Microfiltration Polysulfone (PSU) Membranes for Polar Product Recovery

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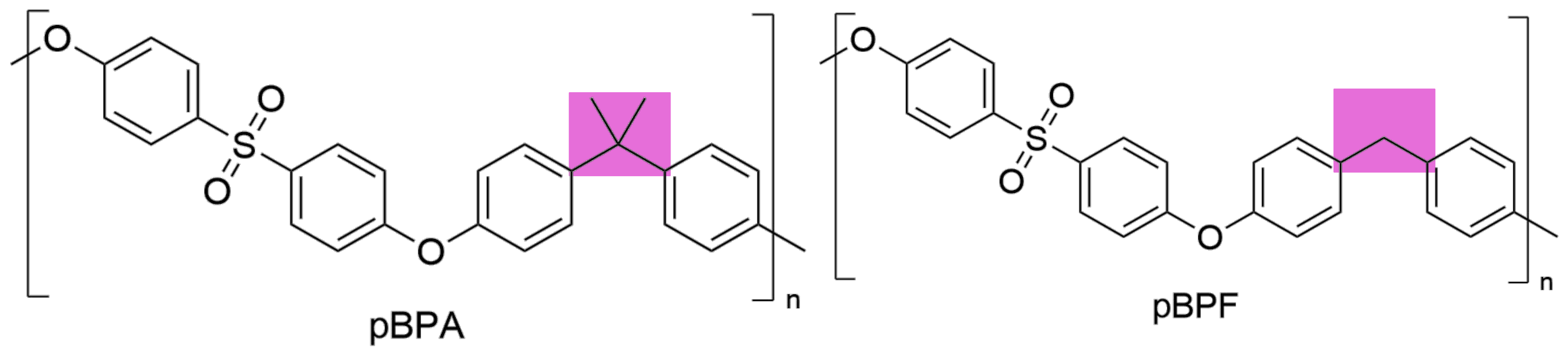
MOTIVATION

Studying PSU microfiltration membranes will advance the field of membrane technology, specifically separating polyurethane depolymerization products, and how it is applicable to wastewater treatment.

