Enviro Arabia 2007

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Acwa Emirates LLC, PO Box 118803, Dubai, UAE. Tel: 971 (0) 4 3341445, Fax: +971 (0) 3341448. Email: acwa@acwa.ae. Web: www.acwa.co.uk

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Workshop 6

"Membrane Biological Reactor Design, Operations and Maintenance"

Hassan Elokdi
Projects Manager
Acwa Emirates LLC

Program

- General Technology Overview (MBR) — 45 min
  - Coffee Break/ Questions — 5 min
- Kubota MBR Design — 35 min
  - Coffee Break/ Questions — 10 min
- Kubota MBR Installation — 35 min
  - Coffee Break/ Questions — 10 min
- Kubota MBR Operation — 30 min
- Plant Walk Through Video — 10 min

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Section One

General Technology Overview (MBR)

Hassan Elokdi
Projects Manager
Acwa Emirates LLC

45 Minutes

General Technology Overview

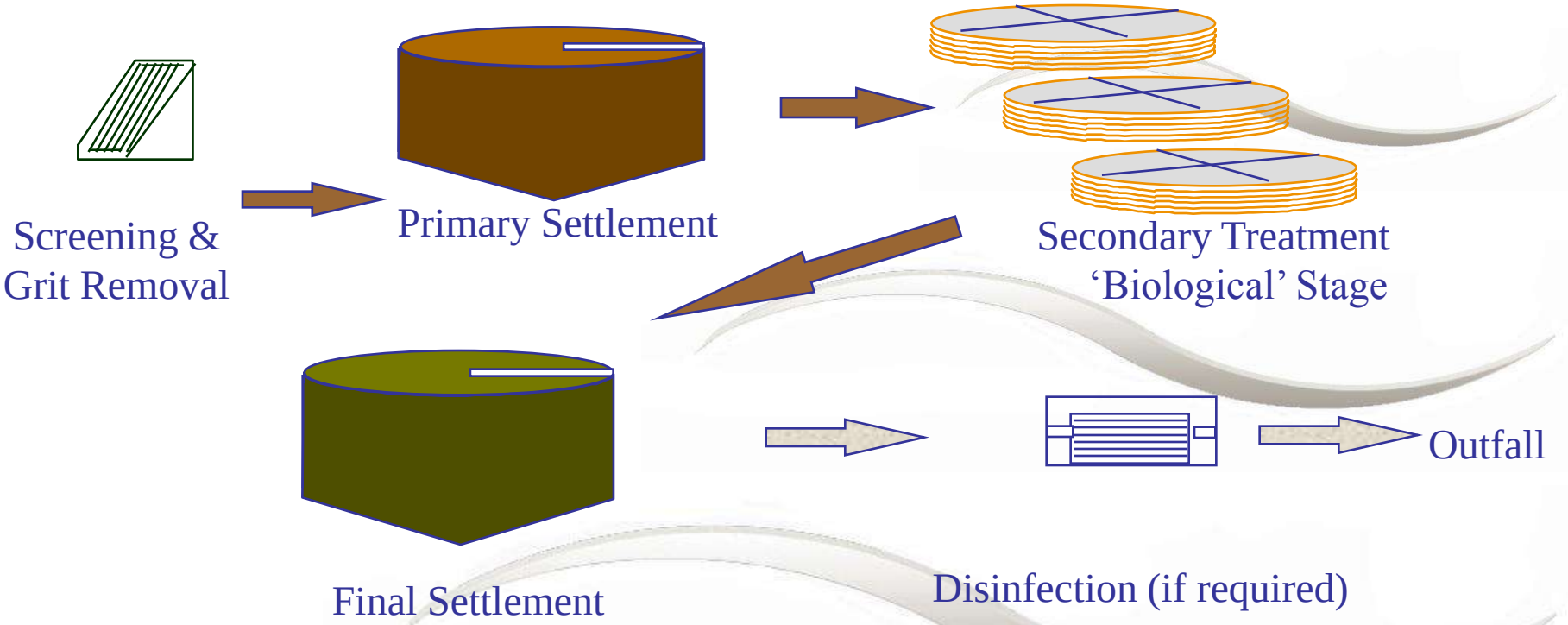
Contents

- Why Use MBR ?
  - Difference from Conventional systems
  - A Short Video (00:01:02)
  - Listing
- Why Use Kubota MBR?
  - An Animated Video (00:04:56)
  - Listing
- Product Overview
- Product Technical Overview

General Technology Overview

Why Use MBR?

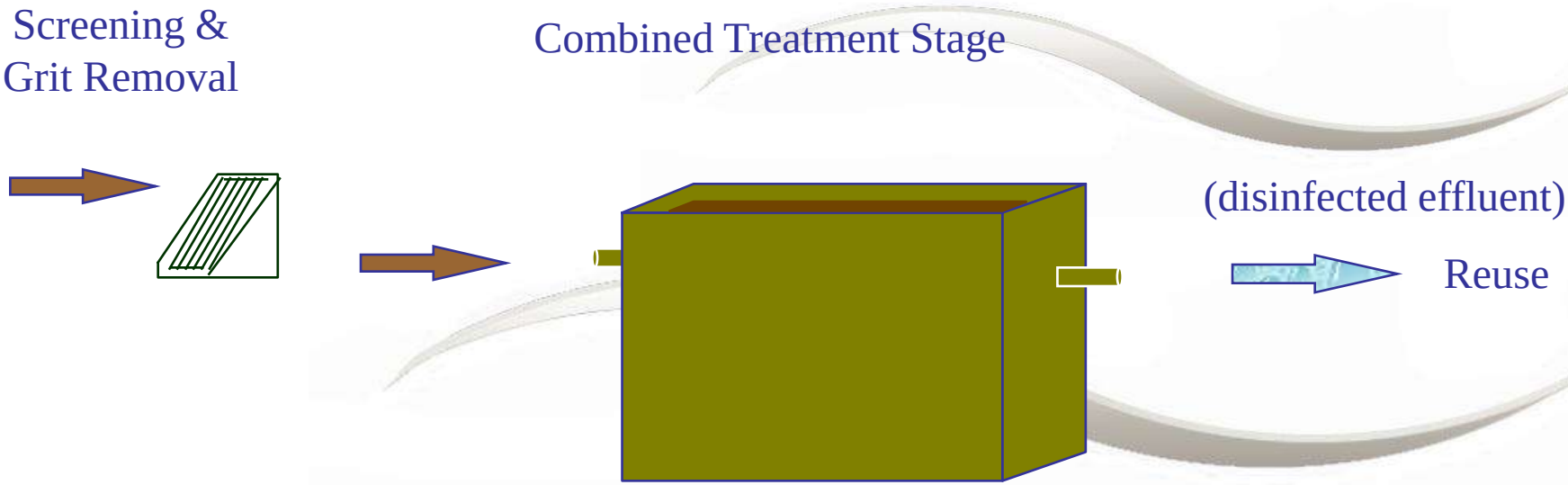
- Conventional Treatment -> Reliance on gravity separation



General Technology Overview

Why Use MBR?

- The Genius Of SMBR -> Placing membrane units inside the activated sludge aeration tank & using the aeration for membrane cleaning AND biological aeration supply



General Technology Overview

Why Use MBR?

- Let us take a look at the video first.

(run time 00:01:02)

General Technology Overview

Why Use MBR?

- No Odor
- Fully Automated
- Fully Disinfected Effluent
- Industrial Treatment and Reuse
- Minimal Sludge Volume
- Modular Expansion
- Multiple Reuse- Opportunities
- Dedicated Water Treatment Facility
- World Leader
- Small Footprint

General Technology Overview

Why Use Kubota MBR?

- Let us take a look at the video first.

(run time 00:04:56)

General Technology Overview

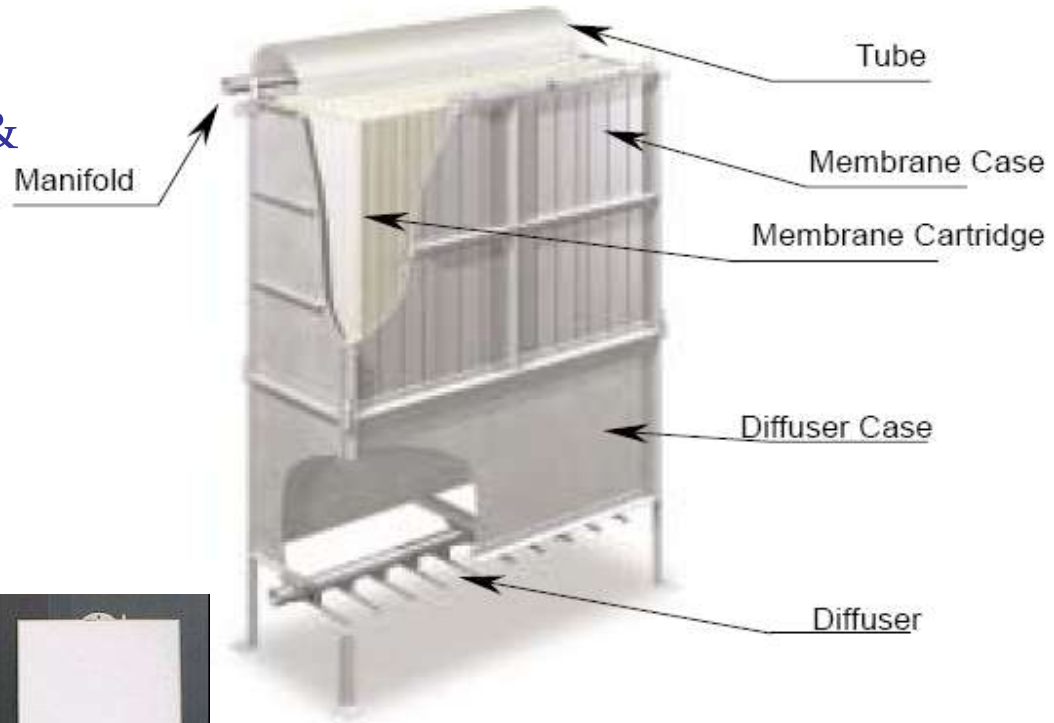
Why Use Kubota MBR?

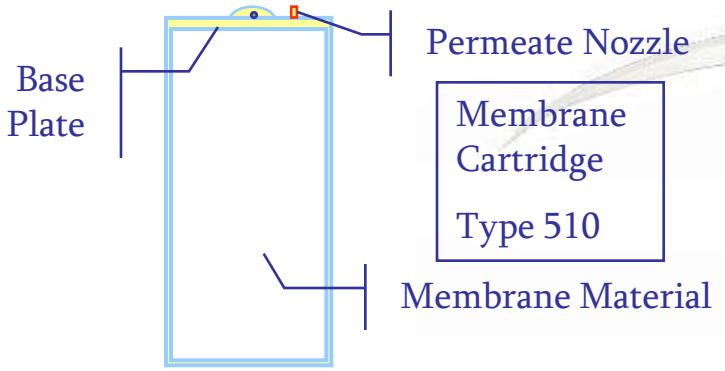
- Only 3 mm (bi-directional) Pre-Screening Required
- Low Trans Membrane Pressure (TMP)
- Operate on Gravity Head (1.2 m)
- No Back-pulse Required
- Cleaning In Situ
- Less Equipment and Complexity
- World Leader- Over 2000 Installations
- Global Presence and Technology Transfer
- ……and More

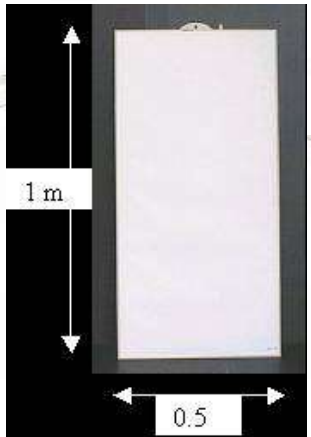
General Technology Overview

Product Overview

- A Membrane Unit is Made of
  - Diffuser Case (Air Supply)
  - Membrane Case (Support & Flume)
  - Membrane Cartridge
  - Permeate Tube (hose)
  - Permeate Manifold (PVC)
  - ……Continued



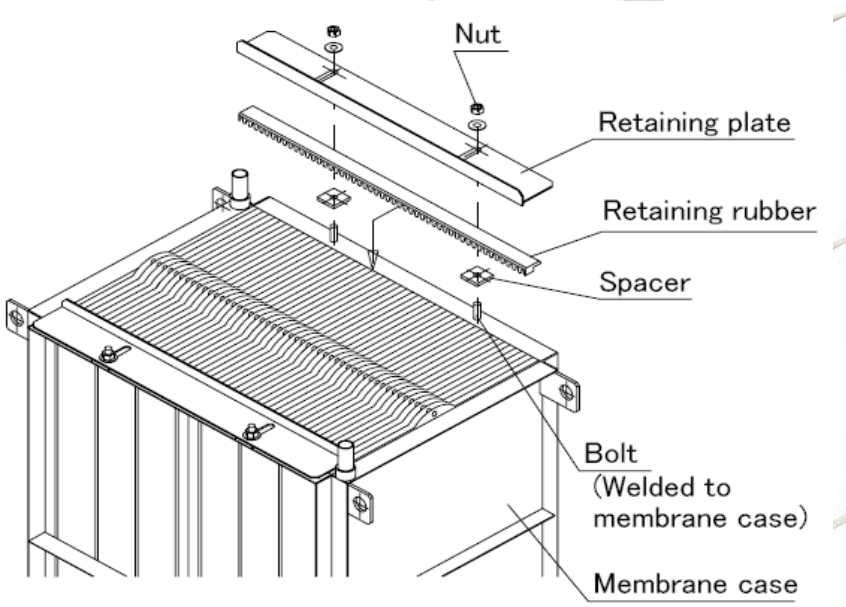




General Technology Overview

Product Overview

- A Membrane Unit is Made of
  - ……..Continued
  - Retaining Rubber (To keep cartridges held 7mm apart)
  - Retaining Plate (Support)
  - Spacers, Bolts & Nuts.

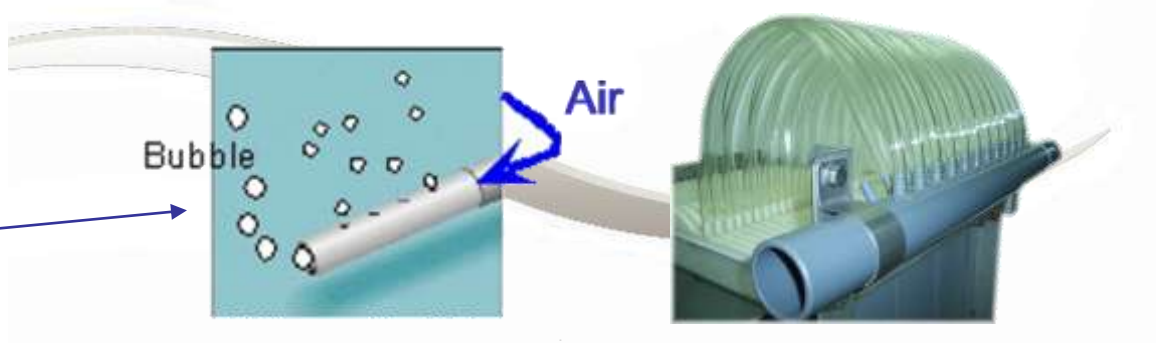


Retaining Rubber

General Technology Overview

Product Overview

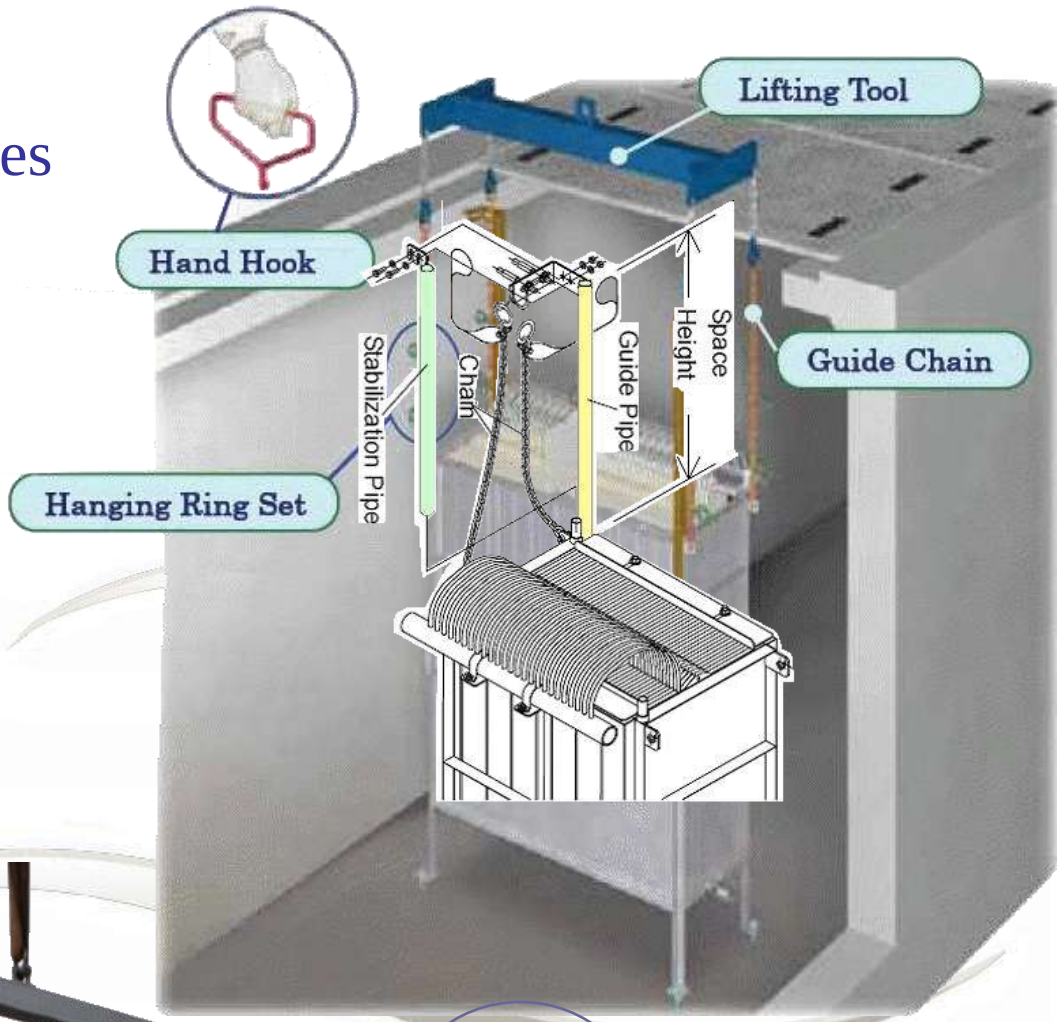
- A Membrane Unit is Made of



General Technology Overview

Product Overview

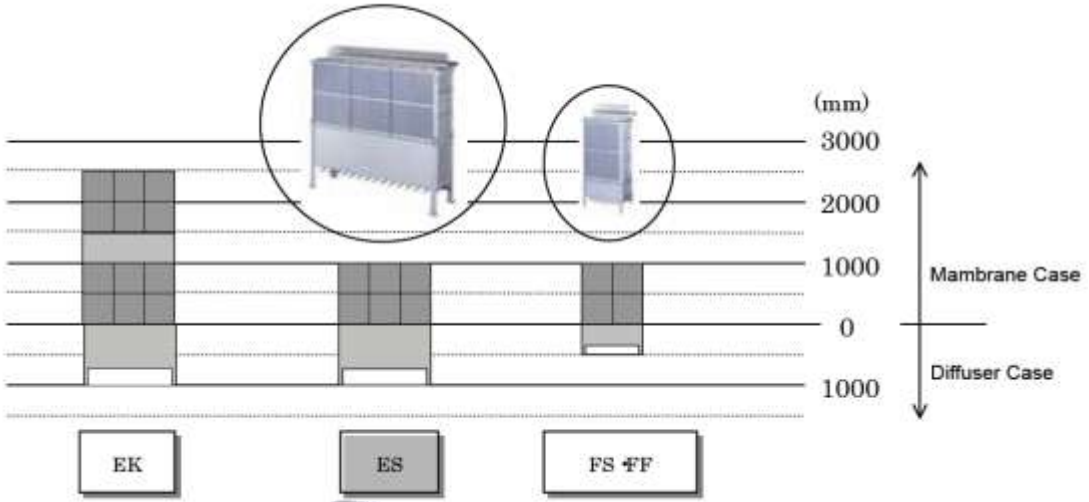
- Membrane Unit Accessories
  - Guide Pipe (Required)
  - Stabilizer Pipe (Required)
  - Lifting Tool (Required)
  - Hand Hook (Optional)
  - Chain (Optional)



General Technology Overview

Product Overview

- E K 400 N
- a b c d
- a: Height of Diffuser Case
- E ⇒ 1000mm
- b: Variations in Application
  - S ⇒ Single-Deck Unit
  - K ⇒ Double-Deck Unit
- c: Number of Membrane Cartridges per Unit
  - From 300 to 400 Pieces (25, 50, 75, 100, 150, 200, 300, 400)
- d: Metal Parts Material
  - None ⇒ SUS304 (JIS, equivalent to 304 Stainless Steel).



