



GREEN SOLUTIONS



GLOBAL OUTLOOK



INNOVATIONS



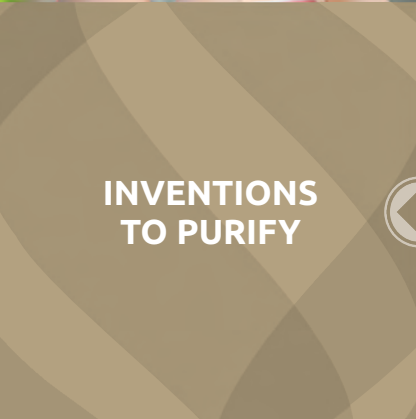
RESEARCH AND DEVELOPMENT



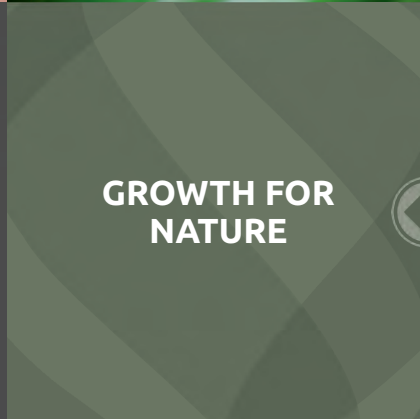
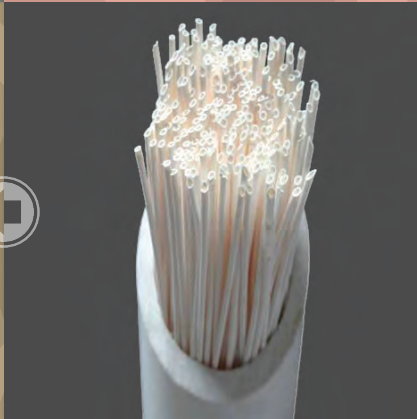
ETHICS AND INTEGRITY



CONNECT WITH NATURE



INVENTIONS TO PURIFY



GROWTH FOR NATURE



Green Chemistry Clean Planet

At Technorbital, we work towards adding value to water. Using water, Treating water, Conditioning water, Recycling Water and Reusing water-making every effort to ensure that the use of fresh water is minimized by removing pollutants from water to make it pristine and pure, the way it naturally is.

We are committed to green chemistry, Research and Development, improvising existing Treatment Plants and identifying synergies between various treatment technologies.

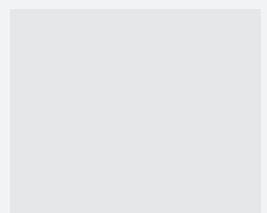
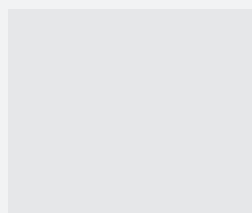
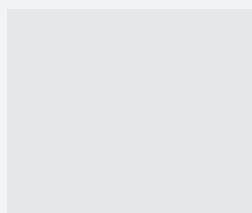
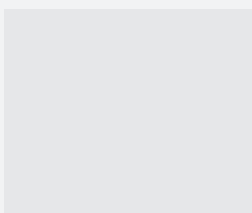
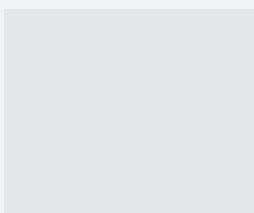
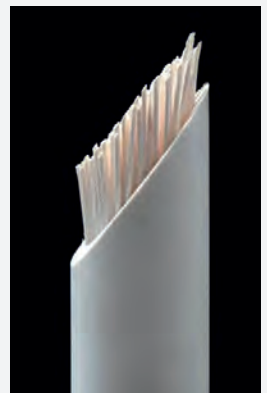
Our Membrane division at Kanpur, India has a state-of-the-art Manufacturing facility spread over 120,000 ft², integrated from raw material storage till membrane packaging all under 1 roof.

The facility is also equipped with a Research & Development center and a QC lab to ensure continuous product improvement as well as consistency of latest specifications. Technorbital is one of the few membrane manufactures with An ISO 9001:2000 certified Quality Management System.

GRAFIL from Technorbital connects our innovations, experience, commitment to offer low cost simple solutions to our global customers and we are blessed that our products have over 4000000 satisfied users.



TECHNORBITAL - GREEN SOLUTION FOR BLUE REVOLUTION



ULTRAFILTRATION MEMBRANE

The sheet provides basic guideline for the use of GRAFiL Ultrafiltration membranes for industrial water and waste water management applications for removal of small particulates, colloids and microbial contaminations.

