



VIA
SEPARATIONS



Outline

Introduce Via and our Technology
Highlight our success in pulp and paper
Preview our Refinery Applications
Application with Sour Water



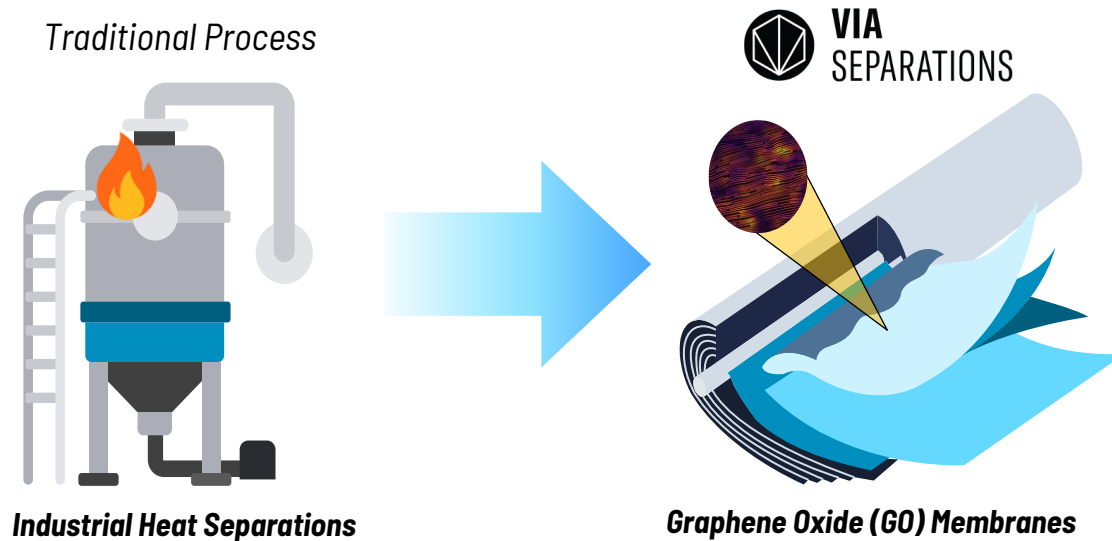
Bryce Mason
Sales Manager
Bmason@ViaSeparations.com



Via Separations was founded to revolutionize industrial separations

Replacing industrial heat with mechanical filtration helps industrial manufacturing customers do more with less

Via Overview



Founding Team



Brent Keller
CTO and acting COO

Shreya Dave
CEO

Jeff Grossman
Chief Scientist

Via **spun out of MIT in 2017**, where Shreya & Brent met and worked under Prof. Jeff Grossman

Via **augments and electrifies** existing assets to deliver:

Up to **90%** energy reduction

Improved **stability** & capacity

Modular, demand responsive systems

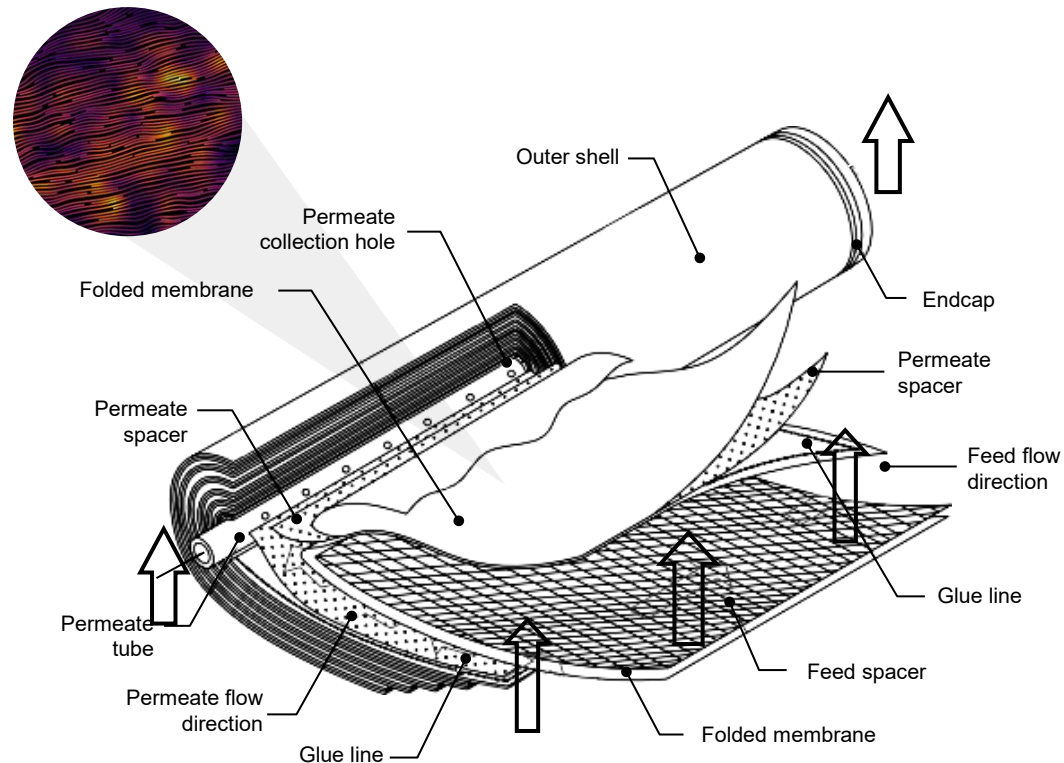
Integration with **no downtime**



Developed at MIT, proprietary graphene oxide membranes are Via's differentiated technology

Graphene oxide is a low-cost material with extreme chemical and thermal stability, ideal for tolerating the harsh conditions of many industrial separations

Via's GO Membrane



Key Features of the GO Membrane

1

Graphene oxide is a cousin of graphene (pencil lead) that has been 'chemically exploded' (i.e., is **dispersible** in water)

2

A **GO solution** can be coated as a **thin film** on a substrate or support, so it can be used as a membrane material

3

GO is **precisely tunable** and can be chemically modified to meet specifications depending on the application

4

GO membranes are Via's core technology, but the main product is a **filtration system** including the equipment (pumps & pipes) needed to integrate membranes into existing manufacturing processes

