



Membrane Bioreactor & Membrane Tertiary for Wastewater Reuse

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Presentation Outline



Title 22 Reuse Standard



MBR Review



L&T Reuse Experience



MBR Going Forward



Motivational Quotes for Sewage Reuse

- “No higher quality water should be used for a purpose that can tolerate a lower grade” UN Council Resolution 1958;
- “Water should not be judged by its history but its quality” Dr. Lucs Van Vuuren, one of the pioneers of Windhoek Water Reclamation System in Namibia, Africa.



Title 22 Reuse Standard

- Title 22 is globally recognized standard for reuse;
- Have 40 specific uses for tertiary treated sewage, 24 for secondary and 7 for un-disinfected secondary
- Total coliform = 2.2 MPN/100 mL (average secondary and tertiary treated sewage);
- Total coliform = 23 MPN/100 mL (average for secondary);
- Turbidity = 2 NTU for tertiary



Main MBR Drivers

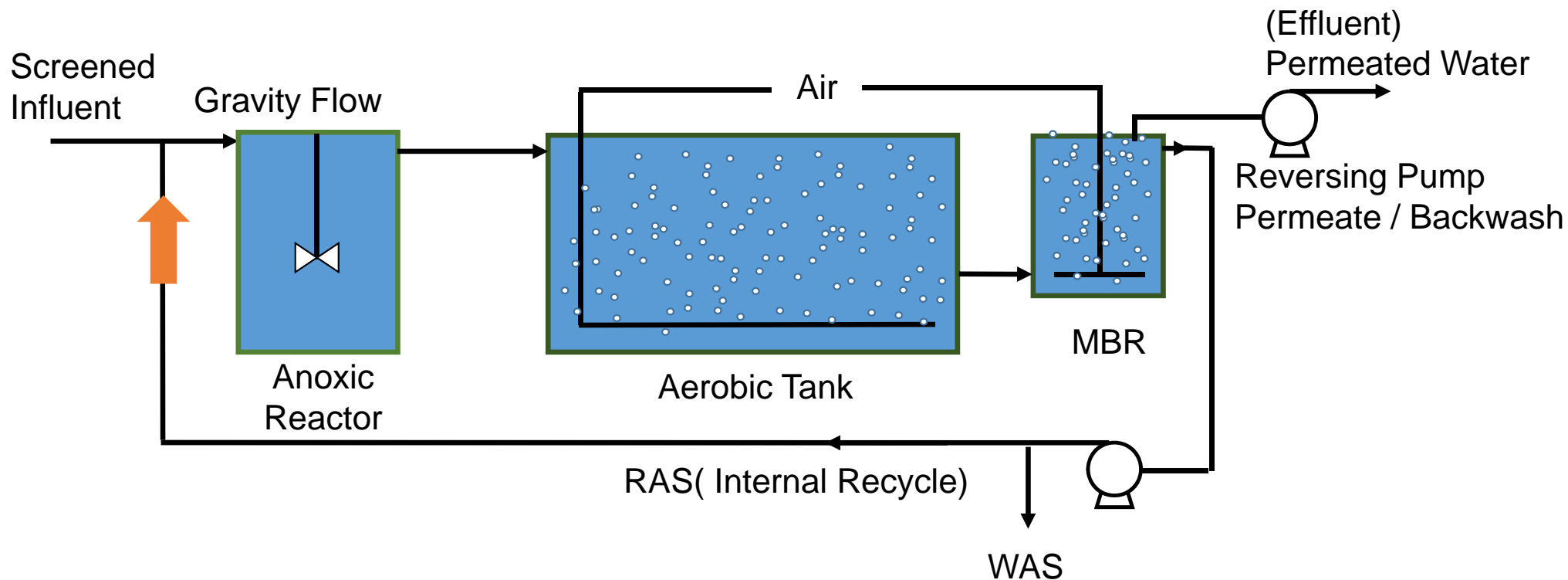
Smaller footprint;

- Less construction cost and time;
- Less piping and utilities;
- Reuse quality water without tertiary treatment;
- Typical effluent:

BOD/TSS/ $\text{NH}_3\text{-N}$ /TN/TP/Turbidity; 5/0/1/10/1/0.2
respectively.