General Technology Overview

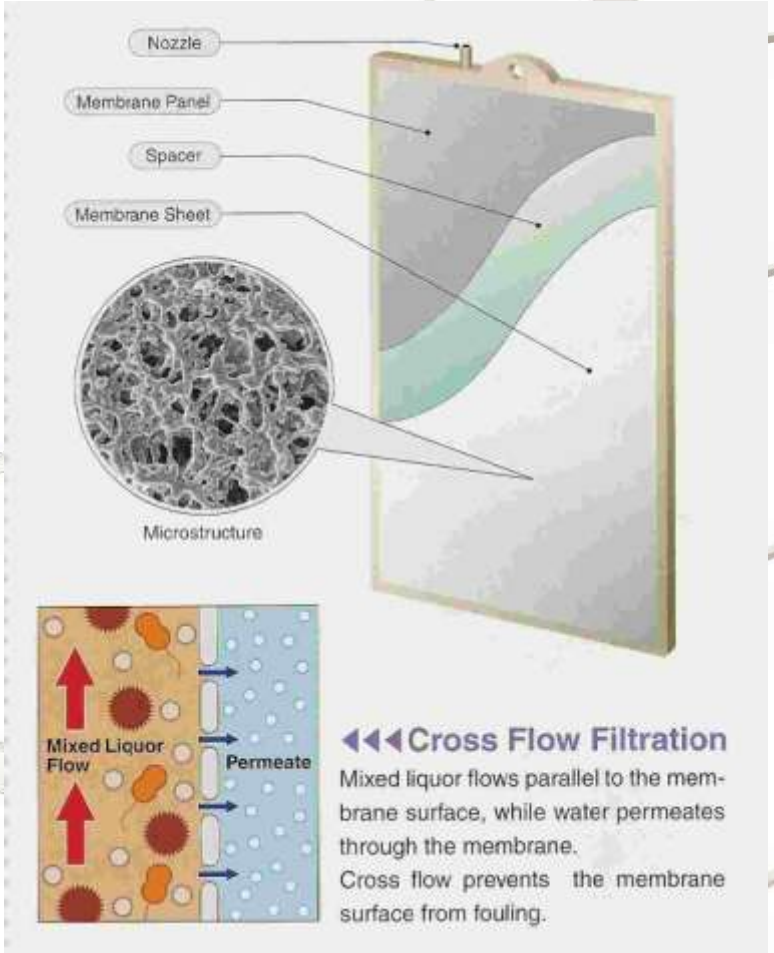
Product Overview

Types	Size, Membrane case + Diffuser case	Uses	Air supply rate by diffusers L/(min/sheet)		Examples of applications
			Necessary volume	Upper limit	
A type	1000 + 1500 (mm)	When designed to be placed in deep water	10.0	15.0	Night soil treatment facilities Combined type (domestic wastewater treatment plant) Industrial wastewater
E type	1000 + 1000 (mm)	Standard type	10.0	15.0	Combined type Wastewater reuse facility Industrial wastewater
F type	1000 + 500 (mm)	When designed to be placed in shallow water	12.5	20.0	Wastewater reuse facility
FC type	1000 + 500 (mm)	When designed to be placed in shallow water	15.0	20.0	

General Technology Overview

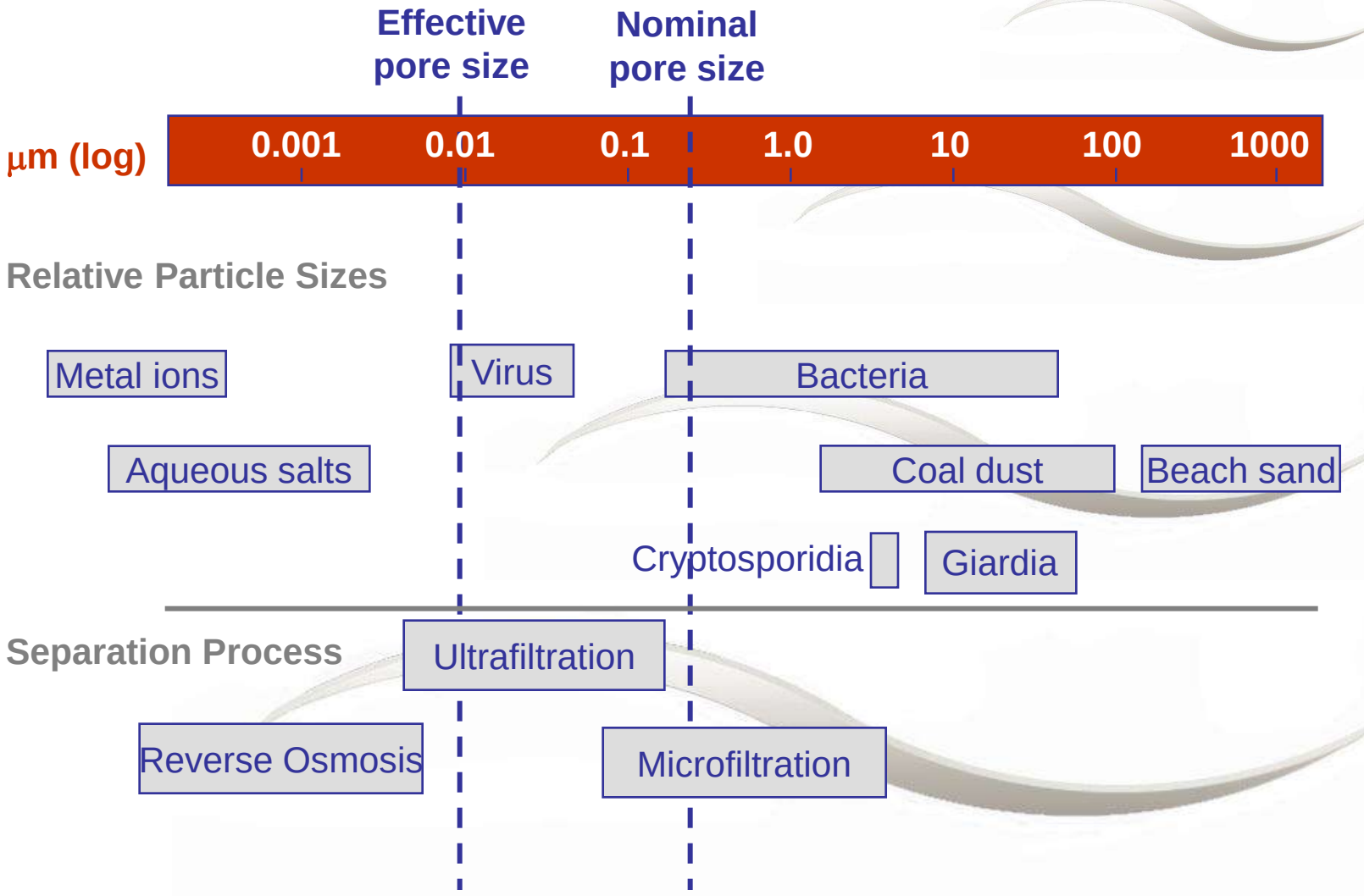
Product Technical Overview

- A Membrane Cartridge is Made of
  - Membrane Panel
  - Spacer
  - Membrane Sheet
- Nominal Size
  - 0.4 Microns (Dry Condition)
  - 0.01 Microns (Effective Size in operation)



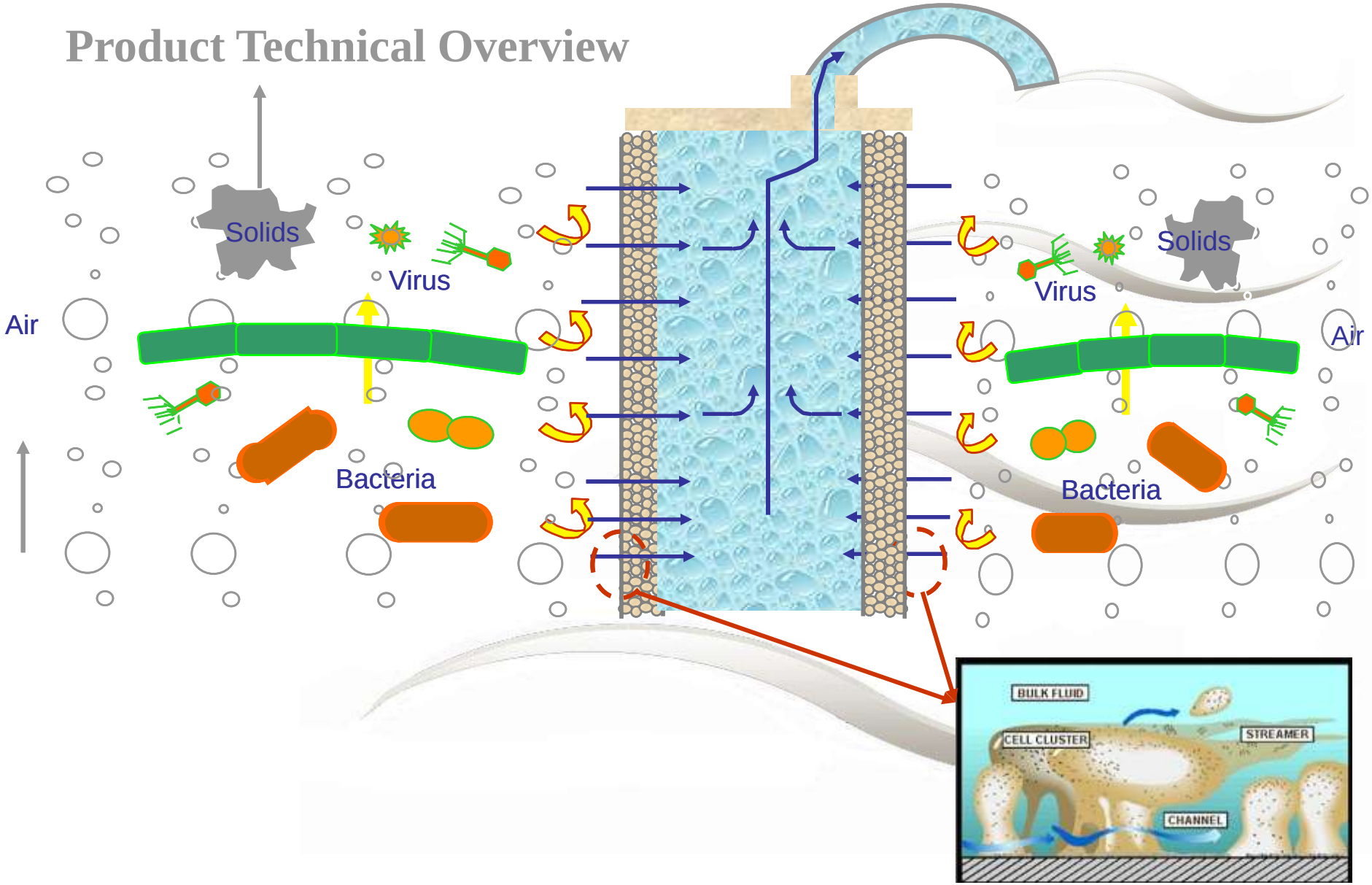
General Technology Overview

Product Technical Overview



General Technology Overview

Product Technical Overview

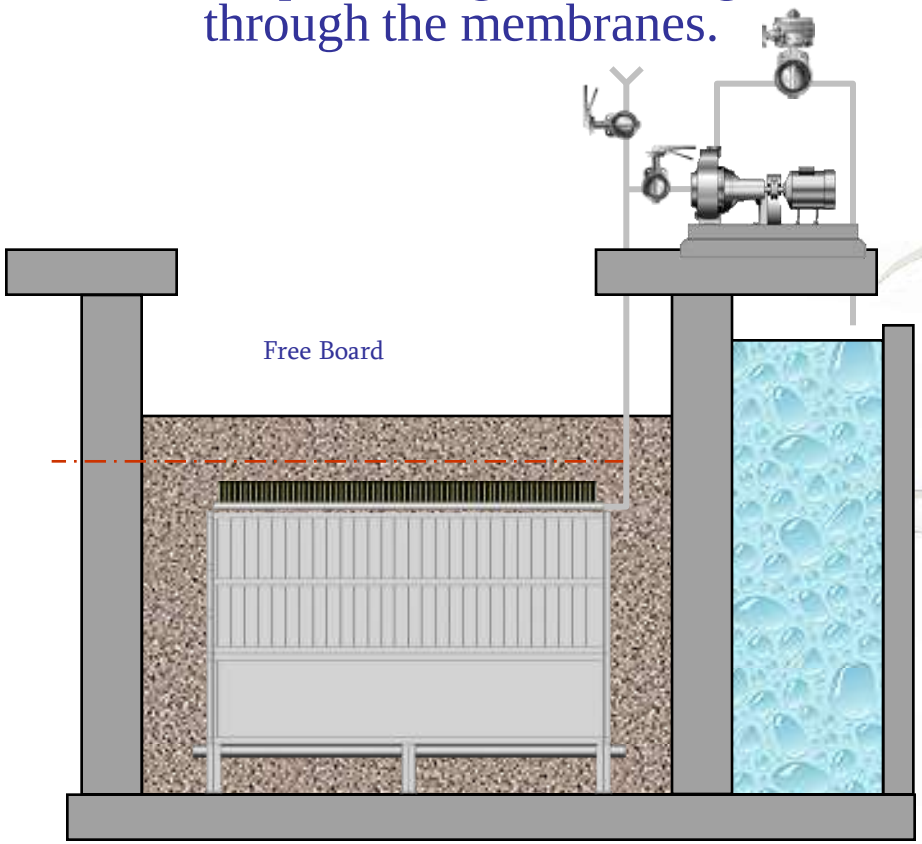


General Technology Overview

Product Technical Overview

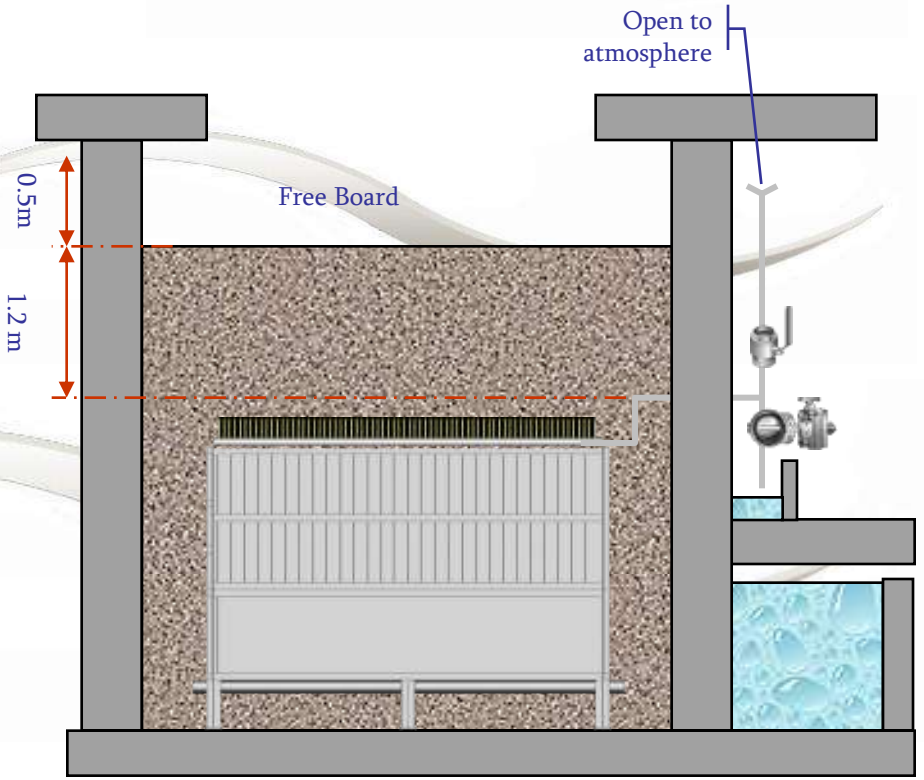
- **Suction System**

  A suction pump can be utilized for producing the driving force through the membranes.



- **Gravity System**

  Low TMP Allows Static Head to be the driving force in a worst case scenario.



General Technology Overview

Product Technical Overview

Relaxation Sequence

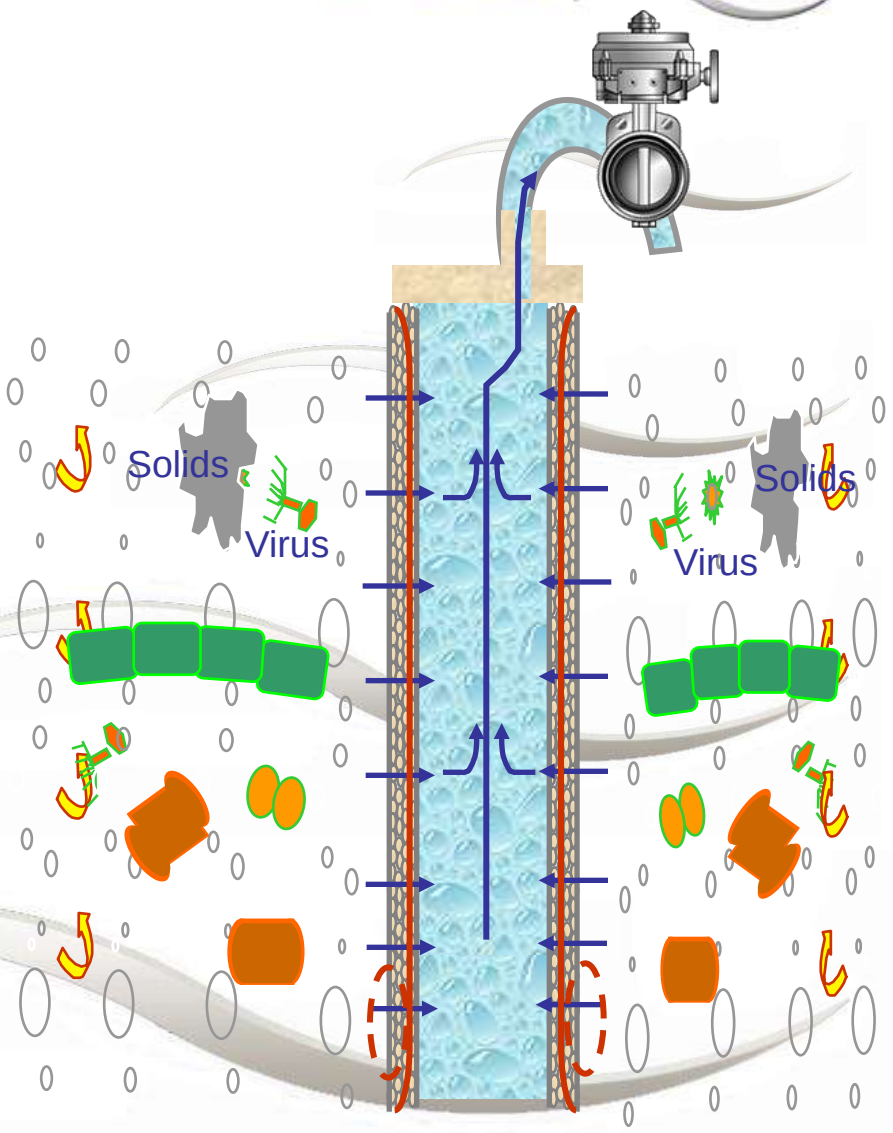
1. Permeation is halted for set time
2. Membrane relaxes
3. Air cleans
4. Permeation resumes

