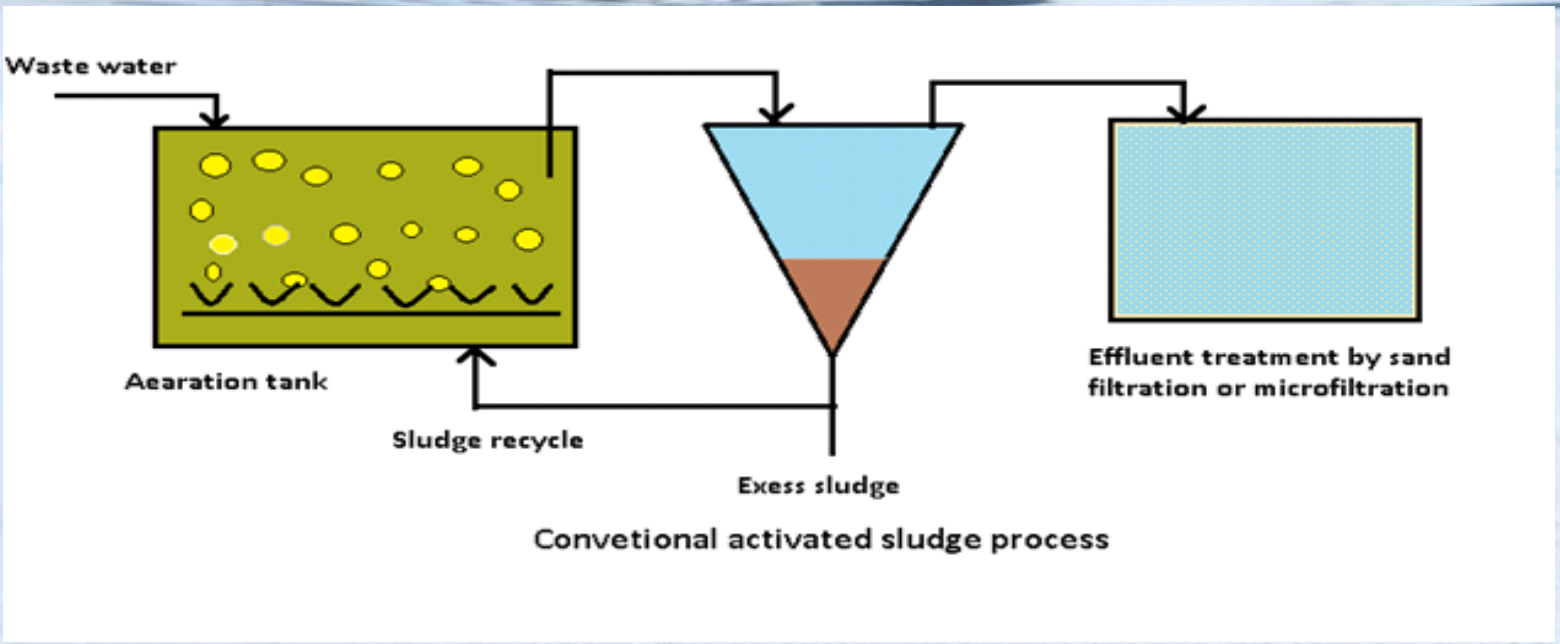
Advanced Submerged UF Membranes for MBR

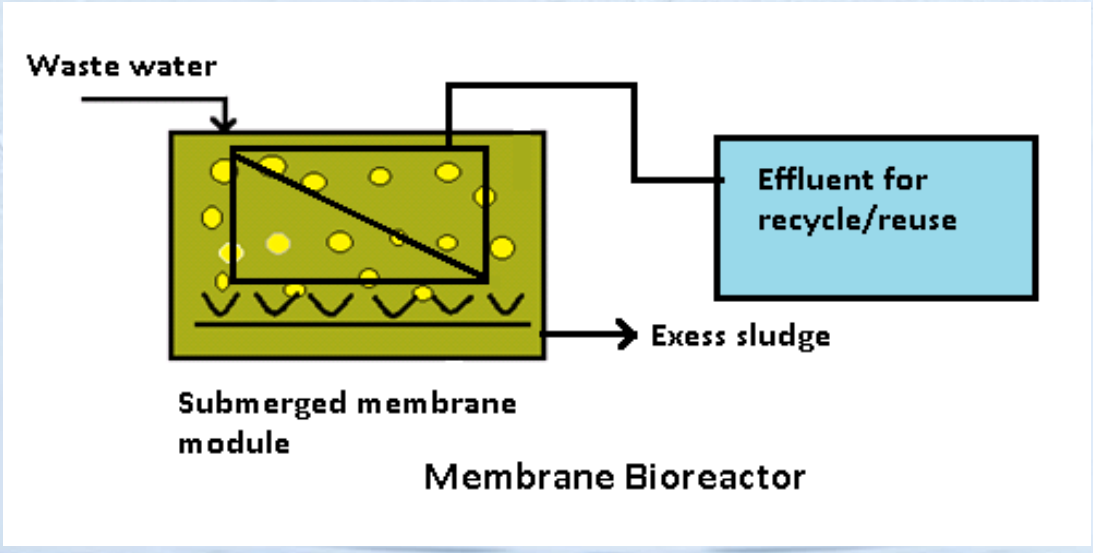
What is MBR ?

- MBR is a technology using a combination of biological treatment and membranes.
- Concept of filtering clean water from a high turbid environment – Aeration Tank.
- The membrane used in the MBR is PVDF.
- Eliminates - Tertiary Treatment
- Allows Activated Sludge process to operate at very High MLSS (> 8000 mg/L).
- Enables Longer Sludge Retention Time – NH3 N removal /De-nitrification is complete.

