

“MEMBRANE BIOREACTOR”

NIHAR DOCTOR

Director

en-VISION **Enviro Technologies Pvt. Ltd.**

(Pollution Control Consultants & Engineers)

**Shree Ram Complex, 2nd Floor, Above Bank Of India,
Near Kargil Chowk, Surat Dumas Road, Piplod,
Surat-395007,Gujarat,India,**

Phone No- +91 261 2224004 & +9194261 18309,

www.en-vision.in, e-mail: info@en-vision.in



Confederation of Indian Industry

**“WASTE MANAGEMENT SUMMIT 2014”,
16 & 17 December 2014**



OUR SERVICES

Solid & Hazardous Waste Management



Biomedical Waste Management



Turnkey Project Execution



Environment Consultancy & Clearance



Engineering & Procurement



Monitoring & Analysis



INTRODUCTION

- Effluent treatment covers the mechanisms and processes used to treat waters that have been contaminated in some way by anthropogenic **industrial or commercial activities** prior to its release into the environment or its re-use.
- The different types of contamination of wastewater require a variety of strategies **to remove the contamination** depending upon the end discharge condition.
- Wastewater treatment plant requires **continuous maintenance** to function in a safe, efficient and reliable manner.
- If one component of a unit process fails, the entire system may break down. The result will be an inferior product.

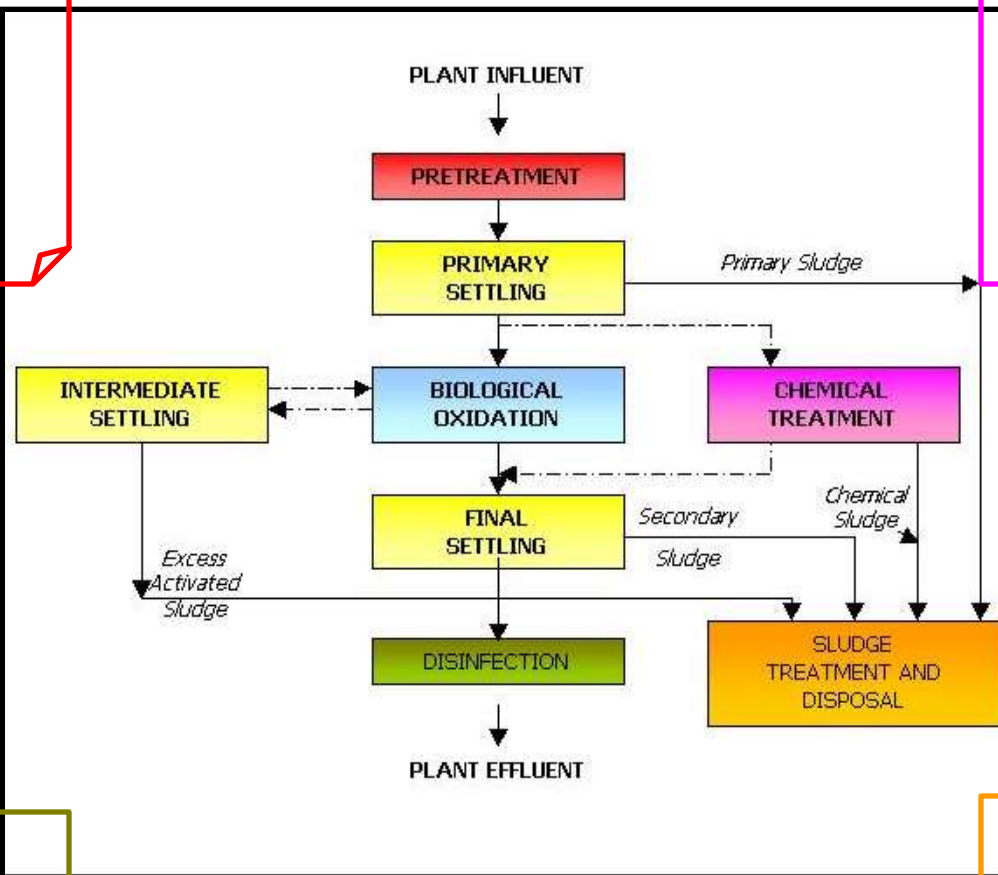
CONVENTIONAL WASTEWATER TREATMENT

Pretreatment involves:

- ✓ Screening
- ✓ Grit Removal
- ✓ Oil separation
- ✓ Flow equalization

Chemical Treatment is

- used in conjunction with the physical and chemical processes:
- ✓ Chemical precipitation
 - ✓ Adsorption



Disinfection can use:

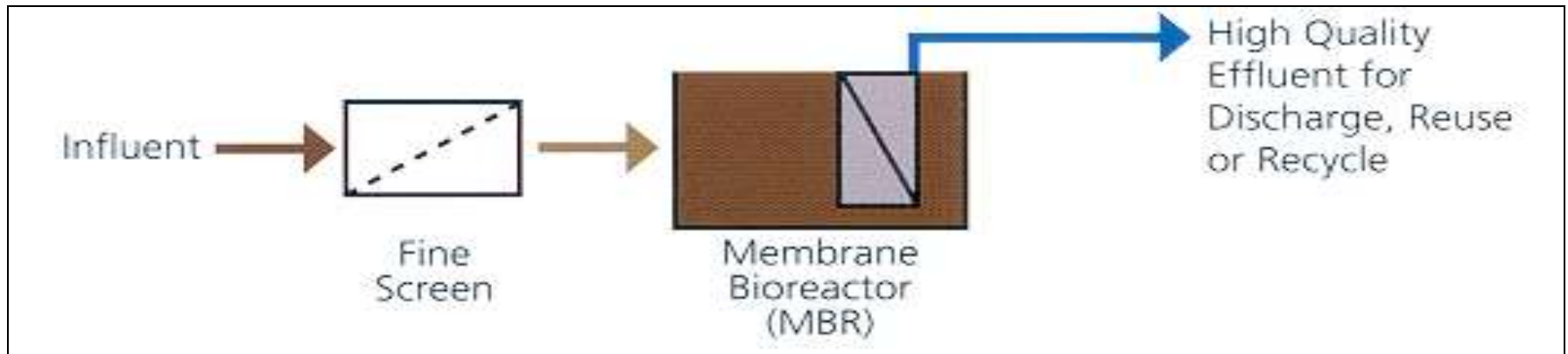
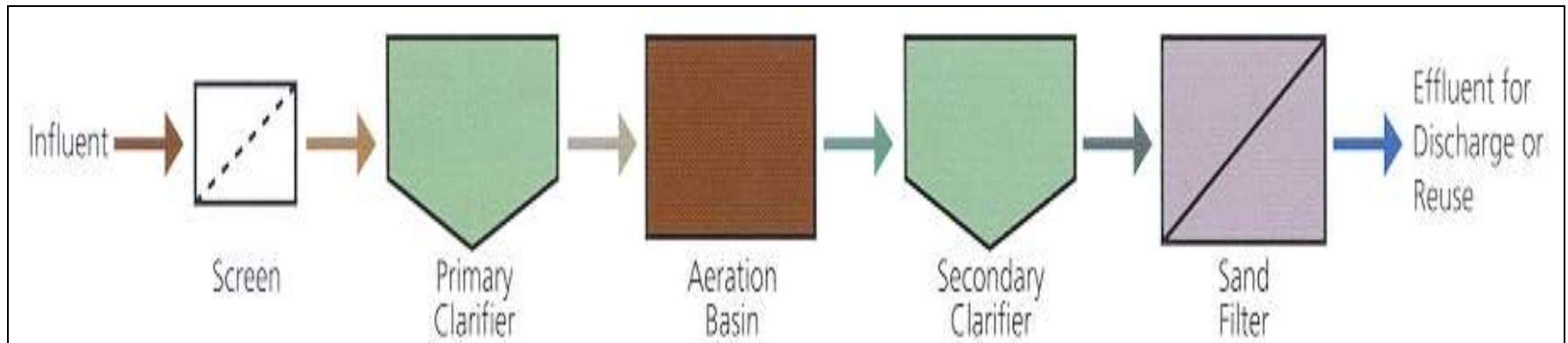
- ✓ Chlorine compounds
- ✓ Bromine Chloride
- ✓ Ozone
- ✓ UV Radiation

Sludge Treatment and Disposal involves:

- grinding, degritting, blending, thickening, stabilization, conditioning, disinfection, dewatering, heat drying, thermal reduction, ultimate disposal

MBR TECHNOLOGY

- Modification of Activated Sludge Process.



HOW DOES IT WORK ?

Filtration Process

- Barrier filtration
- Membranes
- Separates solids and liquids

Biological Process

- Activated sludge (MLSS)
- Bacteria
- Oxidizes organic constituents, BOD, and Nitrification of Ammonia to Nitrate

The diagram illustrates the integration of two processes. On the left, under the heading 'Filtration Process', are three bullet points: 'Barrier filtration', 'Membranes', and 'Separates solids and liquids'. On the right, under the heading 'Biological Process', are three bullet points: 'Activated sludge (MLSS)', 'Bacteria', and 'Oxidizes organic constituents, BOD, and Nitrification of Ammonia to Nitrate'. Two arrows originate from the bottom of the 'Separates solids and liquids' and 'Oxidizes organic constituents...' items, pointing towards the central text 'Membrane + Bioreactor'.

