Aerobic Granular Sludge System
Aerobic Granular Sludge

Definition

- True microbial biomass (no carrier!)
- Minimum particle diameter of $\sim 0.2$ mm (1-2mm optimum size)
- AGS SVI5 is comparable to SVI30 of typical activated sludge
Aerobic Granular Sludge
Granule Structure

Conventional Activated Sludge
Mixed Microbial Community

Aerobic Granular Sludge
Layered Microbial Community

PAO
Denitrifiers
Nitrifiers
GAO

Aerobic
Anoxic
Anaerobic
Aerobic Granular Sludge

- Excellent Settling Properties
- Increased MLSS

Granules
8 g/l or more
SVI$_5$

Flocs
4 g/l
SVI$_5$
Granule Formation
Selection Mechanisms

1) Hydraulic selection for fast settling particles
2) Biology selection of EPS forming microorganisms
   • PAO / GAO’s
Operational Description
AquaNereda® Process Flow

1. Influent
   - Grit Removal and Screening
2. Pre-EQ (if needed)
3. AGS Reactors
4. Side Stream Sludge Thickening
   - Tertiary Filtration and Disinfection (if needed)
5. Effluent
   - Digester
AquaNereda® Process Cycle
Process Characteristics
Characteristics

• Excellent settling properties
• Up to 75% smaller footprint
• Up to 50% energy savings
• Increased capacity
• Sustainable robust technology
• No support media
• No bulking sludge
• Chemical savings

Source: T.R. Devlin Aerobic Granular Sludge Presentation
Process Robustness

- Robust during less favorable conditions:
  - Salinity fluctuations
  - Chemical spikes
  - pH fluctuations
  - Load variations

Activated sludge and granular sludge with shock addition of 5,000 ppm NaCl after 5 min of settling
Applications and Scope
Ideal Applications

- Retrofit Applications
  - Any existing process
  - Higher flows and loads
- New construction
- Limited footprint
- Plant expansion
- Upgrade to BNR requirements
- Industrial plants
Existing Installations
## Nereda® Plants Around the World

### 40 Plants Worldwide

<table>
<thead>
<tr>
<th>Plant Name</th>
<th>Daily average flow (MGD)</th>
<th>Peak flow (MGD)</th>
<th>Startup Year</th>
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Garmerwolde, NL
Side-by-Side Operation
Garmerwolde, NL

Footprint

Flow Split

35%

65%
Frielas WWTP, Portugal
Partial Retrofit

• 1 of 6 Aeration basins was retrofitted into a Nereda® reactor
• Combined effluent of CAS and AGS meets effluent permit requirement
• 33% energy savings on aeration alone
### Flows

<table>
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<th>Average Flow (MGD)</th>
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### Parameters

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<td>TP</td>
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Effluent quality is after filtration
AquaNereda®
Demonstration Facility
Aerobic Granular Sludge
Demonstration Facility – Rockford, IL
0.2 MGD AGS
Demonstration Facility
Rockford, IL - 0.2 MGD AGS

Construction of a 0.2 MGD AquaNereda® reactor with associated pretreatment, instrumentation and mechanical equipment
AquaNereda®

Pilot Plant
Aerobic Granular Sludge
Pilot Plant
AquaNereda® Summary

- AGS reduces footprint, increases capacity and reduces energy
- Compact, sustainable, robust
- Achieves BNR and Bio-P removal
- Over 40 full scale installations worldwide
- Demo facility and pilot are resources to assist with implementation in the U.S.
Questions?