Graphene Oxide Membranes for Targeted PFAS Removal

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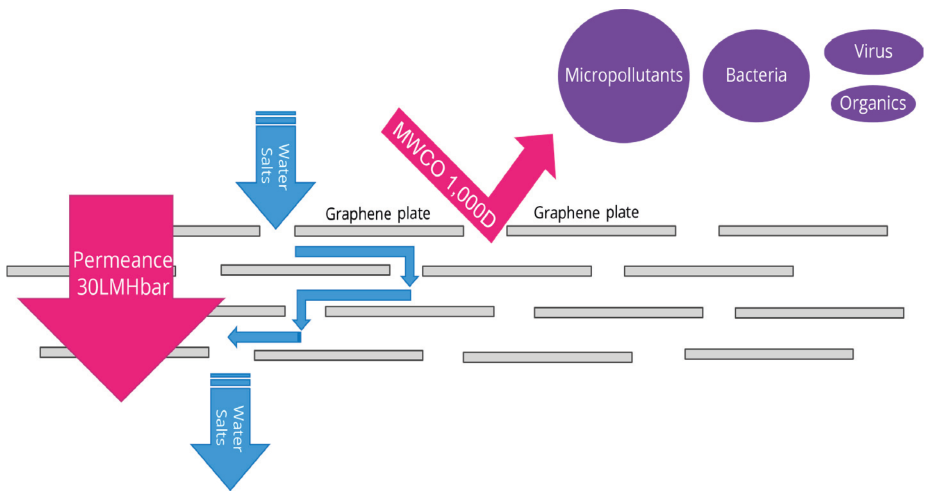
Modified graphene oxide membranes to meet Australian legislative standards for PFAS, with higher permeance and lower salt rejection than commercial alternatives.

Why PFAS is Difficult

- Short-chain PFAS are too small and hydrophilic
- Activated carbon and ion exchange cannot capture them effectively
- RO/NF remove PFAS, but reject salts and generate large brine volumes
- Brine disposal/destruction is costly and complex

Graphene Oxide Membranes

- Operate at low pressure (~2 bar)
- High water permeability and low fouling
- Very low salt rejection
- Stacked GO layers create nanochannels



Designed to Target PFAS

Beta-Cyclodextrin Engineering:
- Integrated into the membrane for selective removal of both long- and short-chain PFAS

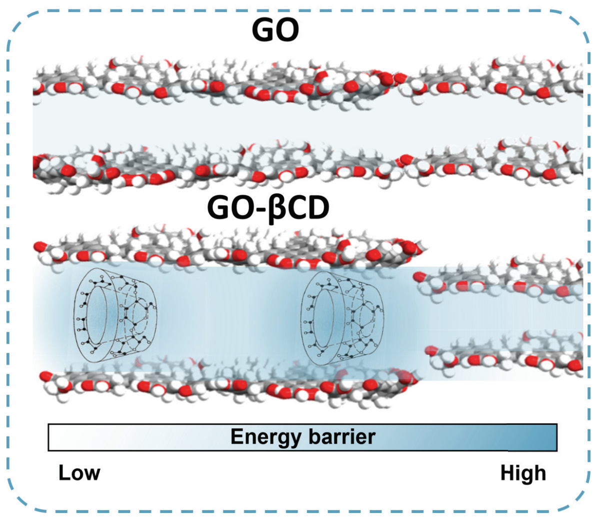
Asymmetric Nanochannels:
- Restrict PFAS by size
- Create directional transport pathways

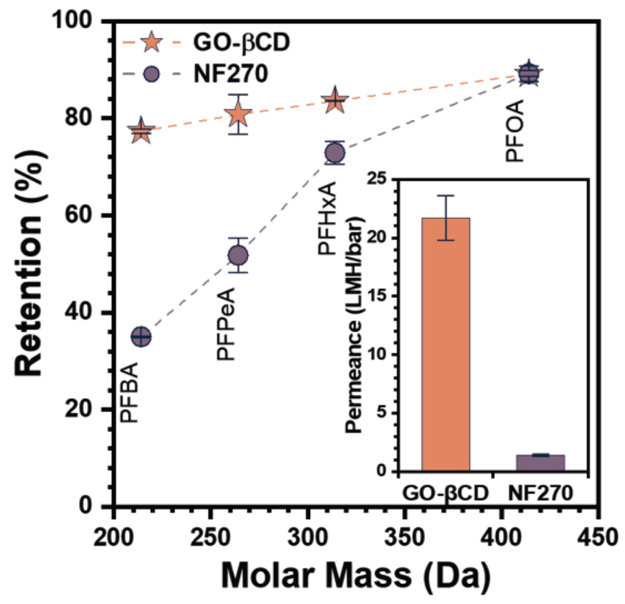
Intrapore Energy Barriers:
- Slow down or block PFAS passage
- Increase retention of molecules

