Wastewater Pretreatment for Potable Reuse

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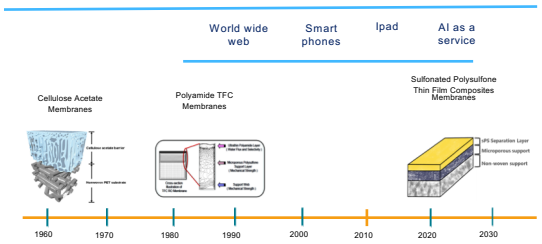
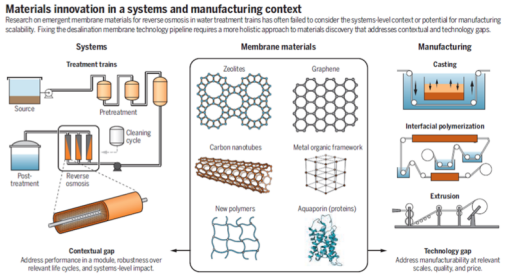
Get ready for a new age of Chlorine Stable RO Membranes

A New Generation of RO Membranes: Sulfonated Polysulfones (sPS)

Reverse Osmosis Membrane Technology Advancements



Why the 40 year gap?



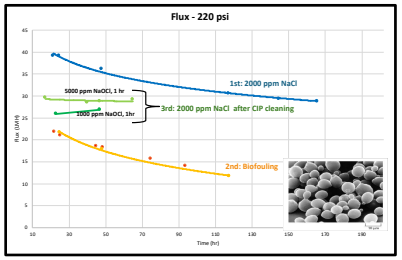
"Fixing the desalination membrane pipeline", *McCutcheon and Mauter, Science, April 2023, vol 380 issue 6642*

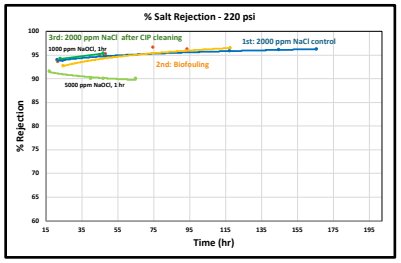
Manufacturing Context
- Develop and scale patented polymers
- Optimize and scale new TFC manufacturing process
- Scale spiral wound element manufacturing process

Systems Context
- Test TFC performance (different lab conditions)
- Pilot spiral element performance in the field

Fouling/Scaling/Cleaning of sPS RO Membranes

Clean In Place (CIP) of Biofouled sPS Membranes





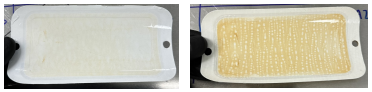
Rapid and Effective Cleaning

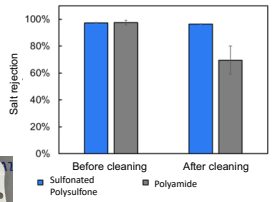
Aggressive Cleaning Protocol

Step 1: Surfactant, pH 7 (1 hr)

Step 2: 5,000 ppm NaOCl, pH 11.3 (2 hrs)

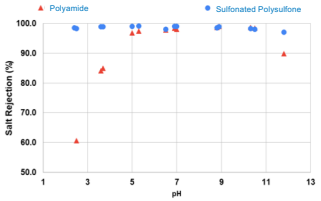
Step 3: 2% Citric acid, pH 2 (1 hr)





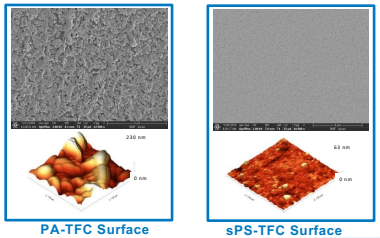
Flat sheet crossflow test cells, 2000 ppm NaCl at 220 psi

Salt Rejection Across Broad pH Range

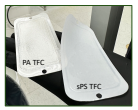


Global Prize Innovation in Desalination

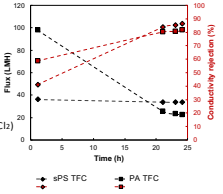
Surface Features Impact Membrane Fouling and Scaling



Calcium Carbonate Scaling Test

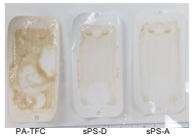


Simulated feedwater:
Mixed Salts (2,000 ppm of NaCl, 208 ppm $CaCl_2$)
Pressure: 220 psi
pH: 11
Recirculating System

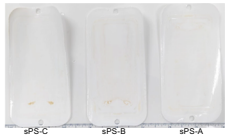


Simulated Biofouling: Tested Coupons

Flat sheet crossflow test cells, Run in 2000 ppm NaCl at 220 psi



Conditions:
- No NaOCl
- pH=4-5.5



Conditions:
- 10 ppm continuous free chlorine (NaOCl)
- pH=6-7

NAWI CONNECTIONS

Period of Performance: January 2024 – December 2025

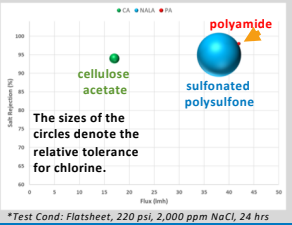
Challenge Area/Topic Area: 1. Process Innovation and Intensification

NAWI Leverage:
Performance testing regarding fouling/scaling/cleaning of new RO membranes with pilot from OCWD

KEY FINDINGS AND CONCLUSIONS

Key Findings:
sPS thin film composite (TFC) membranes have flux and salt rejection on par with current PA TFCs while also having smoother surfaces and extreme chlorine tolerance.

Conclusions:
These next generation sPS RO membranes are pH agnostic and chlorine stable, leading to unprecedented cleanability and with resistance against fouling for RO systems.



**Test Cond: Flatsheet, 220 psi, 2,000 ppm NaCl, 24 hrs*

COMMERCIALIZATION

Characteristics	sPS-TFC	CA	PA-TFC
Chlorine Stability (ppm-hrs)	200,000	10,000	1,000
Smooth Surface	Yes	Yes	No
Operating pH Range	2-12	4-7	4-10
Long Term Durability	High	Low	Moderate
Flux*	38	17	42
Salt Rejection*	95	94	98

40" wide membrane sheets:
Higher Flux/Lower Rejection
Higher Rejection/Lower Flux

Spiral Wound Elements:
2540, 4040, 8040*
Low pressure designs
High pressure designs

TFC sheet manufacturing process at 40"
- Rapid and low waste

Available for evaluations
- Dry membranes
- Spiral wound elements

Talk to our team
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ACKNOWLEDGEMENTS

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