Fermentation Enhanced Nutrient Removal at Janesville WWTF
WWOA – 46th Annual Conference
October 11, 2012

Presented by:
Nathan Cassity, AECOM
Joe Zakovec, Janesville Wastewater Utility
• Project background
• BNR design
• Startup and operation
• Supplemental carbon pilot
• What’s next?
Project Background
Project Background

- Current flow of 14 MGD
- Serves population of 60,000
- Biological phosphorus removal (BPR) first incorporated 2001 to 2003
  - Anaerobic / Oxic (A/O) configuration
  - Included backup chemical P removal facilities
  - Influent lacked sufficient VFAs
  - Chemical polishing used off and on
2003 A/O Process Configuration

- **Anaerobic**
- **Aerobic**
- **Mixing Basins**
- **Aeration Basins**
- **Mixed Liquor**
- **20% anaerobic volume**
- **80% aerobic volume**

*Project Background*
Project Background

2003 A/O Process Configuration
Project Background

- 2010 – 2011 upgrade project
  - $32 million upgrade
  - Capacity increase to 20 MGD
  - Incorporated biological nutrient removal (BNR)
  - New cogeneration facilities
  - Renovation of several 30+ year-old facilities
Biological Nutrient Removal Design
Biological Nutrient Removal Design

• Project goals:
  – Enhance biological phosphorus removal to eliminate chemical polishing
    • Effluent phosphorus goal between 0.3 mg/L and 0.5 mg/L
  – Incorporate biological nitrogen removal
    • Effluent nitrogen goal between 6 mg/L and 8 mg/L

• Resources utilized
  – BioWin computer simulations
  – AECOM Canada experts
**Biological Nutrient Removal Design**

- **Process configuration**
  - Anaerobic / Anoxic / Oxic (A²O)

![Diagram showing process configuration](image-url)
2011 A²O Process Configuration

Mixed Liquor

12% anaerobic volume
21% anoxic volume
67% aerobic volume
Biological Nutrient Removal Design

2011 A²O Process Configuration
• Fermentation incorporated into design due to low wastewater strength
  – Primary sludge is pumped to the fermenters
  – Fermenters store and thicken the sludge
  – VFA production is based on time and temperature
  – Operation based on target SRT
Biological Nutrient Removal Design

Fermenter SRT vs VFA Production

- Acetic Acid
• Overflow from fermenters provides the necessary VFA for biological phosphorus removal
• The remaining VFA flows into the anoxic zone for biological nitrogen removal
Biological Nutrient Removal Design

- Anaerobic Zones
- Anoxic Zones
- Aerobic Zones
- Nitrate Recycle
- VFAs
- Swing
Biological Nutrient Removal Design

• System components
  – Baffle walls
    • Create boundaries for the environments
    • Minimize short-circuiting
Biological Nutrient Removal Design

• System components
  – Mixers
    • Keep tankage completely mixed without aeration
Biological Nutrient Removal Design

- **System components**
  - Nitrate recycle pumps
    - High flow, low head pumping between tankage
Biological Nutrient Removal Design

- System components
  - Swing zones – aeration can be turned on or off
Startup and Operation
• BNR system overview
Startup and Operation

• Fermenters and anaerobic zones
Startup and Operation

- Fermenter overflow
  - Flow of 0.9 MGD
  - 7% of forward flow
  - Currently generating 1000 lbs/day VFA

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Janesville Effluent Phosphorus

- **Start-up**: 0.50 mg/L
- **Ethanol Waste Addition**: Average 0.50 mg/L
- **Ethanol Waste Removal**: Average 0.50 mg/L
Startup and Operation

**Ethanol Plant Waste Being Received**

Janesville Effluent Phosphorus and Nitrogen

- Total Phosphorus Average 0.09 mg/L
- Total Nitrogen Average 5 mg/L
Startup and Operation

Janesville Effluent Phosphorus
Most Recent Two Months

Total Phosphorus Average 0.50 mg/L

Total Phosphorus Average 0.35 mg/L
Startup and Operation

- Anoxic and aeration zones
Startup and Operation

Janesville Effluent Total Nitrogen 2011 - 2012

- Start-up
- Ethanol Waste Addition
- Ethanol Waste Removal

Average 7.0 mg/L
Average 5.5 mg/L
Supplemental Carbon Pilot
Supplemental Carbon Pilot

• Pilot Project
  – Evaluate feeding supplemental carbon from QLF Specialty Products
    • Liquid molasses blend product
    • 7.3 lbs COD per gallon (875,000 mg/L)

• Pilot Goal
  – Stabilize BPR performance near 0.10 mg/L effluent total-P *(no filters and no ferric chloride)*
Supplemental Carbon Pilot

- QLF product fed into fermenters
  - Fermenters convert product to VFA’s
  - VFA loading in fermenter overflow increased

80 gpd QLF Feed (600 lb/d COD)

Overflow (VFAs) to Anaerobic Zones

Fermented primary sludge

Primary sludge
Supplemental Carbon Pilot

Janesville Fermenter Overflow Volatile Acids

Volatile Acids (mg/L)

Ave. temp. in July was 94°F
1600 lbs/day VFA
1000 lbs/day VFA
Started feeding 80 gpd QLF Solution

Supplemental Carbon Pilot

Janesville Fermenter Overflow Volatile Acids

Volatile Acids (mg/L)

Ave. temp. in July was 94°F
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Supplemental Carbon Pilot

Janesville Effluent Phosphorus

- 0.10 mg/L P Average
- 0.35 mg/L P Average

- Started feeding 80 gpd QLF Solution
- Industrial Discharge?
What’s Next?
What’s Next?

• 2012 Fall / Winter Activities
  – Continue supplemental carbon feed pilot
  – Continue BNR optimization study
    • Analysis and adjustment of operating parameters
    • Stabilization of biological phosphorus removal
  – Evaluate (based on above results) if TMDL P limits can be achieved without upgrades.
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