Assists in

- Reducing fouling potential
- Increasing membrane lifetime

Standard Duration

- 55 minutes permeation
- 5 minutes relaxation



General Technology Overview

Product Technical Overview

Souring Sequence

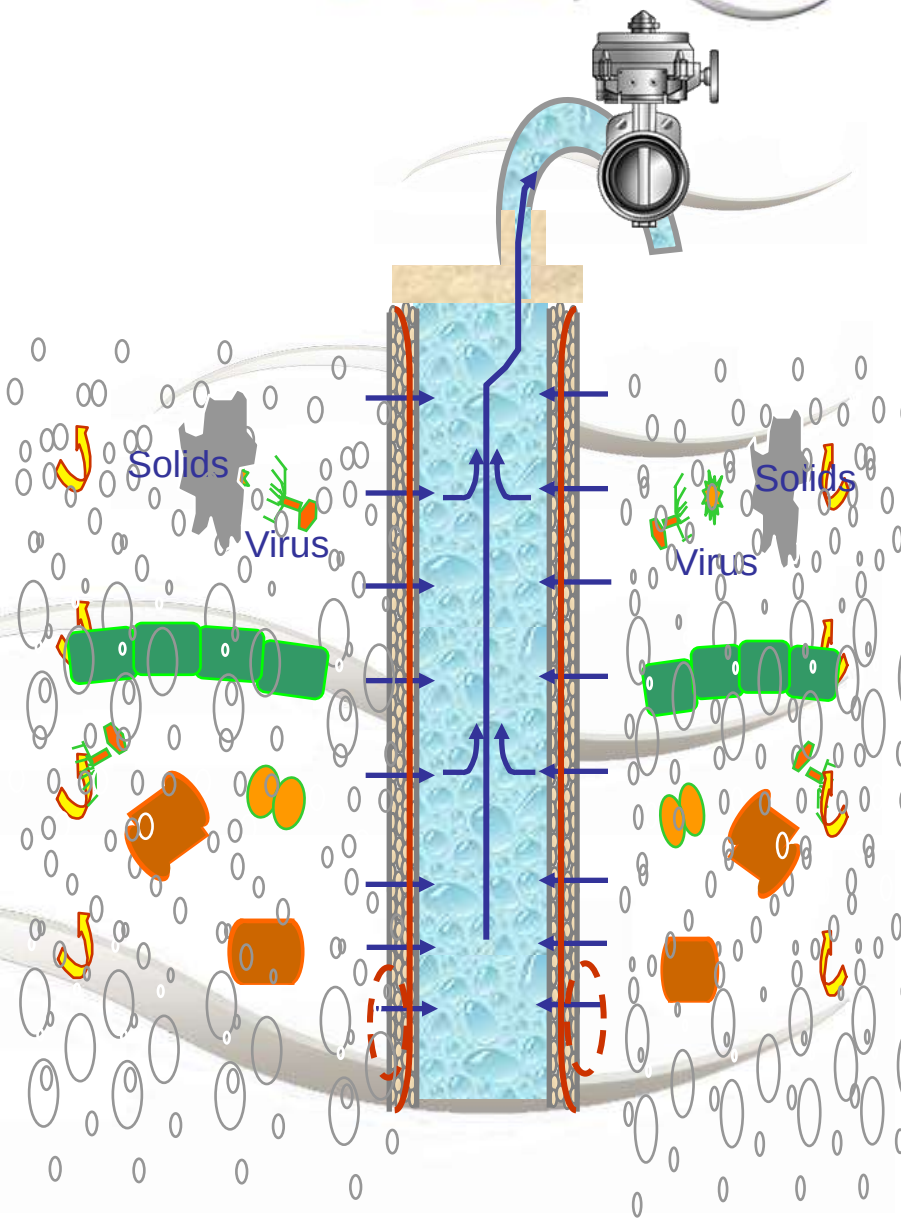
1. Air is increased
2. Permeation is halted for set time
3. Membrane relaxes
4. Air cleans efficiently
5. Permeation resumes
6. Air is reduced to normal

Assists in

- Effectively reducing fouling potential
- Increasing membrane lifetime

Standard Duration

- 15 minutes once per day



General Technology Overview

Product Technical Overview

Diffuser Flushing Sequence

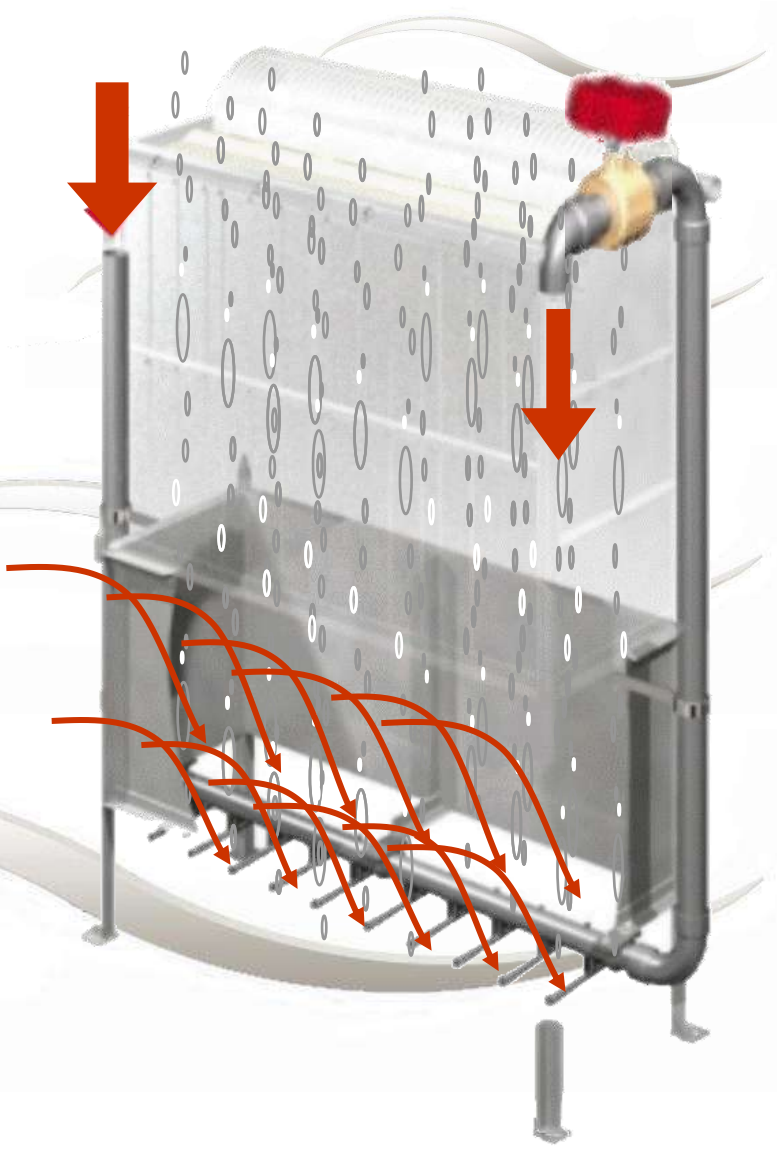
1. Permeation is halted for set time
2. Flushing valve opens
3. Venturi effect cleans diffusers
4. Flushing valve closes
5. Permeation resumes

Assists in

- Reducing fouling potential

Standard Duration

- 5 minutes per day



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Section One

END

Hassan Elokdi
Projects Manager
Acwa Emirates LLC

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Section Two

Kubota MBR Design

Hassan Elokdi
Projects Manager
Acwa Emirates LLC

35 Minutes

Kubota MBR Design

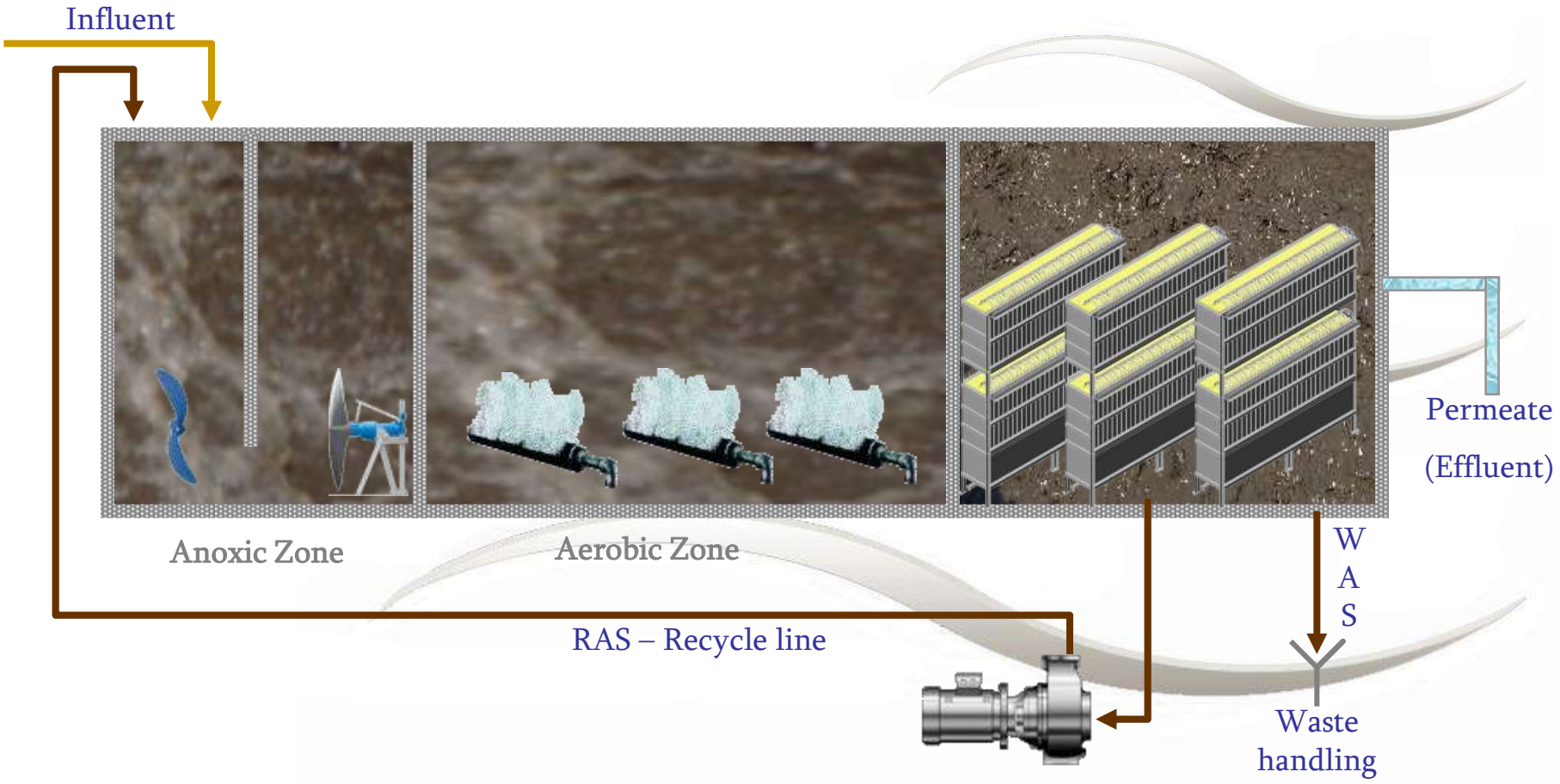
Contents

- Things To Consider (for Any MBR Plant).
- Selecting Number of Cartridges.
- Selection of Units.
- Sizing of Bioreactor.
- Sizing of Lifting Equipment.
- Calculating Required Oxygen.
- Calculating Pipe Sizes.

Kubota MBR Design

Things to Consider

Will Membrane Equipment Affect The Design Of Our Plant?



Kubota MBR Design

Things to Consider

- Will Membrane Equipment Affect The Design Of Our Plant Headworks?
  - Fine Screening 3mm (other competitors< 2mm).
  - FOG Removal (such as DAF).
  - Grit Removal can help protect membranes from heavy abrasives.
- Should We Provide Balancing?
  - All MBRs work best in a narrow range of flow.
  - Without equalization, more membrane area may be required.
  - Most equalization system involve odor, and bioreactor balancing affects the aeration blower system.

Kubota MBR Design

Things to Consider

- What Is The Operating MLSS?

  From 8000 – 20,000 mg/l compared to 2,500-4,000 mg/l in conventional system resulting in:

  - Smaller Bioreactor zone size.
  - Higher Sludge age- more stable and less odor.
  - Less Sludge Production Volume.
  - Need to check Volumetric Oxygenation Capacity.

- What About The RAS (Recycle)?

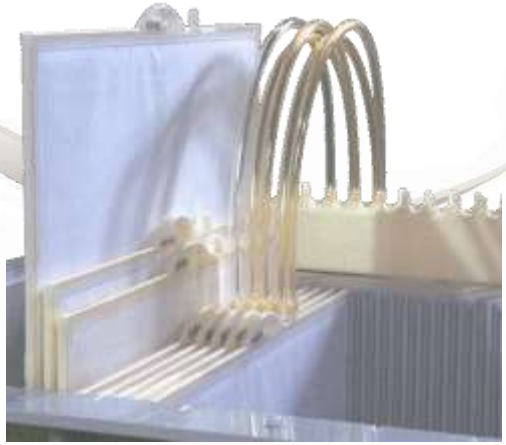
  - Recycle is directly from the MBR Tank which is rich in Oxygen (MBR Coarse Aeration).
  - Affect Denitrification and BNR Processes.

Kubota MBR Design

Number of Cartridges (panels)

Number of cartridges required = Q / S / F

- Q : Average daily flowrate (m3/d)
- S : Effective area of membrane cartridge (m2) (0.8 m2)
- F : Design flux rate for average daily flowrate (m3/m2/d) depending on
  - Type of influent wastewater
  - Influent strength
  - Water temperature etc
- Design flux rate is consulted by ACWA



Size of membrane cartridge

Type	Width (mm)	Length (mm)	Effective area (m2/cartridge)	Remarks
510	490	1000	0.8	

Kubota MBR Design

Selection Of Units

Type	Height (mm)	Application	Aeration supply (L/min/cartridge)		Remarks
	Membrane case + Diffuser case		Min.	Max.	
EK	2500 + 1000	Deep water (>=4.2m)	7.0	10.0	Double deck unit
AS	1000 + 1500	Deep water	10.0	15.0	Single deck unit
ES	1000 + 1000	As standard	10.0	15.0	Single deck unit
FS	1000 + 500	Shallow water	12.5	20.0	Single deck unit

Kubota MBR Design

Selection Of Units-Example

Example

- Q= 180 m^3/d
- S= 0.8 m^2
- F= 0.5625 $m^3/m^2.d$ (assumed)

Number of cartridges required (N)

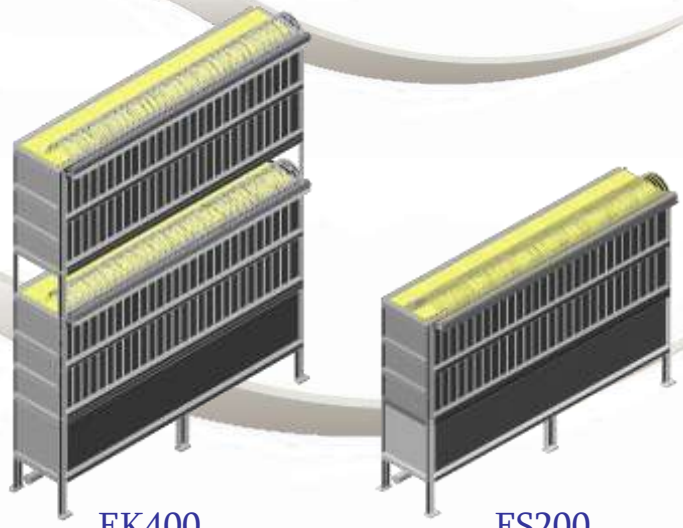
- N=Q/S/F= 180/0.8/0.5625= 800.

We May Select:

- 6 units of ES150
- 4 units of ES200
- 2 units of EK400

We will consider the ES200 and Ek400 for illustration

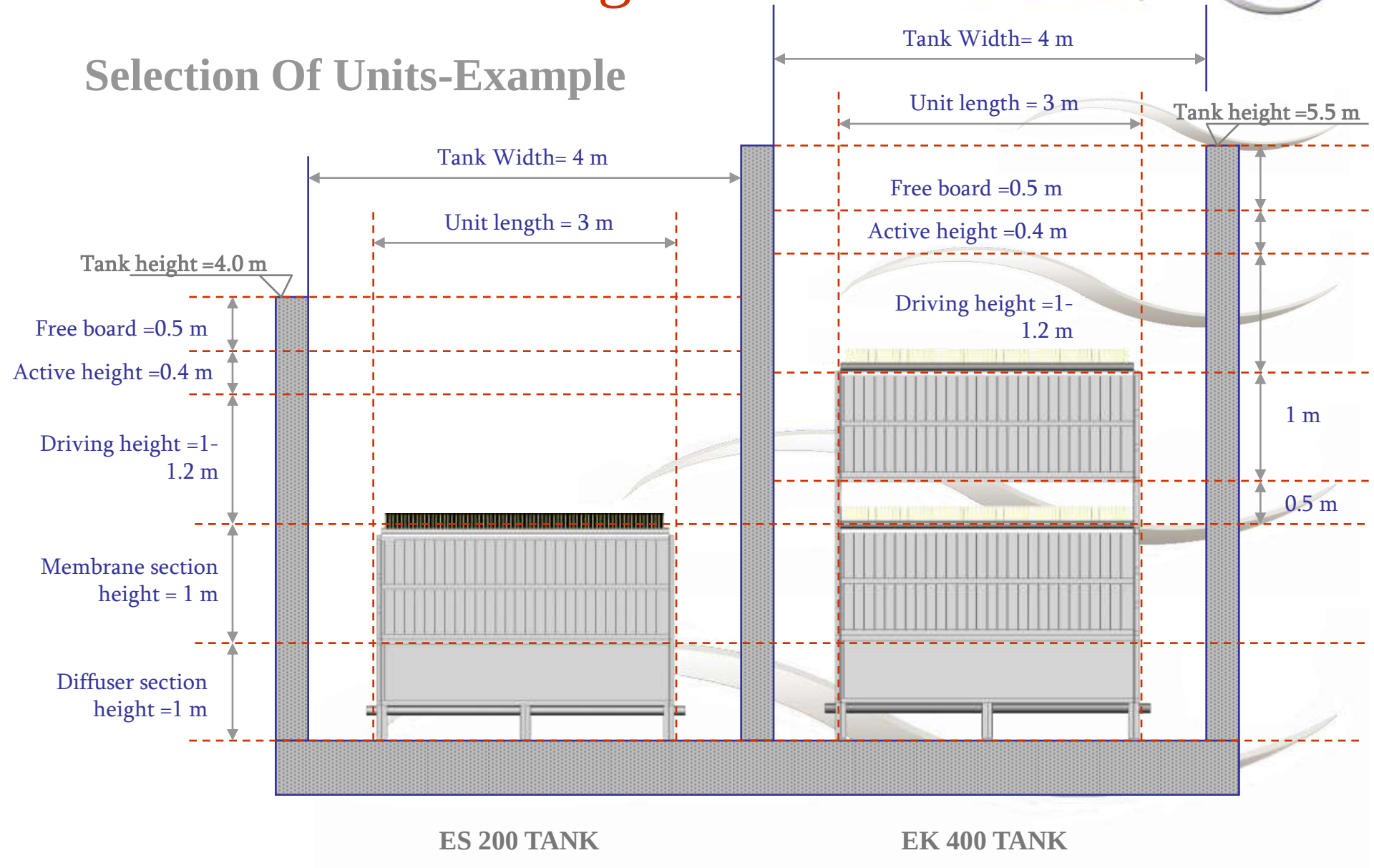
Model	Number of Cartridges (X)	Units Required (800/X)
ES150	150	5.3 Say 6
ES200	200	4
EK400	400	2