Membrane + Bioreactor

WHAT IS MBR TECHNOLOGY?

- A membrane bioreactor is a state of the art wastewater treatment process utilizing biological treatment alongside **filtration all in one common tank.**
- Occupies small foot print.
- **very high MLSS concentrations** (usually 8,000 to 20,000 mg/l).
- **Large amount of biomass** is very resilient to fluctuations in loading and able to handle high loading.

WHY MBR?

1. REUSE QUALITY EFFLUENT

Effluent BOD < 5 mg/L

Effluent TSS < 5 mg/L

Total Phosphorus < 0.5 mg/L

Total Nitrogen < 10 mg/L

Ammonia < 1 mg/L

Turbidity < 0.2 NTU

Up to 6 log removal of bacteria*

Up to 4 log removal of viruses*

SILT DENSITY INDEX < 3
(SUITABLE FOR RO FEED)



WHY MBR?

2. MORE ROBUST AND MORE RESILIENT PROCESS.

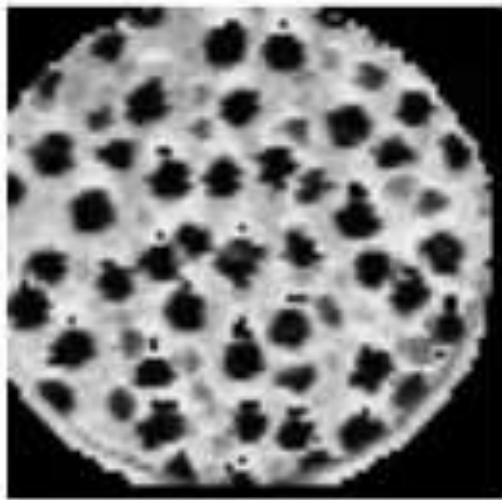
- Functions well even at **low flows and loadings** (very flexible operation).
- Resistant to toxic shocks and upsets.
- **Membrane provides** nearly absolute barrier to solids .

3. EASY TO OPERATE

- **Membrane plants do not require** the constant fine-tuning required in many conventional treatment systems.
- **Fewer man-hours** required for operation.

WHAT IS MEMBRANE?

- It is an intervening phase **separating two phases** and/or,
- Acting as **an active or passive barrier** to the transport of matter between phases.



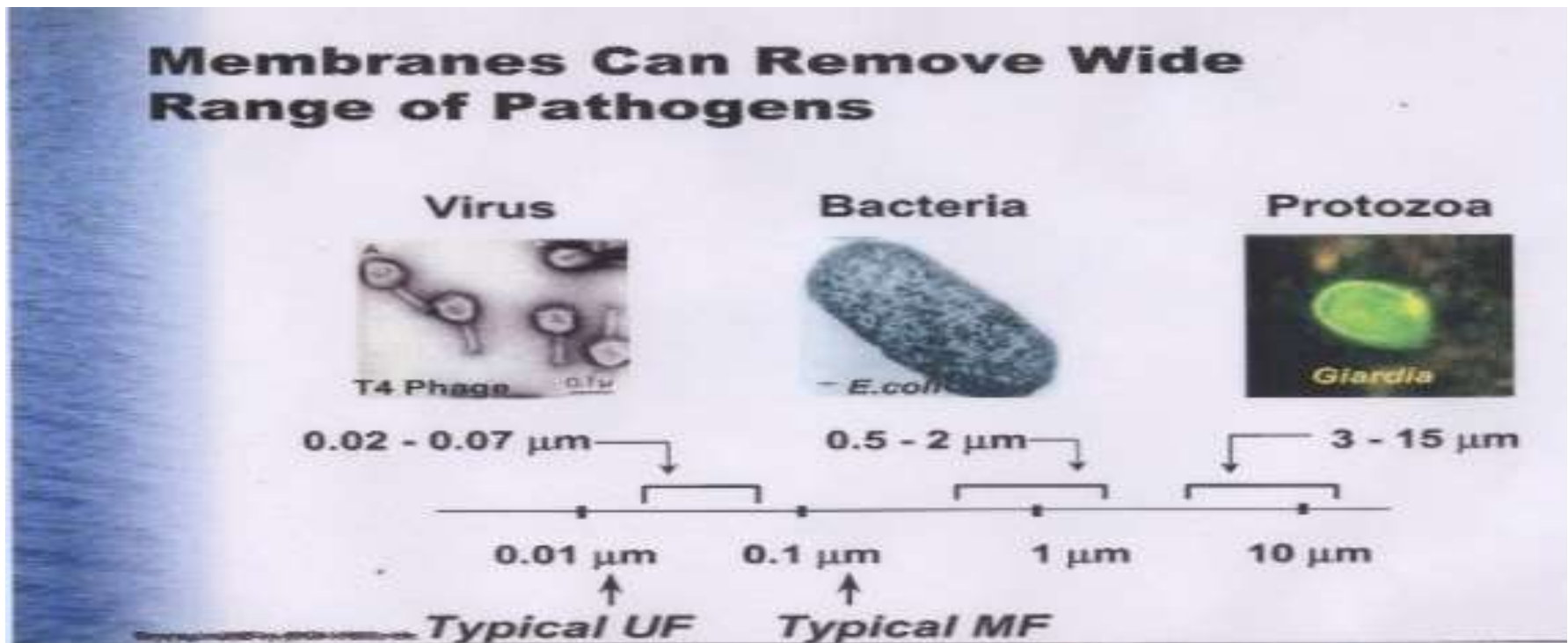
Electron microscope
view of membrane
surface



Membrane
Fibers

HOW IT WORKS?

- Billions of microscopic pores on the surface.
- The pores form a barrier to impurities, while allowing pure water molecules to pass.
- Water is drawn through the pores using gentle suction.



PROCESS CONFIGURATION

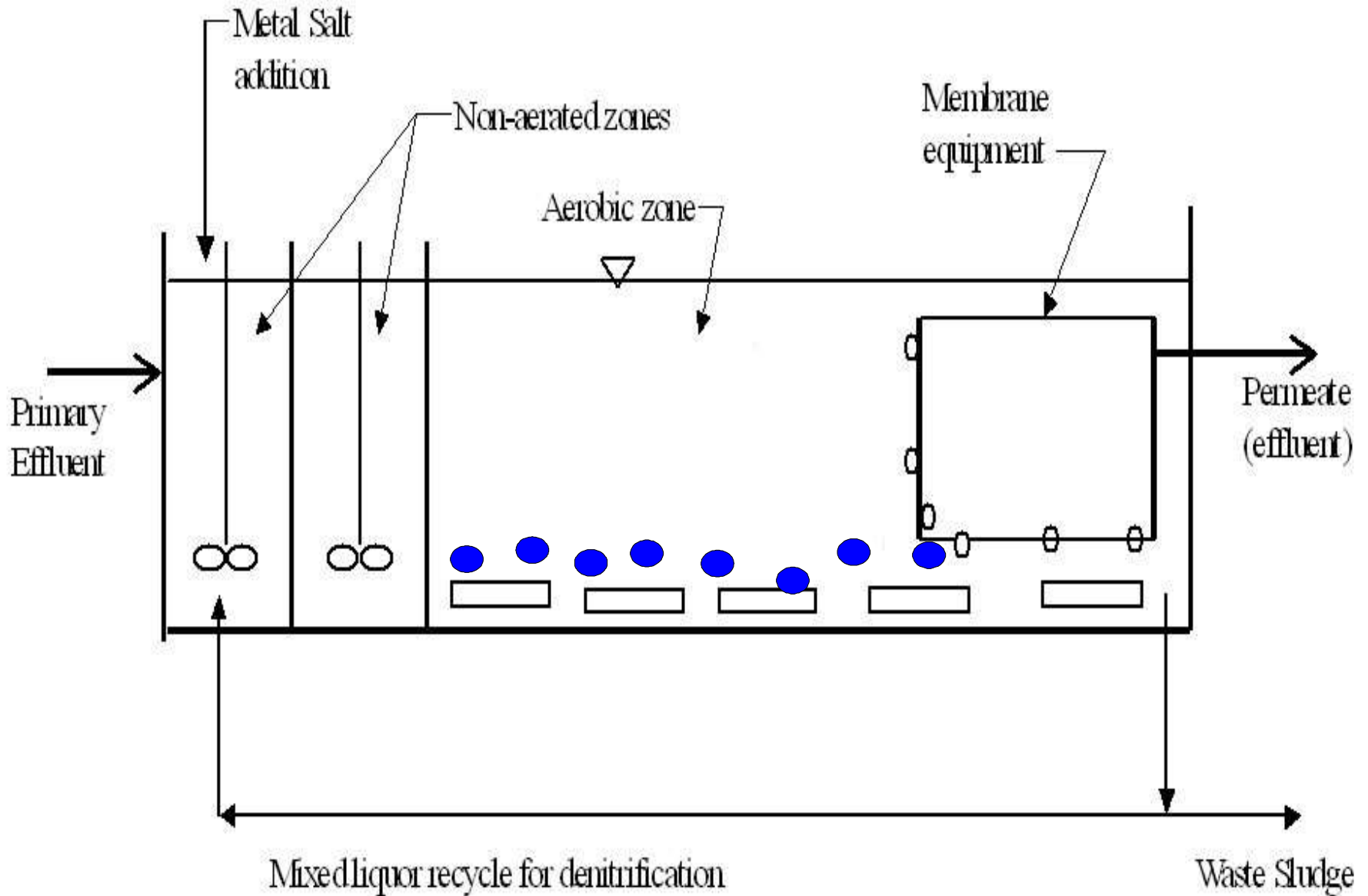
Submerged or immersed MBR(IMBR)

- The membrane is submerged directly in the aeration tank.
- By applying low vacuum or by using the static head of the mixed liquor, effluent is driven through the membrane leaving the solids behind.

