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Siemens Water Technology Corp. Biological Products Overview Riyadh, KSA, June 19, 2007

Julian Pauwels

Regional Sales Manager

Siemens Water Technology

Water Technologies

Agenda

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USFilter/Siemens

- Product Portfolio

Process Overview

- Aerated Anoxic Process.

Products

- Orbal/Verticel (Hybrid Aeration)
- Rim-Flo/Tow-Bro (High Rate Clarification)
- Cannibal
- Spider Disc Filter.

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Hi-Speed Overview BioClar Products

RBC Process Applications

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- Organic removal
- Nitrification
- Denitrification
- Tertiary Applications

Envirex RBC
Self Supported Media Type

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The Orbal™ Process

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Vertical Loop Reactor

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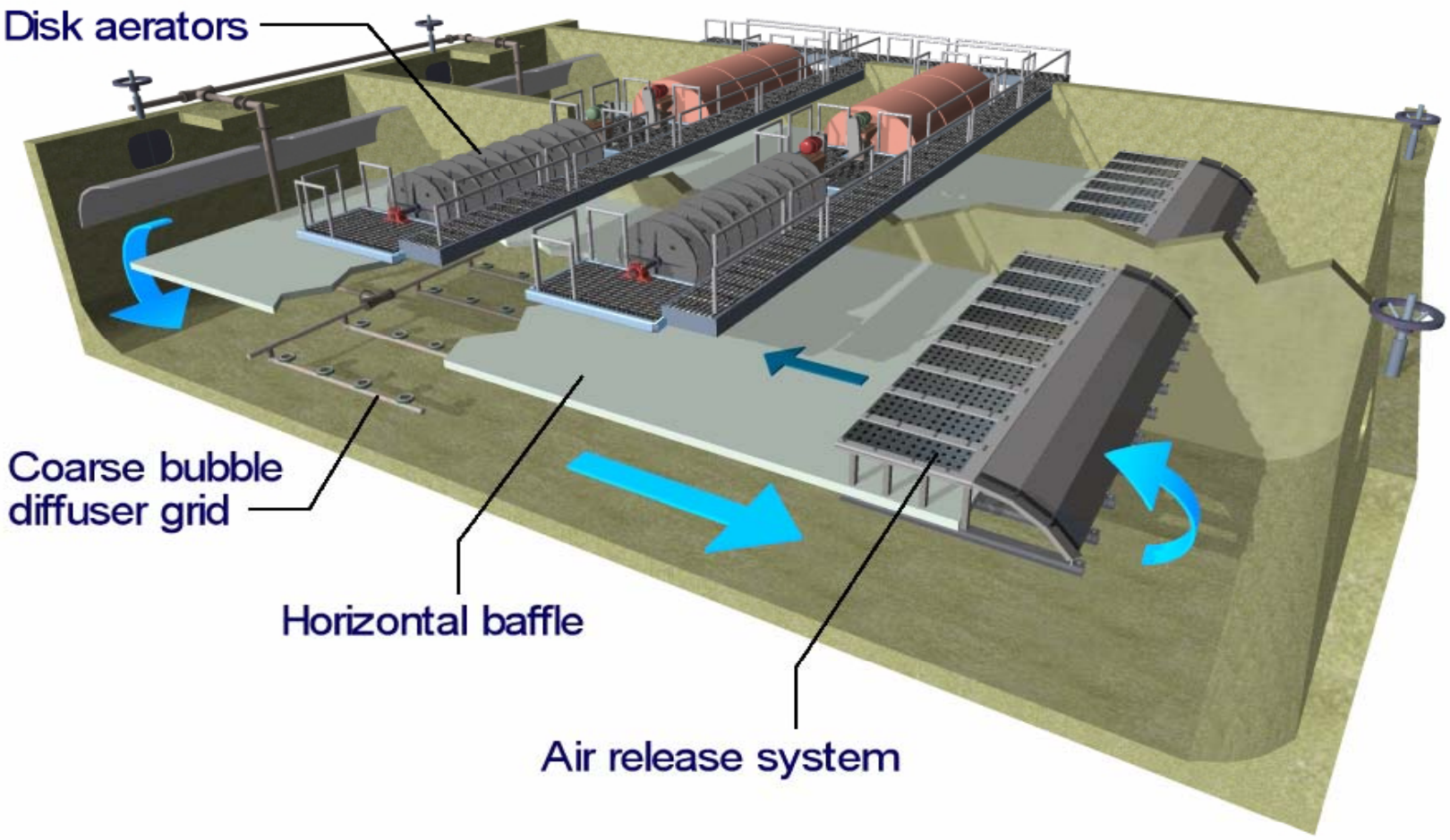

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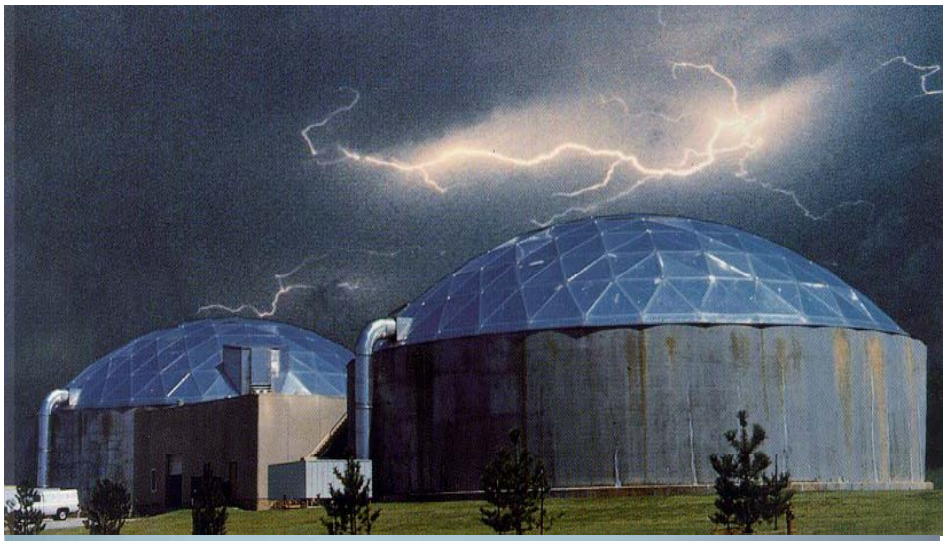
SBR's



Aqua-Lator® DDM Mixers
Nutrient Removal System with Cable Mooring

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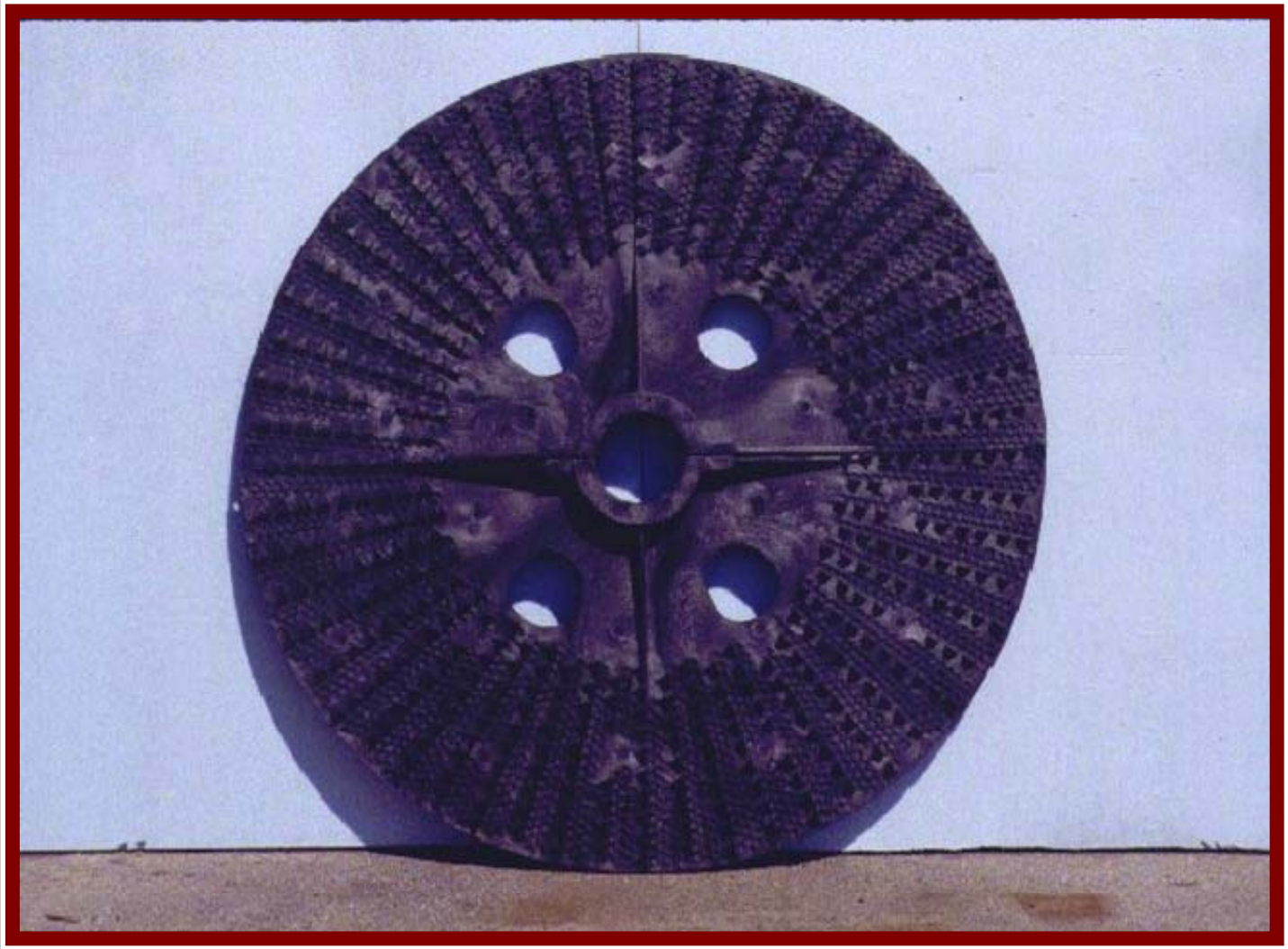

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Activated Sludge Process
Aeration Devices

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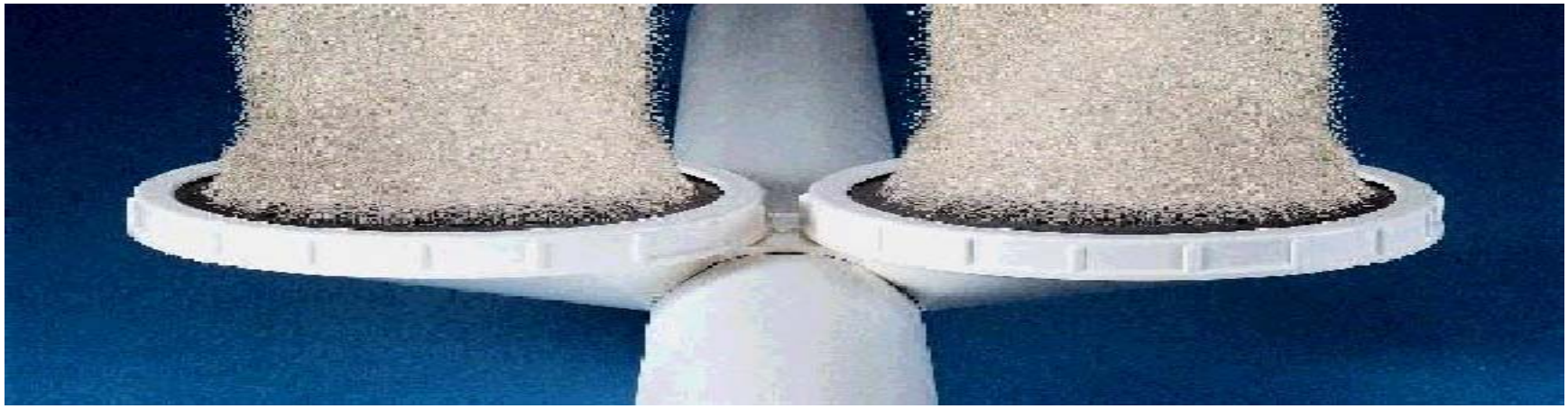
DualAir Membrane & Ceramic Diffuser



- Patented dual base design doubles number of diffusers available per 20’ of air header. As compared to competition
- System costs reduced with fewer headers, pipe supports, piping connections, lower shipping costs, and less installation time
- DualAir’s flexible design allows use of membrane or ceramic media

Activated Sludge Process
Aeration Devices

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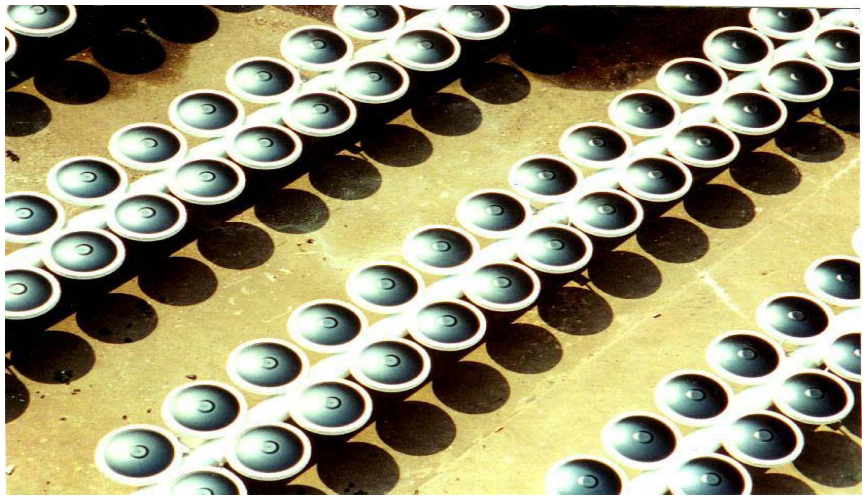
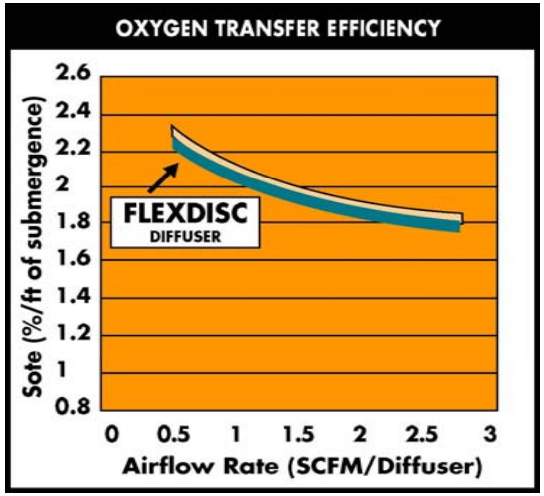
DualAir's Simple Installation

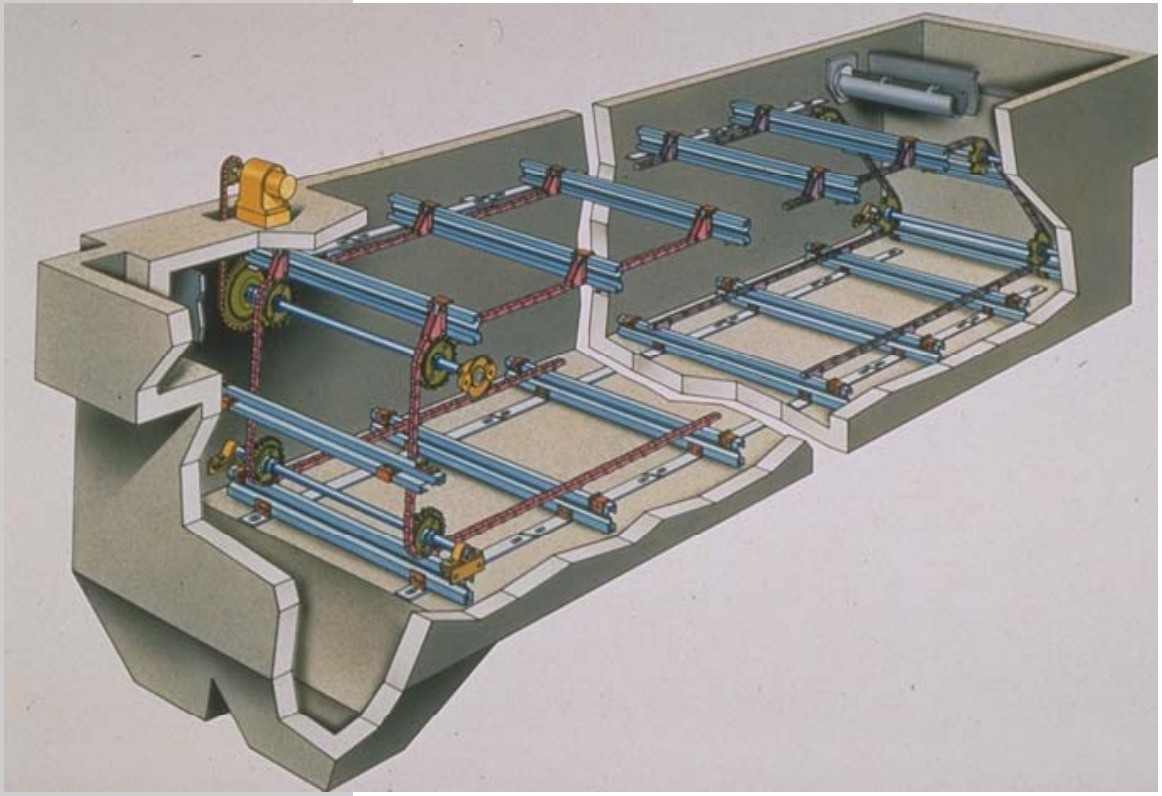
Typical installation



Excellent oxygen transfer



Rectangular Sludge Collectors



Applications

Primary and Secondary Clarifiers for WW

- **Water Treatment**
- **Industrial**
  - **DAF**
  - **API**

Purpose

- **Scrapes settled sludge to influent end**
- **Skims fats, oils, and greases to effluent end of tank**

Advantages of Rectangular Collectors

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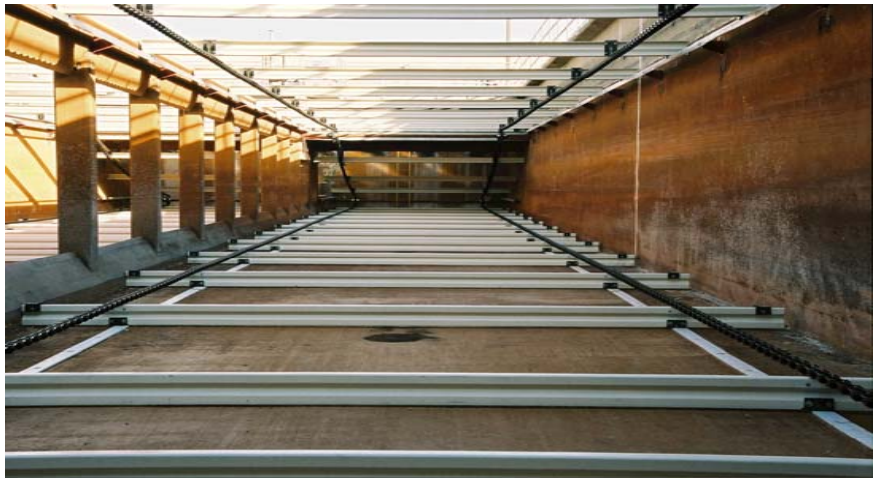

- Predictable performance
- Easy to maintain
- Easier to remove scum and floating solids than circular collectors
- Best suited for large and small capacity plants
- Common wall construction when many tanks are required
- Compact design for small tanks

RIM-FLO Tow-Bro Design

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Spider™ Disc Filter

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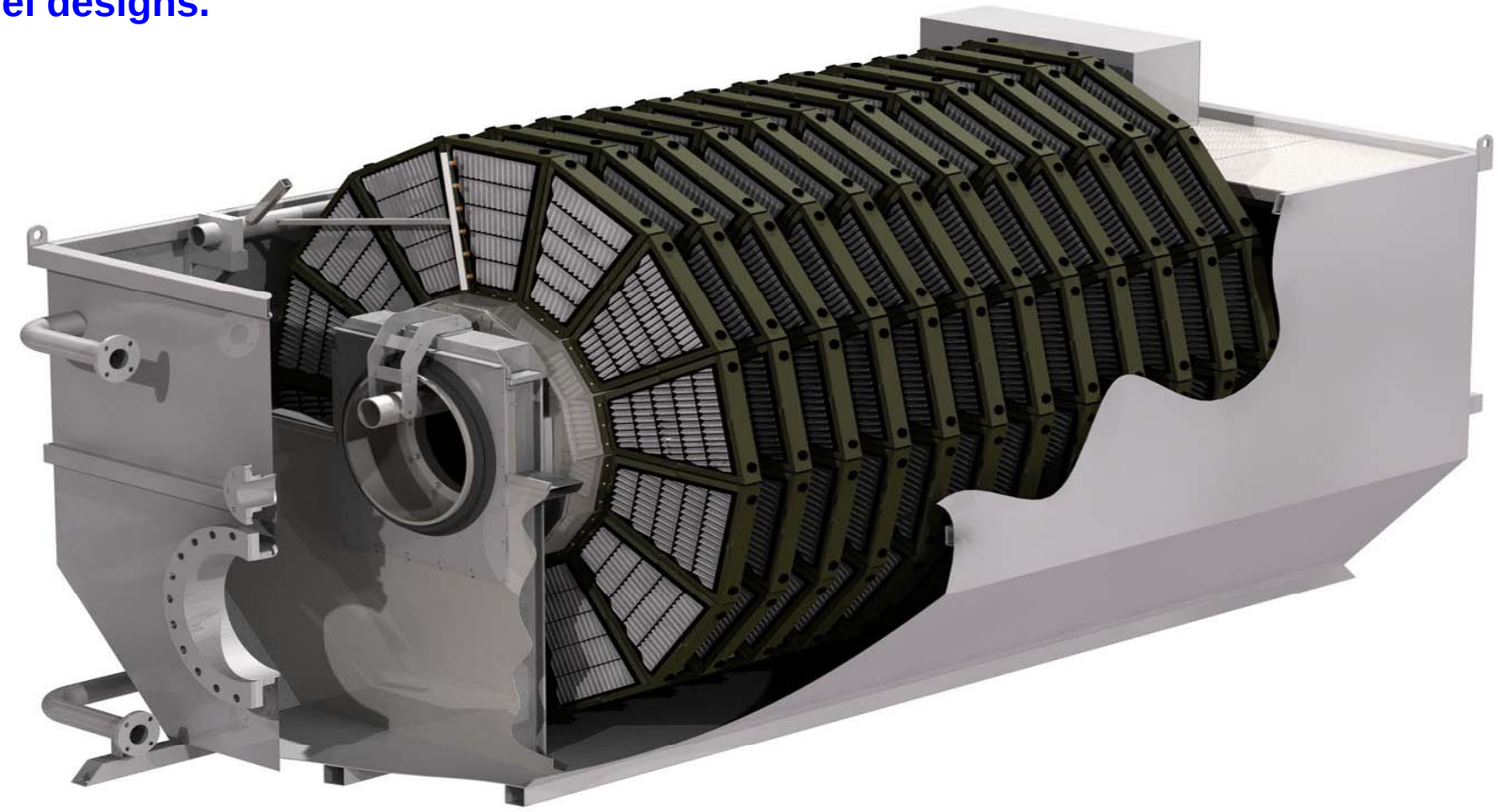
Innovation: Pleated disc panel design allows for 40% more filtration area than flat panel designs.