EK400 ES200

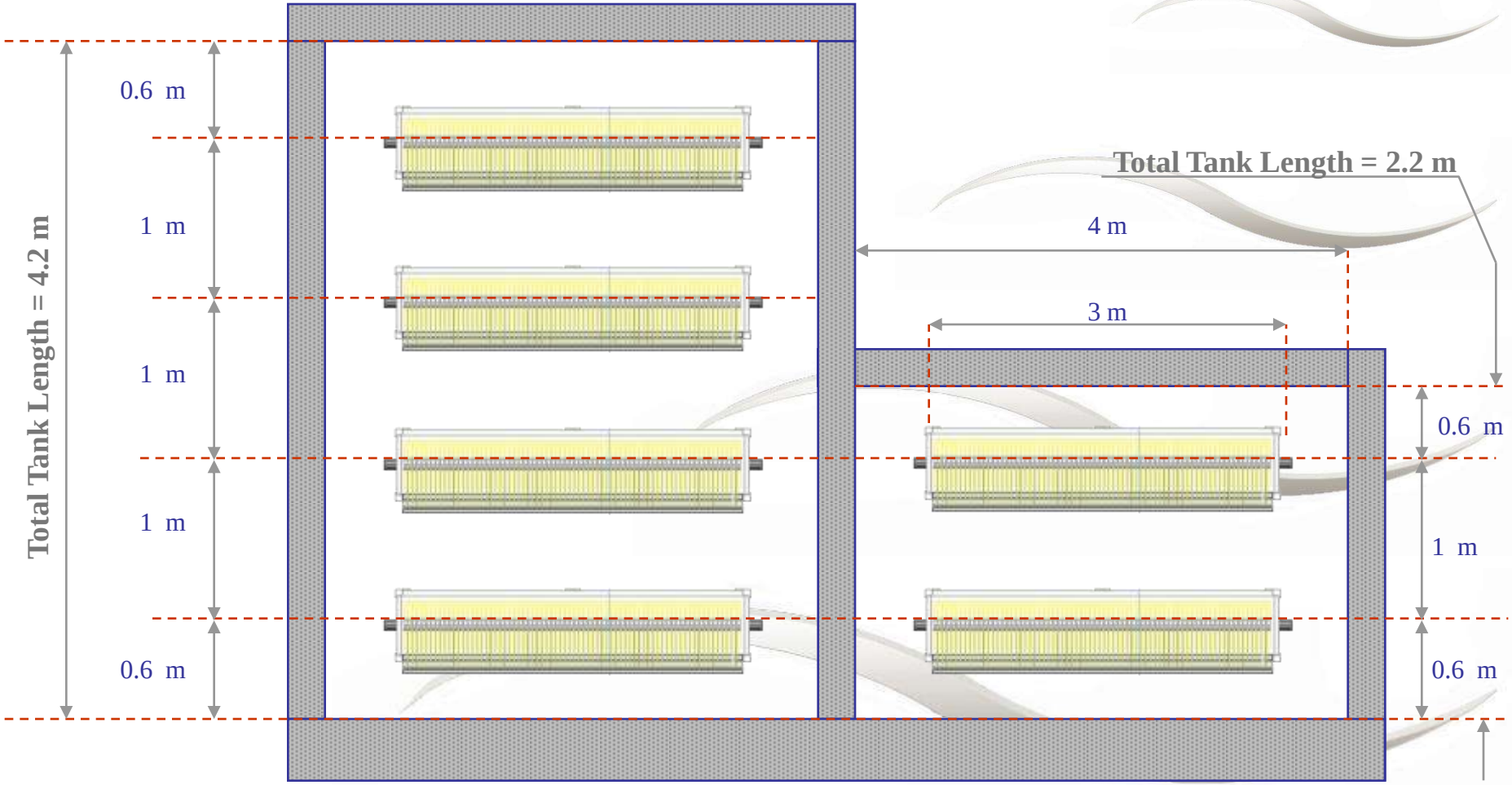
Kubota MBR Design

Selection Of Units-Example



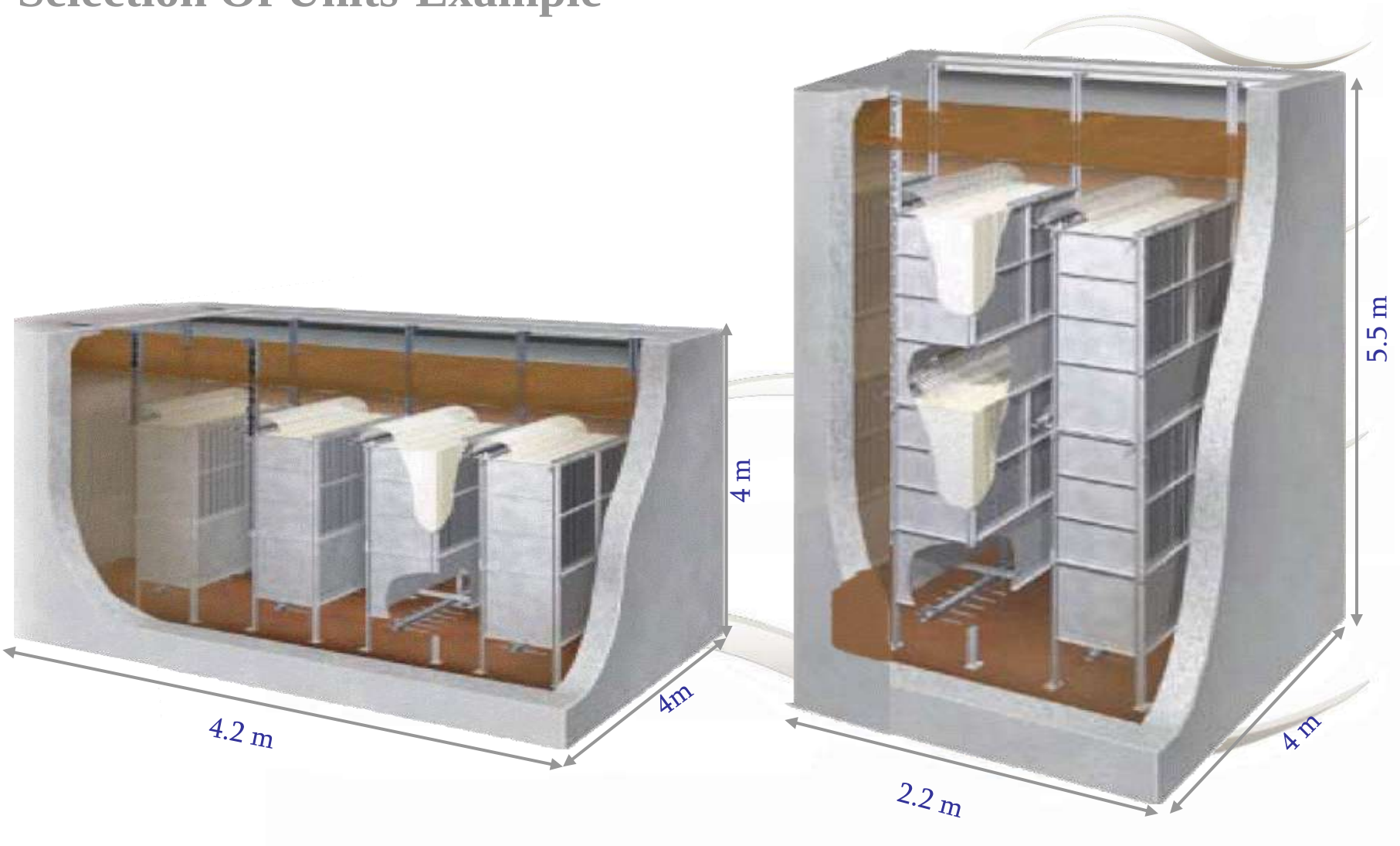
Kubota MBR Design

Selection Of Units-Example



Kubota MBR Design

Selection Of Units-Example



Kubota MBR Design

Selection Of Units-Example

We can Select

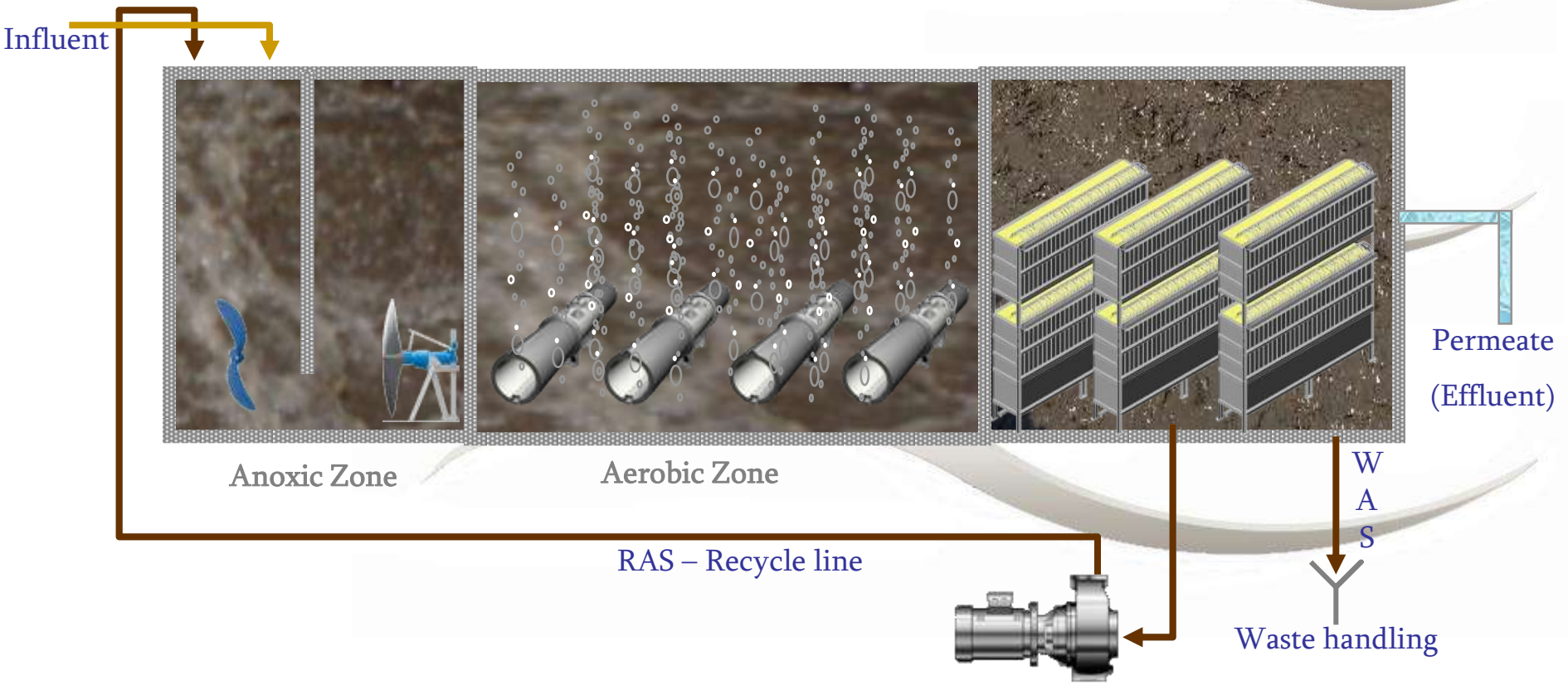
- 4 No. ES200
  - A tank with Dimensions (4.2 m X 4 m X 4m) (LxWxH)
  - Blower/s capacity of 4x200x10=8000L/min @ 45 KPa (40 KPa tank height + 5 KPa Losses in pipework) with scouring capacity of 4x200x15 l/min=12000 L/min @ 45 KPa as follows:
    - Three (3) Blowers each of capacity 4000 l/min @45KPa and operating as two (2) duty (8000 l/min) and One (1) Stand By to assist during scouring (15min/day).
    - Two Blowers each of capacity of 6000 l/min @45KPa Variable speed drive. Increases production from 8000 to 12000 during Scouring.
- 2 No. EK400
  - A tank with Dimensions (2.2 m X 4 m X 5.5m) (LxWxH)
  - Blower/s capacity of 2x400x7=5600L/min @ 60 KPa (55 KPa tank height + 5 KPa Losses in pipework) with scouring capacity of 2x400x10 l/min=8000 L/min @ 60 KPa as follows:
    - Three (3) Blowers each of capacity 2800 l/min @60KPa and operating as two (2) duty (5600 l/min) and One (1) Stand By to assist during scouring (15min/day).
    - One Blower of capacity of 8000 l/min @60 KPa Variable speed drive. Increases production from 5600 to 8000 during Scouring.
    - Many Other configurations

Kubota MBR Design

Sizing of Bioreactor

A Bioreactor is made up of

- Aeration tank (Membrane tank + pre-aeration tank if necessary)
- De-nitrification tank if T-N removal is necessary



Kubota MBR Design

Sizing of Bioreactor

Sizing of Aeration Tank.

1. Loading used in sizing
   - T-N removal necessary ? :
     - No => BOD loading (depends on water temp., MLSS conc.)
     - Yes => Nitrification rate (depends on water temp., MLSS conc.)

   Determination of BOD loading and nitrification rate is consulted by ACWA.

2. Aeration Tank volume
   - Using BOD Loading:

     $V1 = (BOD_c) \times Q / (BOD_L)$ where
     - V1: Required volume of aeration tank.
     - (BOD_c): Influent BOD conc.
     - Q: Influent flowrate.
     - (BOD_L) BOD loading.

Kubota MBR Design

Sizing of Bioreactor

Sizing of Aeration Tank.

2. Aeration Tank volume

- Using Nitrification Rate:

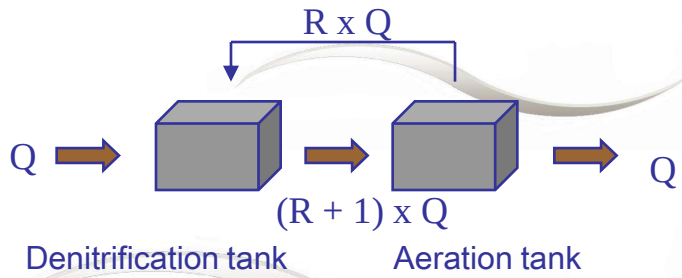
  $V2 = (TN_c) \times Q / ((MLSS) \times (N_R))$ where

  - V2: Required volume of aeration tank.
  - (TN_c): Influent T-N conc.
  - Q: Influent flowrate.
  - MLSS: Mixed Liquor Suspended Solids concentration in aeration tank
  - (N_R) Nitrification Rate.

Note : Excess sludge contains nitrogen, and this nitrogen is removed together with withdrawal of the excess sludge. Influent T-N conc. x Influent flowrate can be replaced to nitrogen remained after this withdrawal.

Kubota MBR Design

Sizing of Bioreactor



Sizing of De-nitrification Tank.

3. Anoxic Tank volume

- Using De-Nitrification Rate:

  $V = (TN_c) \times Q / ((MLSS \times R/(R+1)) \times (DN_R))$ where

  - V2: Required volume of aeration tank.
  - (TN_c): Influent T-N conc.
  - Q: Influent flowrate.
  - MLSS: Mixed Liquor Suspended Solids concentration in aeration tank
  - (DN_R) De-nitirification Rate.
  - R: Recirculation rate

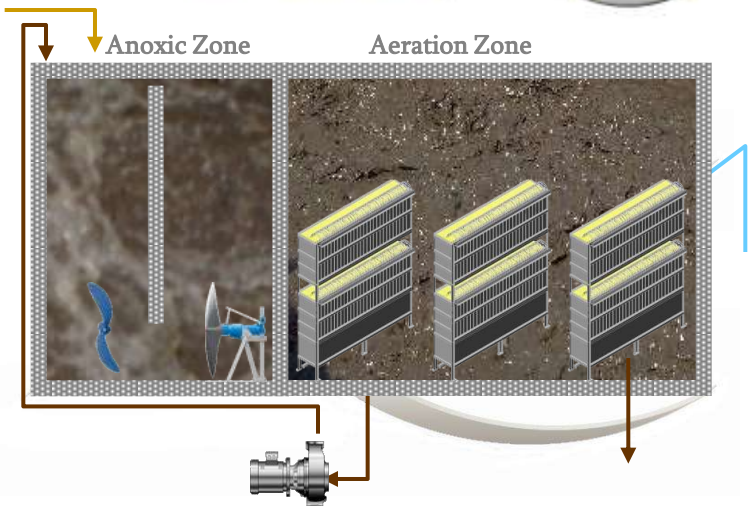
Note : Excess sludge contains nitrogen, and this nitrogen is removed together with withdrawal of the excess sludge. Influent T-N conc. x Influent flowrate can be replaced to nitrogen remained after this withdrawal.

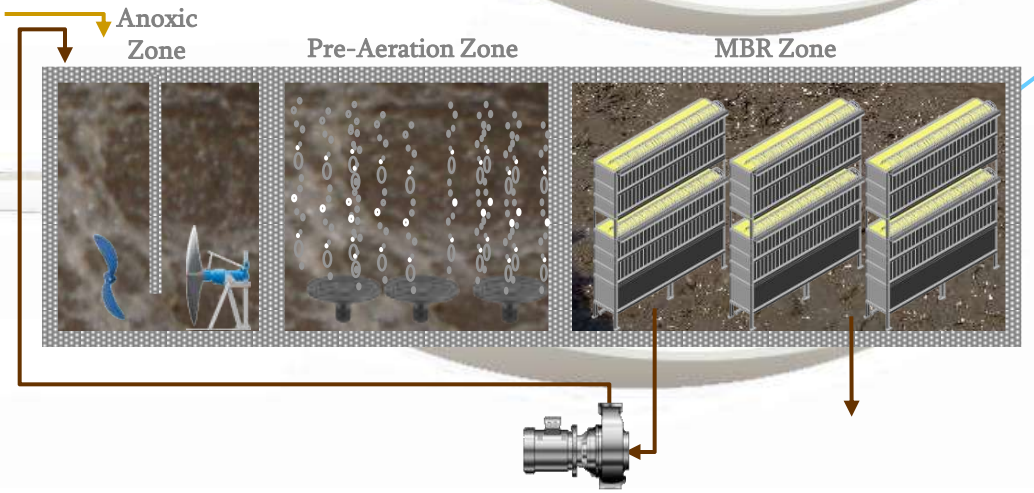
Kubota MBR Design

Sizing of Bioreactor

Sizing of Membrane Tank.

4. Membrane Tank volume
   - Depending on Units Selection
   - May be compromising the whole aeration tank
   - May be separate from pre-aeration tank.





Volume of MBR Tank Will be subtracted from the overall Aeration tank Volume to determine the Pre-aeration tank volume required.

Kubota MBR Design

Sizing of Lifting Equipment

When membrane unit is taken out of membrane tank and checked, lifting equipment is chosen in consideration with the following table :

	FS50	ES75 FS75	AS100 ES100	AS125 ES125	AS150 ES150	ES200	EK300	EK400	Remarks
Dry Weight (kg)	230	330	440	550	650	880	720 (650)	1000 (880)	
Maximum Weight (kg)	440	650	870	1090	1300	1760	1370 (1300)	1880 (1760)	Note1

- Note 1: Max. weight is in the case that membrane gaps are filled with sludge, and includes weight of lifting tool.
- Note 2 : Figures in parenthesis show weight of upper membrane case

Kubota MBR Design

Calculating Required Oxygen

To convert the amount of air form MBR Blowers (Q_{air}) into oxygen (Q_{oxy}), we calculate by the following formula:

- $(Q_{oxy}) = (Q_{air}\ (l/min)) \times (\xi) \times (a) \times 0.227\ Kg\ O^2/m^3$

Water depth (m)	1	2	3	4	5
Oxygen dissolving efficiency (%) (ξ)	2	3.5	5	6	7
MLSS (%)	0	0.5	1	1.5	2
Alpha factor (a)	1.00	0.95	0.85	0.75	0.60

From the previous example if you select 4 Nos ES200, with 4 m tank height and assuming MLSS is 15,000 mg/l, then the MBR delivers:

$(Qoxy) = (4x200x10)l/min \times 6\% \times 0.75 \times 0.227Kg/m3 = 117.6\ kg/d\ of\ O_2$

If this amount of Oxygen is not sufficient for the biological process then additional oxygen will be introduced via fine bubble diffusers in the MBR tank or separately in the pre-Aeration tank.

Kubota MBR Design

Calculating Pipe Sizes

Pipe sizing follow normal velocity and friction loss consideration with the exeption of velocities in the main Air header, and the permeate header, which are consulted by ACWA for each plant. Connections to the individual units is as per below pipe (port) sizes.

Membrane Unit	Permeate port	Diffuser port
FS50	ND40	ND40
ES75, FS75, AS100,ES100	ND50	ND50
AS125, ES125, AS150, ES150	ND50	ND75
ES200	ND65	ND75
EK300	ND50 x 2	ND75
EK400	ND65 x 2	ND75

Section Two

END

Hassan Elokdi
Projects Manager
Acwa Emirates LLC

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Section Three

Kubota MBR Installation

Hassan Elokdi
Projects Manager
Acwa Emirates LLC

35 Minutes

Kubota MBR Installation

Contents

- Where in the Middle East.
- Diffuser Installation.
  - Layout.
  - Anchoring.
  - Leveling.
- Guide Pipes.
- Pipe Work.
- Lower Membrane Case.
- Upper membrane Case.
- Stabilizer Pipe.
- Permeate Manifolds

Kubota MBR Installation

Where in the Middle East?

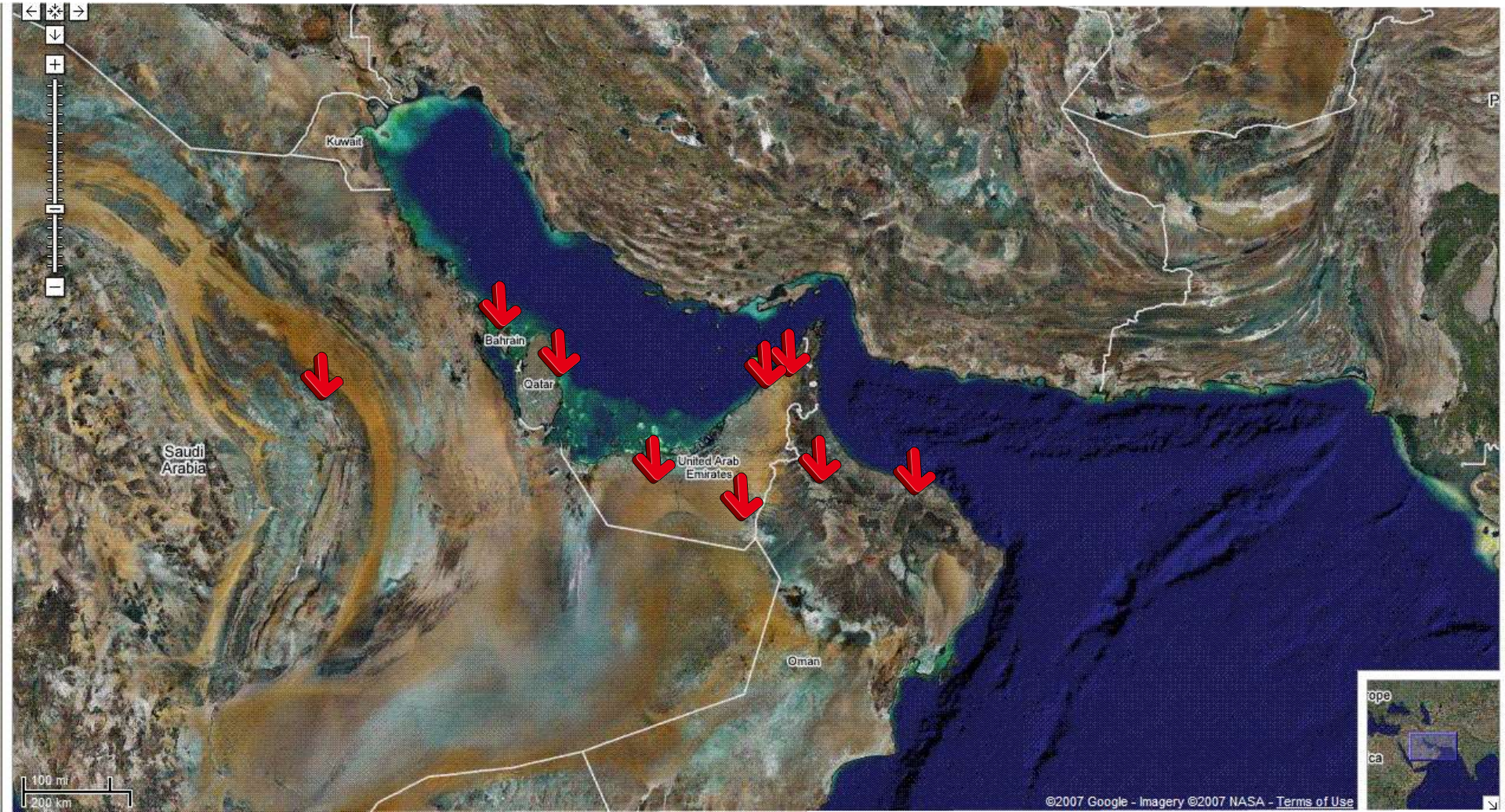
- Let us take a look at the video.

