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Effluent Treatment and Recovery of Polyether Using Nanoporous Technology

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CHEMICAL AND LIFE SCIENCE

Effluent Treatment and Recovery of Polyether Using Nanoporous Technology

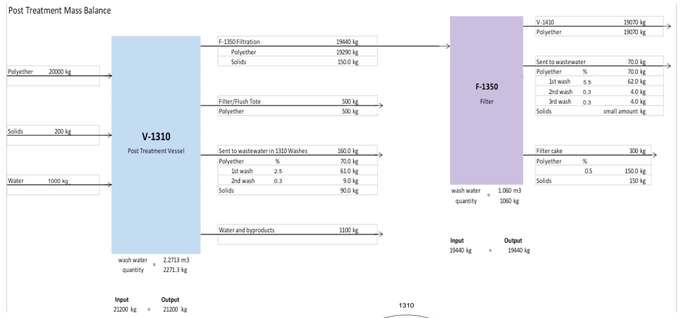
CAPSTONE DESIGN EXPO 2015

Background

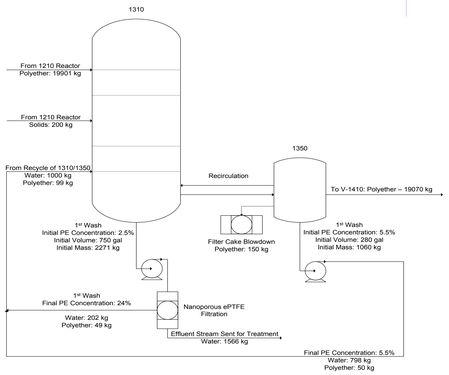
Our Mission:
- Recover lost polyether from effluent
- Use a combined recycle stream/nanoporous technology
- Steady state process
- Save Evonik money in the areas of product recovery and water treatment

Hypothesis & Specific Aims

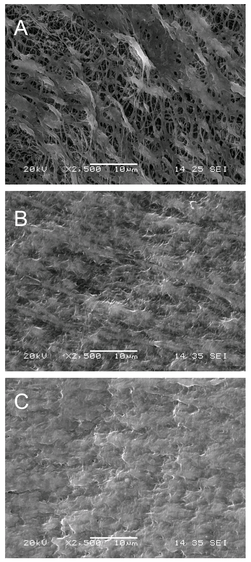
Our group devised a method that recycles the first wash of the filtration vessel, 1350, back into the post treatment vessel, 1310. The first wash from 1310 will be concentrated using an expanded Polytetrafluoroethylene (ePTFE) and recycled back into 1310 as well, eventually reaching a steady state process.



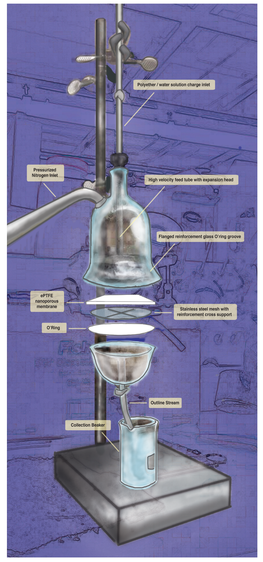
- Recovery of 50 kg polyether from 1350 (280 gal)
- Concentration of 1310 from 2.5% to 24%
- Recovery of 49 kg polyether from 1310 (~66 gal)



Results



- **Right:** Detailed phase separator used for bench scale experimentation
- **Left:** Scanning Electron Microscopy (SEM) of both ePTFE membranes used for experimentation
- **A:** ePTFE membrane with pore size of 0.2-0.5 µm and 80% porosity (used)
- **B:** ePTFE membrane membrane with pore size 0.1-1 µm and thickness of 100 µm (unused)
- **C:** ePTFE membrane membrane with pore size 0.1-1 µm and thickness of 100 µm (used)



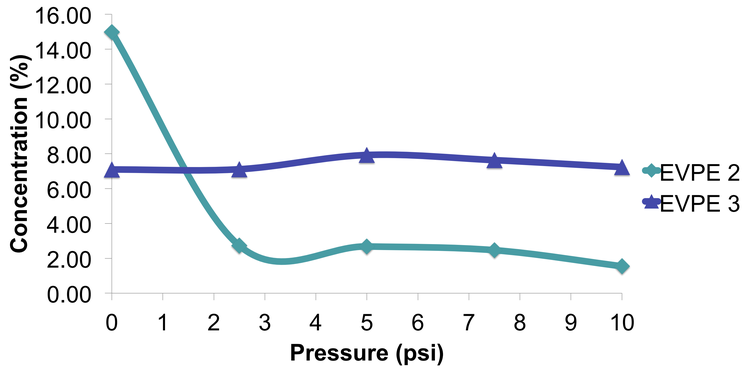


Figure 1. Experimental Results of EVPE 2 and EVPE 3 from Phase Separator Performed in Laboratory 347 Engineering West Hall.

Table 1. Cost Analysis Including Capital Investment and Monthly Income of 80% Recovered Polyether from 1310 and 1350.

Money Saved Recycling		
Batches/year	365	
$ Saved/year	118,260	$
Yearly Costs		
ePTFE Membrane	5.47	$/ft^2
Estimated ePTFE needed	750	ft^2
Costs of ePTFE	4,103	$/year
Capital Costs		
Equipment (Uninstalled)	5,000	$
Equipment (Installation Factor)	300%	
Capital Investment	15,000	$
Annual Income	114,158	$
Monthly Income	9,513	$

Table 2. Return of Investment Calculations.

Time	Month 0	Month 1	Month 2	Month 3	Month 4
Investment Payback ($)	-15000	-5487	4026	13539	23053
ROI (%)	-100	-37	27	90	154

Conclusion

- Further experimentation needed for EVPE 1
- Nanoporous ePTFE filtration is an effective method for concentrating 1310
- Membrane thickness plays an important role in filtration

Future Plans

- Several types of membranes
  - varying porosity, mean pore size, and membrane thickness
- Adjusting independent variables such as pressure & temperature
- More efficient phase separator
- Running several systems in series to simulate scale up

Acknowledgments

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VCU School of Engineering

Make it real.

VIRGINIA COMMONWEALTH UNIVERSITY