energy import in comparison to ammonia and methanol. The simple liquefaction of DME enables a high volumetric energy or hydrogen density, which, according to the study, manifests itself in advantages in transport and storage.
In this concept, DME is synthesized from CO_2 and H_2 at a location with high availability of renewable power. In addition to DME, this process also produces water, which can be purified and returned to the electrolysis process, thereby reducing the fresh water requirement by up to 50% compared to the direct transport of hydrogen or ammonia synthesis. In regions where renewable energies are only available to a limited extent, reducing the demand for fresh water for energy exports can significantly increase local acceptance. Due to the great similarity between the physical properties of DME and LPG, the existing LPG infrastructure can be used for shipping to Europe or Germany without major modifications [2]. At the import location, the DME can be used directly or reformed back to H_2 and CO_2 by adding water. The technology required for this is very similar to classic natural gas reforming, but further research and development is needed to adapt the reformer technology to DME.
The main advantage of this concept is, that CO_2 is captured at the location of used and back-transport to the location of DME synthesis. This heavily reduces the need for eligible carbon at the location of synthesis, thereby reducing costs and enabling upscaling of the concept.
In this talk the overall concept of the DME/CO_2 cycle as well as the technical concept for DME reforming and medium scale power production both with integrated carbon capture will be presented and development needs will be addressed.

[1] Schühle, P., Stöber, R., Semmel, M., Schaadt, A., Szolak, R., Thill, S., Alders, M., Hebling, C., Wasserscheid, P., & Salem, O. (2023). Dimethyl ether/CO2 – a hitherto underestimated H2 storage cycle. Energy Environ. Sci., 16(7), 3002–3013. https://doi.org/10.1039/D3EE00228D

[2] Japan Science and Technology Agency, 2024, https://sj.jst.go.jp/news/202401/n0115-02k.html

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