

SIEMENS

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Membrane BioReactor Application and Technology



Introduction

- Driver**
 - The Main Driver for Membrane BioReactor Treatment is REUSE of Water

- Reuse**
 - REUSE for:
 - ◆ Irrigation Water
 - ◆ Cooling Tower Make Up
 - ◆ RO Pretreatment for Boiler Feed Water

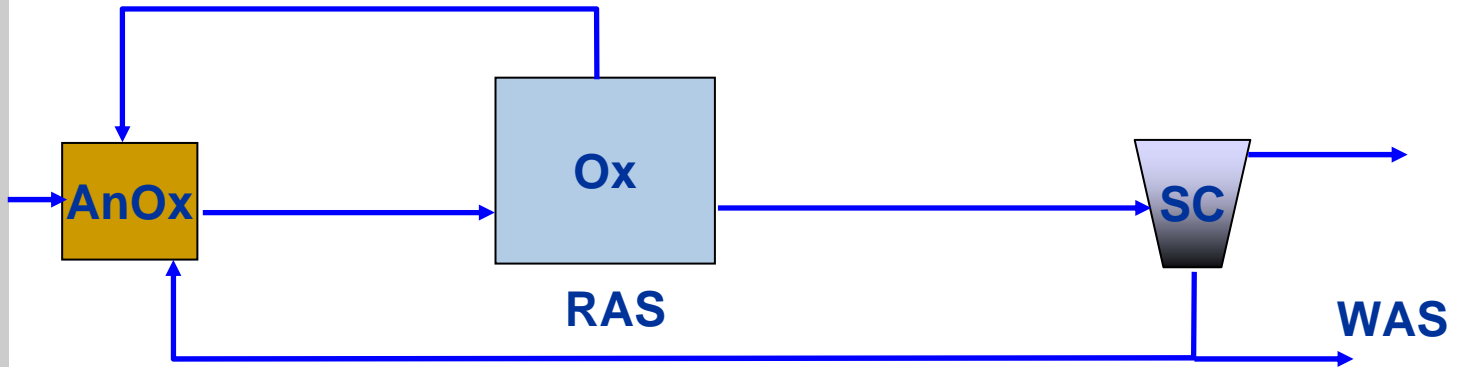
- Technology**
 - MBR Systems Include:
 - ◆ Pre Treatment
 - ◆ Screening
 - ◆ Biological Aeration Systems
 - ◆ Membrane Operating System (MOS)

Conventional Activated Sludge Typical Effluent Quality

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Technology



Total Suspended Solids (TSS)

20 mg/l

CBOD5

20 mg/l

Turbidity

> 20 NTU

Coliform Bacteria Count

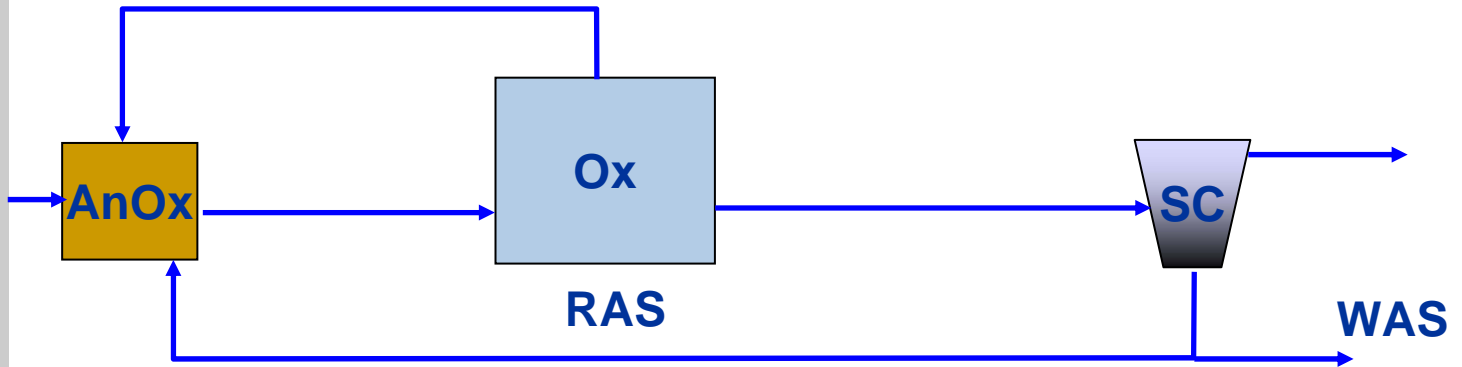
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REUSE Effluent Quality **Required** (Baseline)