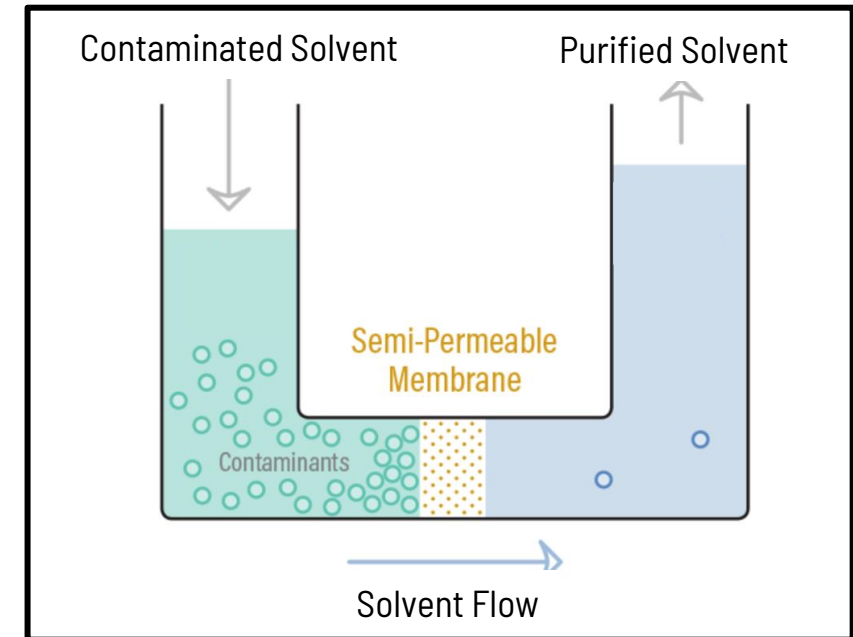


Membrane Separations deliver significant OPEX and CAPEX savings

Via Separations develops membrane-based processes to unlock capital and operational savings through a range of industrial separation processes



- Uses electrical energy to push a dilute fluid through a membrane, separating it into concentrated and purified streams.
- Value lies in either the purified fluid or the concentrated byproduct, depending on the application.



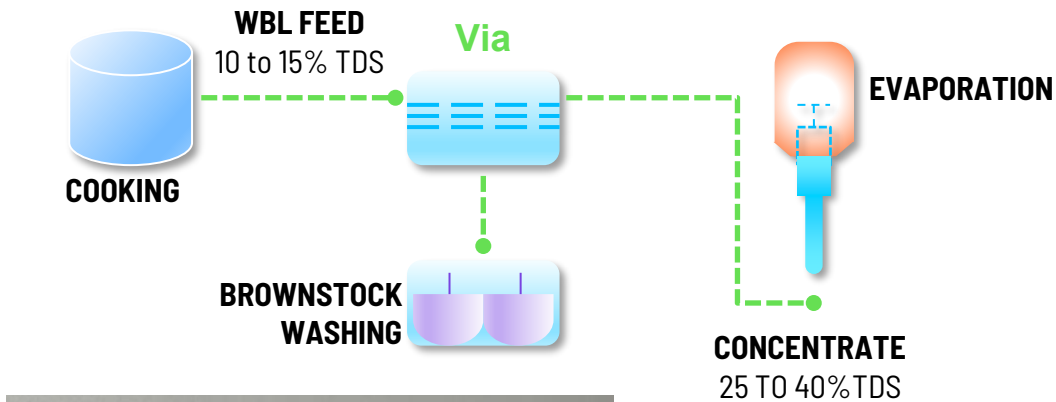
Membrane Separation Technology Simplified



Via's Commercial Start: Pulp & Paper

Concentration of weak black liquor (WBL), a hot (180 °F) and corrosive (pH~13) byproduct stream, proves industrial possibilities

Illustrative Result of Via's System



Via delivers clean water permeate (right) through filtration of WBL (left)

Detailed Capabilities of Via's Systems

- **Weak black liquor** is a valuable sulfurous byproduct of the kraft pulping process; it is concentrated with evaporators and burned for energy & chemical recovery
- **Via's systems 'pre-concentrate'** some of the WBL feed, removing water as permeate prior to going to the evaporators, delivering clean water and concentrated black liquor (25-40% solids) to the customer
- First commercial project was installed with **zero downtime** by the customer in only 11 months.
- That project **augments existing assets**, processing a slipstream (~20%) of the mill's full WBL feed
- **Modular systems** offer the ability to expand filtration capacity in the future, or to completely replace thermal processes for facilities evaluating major capital projects



With 15+ months of operation at commercial scale, Via has retired technical risk

Via delivering value today to industrial customer International Paper at their Grande Prairie pulp mill



Project Performance

150M

Gallons of customer flow processed

10,000

Hours of commercial operation

120

Gallons Per Minute of water separation achieved

76%

Energy reduction at full capacity

99+%

Uptime demonstrated

“Working with Via has been a great experience...It allows us to run more wash on our product, which creates a better and cleaner product with lower chemical costs”

Sep 2024: Mill Manager & President, IP Canada



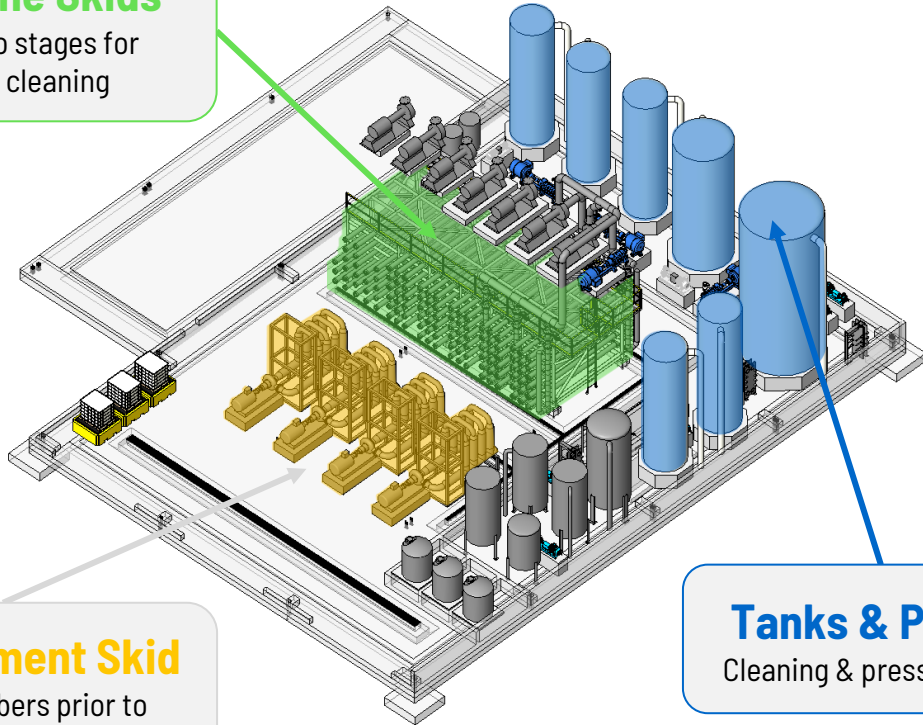
Deployment of Via's proven technology enables cost savings and emissions reduction