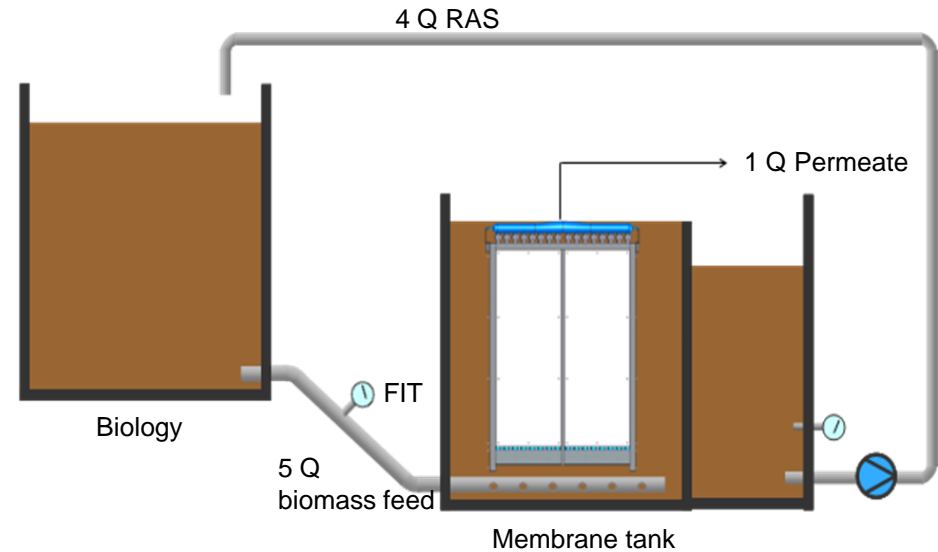
MBR Plant Flow Diagram – MLE Process





Membrane Bioreactor (MBR) Technology

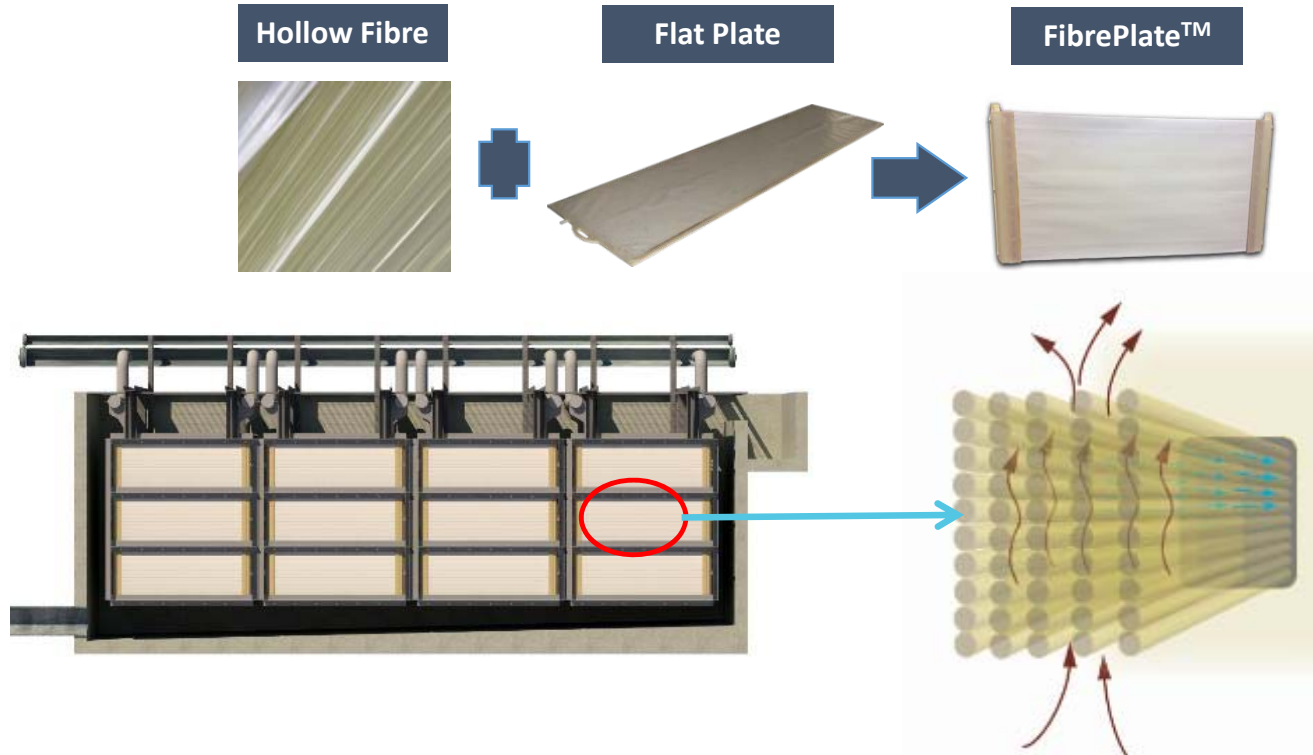
- Combination of secondary and tertiary treatment;
- Submerged UF membranes;
- Most vendors use PVDF;
- Hollow fibre or flat sheet;
- Smaller footprint and better quality than ASP and SBR.