MBR- The Process

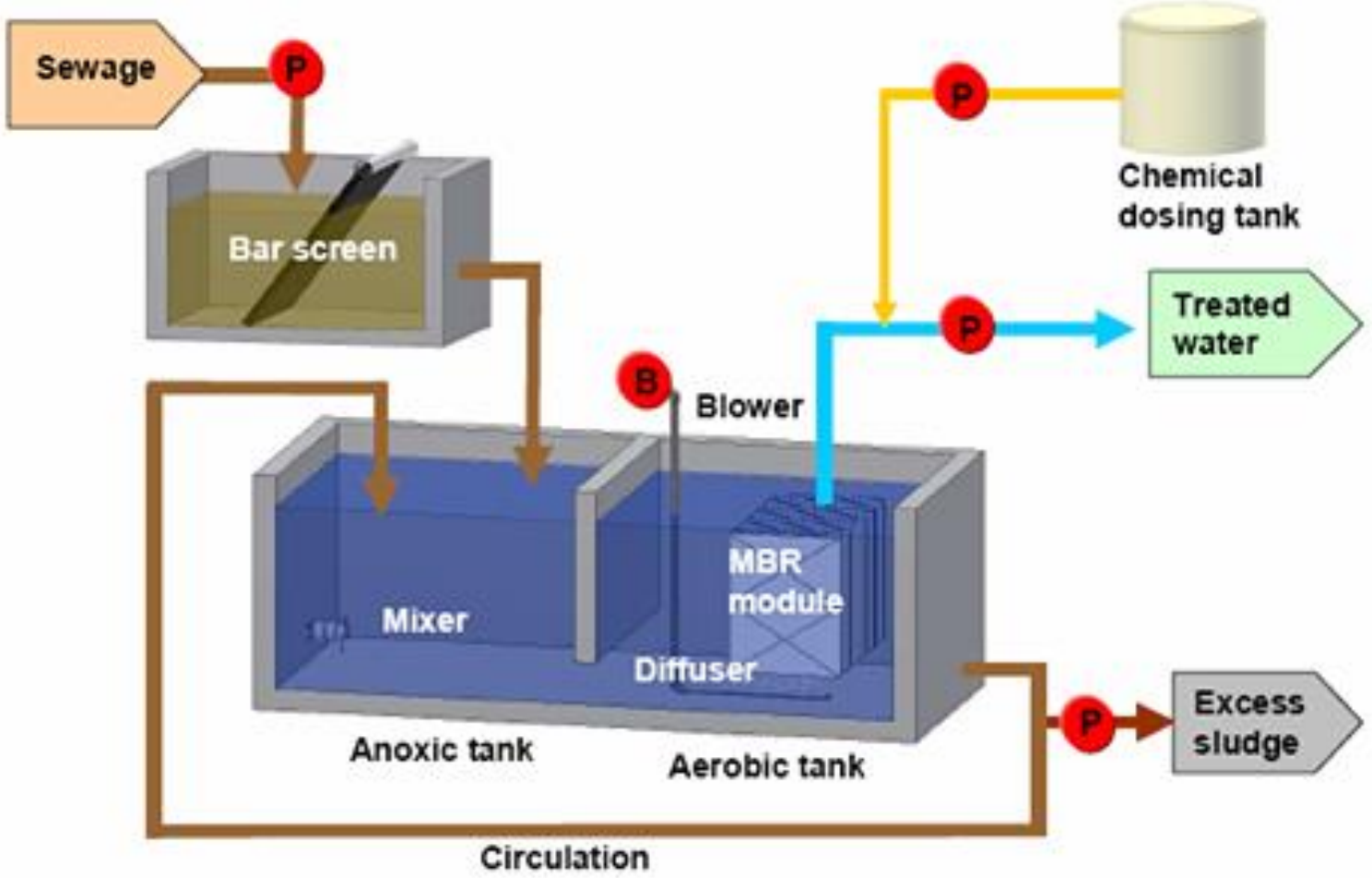


Convetional activated sludge process

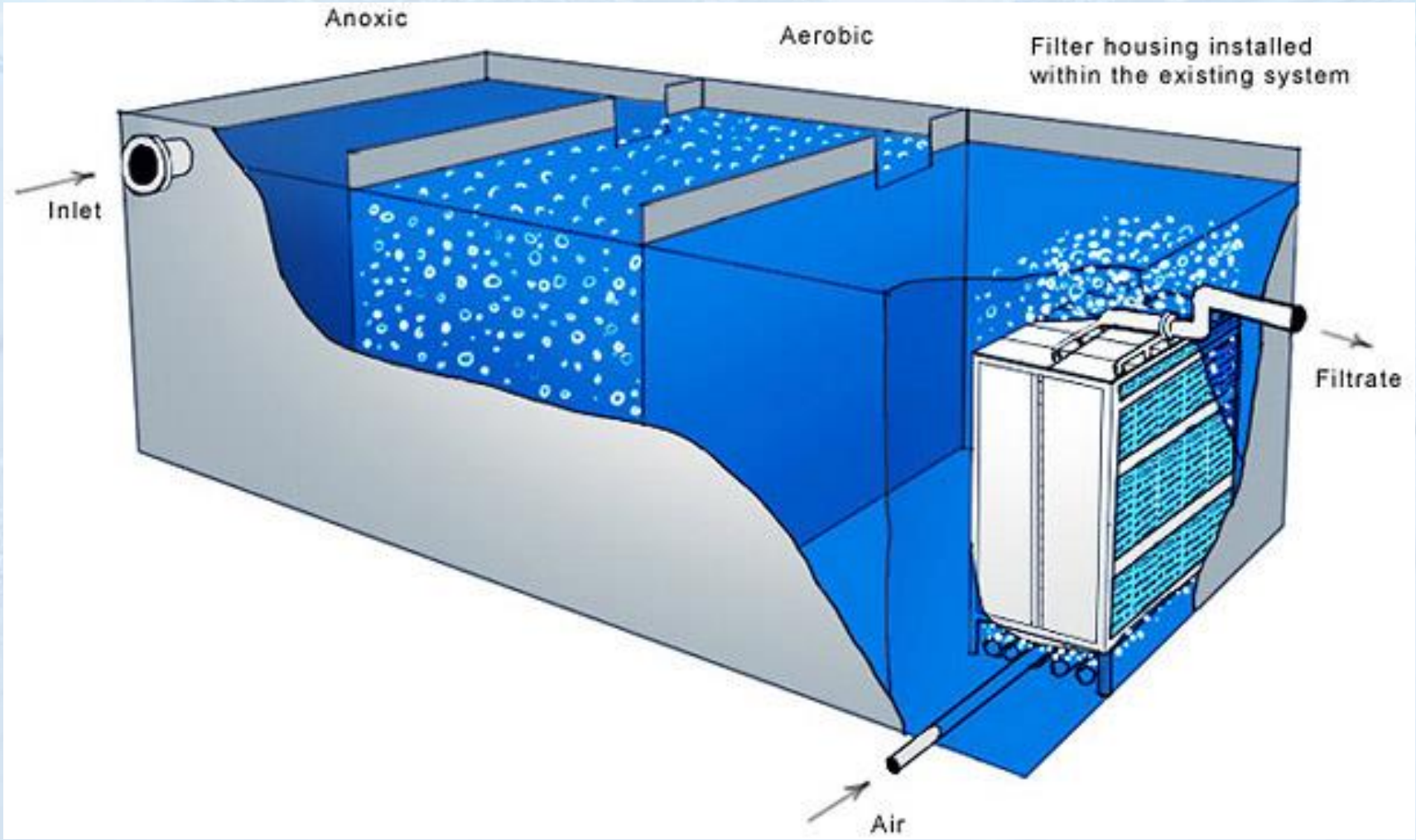


Membrane Bioreactor

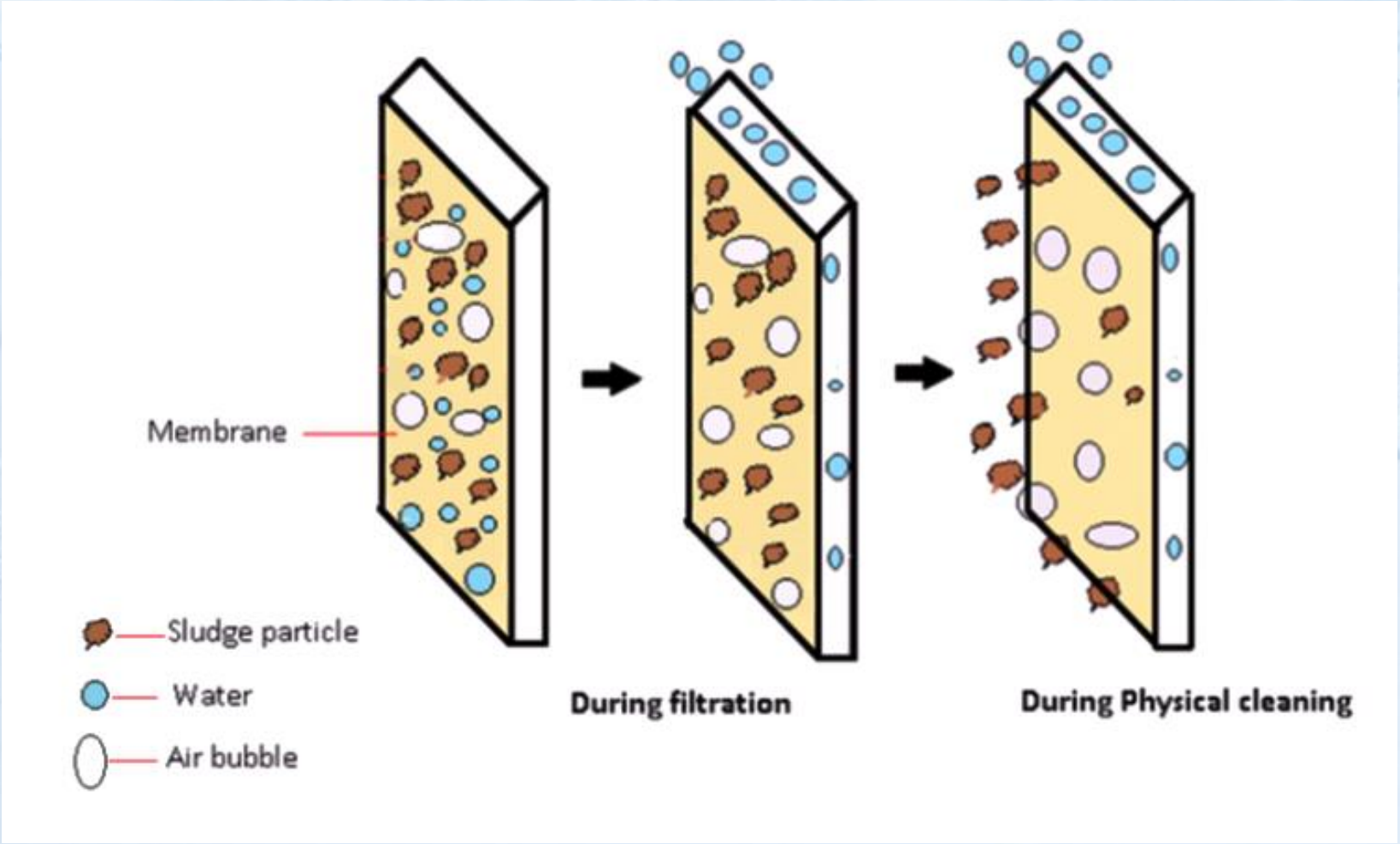
General Process Flow Diagram



Two Tank System - MBR.



Filtration Principal of submerged MBR



Why MBR ?

- With rising raw water costs and scarcity ,cost effective recycling to utility requirements makes economic, more importantly the social sense.
- The permeate of MBR will be used for Utilities such as CT makeup, Boiler feed , RO units and Flushing requirements.
- Reduced Unit step of Operations .
