FULL SCALE PILOT TARGETING LOW PHOSPHORUS AT JANESVILLE WPCF

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Presentation Outline

- Project background
- Pilot overview
- Results
- Conclusions
Project Background
Project Background

- Current flow of 14 mgd
- Serves population of 60,000
- 2010 – 2011 upgrade project
  - $32 million upgrade
  - Capacity increase to 19 mgd
  - Incorporated biological nutrient removal (BNR)
  - Renovation of several 30+ year-old facilities
Project Background

- BNR process configuration
  - Anaerobic / Anoxic / Oxic (A²O)
- Effluent phosphorus goal between 0.3 mg/L and 0.5 mg/L
Project Background

- TMDL Implementation for Rock River
  - Janesville is expecting permit renewal late this year
  - Monthly mass allocations will necessitate effluent P concentrations at or below 0.1 mg/L
  - Compliance schedule of 7 – 9 years
Pilot Overview
Pilot Overview

Lower than 0.1 mg/L technologies

- ACTIFLO® - Kruger, Inc.
- Densadeg® - Infilco Degremont, Inc.
- AquaDAF® - Infilco Degremont, Inc.
- Blue PRO™ - Blue Water Technologies, Inc.
- CoMag™ - Cambridge Water Technology
- DynaSand D2 Dual Filtration System - Parkson
- Ultra Filtration Membranes
Pilot Overview

ACTIFLO® - Kruger, Inc.

- Chemical demand – coagulant + 0.3 mg/l polymer
  - 30 mg/l FeCl₃
  - 75 mg /l Al₂ (SO₄)₃
  - 85 mg/l PAC
Pilot Overview

AquaDAF® - Infilco Degremont, Inc.

- Chemical demand – coagulant + 0.3 mg/l polymer
  - 40 mg/L FeCl₃
  - 60 mg/L Al₂(SO₄)₃
  - 80 mg/L PAC
CoMag™ - Cambridge Water Technology

- Chemical demand – coagulant + 3 mg/L polymer
  - 30 mg/l FeCl₃
  - 70 mg/l Al₂(SO₄)₃
  - 80 mg/l PAC
Pilot Overview

Pilot objectives

- Use coagulant + polymer dosing scheme to secondary treatment
- Evaluate if 0.10 mg/L effluent P is achievable without addition of tertiary treatment
- Establish chemical dosing requirements
Pilot Overview

Pilot methodology (Sept. 3 – Oct. 5, 2013)

- Phase 1 – ferric chloride dosing only
  - 35 mg/L ferric dose (300 gpd ferric, Q = 12 MGD)
  - 3 week duration

- Phase 2 – ferric chloride + polymer dosing
  - Maintain 35 mg/L ferric dose
  - 1.2 mg/L polymer dose (48 gpd, Q = 12 MGD)
  - 2 week duration
Pilot Overview

- Ferric dosing – use existing system
- Polymer dosing – set up temporary system
Pilot Results
Pilot Results

Influent and primary effluent total P

- Influent Total P
- Influent Average
- Primary Effluent Total P
- Primary Effluent Average

Phase 1
Phase 2
Pilot Results

➢ Effluent total P

![Phosphorus Concentration (mg/L) vs Time (08/24/13 to 10/12/13)]

- **Phase 1**: 0.0 to 0.7 mg/L
- **Phase 2**: 0.2 to 0.9 mg/L

- Phosphorus Concentration (mg/L)
- Time: 08/24/13 to 10/12/13

Legend:
- **Effluent Total P**

Graph shows the effluent total phosphorus concentration over time, with two distinct phases.
Pilot Results

- Effluent total P and filtered (soluble) total P

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<thead>
<tr>
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<th>08/24/13</th>
<th>08/31/13</th>
<th>09/07/13</th>
<th>09/14/13</th>
<th>09/21/13</th>
<th>09/28/13</th>
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<tbody>
<tr>
<td>Effluent Total P</td>
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<td>5-day Rolling Average Total P</td>
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- Phase 1
- Phase 2
Pilot Results