Cannibal Process Flowsheet

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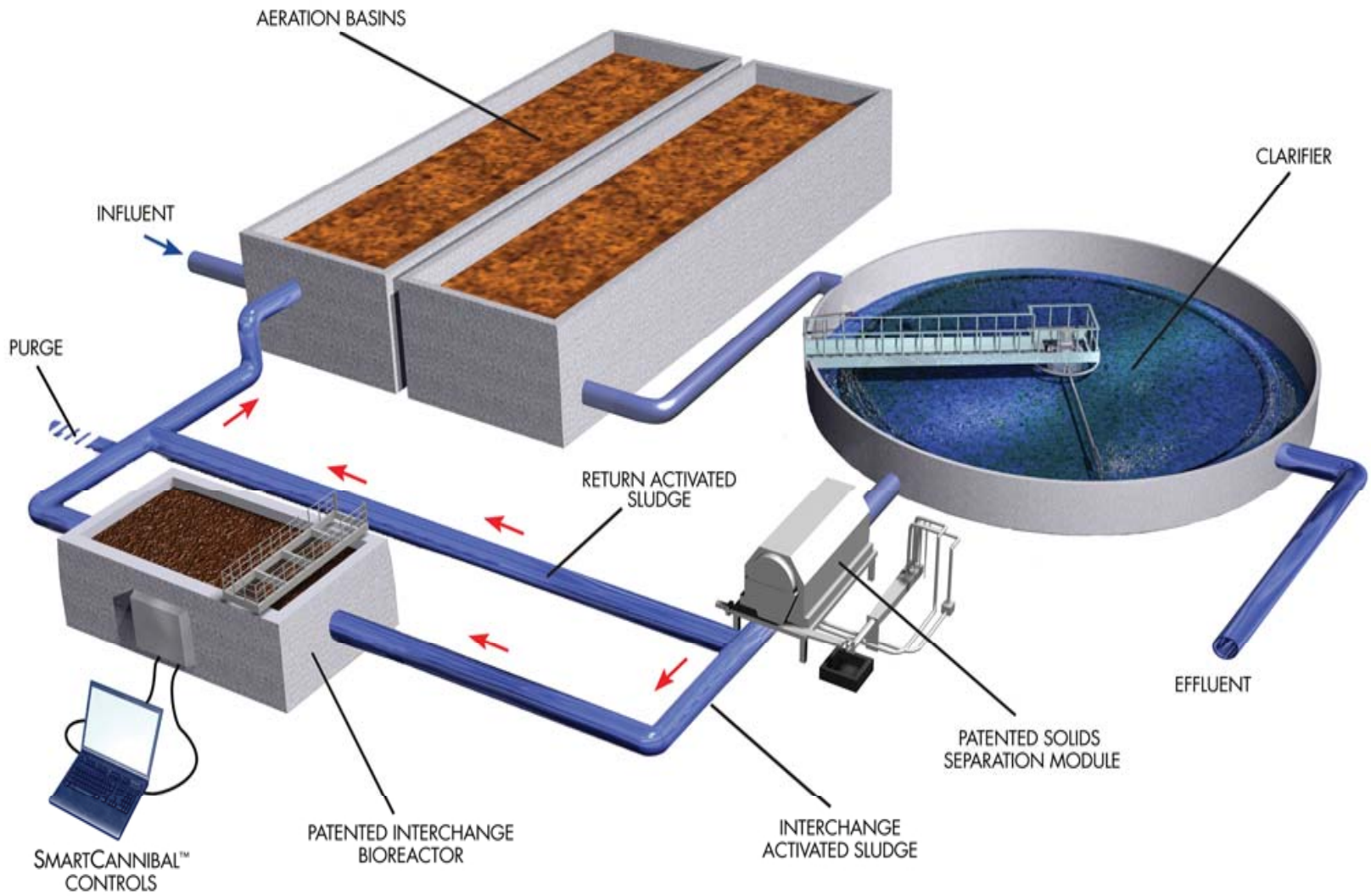

How Much Sludge Reduction to Expect?

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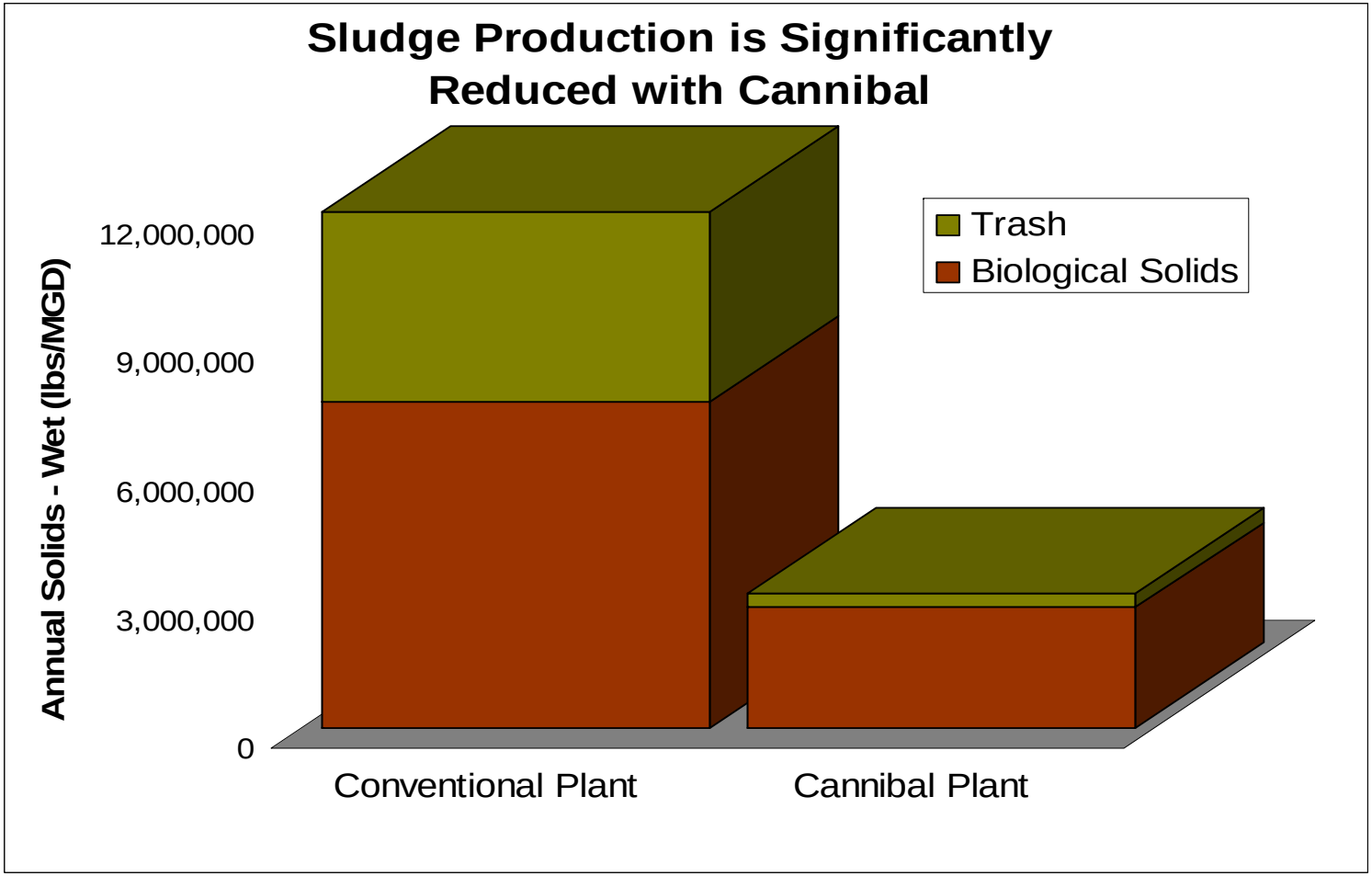

Assumptions: Conventional yield of 0.75 plus 35% VSS reduction, Cannibal Yield of 0.125, Cannibal Trash Removed at 40% solids, Liquid Hauling

Process Overview

Nitrogen Removal Processes
Modified Ludzack-Ettinger Process

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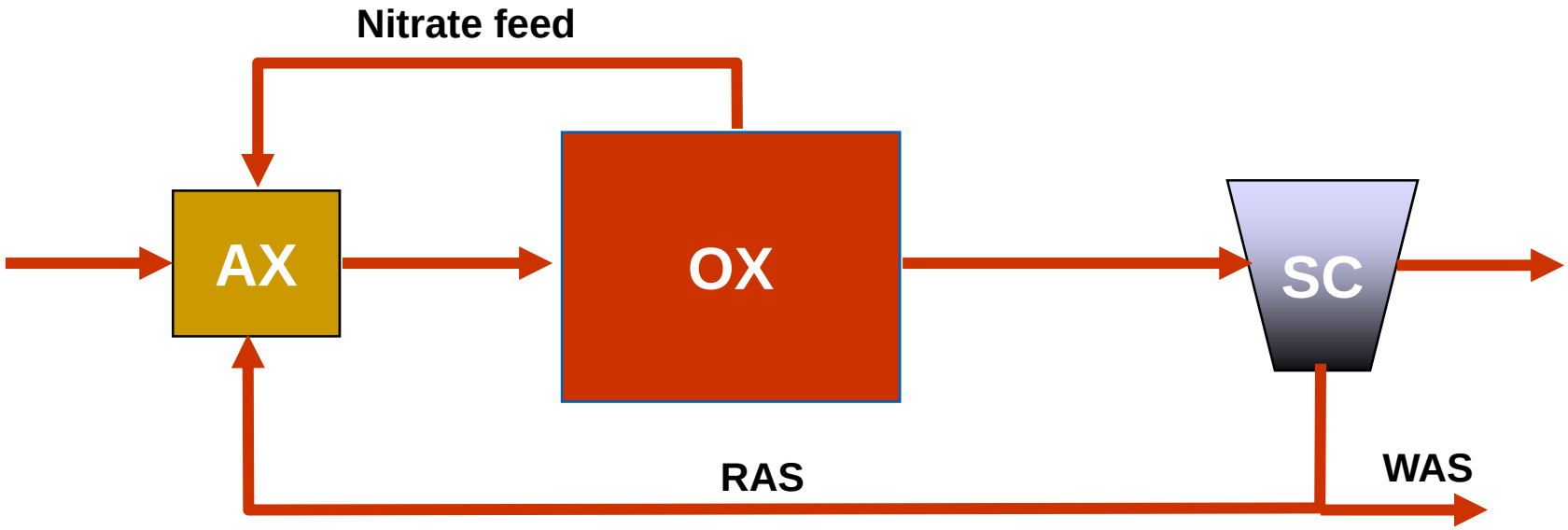
AX = anoxic OX = aerobic SC = Clarifier



Nitrogen removed is dependent upon:

- Detention Time
- MLVSS Concentration
- Internal Recycle rate and return sludge flow
- Influent BOD and biodegradable COD
- Temperature

Phosphorus + Nitrogen Removal Processes
Five-Stage BNR Process

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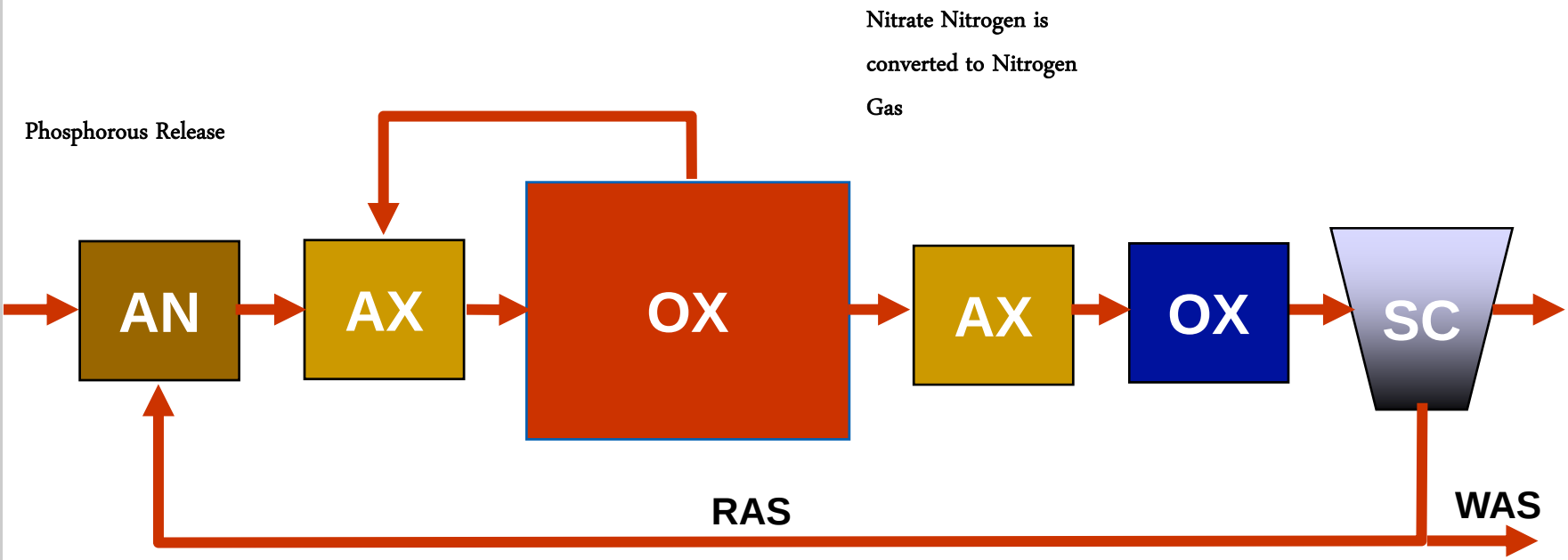

AN = Anaerobic AX = anoxic OX = aerobic SC = Clarifier

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Aerated-Anoxic Nitrification/Denitrification

Aerated Anoxic Reactors

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Definition

- **Biological reactor with a constant oxygen deficit condition**
- **Oxygen supplied should be less than the demand**
- **Suppled oxygen includes oxygen recovered through denitrification**

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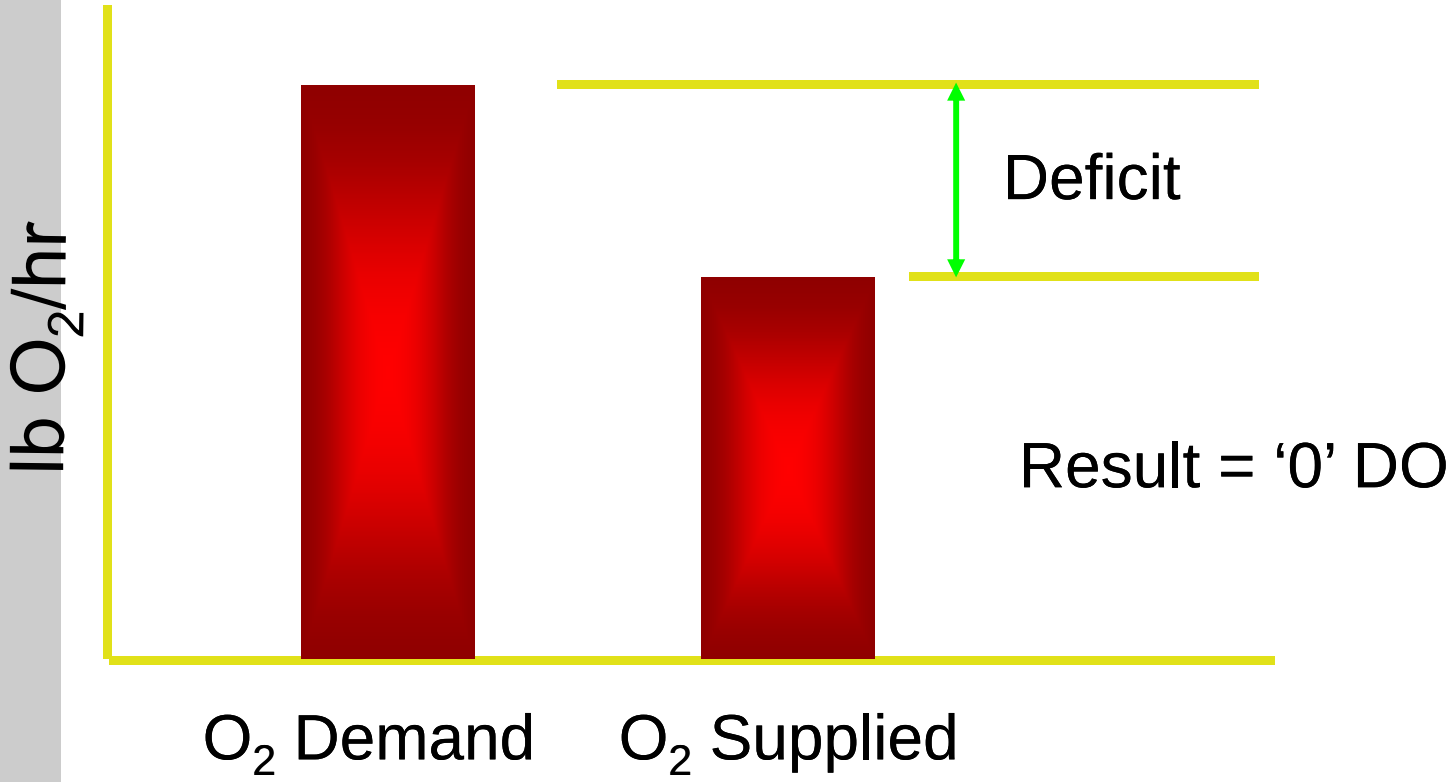
Deficit Condition



O_2 Supplied < 75% of O_2 Demand

Biological Nitrogen Removal Processes

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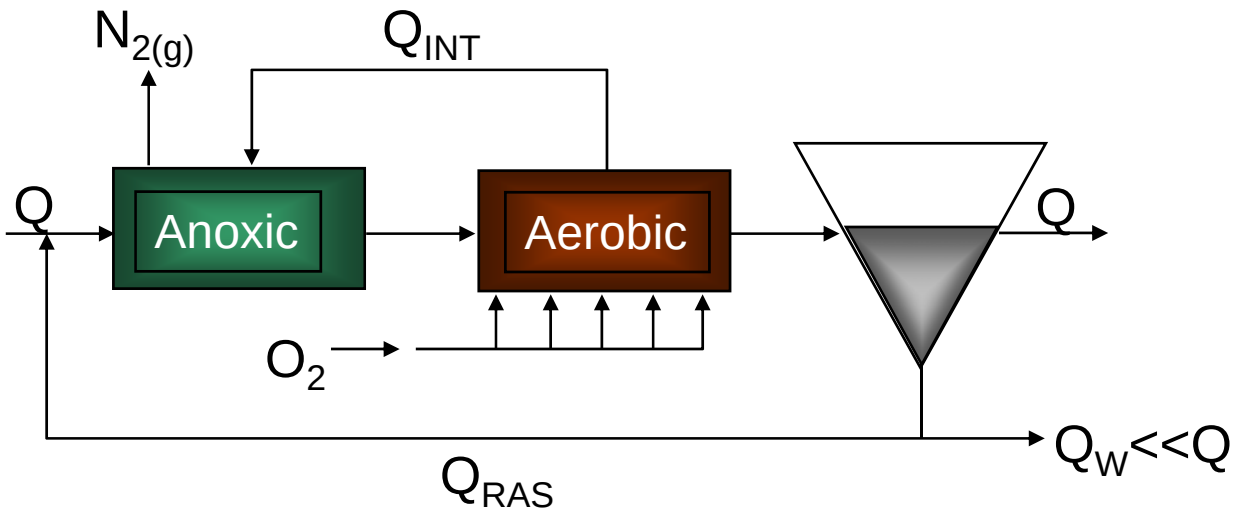
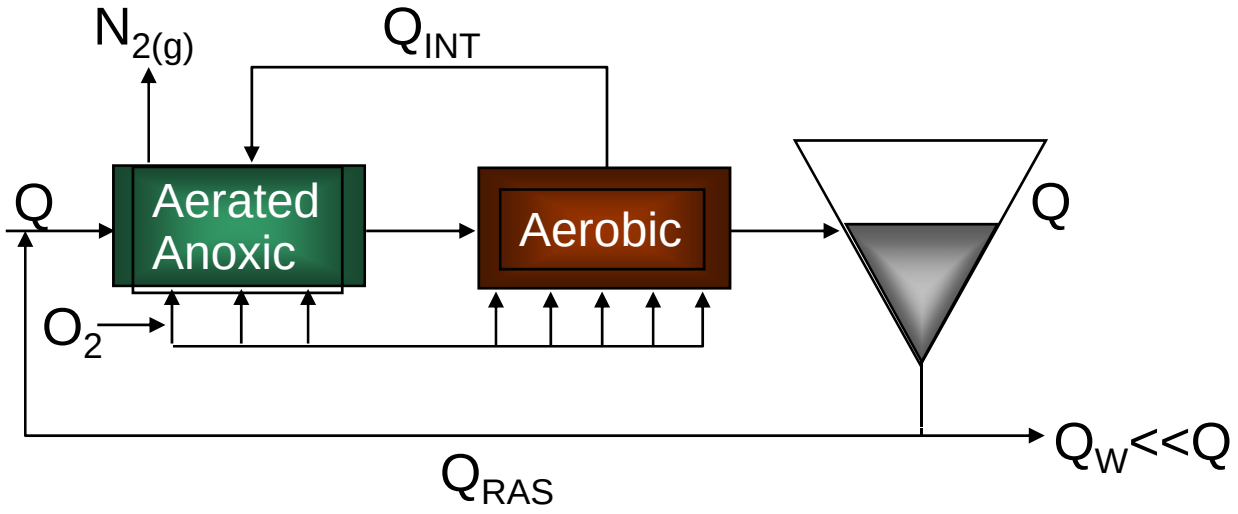
a)



b)



DO Profile in Orbal

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Total Nitrogen Removal Comparison