- Operating at higher MLSS - allows to absorb shock loads from influent.

Why MBR?

- MBR combines conventional activated sludge technology with membrane filtration to expand normal operating region
- MBRs can be designed at higher MLSS concentration because they are not affected by limitations of gravity sedimentation for solid liquid separation
- HRT can be reduced
- Long SRT provided
- Smaller foot print
- Upgrade of existing plant
- Effluent reuse (agriculture, industry) and recharge

MBR Vs ASP

Parameters	ASP	MBR
MLSS	<3000 mg/lit	<15000 mg/lit
HRT (Hydraulic Retention Time)	10-15 hours	4-8 hours
Waste sludge yield	>80%	<80%
Bioreactor volume		3-4 times smaller
Clarifier	Primary/secondary	None
Tertiary treatment	Sand filtration/UV	None required provides UF permeate quality
Overall foot print		3-4 times smaller
Process stability	Sludge settlement problem	Not affected by sludge settling character
SDI of permeate	Not measurable	3-5

Where MBR?

❖ **Municipal waste water (Sewage Treatment)**

Almost any size (50 m3/day – >60,000m3/day)

- Hotels, Housing colony, Commercial building etc.

❖ **Industrial Waste water**

- Pulp and paper
- Food and Beverages
- Tanneries
- Chemical
- Oil and gas
- Pharmaceutical

Pilot study results

Comparison of MBR Vs ASP and UF

Comparison of Various technologies Vis – a – Vis MBR			
Technical Parameters	**Conventional STP + UF**	**MBBR STP + UF**	**ENVI Q -MBR**
Feed Limiting conditions for Membranes			
Turbidity	5 NTU	5 NTU	Infinity
MLSS/TSS	< 5 ppm	< 5 ppm	20,000 ppm
Feed Pressure Requirement's	2.0 Bar	2.0 Bar	Upto 1.0 bar
Comparison for a 100 KLD plant (20 – 22 Hr operation)			
Working load HP rating.	~ 12 HP	~ 10.7 HP	~ 6.5 HP
Foot Print Area	~ 95 Sq.M	~ 71 Sq.M	~ 45 Sq.M
Chemical Consumption including Disinfection*	Hypo - **20.35 L/day #** Caustic – **0.1 L/d** HCL – **0.5 L/d**	Hypo - **20.35 L/day #** Caustic – **0.1 L/d** HCL – **0.5 L/d**	Hypo – **10.04L/day** Citric Acid – **23g/d**

