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# CFD-Analysis Of A Sorbtion Enhanced Methanation Reactor
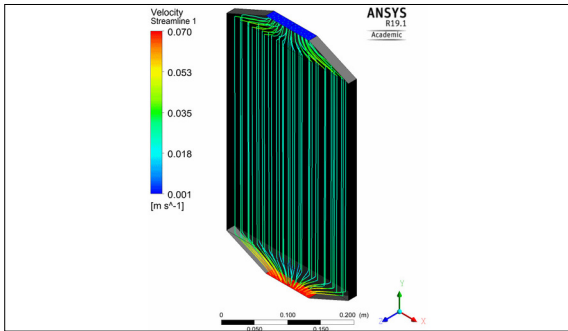


Flow field through the porous methanation reactor with the in and outlet in blue and red.
Own presentment
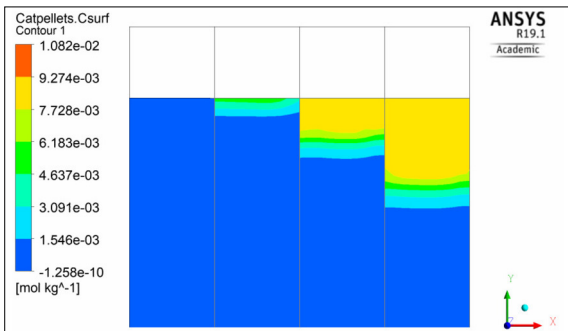


Water surface concentration on the virtual adsorbent catalyst pellet shown with the typical adsorption front.
Own presentment
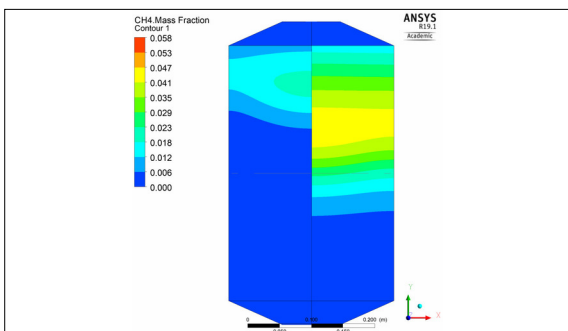


Methane mass fraction for two time steps, where the middle temperature hot spot lead to a forced conversion.
Own presentment

**Introduction:** The ambitious goals for Switzerland's energy transition 2050 lead to a growing interest on renewable energies. Unfortunately, these energy sources cannot be planned and were usually called fluctuating energies, especially wind and solar energy. So relevant components in the future's energy system will be different storage systems. A widely handled method is to storage the power in chemicals, mainly hydrogen, methane, methanol etc. Since hydrogen has different risks and weaknesses, the reaction with carbon dioxide to methane becomes more interesting. One way to produce pure methane out of one reactor is the sorption enhanced methanation reactor, which adsorbs the byproduct water within the reactor on a adsorbent.

**Objective:** The construction of these reactors is of interest in research. This study should deliver thermodynamic and constructive parameters to develop a optimized reactor. With the simulation of a reactor on the meso scale, different variables like the flow field, the temperature distribution, the water adsorption or a resident time distribution should be calculated.
To deviate those parameters and variables, the different chemical and physical effects were implemented in a ANSYS CFX simulation step by step. First, the flow field with the resulted pressure loss is calculated. As further steps, the chemical reaction is implemented, followed by the water adsorption on a virtual pellet surface. The intermediate results were compared with literature.

**Result:** The simulation of the chemical conversion or the mass fraction for the species were successful. The following implementation of the water adsorption, as well as the resulting adsorption front, were again possible. Unfortunately, the results deviate strongly from the measured results from literature and could not be validated within this work. Since those chemical and adsorption effects are handled on the base of balance and energy equations, deeper physical effects could not be considered. Basically, it could be shown that such complex models are possible within a CFX simulation, but the effort for stable and validated results is highly time intensive and needs a wide range of chemical and physical engineering basics.