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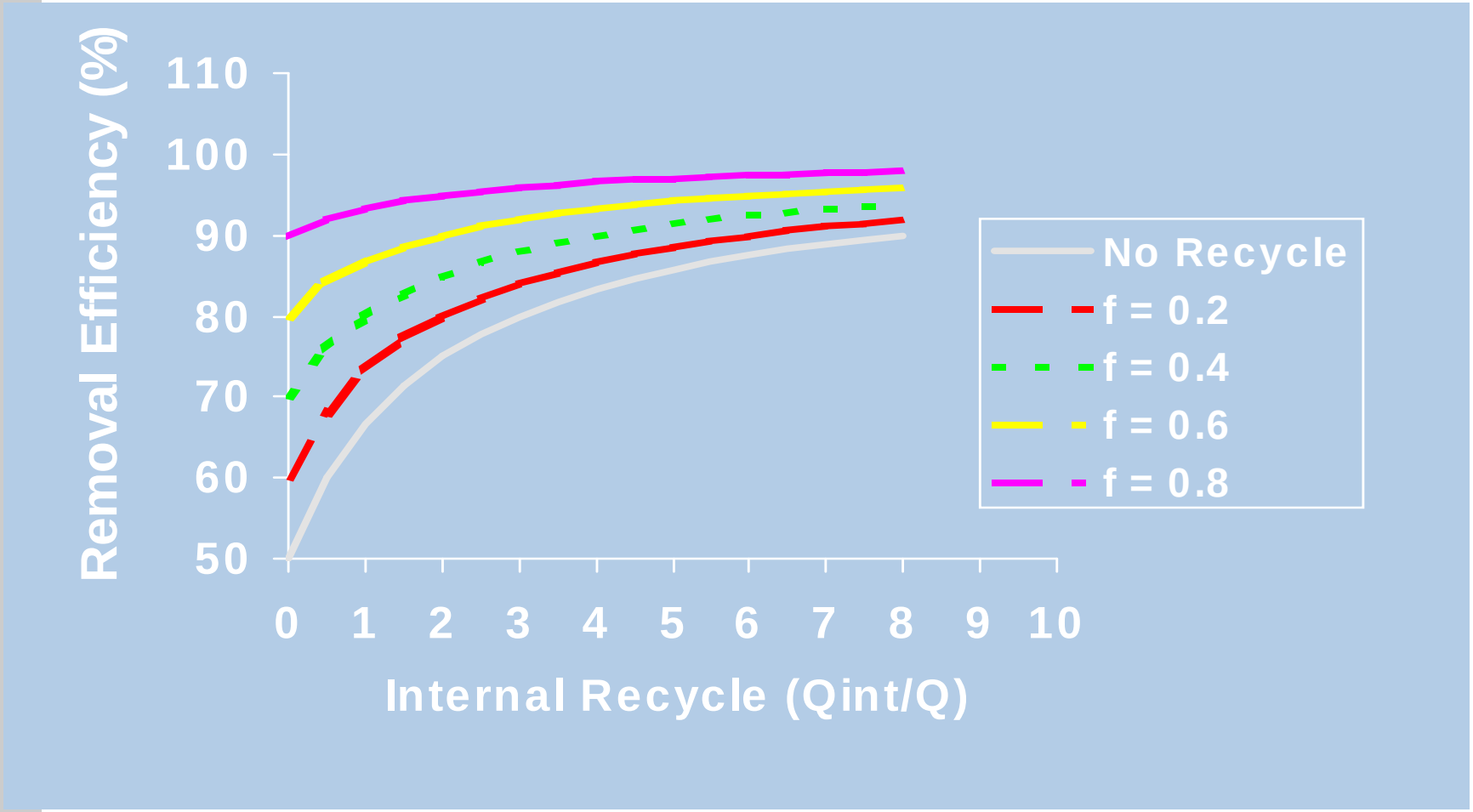

Note: 100% RAS
f = fraction aerated-anoxic stage nitrification

Evidence

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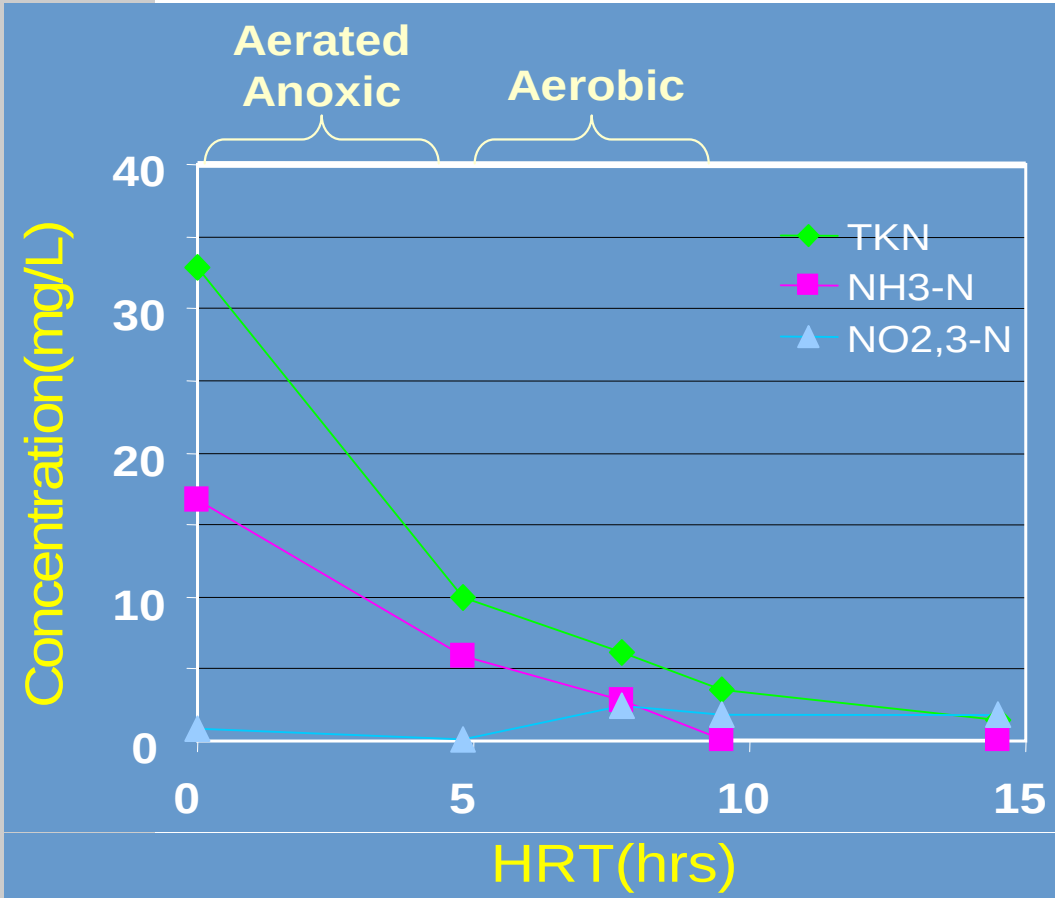
- Over 30 years of Orbal field results
- Huntsville, TX Studies (Applegate, et. al.)
- Silver Lake results
- Rutgers University studies
- University of Wisconsin studies

Low-DO Nitrification



- 50 ~ 80% of the total nitrification occurs under non-detectable DO levels (Applegate *et al*., 1980; Diagger and Littleton, 2000; Park *et al*., 2001)

The Marshall WWTP

Low-DO Nitrification – University of Wisconsin Studies

The Marshall WWTP (Marshall, WI)

Microbial Ecology Comparison

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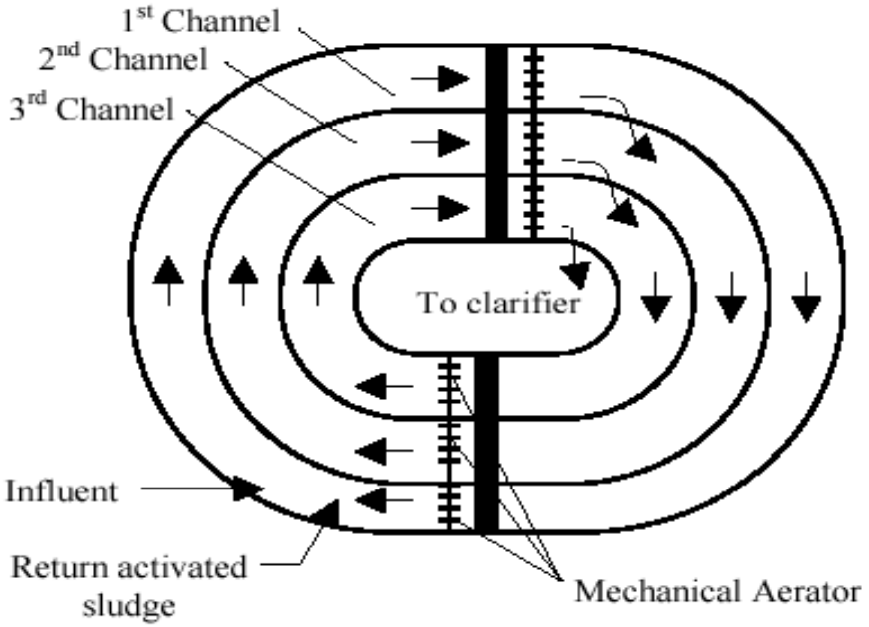
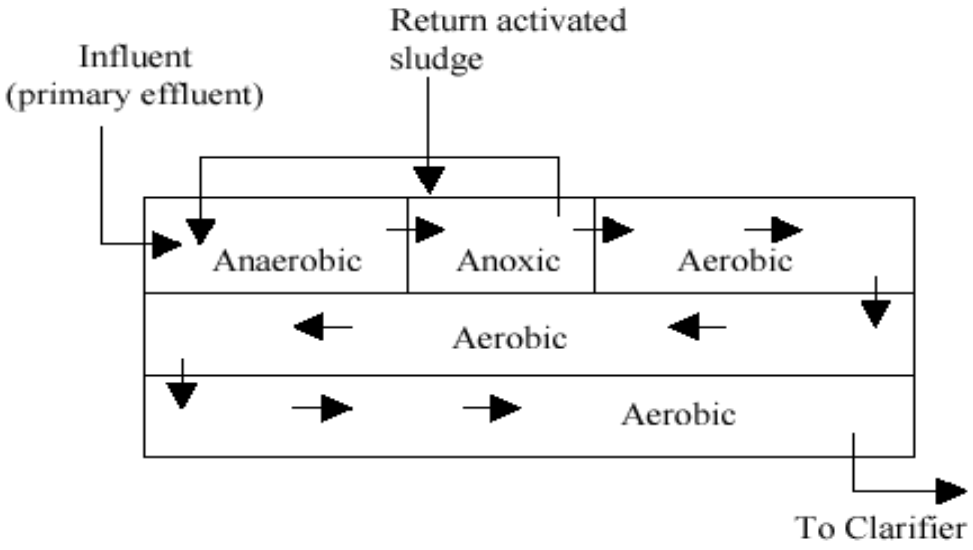


(a) Marshall WWTP



(b) Nine Springs WWTP

Aerated-anoxic Orbal process

Modified UCT process

Courtesy of Hee Deung Park

Nitrogen Profile

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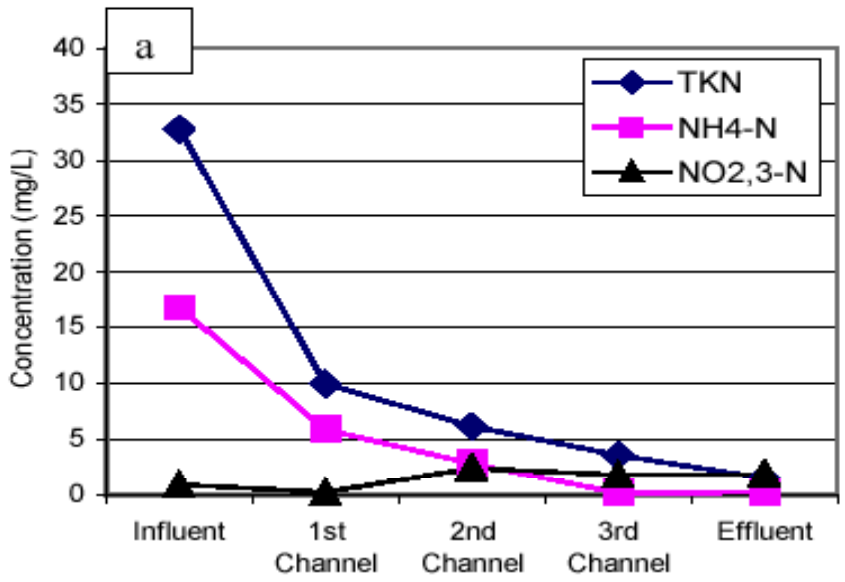
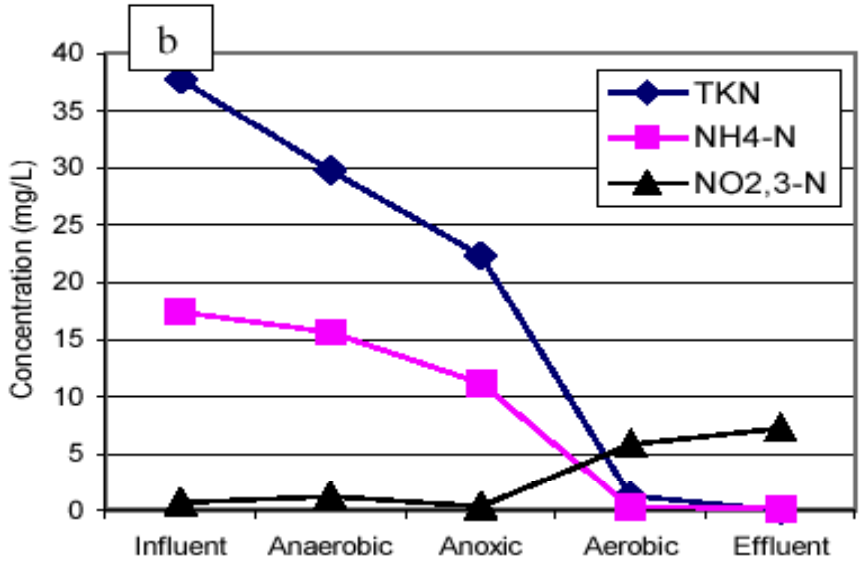


Aerated-anoxic Orbal process



Modified UCT process

Courtesy of Hee Deung Park

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Products Overview

Orbal

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The Orbal™ Process

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Three Channel Orbal

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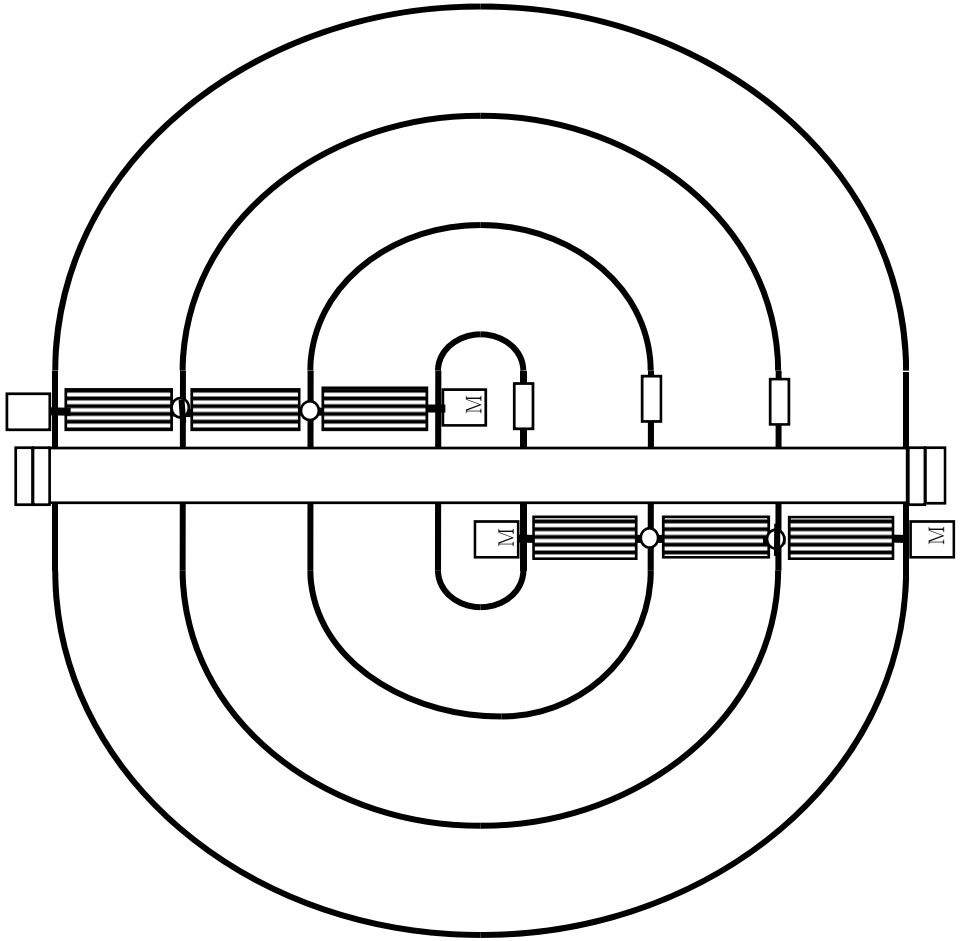

5 mg/l BOD (w/filters)

5 mg/l TSS (w/filters)

80% Total-N removal

- No lower than 10 mg/l

1 mg/l P

SmartBNR & Tow-Bro for Process Warranty

Three Channel Orbal with Internal MLSS Recycle

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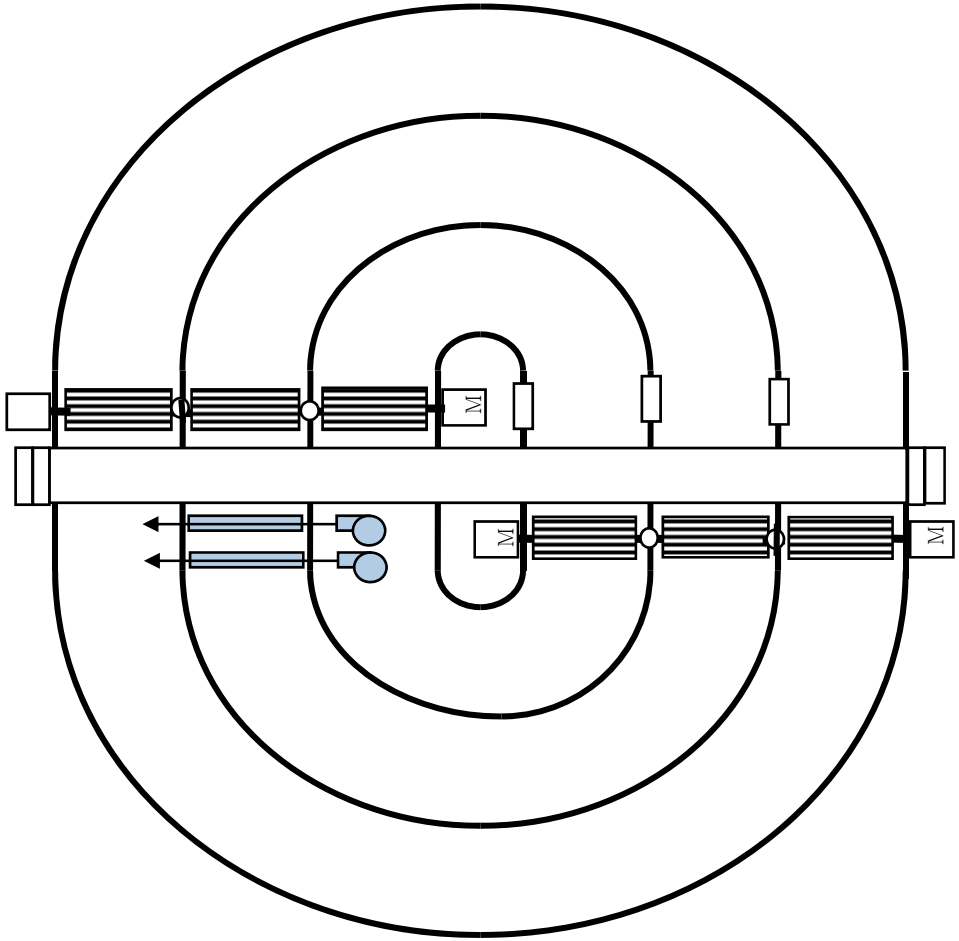
5 mg/l BOD (w/filters)

5 mg/l TSS (w/filters)

5 mg/l Total-N

SmartBNR & Tow-Bro for Process Warranty

Includes Aerators & Wall Pumps



Three Channel Orbal

Anaerobic Selector, Internal Recycle, Second Anoxic & Reaeration

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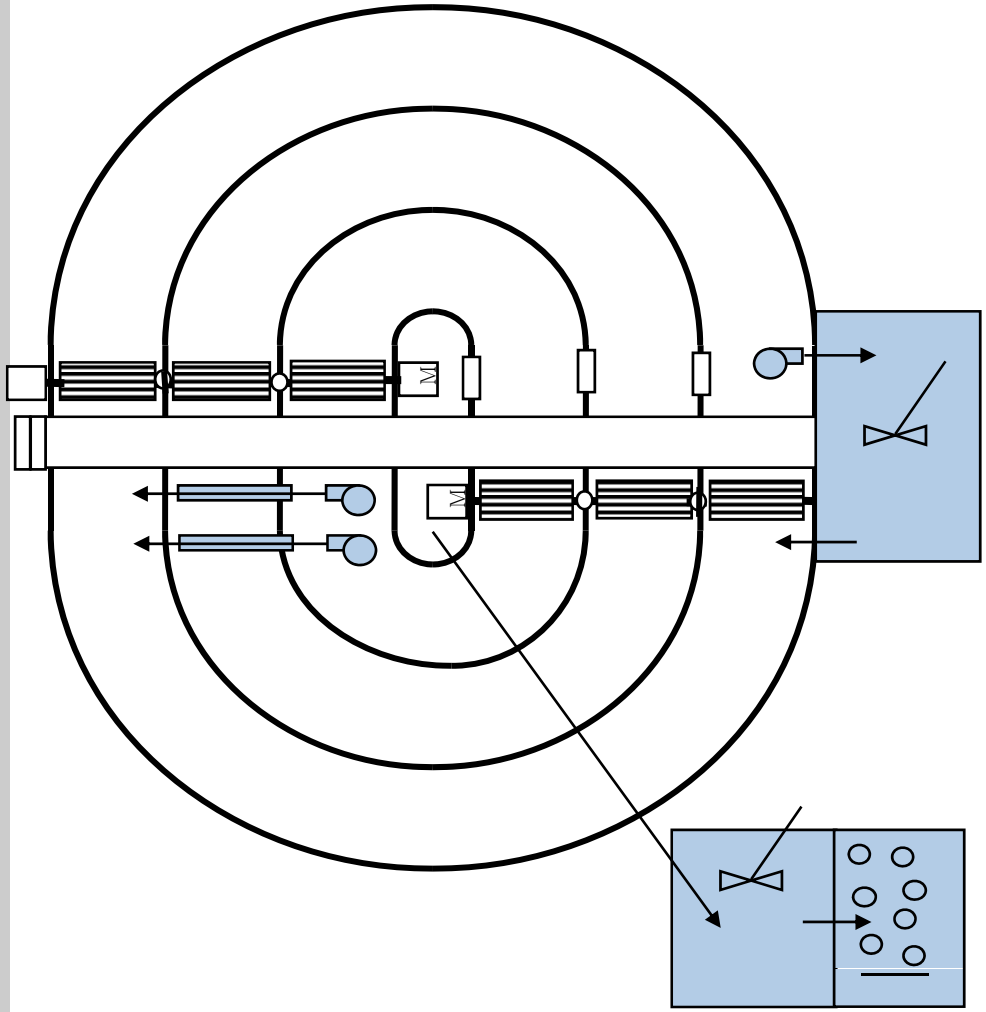

