



AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company



Reduced Life-Cycle Costs and Enhanced Sustainability of Wastewater Treatment Utilizing AquaNereda[®] Aerobic Granular Sludge Technology

TIEEP Virtual Water Forum 2021

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Product Manager - AquaNereda[®]
Aqua-Aerobic Systems, Inc.



Overview



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- Technology Intro
- Applications in the Industrial Sector
- Major Advantages
- Case studies
- Conclusion



Aerobic Granular Sludge Technology

Technical Overview

AquaNereda® Technology

Process Overview

- Simple, one-tank reactor concept
- No secondary clarifiers
- Enhanced biological nutrient removal
- Timed cycle flexibility
- No sludge recirculation



Aerobic Granular Sludge

Settleability

- Increased MLSS
- $SVI_5 \approx SVI_{30}$



Aerobic Granular Sludge

Settleability Video

A Settling Comparison: Conventional Activated Sludge vs. Aerobic Granular Sludge



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Process Comparison

Footprint



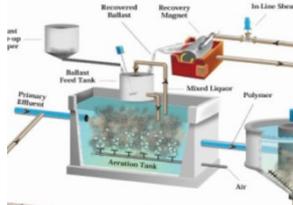
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BNR



SBR



Ballasted Floc



IFAS



MBR



25%

25%

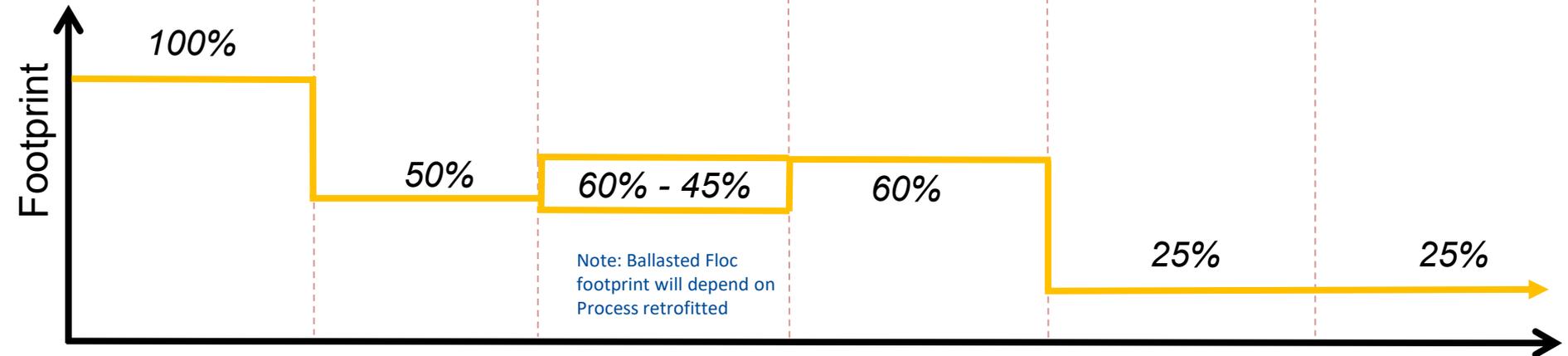
60%

60% - 45%

50%

100%

Note: Ballasted Floc footprint will depend on Process retrofitted



Process Comparison

Energy



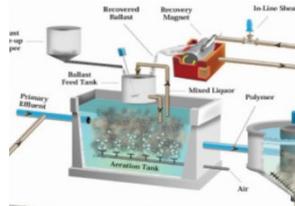
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BNR



SBR



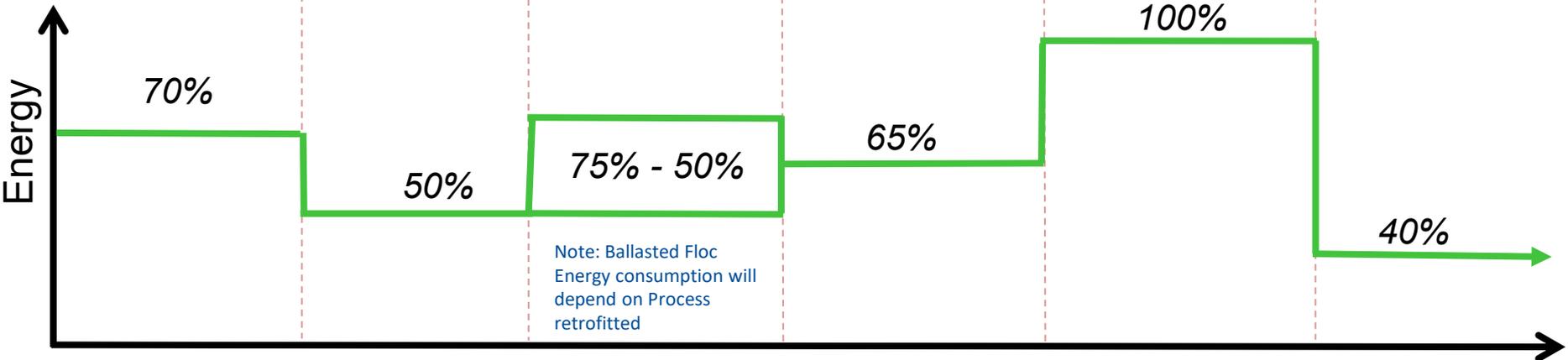
Ballasted Floc



IFAS



MBR



Process Comparison

20-Year Life Cycle Cost



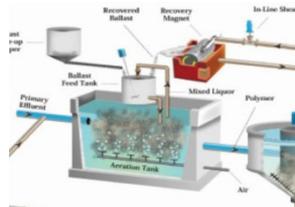
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BNR