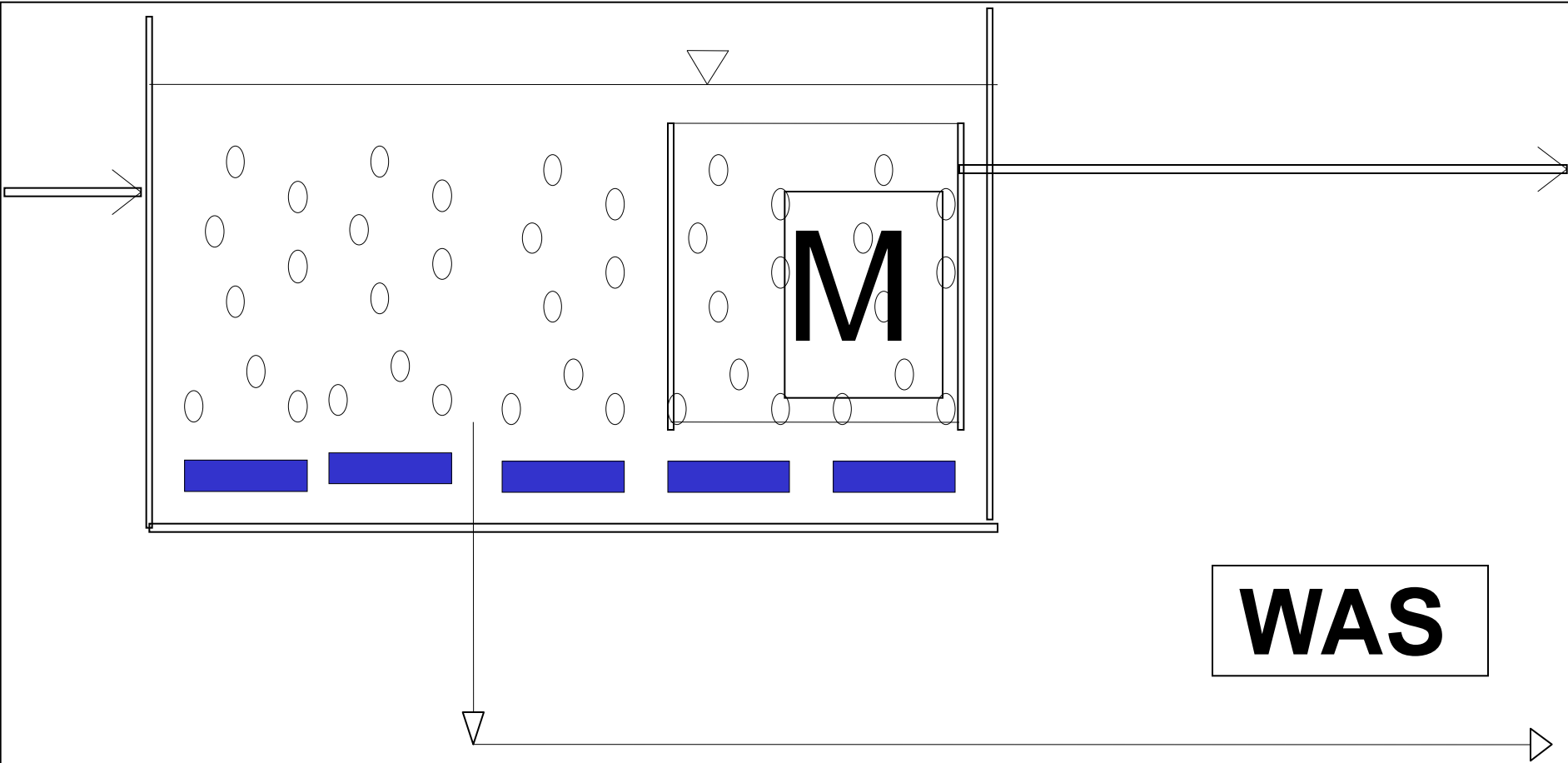
External /Side stream MBR(EMBR)

- The mixed liquor is pumped from the aeration tank.
- Membrane at flow rates that are 20-30 times the product water flow.
- To provide adequate shear for controlling solids accumulation at the membrane surface.
- The high cost of pumping makes EMBR system impractical for full-scale municipal wastewater treatment plants.