Modularity of Via's filtration system product offering represents a meaningful improvement over industry standard separations

Via System Overview

Membrane Skids

Broken into stages for efficient cleaning



Pretreatment Skid

Removes fibers prior to membrane system

Tanks & Pumps

Cleaning & pressurization

Key Value Propositions

Small Footprint

Via's system can be added even in space constrained environments

Augments Existing Systems

Option to revert to old method of production if needed

Small Capital Outlay

Minimal capital expense for installation

Modularity

Multiple systems can be added to increase throughput

Plug-and-Play

Minimal downtime needed for installation



Via is developing 3 products that drive immediate value for O&G refiners

10+ other applications identified in earlier stages of evaluation

Laboratory Validation



Vacuum column debottlenecking

Enables refineries to process heavier crude, reducing costs and energy

Developing Pilot System



Sulfuric acid regeneration

Enables on-site processing of sulfuric acid, reducing costs

Planning Pilot Deployment

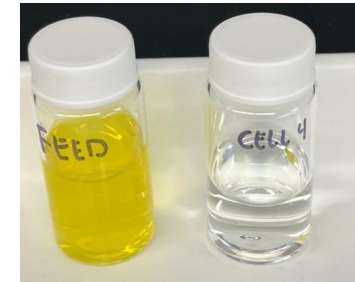
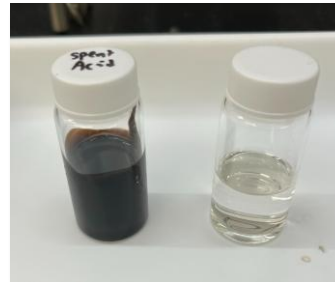
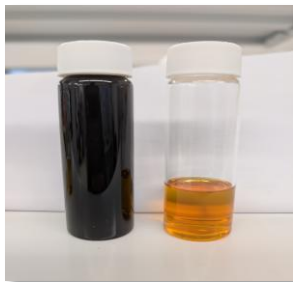


Sour Water Stripping (SWS)

Reduces energy and increases throughput for SWS

Value Proposition

- **Direct equipment benefits:** Lower capex, opex, and footprint requirements with reduced or eliminated need for heat integration
- **Debottlenecking & capacity increase:** Lower per unit energy consumption enables process intensification and operational flexibility
- **Reduced downtime:** Low-cost excess capacity serves as a tool to reduce loss of earning events
- **Fuel switching opportunities:** Enable higher sulfur or heavier crude utilization to improve refinery profitability



