SYNTHESIS OF POLYMERS TO MAKE MEMBRANES FOR WATER PURIFICATION

Bryce Askew, Chemical Engineering B.S.E.
Mentor: Dr. Matthew Green, Associate Professor
School for the Engineering of Matter, Transport, and Energy (SEMTE)

RESEARCH QUESTION

This project seeks to examine the effect of using different functionalizations of polydimethylsiloxane (PDMS), fabricated into a membrane, on the efficacy of the membrane in removing volatile organic compounds (VOCs) from water.

METHODS

This project uses pervaporation, a process combining permeation and evaporation, as the method of separation of volatile organic compounds (VOCs) from water.

Process:

- Fabricated membrane in Teflon plate or via drawdown casting
- Cut 16 cm² square out of membrane sample and measured the thickness of this square
- Set up the crossflow cell with the 16 cm² membrane sample
- Set up peristaltic pump with sample solution
- Pulled vacuum on membrane with solution pumping for 1 hour to clear out excess solution from the system
- Weighed condenser after cleaning out any condensed solution, re-set up apparatus
- Pulled vacuum on sample (1 hour for pure solvents, 24 hours for solutions)
- Ran at least 2-3 runs on each membrane with each pure solvent and with a solution of 2 wt% ethanol in water

Efficacy of membranes was measured from flux, permeance, permeability, and selectivity (calculated using pervaporation data).

OBTACLES

- Some of the membranes have been very weak, and have broken before all needed data is collected
- Due to only working 10 hours a week, has been difficult to collect a lot of data as runs can take a while (both setup and actual experiment time)

FINDINGS

- PDMS-PDPS Co-polymer and TFPMS both show promising selectivity for ethanol and methanol in pure sample testing, and both show promising selectivity data for Ethanol in 2 wt% EtOH:Water solutions
- Very little difference between liquid nitrogen and dry ice for condensing volatiles
- Standard plastic petri dishes do not work well for making PDMS-PDPS membranes, Teflon works much better
- For drawdown casting, organic solvents like ethanol help with release membrane from substrate

FUTURE WORK

- With the data collected so far, there is a clear path to continue research into the efficacy of these polymers
- More testing with 2 wt% ethanol, but also testing different wt%, water in solution with methanol and other VOCs, as well as flipping the dominant solvent (i.e. 2 wt% water in ethanol)
- Additionally, other functionalizations of PDMS polymers could be explored with separations
- Other methods of separation, like microfiltration, could be explored in addition to further pervaporation tests

ACKNOWLEDGEMENTS

- Dr. Matthew Green
- Taysha Telenar
- Husain Mithaiwala
- Hoda Shokrollahzadeh Behbahani
- Ani Nazari
- Marlene Velazco Medel
- The entire Green group
- Alexis Powell