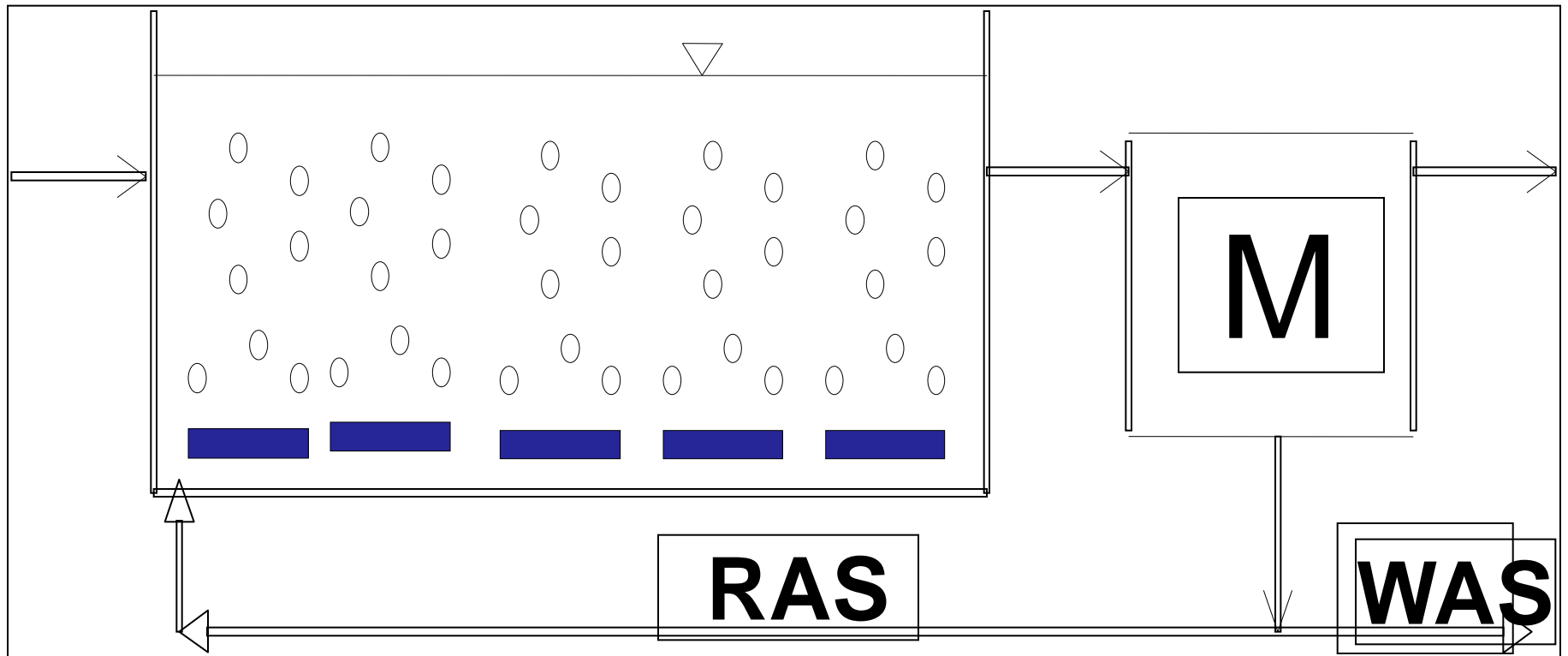
FLOW SCHEMATIC FOR MBR SYSTEM



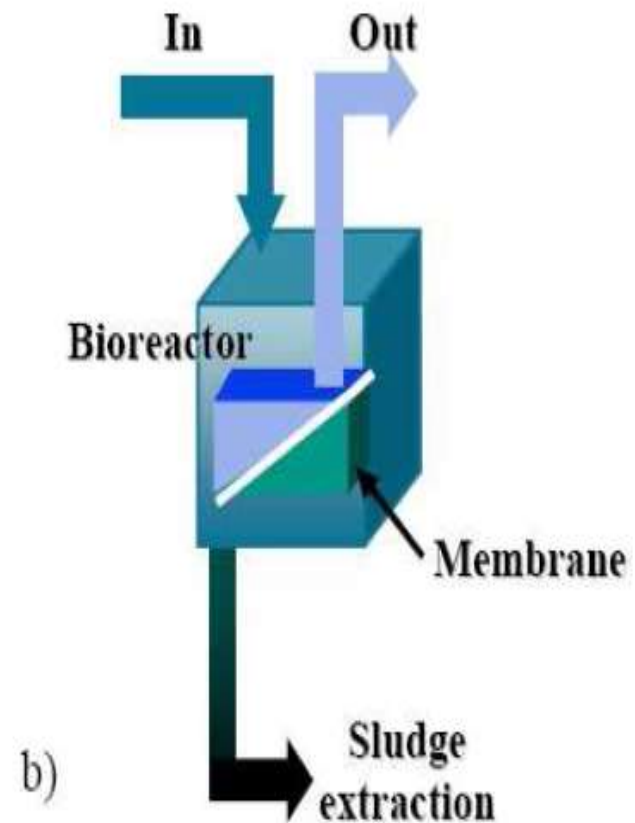
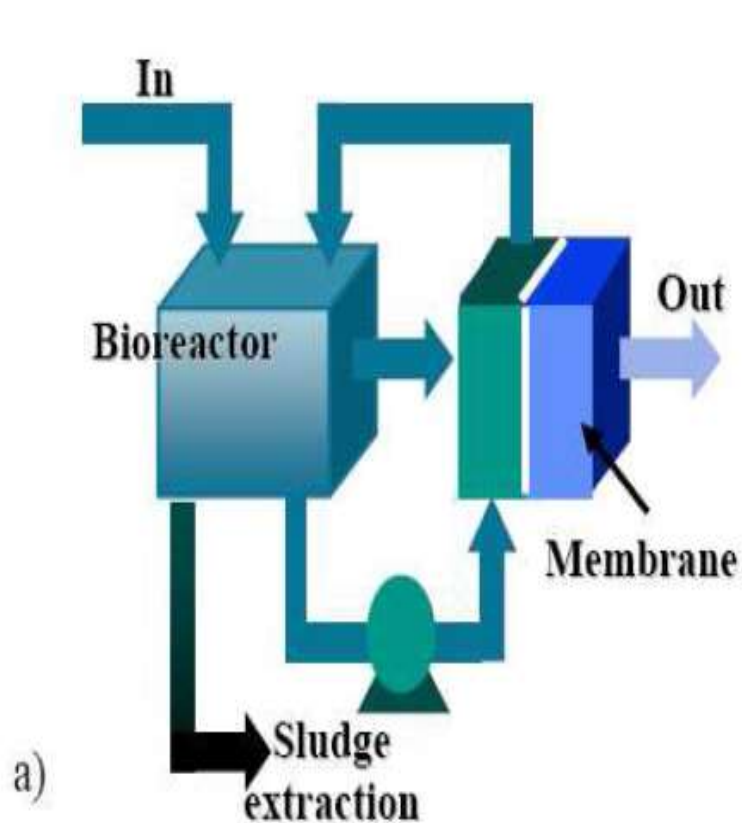
INTERNAL MBR



EXTERNAL MBR



TWO DIFFERENT MBR CONFIGURATIONS: SIDE-STREAM (EXTERNAL) AND SUBMERGED (INTERNAL)