5 mg/l BOD (w/filters)

5 mg/l TSS (w/filters)

3 mg/l Total-N

1 mg/l P

SmartBNR & Tow-Bro for Process Warranty

Includes Aerators, Wall Pumps, Mixers & Aerator for Reaeration (either coarse bubble or floating aerator)

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Activated Sludge Systems

VLR/Verticel

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Vertical Loop Reactor

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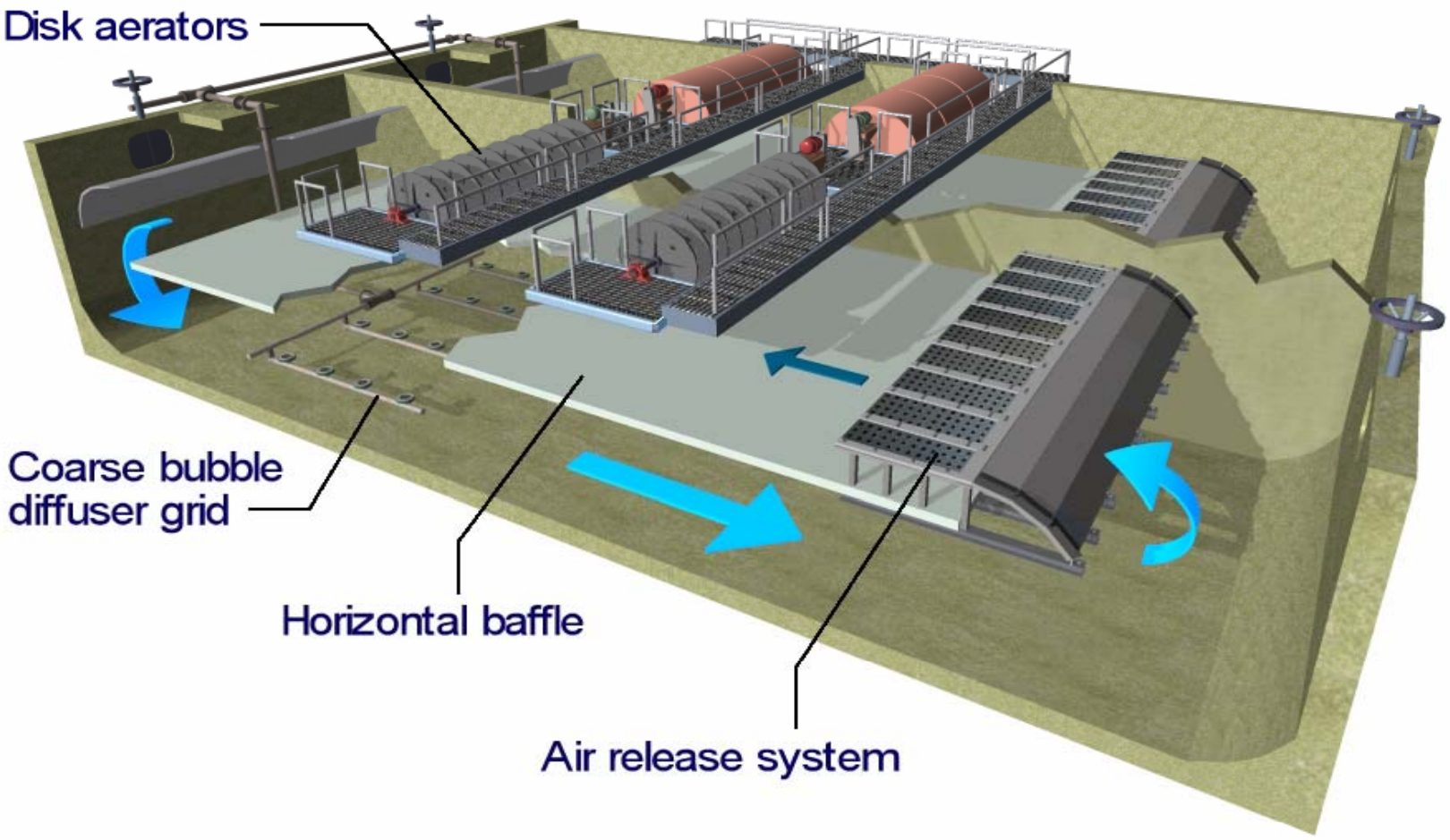

VertiCel System

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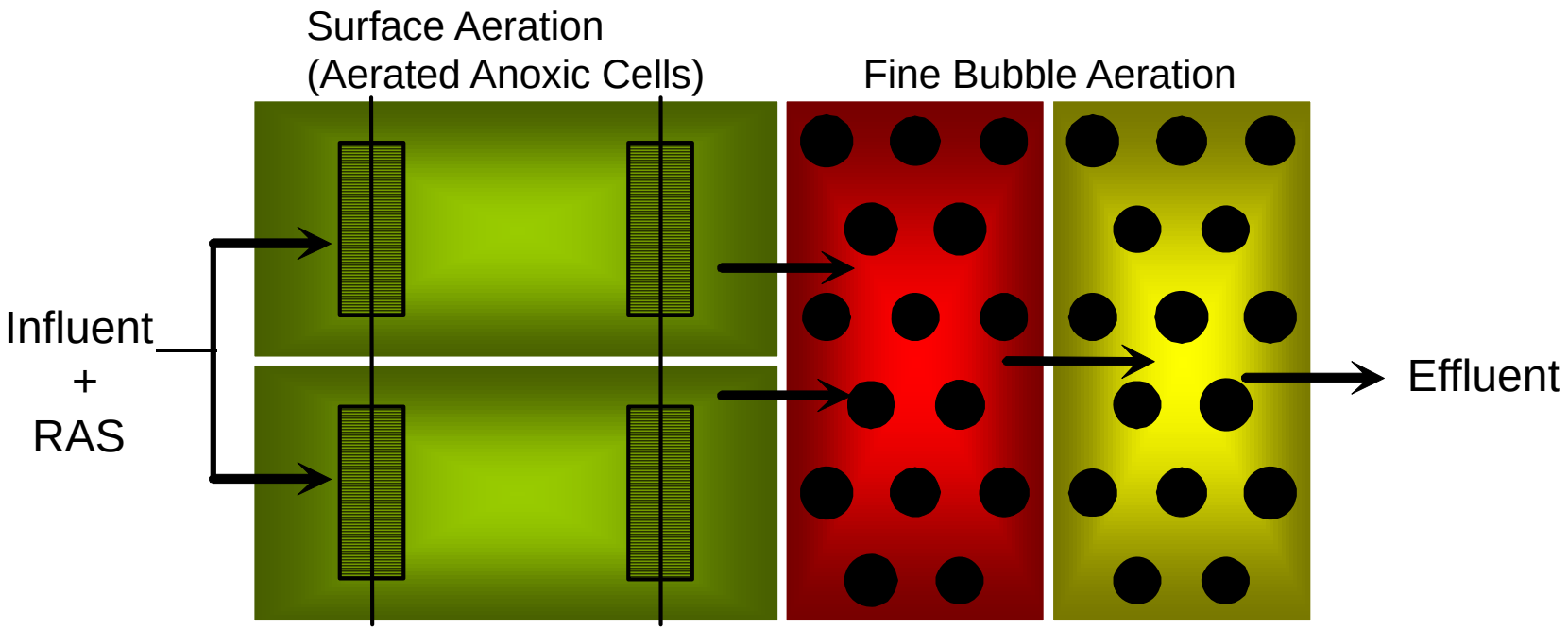

Vertical Loop Reactor

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VertiCel System

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Stormflow Mode Example - VLR Plant in Brookfield, OH

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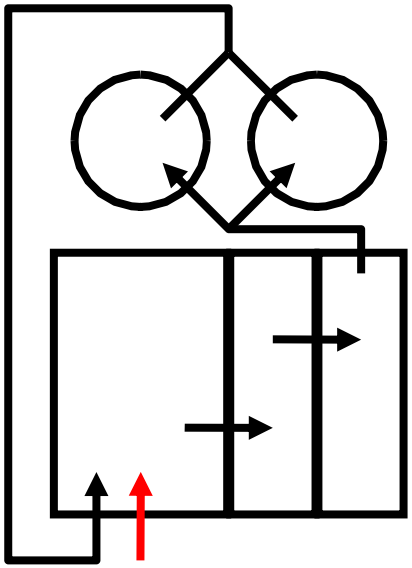
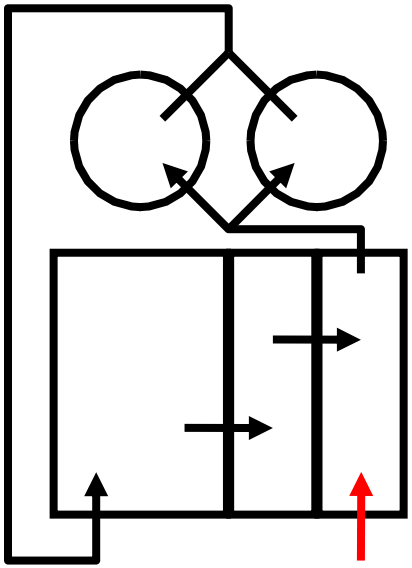
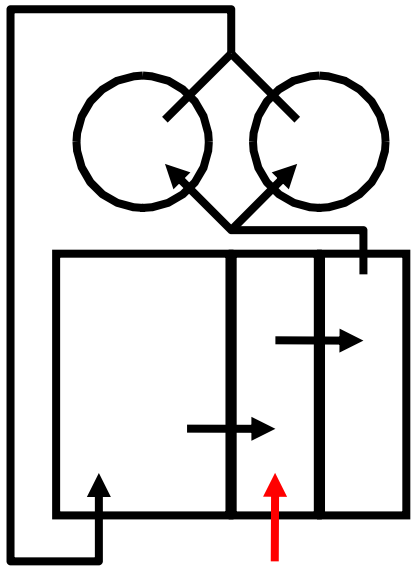


A = Normal



B = influent to VLR#3



C = Influent to VLR#2

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The Design of a Hybrid Aeration System for the Gills Creek Wastewater Treatment Plant Columbia, SC

George W. Smith, USFilter Envirex Products
William H. Davis, B.P. Barber & Associates

Water Technologies

VertiCel System

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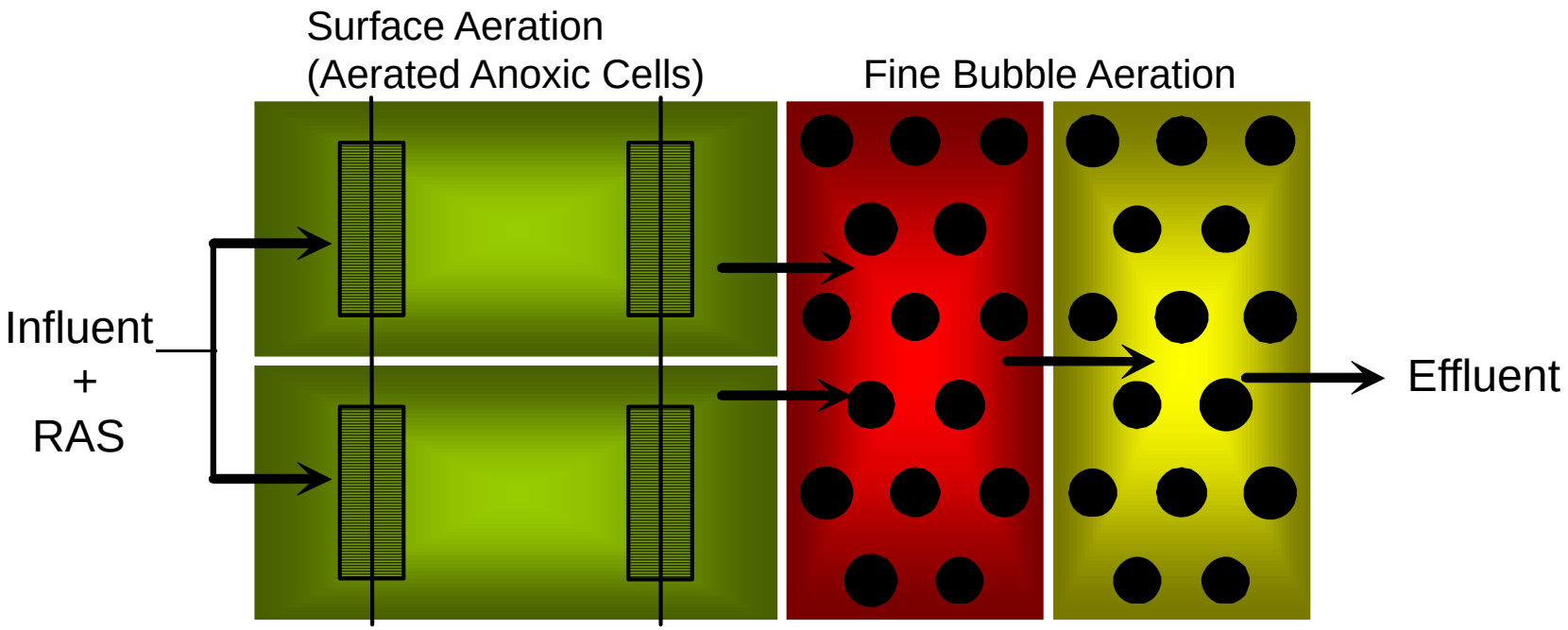
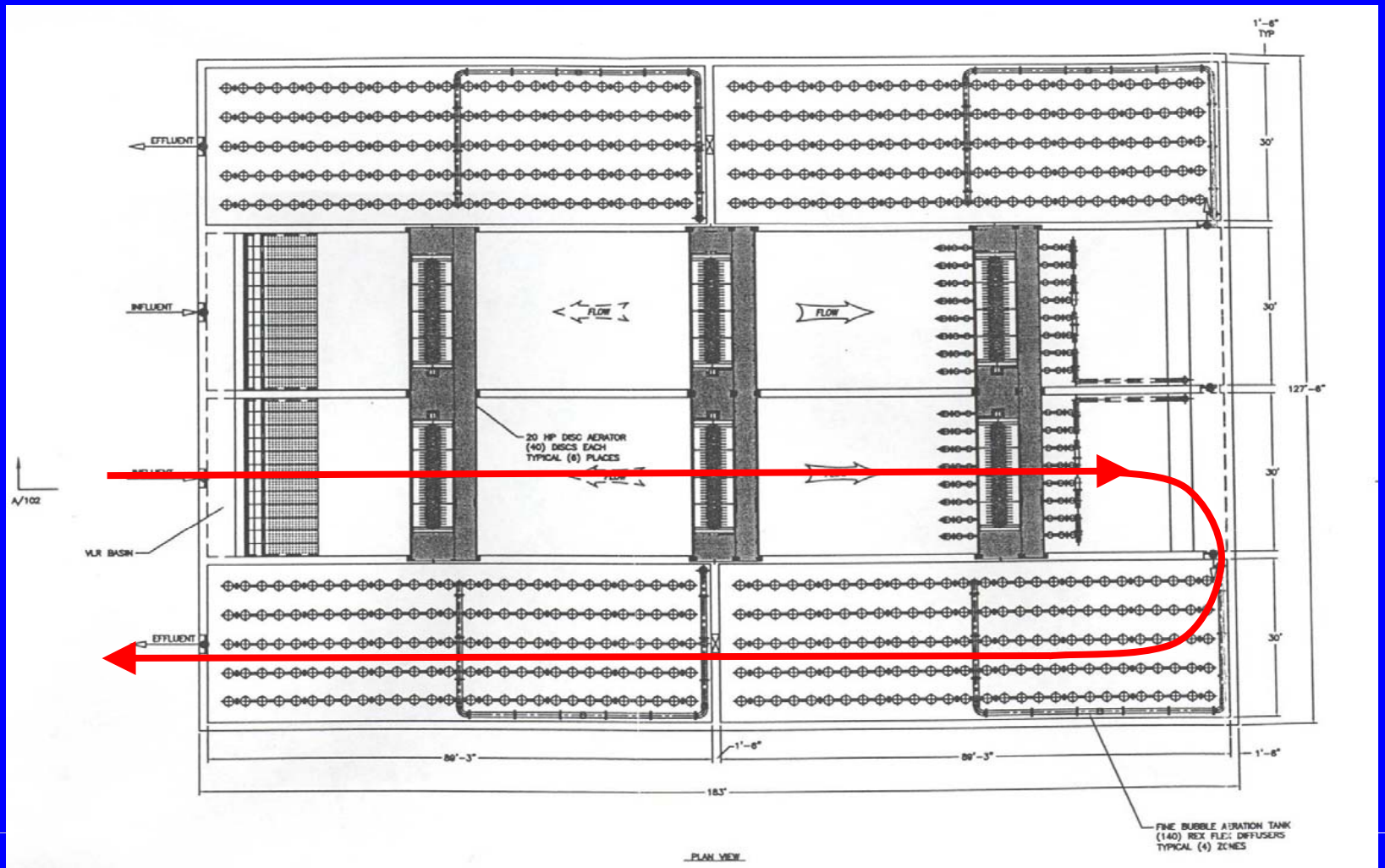


VLR & Fine Bubble Tanks



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Hybrid Aeration Design for Gills Creek

Design Parameters for Gills Creek Aeration System

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Influent Flow @ 61,000 m^3/day and 250 mg/l BOD

BOD loading: .56 kg/m^3

MLSS @ 4500 mg/l

Solids under aeration @ 121,500 kg

Waste Sludge @ 13,500 kg/day

Sludge Age @ 9 days

Comparison of Power

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Conventional Fine Bubble @ 547 kW

Hybrid Aeration @ 385 kW

Conventional Fine Bubble is 42% higher than Hybrid Aeration

New Aeration Basins Under Construction

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VLR Tanks Under Construction

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Tanks Under Construction

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End Wall of VLR

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Site View

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Site View

SIEMENS

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Introduction of the High Rate Clarification System Rim-Flo/Tow-Bro

George W. Smith, USFilter Envirex Products
William H. Davis, B.P. Barber & Associates

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Process and Operation – Sludge Removal

1. Rapid Sludge Removal
2. Minimum Sludge Agitation
3. Operation Flexibility
4. Balanced Sludge Removal
5. Maximum Solids Concentration
6. Thickening Capability
7. Density Dissipation

Clarifier Designs for Activated Sludge Removal

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- Conventional Scraper Type
- Spiral Scraper Type
- Riser Pipe Hydraulic Sludge Removal
- Uni-Tube Header Hydraulic Sludge Removal

- Center Siphon Feed
- Peripheral Feed

Pier Supported Secondary Clarifiers
Conventional Scraper Type

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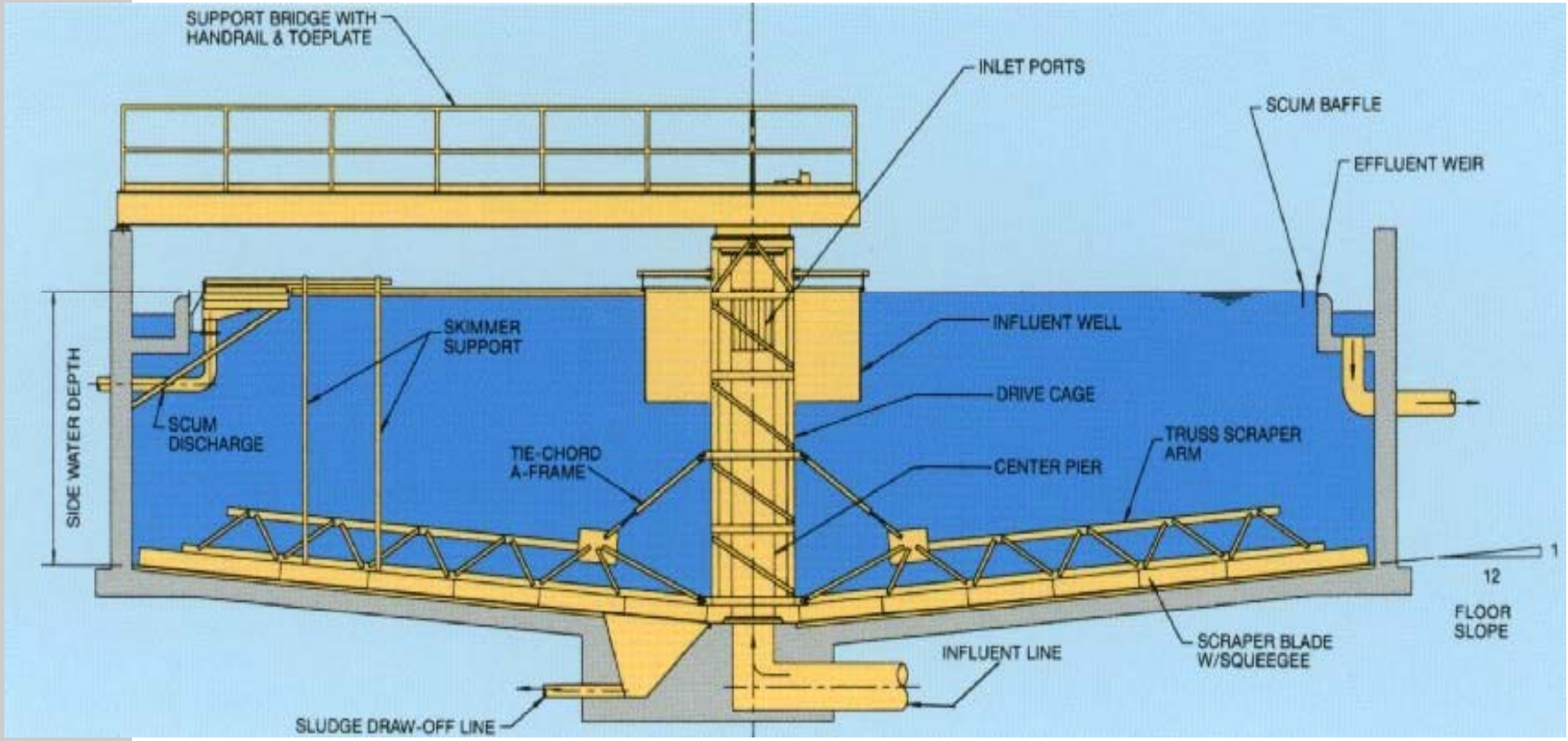

