Advancing Nanofiltration for the Separation of Reaction Mixtures through Membrane Characteriation and Automated Screening

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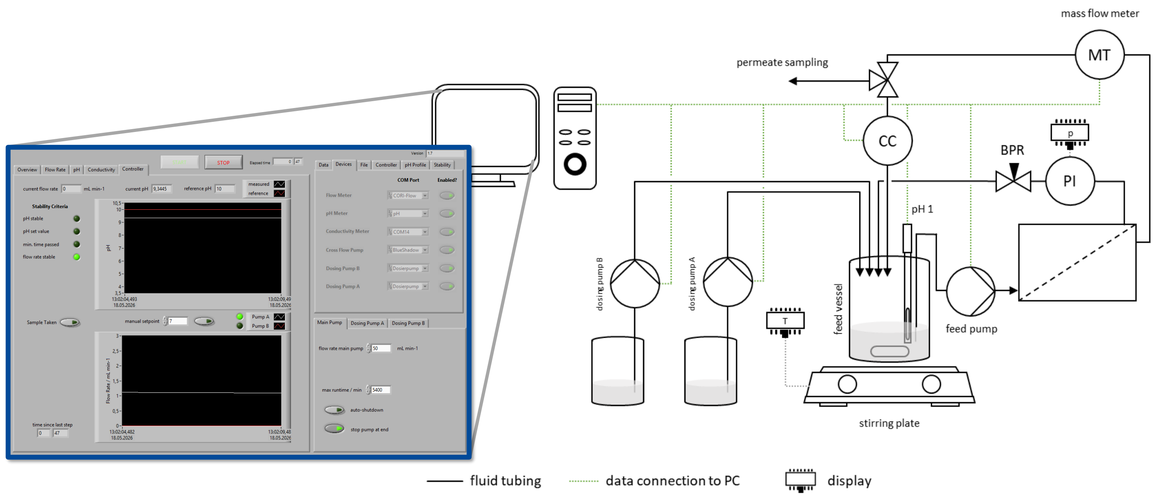
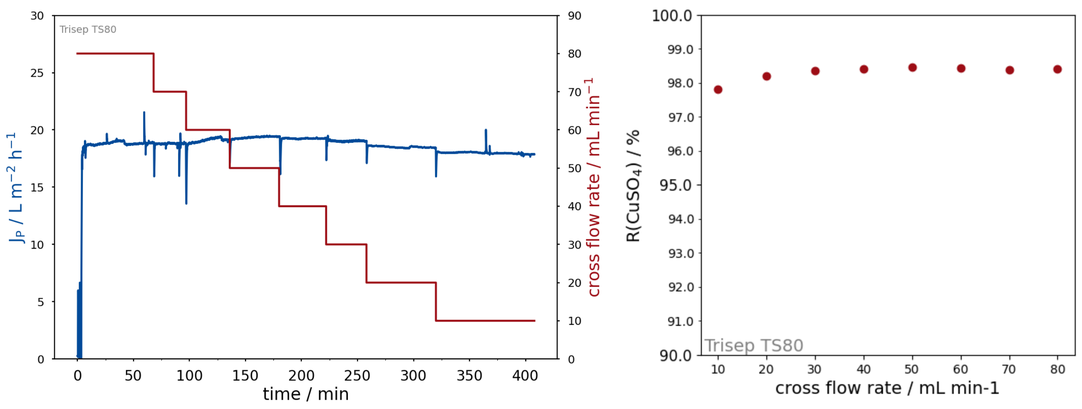
Methodology

Experimental Setup

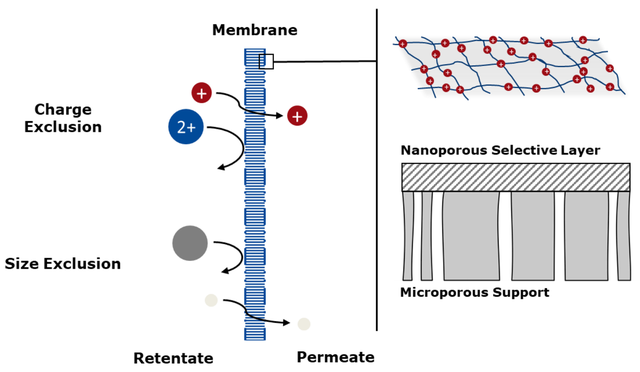


- highly integrated and flexible setup, supporting various methods of automated screening
- filtration performance can be determined based on permeate flux and conductivity
- automated logging of data and metadata
- quick identification of optimal conditions and operating windows



