CSWEA Resource Recovery Seminar
November 10, 2016

NEW Water
Optimization Case Study
Clarifier Field Testing

Nathan Cassity, PE, BCEE
Donohue & Associates
Outline

- Background
- Clarifier Field Testing
- Test Results
- Potential Improvements

Acknowledgments

- NEW Water
  - Phil Mentink
  - Pat Wescott
  - Bruce Bartel
  - Jake Becken
  - Aaron Eichhorst
  - Matt Hooker
  - John Strandberg

- CPE Services
  - John Esler
  - Tim Miller

- Donohue
  - Andrew Dow
Background
Background

- 2014 permit renewal
  - Combined permit for Green Bay Facility and De Pere Facility
  - Part of Lower Fox River TMDL
  - Included mass allocation limits for P and TSS
  - Included 9 year compliance schedule
Background

NEW Water’s Permit Compliance Reports

- Operational Evaluation Report Due: June 2015
- Status Report #1 Due: June 2016
- Status Report #2 Due: June 2017
- Operational Evaluation Report Amendment Due: Dec 2017
- Pre-Compliance Alternatives Plan Due: March 2018
- Status Report #4 Due: June 2018
- Final Compliance Alternatives Plan Due: Dec 2018
Green Bay Facility (GBF)

Design: 49 MGD
Current: 32 MGD
De Pere Facility (DPF)

Design: 10 MGD
Current: 8 MGD
Phosphorus – De Pere Facility
Phosphorus – Combined GBF + DPF

6-month limit of 68 lbs/day
P Performance Required to Meet Limit

Target Effluent TP (mg/L) based on 68 lb/day discharge

- 0.14 mg/L at 58 MGD
- 0.24 mg/L at 34 MGD

Graph showing performance over time from January 2012 to December 2014.
TSS – Combined GBF + DPF

Monthly Limit of 1,601 lbs/day
TSS Performance Required to Meet Limit

Target Effluent TSS (mg/L) based on 1,600 lb/day discharge

- 3.3 mg/L at 58 MGD
- 5.6 mg/L at 34 MGD
Clarifier Testing
Background
Clarifier Testing Background

- **TSS Optimization Action Item**
  - Goal: Identify hydraulic improvements through field testing to improve clarifier performance (TSS performance)
  - Results of testing used to identify potential clarifier improvements
Clarifier Field Evaluation

CPE Services

- John Esler – founder and president
- Specializes in clarifier field evaluations
- Author of Field Testing Chapter 7 WEF MOP FD-8
NEW Water Clarifiers

Green Bay Facility – North Plant

8 “Squircle” Secondary Clarifiers
Inboard Launders
Size: 123 ft
SWD: 15 ft
NEW Water Clarifiers

Green Bay Facility – South Plant
2 Circular Clarifiers
Perimeter Launders
Diameter: 135 ft
SWD: 18 ft
Green Bay Facility Clarifiers

North Plant Clarifiers #5 & #6

South Plant Clarifier #4
At baseline flow rate:

- Determine hydraulic characteristics (e.g. flow curves, HRT, major currents)
- Monitor formation and movement of sludge blankets
- Monitor settling characteristics of mixed liquor and effluent solids

Repeat tests at successive elevated surface overflow rates
Clarifier
Field Testing
Field Tests

- Conducted in April 2016
  - Timed to fall during elevated spring flows
- Dye Tracer Tests
- Drogue Current Tests
- Dispersed/Flocculated Suspended Solids (DSS, FSS)
- Vertical Solids Profiles
Dye Tracer Tests
Dye Tracer Tests
Dye Tracer Tests
Drogue Current Measurements
Drogue Current Measurements
Settling & Floc. Potential
Vertical Solids Profiles
Vertical Solids Profiles
Vertical Solids Profiles
Field Testing Results
North - Dye Tracer Test Results

TEST #2: North Clarifiers #5 & #6 - Flow Curves at 15.6 mgd
SOR = 1070 gal/sq ft/day

Theoretical D.T. = 157 minutes
Clarifier 5 Operating D.T. = 62 minutes
Clarifier 6 Operating D.T. = 51 minutes

Imbalance in launders
North - Dye Tracer Test Results

North Plant Clarifier No. 5: Outside weirs favored at elevated flow
South - Dye Tracer Test Results

TEST #2: South Clarifier #4 - Flow Curve at 15 mgd
SOR = 1050 gal/sq ft/day

Theoretical D.T. = 202 minutes
Operating D.T. = 81 minutes

Short-circuiting dampened by sludge blanket elevation (deeper centerwell)
Drogue Current Measurements

North Plant Clarifier No. 5 at elevated flow: strong density currents
South - Vertical Solids Profiles

South Plant Clarifier

7:00 AM
8:30 AM
9:50 AM
Flocculation Potential Results

South plant mixed liquor – improved settling with more flocculation time
Potential Improvements
## Potential Improvements – North

<table>
<thead>
<tr>
<th>Identified Performance Characteristic</th>
<th>Supporting Field Test Data</th>
<th>Potential Improvement</th>
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</thead>
<tbody>
<tr>
<td>Density currents: short-circuiting</td>
<td>• Drogue current measurements</td>
<td>• Increase centerwell diameter to 20-25%</td>
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<tr>
<td></td>
<td>• Dye testing results</td>
<td>• Reduce centerwell depth</td>
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<td></td>
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<td>• Install energy dissipating inlet</td>
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<td></td>
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<td>• Install mid-radius cylindrical baffle</td>
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<tr>
<td>Out-of-balance launder: short-circuiting</td>
<td>• Dye testing results</td>
<td>• Replace launders in Clarifier No. 6</td>
</tr>
<tr>
<td>Inboard launder: short-circuiting at perimeter</td>
<td>• Dye testing results</td>
<td>• Replace launders with launders attached to outer wall</td>
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<tr>
<td>Disturbance and expansion of sludge blankets based on centerwell layout</td>
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<td>• Reduce centerwell depth</td>
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<td></td>
<td>• Vertical solids profile results</td>
<td>• Install an energy dissipating inlet</td>
</tr>
<tr>
<td>Potential for improved mixed liquor settling with additional flocculation</td>
<td>• Floc. potential test results</td>
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Mid-radius Cylindrical Baffle
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