Process and Operation – Sludge Removal Scraper Design

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1. ~~Rapid Sludge Removal~~
2. ~~Minimum Sludge Agitation~~
3. ~~Operation Flexibility~~
4. ~~Balanced Sludge Removal~~
5. ~~Maximum Solids Concentration~~
6. Thickening Capability
7. Density Dissipation

Spiral Scraper Type Clarifiers

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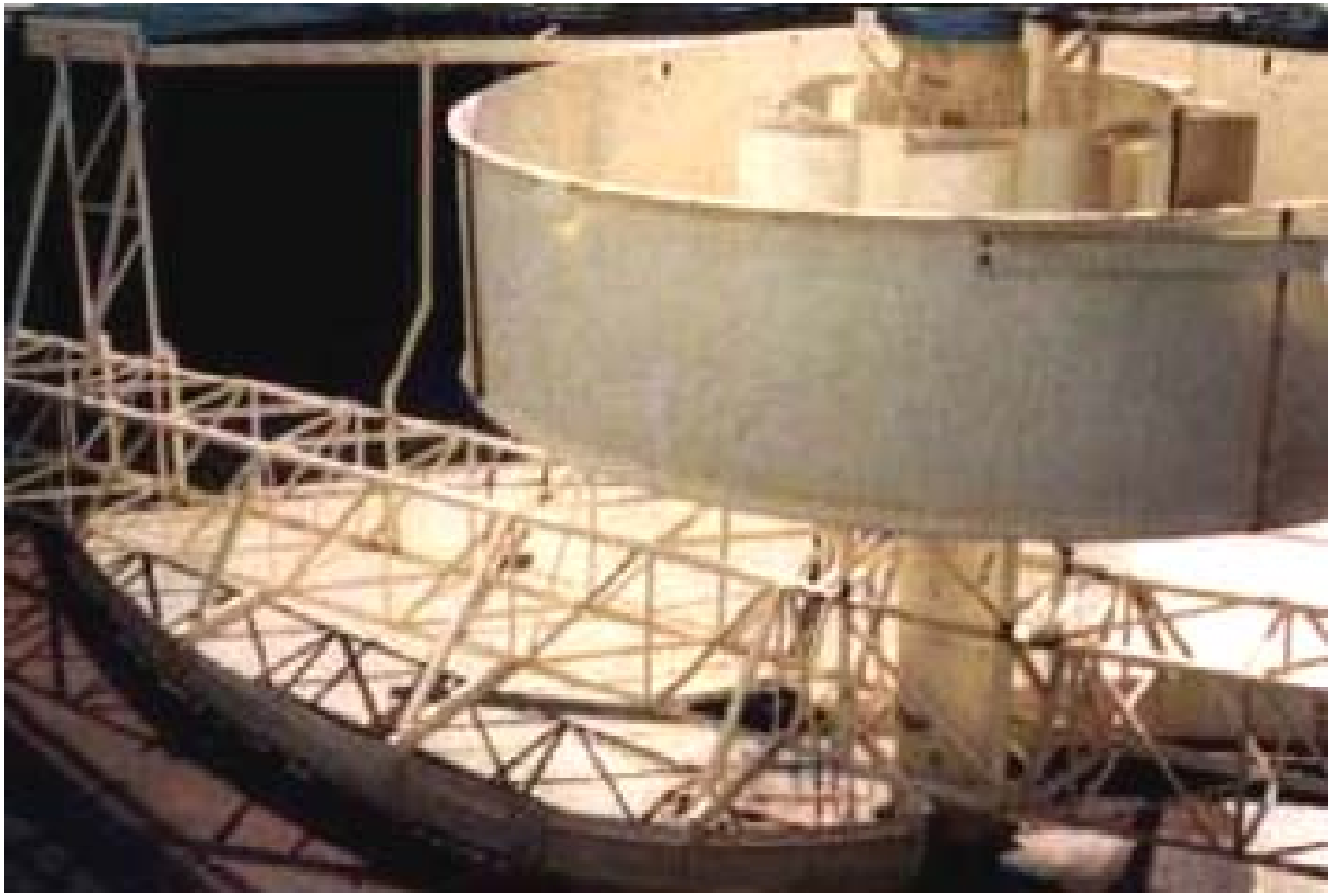

Spiral Scraper Clarifier w/ Sludge Ring

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Process and Operation – Sludge Removal
Spiral Scraper Design

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1. ~~Rapid Sludge Removal~~
2. ~~Minimum Sludge Agitation~~
3. ~~Operation Flexibility~~
4. ~~Balanced Sludge Removal~~
5. ~~Maximum Solids Concentration~~
6. Thickening Capability
7. Density Dissipation

Riser Pipe Hydraulic Sludge Removal
RSR – Rapid Sludge Removal

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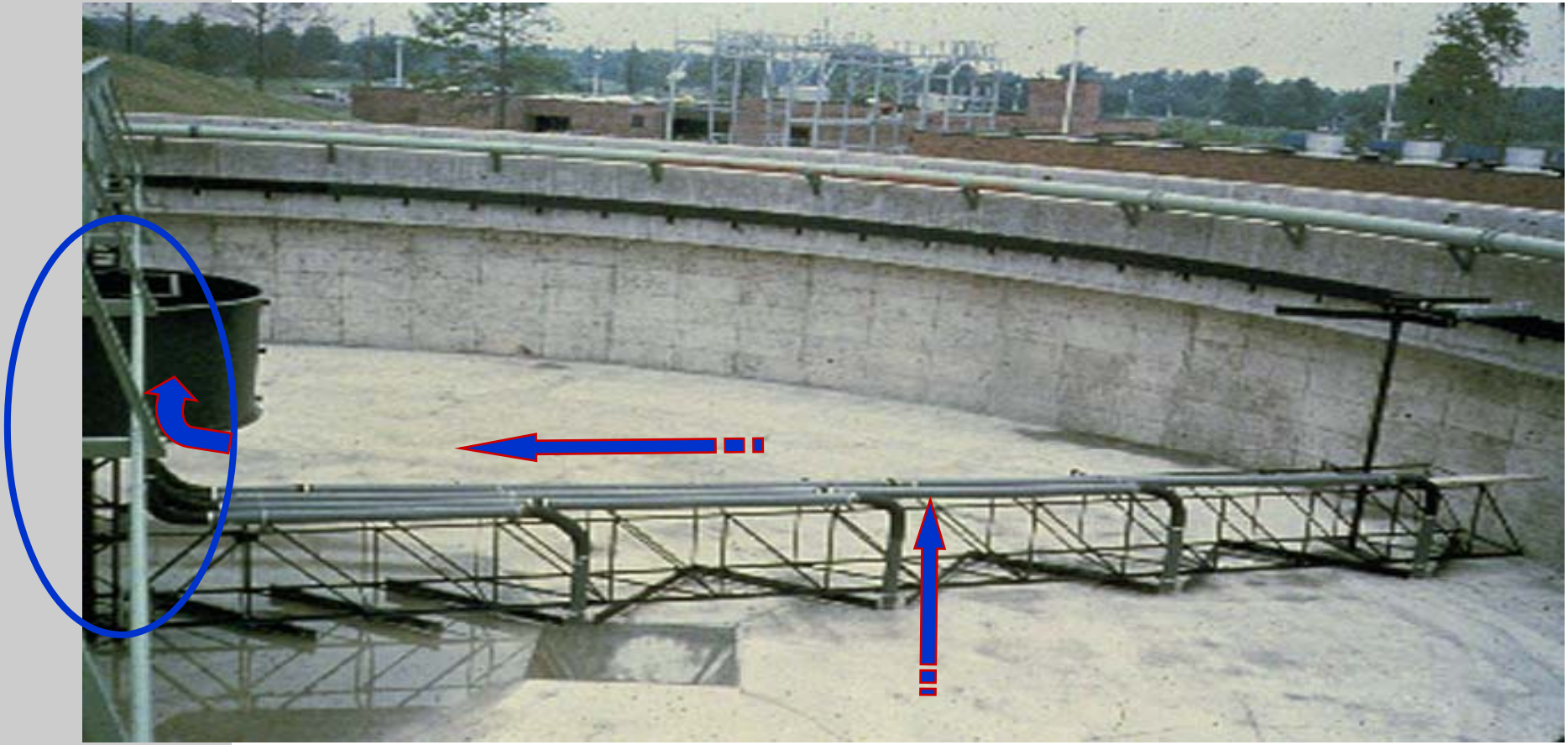

Sludge Control Box With Plugged Pipe

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Process and Operation – Sludge Removal
Riser Pipe Design

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1. Rapid Sludge Removal
2. Minimum Sludge Agitation
3. ~~Operation Flexibility~~
4. ~~Balanced Sludge Removal~~
5. ~~Maximum Solids Concentration~~
6. Thickening Capability
7. Density Dissipation

Uni-Tube Hydraulic Removal Design Satisfies All Activated Sludge Requirements

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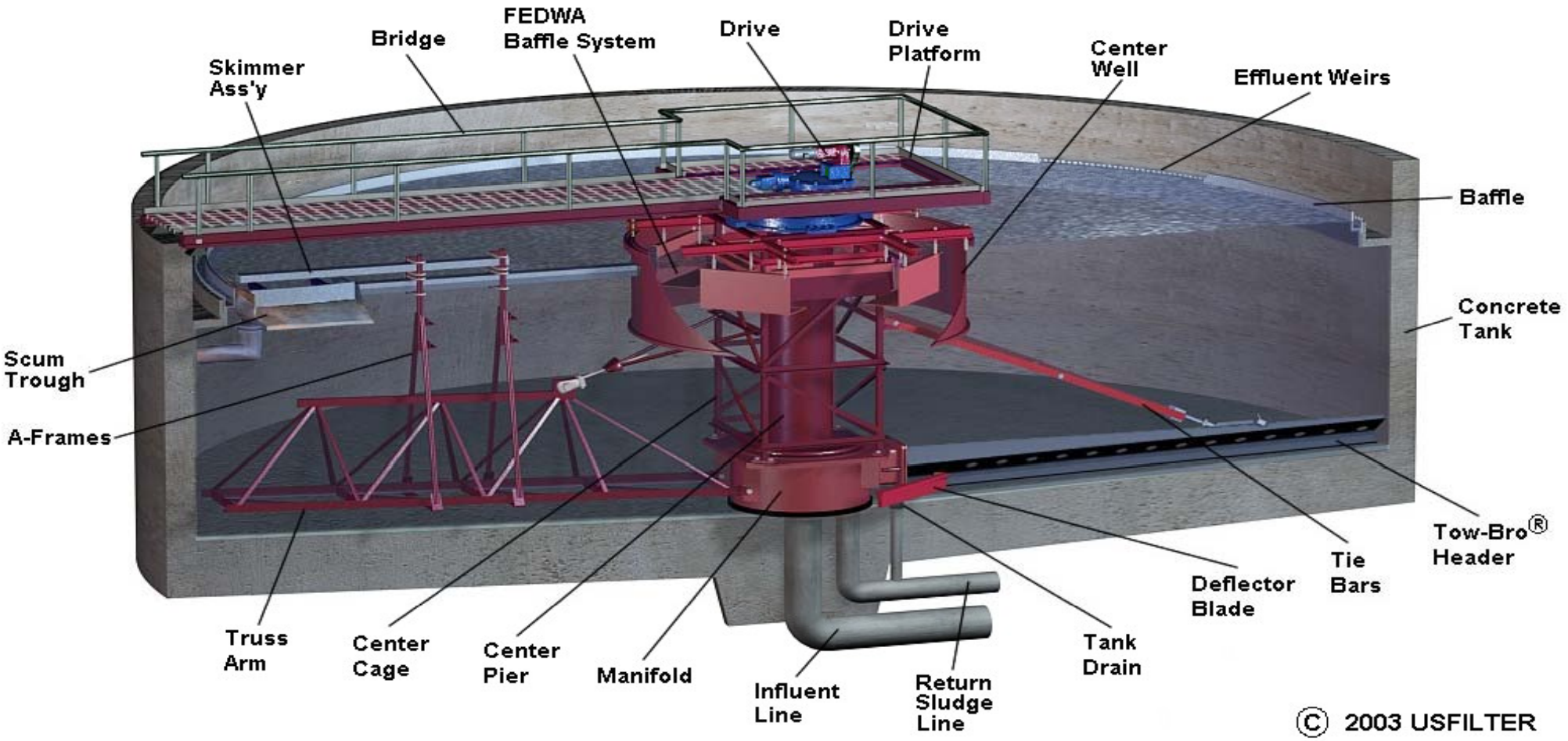
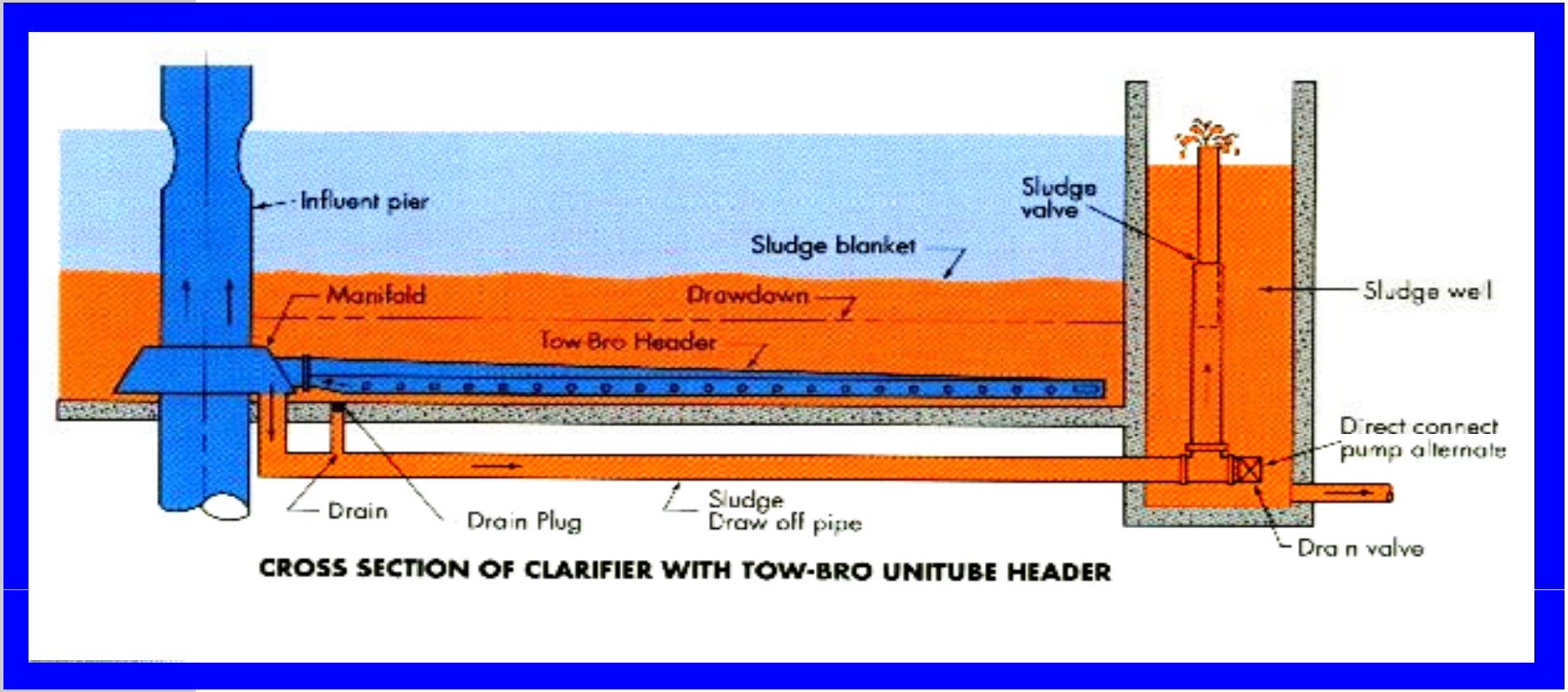


Activated Sludge Removal Process -Unitube Header



Rapid Sludge Removal

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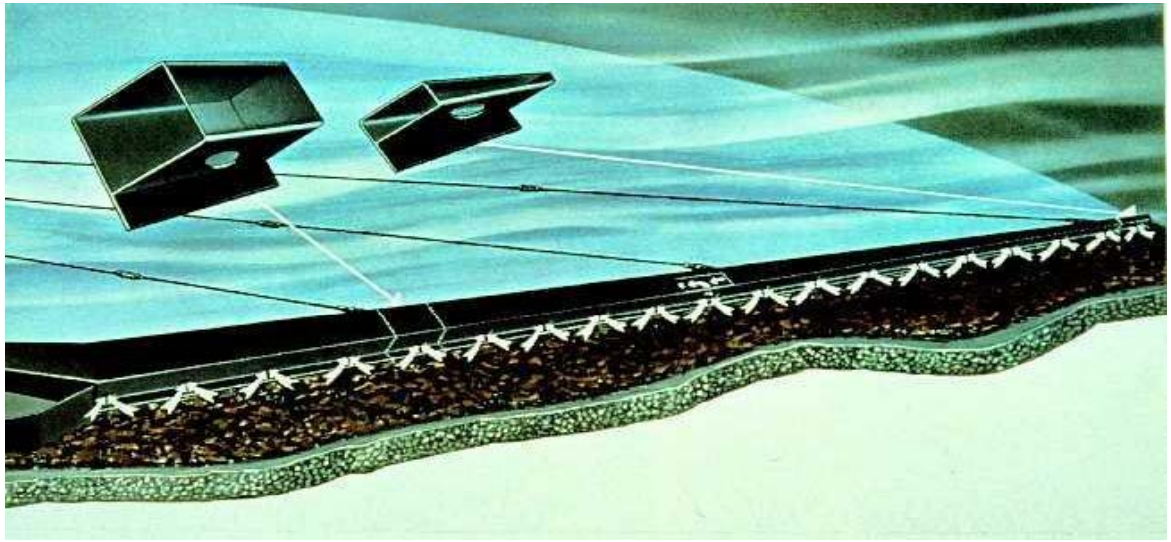
- Fresher sludge, less aeration required
- Eliminates rising solids produced from denitrification in clarifier
- Limits phosphate release to effluent
- Limits growth of filamentous bacteria



Minimum Sludge Agitation

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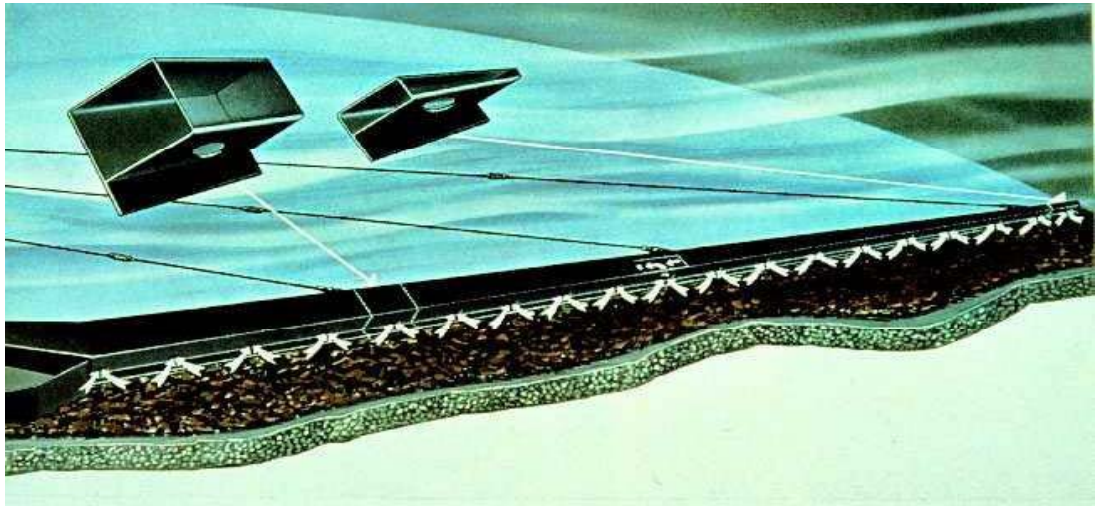
- Required for maximum solids concentration
- Minimum of underwater disturbance
- Longer compaction time
- Positive removal



Operation Flexibility

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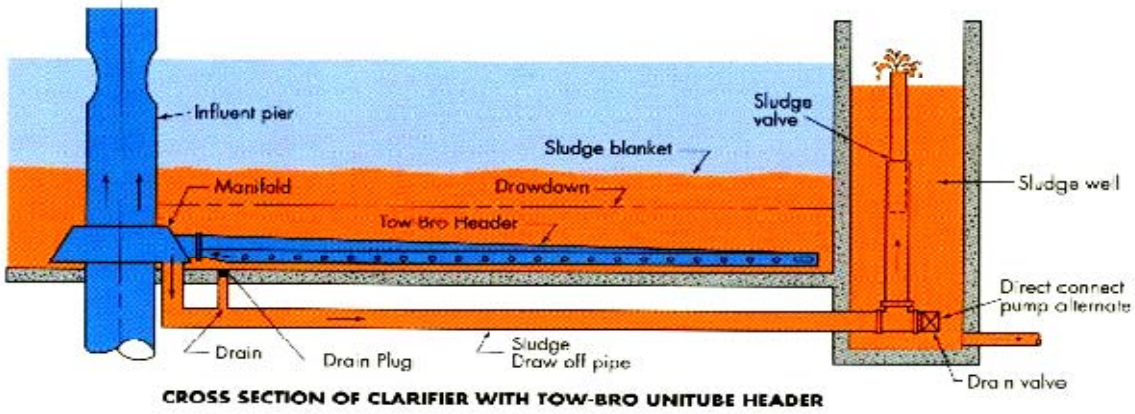
- Vary over a wide range of withdrawal rates
- Vary over wide range of blanket depths
- Adjust sludge rates quickly at sludge pump
- Control of sludge blanket
- Only “zero blanket depth” collector available



CROSS SECTION OF CLARIFIER WITH TOW-BRO UNITUBE HEADER

Balanced Removal Design

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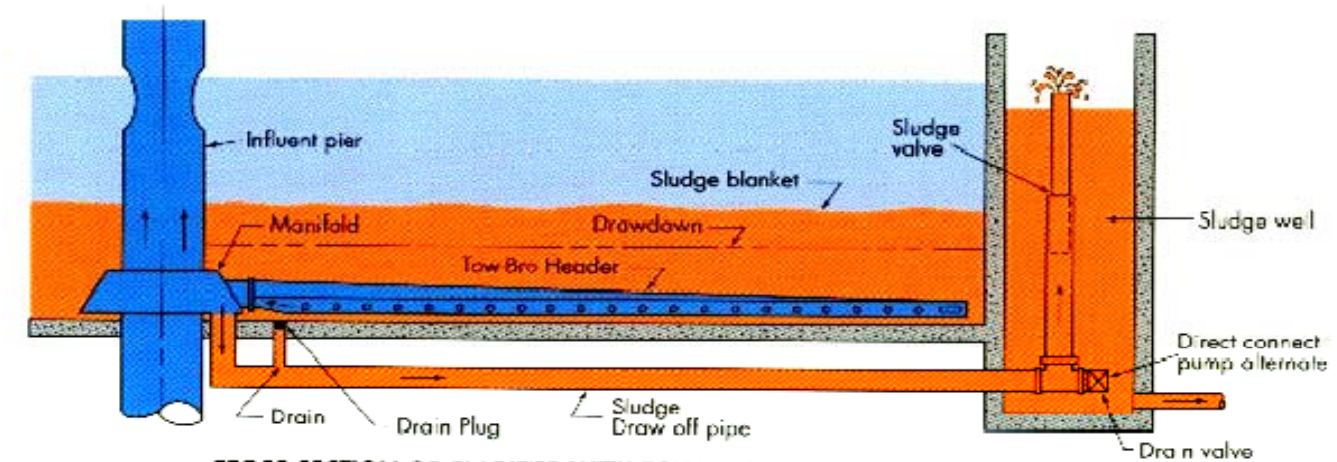
- Uniform Sludge blanket
- Removal of sludge in proportion to area covered