(run time 00:03:22)

Kubota MBR Installation

Where in the Middle East?

skip



Kubota MBR Installation

Gulf Area Installations- Saudi Arabia

- Project : Almarai ETP
- Waste from dairy operations, Al Kharj
- Full flow 4000m3/d
- 12 no. EK400 membrane units (up to 16)
- COD ~ 2000mg/L
- Retrofit of existing conventional plant
- Client : Saudi Berkefeld – Wetico
- End User : Almarai Corporation
- Status: Operational since June 2005

Kubota MBR Installation

Gulf Area Installations- Saudi Arabia

- Project: Almarai STP
- Sewage waste from Accommodation, canteens,& kitchens
- Full flow 750m^3/d
- 4/6 no. ES200 membrane units
- Client : Saudi-Berkefeld WETICO
- End-User: Almarai Company Ltd
- Status: Operational since April 2005

Kubota MBR Installation

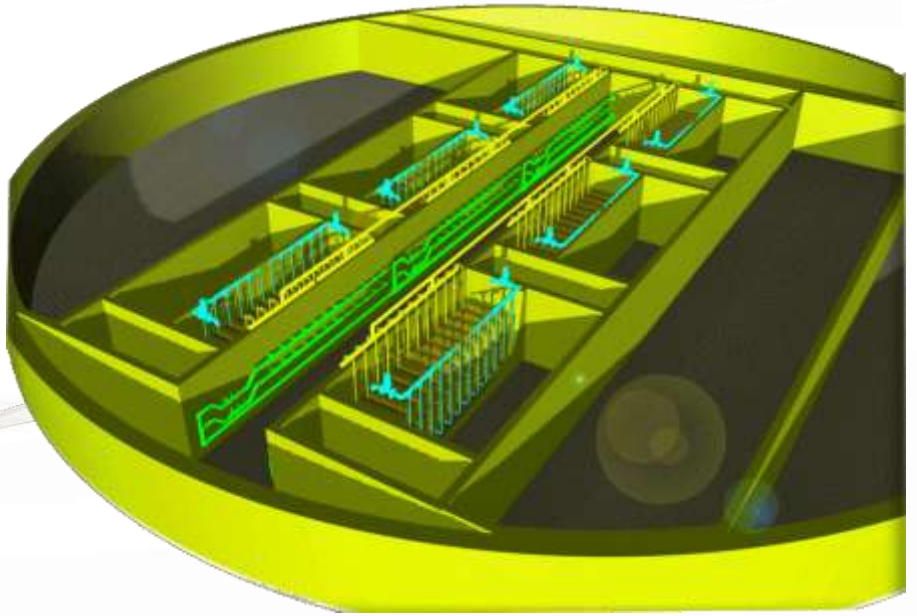
Gulf Area Installations- Qatar

- Project: Qatar Vinyl
- Location: QVC, Messaid Industrial City, Qatar
- Design Flow : 320m^3/day
- COD ~ 2,000mg/L
- Cl^- ~ 10,000mg/L
- Client : Technip (Rome)
- 40' ISO shipping container plant
- Status: Operational since November 2003

Kubota MBR Installation

Gulf Area Installations- UAE

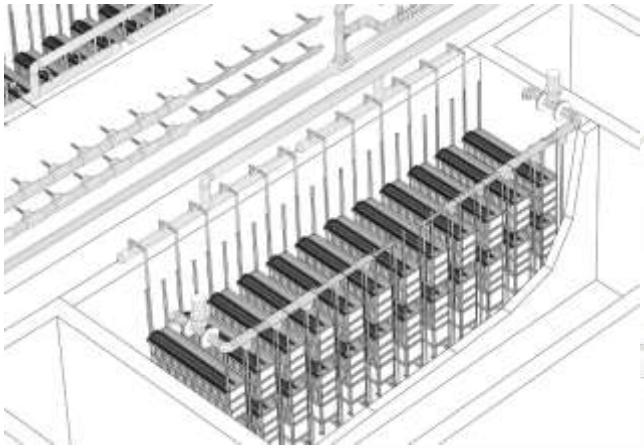
- Project: Palm Jumeirah STP
- Location: Dubai- UAE
- Plant capacity = 18,000m3/d AADF
- 6 separate streams of 3,000m3/d to cater for increasing flow profile over time
- Client: Metito
- End User: Nakheel
- Status: Operational *since November 2006



Kubota MBR Installation

Gulf Area Installations- UAE

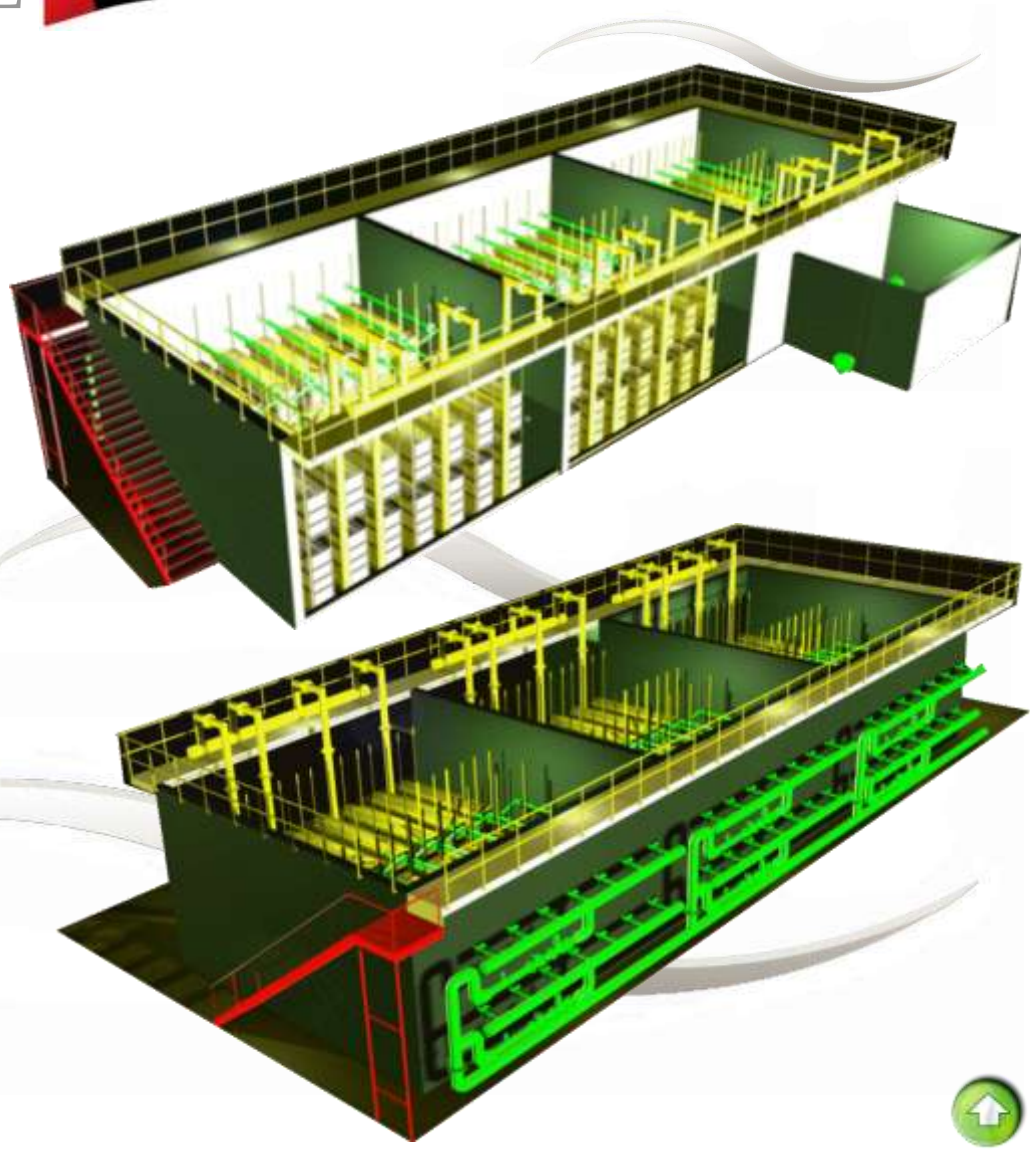
- Project: Palm Jumeirah STP



Kubota MBR Installation

Gulf Area Installations- UAE

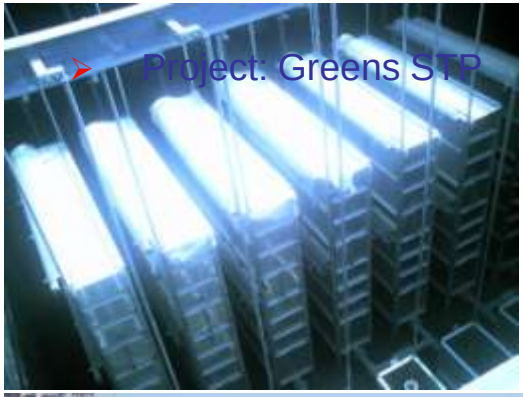
- Project: Greens STP
- Location: Dubai - UAE
- Plant capacity = 10,000m3/d AADF
- Upgrade of existing plant from 3,000 to 10,000 m3/d
- Domestic Sewage
- Client: Metito
- End User: EMAAR
- Status: Operational *since August 2006



Kubota MBR Installation

Gulf Area Installations- UAE

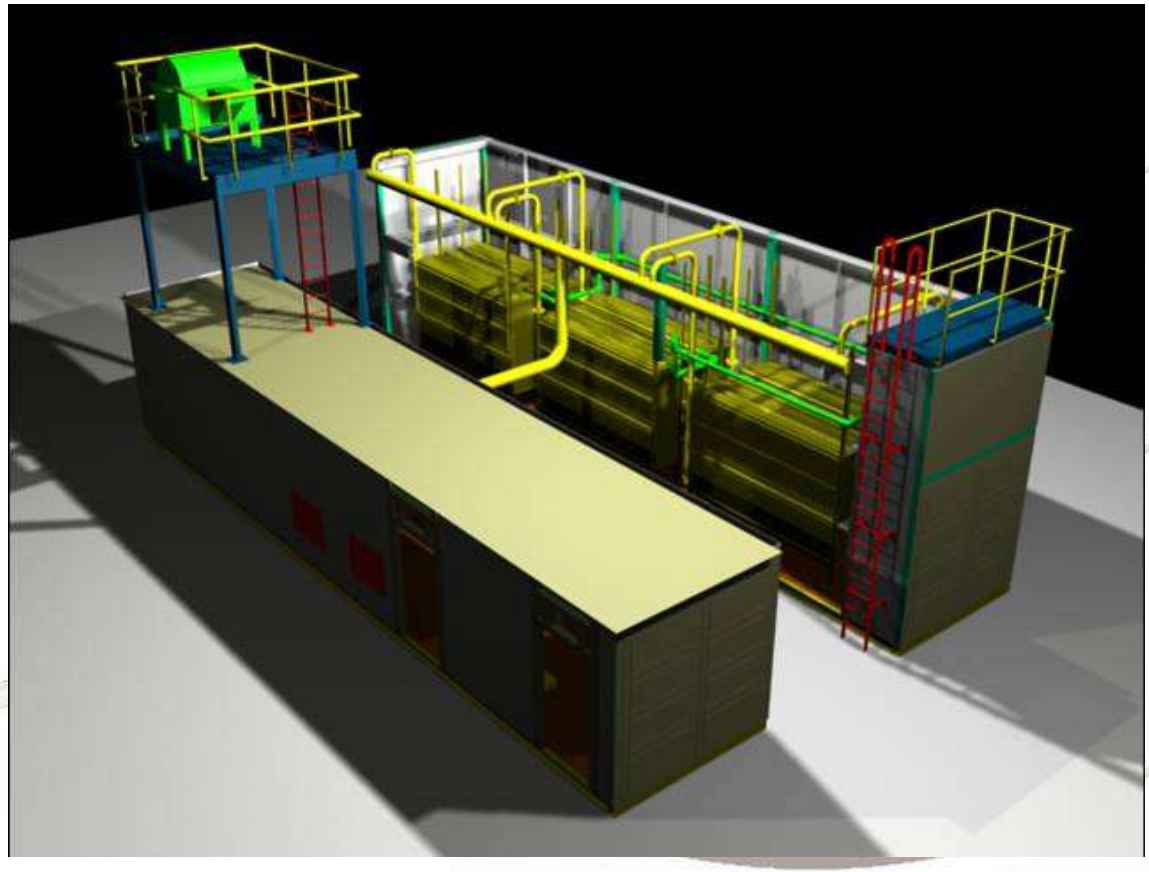
- Project: Greens STP



Kubota MBR Installation

Gulf Area Installations- UAE

- Project: Ruwias MBR
- Location: Ruwais- AbuDhabi - UAE
- Plant capacity = 6 plants, each 500m3/d AADF
- Mobile Units
- Domestic Sewage
- Client: CCC
- Status: Operational *since February 2006



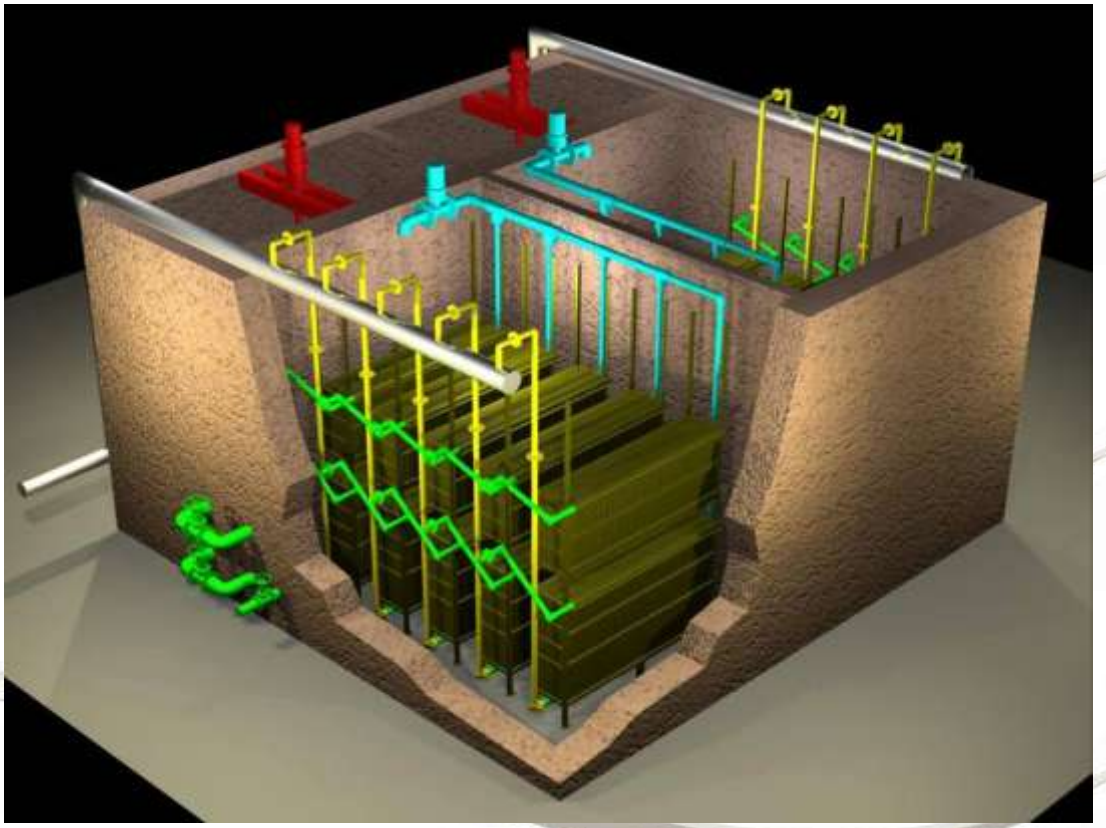
Kubota MBR Installation

Gulf Area Installations- UAE

Kubota MBR Installation

Gulf Area Installations- UAE

- Project: Alkhazna MBR
- Location: Alkhazna- Al Ain - UAE
- Plant capacity = 2,000m3/d AADF
- Upgrade of existing plant
- Domestic Sewage & Slaughter house
- Client: Nael Energy
- End User: Al Ain Municipality
- Status: Under Installation



Kubota MBR Installation

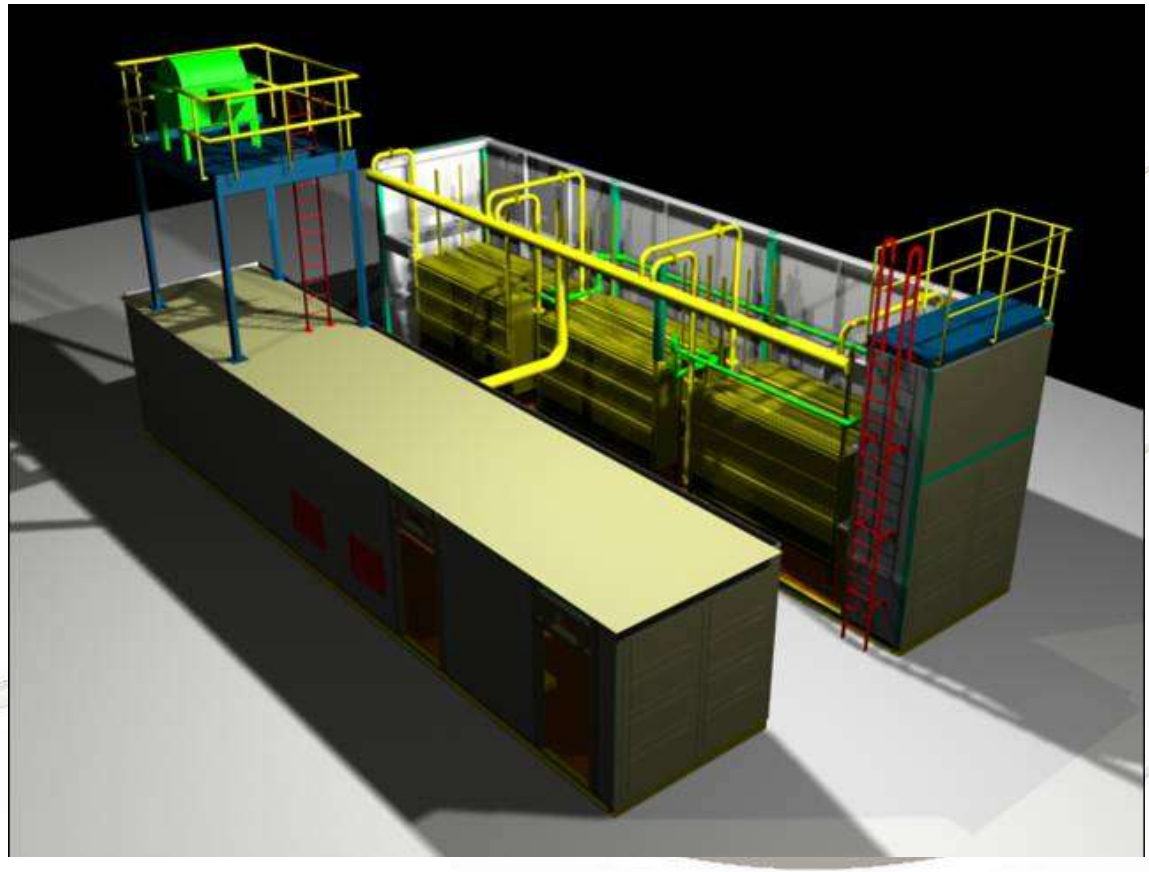
Gulf Area Installations- UAE

- Project: Sharjah Demo MBR
- Location: Sharjah- UAE
- Plant capacity = 150m3/d AADF
- Mobile Unit
- Domestic Sewage
- Client: Sharjah Municipality
- Status: Operational *since 2004

