Alternative Polish Filtration Methods

Iustina Banerji, Jessie Hainline, Jackson Massey, Trey McCoy, Brooke Roed
Advisors: Brandon Jones, Justin Galloway

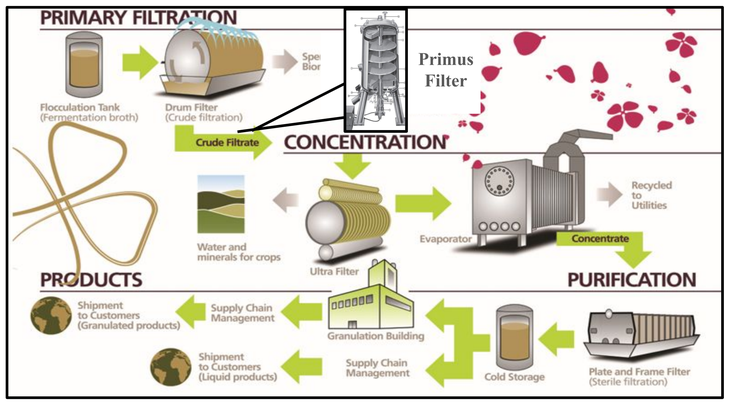
Project Goals

- Find alternatives to the current filter used at Novonesis achieving solids reduction similar to the established polish filtration
- Redesign the new filtration step prior to ultrafilters (UF) that fits within the existing footprint
- Ensure the safety and quality of product is not compromised in redesign

Recovery Process

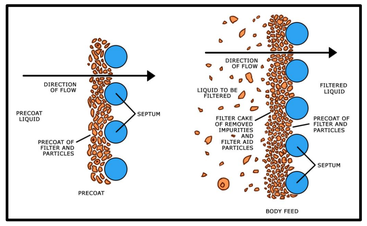
What is Novonesis?

- An industrial enzyme manufacturer which harvests microorganisms to catalyze processes and build up or break down molecules
- These enzymes are sold to customers in various industries from agricultural and industrial biosolutions to consumer products

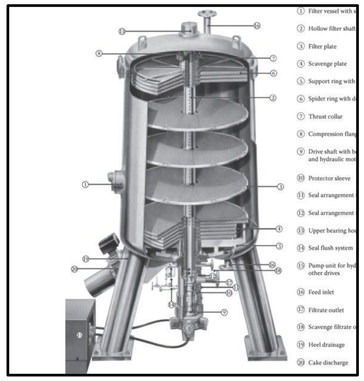


What is the Primus?

- Downstream depth filter located between the drum filter and the ultrafilter to remove impurities from the enzyme product stream
- Composed of multiple filter plates for maximum separation
- Filtrate enters an inlet port then travels down plates to a filtrate cavity while separating any unwanted solids, exits through the middle of the filter via the outlet port
- Current state issues include:
  - Particulates bypass the filter and reach the UF system
  - Unwanted solids entering the products
  - Companies are no longer installing Primus filters



Visual of Primus filtration process



Primus filter cross section

Lab Testing

Goals of Lab Testing

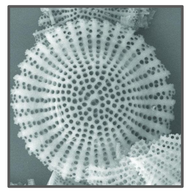
- Create an experimental design a lab-scale process to mimic the Primus filter
- Test various filter aids to find the optimal chemistry for this process
- Test various mesh screens that could replace the current damaged Primus screens

Results of Lab Testing

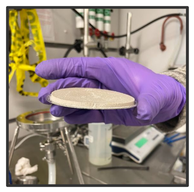
- Diatomaceous Earth (DE) filter cake created on a stainless steel filter screen
- Particle size analysis done on all filter aids
- Design of experiment to effectively test new filter aids and screens

Independent Variables	Dependent Variables
Filter Aid	Precoat Time
Filter Flux	Filtration Efficiency
DE Loading	
Volume	

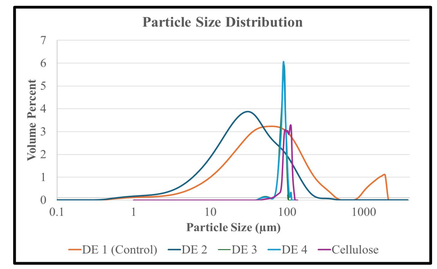
Bench-top Primus Set-Up



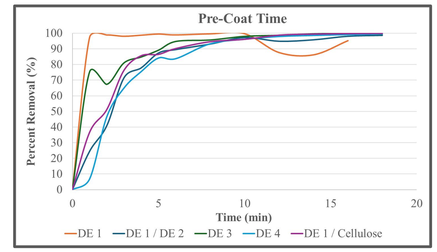
Microscopic image of DE



Filter cake after filtration



Particle Size distributions for each filter aid



Percent removal of filter aid during precoat

Potential Solutions

Short Term Solutions

DE 1	DE 2	Cellulose
• Current Novonesis Filter Aid • Proven procedure • Bleeds through filter • Abrasive to UFs	• Smaller particle size • More tortuous filtration path • Faster filter plugging • Longer Precoat Time • Easily bleeds through	• Long organic fibers • Faster precoat time • Not fully compatible • Less bleed through

Long Term Solutions

Pre-Filtration Device	Candle Filter
Benefits • Provides second line of deference to protect UF • Keeps current equipment • Minimal changes to building infrastructure Drawbacks • Uncertain of the improvements to product quality • Uncertain if UF membranes will be protected	Benefits • More robust cleaning regime • Quicker filtration rate • Eliminates all current state Primus issues Drawbacks • Requires removing current equipment • Largest capital expense

Cost Analysis

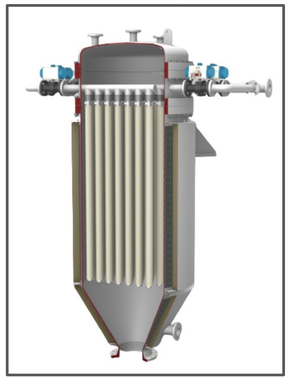
- To deal with the current Primus issues, Novonesis currently:
  - Replaces their UF membranes every 3 months ~$400K per year
  - Rescreens Primus~ $1.02M

Filter Aid	Cost Comparison
DE 1	Baseline
DE 2	1x DE 1
Cellulose	4x DE 1

	Prefiltration Device	Candle Filter
Direct Cost	$318K	$8.1M
Indirect Cost	$80K	$2.7M
Cost Estimate	$397K	$10.8M
OME Total	$437K	$15.1M

Recommendations

- **Long Term**
  - Invest in Candle Filters to replace all Primus filters



- **Short Term**
  - Continue lab-scale Primus testing using newly created SOP to determine best new DE option
  - Further investigate ratios of filter aid mixtures DE 1/2 & 1/Cellulose
- **Deliverables**
  - Project Charter - Justification of funding for candle filter installation
  - Lab SOP - Created for Novonesis to continue with experiments and DE data analysis

Acknowledgements

We would like to thank our mentors Brandon Jones and Justin Galloway, as well as all Novonesis employees for their help and guidance throughout this project.