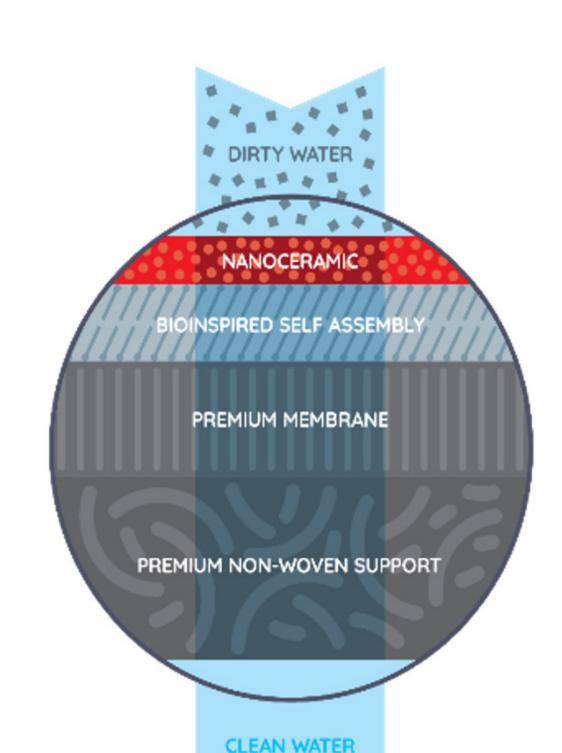


CROSSTEK Technology overview

coated membrane



- The base polymeric membranes are coated.
- The coating creates a nanoceramic layer on a material to enhance its performance.
- This innovative, bio-inspired, self-assembled nanoceramic coating can be used to enhance ANY water purification membrane by:
- Sol-gel encapsulation
- Surfactant Self Assembly
- Covalent surface grafting
- Currently coated on UF and NF membranes
- Will be coated on RO next
- Coating demonstrates high mechanical durability on other surfaces like paint

Hydrophilicity

- To transport water through a membrane, a membrane material with an affinity for water, i.e. hydrophilic material, reduces en-
- When combining water transmittance through, and oil/organics removal by the membrane, then hydrophilicity is vital to success, since material with an affinity for water (hydrophilic) also repels oil (oleophobic)Hydrophilicity is measured by contact angle (q). Lower q = more hydrophilic
- Contact angles: ceramic UF(Alumina) ~ 29, CT Ultressa ~ 18

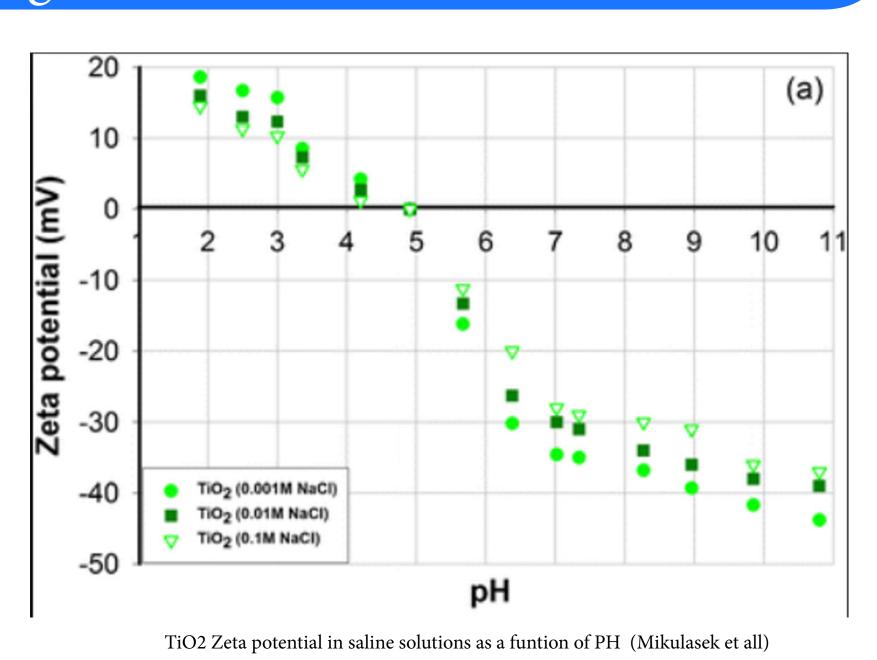
Crossflow Max dP and Max Crossflow vs Temp Tubular Ceramic Ultressa Coated Tubular Format Spiral wound Inside out, Crossflow **Crossflow type** Inside out, Crossflow 0.025µm 0.025µm Pore size Moderate TSS / Oil Moderate TSS / Oil Feed wastewater wastewater ---- GPM max HX ----- GPM max HXmax ----- dP,max, psid **Concentrate limits** < 1,000mg/l TSS < 1,000mg/l TSS; < 100,000mg/l Oil < 100,000mg/l Oil ~333gpm/12psid esign temperatur ~0.20kW/m2 50 60 70 TEMP (OC)