*** - Considering that the disinfection is done on a continuous basis post filtration**

 # - One CEB is performed Every day for the UF

Comparison of MBR Vs ASP and UF

Comparison of Various technologies Vis – a – Vis MBR			
Technical Parameters	**Conventional STP + UF**	**MBBR STP + UF**	**MBR**
Other Parameters / Advantages			
Outlet BOD Guarantee	< 20 ppm	< 20 ppm	< 5 ppm
Sludge Generation	Very High	High	Very Low (due to very high SRT's)
Opex without Manpower	Rs 2.71 / KL	Rs 2.64 / KL	**Rs 1.25 / KL**

Comparison of Flat Sheet vs Hollow Fibre.

Description	Flat Sheet (Qua)	Hollow Fiber
Number of Backwashes	Low (One BW / 2 – 4 hrs)	High (One BW / 5 – 15 mins)
Air Scouring efficiency	High (the gap between the membranes is EVEN all through)	Low (gap between the fibers is not constant as they are free flowing along Eddy's)
Automation/ Instrumentation Required	Low	**Elaborate** (Required because fouling tendency is higher as compared to Flat sheet)
Maintenance Handling	Can be handled	Cumbersome
Strength of PVDF membrane	High	High (When Braided)
Foot Print Area Required	Relatively Higher compared to Hollow fiber	Lower
Screening Requirement's	2- 3 mm	1 – 2 mm
Power Requirement	~ 0.06 HP/KL	~ 0.09 HP /KL (additional Power required for Backwashes & Chemical Cleaning)

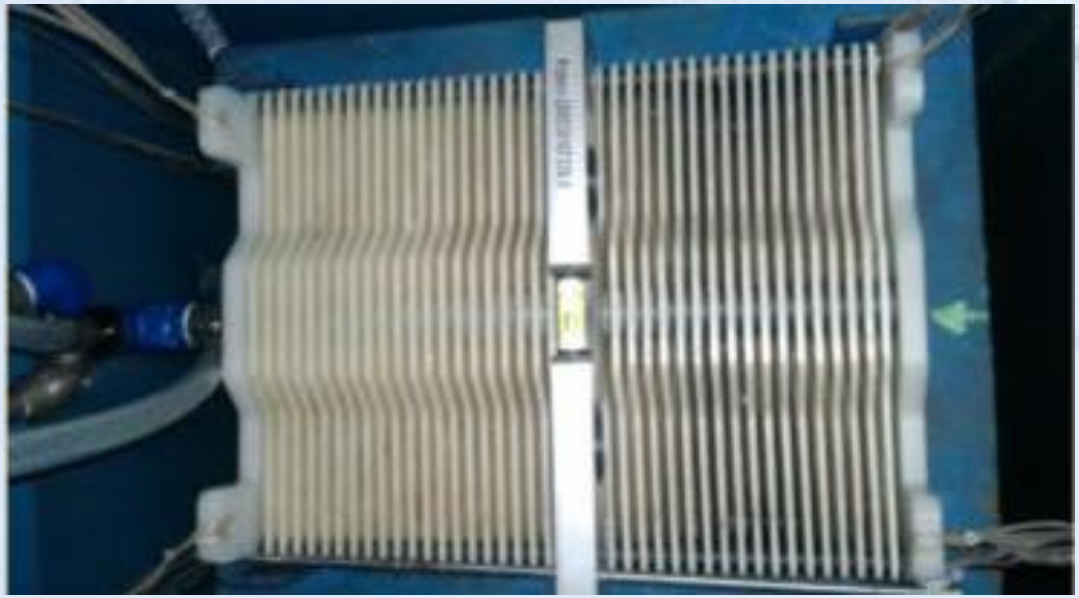
Advantages of Flat Sheet MBR vs Cross Flow MBR