Kubota MBR Installation

Gulf Area Installations- UAE

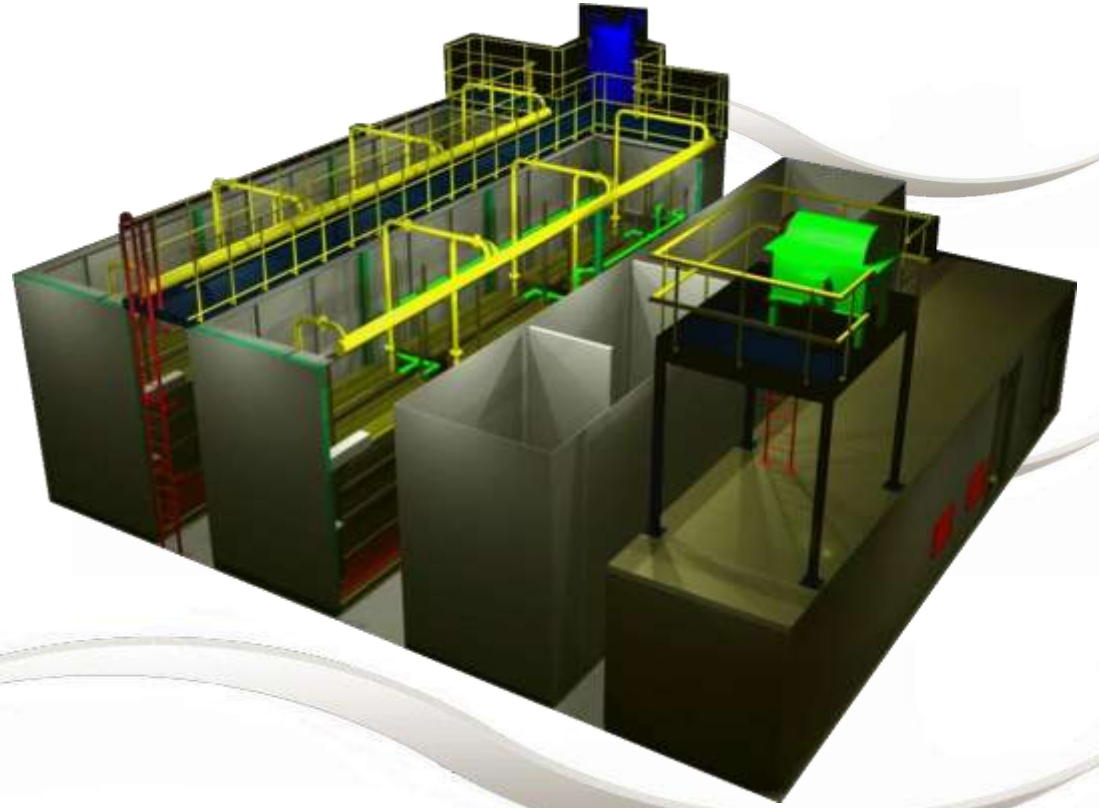
- Project: Palm Containers MBR
- Location: Dubai (I.C.)- UAE
- Plant capacity = 2 plants, each 500m3/d AADF
- Mobile Units
- Domestic Sewage
- Client: Palm Water
- Status: Under installation



Kubota MBR Installation

Gulf Area Installations- Oman

- Project: Sohar Smelter MBR
- Location: Sohar- Oman
- Plant capacity = 1,000m3/d AADF
- Mobile plant
- Domestic Sewage (camp)
- Client: Veolia water
- End User: Bechtel
- Status: Under Commissioning



Kubota MBR Installation

Gulf Area Installations- Oman

- Project: Sohar Smelter MBR

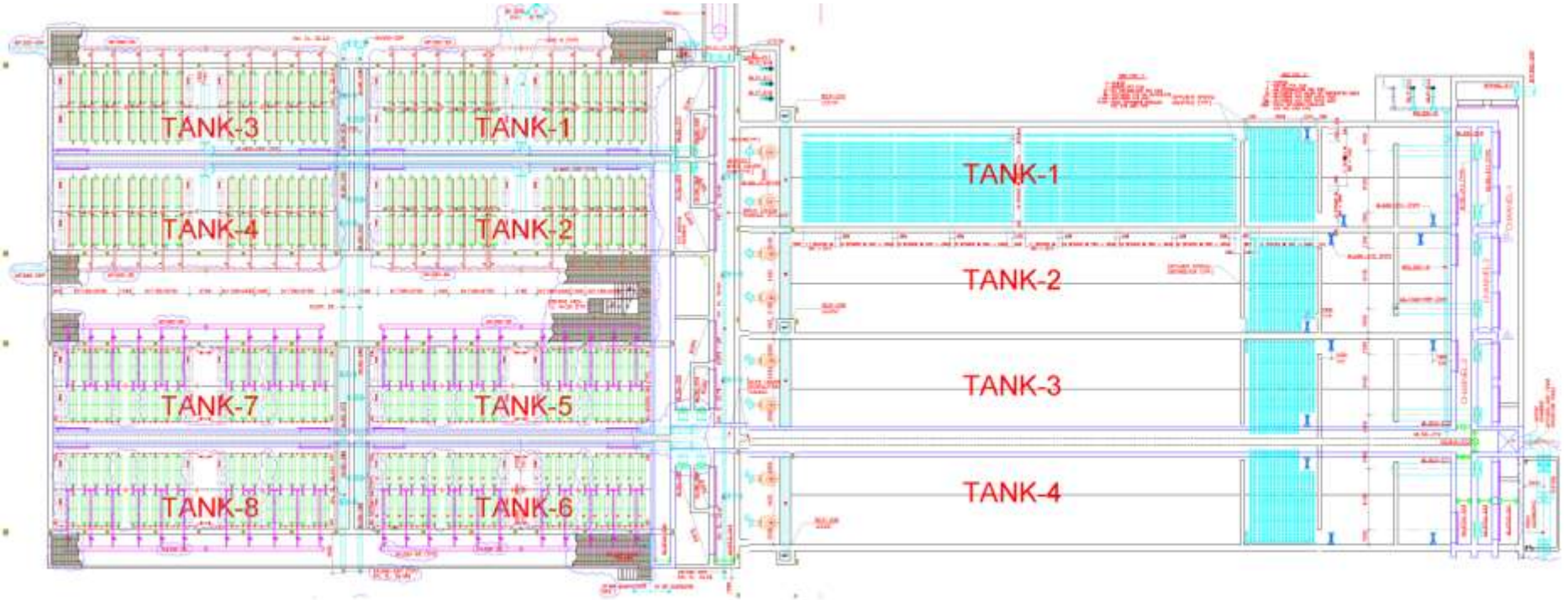
Kubota MBR Installation

Gulf Area Installations- Oman

- Project: AlAnsab MBR
- Location: Muscat- Oman
- Plant capacity = 78,000m3/d
- Collaborative design between Metcalf & Eddy and Aquator
- Domestic Sewage (camp)
- Client: Oman Water Services Company
- Status: Under Commissioning

Kubota MBR Installation

Gulf Area Installations- Oman



Membrane Tanks

Recycle Channel

Aeration Tanks

Anoxic Tanks

Distribution Chambers

- Total footprint of treatment tanks is 150m * 50m

Kubota MBR Installation

Middle East Installations- Turkey

- Project: British American Tubaco
- Location : Izmir, Turkey
- Combined Cigarette/Domestic Waste
- 680m^3/d Daily Flow
- COD ~ 2000 mg/L
- TSS ~ 550 mg/L
- Client : British American Tobacco
- 800 no membrane panels
- Status: Operational since October 2002

Kubota MBR Installation

Middle East Installations- Jordan

- Project: Jordan Labor Camp
- Location: Sahab- Jordan
- Sewage waste from trainees/workers
- Design flow 360m^3/d, upgradable to 900m3/d
- Blackwater
  - BOD 700mg/L< 5mg/L
  - Ammonia 100mg/L< 5mg/L
  - Suspended Solids 500mg/L < 5mg/L
- Client : Morganti / CCC
- Circular Steel tanks due to rapid construction requirement
- Status: Commissioned January 2005

Kubota MBR Installation

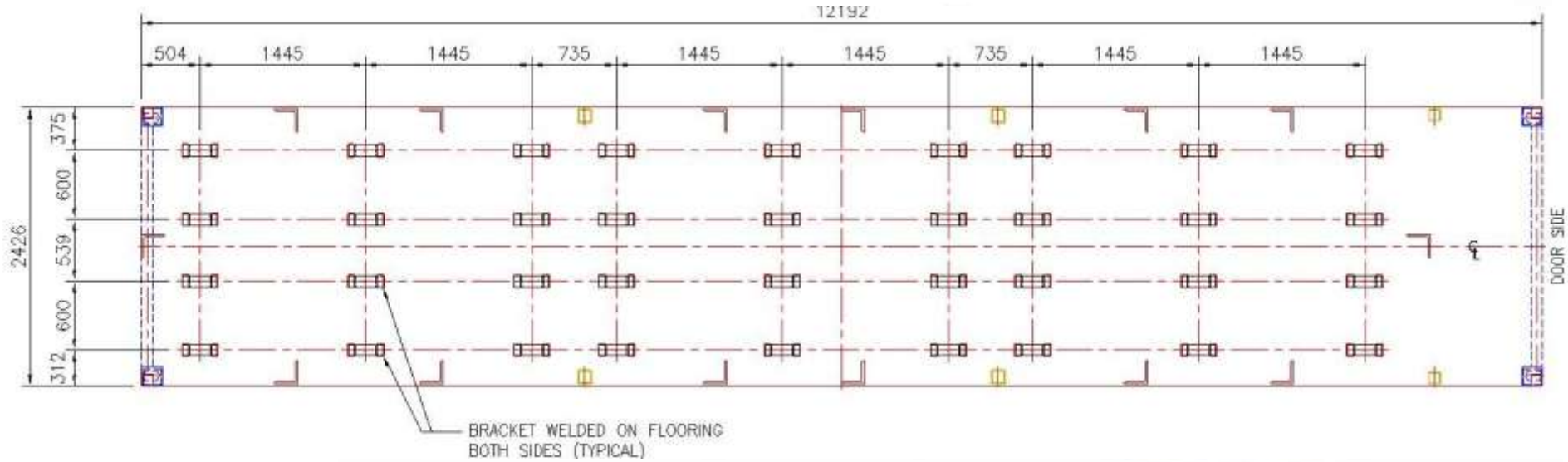
Steps for Installation

1. Layout and Handling of Units
2. Diffuser Case Installation
3. Guide Pipe Installation
4. Supports and Pipe work Installation
5. Lower Membrane Case Installation
6. Upper membrane Case Installation
7. Stabilizer Pipe Installation & Permeate Manifold Connections.

Kubota MBR Installation

Diffuser-Layout

- Check the arrangement of SMU(s) with an equipment layout drawing for the facility.
- Load in a limited number of diffusers, enough to mark positions, but not many to keep easy moving/ drilling space.
- (Puddle pipes are pre-located as part of the Tank)

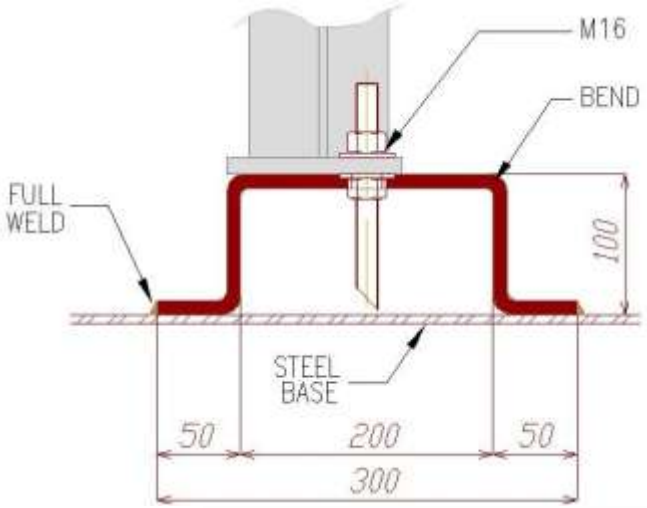


Kubota MBR Installation

Diffuser-Anchoring

- Mark the locations of anchor/chemical bolts.
- Install the anchor bolts and keep 70-90mm above finish ground level.
- A 50mm span is required for levelling.
- A nut below each pedestal and another above are used for the levelling of base units

STEEL



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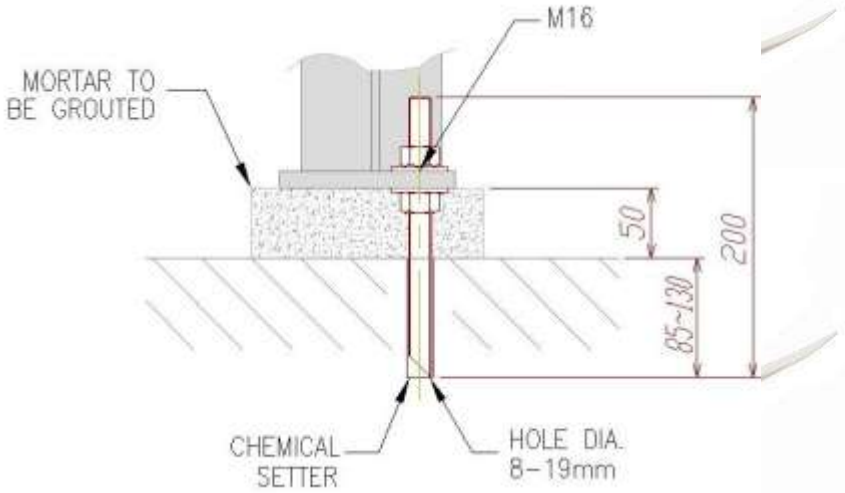
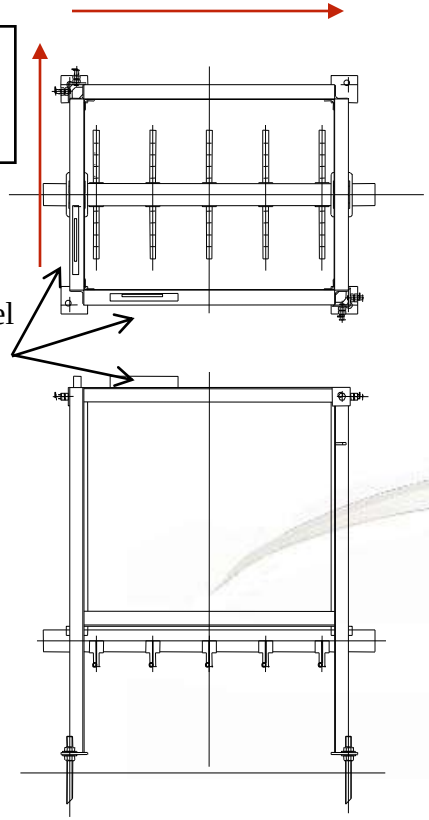


Kubota MBR Installation

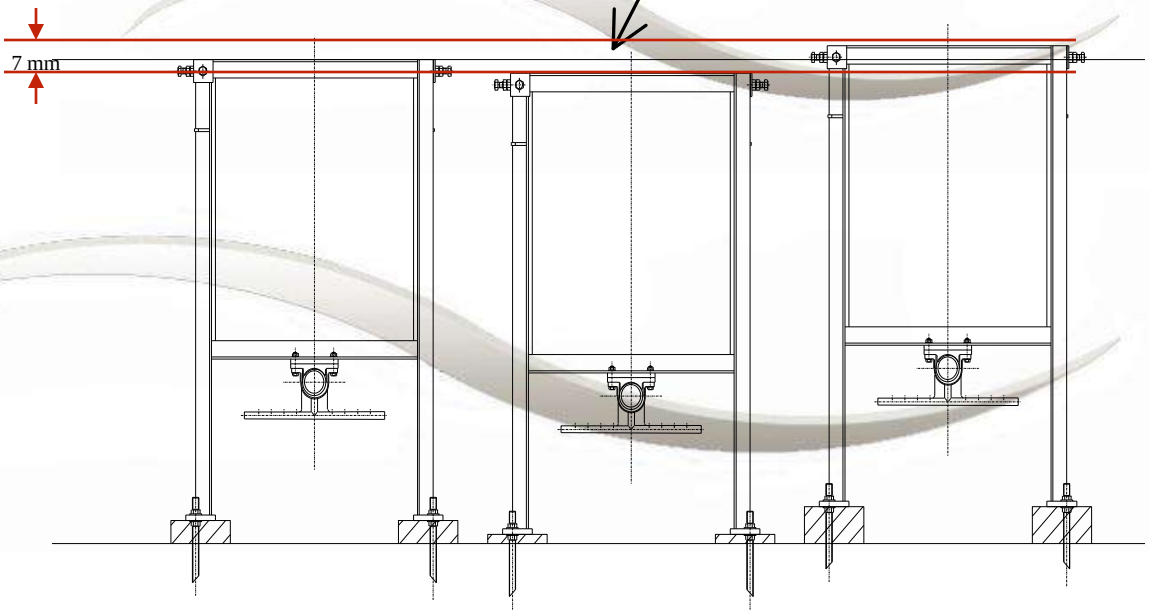
Diffuser- Leveling

- It is CRITICAL to Install a diffuser case so that the upper surface is levelled within 3 mm deviation. When installing multiple diffuser cases, install them such that upper surfaces of any and all the cases are levelled within 7 mm difference

Each Single unit to be leveled within 3mm in all axis



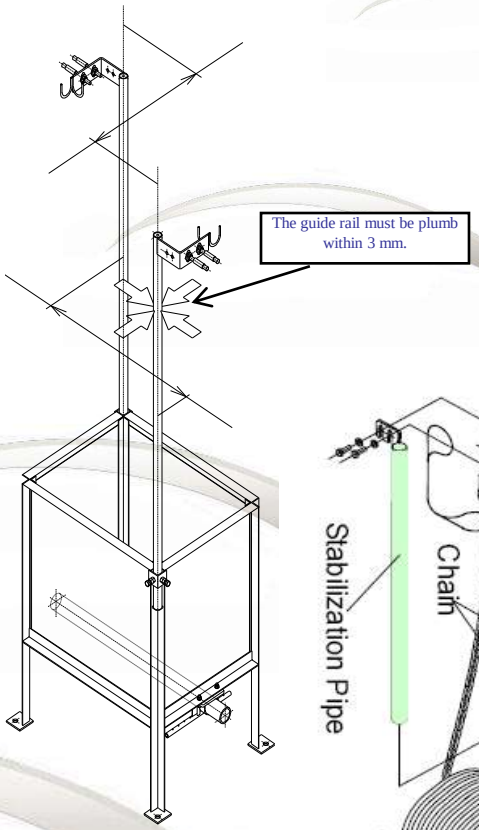
Diffuser cases must be leveled within 7 mm deviation.

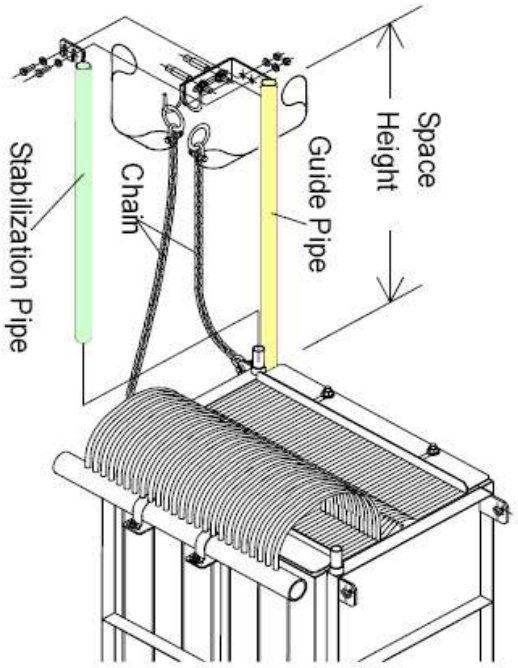


Kubota MBR Installation

Guide Pipes

- Direct To wall mounting: Drill anchor holes for the anchor bolts on the MBR wall and mount the guide pipe support brackets so that guide pipe can be plumbed. The size of the anchor bolts must be M12×120 (Length of insertion: 50L), and the anchor hole size must be ϕ18×50L.
- Direct To supports, install Guide pipe, level vertically , measure support and install, keep 50mm threaded bolt with two nuts (one each side) to level guide pipe (<3mm) after connecting to support, and tighten.
- Install two guide pipes, adjusted their length at the site, and tighten anchor bolts.
- Then the guide pipes should be fixed to diffuser case with guide pipe locking bolts.





Kubota MBR Installation

Guide Pipes

Kubota MBR Installation

Pipe work

- Proceed with all pipe work and supports, paying attention to PVC diffuser (must be protected and covered), and make ready permeate pipe work
- Perform Diffuser Cases Integrity test (See Operation and Maintenance).