Surface charg

 Organics incl. oils typically have negative charge. Ultressa has negatively charged membranes to repel oil / organic fouling

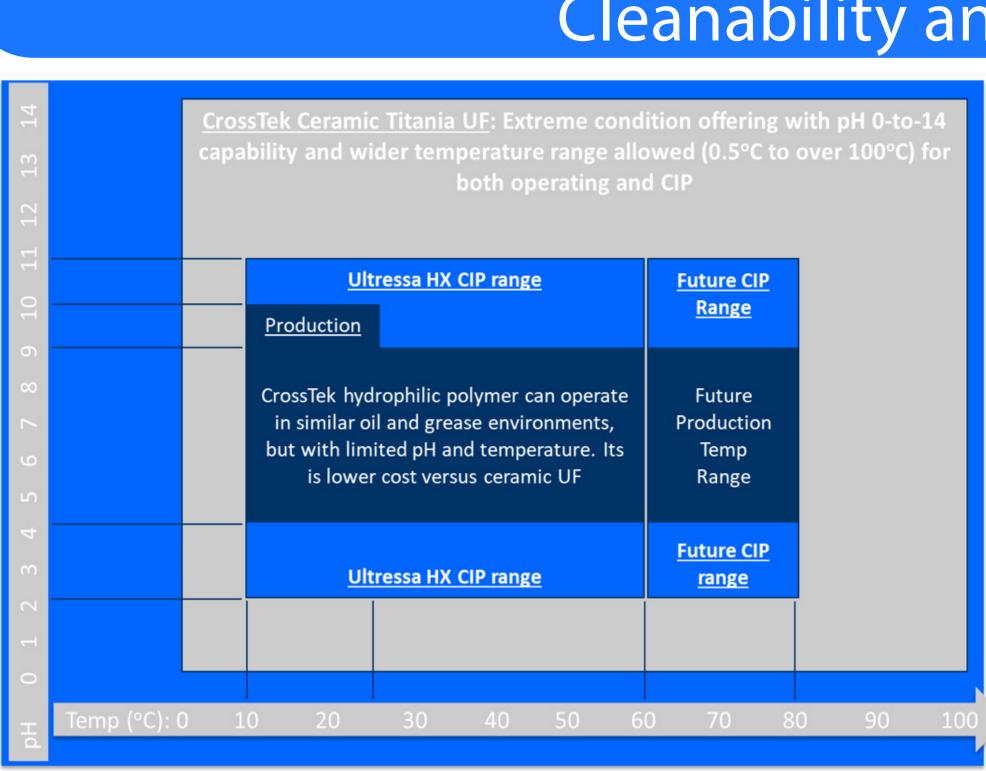
(Hexadecane)

• Ultressa has a pH-charge relationship similar to titania ceramic membranes – giving it the same ability to be negatively charged with most wastewater pH (i.e. pH>5) while also retaining ability to reverse charge for cleaning at pH < 5



Novel Surface-Enhanced Polymer Membranes for Reuse of Challenging Organics and Oily Wastewater

