Energy Savings with High Rate Aeration

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Today’s Presentation

Objective

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Oxygen transfer efficiency

Aeration upgrade

Side-by-side testing

Performance and measured savings

What these results mean
Maximizing Energy Saving with Aeration Upgrade

- Convert surface mechanical (60, 2-speed units) to **fine bubble** aeration
- Predicted saving of **7.4 GWh/yr** and **$550,000/yr**
- **Enhance** operability and process flexibility
- Minimal **noise** emission
- Maintain **compliant** plant operations during construction
- **Phased** approach with consideration of primary tank improvements
135/200/630 MGD Treatment Plant

- **Preliminary** Treatment (630 MGD)
  - Screen and grit removal

- **Primary** Treatment (200 MGD)
  - East/West Clarifiers

- **Secondary** Treatment (135 MGD)
  - 20 Aeration Tanks
  - 4 Quadrants of 5 Tanks
  - 6 Final Clarifiers

- **Sludge** Thickening
  - 8 Gravity Units

- **Sludge** Dewatering
  - 4 Centrifuges
Aeration Tanks

- **High Rate Activated Sludge**
  - 1.5-2.5 hours HRT
  - 14 to 18 tanks in service (varies seasonally)
  - Monitor for nitrate and control F:M to minimize

30 manual gate valves
Aeration Basis of Design

Flow
(PE, RAS, Recycle)

- Max: 290 MGD
- Avg: 150 MGD
- Min: 95 MGD

BOD$_5$
Load

- Max: 180,000 lb/d
- Avg: 95,000 lb/d
- Min: 50,000 lb/d
Old Aeration Tank Configuration

- **Field measurements**
  - Structural integrity
  - Complete mix
  - Oxygen transfer efficiency
    - 1.8 lb/hp-hr
    - 61% of clean water ($\alpha$)
Aeration Efficiency in High Rate Systems

- **High Rate Systems**
  - Low oxygen transfer efficiency
  - Fine bubble has less turbulence
  - Interference of soluble BOD (surfactants)

- **Solution**
  - High sBOD gradient
  - Tank configuration

- **Surfactant molecules form a rigid surface on bubbles**
- **Aeration difficulty decreases with smaller bubbles**
  - Lower Alpha for fine bubble than for coarse bubble

- **Mechanical aeration**
  - Surfactants reduce surface tension resulting in formation of smaller liquid droplets
    - Increases available surface area for transfer
    - Alpha factors can be greater than 1.0
A Solution

- Add anaerobic selector
- Modify configuration to plug flow
  - Extend piping
  - Close 2 effluent sluice gates
Phasing Aeration Tank Upgrades
Phase 1 Aeration Tanks
Tank Modifications – Level Bottom

11% volume reduction
Tank Modifications – Install Over/Under Baffles
Ceramic Disks
Ceramic Disks

Sanitaire 9-inch ceramic diffusers
- 898 disks, 3 zones per tank
- 0.5 – 4 scfm per diffuser

Tank 1
1,138 disks
4 zones
Blowers

APG-Neuros Single-Stage Centrifugal Blowers
- 350 HP, 10,500-21,000 rpm
- 5,250 scfm @ 12.5 psig
Side-by-Side Testing – Does the Selector Improve OTE?

Fine Bubble w/ and w/o Selector

Test Parameters
- Flow: liquid and air
- MLSS/MLVSS
- Filtered BOD$_5$
- Dissolved oxygen

Results Indicator
- Airflow usage
Design average = 9.4 MGD
Tank 1 actual average = 8.1 MGD
Tank 2 actual average = 8.2 MGD
BOD$_5$ Load per Aeration Tank

Design average = 5,900 lb/d
Actual average = 6,100 lb/d
MLVSS per Aeration Tank
Aeration Tank Effluent Filtered BOD$_5$ Concentration
Airflow per Aeration Tank

Average Airflow
Tank 1 (no sel) = 1,950 scfm
Tank 2 (sel) = 1,630 scfm

Selector improves OTE by 16%
DO Probe Relocation

Tank 1

Tank 2

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Airflow per Aeration Tank (after DO probe relocation)

**Average Airflow**
Tank 1 (no sel) = 2,700 scfm
Tank 2 (sel) = 1,900 scfm

Selector improves OTE by 29%
DO Profiles and Probe Location

Selector eliminates DO sag at head of tank
Rebate for Saving Energy

- Initial estimate of 7.4 gWh/yr
- Application for 8.6 gWh/yr
  - $1,033,000 at $0.12/kWh saved
- Certified saving of 6.5 gWh/yr (value of $783,000)
  - Baseline usage = 16.1 gWh/yr
  - Blower usage = 8.3 gWh/yr
  - Selector mixing = 1.3 gWh/yr
- Phase 1
  - 4 Tanks modified (3 with selector)
  - 1.46 gWh/yr measured and verified saving (20% of 7.4)
What these results mean

- **Selector**
  - Does improve OTE
  - Stops DO sag at head of tank
  - Retrofit all aeration tanks with selector

- Modification in selector **mixing** can increase savings
  - Use influent flow kinetic energy for mixing

- **M&V** for Phase 1A and Phase 2
  - Improve airflow control
  - Lower system supply pressure
  - Stabilize blower start/stop cycles
  - Show the real electricity savings for this project
QUESTIONS?

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THANK YOU

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