Via System Integration – Multiple Configurations Possible

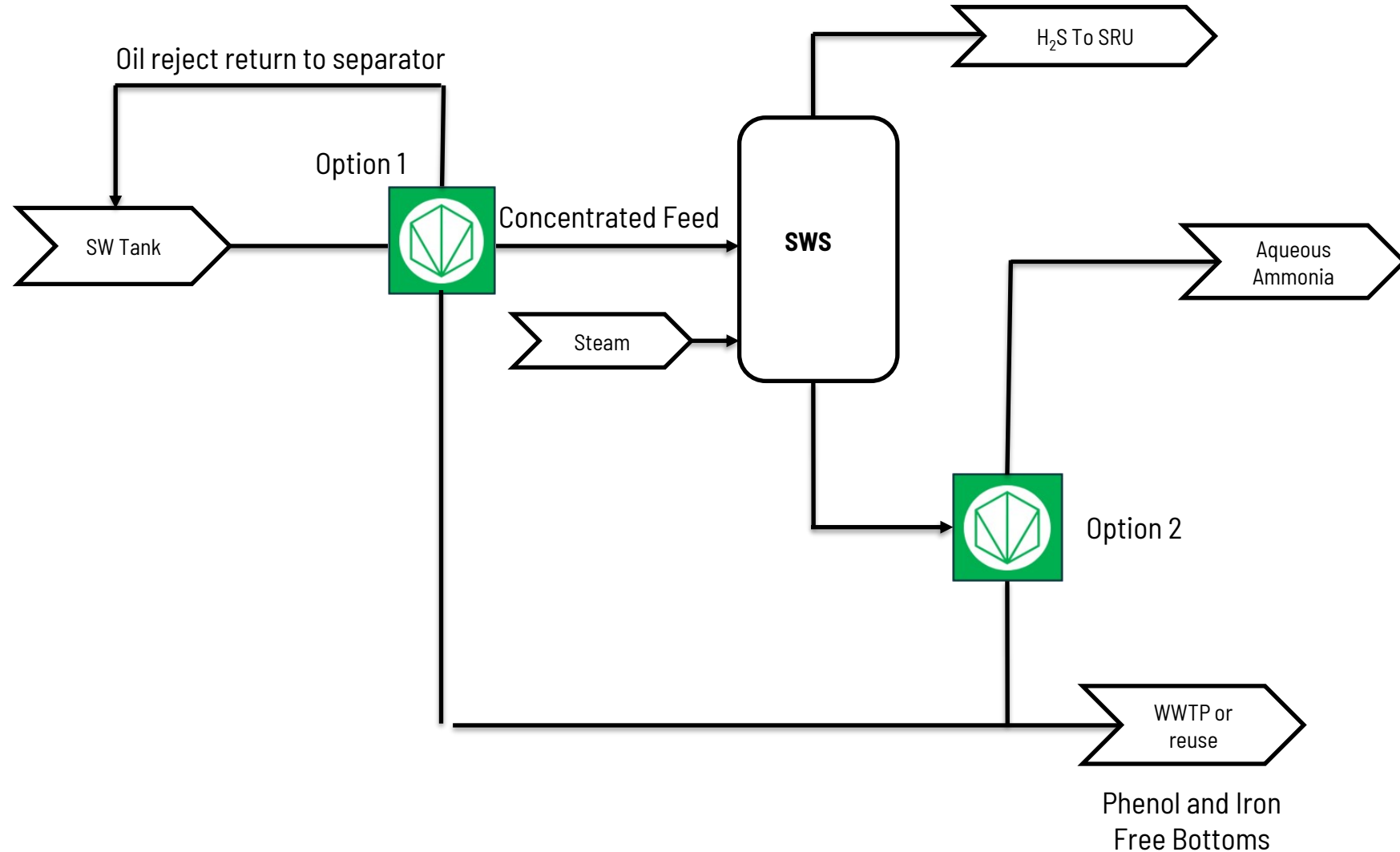
Option 1: Concentrate SWS feed

- Increase capacity and save steam
- Remove oils which can disrupt stripping

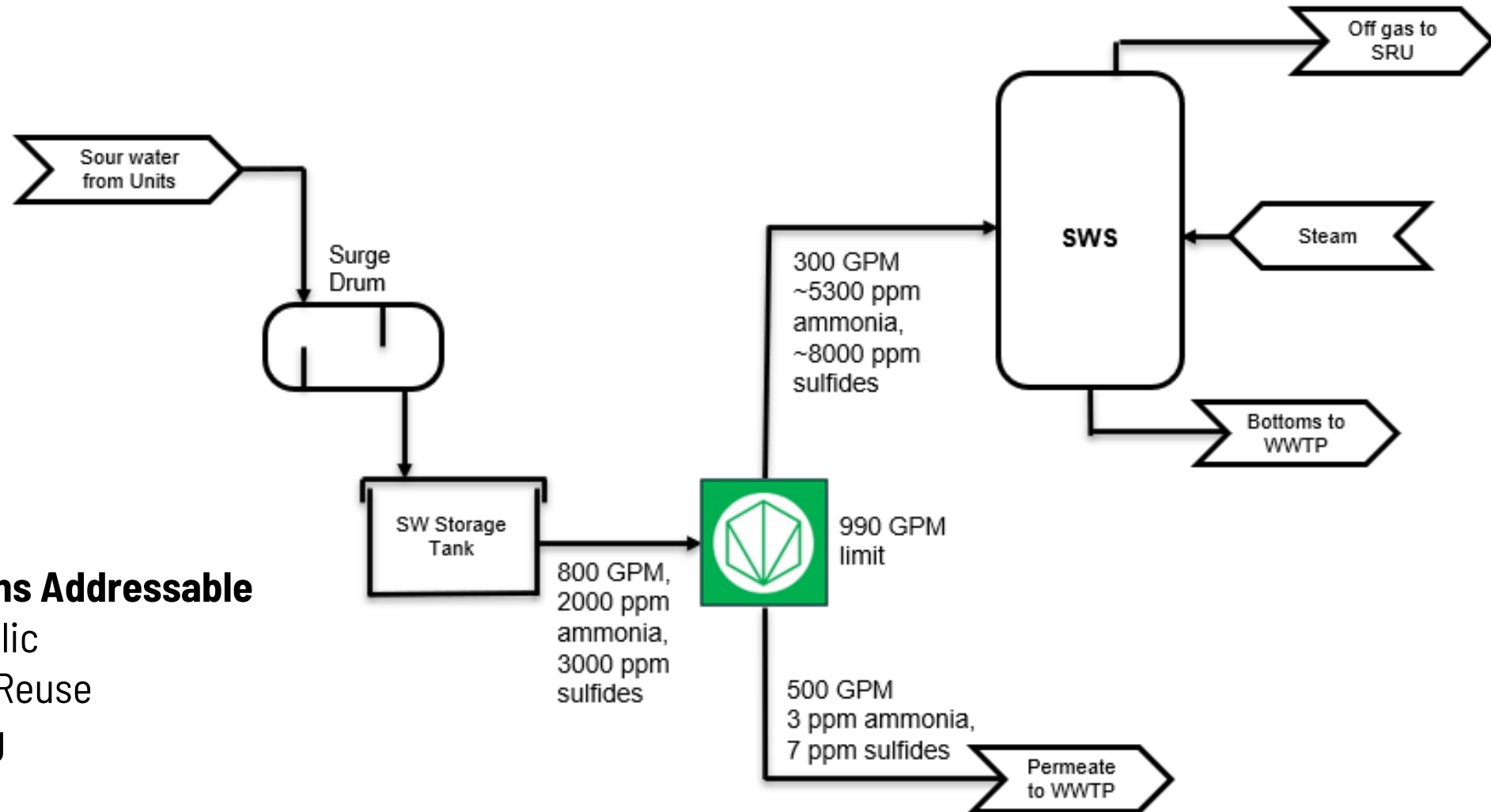
Option 2: Concentrate Ammonia

- Saves steam in SWS – only strip H_2S
- Removes iron, phenols, and other contaminants which can limit reuse