SBR



Ballasted Floc



IFAS



MBR



60%

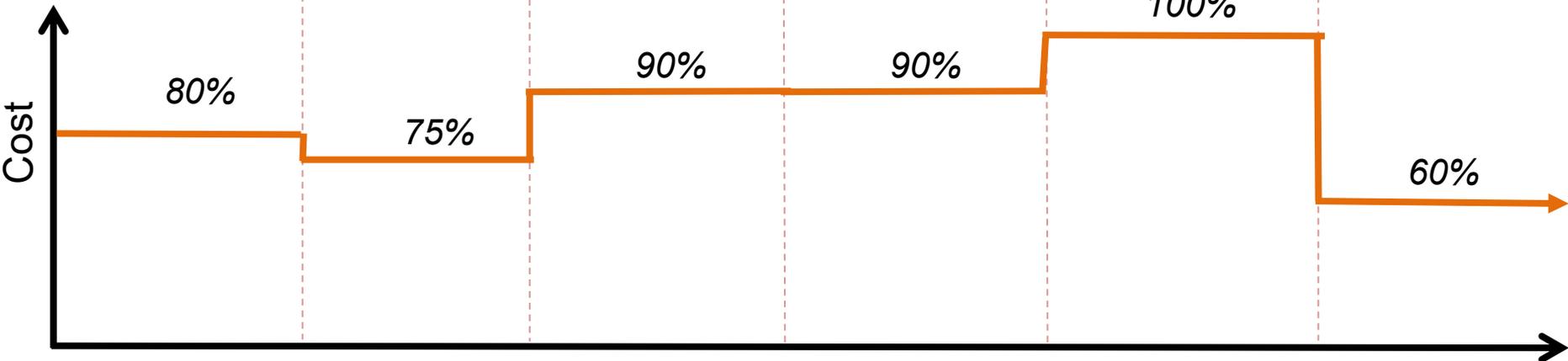
100%

90%

90%

75%

80%

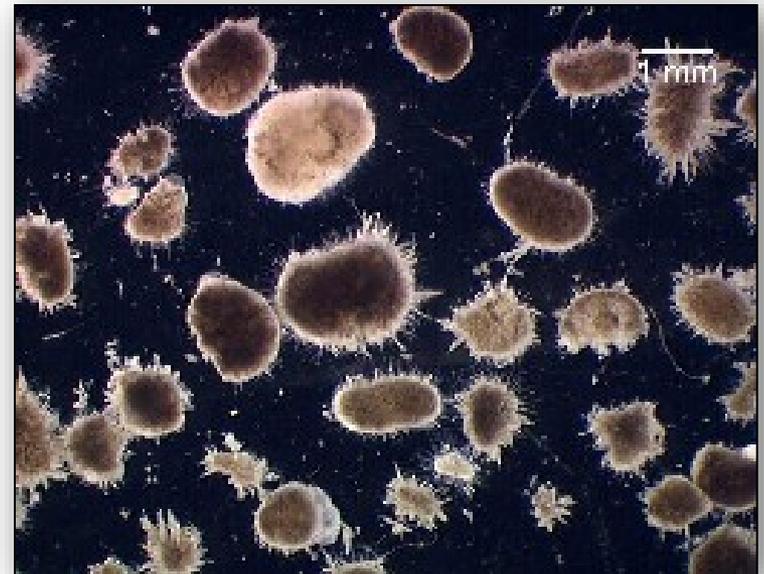
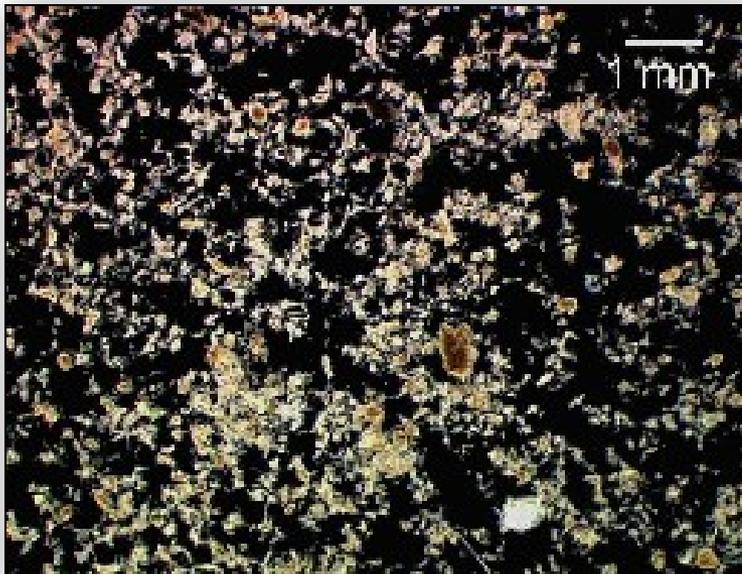


*R. Reardon, et. al., "Can Innovative Technologies Provide Benefits to Municipal Water Resource Recovery Facilities." 2016