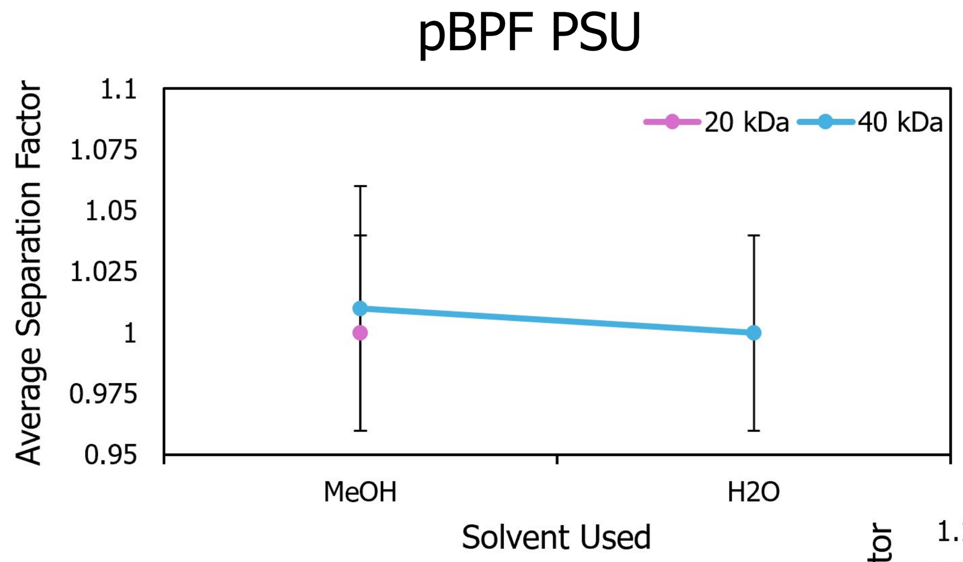
BACKGROUND

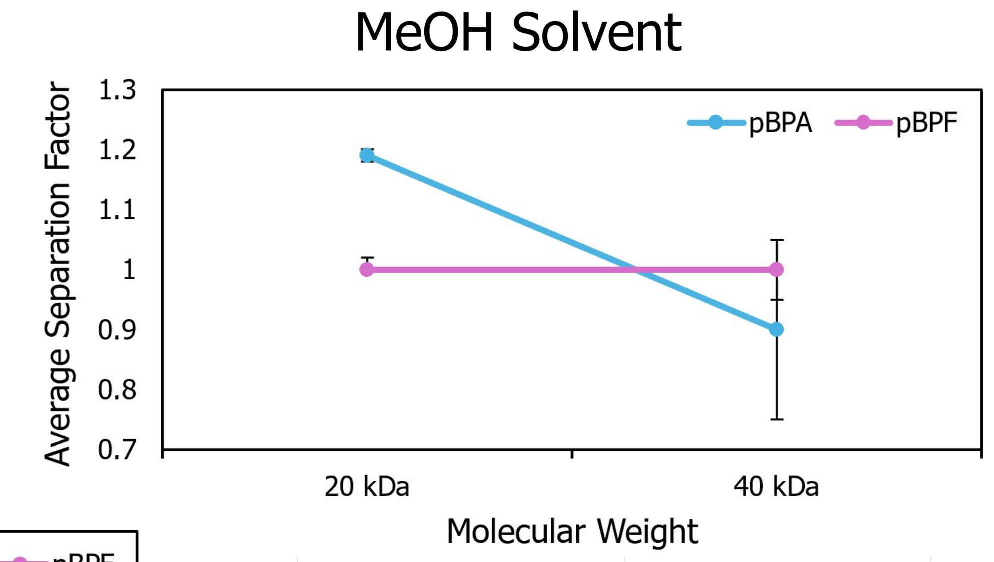
- PSU made with Bisphenol A or F (pBPA/pBPF)