FiberCast MBR: Latest Arrival

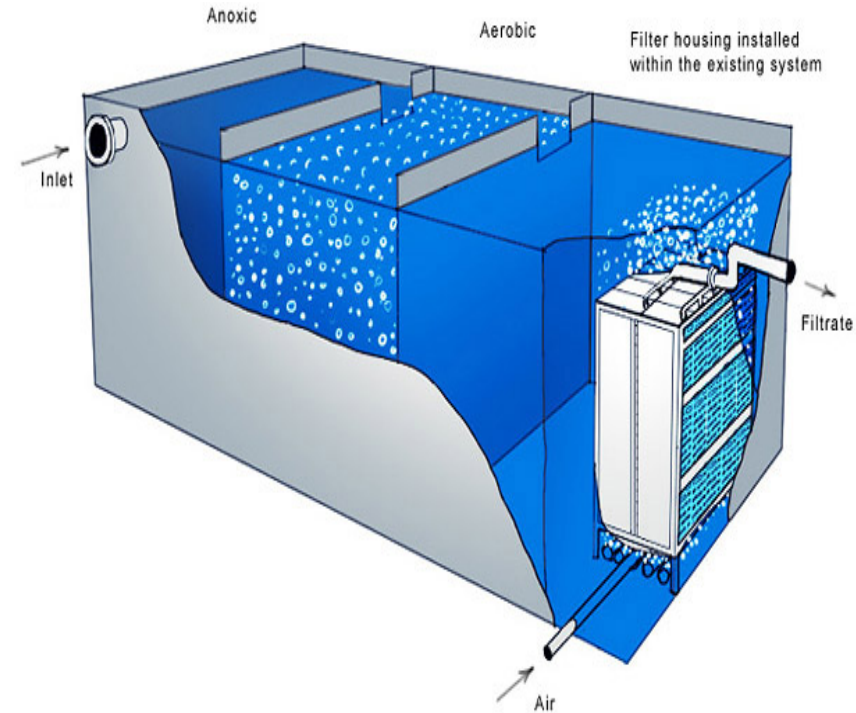
- Hybrid of hollow fibre and flat sheet;
- 0.04 microns pore size





MBR Process Parameters

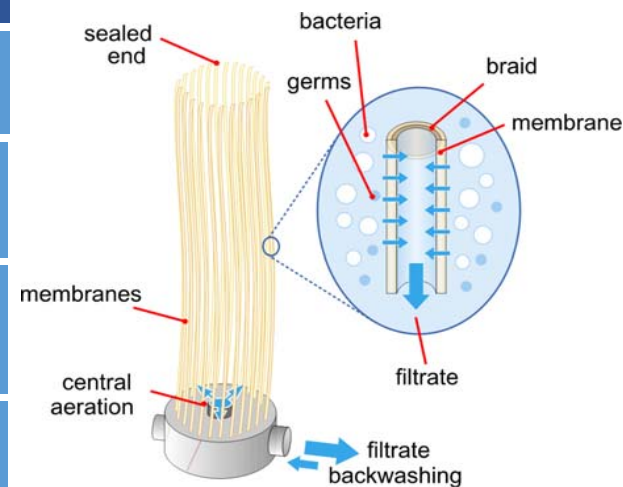
- Bioreactor operates at MLSS of 8000-9000 mg/L;
- Flux rate 18-30 LMH at average flow and 40-50 LMH at peak;
- Air scouring ($\sim 0.1 \text{ Nm}^3/\text{m}^2$ and recirculation rate (4x) required;
- Maintenance cleaning 7 days.
Recovery cleaning 90-180 day;
- BOD/NTU/TN of 5/0.2/10 respectively.





MBR vs ASP

Parameters		ASP Process		MBR/ Tertiary UF
		w/o Tertiary	with Tertiary GMF	
Solids (TSS)	mg/L	20 – 40	3 – 8	0
COD	mg/L	40 – 50	30 – 40	< 30
P _{tot} (with simultaneous precipitation)	mg/L	1.0 – 2.0	0.3 – 0.5	< 0.3
Microbiological quality		poor bathing water quality		Excellent bathing water quality
MLSS	g/L	< 4	< 4	< 12
Specific Energy demand	(kWh/m ³)	0.2 – 0.4	0.4 – 0.8	0.4 – 0.9