Kubota MBR Installation

Lower Membrane Case

- Extreme care must be taken not to expose membrane case to welder or grinder sparks.
- Connect the lifting tool to lifting tab at each corner of the membrane case and lift into position above the diffuser. Slide the membrane case onto the diffuser case along the guide pipe

Kubota MBR Installation

Upper Membrane Case

- Follows Same installation Procedure As Lower Membrane case
- Do not remove the plastic sheet for packing until clean water operation starts.
- Extreme care must be taken not to expose membrane case to welder or grinder sparks.
- Connect the lifting tool to lifting tab at each corner of the upper membrane case and lift into position above the lower membrane case. Slide the upper membrane case onto the lower membrane case along the guide pipe.

Kubota MBR Installation

Stabilizer Pipe

- Insert the stabilizer pipe over the projections located on top of the upper membrane case

- The stabilizer pipe should then be fixed to the guide pipe by fixing bolts.

Kubota MBR Installation

Permeate Manifolds

- Connect the Permeate manifold to the individual units
- Use Anoxillic coupling (tee Kay) For easy Dismantling and to cater for any miss alignment in level and size
- Membrane installation is complete.

Section Three

END

Hassan Elokdi
Projects Manager
Acwa Emirates LLC

Enviro Arabia 2007

Section Four

Operation

Hassan Elokdi
Projects Manager
Acwa Emirates LLC

30 Minutes

Operation and Maintenance

Pre- Commissioning Checks

1. Removal of all debris from tanks, sumps, chambers, pipes, manifolds and plant items.
2. Integrity testing of tanks, sumps and chambers
3. Check the 3 mm screen at design flow rate.
4. Check flow distribution from flow split chambers, weirs, penstocks and bell-mouths.
5. Pressure testing of air pipes, manifolds, flanges and fittings.
6. Pressure testing of liquid pipes, manifolds, flanges and fittings.
7. Check site drainage.
8. Testing of all site cabling, trays and ducts.
9. Site Acceptance Test (SAT) of the MCC panel
10. Testing of all motors.
11. Testing of all actuated valves.
12. Testing of all manual valves.
13. Testing of all instrumentation
14. SAT of the PLC control system, covering all aspects of plant operation.
15. Manual control of plant items via SCADA.

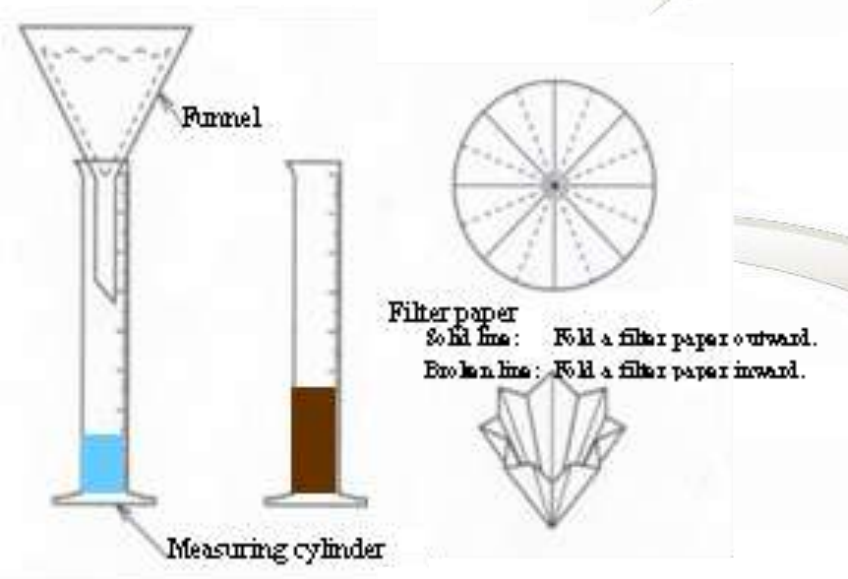
Operation and Maintenance

Testing and Commissioning requirements

1. Detailed analysis of influent, and seed sludge (PH, Temperature, Conductivity, SS, MLSS, MLVSS, BOD, COD, TN, NH4-N, NOX-N, Cl- , FOGs, PO4-P, TP, Total calcium and magnesium hardness, Indicator bacteria, Indicator viruses)

2. Portable measuring devices.

3. Sludge Filterability Test.

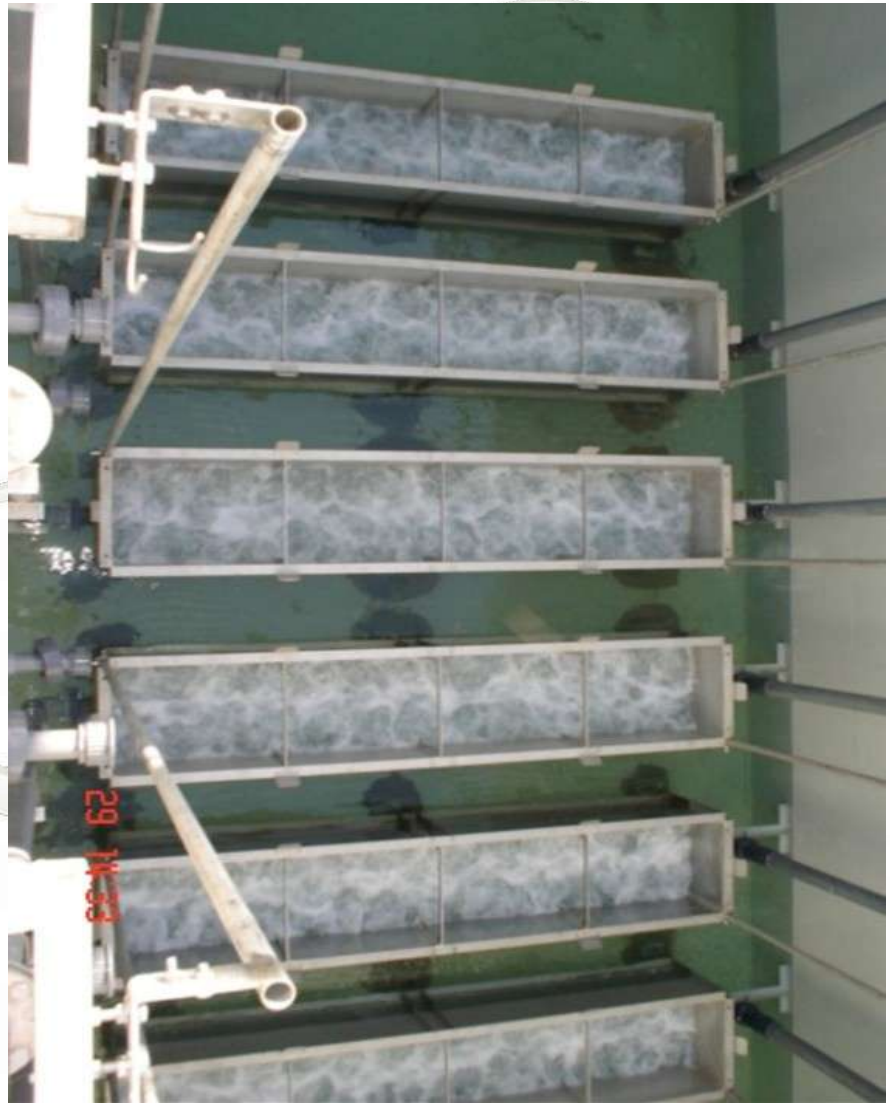


Operation and Maintenance

Start Up – Integrity Test.

Before installing membrane sections

- Fill potable water 300 mm above the diffusers grid
- Operate blower/s and check uniform air distribution.
- Double check all air pipe work for any leaks.
- Check for any Air leak from the fully closed Purge Valves.

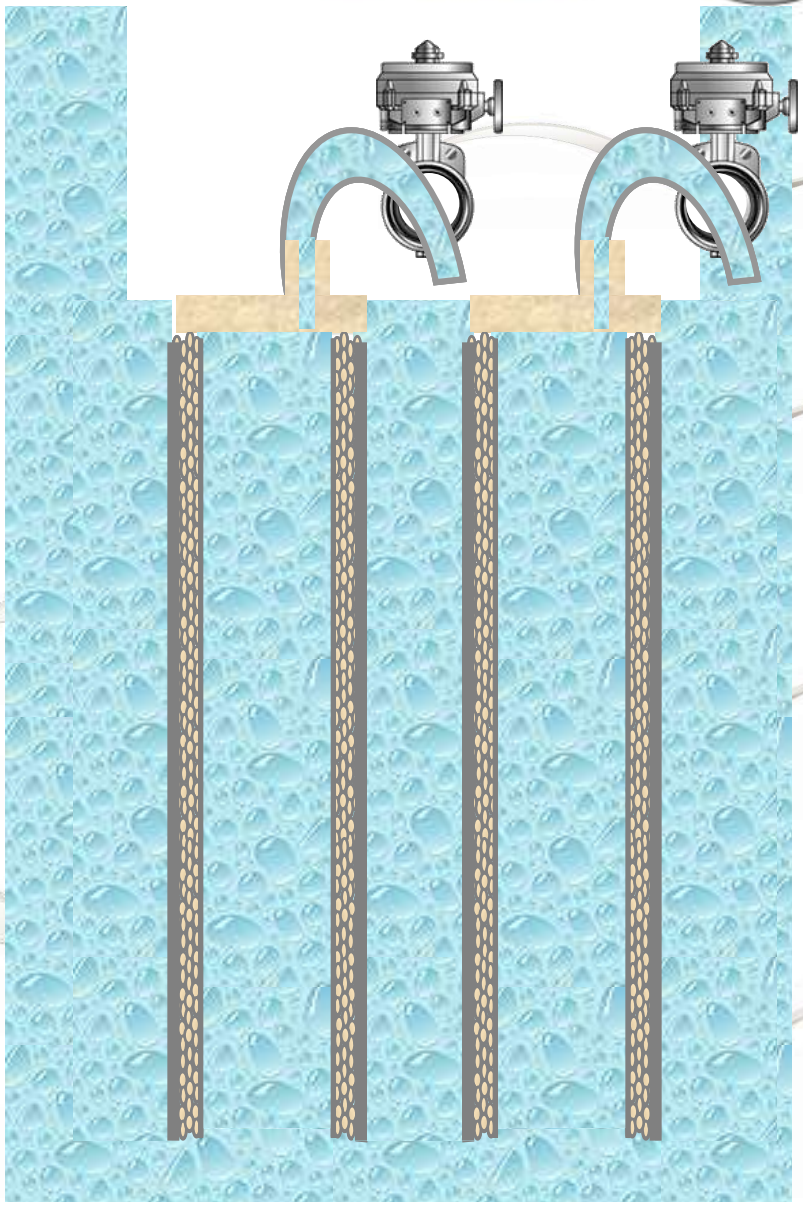


Operation and Maintenance

Start Up – Integrity Test.

After Installing membranes

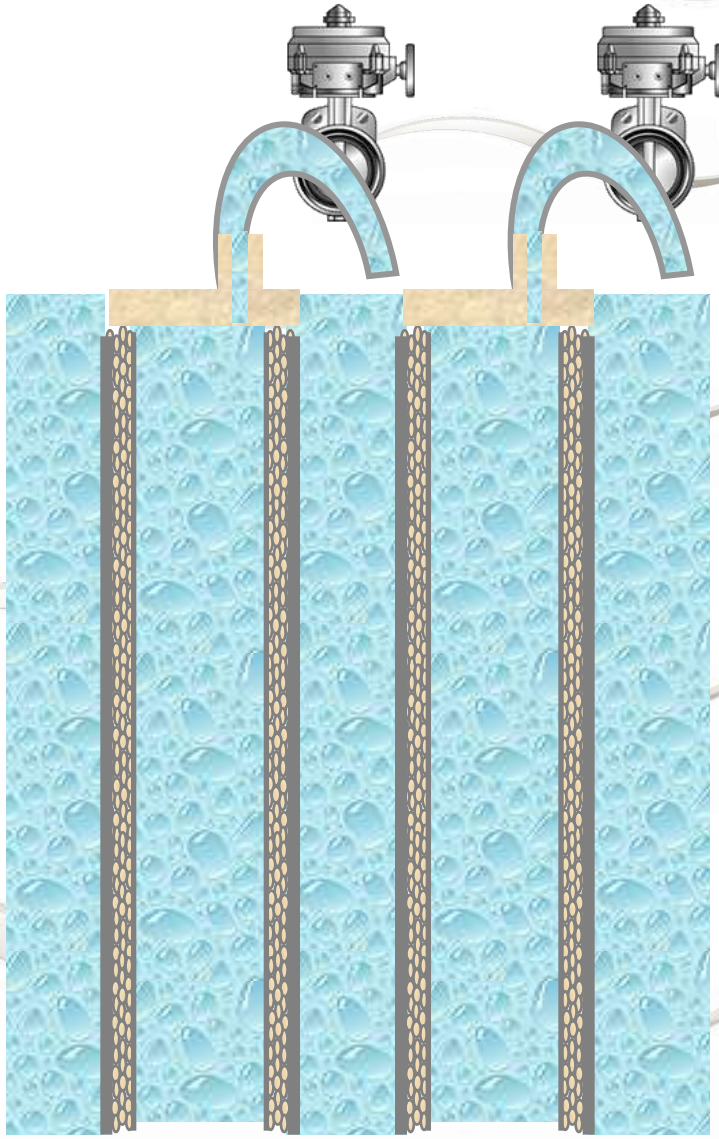
- Isolate blowers (No air).
- Close all valves and vents.
- Fill potable water 300 mm above top membrane manifold.
- Observe for any air bubbles indicating leaks.
- Membrane panels will inflate and touch each other.
- After Sometime after opening the vent valves air will be released from the work, and water will follow indicating no leaks in system.
- Membrane panels will deflate to normal position.



Operation and Maintenance

Membrane Flux Test

1. Ensure there is no trapped air within the membrane units, permeate manifolds, etc
2. Ensure the permeate outlet air vents are open on the membrane units
3. Ensure the manual permeate outlet valve is closed and locked off
4. Raise the liquid level to approximately 300 mm above the lower membrane units



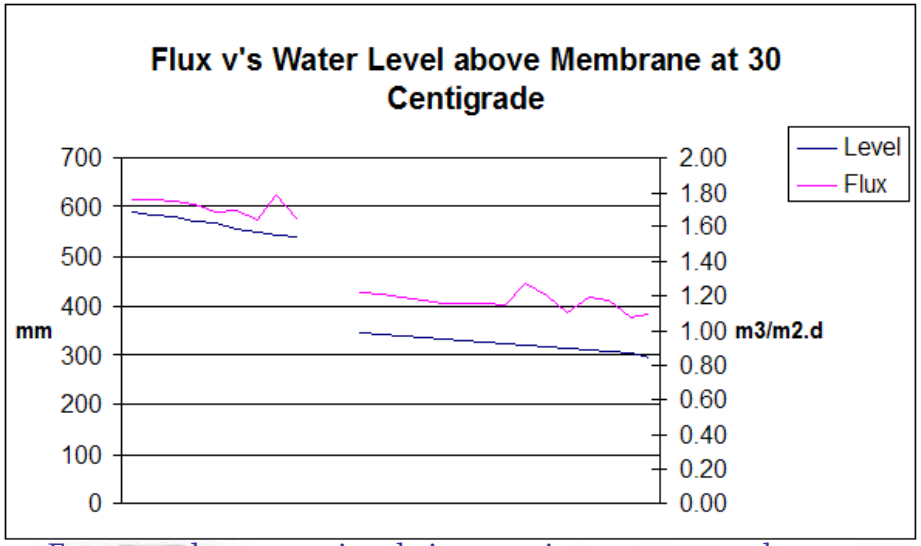
Operation and Maintenance

Start Up- Membrane Flux Test

5. Note the exact liquid level
6. Note the temperature of the clean water
7. Initiate air diffuser aeration (at the normal operational air flow rate)
8. Open the manual permeate outlet valve on the membrane unit to be tested
9. After 5-10 minutes measure the permeate flow rate, the liquid level and the pressure in the permeate pipe
10. Close the manual permeate outlet valve on the membrane unit tested
11. Repeat steps 1 to 10 for a representative number of individual membrane units in the lower bank
12. Repeat steps 1 to 10 for all the membrane units in the bank
13. Repeat steps 1 to 12 at a liquid level of approximately 500 mm (step 4)
14. Raise liquid level to approximately 300mm above the upper membrane unit
15. Repeat steps 1 to 13 on upper membrane units

Operation and Maintenance

Start Up - Membrane Flux Test



For every degree centigrade increase in temperature there should be a 2% increase in the flux through the membranes

Unit No. XXXXXX

Field Readings

Observed flow: XX.XX m3/hr

Duration: X minutes

HMI readings

Totalized Flow Start: XXXX m3

Totalized Flow End: XXXXm3

Observed flow: XXXXm3/hr

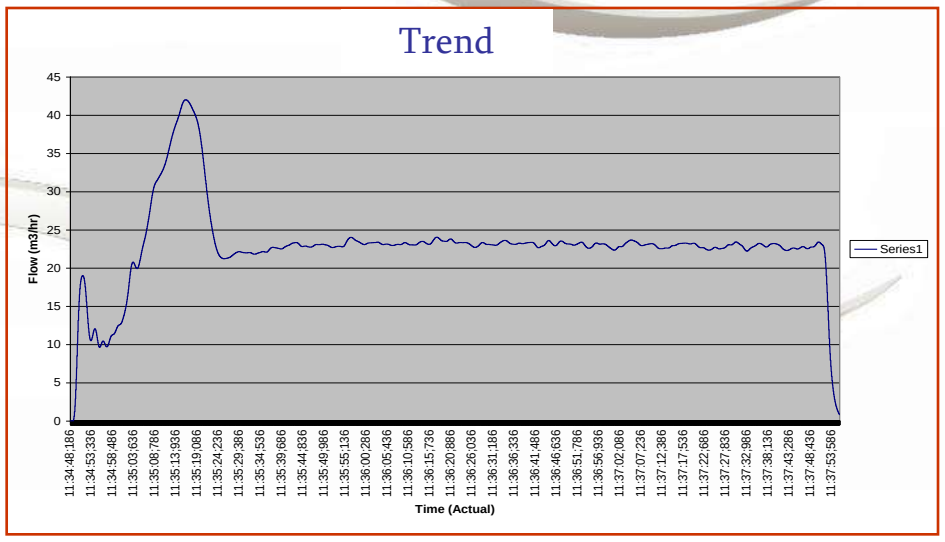
Start Level: XXX m

End level: XXXXm

Start Time: XXXXXX

End time: XXXXXX

Trend (see figure)



Conclusion

Average flow is XXXXm3/hr

Membrane area: XXXm2

Giving Flux: XXXX m3/m3.day @ XXX mm from top of permeate outlet. (Compare to Graph).