Granule Formation

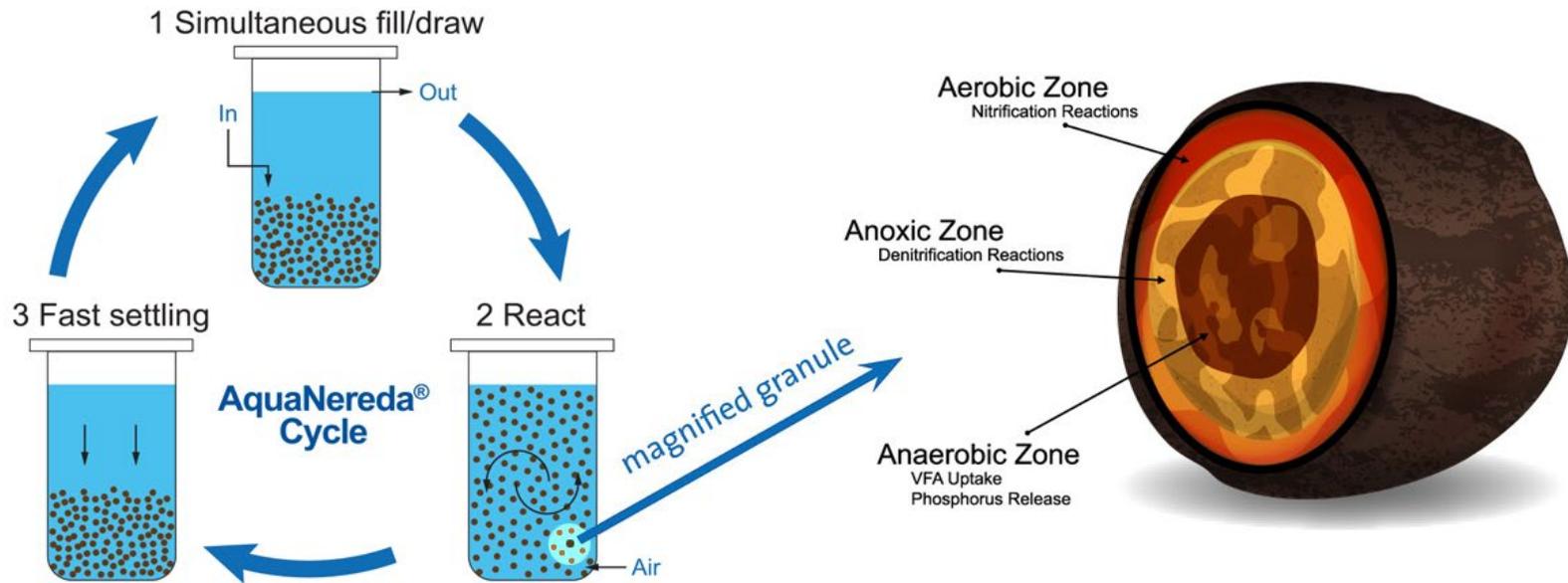
Selection Mechanisms

1. Hydraulic selection for fast-settling particles
2. Biological selection of EPS-forming microorganisms



AquaNereda[®] Technology

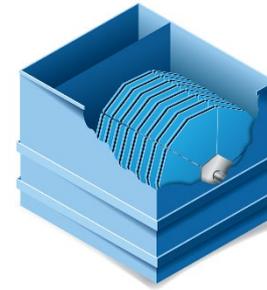
Process Cycle



Effluent Quality



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BOD < 10.0 mg/l
TSS < 10.0 mg/l
TN < 3.0 mg/l
TP < 1.0 mg/l



BOD < 5.0 mg/l
TSS < 5.0 mg/l
TN < 3.0 mg/l
TP < 0.05 mg/l

Nereda[®] Industrial Applications



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Food Processing



Edible Oil



Meat and Poultry



Pulp & Paper



Dairy & Beverage



Oil & Gas

Treatment Objectives



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- Process water makeup
- In-plant use
- Non-contact cooling
- Irrigation or land application
- Surface water discharge / aquifer injection
- Pretreatment to tertiary treatment
- Other beneficial reuse



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AquaNereda®

Major Advantages

Major Benefits & Advantages



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- Excellent settling properties
- Increased capacity
- Enhanced BNR
 - TN 3 mg/L
 - TP < 1 mg/L
- Up to 75% smaller footprint
- Up to 50% energy savings
- No carrier media
- No bulking sludge
- Chemical savings – true biological
- Sustainable & robust technology

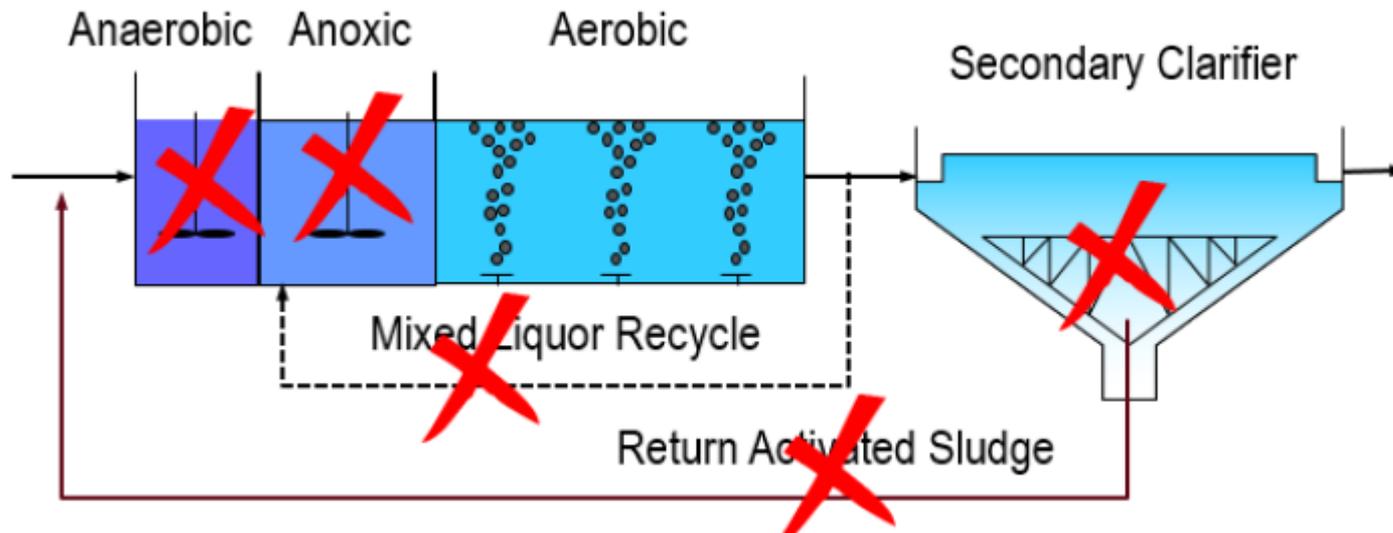


Simplified Construction & Operation



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- Elimination of “selector” zones/basins
- Elimination of all recycle (RAS) pumping (up to 4Q of feed flow)
- Combine clarifier and biological treatment in a single basin



