Engler-Bunte-Institut|
Wasserchemie und Wassertechnologie

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**Determination and mitigation of the wetting development in hydrophobic porous membranes in membrane biofilm reactors (MBfR)**

**Problem:**

The membrane biofilm reactor (MBfR) is an emerging reactor concept for biotechnological applications as well as biological wastewater treatment (e.g., biological methanation, autotrophic denitrification). In such reactors the microorganisms are fixed in a biofilm on polymeric membranes. Gaseous substrates are supplied to the biofilm through the lumen of the membrane, while nutrients are supplied from the liquid phase in a counter-diffusional manner. This configuration circumvents the typical bottleneck of low gas solubilities in water, especially of gaseous electron donors such as hydrogen.

The choice of membrane is crucial to the gas-transfer efficiency of an MBfR. Hydrophobic porous membranes (e.g. made from polypropylene) have the potential to provide higher rates of gaseous substrates with a low separation of mixed gases, in comparison to dense membranes. However, due to their open structure at the gas-liquid interface, porous membranes are prone to wetting. The wetting of membranes drastically decreases gas supply efficiency of membranes due to the intrusion of water into the membrane pores adding a diffusion barrier to the gas transport.

**Tasks:**

Wetting detection in membranes is challenging and often either limited to end-of-experiment analysis (e.g. via scanning electron microscopy) or to indirect deduction of monitored parameters such as pressure drop. Magnetic Resonance Imaging (MRI) offers a versatile method for the in-situ and non-invasive characterization of liquid-liquid and liquid-solid systems and allows for the detection of liquid intrusion in the membrane pore structure.

In this study, the wetting detection by means of MRI should be validated for microporous polypropylene membranes applied in MBfRs for a time-resolved monitoring of the development of the wetting front in the membrane pore structure. Furthermore, the impact of operational parameters (e.g., membrane pressure, gas supply operation mode, and liquid phase composition) and mitigation strategies (e.g., membrane coating) on the wettability of membranes will be investigated.

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

**Type:** 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