Parameters	Flat Sheet MBR	Cross Flow MBR
Technology	Advanced	Developed before the advent of Immersed MBR Membranes
Space Requirements	Immersed inside the Aeration Tank /Bio Reactor – Space Saving	Housed Separate – Additional Space requirement
Energy Requirements	Far Less as no Recirculation – 1/40th of HP requirement of Cross- Flow . **Approx - 0.1kwH/M3**	Very High as Recirculation Required. Almost more than 20 times the service flow to be circulated. **Approx - 4.0kwH/m3**
Maintenance	Less Cumbersome	Cumbersome.
Pore Size	0.04 micron	0.04 micron
Permeate Quality	Good	Good

Envi Q Features vs Competition

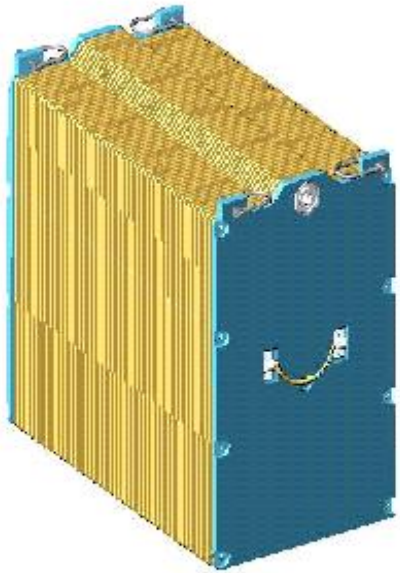
Envi Q Advantage points	Hollow Fiber	Other Flat Sheet	Remarks
Size of Each Module - Small	Height ~ 2.3 M	Height ~ 2.1 M	Other membranes tend to get damaged handling is difficult during maintenance.
Air Scouring is more even	Tend to bunch in the middle – Not effective	Tend to Sag because of height .	Each membrane being small, flow of bubbles is even across the surface area.
Back Washes (once in 2 to 4 hours)	**Forced Back washes – No: of Back washes are far higher as compared to Flat Sheet (~ every 5 min to 20 minutes)**	Forced Back washes / No Backwashes	Loss of time in back washes more pronounced in Hollow Fibres.
Instrumentation - Minimal	Complete Automation – Very Elaborate	Automation is present – the degree of it may vary among the various manufacturers.	The level of instrumentation in Envi Q is bare minimum.
Space Required	The least space occupied	All Flat sheets occupy the same space	Hollow fibers occupy at least 10% - 20% less space compared to Flat sheets
Make In India	Not applicable	Not applicable	Local Technical support and expertise.

EnviQ **Membrane Cartridge**

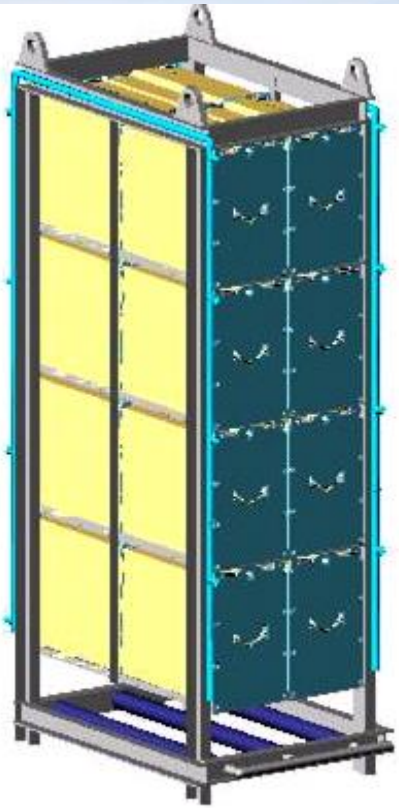


EnviQ **Modular design**

Membrane plate



Membrane cartridge



Module

MBR has become a very attractive technology because of

- Rugged and sturdy membranes.
- Very simple controls and hence easy operation.
- Manufactured in India and hence availability of products, technical know how and after sales support.

THANK YOU