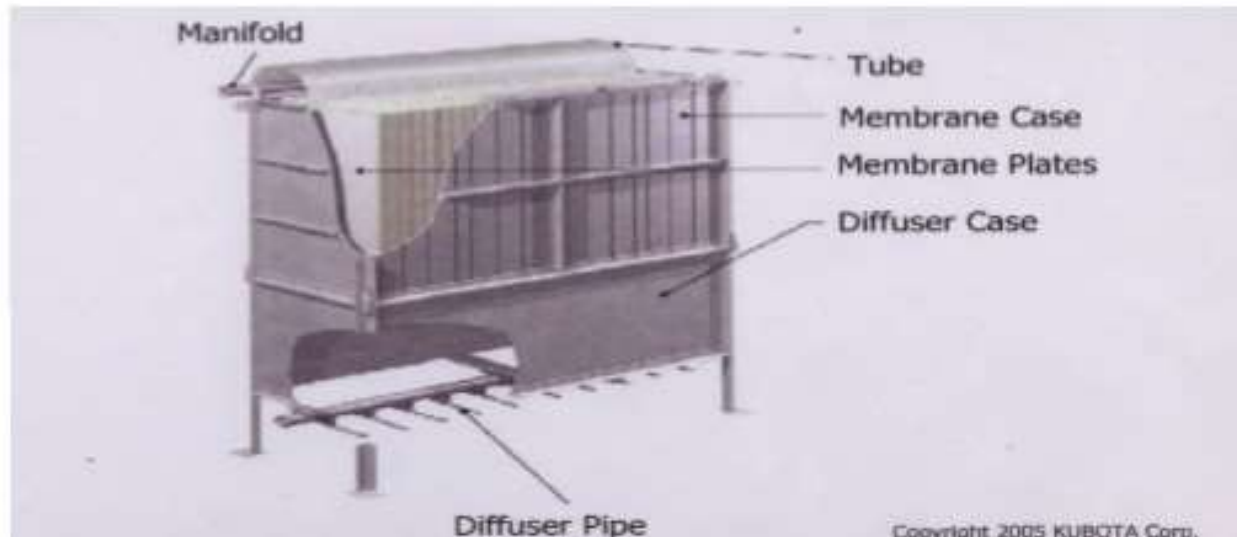
HOLLOW FIBER MEMBRANE



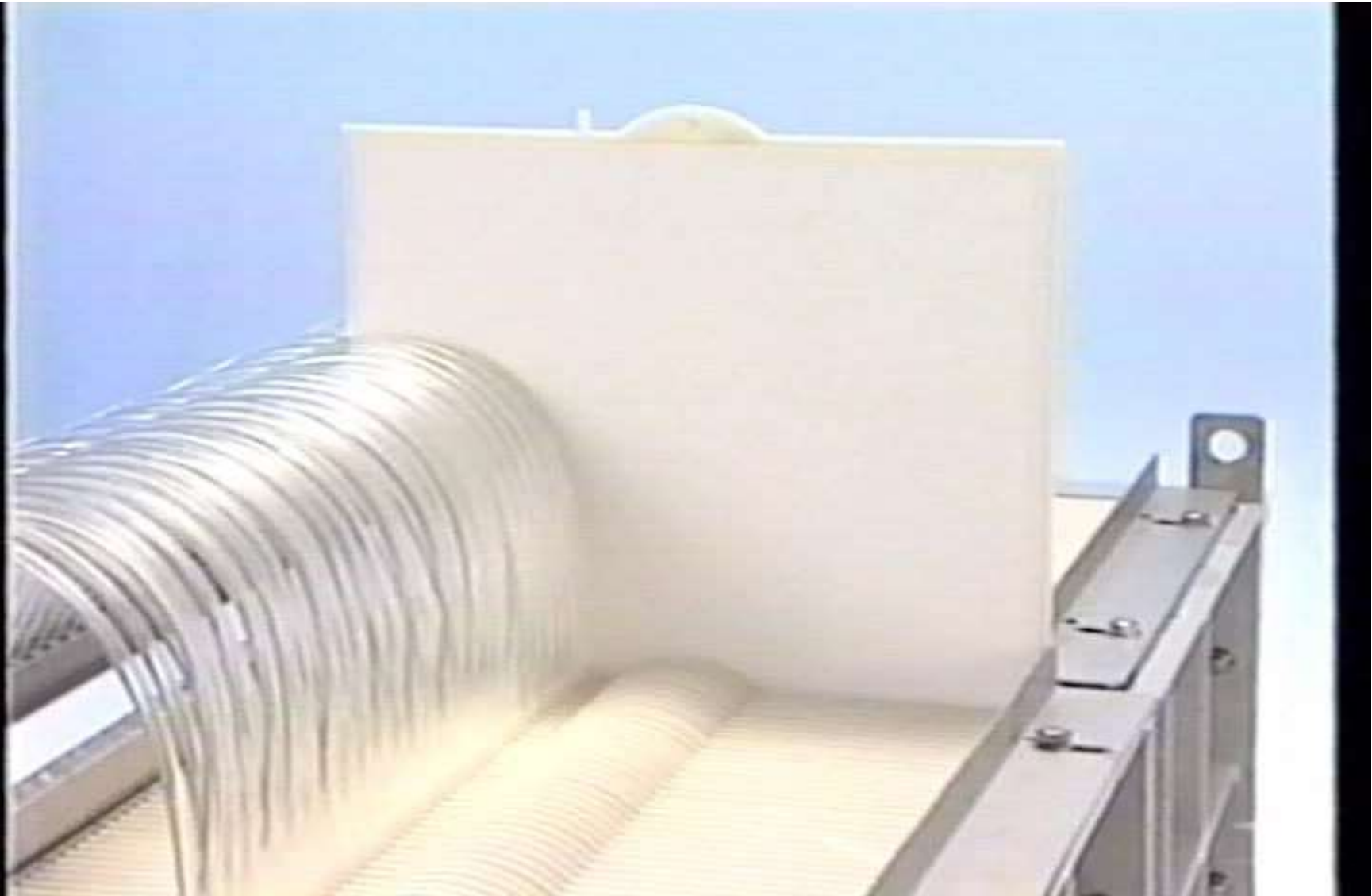
FLAT PLATE MEMBRANE



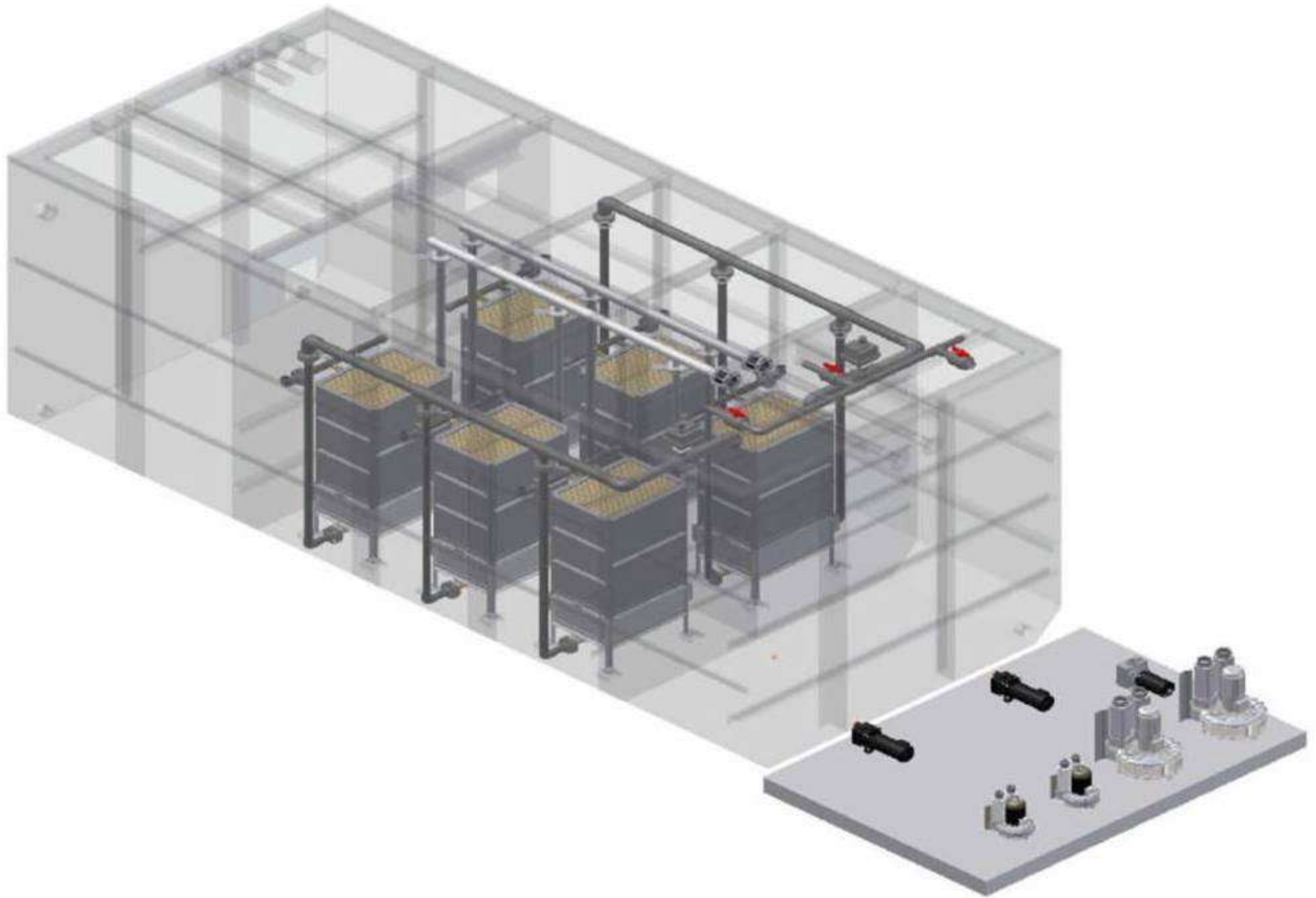
STRUCTURE OF MEMBRANE UNIT



MEMBRANE UNIT

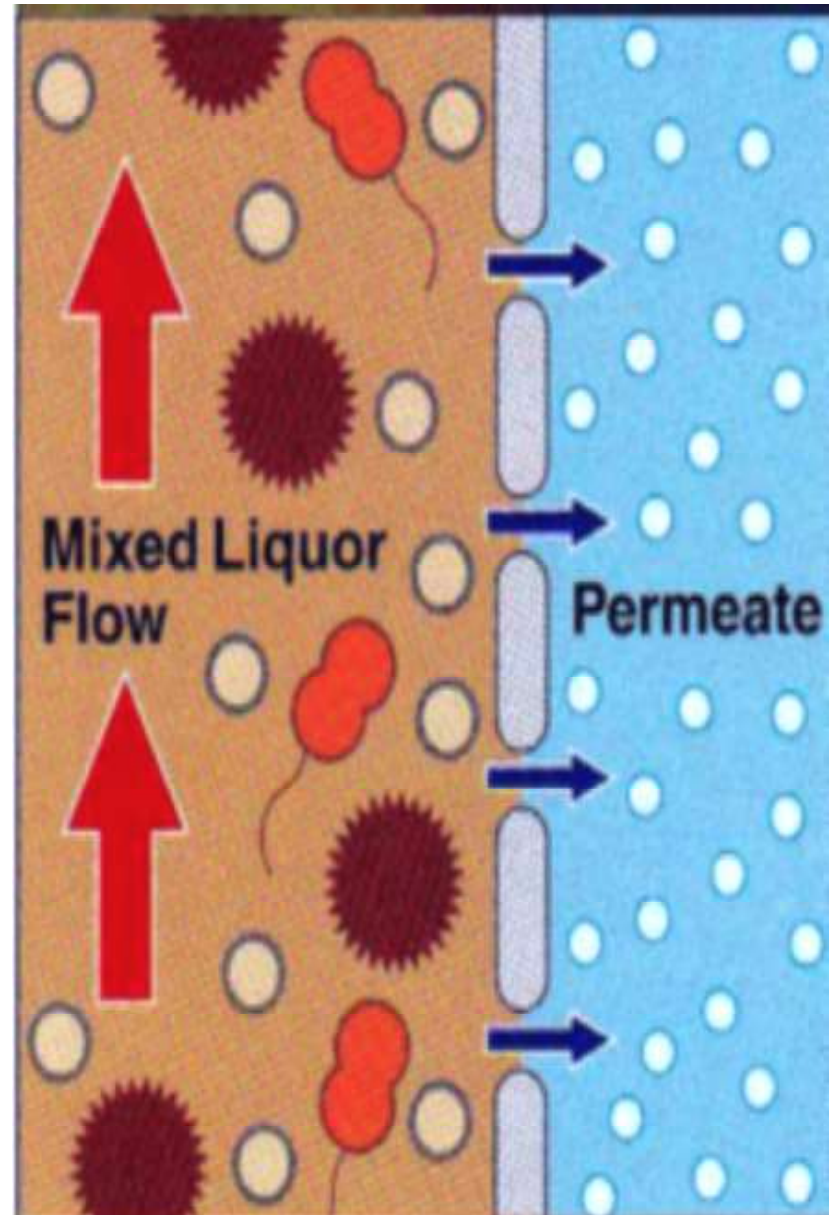


INSTALLATION OF MBR UNIT



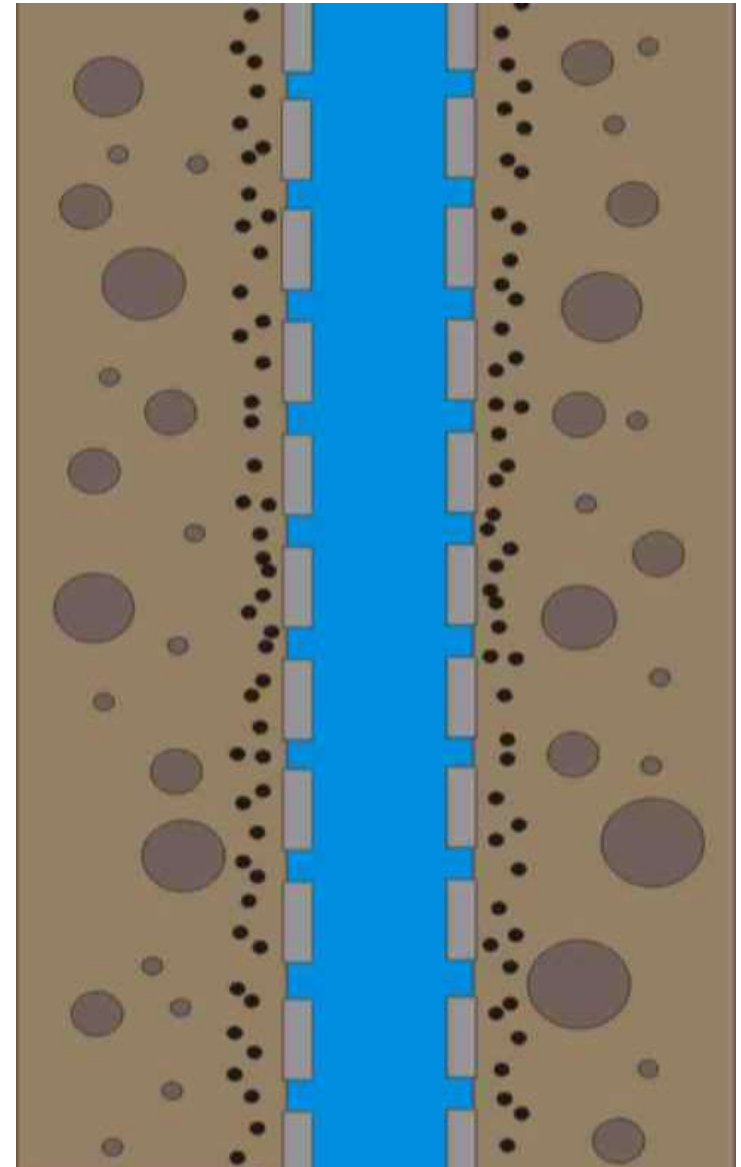
HOW MBR WORKS

- The MLSS is moved parallel to the **surface and cleaning** is achieved by the shear force generated by the cross flow velocity over the membrane surface.
- **Light suction** or hydraulic head forces clean water through membrane.



HOW MBR WORKS

- Limited formation in water treatment.
- Almost instantaneously forms on all membranes submerged in mixed liquor.
- Serves as primary filtering mechanism (<0.1 mm).
- Biofilm control is key to membrane performance in mixed liquor.
- Biofilm protects membranes and extends membrane life.



HOW MBR WORKS

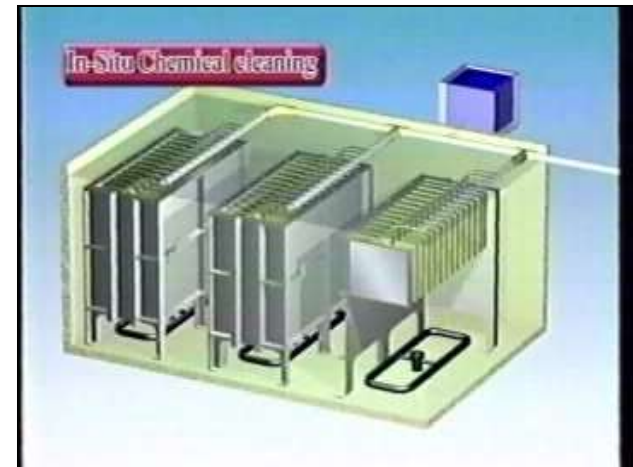
- Membrane modules immersed inside tank which degrade organic contents by activated sludge.
- **MLSS concentration** in MBR higher than ASP which reduce retention time by 30%.
- **Membranes separates** solids from liquids.
- **0.1 μm pore size** membrane removes SS and coli form bacteria.