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Total Suspended Solids (TSS)	1-5 mg/l
CBOD5	5 mg/l
Turbidity	1-2 NTU
Coliform Bacteria Count	2.2 MPN

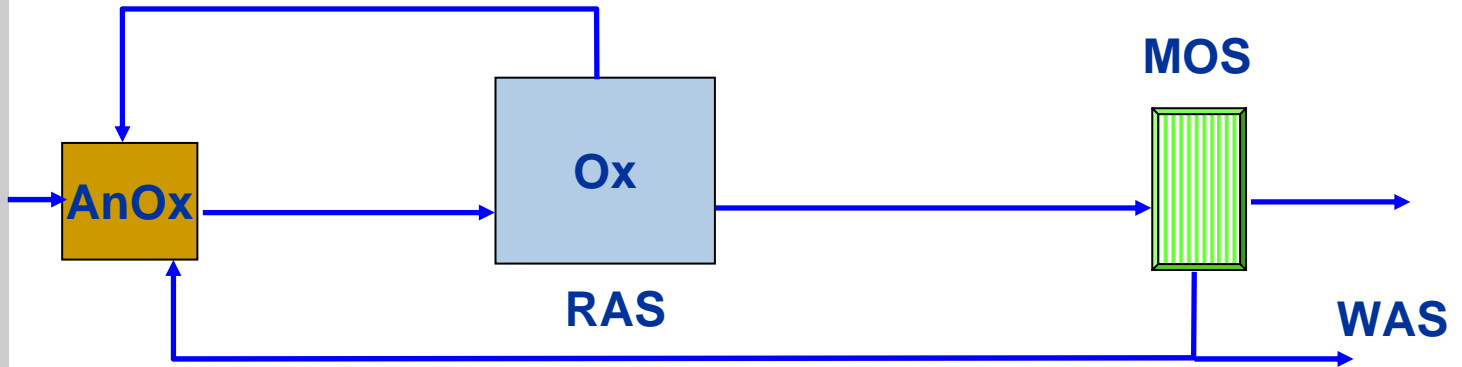
SECONDARY GRAVITY CLARIFIER IS LIMITING!

REUSE Effluent Quality Required (Baseline)

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Total Suspended Solids (TSS)

< 5 mg/l

CBOD5

< 5 mg/l

Turbidity

< 0.2 NTU

Coliform Bacteria Count

< 2.2 MPN

MEMBRANE OPERATING SYSTEM (MOS) CAN ACHIEVE THESE LIMITS!

REUSE of Waste Water-Recap

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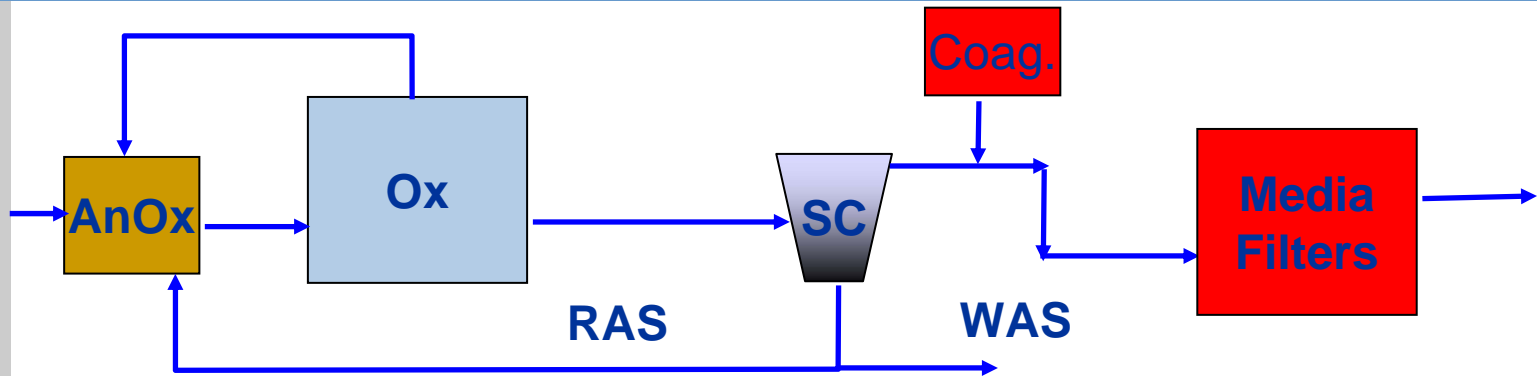
- REUSE for:
 - ◆ Irrigation Water
 - ◆ Cooling Tower Make Up
 - ◆ RO Pretreatment for Boiler Feed Water
 - ◆ Gray Water Feed