Operation and Maintenance

Start Up - Seeding

1. Ensure the permeate outlet air vents are open
2. Ensure the manual permeate outlet valves from the individual membrane units in the tank are open
3. Ensure the actuated permeate flow control valve is closed
4. Ensure the sludge recirculation system is off
5. Prior to entering the membrane tanks the seed sludge should be screened to 3mm.
6. Once the seed sludge level has covered the upper membrane units the membrane air diffuser aeration can be initiated. there is no trapped air within the membrane units, permeate manifolds, etc

Operation and Maintenance

Start Up - Seeding

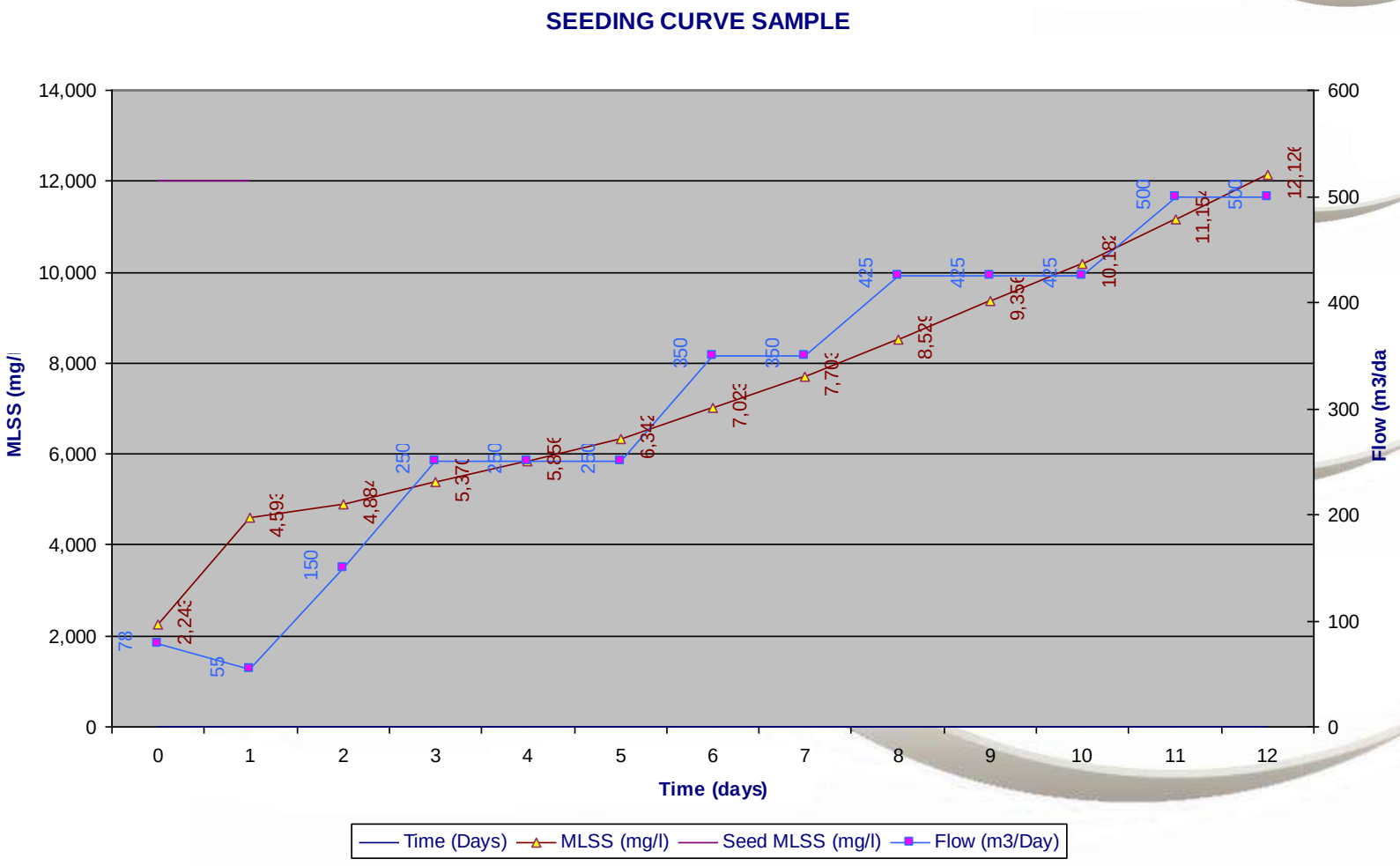
7. Depending on the situation of the activated seed sludge and after sufficient aeration of the seed sludge, the permeate flow control valve can be placed into automatic PLC control at a permeate flow rate dependent upon the measured MLSS concentration (see table)
8. Even after seeding the MLSS concentration of the sludge is greater than 10,000mg/L it is not advised that the permeate flow rate be immediately ramped up to F.F.T. A gradual step wise increase in permeate flow rate should be carried out.

MLSS concentration	Acceptable Permeate flowrate[1]
mg/l	%
<3000	10-20
3000-4500	30
4500-6000	45
6000-7500	60
7500-10000	80
>10000	100

1 As a % of the design full flow to treatment (FFT)

Operation and Maintenance

Start Up - Seeding



Operation and Maintenance

Operation - Results

Industrial (Dairy) Influent and Effluent from Almarai ETP MBR.

Domestic (Accommodation) Influent and Effluent from Almarai STP MBR.

Operation and Maintenance

Operation- Plant Log

Project **Client**

Scheme **Date** **Tank**

Send Daily To ACWA MBR : helokdi@acwa.ae Fax: 00971 4 3341448

Time	Level (m)	Flow (m^3/hr) (Upper)	Totalized Flow (m^3) (upper)	Pressure (m) (upper)	DP (m) (upper)	Flow (m^3/hr) (lower)	Totalized Flow (m^3) (lower)	Pressure (m) (lower)	DP (m) (lower)	MLSS (mg/l)	Seed (m^3)	DesLudge (m^3)	No. of Blowers On	Air Header Valves Open (Y/N)	Remarks
0:00															
1:00															
2:00															
3:00															
4:00															
5:00															
6:00															
7:00															
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23:00															
0:00															

Remarks

Operator Name _____ Signature _____ Date _____

Operation and Maintenance

Operation

The MBR Plants may be designed to be Fully Automated Plants and are monitored remotely and require minimal operator intervention.

Depending on specifications, client requirements, and budget, the plants may not be fully automated ,where some operator intervention is required for MLSS monitoring and sludge disposal, however even in such systems the flow control, DP control, Do control, Sequence controls, and membrane protection controls remain fully automatic controlled by logical controllers (PLC, DCS,..etc).

Operation and Maintenance

Operation- Automatic

HMI Screen Showing Live MBR Plant data.

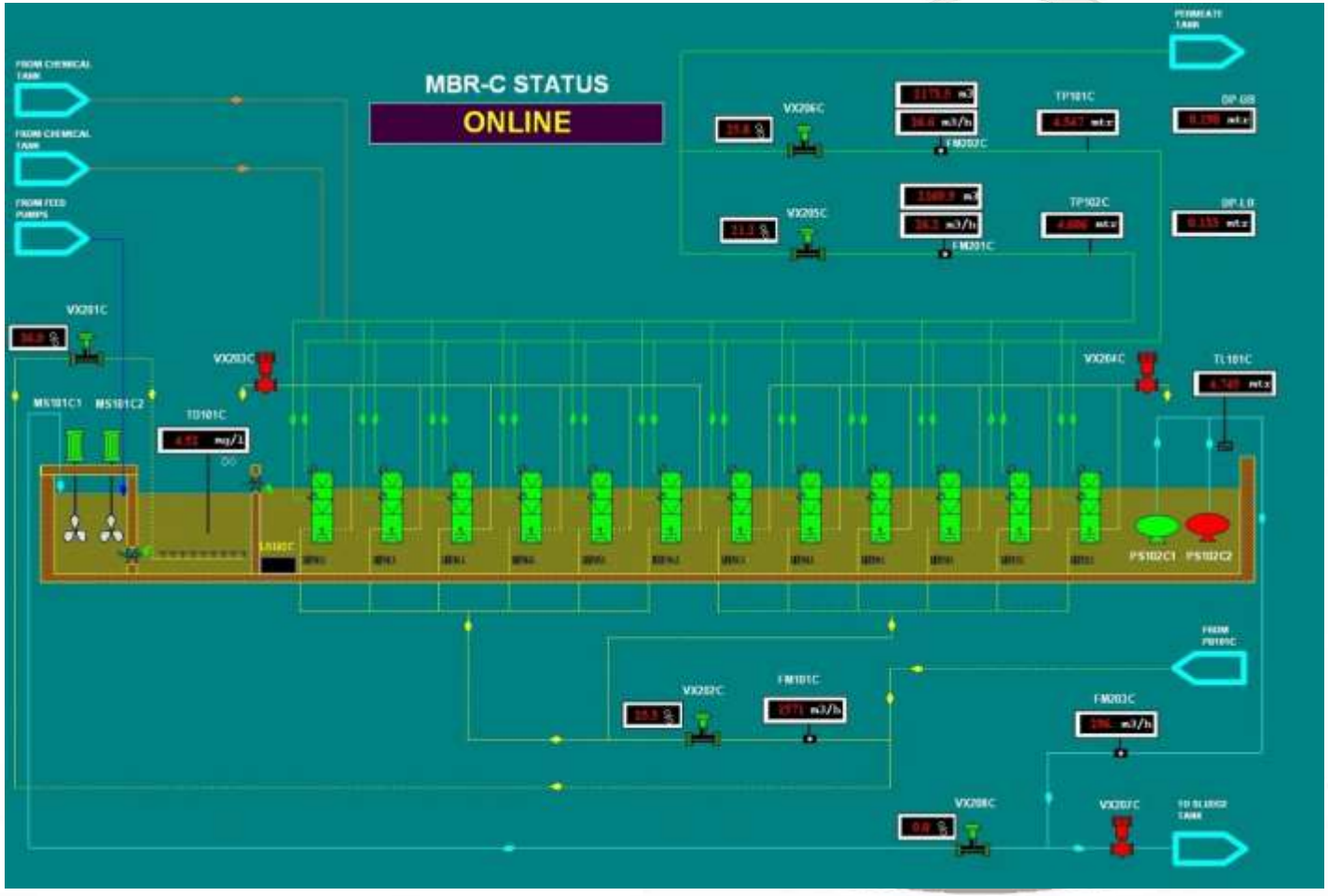
Palm Jumeirah MBR

Capacity: 21000m3/d

Client: metito.

End User: Nakheel

Location: UAE



The Palm Jumeirah Plant. Courtesy of metito (overseas) ltd.

Operation and Maintenance

Operation- Automatic

HMI Screen Showing Live MBR Plant Setpoints.

Palm Jumeirah MBR

Capacity: 21000m3/d

Client: metito.

End User: Nakheel

Location: UAE

The Palm Jumeirah Plant. Courtesy of metito (overseas (ltd)

Operation and Maintenance

Operation- Automatic

HMI Screen Showing Live MBR Trend.

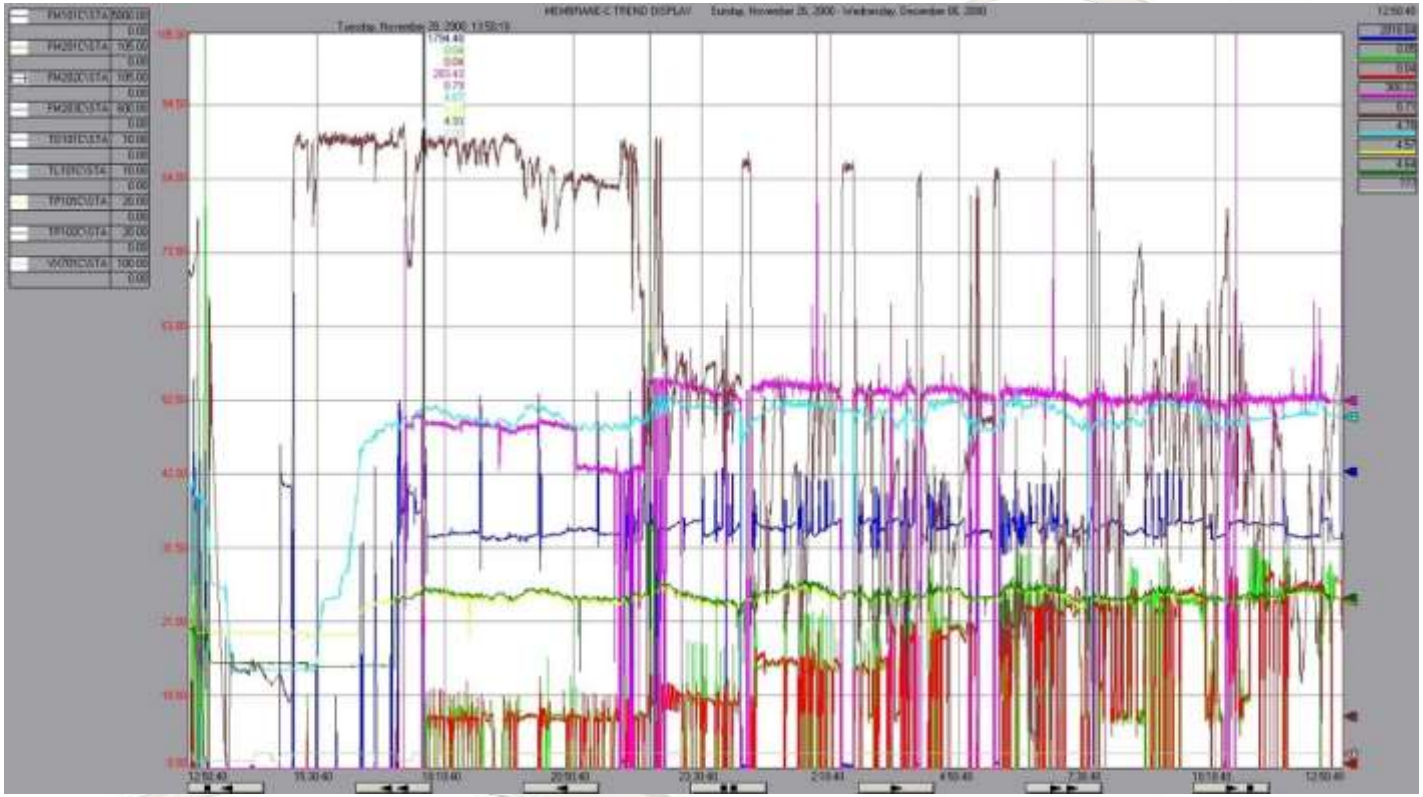
Palm Jumeirah MBR

Capacity: 21000m3/d

Client: metito.

End User: Nakheel

Location: UAE



The Palm Jumeirah Plant. Courtesy of metito (overseas) ltd.

Operation and Maintenance

Operation- Automatic

HMI Screen Showing Live MBR Trend.

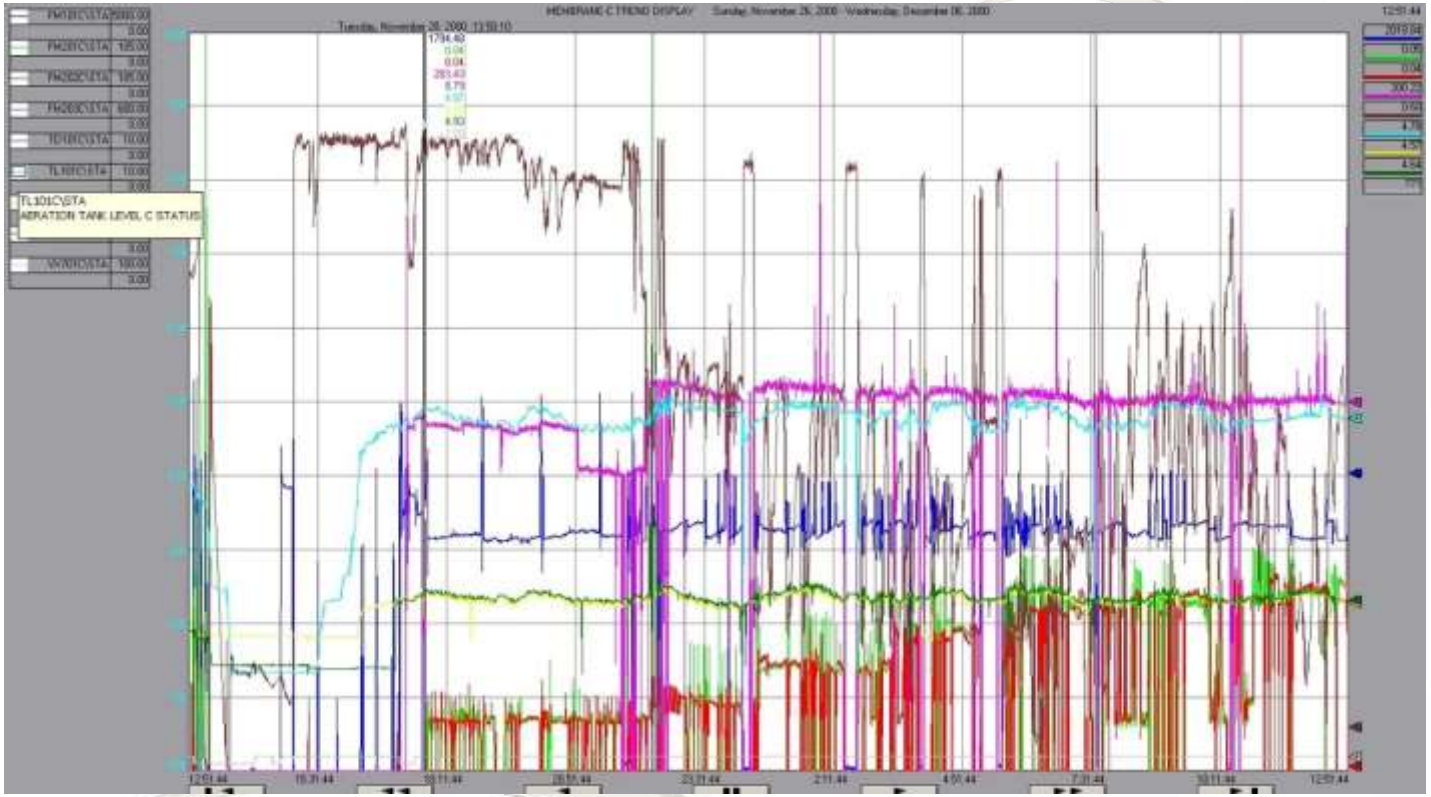
Palm Jumeirah MBR

Capacity: 21000m3/d

Client: metito.

End User: Nakheel

Location: UAE



The Palm Jumeirah Plant. Courtesy of metito (overseas) ltd.

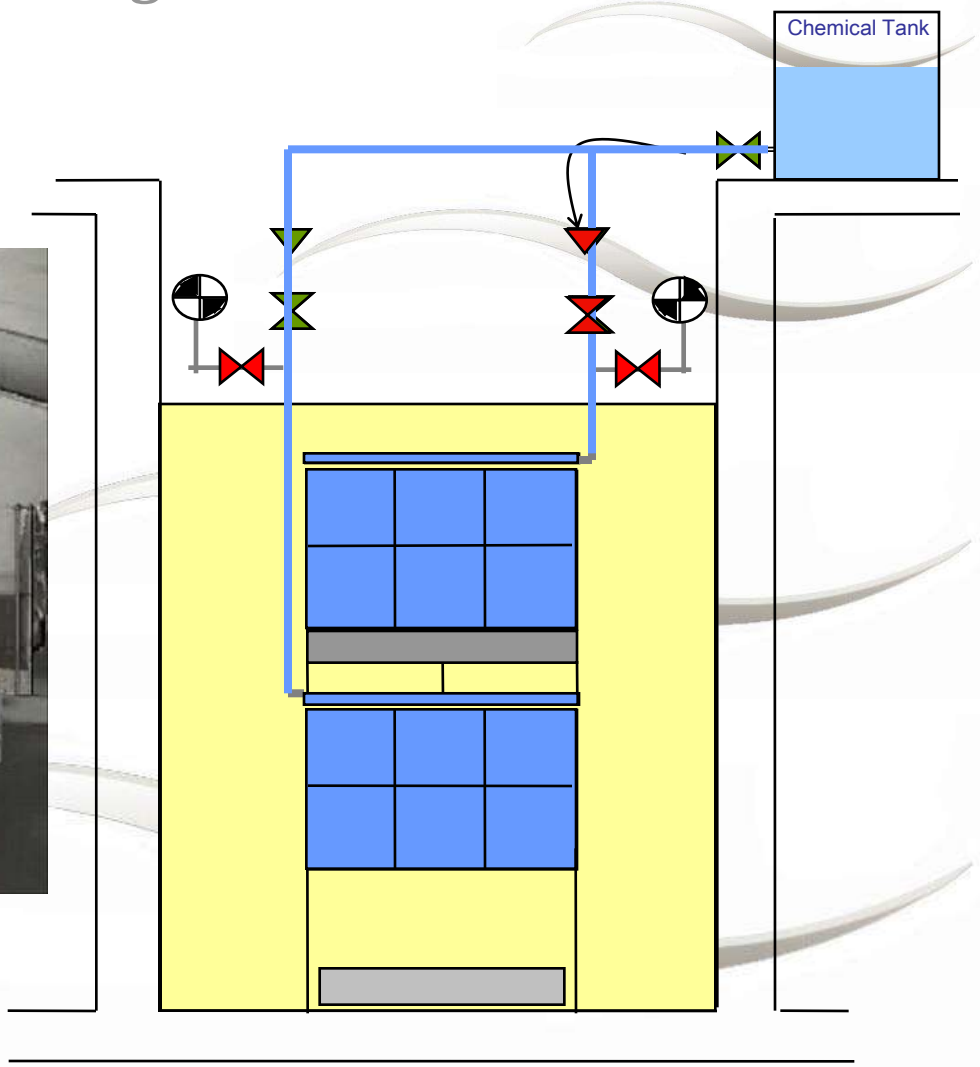
Operation and Maintenance

Maintenance- Schedule

Frequency	Maintenance Required
Daily	None, except sludge removal as required
Weekly	1. Routine sampling of MLSS (or as required).
Fortnightly / Monthly	1. Visual inspection of final effluent 2. Visual inspection of M&E equipment 3. Check on Screenings collection 4. Check on Sludge / MLSS production
Six-Monthly	1. Chemical cleaning of membrane units.
Annually	1. Drain tank to reveal membrane unit manifolds (upper unit), water hose clean and visually inspect membrane unit manifolds
Every five years	1. Remove and inspect membrane unit panels for signs of wear and excessive fouling. 2. Undertake cleaning and replacement as necessary.

Operation and Maintenance

Maintenance – Chemical Cleaning



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Section Four

END

Hassan Elokdi
Projects Manager
Acwa Emirates LLC

Enviro Arabia 2007

Section Five

Plant Walk Through

Hassan Elokdi
Projects Manager
Acwa Emirates LLC

10 Minutes

Plant Walk through

Westbury- UK

- Here is the Video.

(run time 00:06:11)

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Section Five

END

Hassan Elokdi
Projects Manager
Acwa Emirates LLC

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Workshop

END

THANK YOU FOR ATTENDING.

Hassan Elokdi
Projects Manager
Acwa Emirates LLC