- In actual practice, two basin through which whole MBR process carried out.
 - Pre air basin
 - MBR basin

HOW MBR WORKS

- Diffusers provided in pre air basin to maintain DO and MLSS development.
- Membrane units placed in MBR Basin.
- Vacuum suction provided which helps the filtration process.
- In pre-aeration basin, air is supplied to provide oxygen for carbonaceous BOD removal and ammonia conversion to nitrates through nitrification. (Ammonia conversion to nitrates)
- Partially stabilized mixed liquor from pre-aeration basins is pumped to MBR basin equipped with submerged membrane units for solid liquid separation.
- The permeate is stored in final treated water tank.

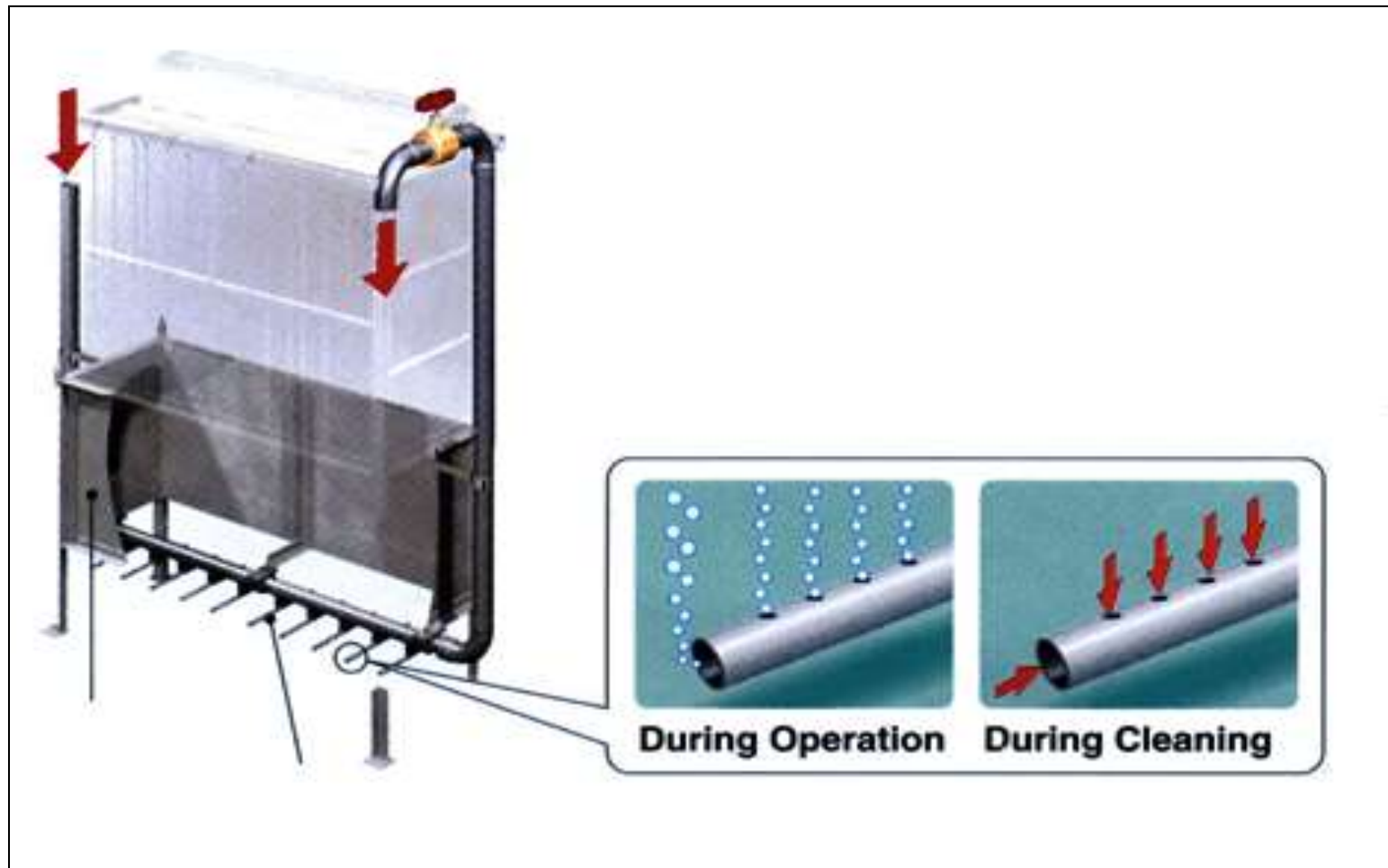
MBR MEMBRANE CLEANING

- Cleaning takes approximately 3-6 hours per basin,
- Using 0.25% Sodium Hypochlorite or 1% organic acid (e.g. oxalic acid, citric acid).
- Cleaning of membranes is required only once every 6 to 12 months.
- No back flushing, backwashing or maintenance cleaning required.
- Manual, semi-automated and fully-automated systems available.



DIFFUSER CLEANING

- Diffuser cleaning is automatic and only required weekly for 3 to 10 minutes.