REUSE of Waste Water-IRRIGATION

Conventional A/S Approach

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- Addition of Chemicals-Operational Cost/Maintenance
- Addition of Media Filters and Booster Pumps
- Effluent Quality will be Variable - Based on Clarifier Effluent
- Turbidity Not Tied to TSS - Filter Cannot Address Consistently
- MBR Satisfies Requirements without chemicals-CONSISTENTLY

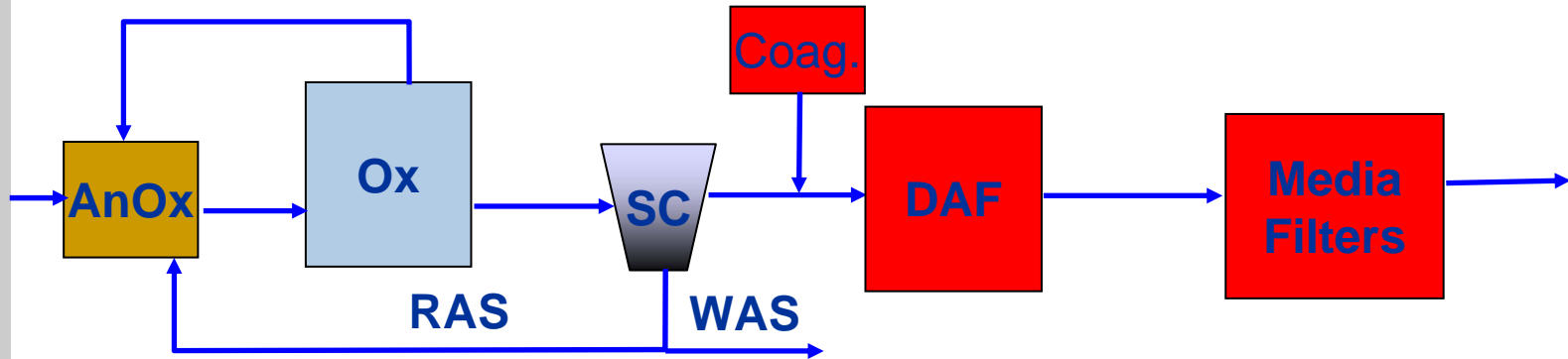
Technology

REUSE of Waste Water-Cooling Tower MU-Conventional Approach Case Study

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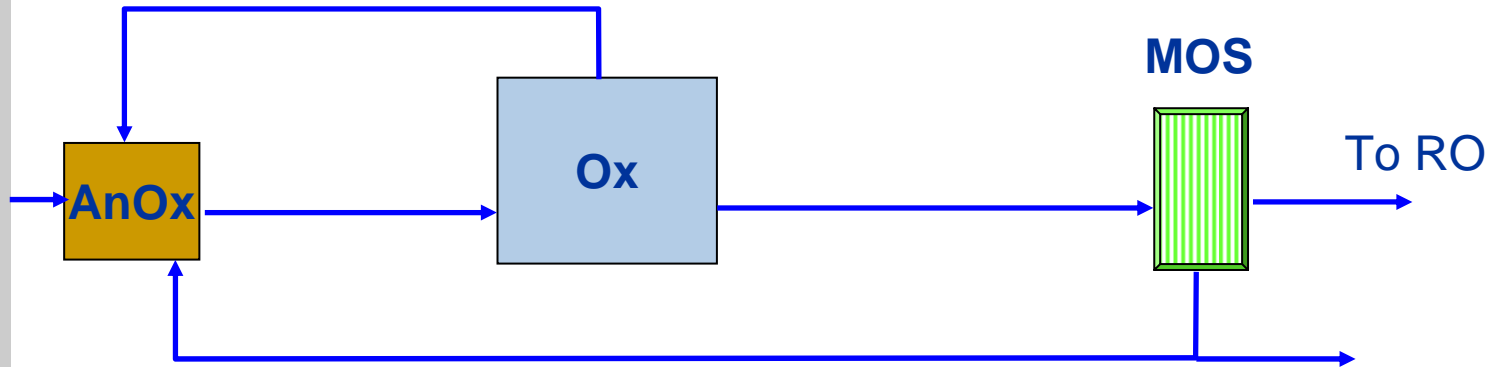
- Facility with Poor Settling Sludge
- Conventional Plant Followed by DAF and Media Filters to Achieve 10 mg/l TSS!!
- Very Large Footprint/High Installed Cost
- AN MOS WOULD HAVE REPLACED THREE PROCESS UNITS AND YIELDED MUCH BETTER EFFLUENT QUALITY. MBR WOULD HAVE ALSO YIELDED HIGH QUALITY RO FEED WATER.