1. Flux GUIDELINE

Type of Feed Water	Unit	Operational Flux Guidelines						
		Filtration Cycle						Backwash l.m ² .h ⁻¹
		Dead End		Cross-Flow				
		Time, min	Flux, l.m ² .h ⁻¹	With Media Filter		Without Media Filter		
Time, min	Flux, l.m ² .h ⁻¹			Time, min	Flux, l.m ² .h ⁻¹			
Bore Water	l.m ² .h ⁻¹	0.5	80	NA	NA	NA	NA	160
Surface Water	l.m ² .h ⁻¹	0.5	50	1	85	0.5	70	160
Treated Sewage	l.m ² .h ⁻¹	NA	NA	1	70	0.5	50	160
Treated Effluent	l.m ² .h ⁻¹	NA	NA	0.5	60	0.5	40	160
Effluent with Solvent*	l.m ² .h ⁻¹	NA	NA	0.5	50	0.5	40	160
Sea Water	l.m ² .h ⁻¹	NA	NA	0.5	40	0.5	30	160

*Use of GRAFiL depends on the type of solvent present in the effluent. For example we don't recommend GRAFiL for effluent having solvents like DMF, DMAc, DMSO and NMP.

2. Process ENGINEERING

Ultrafiltration Module	Unit	All Model
Mode of Operation		Out - In
Maximum Applied Feed Pressure	kg.cm ⁻²	2
Maximum Trans-membrane Pressure	kg.cm ⁻²	< 1.5
Backwash Duration	s	30-60
Backwash Frequency	min	15-60
Backwash Flux	l.m ² .h ⁻¹	160
Typical Clean water Flux Range	l.m ² .h ⁻¹	200 - 250
Minimum Operating Temperature	°C	5
Maximum Operating Temperature	°C	40
Operating pH Range		3.5- 10.5
Cleaning pH Range		2-12
Instantaneous Chlorine Tolerance	mg.l ⁻¹	200
Maximum Instantaneous Feed Turbidity	NTU	100-300
Maximum shell inlet pressure	kg.cm ⁻²	3.5
Continuous FRC	mg.l ⁻¹	0.2
Process Cycle		Process-Backwash
Chemical Cleaning Method		CIP

3. Physical PROPERTIES

Ultrafiltration Module	Unit	All Model
Configuration		Cross-flow / Dead End
Membrane Type		Hollow Fibers
Membrane Material		PolyNorbit
Housing Material		UPVC
Fiber Dimensions OD ID	mm	1.2 0.8
Pore Size	micron (μ)	0.02
MWCO (Nominal)	kDa	75
System Integration		Modular Rack