Time-based cycle structure

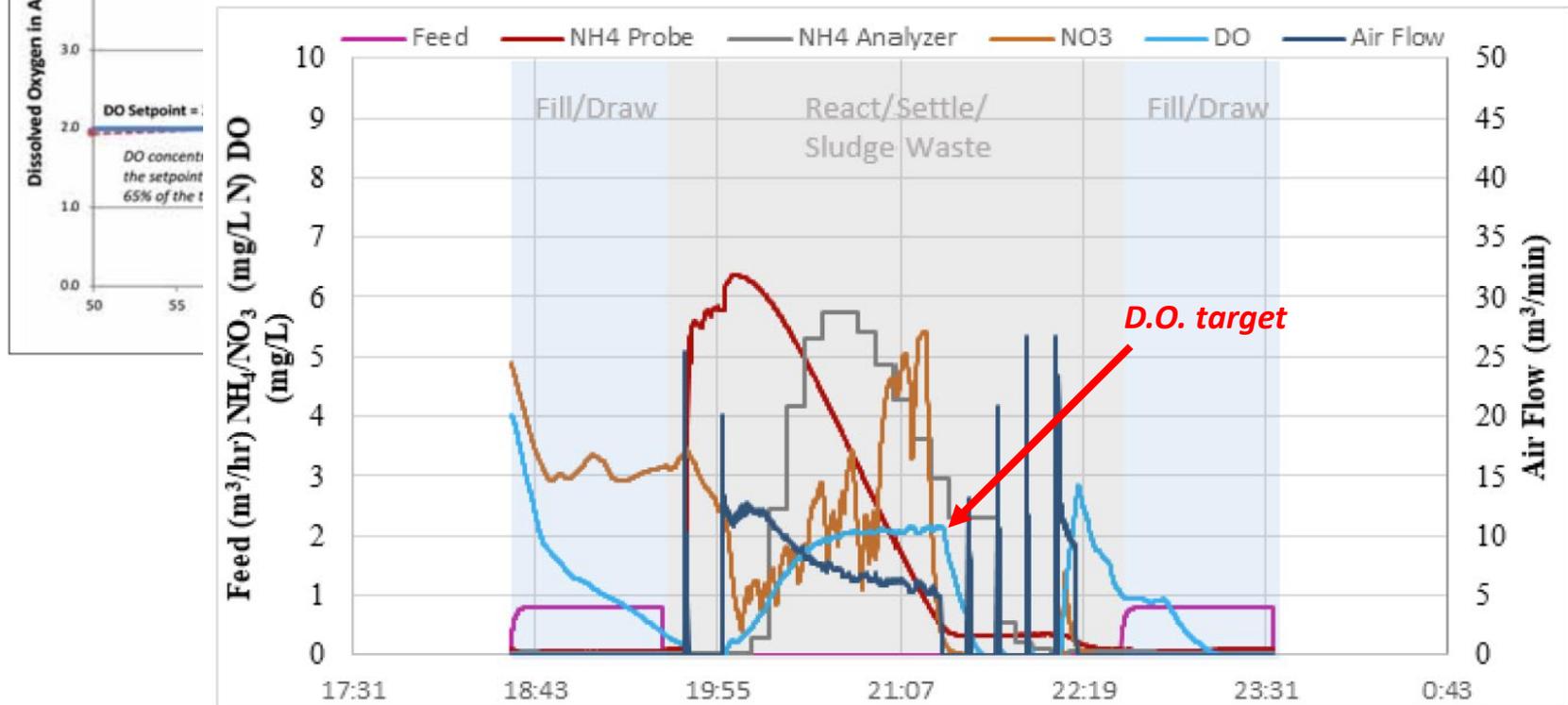


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Benefits include:

- Maintain target D.O. set point without over-aerating
- Simultaneous fill-draw = continuous flow
- Quiescent settling without inflow
- React phase duration flexible to meet treatment objectives

Aeration Efficiency



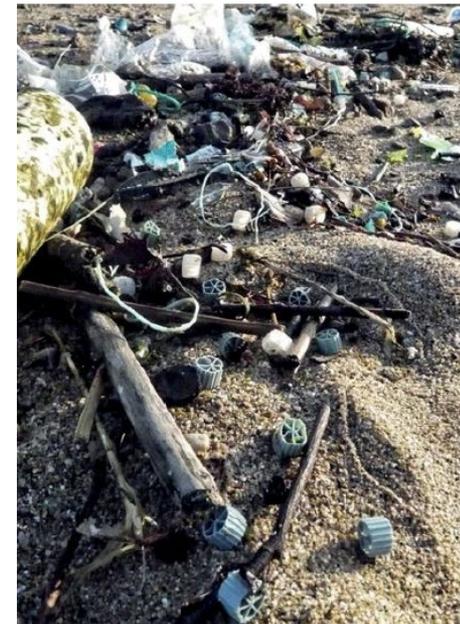
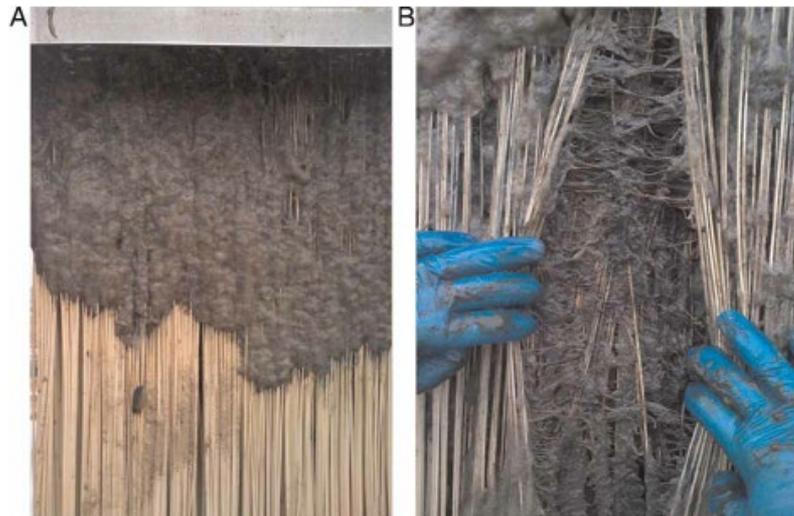
DO Setpoint = 2.0
DO concs the setpoint 65% of the t