REUSE of Waste Water-RO Pretreatment-Boiler Feed Water

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- Microfiltration Step of MBR is Ideal RO Pretreatment
 - ◆ Reduces Chemical Cleaning Frequency of RO Membranes
 - ◆ Extends RO Membrane Life
 - ◆ Improves RO Reliability and Uptime/Production
 - ◆ Reduces Pre Treatment Footprint/Maintenance/Operating Cost



The MBR Technology

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- MBR Systems Include:
 - ◆ Pre Treatment (Oily Waste Water)
 - ◆ Equalization
 - ◆ Screening
 - ◆ Biological Aeration Systems
 - ◆ Membrane Operating Systems

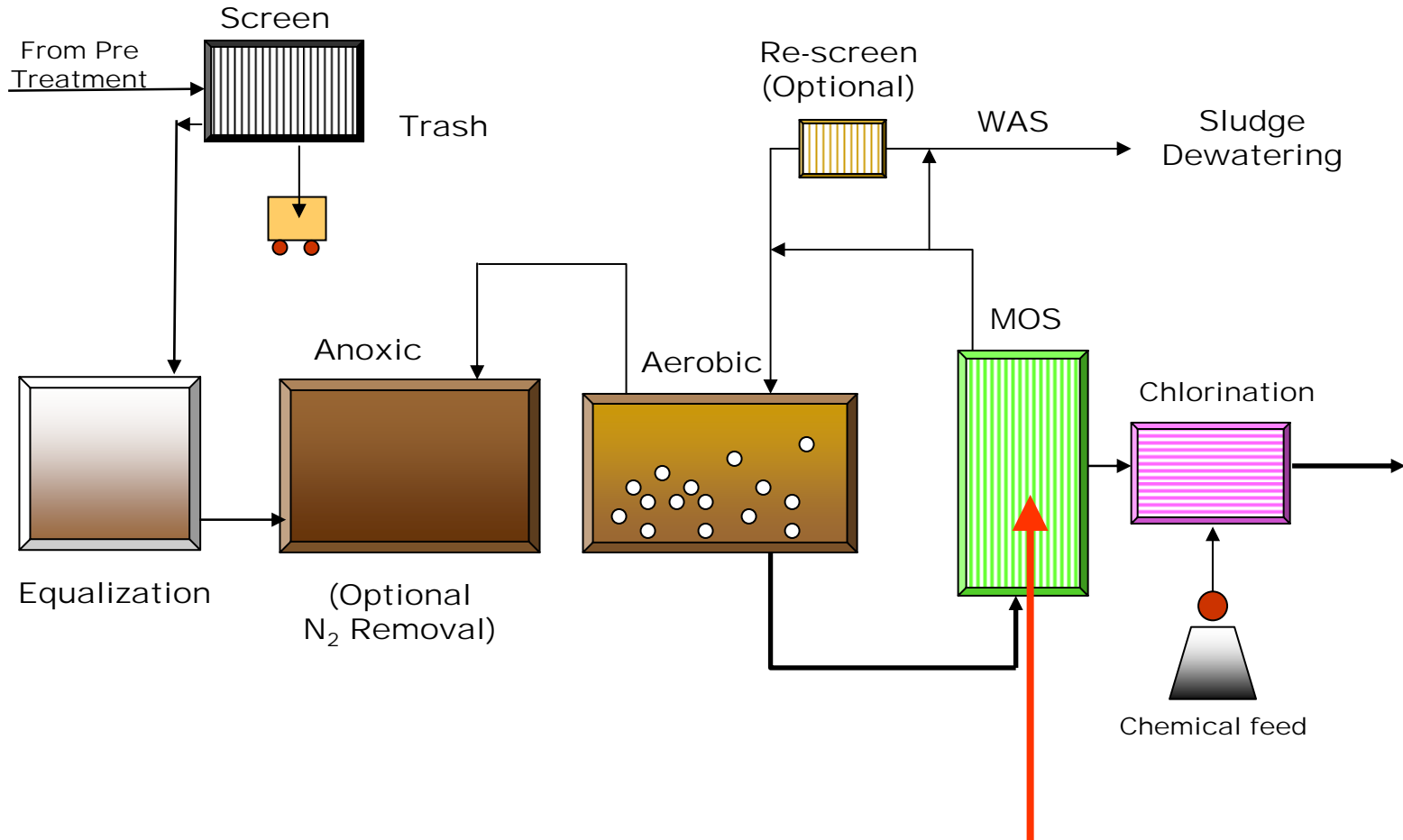


Integrated Process

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Membrane Operating System

The MBR Technology-PRE TREATMENT

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- Pre Treatment of Oily Waste Water is *Critical* to MBRs

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- ◆ Should Consider at least two stage process
- ◆ Must be Robust to Handle Oily Water Upsets/Releases
- ◆ Efficient Oil Removal is Most Important

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The MBR Technology-EQUALIZATION

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- Equalization Systems are Provided to Keep a 'Constant' Flow to the Biological System, and Should Consider:
 - ◆ Average Daily Flow