4. Chemical COMPATIBILITY

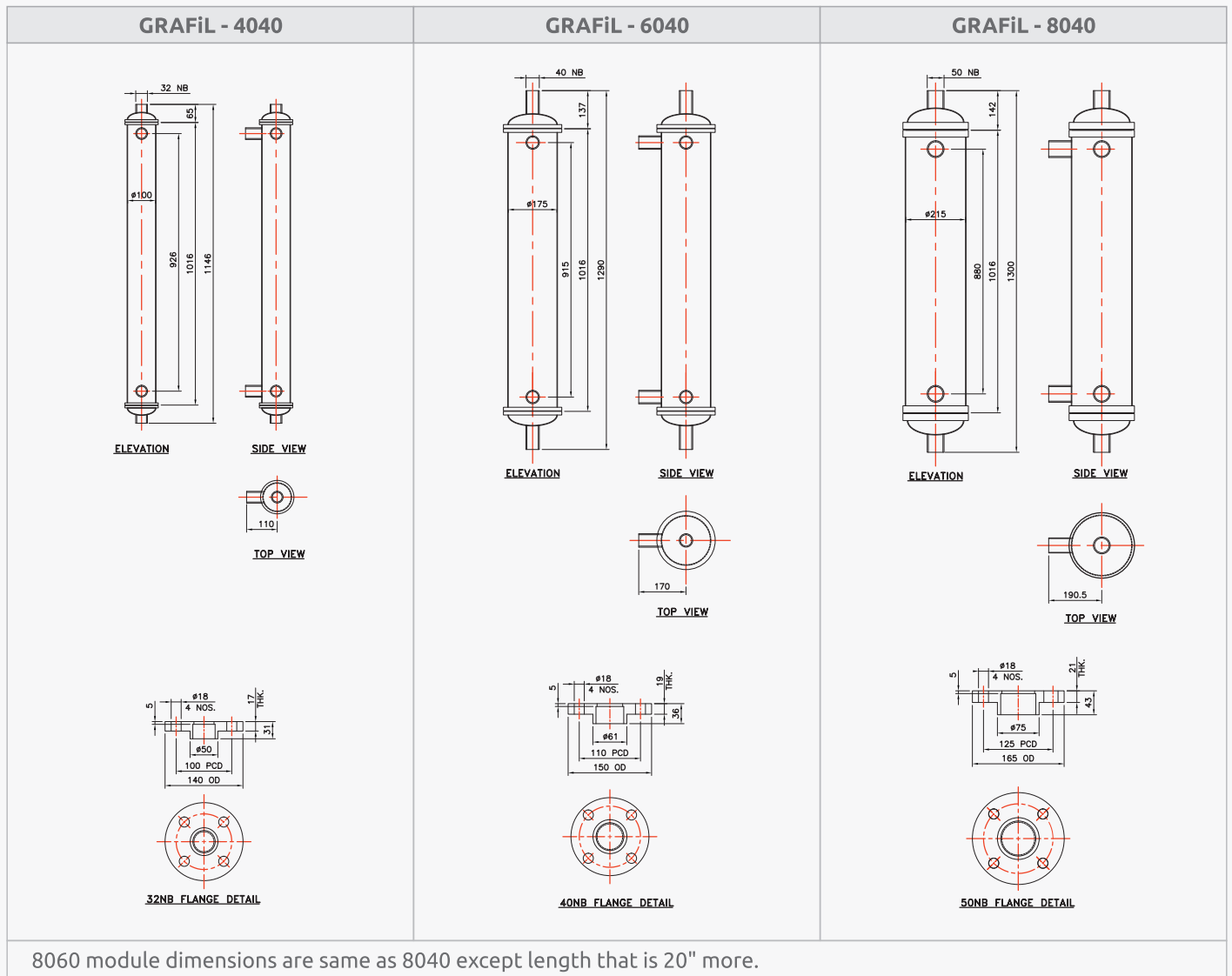
Ultrafiltration Module	All Model
Disinfection Chemicals	NaOCl / H ₂ O ₂
Cleaning Chemicals	Citric Acid
Cleaning Chemicals	Na ₂ CO ₃

5. Performance GUARANTEE

Ultrafiltration Module	Unit	All Model
Filtrate Turbidity	NTU	< 0.5
Bacteria Removal	log reduction	6
Virus Removal	log reduction	4
Total Suspended Solids	mg.l ⁻¹	<1
Silt Density Index SDI ₁₅		<3

6. Engineering SPECIFICATIONS

Ultrafiltration Module	Specification	GRAFiL 4040	GRAFiL 6040	GRAFiL 8040	GRAFiL 8060
Module Diameter	mm (inch)	100 (4)	175 (7)	215 (8.5)	215 (8.5)
Module Length	mm (inch)	1146 (45)	1290 (51)	1300 (51)	1524 (60)
Weight	kg	7	18	28	38
Nominal Membrane Area	m ²	9	26	37	55



7. Storage PROTOCOL

GRAFiL pressurized UF Modules shall be stored between 5°C and 35°C (41°F to 95°F) intact in original factory packaging for up to 18 months. Do not expose the membrane module to sources of heat, ignition, flooded water or direct sunlight (UV light).



GRAFiL UF MEMBRANE RESTORATION PROCEDURE



As Contaminants deposit on the surface of UF membrane we expect deterioration in performance due to fouling with time. To restore the membrane performance without dismantling the unit, we shall adopt the Clean In Place (CIP). This document focuses on membrane performance restoration to make it as good as new.

Want to Resolve Fouling Problem ?

During UF Operation the Foulants start depositing on the surface of the membrane and it starts fouling. If the Feed pressure is constant, it will result in drop in productivity (Flux). To restore productivity the operator shall increase the feed pressure to compensate for the resistance due to fouled membrane. Since the permeate is open to atmospheric pressure, this method will increase the Trans membrane pressure differential (TMP). But the good thing is production will restore.

How to know rate of Fouling & CIP Frequency ?

We are monitoring membrane performance in new term called Permeability (Can be calculated by $\text{Flux} \div \text{TMP}$). When Fouling occurs Permeability decreases. To restore the membrane performance one must perform CIP. Be aware the TMP can not be higher than the maximum recommended TMP in Process Engineering Datasheet.