Sour Water Feed & Via's Permeate



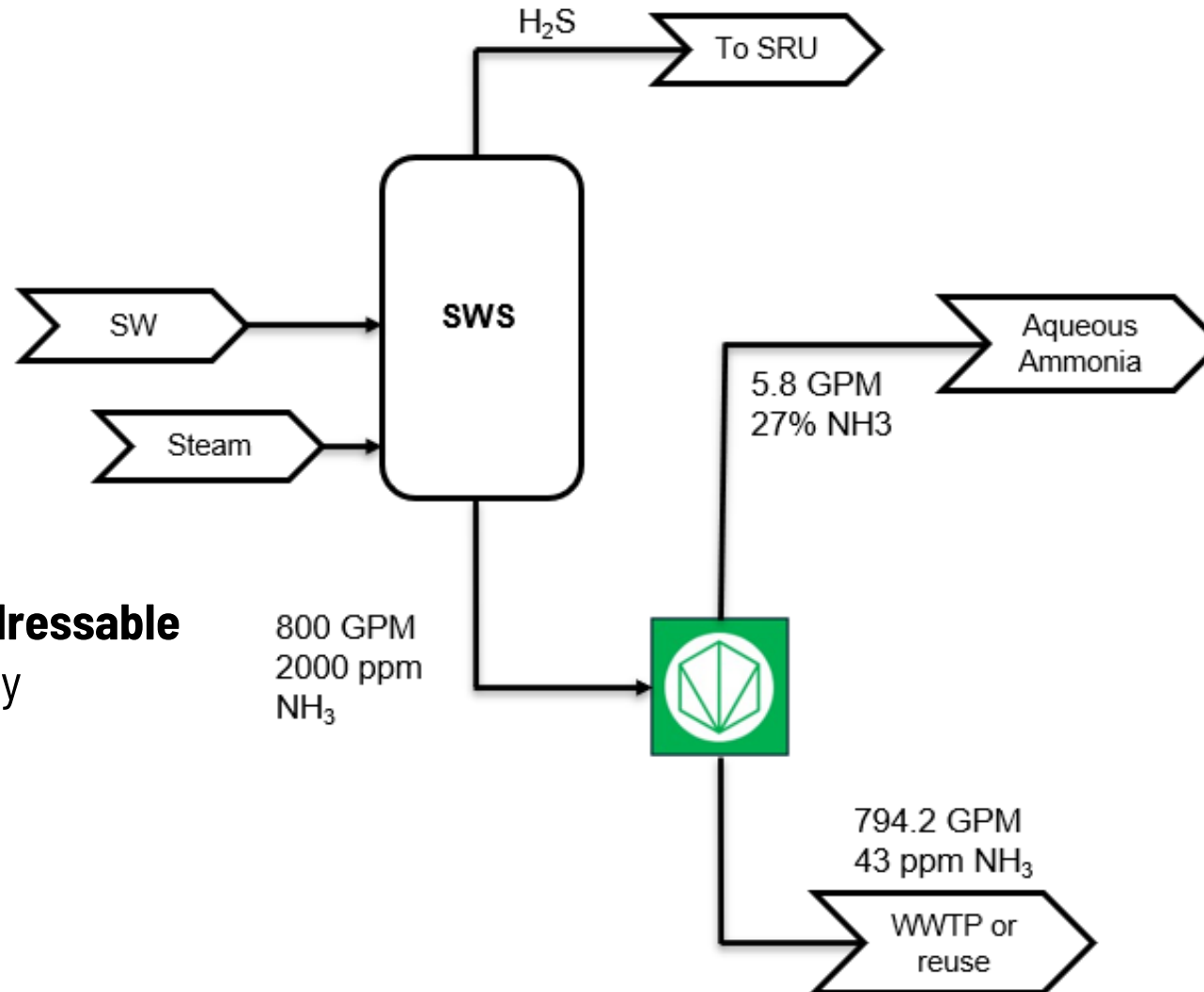
Sour water concentration with Via Membranes



Limitations Addressable

- Hydraulic
- Water Reuse
- Fouling

Ammonia concentration with Via Membranes



Limitations Addressable

- Steam/Energy
- New Product

Initial Screening- Dead End Testing

First Stage of Testing

- Load the Membrane to be tested in the bottom in the bottom of the chamber
- Fill Chamber with Liquid to be tested
- Pressurize the chamber with Gas to provide the motive force
- Measure the Volume and Retained Fluid as a function of time
- Characterize the retentate and Permeate

Feed for SW DE*:

- Phenols - 50 mg/L
- Cyanide - <0.005 mg/mL
- Sulfide - 3000 mg/L
- Ammonia - 2000 mg/L

Permeate from SW DE:

- Phenols - <0.1 mg/L
- Cyanide - <0.005 mg/mL
- Sulfide - 1 mg/L
- Ammonia - 80 mg/L**

*Values are approximate to protect sensitive information from customer

**Ammonia can be further reduced by additional membrane pass



Cross Flow Testing

Determines many of the design parameters for full scale adaptation



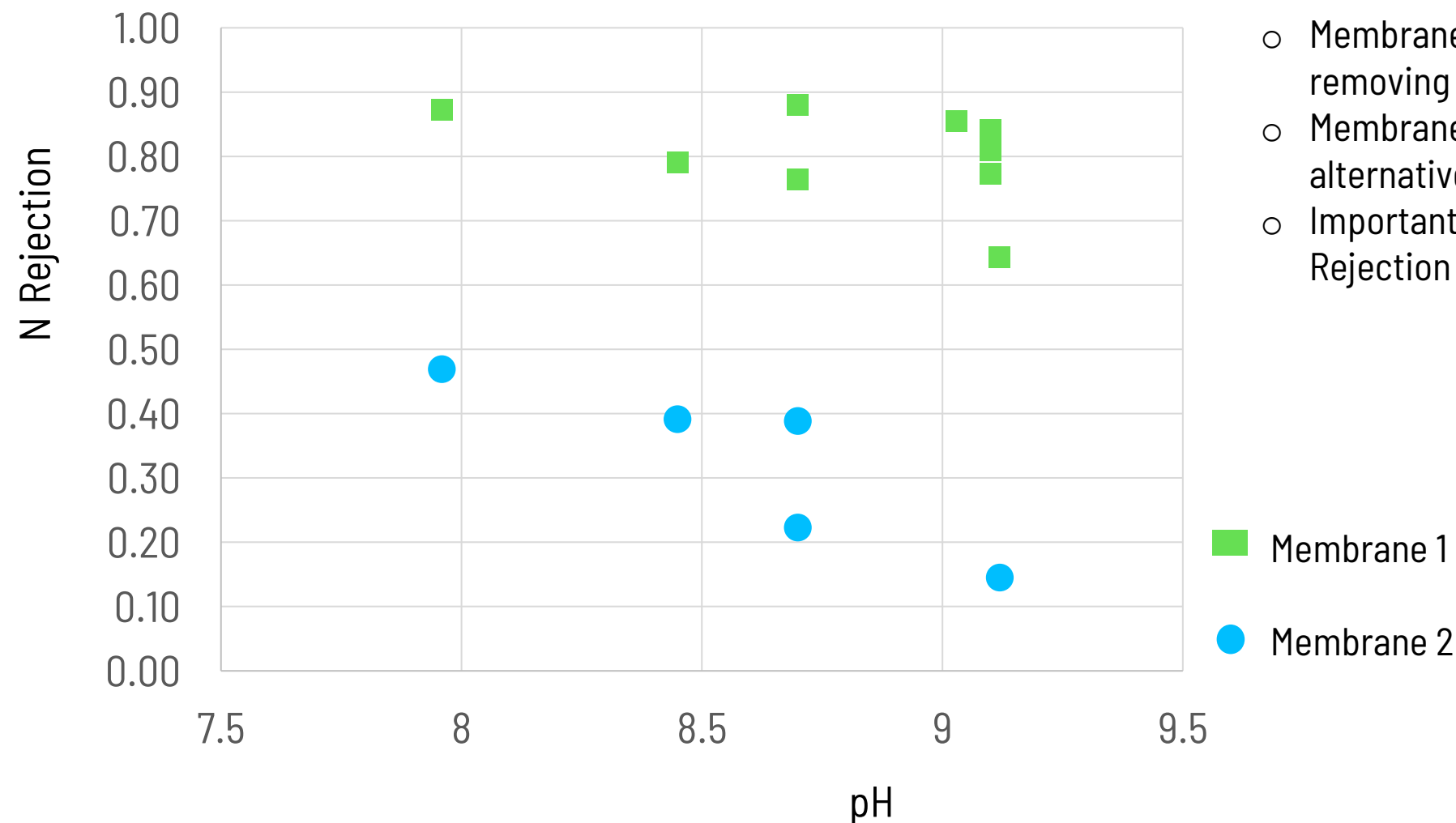
- Via cart sized system (left) used for more representative testing
- Fluid flow over membrane surface is consistent with commercial scale designs
- Runs in a Semi Batch Mode.
 - Fill system with starting fluid
 - Permeate is removed until the feed tank reaches the low point shutoff
 - Concentrate is collected separately