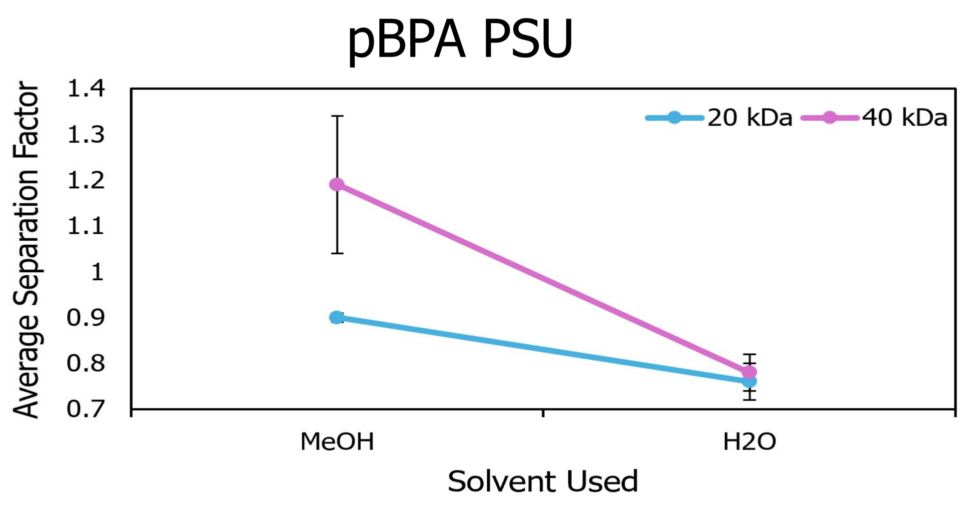


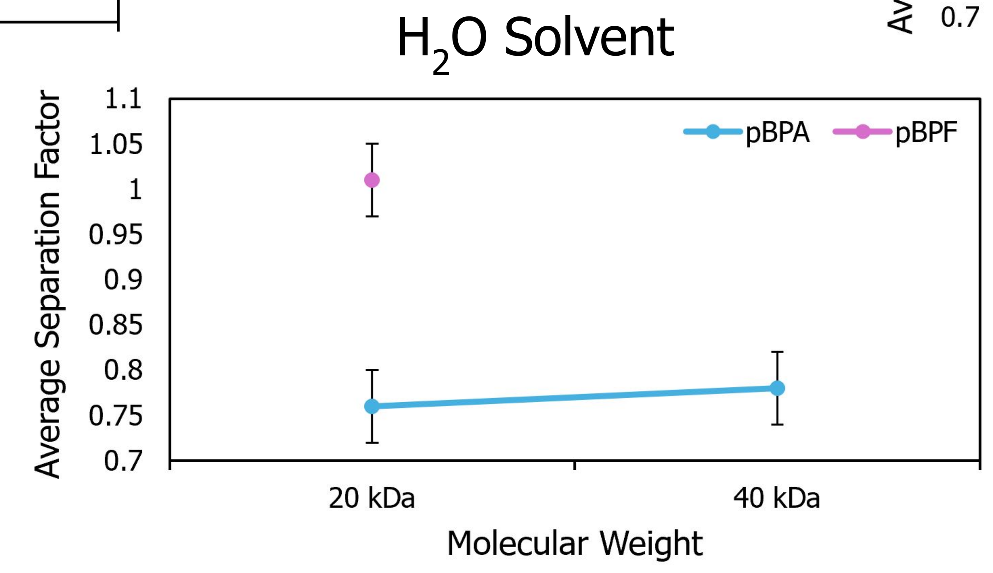
- Product from PU depolymerization includes polyols like poly(ethylene glycol) (PEG)
- PEG water soluble
- Use microfiltration PSU membranes to filter out PEG from water streams