Julian Arroyo, Stanton Smith, Adrain Brozell and Bruce Bishop

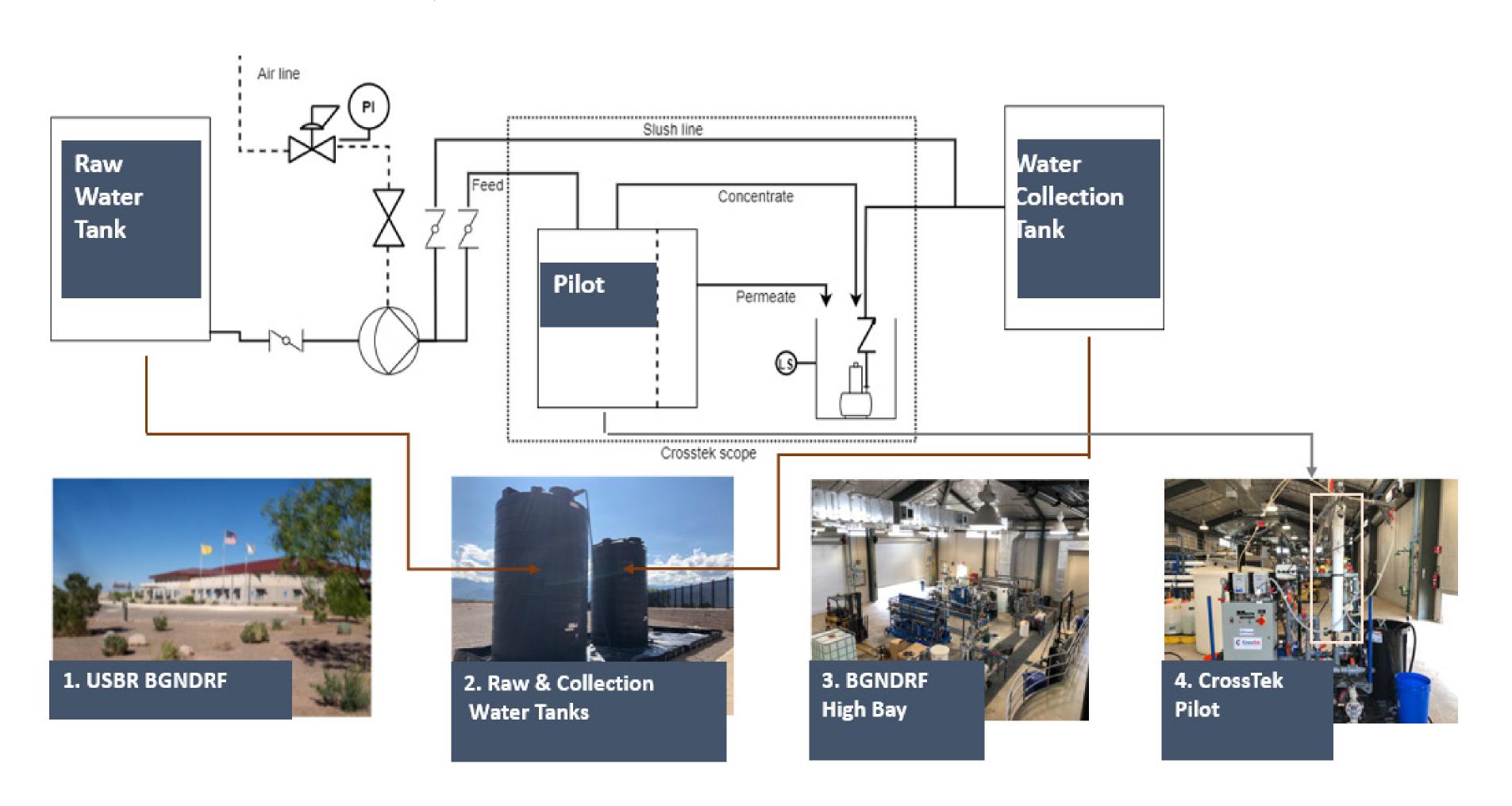


Cleanability and reliability

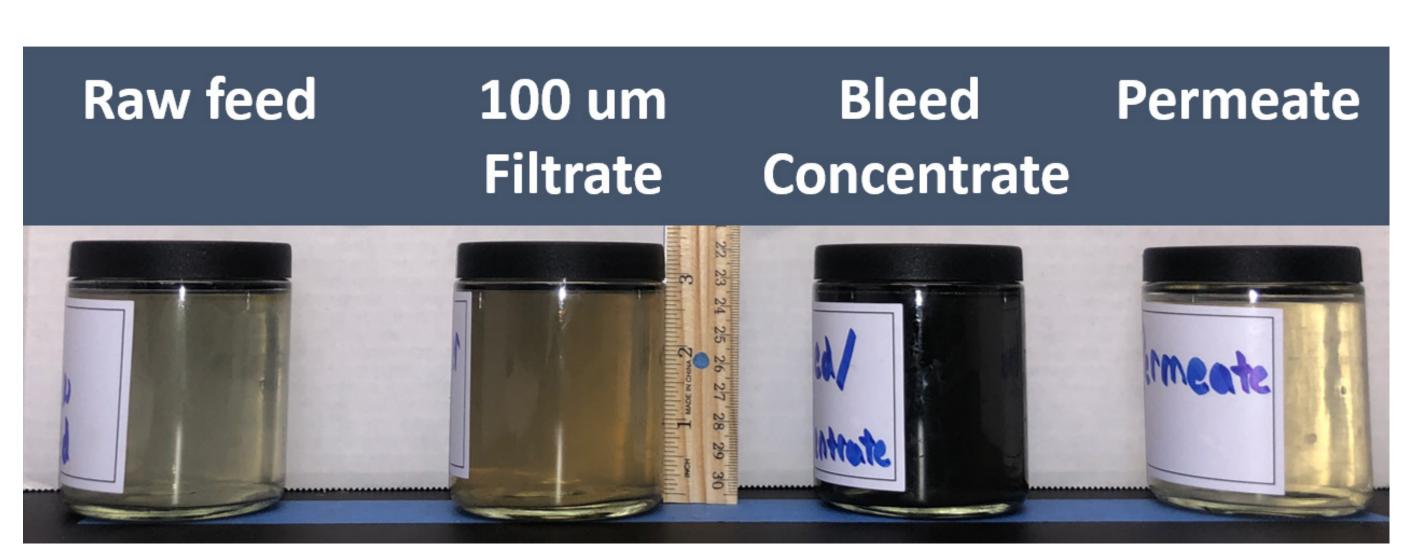
- The Ceramic coating allowed the membranes to got up to 12 pH and 140 F for recovery CIPs.
- The membranes have recovered with intence cleaning from severe fouling from produce water, industrial streams and biofouling. Recoveryng from 1 lmh/bar to 300 lmh/bar

Trials and pilot studies

• Demonstration of cost-effective and energy-efficient mobile or fixed pretreatment technologies compatible with high salinity produced water from the Permian Basin (NM)