Sustainability



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- No media replacement costs
- No media cleaning / regeneration
- No repair and ongoing maintenance
- No chemical cleaning



Water Savings



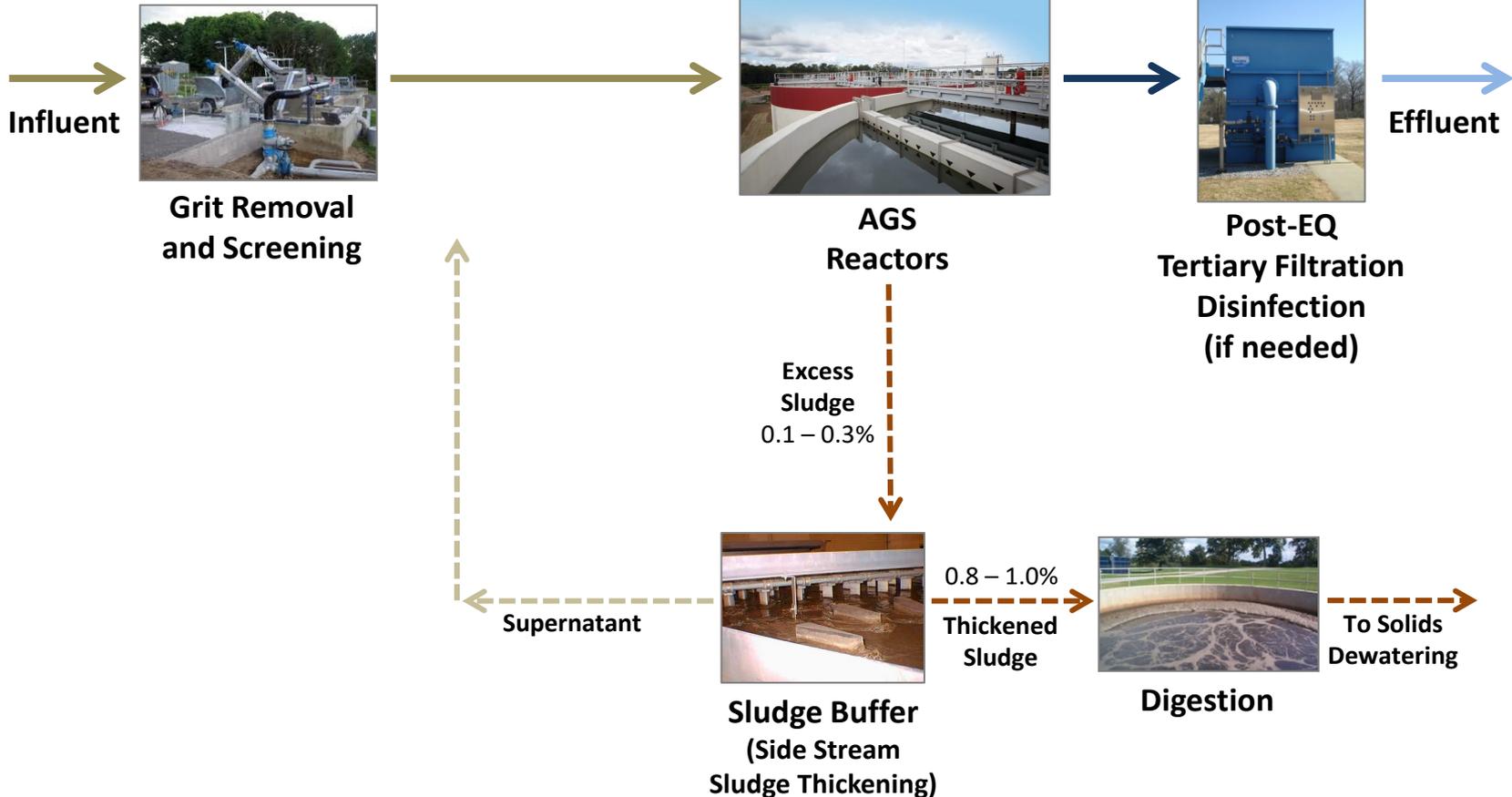
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- No backwash loss
- No chemical cleaning waste
- No media regeneration
- No “filter to waste” period