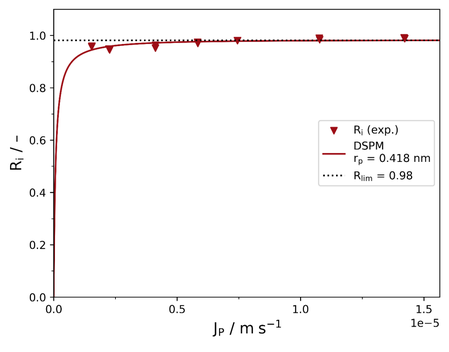
Conditions: Trisep TS80, 5 mM $CuSO_4$, 10 bar, 25 °C. Retention of $CuSO_4$ was determined by in-line conductivity measurements.

Membrane Characterization



Pore Size

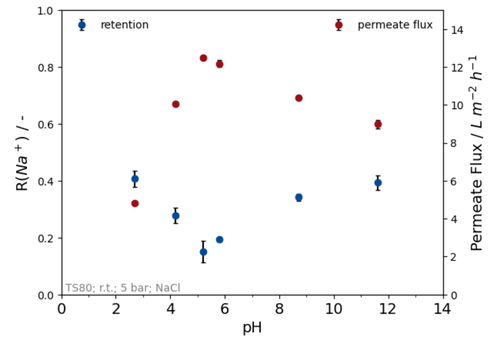
Neutral Solute Filtration



Conditions: Trisep TS80, 0.2 g L^{-1} glucose, 1-20 bar, 25 mL min^{-1} cross flow rate. Glucose was determined by HPLC.

Isoelectric Point

Charged Solute Filtration



Conditions: Trisep TS80, 0.1 mol L^{-1} NaCl, 5 bar, 10 mL min^{-1} cross flow rate, pH was adjusted using NaOH and HCl. Na^+ was determined by ion chromatography.

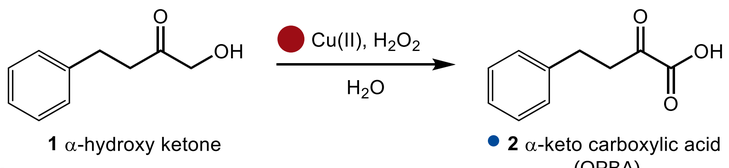
- acquisition of general membrane descriptors to allow for rational selection of membranes and operating conditions for emerging separation problems

[1] H. Schröter, U. Kragl, *Membranes* **2026**, *16(2)*, 60.
[2] H. Schröter, J. Behrens, A. Kienle, U. Kragl, *in preparation*.

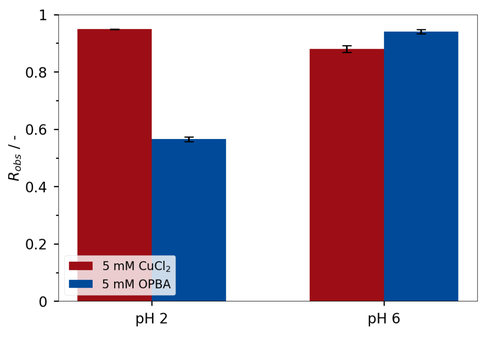
Application

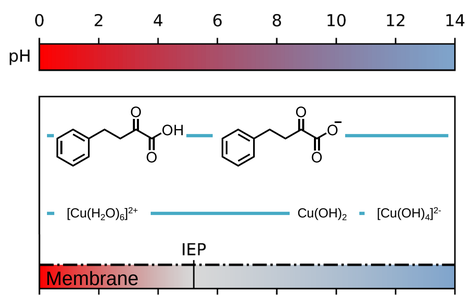
Separation of Oxidation Catalysts

Prof. Nora Kulak, Isabell Prediger, University of Potsdam



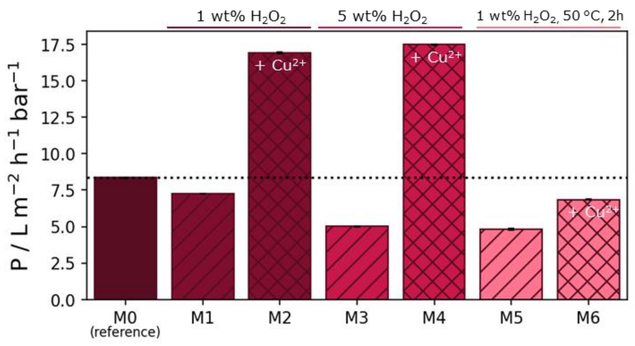
Selectivity





Conditions: Trisep TS80, 5 mM CuCl2 and OPBA, r.t., pH was adjusted using NaOH and HCl.

