Engler-Bunte-Institut|
Wasserchemie und Wassertechnologie

Prof. Harald Horn

Investigation of a novel dual membrane biofilm reactor concept for individual supply of gaseous substrates through dense membranes

Problem:

Membrane biofilm reactors (MBfR) are a promising concept for biological upgrading of biogas via hydrogenotrophic methanation. Biogas with a residual CO_2 fraction of approx. 40 % is stoichiometrically enriched with hydrogen and is converted biologically by methanogenic archaea to additional methane. In an MBfR the biofilm is fixed on a hydrophobic membrane, whereas gaseous substrates and nutrients are supplied through the membrane lumen and the liquid phase, respectively, in a counter-diffusional manner. This concept of gas transfer circumvents the typical drawback of low gas solubilities in water and allows for an efficient supply of the biofilm with gaseous substrates.

Commonly, dense membranes are applied e.g., in membrane aerated biofilm reactors, to avoid liquid intrusion into the membrane (wetting) impairing the gas transfer to the biofilm. Despite good gas transfer properties of dense membranes, due to the different permeabilities of the gases in the mixture (CO_2, H_2, CH_4) supplied for biological upgrading of biogas, the substate gases are separated, limiting the systems efficiency and ability to produce high gas purities.

Tasks:

In a dual membrane biofilm reactor (dMBfR), the substate gases (biogas and hydrogen) will be supplied individually to two dense membranes. This approach allows for an individual supply of the substrate gases to the biofilm, compensating for the difference in gas permeability.

Within this work, the dMBfR concept will be experimentally investigated to optimize membrane arrangement, membrane area ratio and gas supply parameters, with the target of maximizing the methane production rate. The experimental work can be accompanied by simulations to optimize the reactor configuration. Results of this work will be compared to other reactor concepts the biological upgrading of biogas.

The results of the study are to be documented in written form and presented in a public lecture (e.g., institute's seminar).

Type: The scope of this work can be adjusted to Bachelor Thesis, Study Project or Master Thesis (WSE, CIW, BIW)

Starting date: immediately, by appointment

Supervisor: Dr.-Ing. Andreas Netsch

Examiner: Prof. Dr. rer. nat. Harald Horn / Dr. Andrea Hille-Reichel