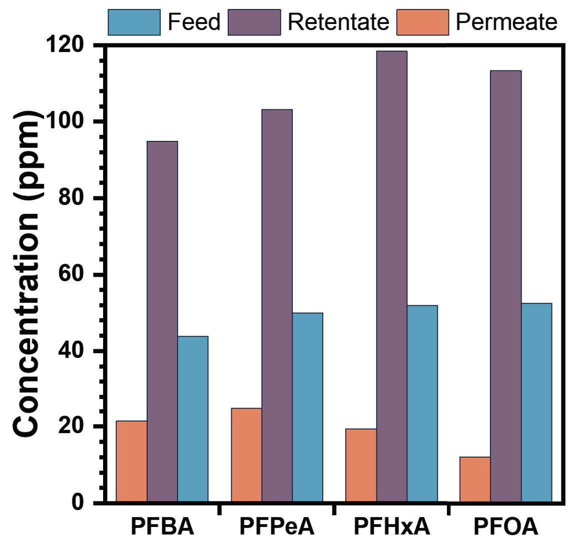
Host-Guest Interactions:
- Cyclodextrin forms selective binding pockets for PFAS
- Enhances affinity for both long- and short-chain PFAS

Salt & Small Molecule Permeability:
- Allows salts to pass
- No excessive salt rejection typical of NF/RO

Performance Summary







Commercially available: NF polyamide membranes exhibit a significant decline in capacity to retain short-chain PFAS (~35 % for PFBA) with permeances below 5 LMH/bar.

Our membranes: achieve high retention of short chain PFAS while maintaining a high permeance of 21.7 ± 2 LMH/bar and up-concentrating the feed by at least 300%, a characteristic necessary to achieve PFAS mineralisation and destruction, and stable long-term (> 24 hours) performance.

Field Trials on Port Melbourne Groundwater

Graphene Membranes operating at 90% water recovery in crossflow configuration.

Detected PFAS (µg/L)	GW02 Raw Feed conc (ng/L)	HR GO-βCD Permeate Conc (ng/L)	HR GO-βCD Retentate Conc (ng/L)	GO-βCD Retention (%)
PFBS	<0.5	-	-	-
PFPeS	<0.5	<0.5	100.5	>99.5 (ND)
PFHxS	26.9	<0.5	17.8	>97.2 (ND)
PFHpS	0.6	<0.5	<0.5	ND
PFOS	115.0	<0.3	66.9	>99.6 (ND)
PFBA	<2.0	-	-	-
PFPeA	17.9	<0.5	<0.9	ND
PFHxA	26.2	1.9	23.0	91.7
PFHpA	12.9	<0.5	0.8	>50.0 (ND)
PFOA	67.1	-	-	-
MeFOSAA	0.8	<0.5	<0.9	ND
EtFOSAA	25.3	<0.5	<0.9	ND
6:2 FTS	<1.0	<1.0	7.0	>85.71 (ND)

Site
- Port Melbourne groundwater

Supported by
- EPA Victoria

Water Matrix
- Contained long- and short-chain PFAS, salts, and organic matter

Initial PFAS Load
- ~300 ng/L total PFAS

Post-Treatment Result:
- Permeate PFAS < 0.5 ng/L (below drinking water guidelines)

Performance
- Stable flux and PFAS rejection
- Effective despite other contaminants
- Robust in realistic operating conditions

- Retention at 90% water recovery ranges from >50 - >99.5%
- Retentions of PFAS <90% are limited by permeate concentration being <LOD
- 2 PFAS were undetected in the raw feed but detected in the GO-βCD retentate (PFPeS and 6:2 FTS)

Performance sampling after 24h membrane operation:

PFAS	Raw Feed (ng/L)			GO-βCD Permeate (ng/L)		
	GW02	GW20	GW25	GW02	GW20	GW25
PFOA	67.1	12.6	12.4	<0.5	-	-
PFOS	115.0	93.4	62.9	<0.3	<0.3	<0.3
PFHxS	26.9	66.9	155.0	<0.5	<0.5	3.4
PFBS	<0.5	22.1	39.6	<0.5	<0.5	<0.5

Where to Use Them

- Stand-alone step or integrated into existing treatment trains
- Pre-concentration of feed/brine ahead of PFAS destruction technologies
- Polishing step following water treatment process
- Sites where brine handling, scaling or high energy costs limit current options

Talk With Us

We are looking for:

- Pilot partners for site trials
- Technology providers interested in integrating the graphene membrane technology
- Investment/distribution partners to scale production

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