Recycling WAS Supernatant



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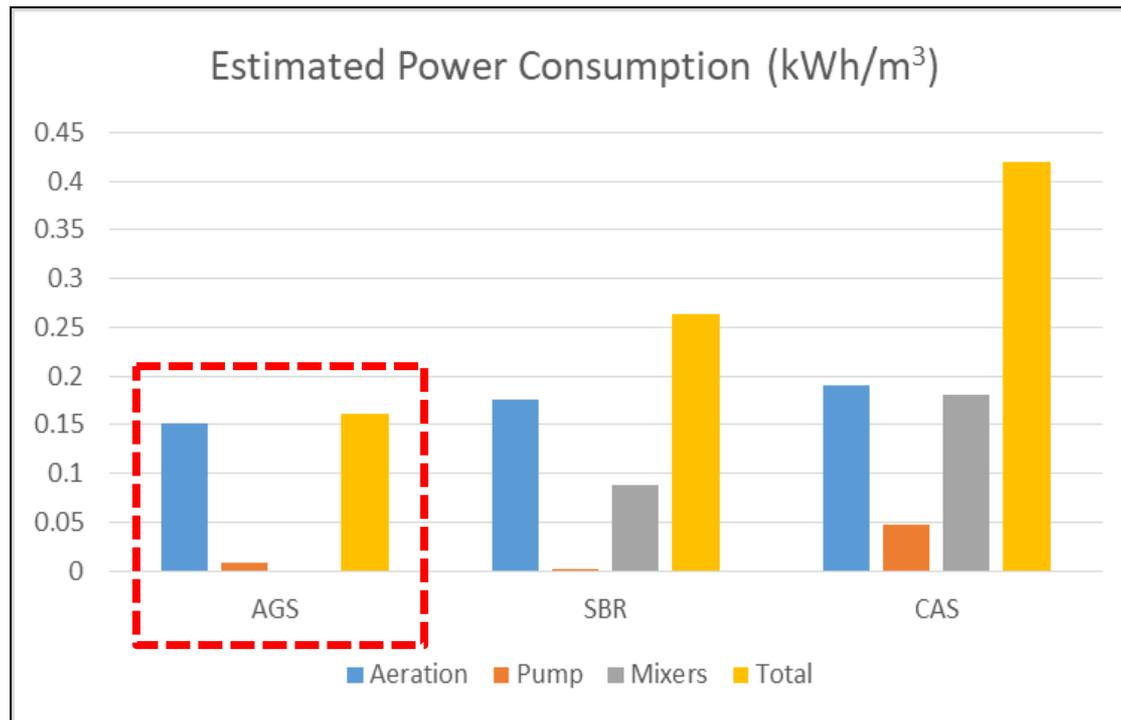


Energy Consumption & Equipment Reduction



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- Elimination of mechanical mixing
- Aeration efficiency
- Elimination of recycle pumping



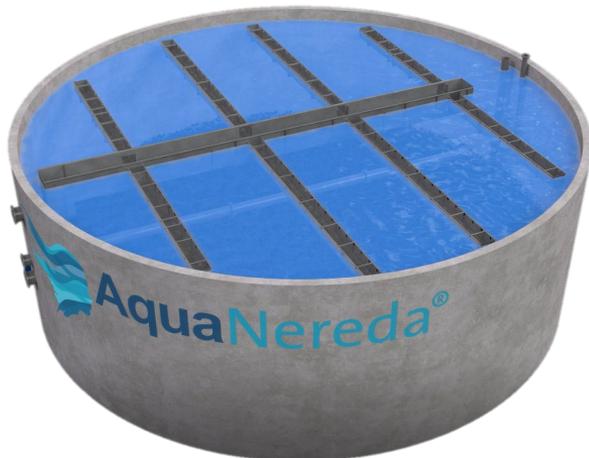
Maintenance & Reliability



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Inside the Tank

- Fine air bubble diffusers



Outside the Tank

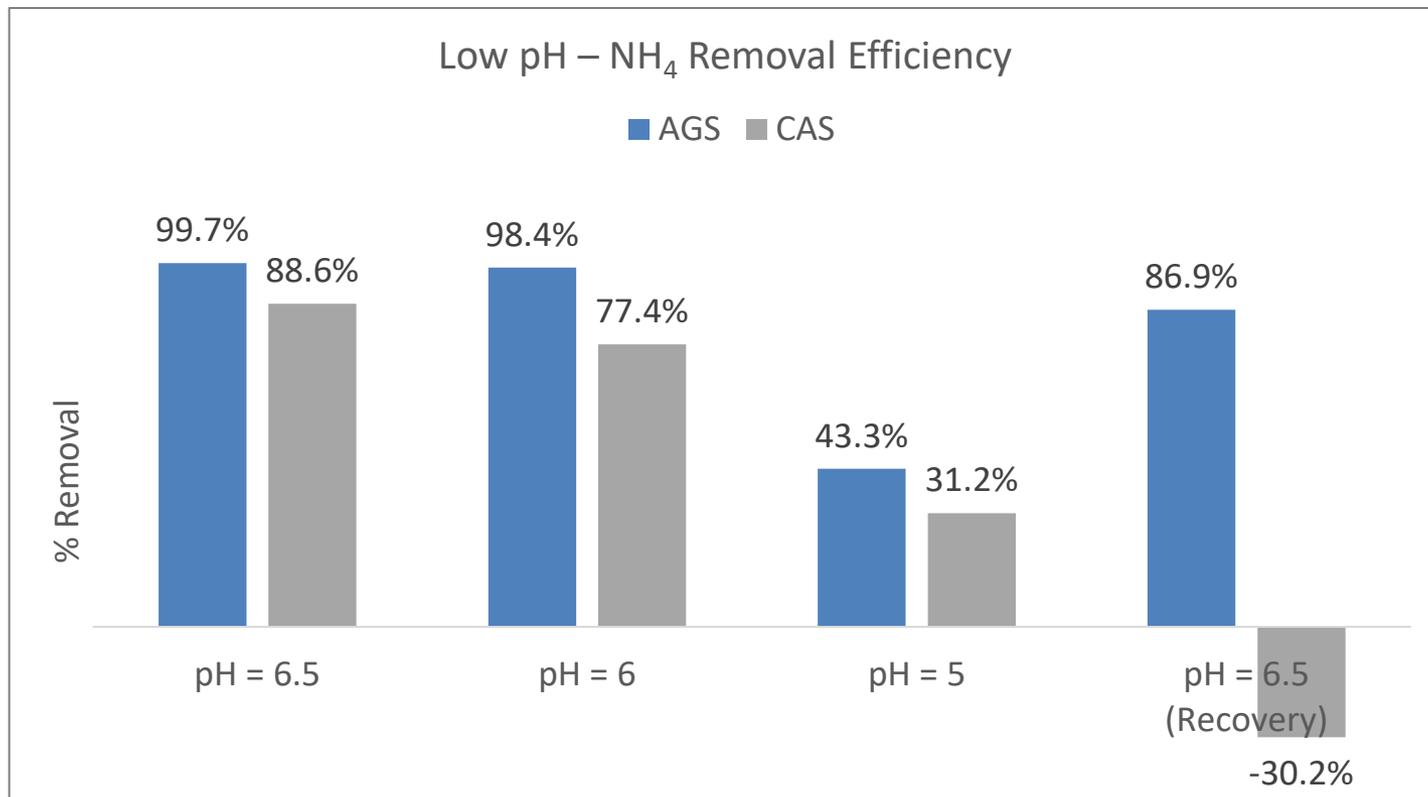
- Pumps
- Valves
- Blowers
- Instrumentation
 - Probes (pH, DO, ORP, TSS)
 - Analyzers (Phosphorus, Ammonia)