Cross Flow Data- Ammonia Rejection

Screening different Membranes is part of our process

NH3 Rejection

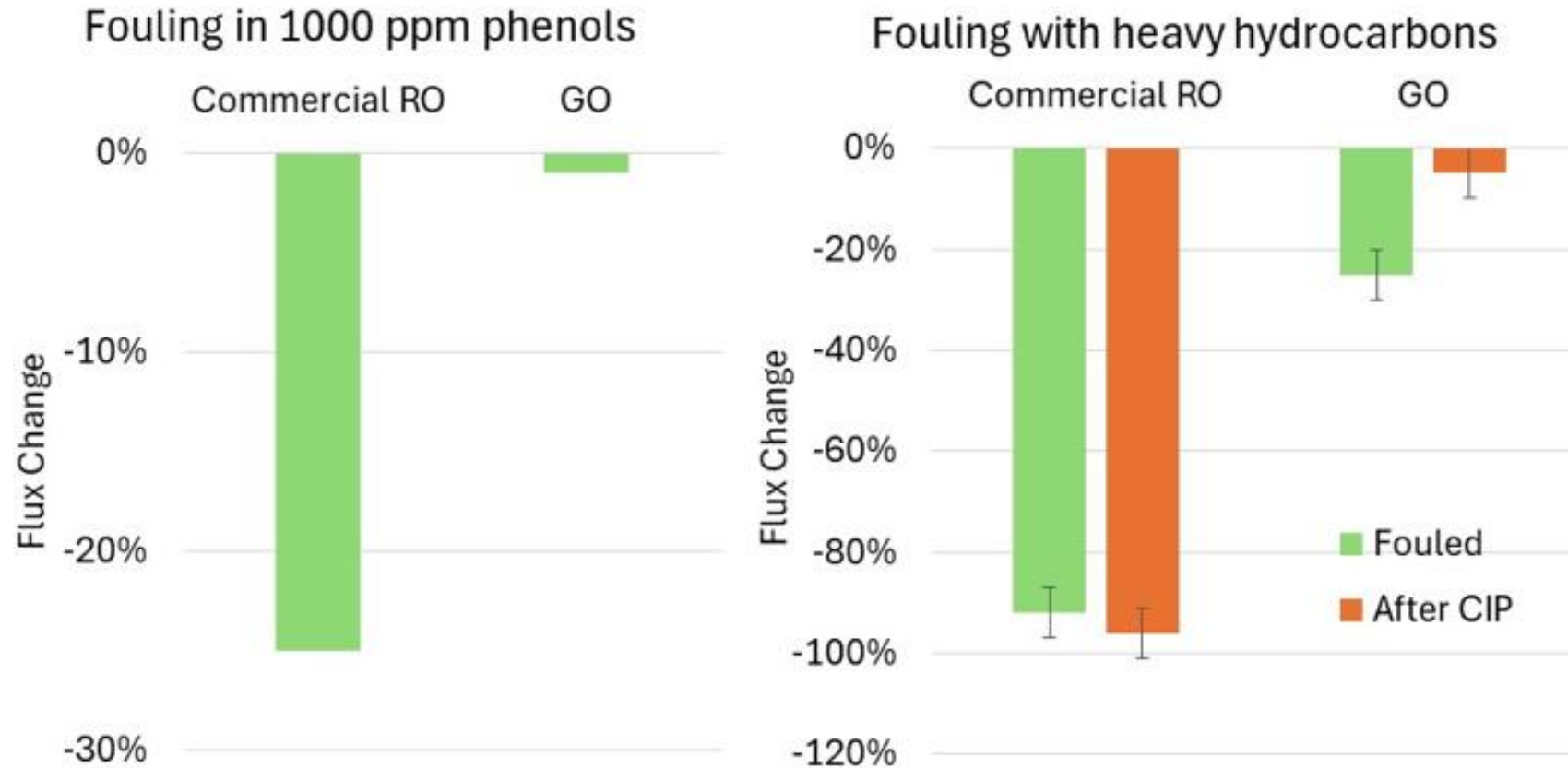


- Membrane type 1 selected as primary tool for removing ammonia.
- Membrane type 2 may be applicable alternative for lower pH sour waters
- Important to balance Flux, Recovery, and Rejection



Fouling Resistance of GO Membranes in Sour Water

GO Membranes are more resistant to common organic contaminants found in sour water than commercial membranes.
GO membranes remove suspended organics in addition to sulfides and ammonia.