CROSS SECTION OF CLARIFIER WITH TOW-BRO UNITUBE HEADER

Field Verification Studies Provide Design Validation

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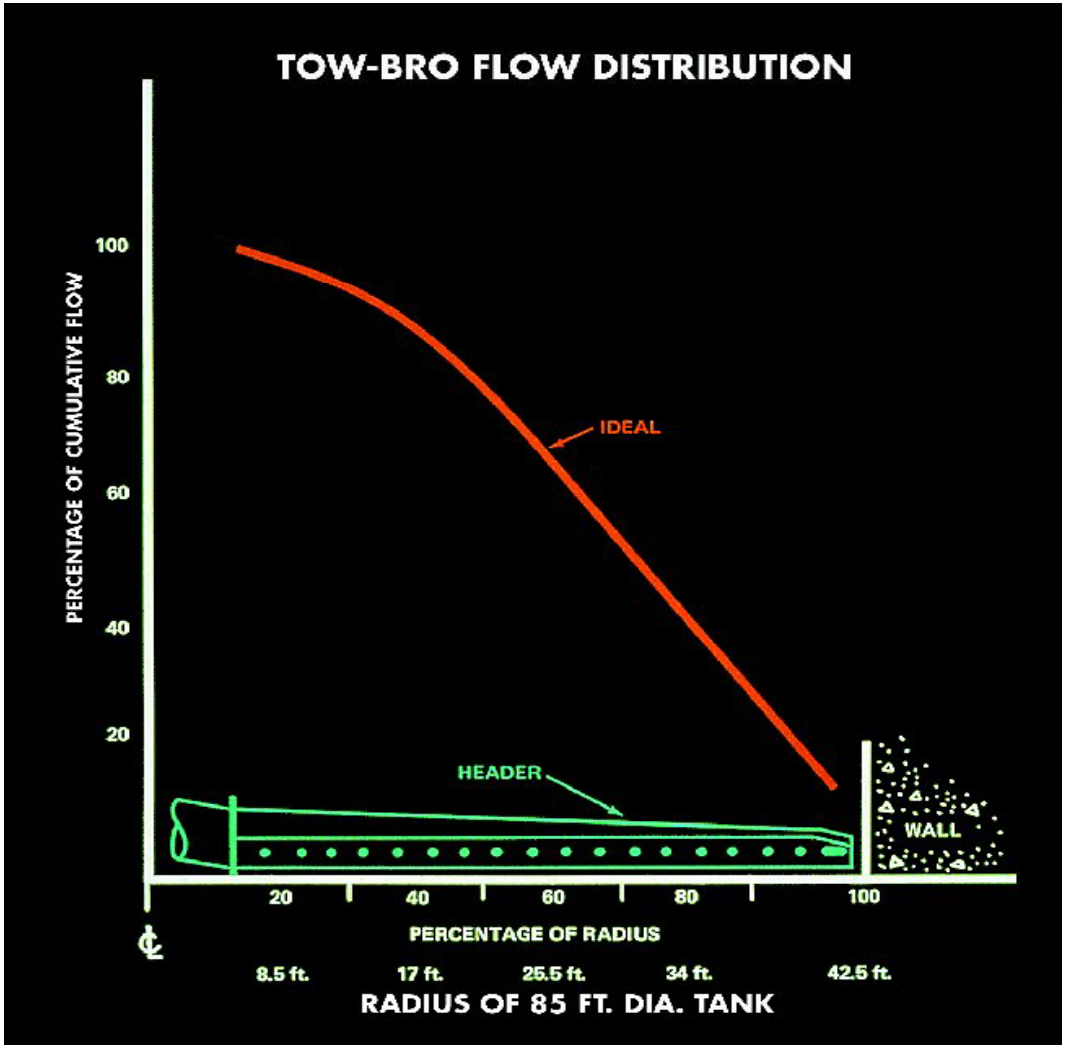
Theoretical Flow

Distribution Curve

Through the Unitube

Sludge Header



Tow-Bro Uni-Tube Header meets all the requirements of activated sludge removal

SIEMENS

Process and Operation – Sludge Removal

1. Rapid Sludge Removal
2. Minimum Sludge Agitation
3. Operation Flexibility
4. Balanced Sludge Removal
5. Maximum Solids Concentration
6. Thickening Capability
7. Density Dissipation

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Introduction of Peripheral Feed Design—RIM-FLO (RF)

George W. Smith, USFilter Envirex Products
William H. Davis, B.P. Barber & Associates

Water Technologies

Flow is Away from the Weirs

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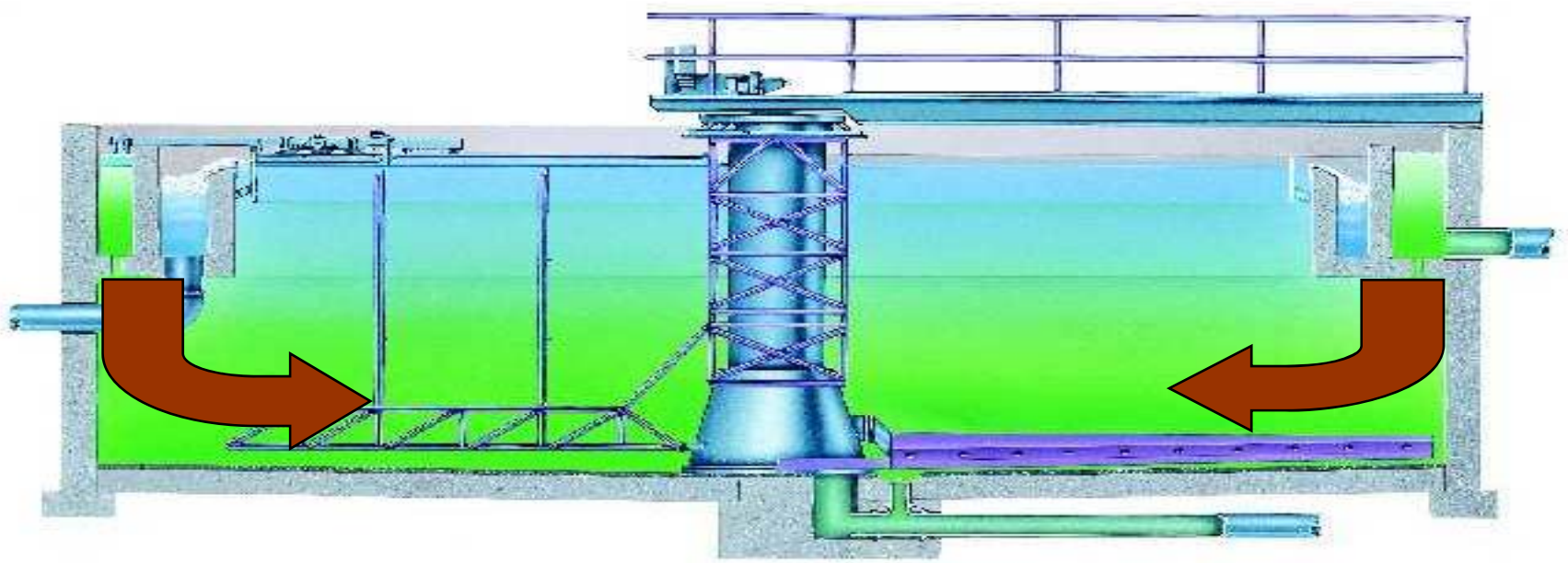

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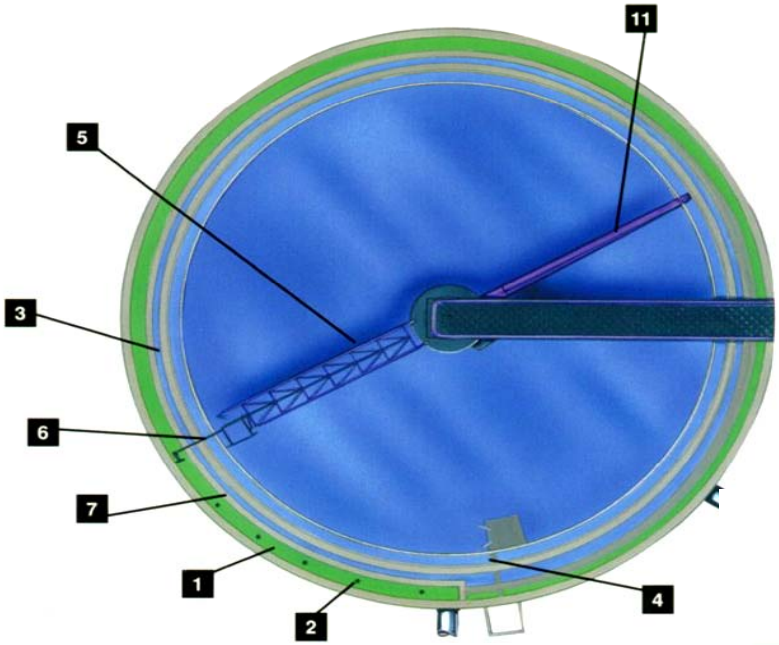
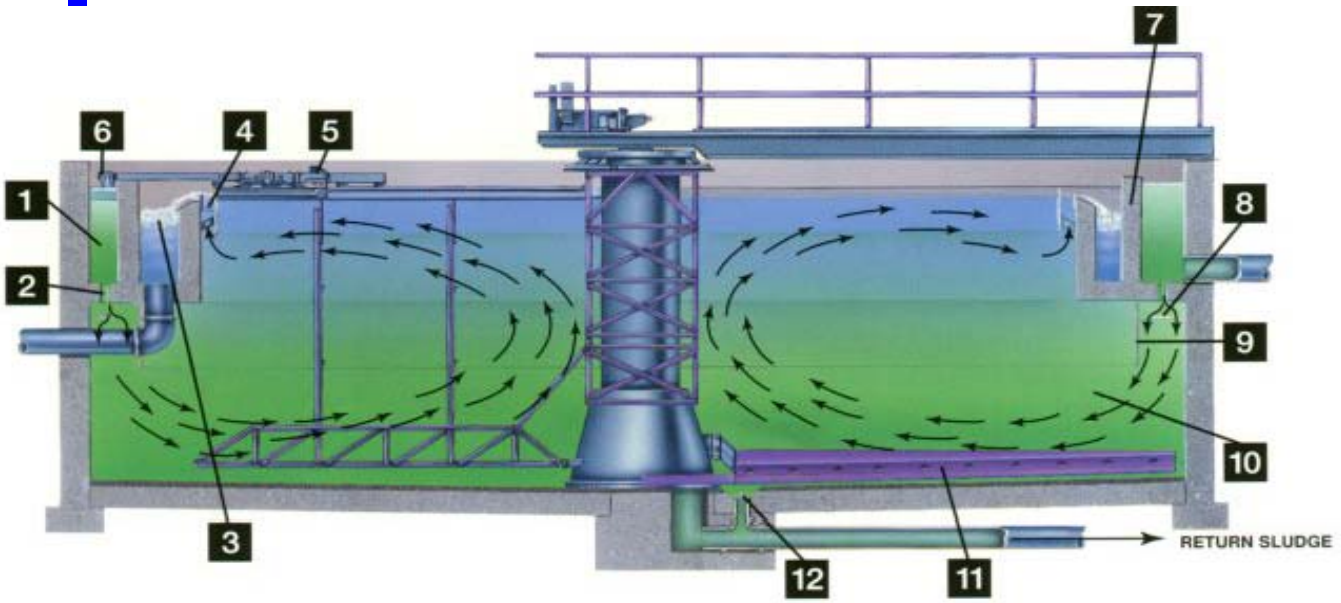
This is the current and True PF/PO



1. Influent Channel
2. Inlet Orifice
3. Effluent Channel
4. Weir and Scum Baffle
5. Skimming - Main Tank
6. Skimming - Influent
7. Divider Wall
8. Deflector Baffle
9. Influent Skirt Baffle
10. Large Inlet Area
11. Sludge Remover Header
12. Tank Drain



RIM-FLO Tow-Bro Design

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Cannibal®

Solids Reduction Process

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Conventional Activated Sludge

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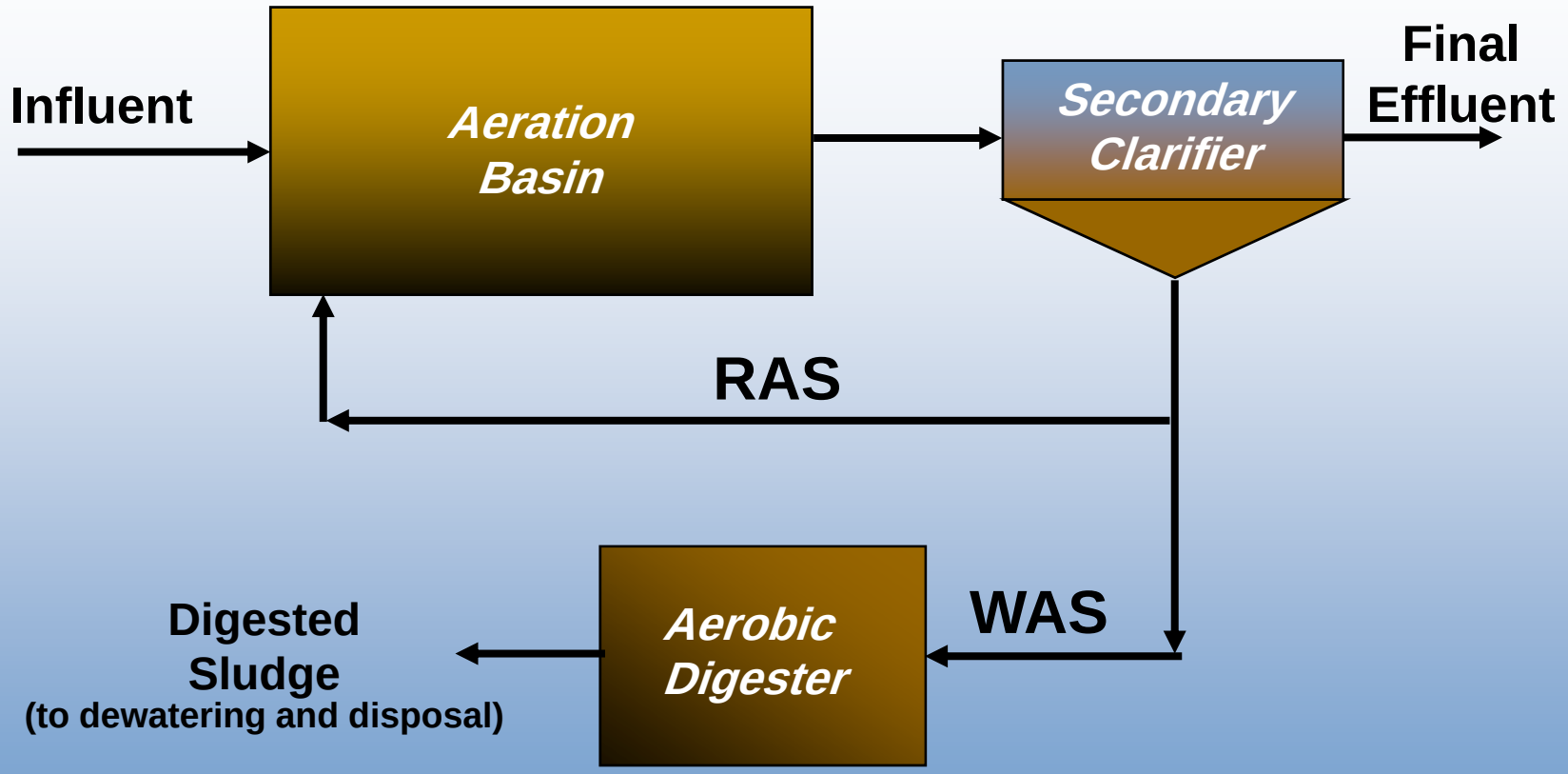

RAS - Return Activated Sludge
WAS - Waste Activated Sludge

Components of Activated Sludge

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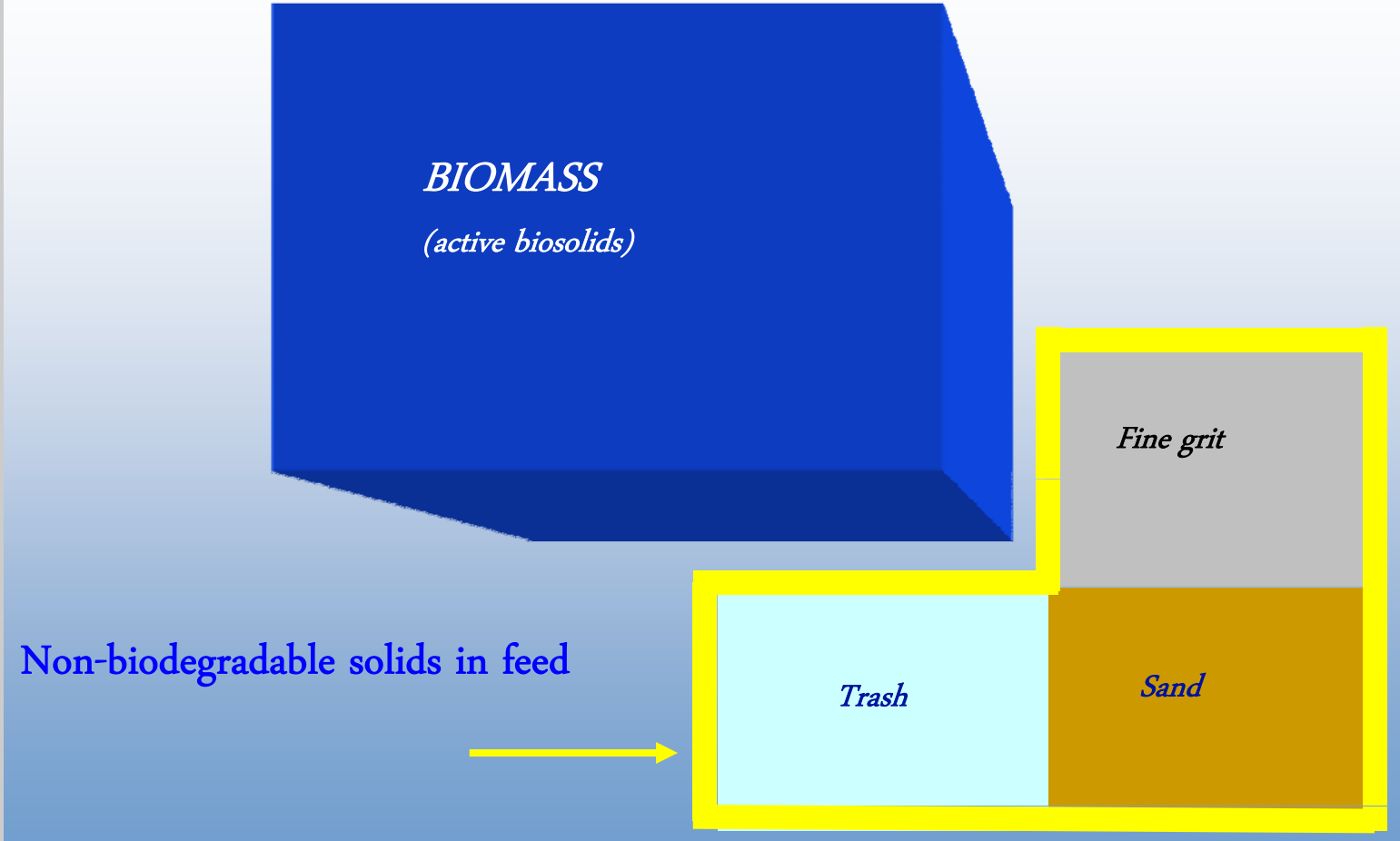
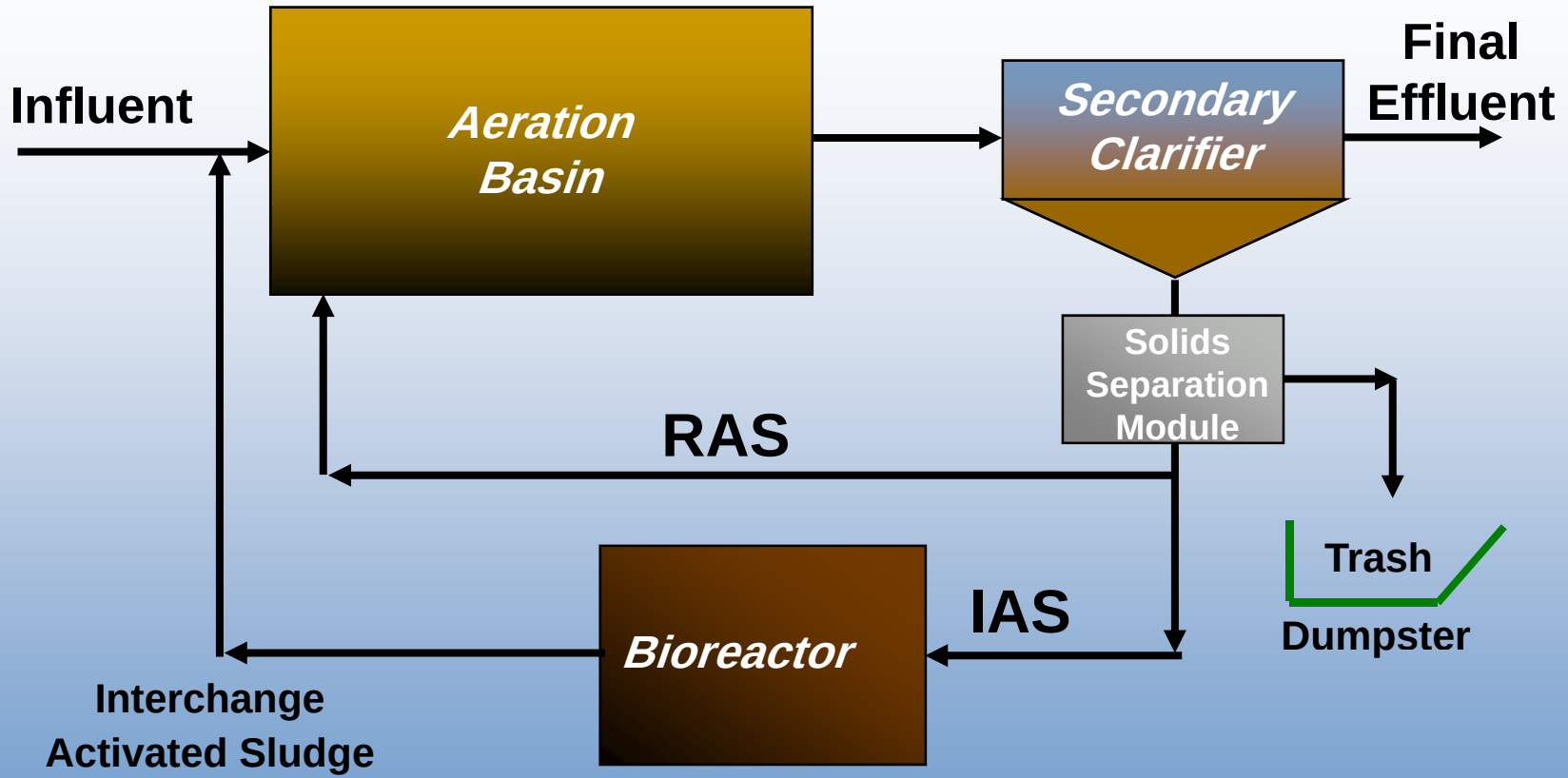