Process Robustness



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- pH impact on nitrification – AGS vs CAS



Footprint

AquaNereda® Aerobic Granular Sludge
Approx. 28,500 sq ft (0.65 acres)
3.5 MGD (avg), 6.0 MGD (peak)

Extended Aeration (Oxidation Ditch)
Approx. 91,675 sq ft (2.1 acres)
2.0 MGD (avg), 3.5 MGD (peak)



AquaNereda® Aerobic Granular Sludge
30% of previous footprint • 75% increase in treatment capacity

CAPEX & OPEX Comparison



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Alternative	Capital Cost ⁽¹⁾ (Millions)	
Alt. 1 – Conventional 3-stage (Diffused)	\$16.6	<p>Alt. 5 GrAS</p> <ul style="list-style-type: none"> ✓ Lowest Capital Cost ✓ Lower Annual O&M ✓ Lower NPV <p>Footprint Comparison</p> <ul style="list-style-type: none"> • Alt 1: 50' x 187', aeration only • Alt 5: 62' x 130', total
Alt. 2 – Conventional 3-stage (Mechanical)	\$18.9	
Alt. 3 – IFAS	\$18.2	
Alt. 4 – Conventional Single Basin (Phased NDN)	\$17.9	
Alt. 5 – GrAS	\$12.0	

(1) Cost for secondary treatment train only.





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AquaNereda[®]

Case Studies

Commercial Application

California, USA



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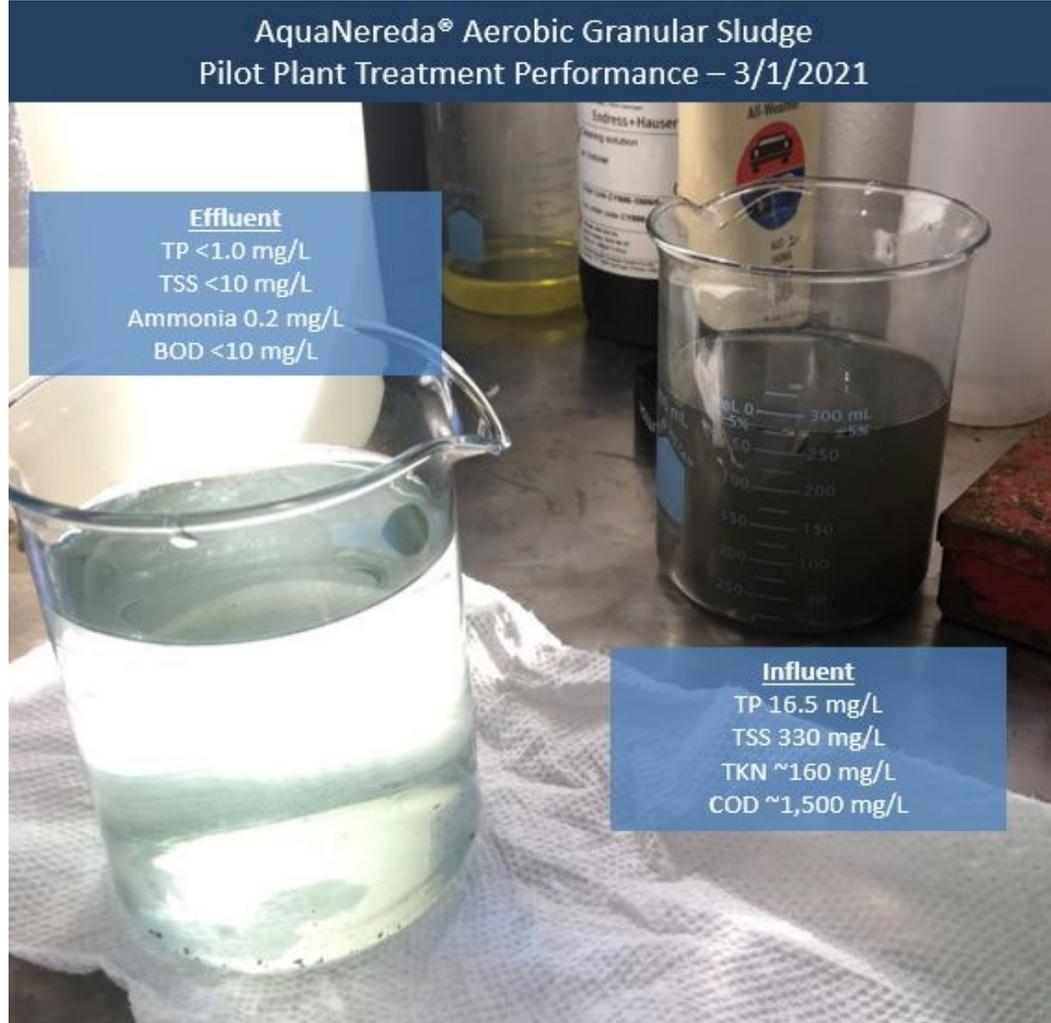
AquaNereda® Aerobic Granular Sludge Pilot Plant Treatment Performance – 3/1/2021