What to do before CIP ?

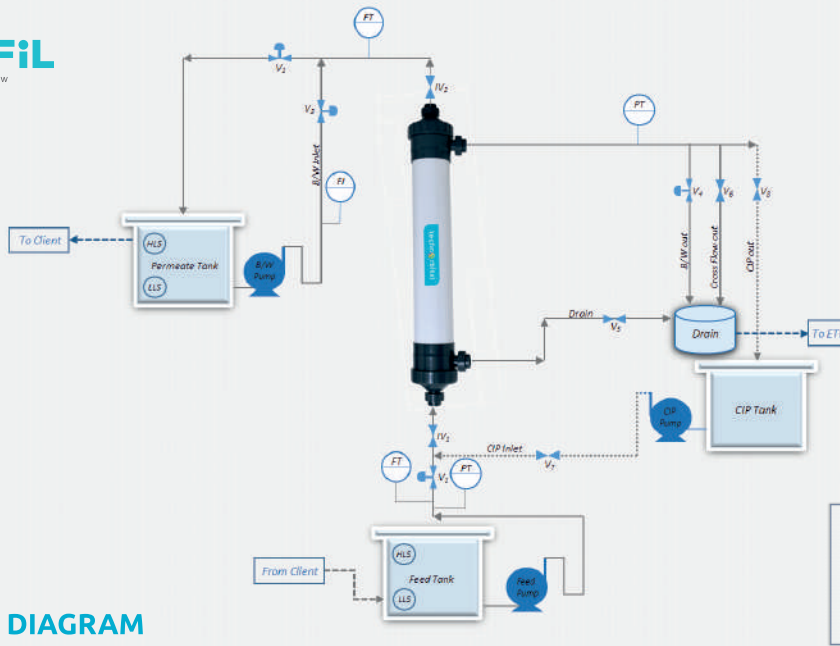
Permeate Tank	Make sure that permeate tank is enough filled with the permeate water or fresh water to perform CIP.
Chemicals	Prepare the CIP solution as per guidelines given in this document.
pH	Check the pH of the CIP solution. (2 To 11 pH)
Valve	Close all the Valves of the UF System.
Temperature	With Prior approval from Technorbital, CIP solution (NaOH) can be heated upto 40°C to increase its effectiveness.

Chemical Preparation Guideline

Sr. No.	Names	IS. NO.	Concentration	Application	Cleaning Time	Attention !
1	Citric Acid	IS 13186 :1991	2.00%	Inorganic CaCO ₃	1-3 Hours	If pH increases by 0.5 while recycling the solution then, restore the pH using HCl.
2	Oxalic Acid	IS 501: 1976	2.00%	Inorganic Metal Ion + CaCO ₃	1-3 Hours	
3	Sodium Carbonate	IS 251:1998	0.20%	Organic, Oil	1-3 Hours	If pH decreases by 0.5 while recycling the solution, then restore the pH using NaOH.
4	Sodium Hypochlorite	IS 11673:1992	0.20%	Biological	1-3 Hours	
5	Sodium Hydroxide	IS 252:1991	0.10%	Organic, Oil	1-3 Hours	Before use take Prior approval by Technorbital Advanced Materials Pvt. Ltd.
6	Sodium Dodecyl Sulfate	IS 4956: 2002	0.10%	Organic, Oil	1-3 Hours	
7	Sodium Benzoate	IS 4447:1994	0.10%	Only Membrane Preservation	NA	This chemical to be used only during Prolong storage membranes. Follow Procedure

Attention !

- 1) Prepare Citric acid solution 12 hrs. before performing the CIP.
- 2) Volume of chemical solution shall be equal to System Volume + 50% Extra.



GRAFiL UF SEQUENCE DIAGRAM

UF System Operation Logic

Step Description	Sr. No.	Time	Flow Rate	UF Feed Pump (P1)	UF Backwash Pump (P2)	CIP Pump (P3)	Feed in Valve (V1)	Permeate Out Valve (V2)	Backwash In Valve (V3)	Backwash Out Valve (V4)	Drain Valve (V5)	Cross Flow Out Valve (V6)	CIP in Valve (V7)	CIP Out Valve (V8)	Feed Isolation Valve (IV1)	Permeate Isolation Valve (IV2)
Filtration Cycle																
Filtration Service	1	29 min	---	ON	OFF	OFF	ON	ON	OFF	OFF	OFF	ON	OFF	OFF	ON	ON
Backwash	2	1 min	---	OFF	ON	OFF	OFF	OFF	ON	ON	OFF	ON	OFF	OFF	ON	ON
Draining	3	NA	---	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF	ON	ON
Attention ! If TMP after backwash is still higher than the limit of 1.5 kg/cm2, perform the backwash cycle 2 times - 5 times subject to availability of permeate in permeate tank.																