 - ◆ Daily Peaking Factor
 - ◆ Daily Peaking Duration
 - ◆ Daily Peaking Frequency
 - ◆ Daily Peaking Timing
 - ◆ Waste Strength Fluctuations and Relation to Flow Peaking
 - ◆ Mixing

With this information EQ basins can be designed to dampen flow and waste strength to keep the biological plant operating as consistently as possible.

The MBR Technology-PRESCREENING

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- Pre Screening Systems Include:
 - ◆ 2 mm Perforated Plate Screen for Fiber Removal
 - ◆ Self Cleaning for Low Maintenance
 - ◆ Requires Utility Water for backwashing screen



The MBR Technology-BIOLOGICAL AERATION

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- Because MBR Uses Higher MLSS than Conventional Activated Sludge, Aeration System Design is Altered and must Consider:

Reuse

- ◆ Lower Alpha Factor (O_2 transfer efficiency)-ensure device can deliver OUR Required by Design
- ◆ Lower F:M-can lead to foaming-especially when F:M changes. Equalization is an important consideration
- ◆ Longer SRT-lower sludge production. Internal digestion of sludge must be considered in oxygen demand. Helps in development of diversified bacterial culture to treat slow-to-degrade compounds

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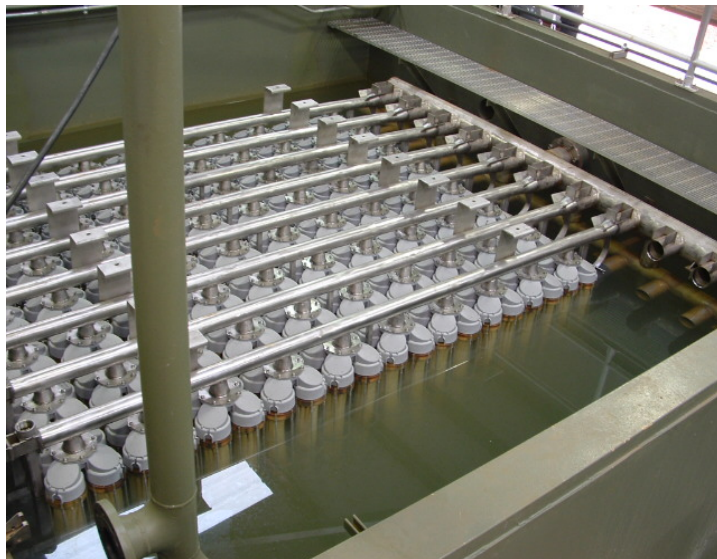
The MBR Technology-MEMBRANE OPERATING SYSTEM