Membrane Stability

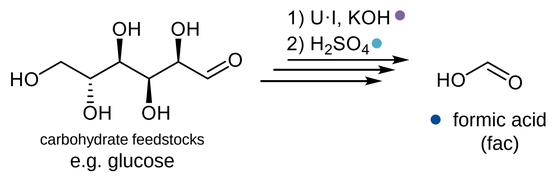


Degradation experiments were conducted at 25 °C, except M5 and M6. 5 mmol L^{-1} $CuSO_4$ was added to M2, M4 & M6. The permeability was determined by filtration experiments with the exposed membrane cutouts at 5 bar, 25 °C with pure water. Membrane used: Trisep TS80.

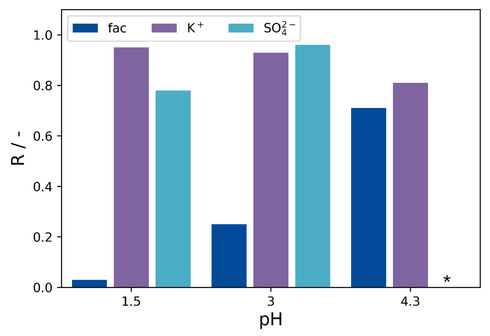
- adjustment of the feed pH modulates both the membrane surface charge and the solute speciation
- higher selectivity can be reached a low pH
- polymeric membrane (polyamide) is degraded by high amounts of reactive oxygen species

[3] H. Schröter, I. Prediger, N. Kulak, U. Kragl, *Sep. Purif. Technol.* **2025**, *377*, 134389.

Purification of Formic Acid

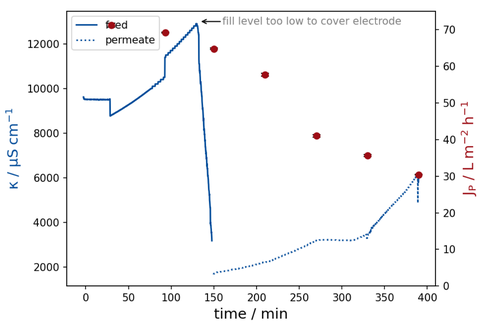


pH Screening



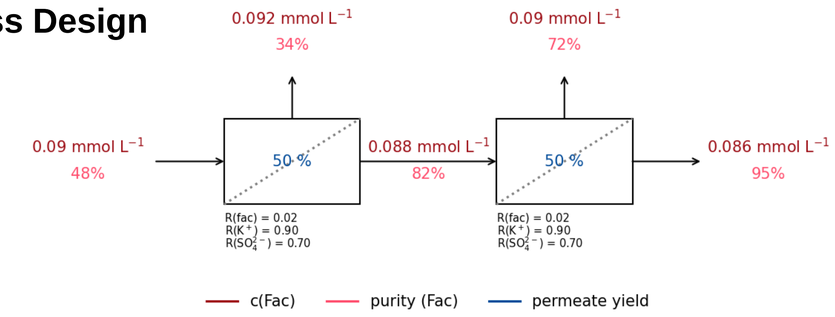
Conditions: 12.5 bar, 25 °C, 2.8 g L^{-1} formic acid, 0.05 mol L^{-1} K^+, pH adjusted with H_2SO_4. *no H_2SO_4 was added to the feed.

Preparative Filtration



Conditions: 12.5 bar, 25 °C, pH 1.5, 2.8 g L^{-1} formic acid, 0.05 mol L^{-1} K^+, pH adjusted with H_2SO_4.

Process Design



- speciation of formic acid is most relevant for the selectivity
- high purity can be reached after two filtration stages

[4] A. Erdmann, H. Schröter, D. Aschenbrenner, U. Kragl, *in preparation*.

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Acknowledgement
This work was funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - grant number 501735683 (FOR 5538, IMPD4Cat).

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