Modelling and Scaling Considerations

Optimisation Potential of a Power-to-Methane Plant

Diplomand

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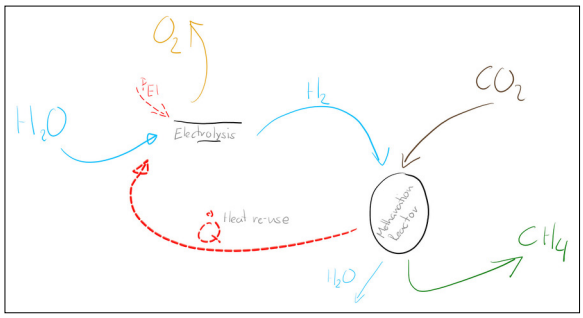
Einleitung: At the site of IET Institute for Energy Technology at OST in Rapperswil there is a Power-to-Methane (PtM) plant to test a concept for high-efficiency: The hydrogen is produced in an High Temperature Electrolyser (HTE) and the water at the HTE's input is pre-heated, which improves the electric efficiency of the HTE. The hydrogen from the HTE is combined with CO2 and fed into a Sabatier reaction to produce CH4. The reaction is exothermic and its heat is used to preheat and evaporate the water for the HTE. Early experiments hinted at efficiencies approaching 70 % in large scale.
Since the experimental plant used is small scale, the efficiency determined experimentally is not 70 %. The IET would like to have a model of the HEPP which allows for the prediction of efficiencies at different scales. For this also software has to be found in which to implement the model.

Vorgehen: A PtM-plant is a complex installation, especially when equipped with a HTE. Size and scale are relevant for each and every component. The model developed cannot state, which size of PtM plant with HTE reaches which efficiency. The model allows to specify the conditions that need to be met to reach a certain efficiency. Such conditions can be a maximum ΔT in heat exchangers or allowable power consumption for auxiliary equipment like the pump circulating the thermal oil.

Ergebnis: The modelling calculations indicate that under optimal conditions efficiencies of just about 70 % can be reached in larger scale. For this to be reachable, the electricity consumption from the thermal oil pump has to be reduced to reasonable levels and the full efficiency potential of large-scale HTE has to be achieved. The calculations assume favourable conditions, requiring further development for implementation. The main influence (on efficiency) comes from the HTE making up about 85 % of the energy consumption. Presumably only improvements to the HTE will make it possible to reach reliably beyond 70 %.

Basic principle of a power to methane plant. Water and carbon dioxide enter the plant, methane exits the plant.
Eigene Darstellung



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