RESULTS

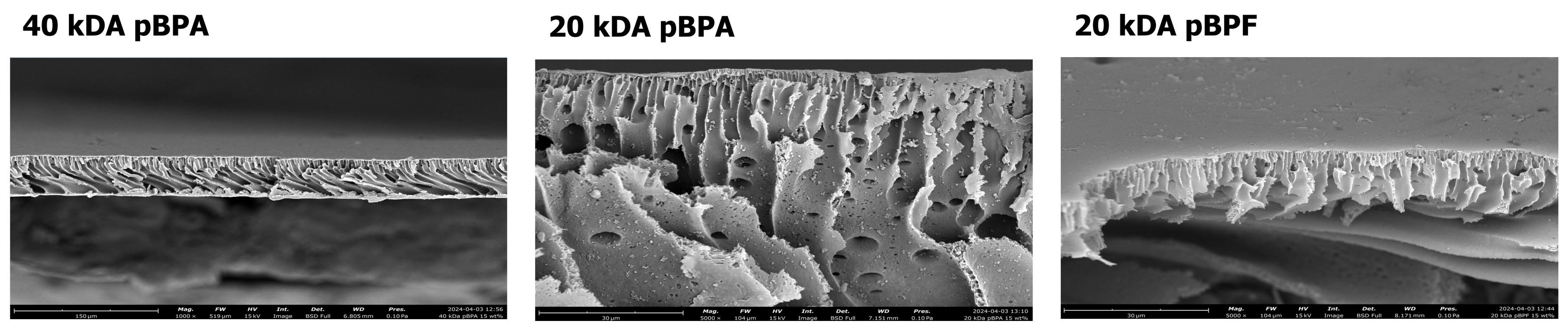






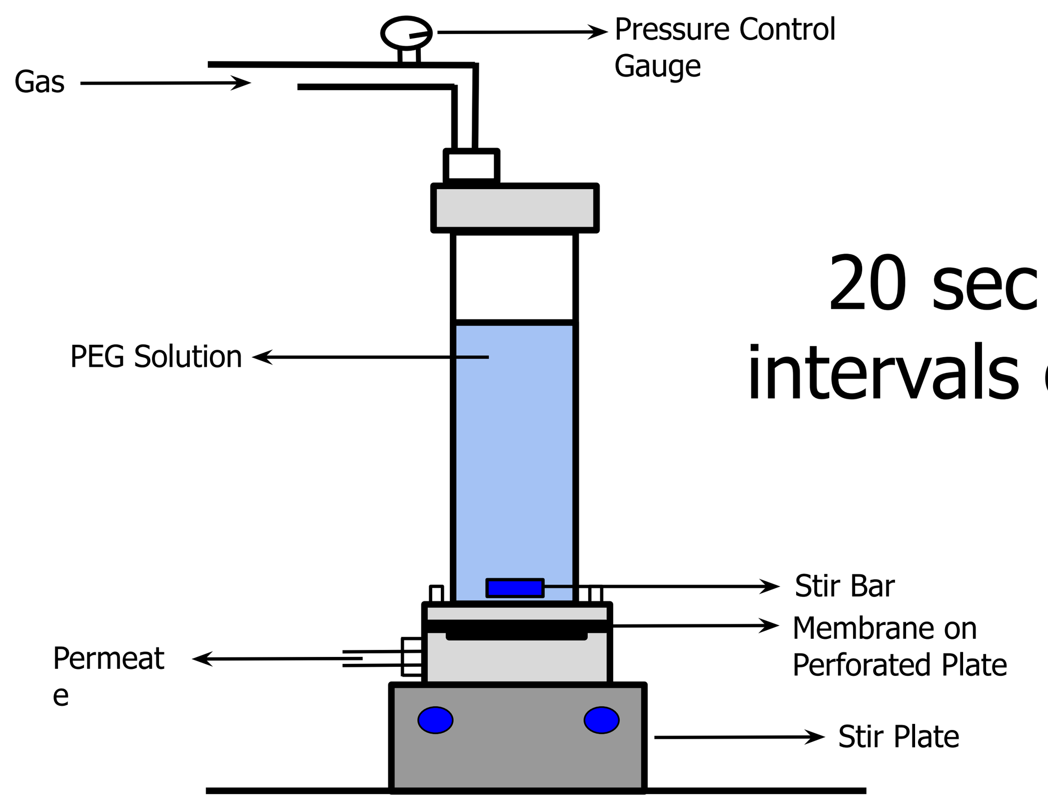


SEM Imaging:



METHODS

Dead-end Cell Filtration



15 min runtime
20 sec aliquots at time intervals of 5, 10, 15 min

Membrane performance represented by measured and calculated values:

Productivity

- **Flux**: $J = \frac{1}{A_m}\left(\frac{dm}{dt}\right)$
- **Permeance**: $Q = \frac{J}{Driving\ Force} = \frac{J}{P_i - P_{down}Y_i}$
- **Permeability**: $\bar{P}_i = S_i \times D_i = Q_i l$

Separation Efficiency

- **Selectivity**: $\beta = \frac{Q_i}{Q_j}$
- **Separation Factor**: $\alpha = \frac{P_i/P_j}{F_i/F_j} = \left(\frac{P}{1-P}\right)\left(\frac{1-F}{F}\right)$

A_m = membrane cross-section area
$\frac{dm}{dt}$ = change in permeate mass over time
P_i = equilibrium vapor pressure of i in the feed
P_{down} = downstream pressure
D_i = diffusion coefficient
S_i = sorption coefficient
l = membrane thickness
$P_{i,j}$ = fraction of components in permeate
$F_{i,j}$ = fraction of components in feed

CONCLUSION

- Membranes with smaller pore sizes more effectively filter out the PEG
- pBPA shows better separation efficiency than pBPF
- The farther from a separation factor of 1, the better separation observed

REFERENCES

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(2) Tokiwa, Y., et al., *Int. J. Mol. Sci.* 2009, **10** (9), 3722–3742.

(3) Obotey Ezugbe, E., et al., *Membranes*, 2020, **10** (5).

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