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Methanol Production from Steel Mill Gases - Comparison of Plant Performance for Different Carbon Sources

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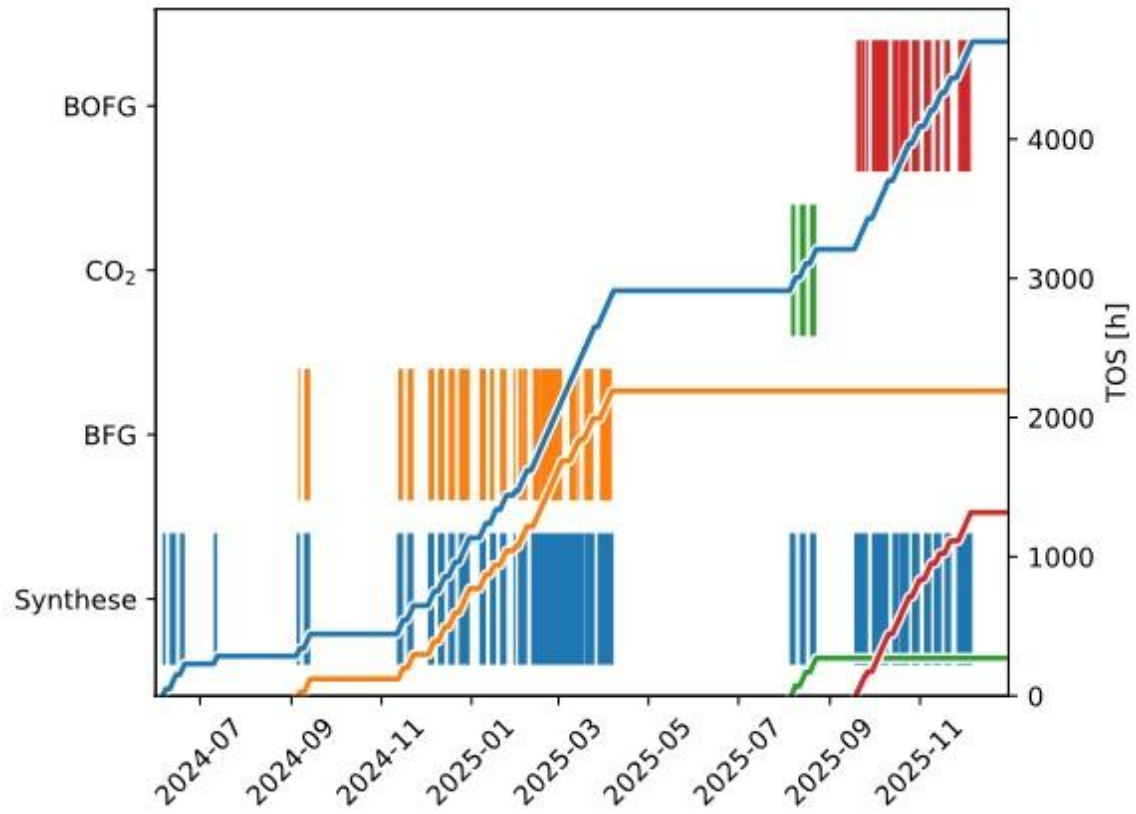
Within the collaborative project “Carbon2Chem” [1], a consortium from industry and academia investigates the potential for carbon sequestration from still mill off-gases and its subsequent utilization for the production of chemicals. A subproject deals with the production of methanol. The hydrogen source is a 2 MW alkaline water electrolysis. The sources for carbon oxides are blast furnace gas (BFG) and basic oxygen furnace gas (BOFG). While BOFG is mainly composed from carbon monoxide and carbon dioxide, BFG contains about 50 % nitrogen unfortunately and this dilutes the reacting gases and affects the efficiency of synthesis gas conversion. [2]

A used demonstration plant for methanol production from pure CO_2 and H_2 was procured and extended for the operation with feedgases with varying share of CO_2 and CO and additionally containing diluting inert gases like N_2 or CH_4. Online IR gas analysers for recycle gas and feedgas were added and a temperature measurement on the reactor axis with 36 measurement points. This plant with a production capacity of 50 ltrs. per day was operated with clean bottle gases on the premises of Fraunhofer UMSICHT for 3 campaigns with 1,257 operating hours in total performed with a single filling of catalyst [3] and subsequently moved to the integrated steel mill of thyssenkrupp Steel Europe in Duisburg and connected to the gas cleaning unit from the Carbon2Chem project. [4]

The demonstration plant is now operated with different carbon sources from the steel mill to compare the plant performance. The first carbon source was cleaned blast furnace gas with its nitrogen dilution. Next, the blast furnace gas is further processed in a water gas shift reaction to convert all CO to CO_2 and subsequently sequestered in an amine wash and converted in demonstration plant. The third source will be basic oxygen furnace gas from the conversion of raw iron to steel. At the end, blast furnace gas will “only” be treated in the amine wash (without prior sulfur adsorption and water gas shift) as a potential cheap cleaning system. With a single filling of commercial catalyst the accumulated TOS reached 4,701 h



Accumulated time-on-stream (TOS) with different steel-mill gases as carbon source

[5]. Liquid samples are taken during the operation and analyzed for main and by-products.

References:

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