The Cannibal Process

SIEMENS



Cannibal Process Flowsheet

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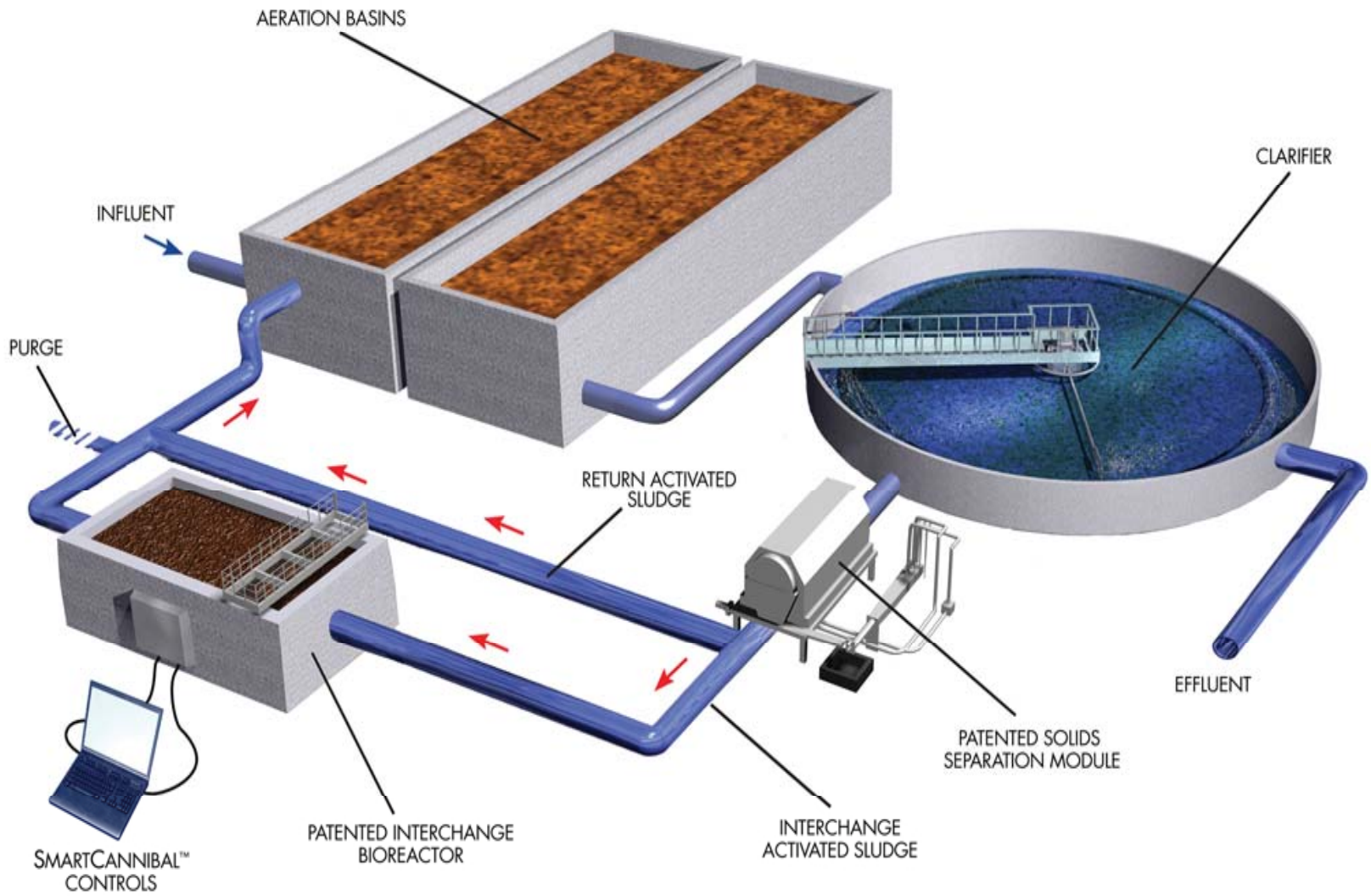

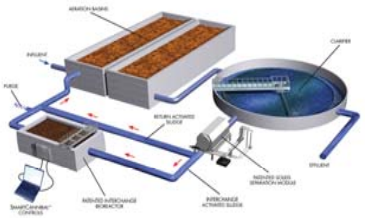

Elements of the Cannibal Process

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1. Solids Separation Module

2. Side-Stream Bioreactor (Cannibal Tanks)

3. Smart Cannibal™ Control System

The Solids Separation Module

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Screens - Separate by particle size

- coarse sand and trash
- fine grit and biological solids

Cyclones - Separate by specific gravity

- fine grit
- biological solids

Fine Screen and Cyclones

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Solids Separation Module

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Screen Discharge

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Return Sludge Screenings

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30 to 40% solids concentration

Cannibal Process Benefits

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Reduced biological solids wasting

- Less power for solids handling
- Less biological solids dewatering
- Less biological solids hauling
- Only a periodic purge

How Much Sludge Reduction to Expect?

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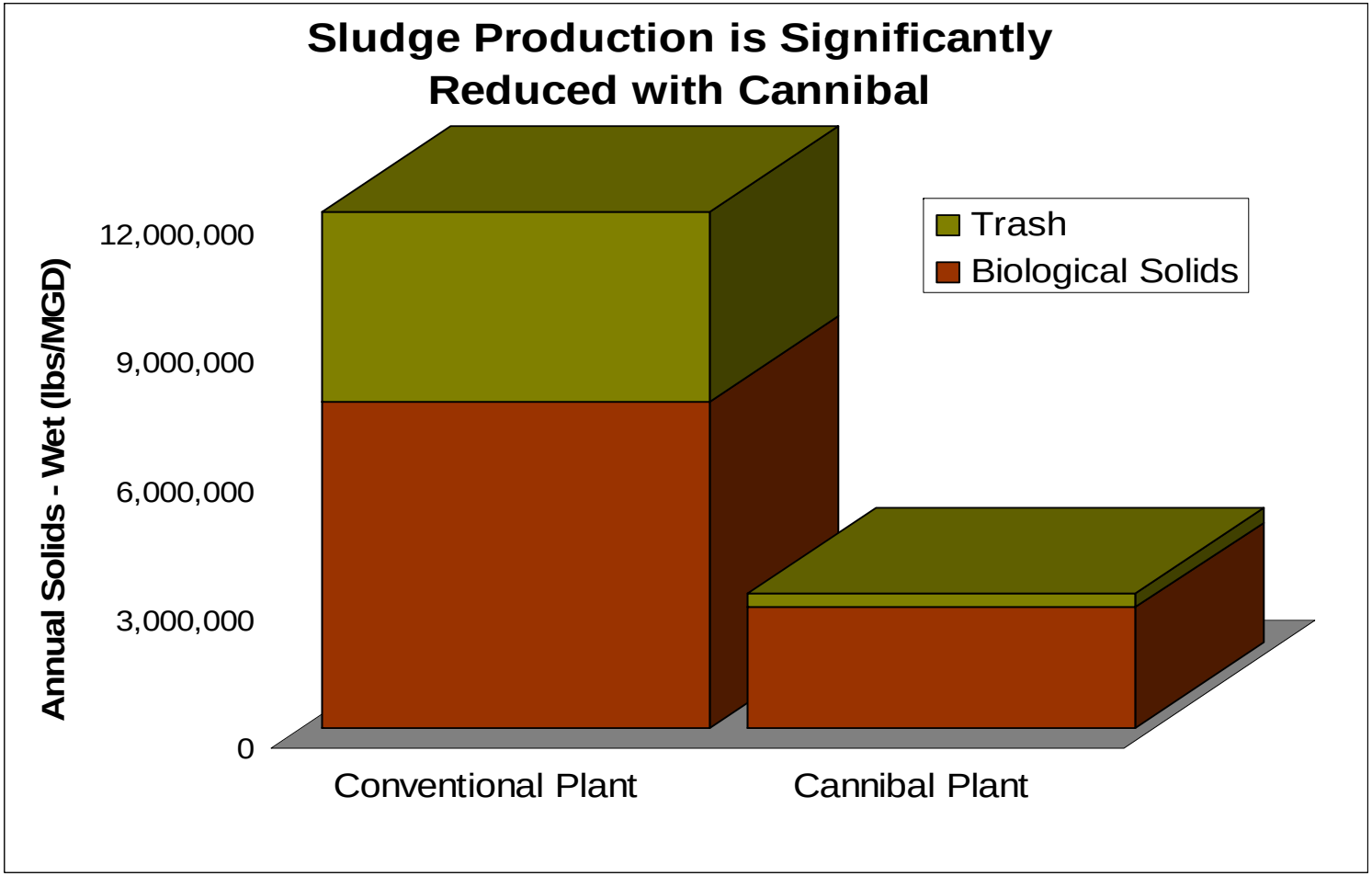


Assumptions: Conventional yield of 0.75 plus 35% VSS reduction, Cannibal Yield of 0.125, Cannibal Trash Removed at 40% solids, Liquid Hauling

Typical Savings Comparison

SIEMENS

Wyoming WWTP (16,000 m3/d))
Cost Comparison
Aerobic Digestion and the Cannibal Process

	Aerobic Digestion	Cannibal Process
Digestion Costs	$167,713	$0
Cannibal Costs	$0	$42,841
Dewatering Costs	$118,000	$23,600
Biosolids Disposal	$179,000	$35,800
Total O&M Costs	$464,713	$102,241
O&M Costs 20 yr. PW (6%)	$5,330,253	$1,172,699
Project Construction Costs	$12,123,677	$12,994,133
Construction + O&M PW	$17,453,930	$14,166,831

Evaluation performed by: The Engineering Company, Ft. Collins, CO

Ideal Cannibal Projects

SIEMENS

MUST HAVE:

- Activated sludge, suspended growth systems – no fixed film
- Plants at less than 85% of their design capacity
- Plants with loadings less than 25 to 30 lbs BOD / 1000 ft^3
- No water plant sludges discharged into sewer system
- Good settleability

NICE TO HAVE:

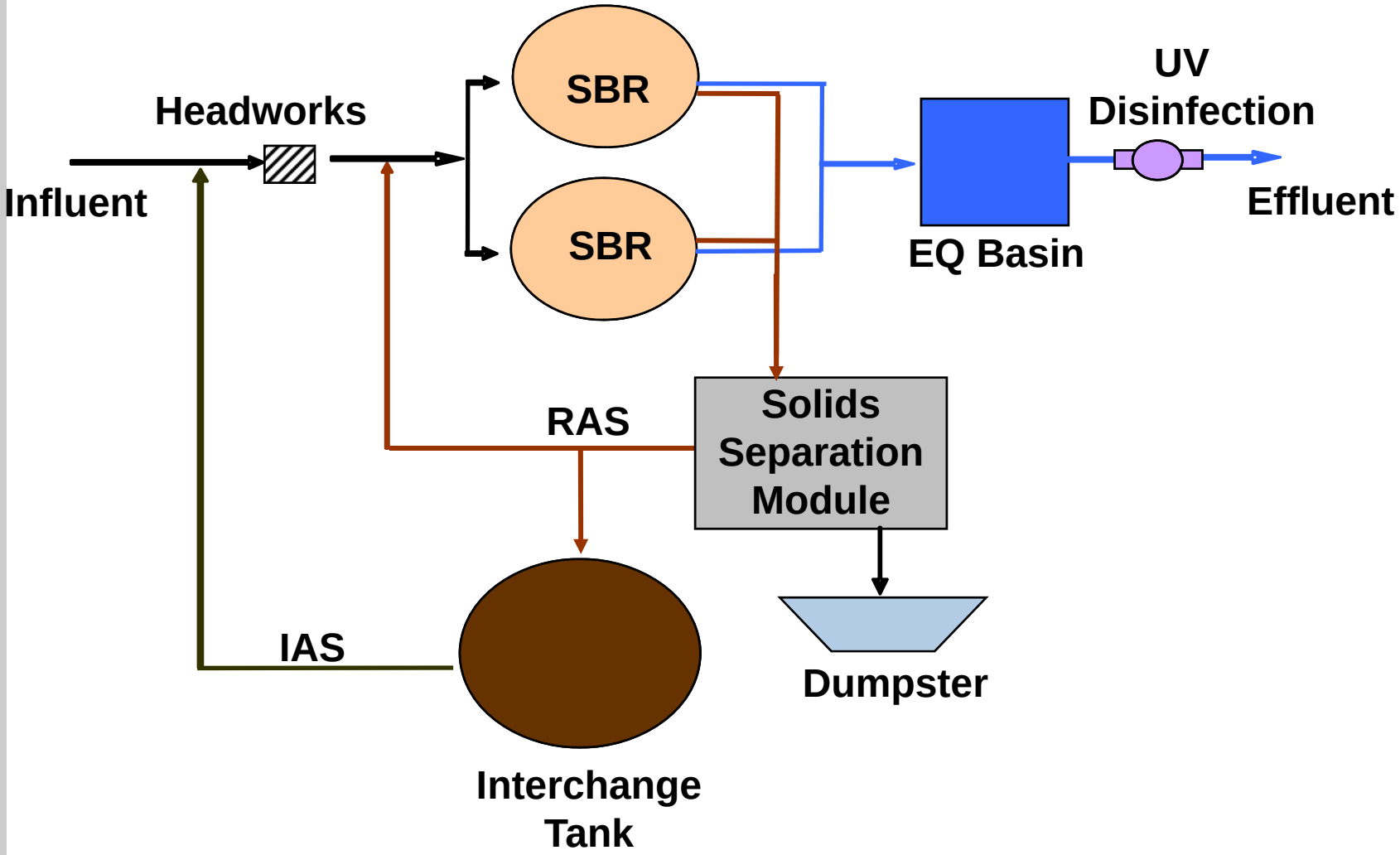
- Anoxic, anaerobic or aerated-anoxic at head of plant
- Minimal industrial discharge
- No primary clarifiers or anaerobic digestion
- Influent flow 1 MGD to 20 MGD

MOST ECONOMICAL

- Available tankage for Interchange Bioreactor
- No phosphorus limits
- High solids handling costs (energy, chemicals, hauling and disposal)
- New facility that can eliminate a solids handling unit operation
- Existing facility that is looking at a solids handling upgrade

Blue Ridge, GA
Start-up Summer 1998

SIEMENS



Blue Ridge – Design and Operating Parameters

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Design Flow	0.75 MGD
Design BOD	200 mg/l
Design TSS	200 mg/l
Aeration Tank Volume	900,000 gal

<u>Operating Parameters – 1998 to Present</u>

Flow ……0.39 MGD
BOD 243mg/l
TSS……..223 mg/l

Aeration tank BOD load…....11 lbs/day/1000 ft^3
MLSS ……..3500 - 4500 mg/l

Biological solids yield since 1998 0.012 lb TSS/lb BOD

Trash yield 0.22 lb TSS/lb BOD

Performance Results
Blue Ridge, GA

SIEMENS

	1998	1999	2000	2001	2002	2003	2004	2005
Flow MGD	0.274	0.354	0.341	0.371	0.365	0.469	.433	.471
Influent BOD mg/L	300	248	273	250	225	220	242	187
Influent TSS mg/L	167	230	288	249	204	210	236	196
MLSS mg/L	2,035	5,319	4,897	4,594	4,507	3,800	3,319	3,214
Effluent BOD mg/L	4	3	3	4	4	3	4	3
Effluent TSS mg/L	5	6	7	10	15	7	12	9
Biosolids Wasted lbs	0	0	0	0	0	20,000	0	0

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The Spider Filtration system

George W. Smith, USFilter Envirex Products
William H. Davis, B.P. Barber & Associates

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Filtration

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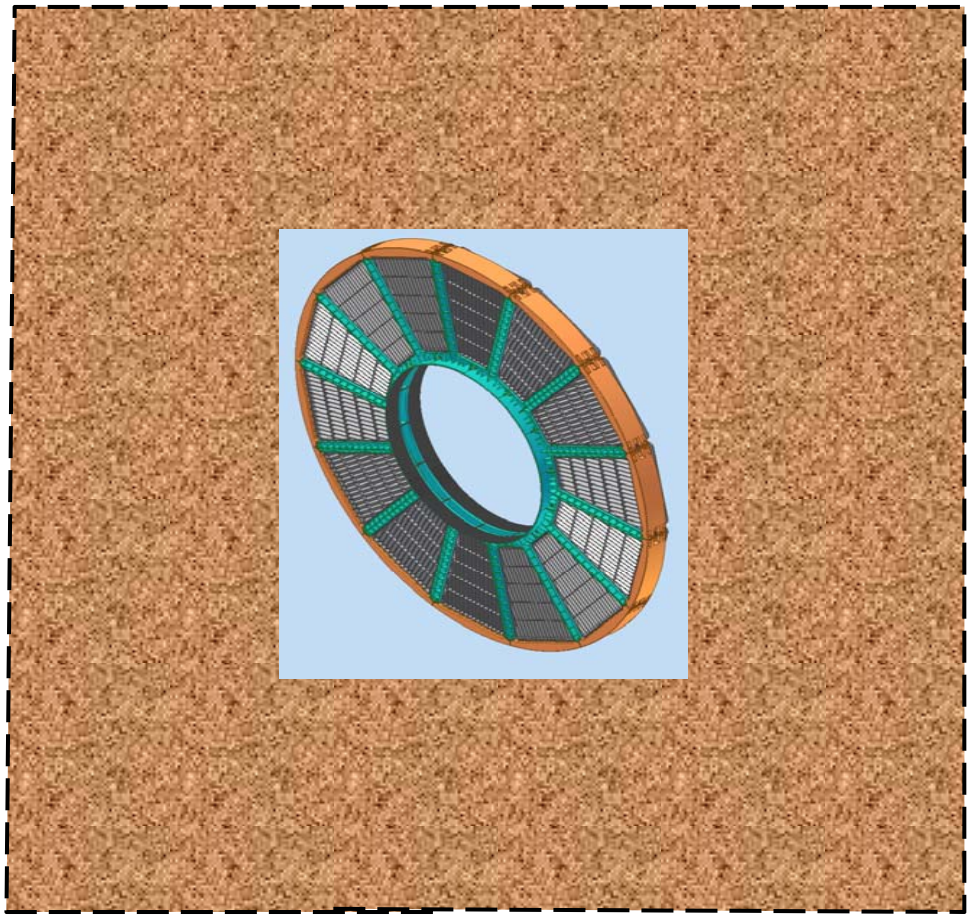
Surface Filtration

The main difference is the filtering medium and whether filtration is from the inside or from the outside……

The main advantage of this technology is the vertical presentation of the filtration surface – Savings of up 80% over conventional sand filters



Disc Filters

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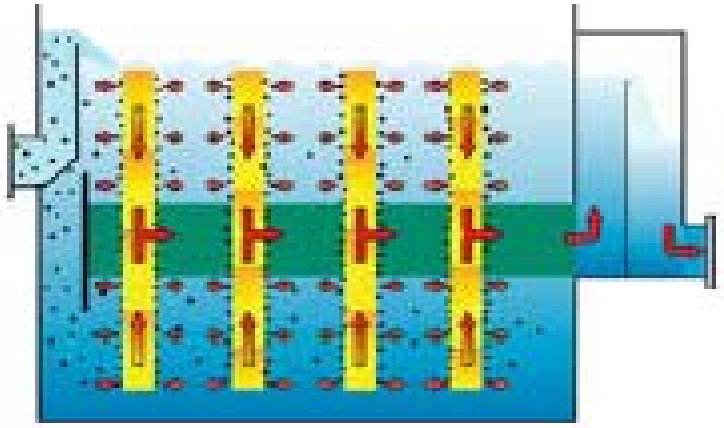
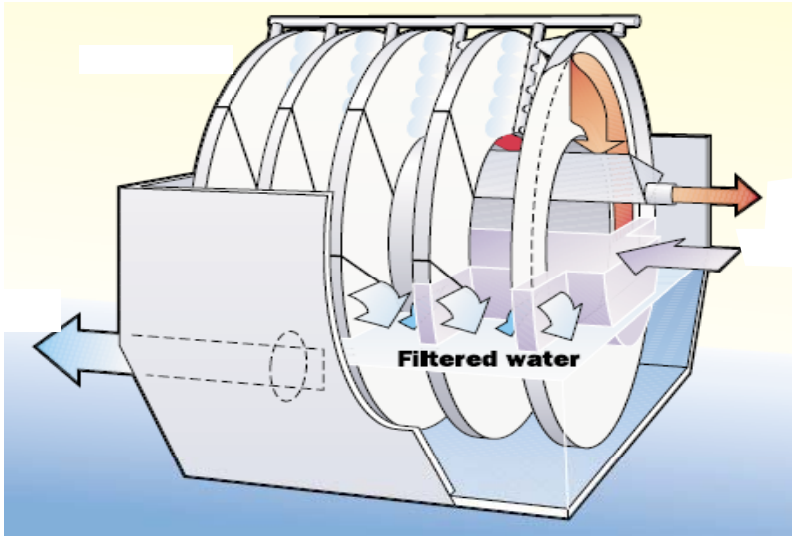
Surface Filtration