Effluent P speciation data

- Effluent Total P
- Effluent Filtered Total P
- Effluent Filtered Reactive P

Graph showing Phosphorus Concentration (mg/L) from 08/24/13 to 10/12/13, with separate data points for different phases.
Pilot Results

Effluent phosphorus speciation – average values

Note: Ortho P is part of reactive P

Prior to Pilot

- Soluble P: 0.076 mg/L
- Total P: 0.160 mg/L
- Particulate P: 0.084 mg/L
- Non-reactive Soluble P: 0.039 mg/L
- Reactive Soluble P: 0.037 mg/L

Phase 1

- Soluble P: 0.023 mg/L
- Total P: 0.060 mg/L
- Particulate P: 0.037 mg/L
- Non-reactive Soluble P: 0.022 mg/L
- Reactive Soluble P: 0.001 mg/L

Phase 2

- Soluble P: 0.032 mg/L
- Total P: 0.062 mg/L
- Particulate P: 0.030 mg/L
- Non-reactive Soluble P: 0.026 mg/L
- Reactive Soluble P: 0.006 mg/L
Pilot Results

Effluent TSS

- Effluent TSS
- 5-day Rolling Average

Phase 1
Phase 2

TSS Concentration (mg/L)

08/24/13  08/31/13  09/07/13  09/14/13  09/21/13  09/28/13  10/05/13  10/12/13
Pilot Results

- Mixed liquor MLSS

Graph showing TSS Concentration (mg/L) from 08/24/13 to 10/12/13, with phases labeled as Phase 1 and Phase 2.
Pilot Results

Mixed liquor MLVSS

- Mixed Liquor Volatile Suspended Solids
- 5-day Rolling Average

Phase 1
Phase 2

08/24/13 08/31/13 09/07/13 09/14/13 09/21/13 09/28/13 10/05/13 10/12/13

VSS (%)
Phase 2

➢ Summer 2014 long-term pilot
  ▪ 10-week duration starting June 1st
  ▪ Better measure of variability / stability
  ▪ June flows elevated
    • Better comparison to TMDL mass limits
  ▪ Refine chemical doses and annual cost estimates
Phase 2 - Pilot Methodology

- Phase 1, Ferric chloride dosing only
  - Start on Monday, June 2nd and run through July 13th
  - Initial ferric dose of 19 mg/L (200 gpd ferric, Q = 15 MGD)
  - Ended at 11.5 mg/L (130 gpd, Q = 16 MGD)
  - 6 week duration
Phase 2 – ferric chloride + polymer dosing

- This phase was canceled due to low effluent TSS and no need for polymer
- Monday, July 14th through August 10th
- Maintain phase 1 ferric dose
- 0.7 mg/L initial polymer dose (35 gpd, Q = 15 MGD)
- 4 week duration
Phase 2 - Pilot Results

Effluent total P versus ferric dose

- Effluent total P
- Ferric Dose

![Graph showing effluent total P versus ferric dose with data points and trend lines.](image-url)
Phase 2 - Pilot Results

Effluent TSS

- Effluent TSS
- 5-day Rolling Average

Graph showing TSS Concentration (mg/L) from 05/11/14 to 07/10/14.
Phase 2 - Pilot Results So Far
Conclusions
Conclusions

- Low primary effluent P = great advantage
- Effluent average P of 0.06 mg/L would allow Janesville to meet TMDL limits
- Phase 1 ferric dose response suggested over-dosing at 35 mg/L (300 gpd) dose
- Phase 2 ferric dose response suggests we are at the correct dose at 11.5 mg/L (130 gpd).
Conclusions

- Polymer benefits have not been fully tested
- Average TSS of 2 mg/L = great advantage
- Phase 1 cost analysis
  - Annual ferric chloride $104,000
  - Annual polymer $176,000
- Phase 2 cost analysis
  - Annual ferric chloride $45,000
  - Annual polymer $???