Dynamic modelling of a 2-10kW methanation reactor

General Information:

Type of project: Master thesis

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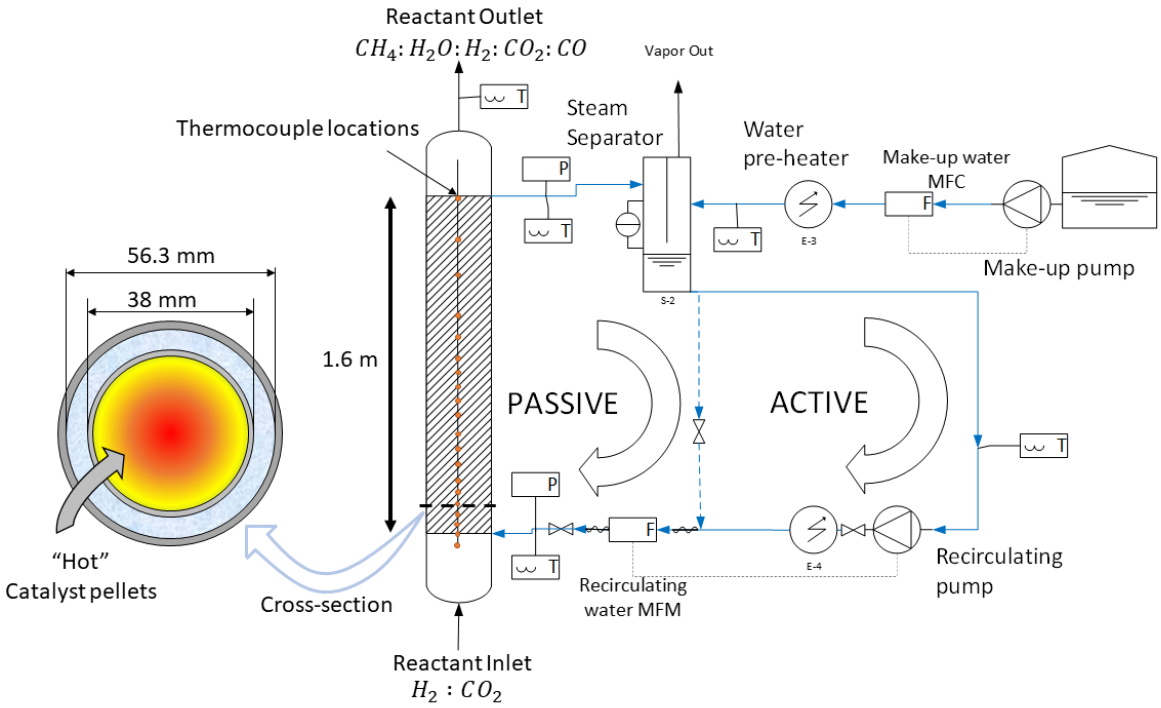

Figure 1: Reactor with BoP.

Project Description:

Chemical energy storage via power-to-methane technology has become one of the most promising options to store redundant renewable energy on a large scale, due to the existing infrastructure of methane storage (the natural gas grid). The power-to-methane technology is expected to be coupled directly with renewable electricity sources without an electrical battery as a buffer. In such a case, dynamic response of a power-to-methane system, particularly the isothermal methanation reactor, is critical to ensure safe and efficient operation. Thus, in this study, the dynamic modeling and response of small-scale methanation reactors are investigated, based on experimental data obtained from the facilities available in the EnergyPolis building.

The key tasks involved include:

1. Modify the current steady-state version of the reactor model.

    a. Investigate the inclusion of the reverse-water-gas-shift and CO methanation reactions.
    b. Parameters estimation of the kinetic model and heat transfer model.
    c. Include the time derivative terms of the governing equations.
    d. Parameters estimation of the dynamic terms.
    e. (Optional: Investigate the inclusion of 2D profile.)
2. Based on the developed models, investigate the influence of inlet velocity, inlet temperature, operating pressure, feed composition, cooling facility on the reactor performance, e.g., carbon conversion rate and catalyst de-activation.
3. Investigate the difference of dynamic response between the methanation of carbon dioxide and syngas methanation.
4. Connect model to existing Aspen plus SOE unit and methanation models.

Skill requirement:

- Familiar with programming language and logics, Matlab (Aspen is a plus)

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