Huaifang MBR Plant in China

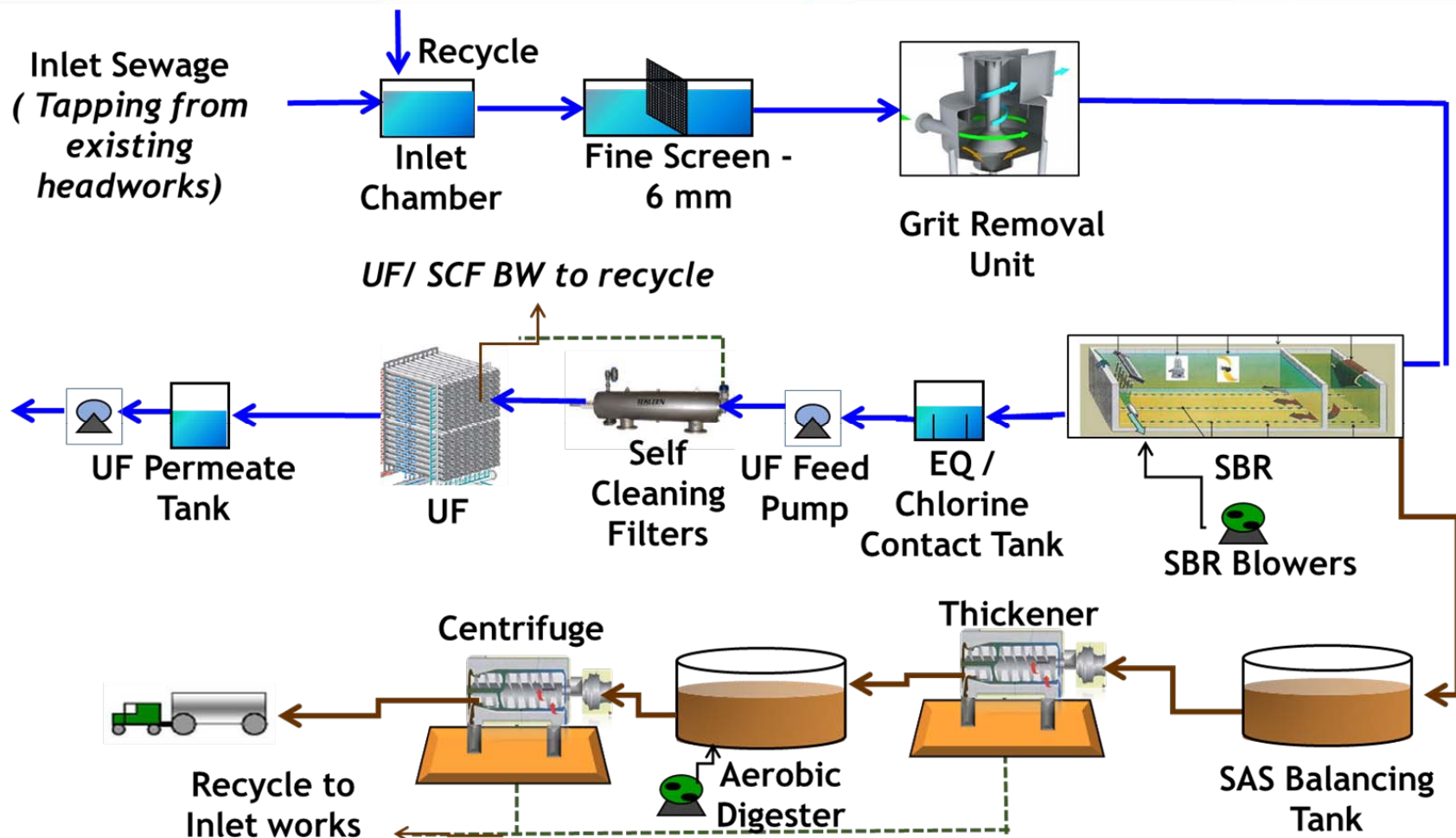


- 600 MLD design capacity, current operation is 500 MLD;
- Treats most of Beijing western urban area and some industrial contribution;
- In operation since 2016;
- Submerged hollow fibre MBR from Memstar;
- Membrane area 1,728,000 m²
- The plant is completely underground and inside building.





UF Tertiary Treatment





UF Tertiary Plant by L&T – Doha, Qatar





MBR Technology Going Forward

❖ **MBR capital cost is coming down:**

- Became mainstream technology. Customer acceptance increased demand;
- Large scale (>500MLD) installations. Economy of scale;
- High demand in the Chinese market;
- Increased vendor pool;
- More industrial applications where reuse is needed;
- Decrease in manufacturing cost;



MBR Technology Going Forward

❖ Improved operating cost:

- Vendors have confidence to guarantee up to 10 years;
- Reduced replacement cost;
- Decrease in chemical consumption;
- Optimization in backwash and air scouring;
- Improved life cycle cost;
- Better trained operators.

THANK YOU