Membrane Performance Restoration																
Draining	1	NA	---	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF	ON	ON
Clean In Place	2	30 min	---	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON
Soaking	3	60 min	NA	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON
Draining	4	NA	---	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF	ON	ON
Backwash	5	1 min	---	OFF	ON	OFF	OFF	OFF	ON	ON	OFF	ON	OFF	OFF	ON	ON
Flushing	6	1 min	---	ON	OFF	OFF	ON	OFF	OFF	ON	OFF	ON	OFF	OFF	ON	ON
Filtration Service	7	29 min	---	ON	OFF	OFF	ON	ON	OFF	OFF	OFF	ON	OFF	OFF	ON	ON

Attention !

- 1) The BW out valve V4 shall be manually activated to open during flushing.
- 2) Soaking time will vary and can be extent to 24 hrs. depending on the degree of fouling. Consult Technorbital for longer soak.
- 3) The CIP steps described above are for a single alkali or acid chemical solution.
- 4) If an acid and alkali cleaning are required, the CIP steps would be repeated for each chemical solution

Membrane Storage Procedure																
Draining	1	NA	---	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF	ON	ON
Clean In Place	2	30 Min	---	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON
Soaking	3	60 Min	NA	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON
Draining	4	NA	---	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF	ON	ON
Backwash	5	1 Min	---	OFF	ON	OFF	OFF	OFF	ON	ON	OFF	ON	OFF	OFF	ON	ON
Flushing	6	1 Min	---	ON	OFF	OFF	ON	OFF	OFF	ON	OFF	ON	OFF	OFF	ON	ON
Preservative Injection	7	2 Min	---	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON
Preservation	8	60 Min	NA	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

Product Range

GRAFI ULTRAFILTRATION MEMBRANE

The Ultra Filtration products are:

- ♦ **Energy Efficient** : 'PolyNorbit' the unique polymer supports 0.02 micron filtration with less feed pressure and no need of air blower.
- ♦ **Low Fouling** : Highly hydrophilic polymer results in Low fouling.
- ♦ **No Aggressive Chemical** : Unique polymer structure allows cleaning with mild cleansers like household citric acid and baking soda. **No HCl No NaOH**
- ♦ **Strong** : Our asymmetric fiber with no reinforcements supports out→In filtration, thus no air scouring need.

GRAFI NANO-FILTRATION (NF) MEMBRANE

The Nano Filtration membrane find application in:

- ♦ **Lower Feed Restriction** : Hollow Fiber, Out-In filtration can support greater tolerance to particles in feed.
- ♦ **Selectivity** : Some essential ions do pass there by offering flexibility to process design engineer.

GRAFI SOFTWARE

- ♦ Our in-house software that's programmed with our knowhow in membrane application guides the right product selection and system integration.
- ♦ It generates schematics and key material list with specifications to enable OEMs supply correct process and design.

GRAFI MBR MEMBRANE

Our MBR Modules support:

- ♦ **High Temperature** : As long as your design Biology supports, our "PolyNorbit" can be used upto 39°C operation yet deliver < 3 SDI
- ♦ **More Tolerant** : Though not recommended from biology perspective, occasional oil up-to 50 ppm does not affect MBR operation.
- ♦ **Low Fouling** : Highly hydrophilic fiber results in Low fouling.
- ♦ **High Tensile strength** : Enables submerged operation as well as external membrane aeration for membrane.

GRAFI PROCESS SEPARATION MEMBRANE ELEMENTS

For specialty applications used in Industry where focus is product not a pollution, our cross flow specialized fibers support:

- ♦ Concentration
- ♦ Separation based on Molecular weight
- ♦ Product Recovery
- ♦ Oil Removal

GRAFI TECH TOOL

Technorbital believes in promise delivery at customer premises and not just product. We support OEM & Customers with:

- ♦ O&M Manual
- ♦ Remote Monitoring & Advise
- ♦ Warranty
- ♦ Log Sheets
- ♦ Spares
- ♦ Training Notes