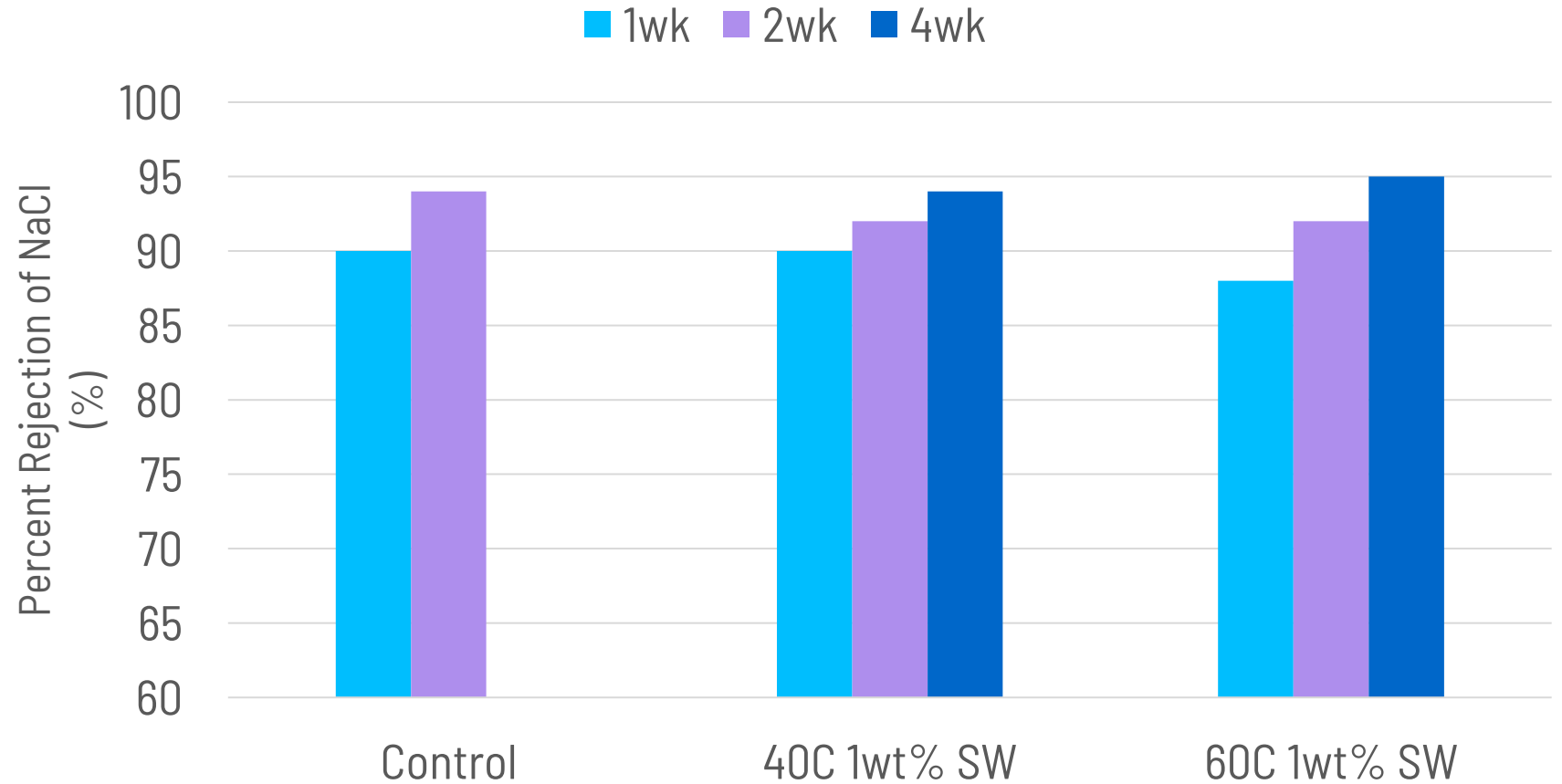


Accelerated Lifetime Testing

Soak Testing

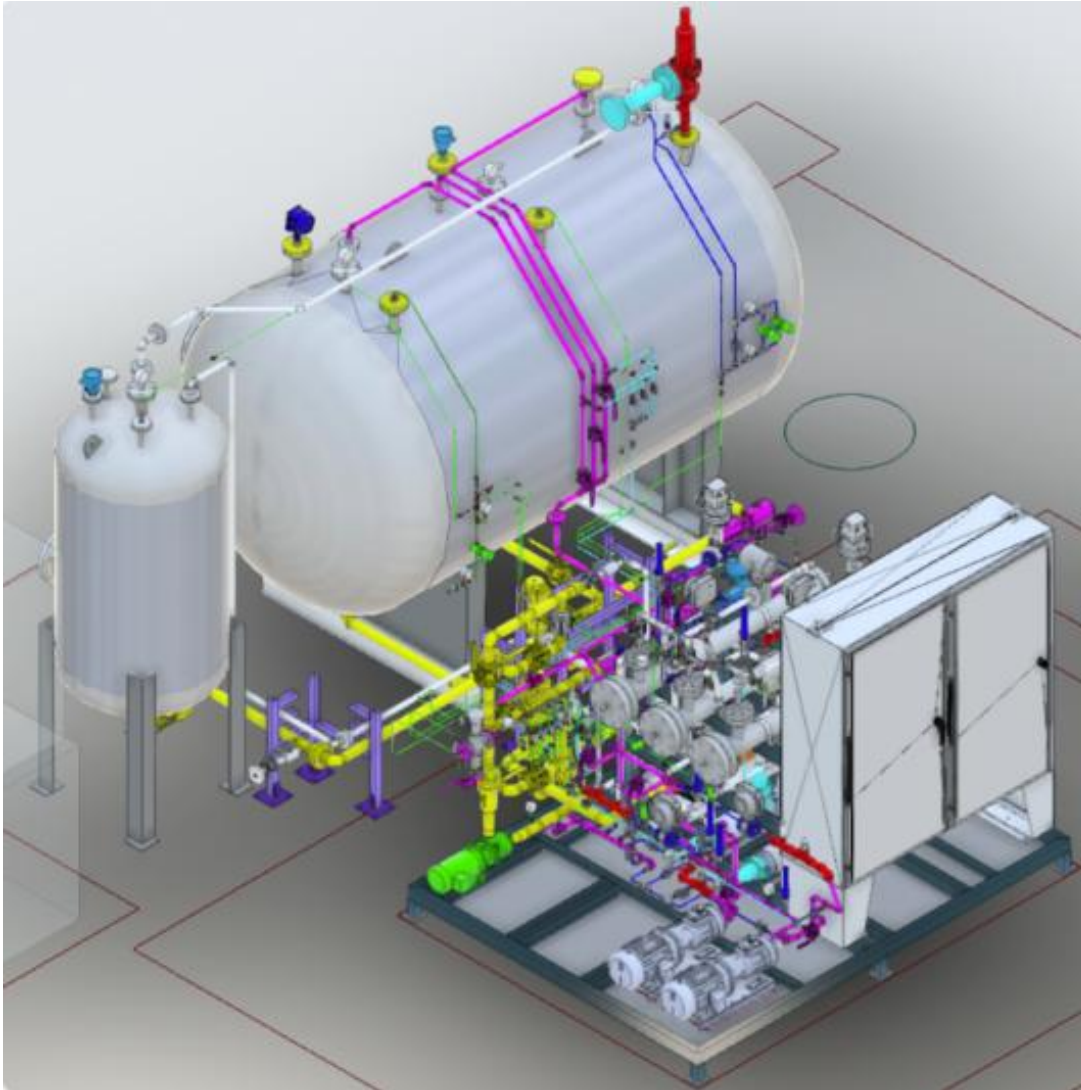
- Membrane Samples are subjected to 1% total N and S concentration with temperature for acceleration of any degradation
- The samples are removed at the required internals, and dead end tested with a concentrated NaCl benchmark
- Membranes so some improvement in performance consistent with control. No indicates of damage to pore chemistry or structure