Outside - In

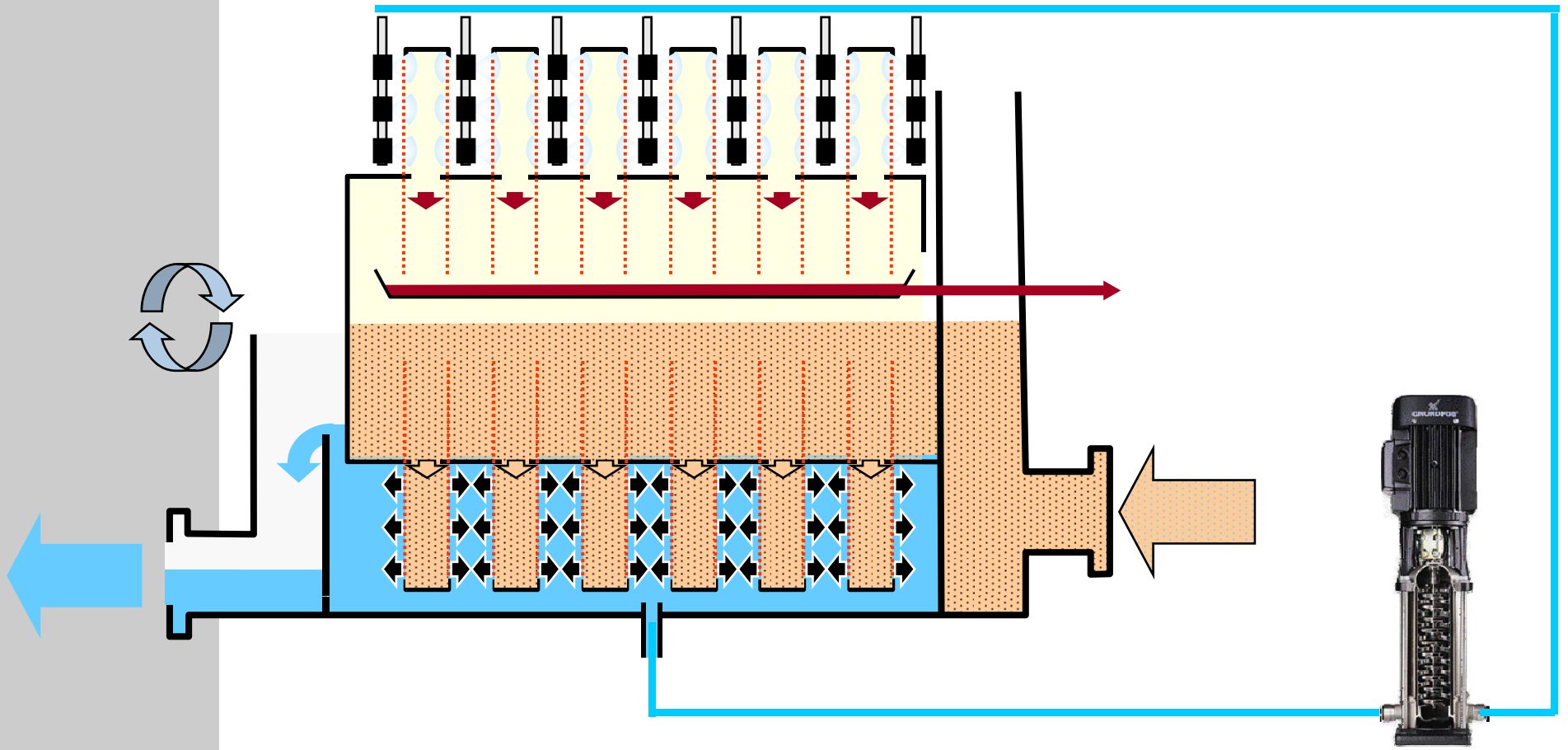


Inside - Out



Disc Filters

SIEMENS



Spider™ Disc Filter

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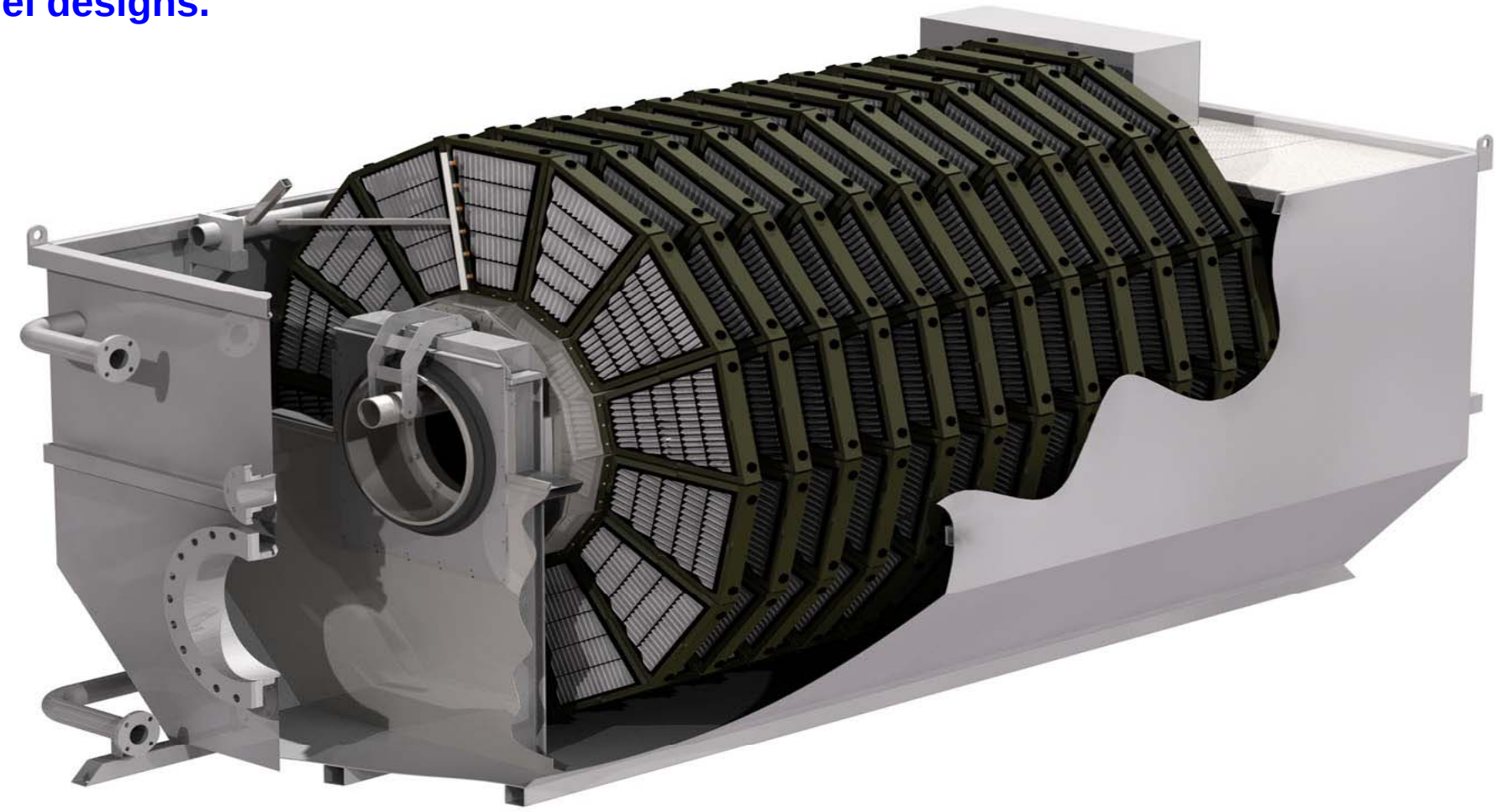
Innovation: Pleated disc panel design allows for 40% more filtration area than flat panel designs.



Spider™ Disc Filter

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Spider™ Disc Filter

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Spider™ Disc Filter

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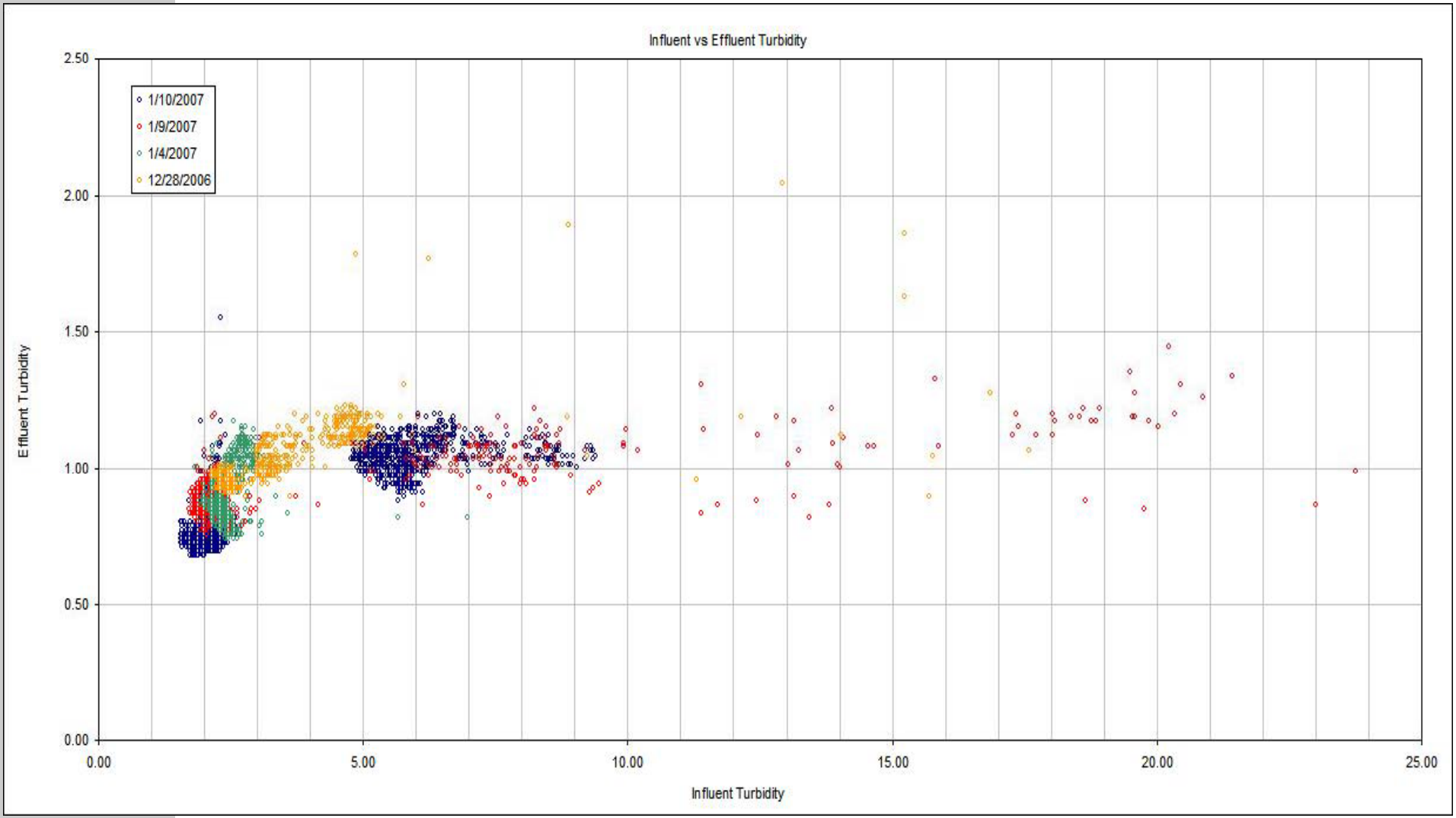
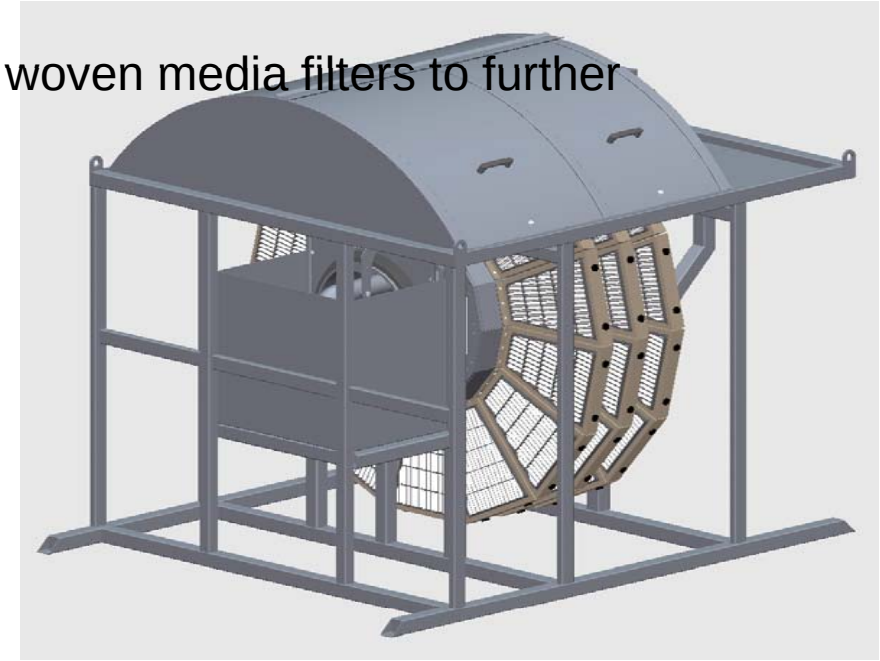


The Spider™ Disc Filter

SIEMENS

Features & Benefits

- Pleated media configuration provides the highest filtration capacity per footprint.
- Micron rated media as absolute barrier to solids removal.
- Design for twice the headloss of current generation woven media filters to further reduce backwash frequencies.
- Ultimate solution for water reuse
- Reliable retrofit for your existing application
- Convenient efficient cleaning



The Spider™ Disc Filter

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Applications

- Municipal Tertiary
- Reuse / Recycle
- Industrial Reuse
- Desalination Pretreatmer
- Product Recovery
- Process Water Filtration
  - Cooling Water Makeup
  - Seal Water
- Retrofit of Conventional Filters

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References

George W. Smith, USFilter Envirex Products
William H. Davis, B.P. Barber & Associates

Water Technologies

Municipal Wastewater Treatment Case Study

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End User: *Anaconda Camp*

Location: *Baghdad, Iraq*

Scope: *Activated sludge wastewater treatment system including an Orbal oxidation ditch, DualAir Diffusers, (2) Tow Bro Clarifiers - 21.3 m dia. x 4.3 m SWD*

Capacity: *5,680 m3/day*

Municipal Wastewater Treatment
Case Study

SIEMENS

End User: *Beni Suef WWTP*

Location: *Beni Suef, Egypt*

Scope: *Biological Treatment by Oxidation Ditch using disc aerators with 4 x 60 HP disc aerators, Secondary Clarification with 4 x 25.0 m dia.*

Capacity: *50,000 m^3/day*

Municipal Wastewater Treatment Case Study

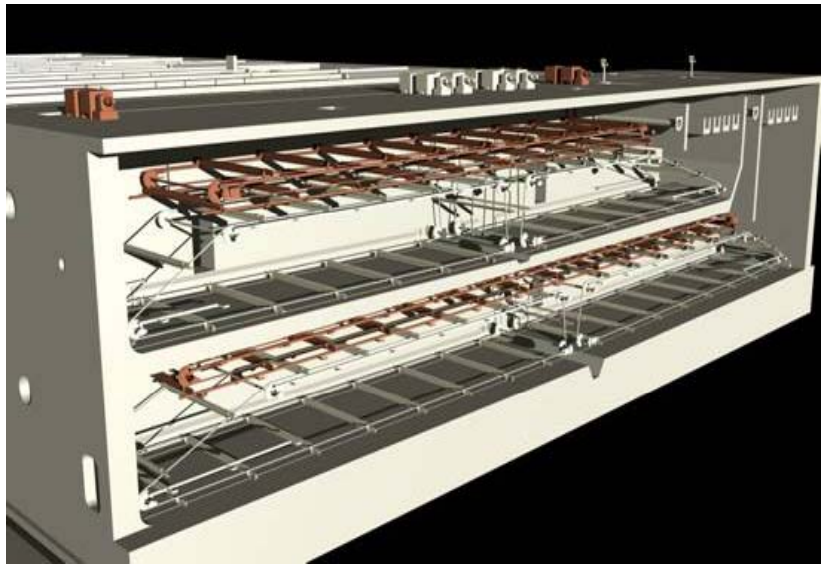
SIEMENS

- ***End User:*** *Ratburana (BMA3) Bangkok, Thailand, Municipal Wastewater Treatment Plant*
- ***Location:*** *Bangkok, Thailand*
- ***Scope:*** *Envirex VertiCel deep tank biological process and TransFlo high rate secondary clarifiers*
- ***Flowrate:*** *65,000 m^3/day*
- ***Year: 2002***

Municipal Wastewater Treatment
Case Study

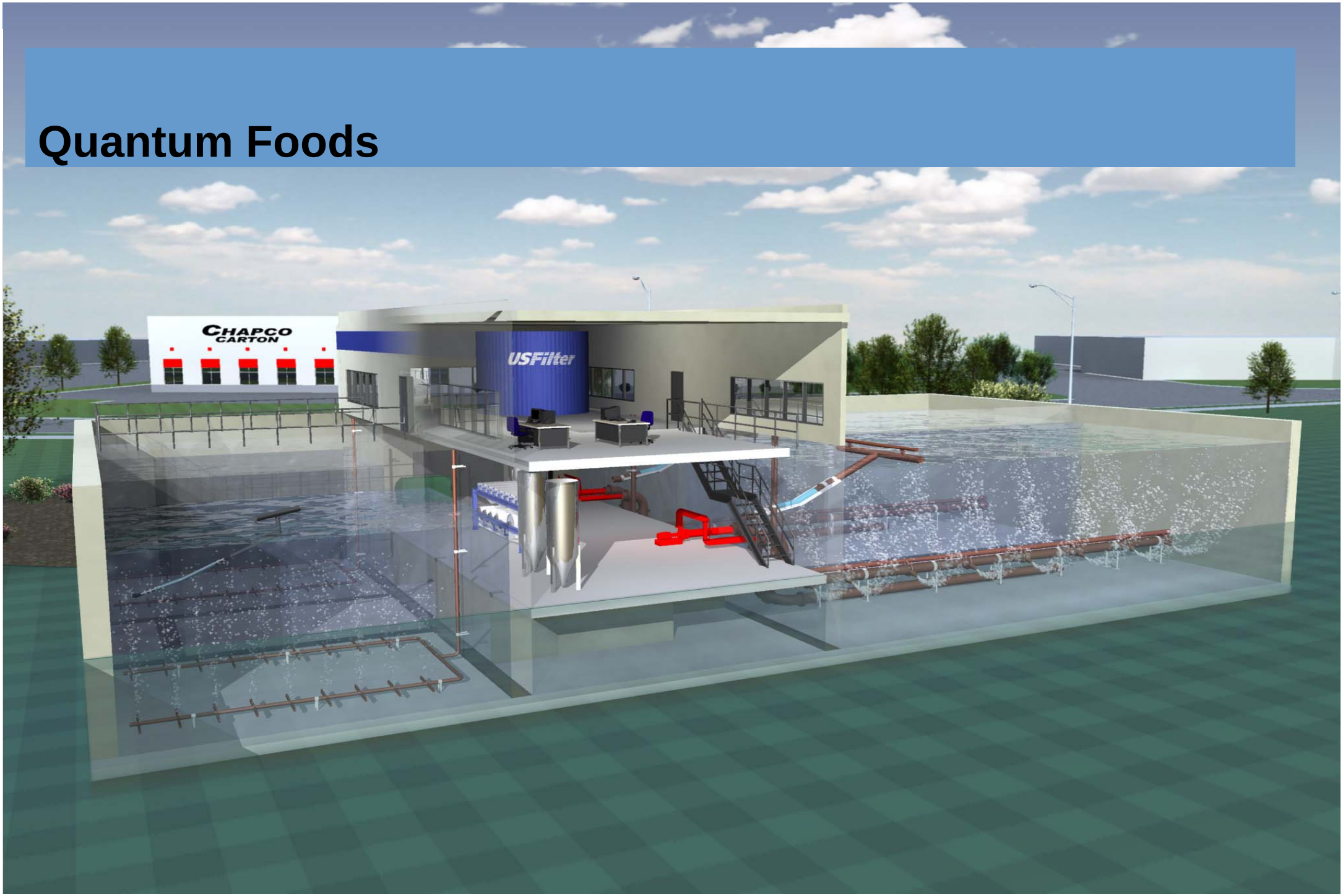
SIEMENS

End User: CWRP, DTSS - Singapore
Location: Singapore
Scope: Oil and Grease removal, Stacked Primary Clarifiers, (SS chain) Stacked Secondary Clarifiers (SS chain) Diffused Aeration (DualAir with ceramic elements)
Flowrate:800,000m3/day
Year: 2003



Quantum Foods

Quantum Foods



La Rosita Power Plant
Mexicali, B.C. Mexico

SIEMENS

Application

Provided technologies for wastewater treatment process at Intergen's La Rosita Power plant

Scope

The plant's state of the art wastewater treatment plant reclaim municipal waste for use in the plant's cooling towers.

Through our former parent company, Veolia Water, USFilter provided headworks, orbal aeration and clarification technologies

Benefit

By recycling and reusing wastewater, the company becomes self-sufficient, while reducing the impact on the environment.

BMA3 – Ratburana, Bangkok, Thaialnd

SIEMENS

- **Application**
  - 65,000 m^3/day Municipal Wastewater Treatment Plant at Ratburana (BMA3) Bangkok, Thailand
  - Limited space and high electrical costs demanded compact and efficient solution
- **Scope**
  - Supply of Envirex VertiCel deep tank biological process and TransFlo high rate secondary clarifiers
  - 3 x VertiCel biological units, 8.5m depth
  - Aerators: Twelve (12) at 20 HP each
  - 6 x TransFlo high rate secondary clarifiers
- Value: 1.5 M USD
- **Performance/Results**
  - Customer very pleased with performance
- Fabrication
  - USA and Thailand

Servicios de Agua Y Drenajae Monterrey (SADM), Noreste WWTP

SIEMENS

Application

- Municipal wastewater treatment plant for industrial reuse.

Scope

- Provided highly efficient vertical loop reactor technology to biologically treat municipal wastewater.
- VLR system uses orbal aeration, along with fine bubble aeration technology.

Benefit

- System provides environmental benefit through clean waterways and streams. As well, the utility SADM produce water for reuse by Monterrey-based industry, where clean water is limited.

Coca Cola - Insurgentes
Monterrey, N.L., Mexico

SIEMENS

Application

- Industrial Waste treatment System, Coca Cola Bottling facility.

Scope

- Provided Turnkey installation, including process design, equipment selection. Slab design and installation. Laboratory with all equipment. Equipment building.
- Used fine bubble diffuser system with centrifugal blowers.

Benefit

- System provides environmental benefit through reduction of the organic loading to the main treatment facility.

Chrysler Venezuela

SIEMENS

Application

- Industrial Waste treatment System, Chrysler Assembly Plant, Venezuela.

Scope

- Provided process design and equipment for a Biological Treatment System. Pretreatment for P –removal and metals removal. Parallel Plate Separator with Sludge Thickener. System designed for biological denitrification. TES filter.
- Local sub contractor was responsible for the installation.

Benefit

- System provides environmental benefit through reduction of the organic loading to the main treatment facility.


Operations
40’ trailer

Mariani Packing Co.

SIEMENS

Siemens LLC – Lower Gulf Region

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Thank you!

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