TECHNISCHE HOCHSCHULE DEGGENDORF

OPTIMIZATION ANALYSIS OF POWER-TO-GAS

EIN TECHNIKUM ALS GRUNDLAGE ZUR SIMULATIVEN OPTIMIERUNGSANALYSE ZUR THEMATISCHEN WEITERENTWICKLUNG VON POWER-TO-GAS TECHNOLOGIE.

Weitere Infos

Abstract

Projekttitel/ Project title:

Optimization Analysis of biological Power-to-Methane with Simulation

Einleitung/ Introduction:

Sustainable energy supply today and in the future remains an intricate issue that calls for concerted political, technical and scientific efforts. One pressing aspect is the storage of renewable energy another question is the distribution of storable renewable energy forms as well as the question how future transportation will be powered. A promising solution for those challenges is chemical energy storage, namely methanation. Surplus renewable energy as well as organic / biological residuals and waste materials are transferred into H_2. Together with CO_2 H_2 can be transformed into renewable natural gas (RNG), which in turn can be fed into the natural gas grid reducing the load on electrical grids. Biological methanation takes place under moderate conditions and biology can handle diverse contaminants. Currently biological methanation is still in the research and development stage and needs further investigation to identify optimisation potential to drive the scale-up process.

Ziel/ Aim:

With the aim of increasing the efficiency of Power-to-Gas plants with biological methanation (PtM), the complete and systematic coupling of a PtG model system with suitable simulation software (Matlab/Simulink) is demonstrated. In addition to that, in the project S6ET an innovative system based on an open source tool (Calliope) for an efficient integration of PtM plants in regions with producer and customer of renewable energies is developed. Therefor weather data as well as detailed parameter about the energy production and demands, not only in form of electrical power even in form of gas and heat are integrated to form a holistic view in so called energy cells.

Methode/ Method:

Based on literature and experimental data, suitable mathematical models for reaction kinetics as well as for the process engineering of methanation are developed. Based on this, the hydrogen transport into the liquid phase of the reactor is modelled and the implementation of a biological reaction system is described. In addition to the simulation of different basic conditions for the exact representation of the functionality, the simulation model is validated holistically on experimental and literature data. The simulation quality will be compared with previously used simulation methods.

Ergebnis/ Result:

The results show that the developed simulation model exceeds common methods with respect to accuracy. A sensitivity analysis of the most important parameters is carried out for a detailed investigation of critical factors influencing the final result. Finally, simulations of process variants consistently show the optimization potential of biological methanation, which leads to proposals for effectively implementable measures.
With the groundwork provided by this study, industrial plants of adjusted size can be built and optimised for a demand driven manner at sites of surplus renewable energy, reducing the load of the electric grid.

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