BENEFITS OF MBR

- Reusable quality treated water
- Efficient in Biological Nutrient Removal
- Lesser Footprint
- Low Maintenance
- Robust
- Retrofit/Upgrade
- Reduced Disinfection Requirements

COMPARISON OF ASP AND MBR

Performance Criteria		Conventional Activated Sludge Process	MBR
Treated Water Quality (Before Chemical precipitation, Tertiary filtration & Disinfection)	BOD (mg/L)	<35	<5
	TSS	<80	<5
	NH3	2	<1
	Nitrate	<15	<10
	Bacteria Removal	Log 2	Log 4-5 (Log 4 removal = 99.99 % removal as compared to 99% in Conventional & SBR)
	Virus Removal	not possible	Log 2 (99% in MBR & SBR)
	Turbidity	20 NTU	< 0.2 NTU
Effluent Water Quality	Aesthetic Appearance	Good	Best
Ease of Operation	Operator intervention required	High	Very less
Hydraulics & piping		More piping (as more tankages req.)	Good & less piping(able to handle shock/lean flows)
Flexibility to accommodate future treatment	Phased development	not possible	can be easily retrofitted/upgraded to higher capacity)

COMPARISON OF ASP AND MBR

Performance Criteria		Conventional Activated Sludge Process	MBR
Odor nuisance		possible	no odour
Tertiary Filtration	For reuse	Required	Not Required
Post Disinfection Requirement	Chemical Dosage / UV Intensity	Must - Requires 15 ppm chlorine post disinfection and tertiary filtration is recommended before UV application.	Not required - Requires only 2-3 ppm chlorine post disinfection to avoid secondary contamination and low dosages UV required and can be used immediately after MBR i.e. w/o tertiary filters
Sludge Handling	Sludge Generation	Highest	Lowest-can be done once in 15 days
Green Technology	Reduction in carbon Footprint due to less volume of concrete tanks and associated CO2 emission due cement use.	HIGH Carbon Foot print due to large volume tanks and high cost of operation mostly to power	LOWEST Carbon Foot print due to SMALL volume tanks and LOW cost of operation as low dosages of post disinfectant chemicals are used.
Public Safety & Acceptance		OK	Preferred worldwide as the advance treatment technology

MEMBRANE BIOREACTOR (MBR)

ADVANTAGES

- Low hydraulic retention time and hence low foot (area) requirement
- High quality effluent in terms of low turbidity, TSS, BOD, and bacteria
- Stabilized sludge
- Ability to absorb shock loads

DISADVANTAGES

- High CAPITAL cost
- Relatively high operation cost
- Periodic cleaning and replacement of membranes
- High automation
- Skilled trained Operators- a must
- No energy production

COMMON EFFLUENT TREATMENT

CETP PROJECT HIGHLIGHTS

Common Effluent Treatment Plant for Zydus Infrastructure Pvt. Ltd on Zero Discharge Concept

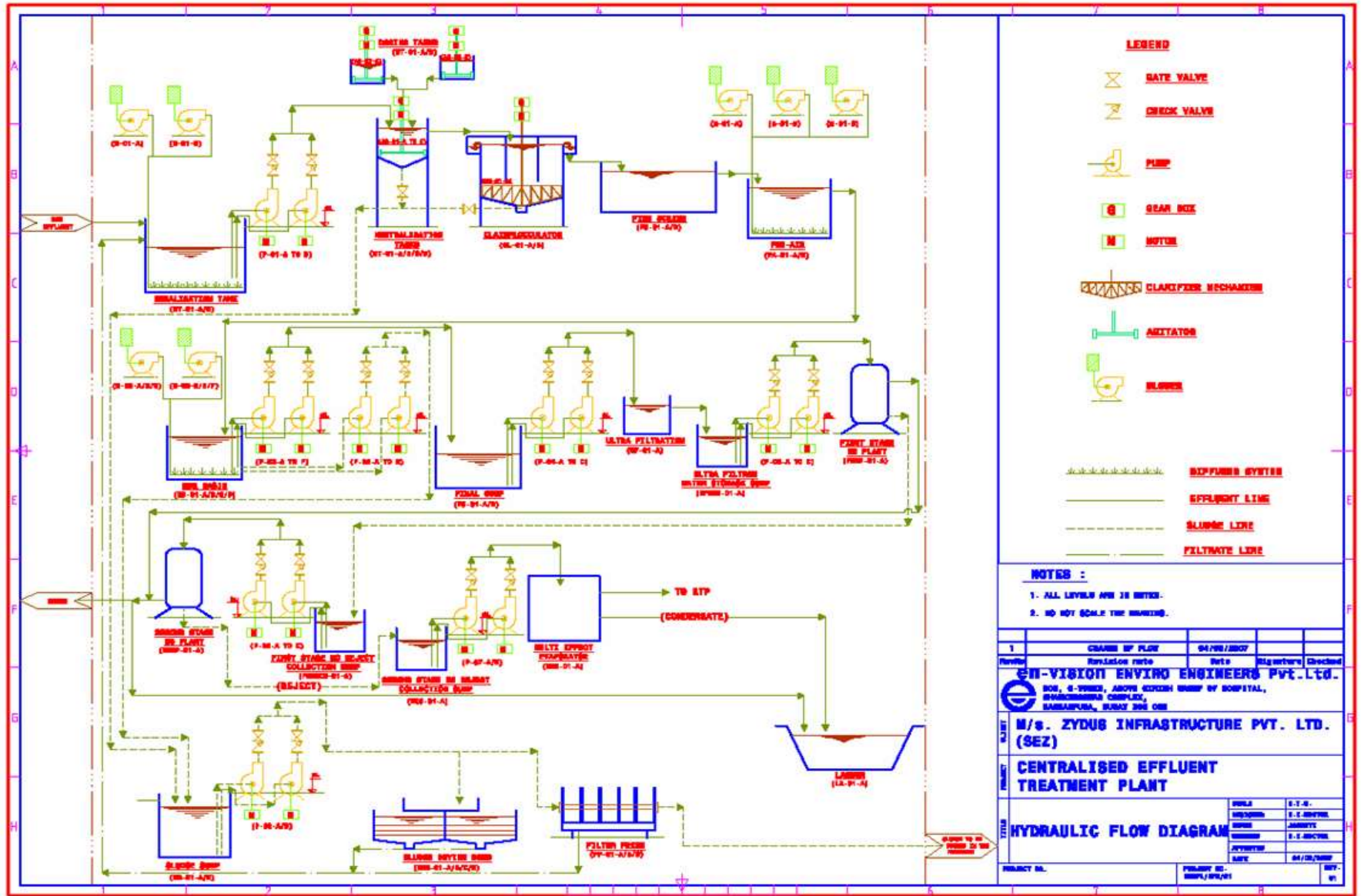


CETP PROJECT HIGHLIGHTS

Common Effluent Treatment Plant for Zydus Infrastructure Pvt. Ltd on Zero Discharge Concept(2007)

- Zero discharge CETP for ZIPL based on **MBR technology**.
- **Total capacity : 1500 cu.m./day**
- Treated effluent supplied back to member units for reuse.
- **CETP is based on Membrane Bio Reactor (MBR) technology – a very new and recent technology in India.**
- **First time for a CETP in India.**
- Completely automatic **SCADA operated plant.**
- Also Reverse Osmosis and Multiple Effect Evaporation.
- **Project Cost: INR 15 Crore**

ZIPL-VITAL COMPONENTS



LEGEND

- GATE VALVE
- CHECK VALVE
- PUMP
- GEAR BOX
- MOTOR
- CLARIFIER MECHANISM
- AERATOR
- BLOWER

- DIFFUSER SYSTEM
- EFFLUENT LINE
- SLUDGE LINE
- FILTRATE LINE

NOTES :

1. ALL LEVELS ARE IN METERS.
2. DO NOT SCALE THE DRAWING.

1	CHANGE OF FLOW	04/06/2007		
2	REVISION	REVISION	DATE	SIGNATURE
EN-VISION ENVIRO ENGINEERS PVT.LTD. 208, 2-THREE, ABOVE GREEN HOSPITAL, BANGALURU, KARNATAKA, INDIA				
M/s. ZYDUS INFRASTRUCTURE PVT. LTD. (SEZ)				
CENTRALISED EFFLUENT TREATMENT PLANT				
HYDRAULIC FLOW DIAGRAM				
SCALE	DATE	04/06/2007	BY	07-01
PROJECT NO.	001/02/01			