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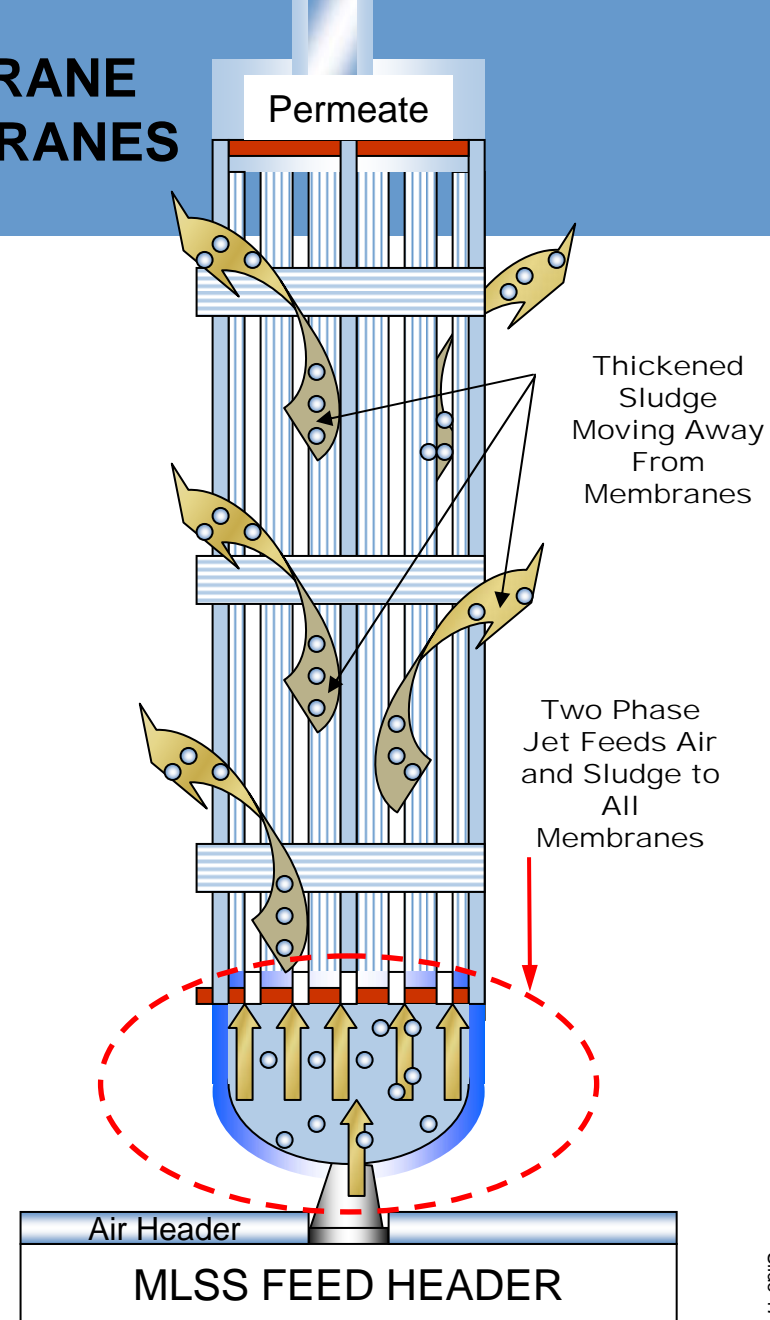
The MBR Technology-MEMBRANE OPERATING SYSTEM-MEMBRANES

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- Most Important: Operational Fouling Rate, Membrane 'Cleanability' and Life Expectancy
 - ◆ Operational control must be such that membrane permeability remains high-Refresh membrane with fresh MLSS
 - ◆ Membrane must be easily cleaned to recover high permeability when needed
 - ◆ Membrane must be robust to endure high agitation and chemical cleaning to offer a 5 year life expectancy





Summary

Driver

- The Main Driver for Membrane BioReactor Treatment is REUSE of Water for:

Reuse

- ◆ Irrigation Water
- ◆ Cooling Tower Make Up
- ◆ RO Pretreatment for Boiler Feed Water

Technology

- MBR Systems Should Address:
 - ◆ Pre Treatment
 - ◆ Screening
 - ◆ Aeration system Special Design Considerations
 - ◆ Membrane Operating Systems
 - Long Life
 - Membranes that Clean Easily
 - Renew Fresh Sludge to Membranes

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Thank you very much for your attention.

Questions?

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