Effluent

TP <1.0 mg/L
TSS <10 mg/L
Ammonia 0.2 mg/L
BOD <10 mg/L

Influent

TP 16.5 mg/L
TSS 330 mg/L
TKN ~160 mg/L
COD ~1,500 mg/L



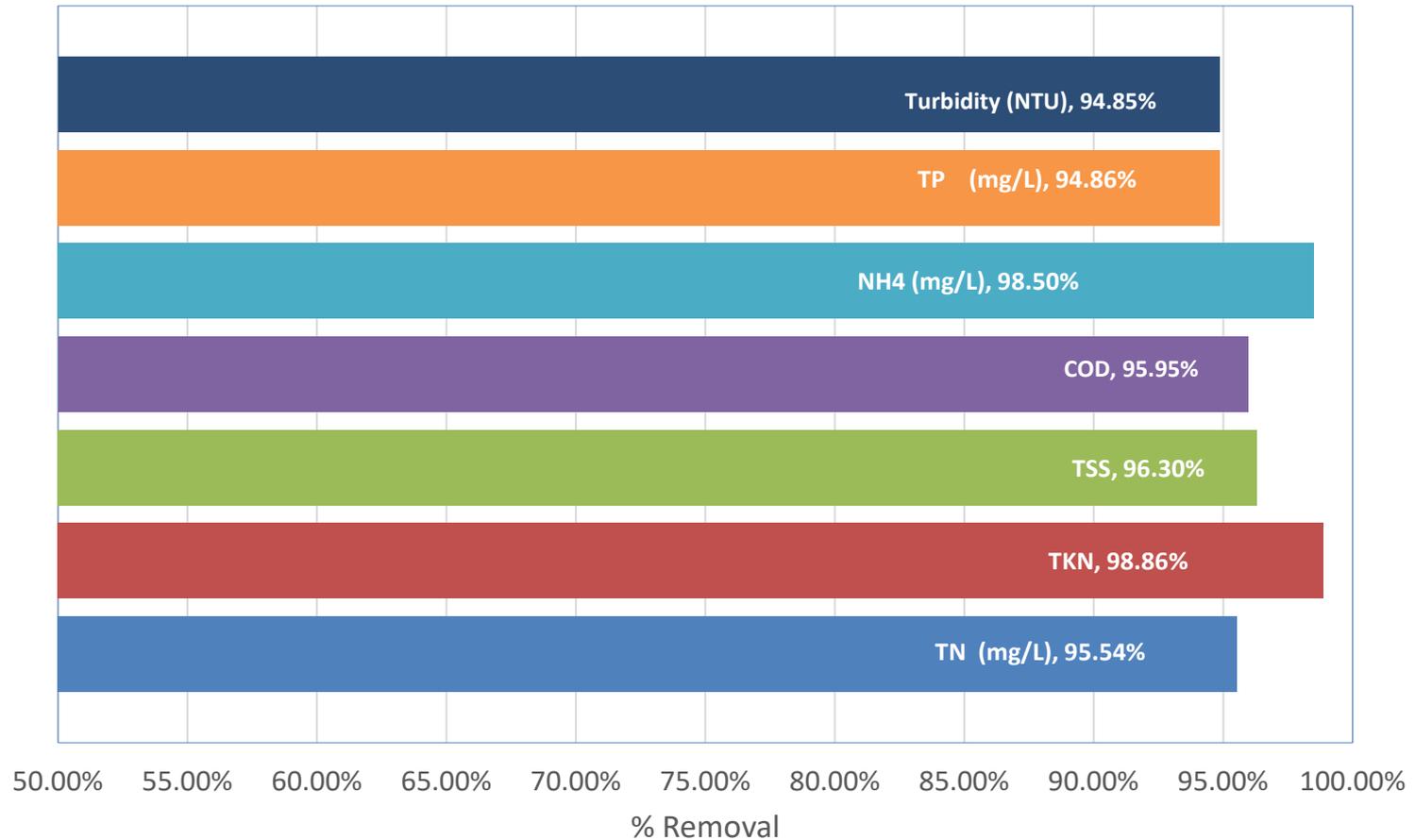
Commercial Application

California, USA



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% Removals (pilot)



Nereda[®] Industrial Experience

Vegetable Oil Refinery



- 2007 startup
- Retrofit of SBR with bulking sludge and TSS wash-out
- Influent COD 5,500 mg/l and ~7,000 mg/l sulphate
- Conversion to AGS quickly improved settling and performance

Idaho Springs, CO

Blended muni/industrial influent

- Retrofit of existing SBR System
- Two (2) basin SBR system
- No land available for expansion
- Domestic & Industrial mix
 - Municipal Waste
 - Brewery Waste
 - Distillery Waste



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Summary

- AquaNereda[®] provides:
 - reliable, simple, compact biological treatment
- “Proven experience - over 80+ plants and 15+ years
- Lowest total cost of ownership
 - Significant footprint and energy reduction
 - Installation costs greatly reduced compared to conventional
- Flexibility and ease of operation