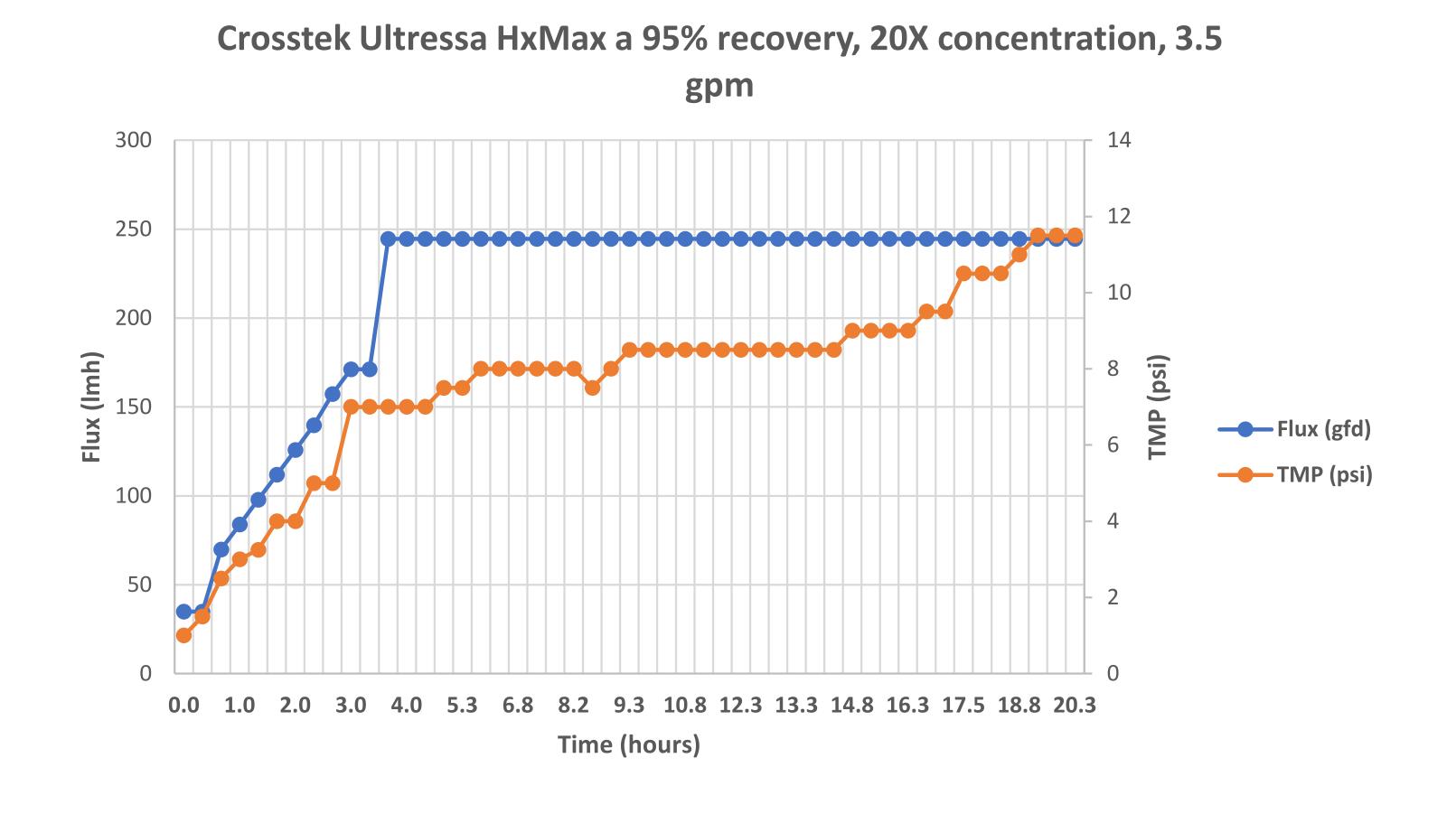


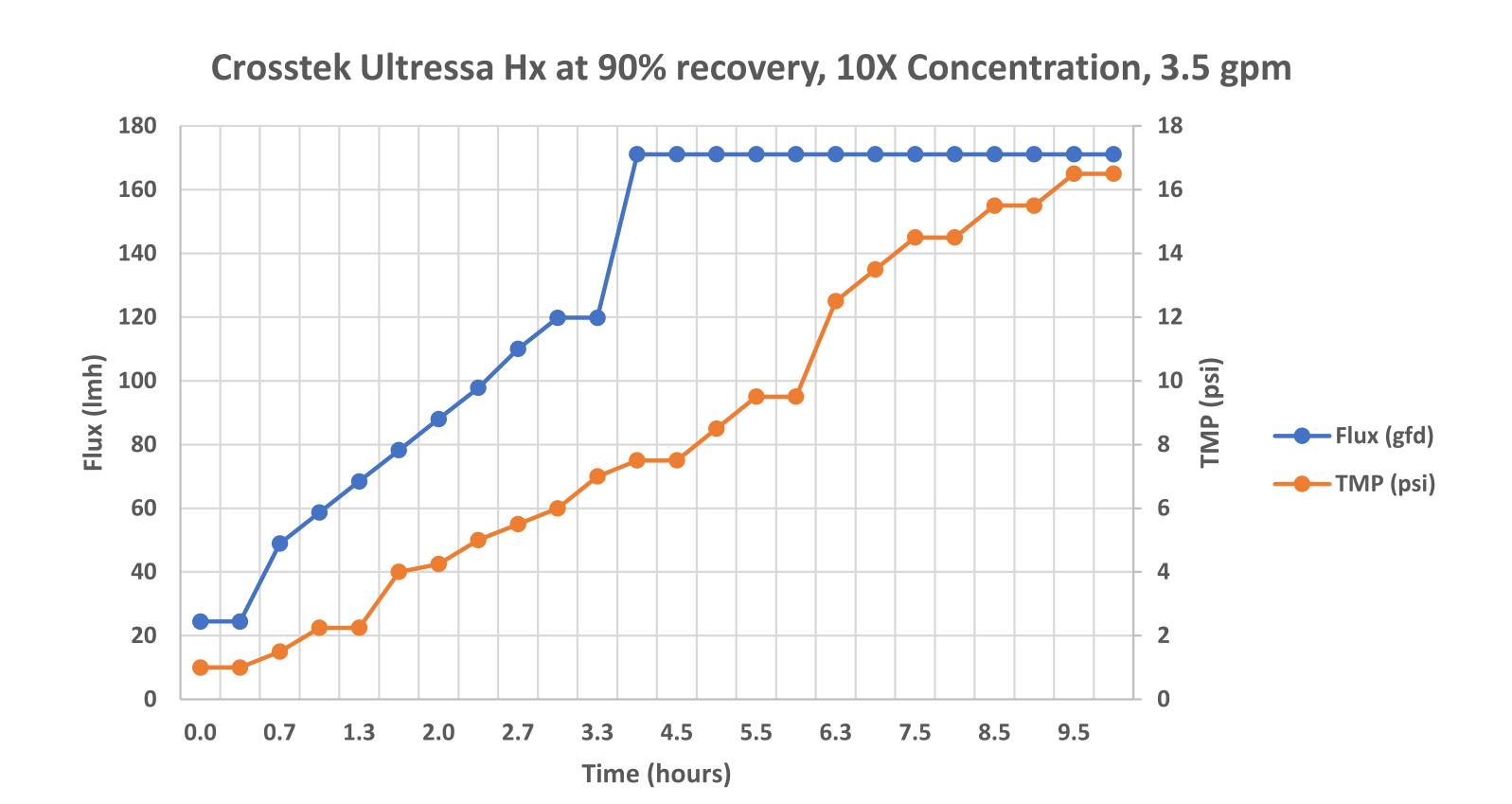
Stream quality

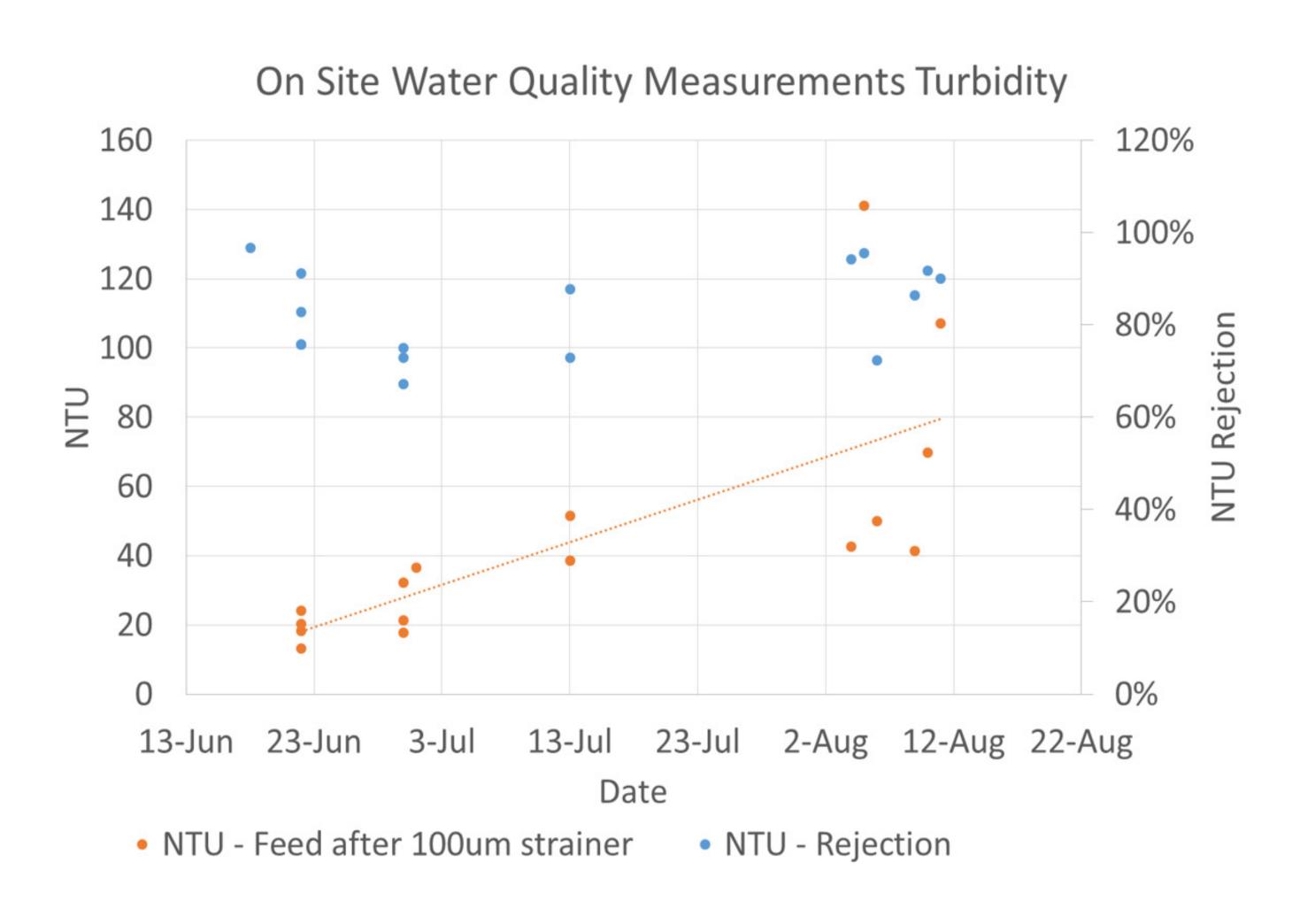


	Average in-site quality measurements					
Source	Raw Feed	Membrane Feed	Concentrate	Filtrate		
Conductivity (mS)	133.1	132.5	131.8	133.4		
Temperature (C)	29.6	32.36	32.67	32.55		
рН	6.7	6.7	6.7	6.7		
ORP (mV)	136.4	136.4	136.3	136.2		

Performance and results







2023 Technology

CONFERENCE & EXPOSITION

Economic Analisys								
		Ultressa Plant		Tubular Ceramic ZrO				
Plant Type		Permanent	Mobile	Permanent	Mobile			
CapEX	Millions USD	4.5	4.5	7.33	7.33			
Financing Charge		8%	8%	8%	8%			
ROI	Years	3	3	3	3			
Uptime	%	80%	33%	80%	33%			
Production rate	m^3/h	1000	1000	1000	1000			
Production rate	m^3/ROI	21,024,000	8,672,400	21,024,000	8,672,400			
Cost (CapEX)	USD per m^3	0.250	0.606	0.407	0.988			
Cost (OpEx)	USD per m^3	0.078	0.078	0.230	0.230			
Total Cost	USD per bbl	0.052	0.109	0.101	0.194			

• The polimeric coated membranes showed a possibility of reducing the cost by 51.5%





Summary

- Our average flow in the long term membrane test (2.05 gpm) exceed our performance target (1.25) by 64%
- Using a conservation flow (1.8 gpm; 53 gfd) supported by the data, the resulting equipment design shows:
- 49% decrease in cost per barrel of treatment for permanent installations
- 44% decrease in cost per barrel of treatment for mobile installations
- Pretreatment was minimal and the 100 um cartridge filter did not need replacement.
- Observed variation in flux with water batches was consistent, althoug the variation of the feed was significant values between 20 and 80 NTU feed.
- Crosstek is working in obtaining long term data to exceed the recommended 53GFD flux for this teed.

Acknowlegements







