Karlsruher Institut für Technologie

Institut für Chemische Verfahrenstechnik
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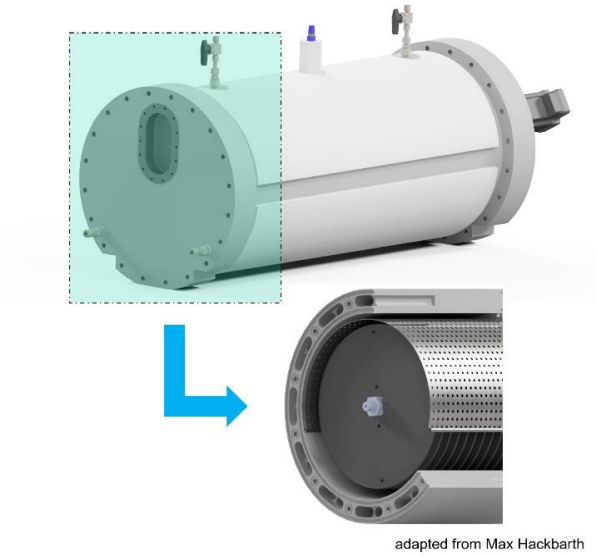
Engler-Bunte-Institut, Wasserchemie und Wassertechnologie
Prof. Dr. Harald Horn

Master's Thesis

Computational fluid dynamics (CFD) of a 100-L microbial electrolysis cell

Background and motivation



adapted from Max Hackbarth

Microbial electrolysis cells (MECs) are sustainable technologies for the production of hydrogen from variable waste streams derived from biomass. The organic substrates are oxidized by an electroactive biofilm that grows on the anode of the MECs. The electrons obtained are transferred via an external circuit to the cathode, where hydrogen is produced abiotically.

Currently, most of the MEC studies are restricted to the lab-scale with a working volume below 1000 mL. In order to up-scale the process, a single-chamber 100 L-reactor was constructed and the system performance was evaluated with biotic operation in the past 2 years. However, limitations were found concerning insufficient bacterial coverage on the working electrode surface, and suboptimal flow distribution inside the reactor was assumed as one of the main reasons for that. Therefore, a hydrodynamic characterization of the reactor is in needed to better understand the limitations of the reactor for further optimization.

As the first step of the cooperation between CVT (Institut für Chemische Verfahrenstechnik) and EBI-WCT (Engler-Bunte-Institut, Wasserchemie und Wassertechnologie), computational fluid dynamics (CFD) simulations will be implemented in the 100-L bioelectrochemical system to figure out the hydrodynamic shortcomings (velocity distribution, dead zones, short-circuits and so on) in the reactor chamber. To validate the model assumptions and parameters, experiments will be carried out at the EBI-WCT to determine the residence time behavior of the reactor.

Task

i. Carrying out a CFD-simulation of the 100-L reactor (at the CVT)
ii. Experimental determination of the residence time behavior of the reactor (at the EBI-WCT)
iii. Carrying out a parametric study to develop proposals for flow control

Requirement

i. Knowledge in CFD simulation
ii. Knowledge on electrochemical systems favorable but not required

Date: immediately, by appointment	**Contact**:
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