Membrane 1: Rejection of benchmark salts after SW exposure



New pilot unit for sour water coming this fall

Complete field validation for sour water processing



- Pilot HAZOP Review completed with first customer
- Construction of the skid underway (~6'x8'x8')
- Deployment is planned for fall of 2025
- Semi-batch pilot allows for allow necessary performance data to be gather using full size modules but at a fraction of the cost
- Pilots are manned by Via Separations
- Typically, 6-8 weeks of operation with a week or two on each end for setup and tear down



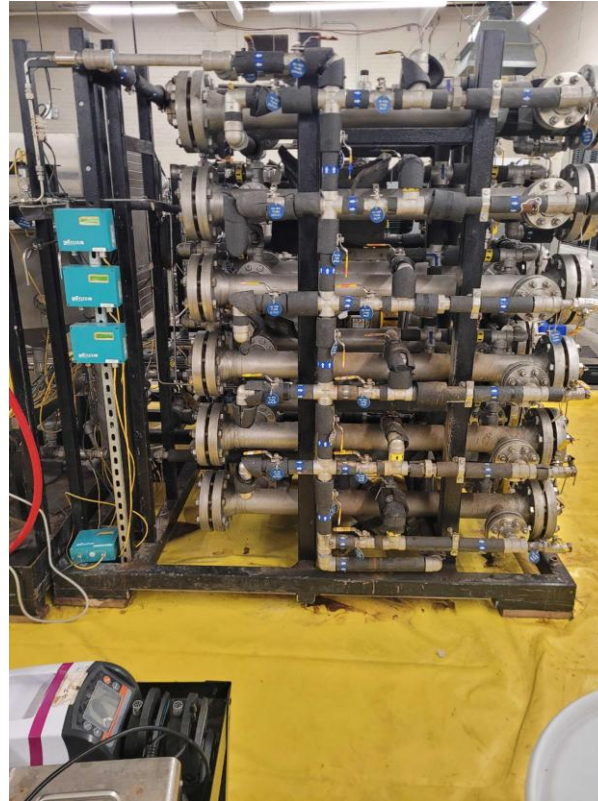


Past Pilots Completed

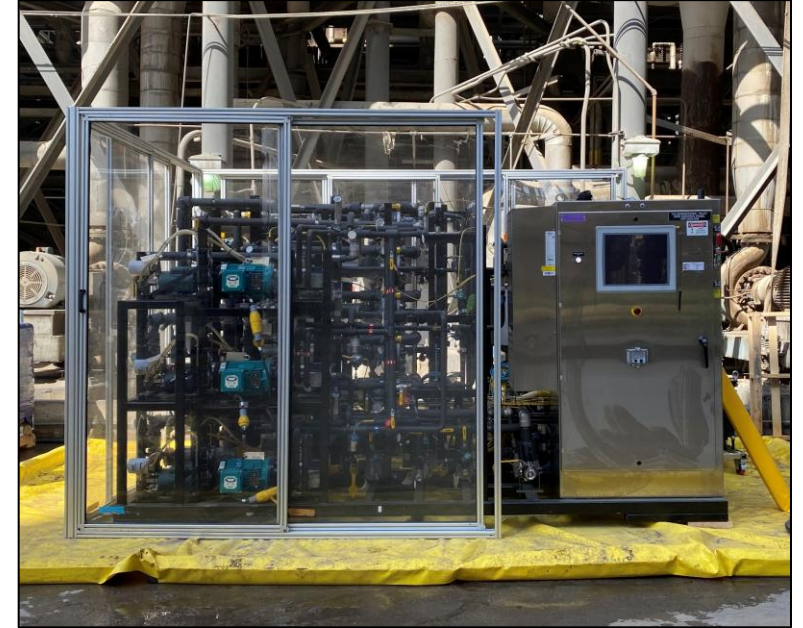
Other On and Off Site Pilots



Pilot skids screening a new type of pulp and paper application -- just finished



Pilot system setup "in house"



Original pulp and paper pilot
logged over 6000 hours in field





Summary

Key Takeaways

Commercial operation for over 15 months
3 applications in active deployments for refineries
Sour Water Application Benefits
Sour Water Quality

Permeate from SW DE:

- Phenols - <0.1 mg/L
- Cyanide - <0.005 mg/mL
- Sulfide - 1 mg/L
- Ammonia - 80 mg/L**

Limitations Addressable

- Hydraulic
- Water Reuse
- Fouling
- Steam/Energy
- New Product

QR Code for Website



Or visit our Website at ViaSeparations.com