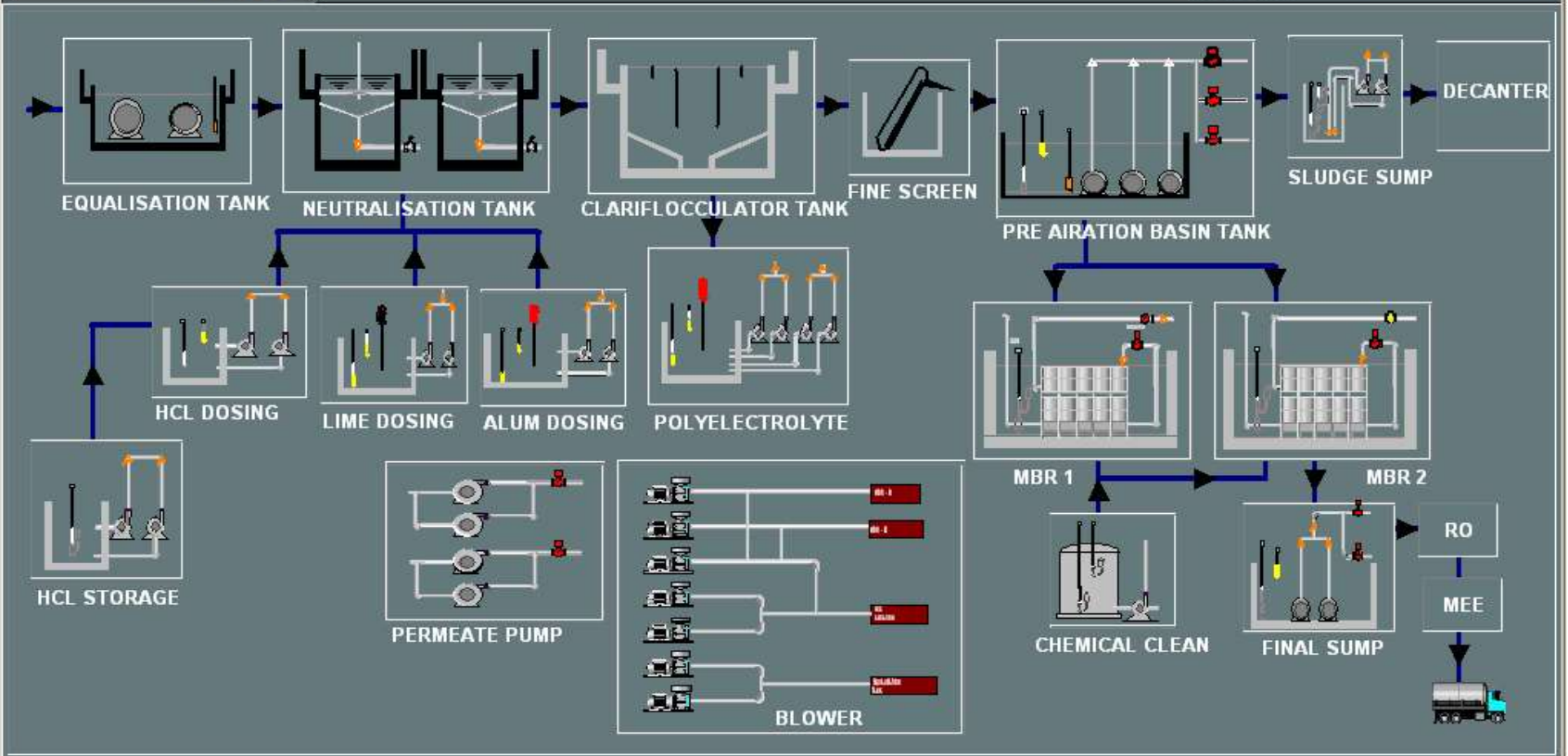
AUTOMATICALLY...



Date	Time	Comment
7/22/2007	3:46:24	GARLAND LEACHATE SUMP LSL750 L

Current User :ILESH
 Access Level :
 22/07 /2007
 15:58:38





An override is True

 Overview

 Alarms

 Ack Current Alarm

 Process Settings

 Trends / Reports

 Sys Admin Diagnostics

 Others Programs

 Print Screen

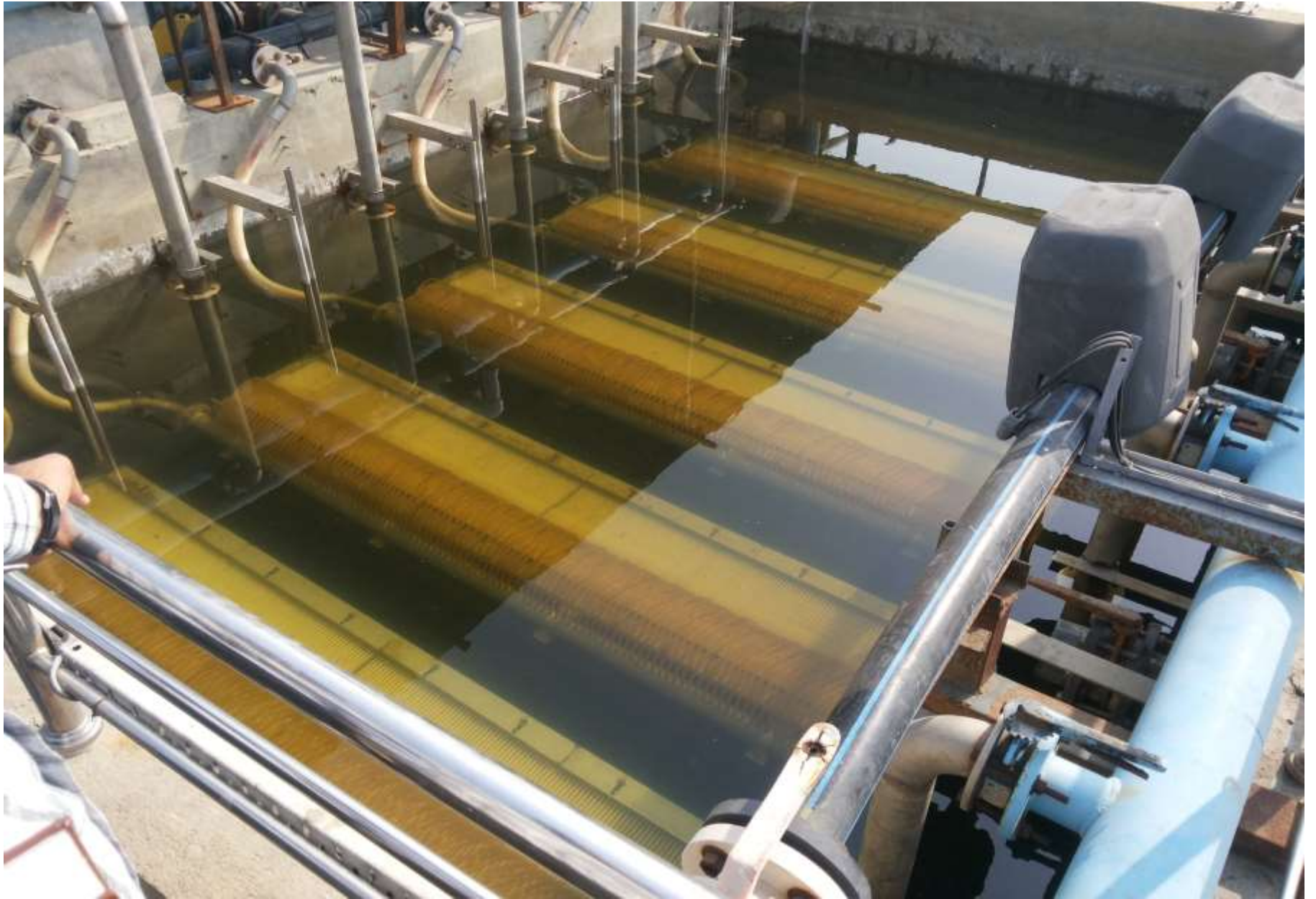


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ZIPL-FROM CONCEPT TO REALITY



ZIPL-FROM CONCEPT TO REALITY



ZIPL-FROM CONCEPT TO REALITY



ZIPL-FROM CONCEPT TO REALITY



WASTEWATER TREATMENT

PROJECT HIGHLIGHTS

Effluent Treatment Plant for Godhrej Tyson Ltd. Taloja MIDC, Panvel, Maharashtra (2012)

Capacity: 726 KLD

Assignment :

- Chicken Processing Unit
- Physico-chemical treatment
- Dissolved Air floatation unit
- Followed by MBR. SCADA Operated automatic Plant
- Treated Effluent with ultra pure quality to meet the stringent norms

PROJECT HIGHLIGHTS



PROJECT HIGHLIGHTS

Effluent Treatment Plant for Sun Pharma Medication Pvt. Ltd.; Dadra, Dadra & Nagar Haveli (2014) (in progress)

Capacity: 120 M³/day

Assignment: Design, Supply, Erection & Commissioning of Effluent Treatment Plant on Turnkey Basis

- Formulation Pharma Unit
- Physico-chemical treatment
- Activated Sludge Process
- Tertiary treatment
- Reverse Osmosis process
- **Advance Treatment (MBR) treatment**
- Zero Liquid Discharge (ZLD) Plant.
- SCADA Operated automatic Plant

PROJECT HIGHLIGHTS



**WE ARE COMMITTED TO
PRESERVING THE
ENVIRONMENT AND SETTING
NEW BENCHMARKS AT IT.**

THANKS