YOUR BUGS ARE DOING BETTER THAN YOU THINK

Nathan Cassity, Donohue
49th Annual Conference
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Acknowledgements

- Rick Wenzel, Brookfield
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- Brian Helminger, Manitowoc
- Michael Bodoh, Tyson Foods
- Trevor Ghylin, Xylem
- Bob Dabkowski, Hach
- William Marten, Donohue
Presentation Outline

➢ Background
  ▪ Chemical P Removal
  ▪ Biological + Chemical P Removal

➢ Ortho-P Analyzers

➢ Case Studies

➢ Wrap Up
Background
Phosphorus Removal

Key to Basic P Removal
1. Convert soluble P to particulate P
2. Remove particles
When considering P removal...

- Conversion of soluble P to particulate P
  - Optimize biological processes
  - Increase chemical addition efficiency
  - Holistic plant approach
- Removal of particulate P
  - Improved clarification
  - Filtration
Chemical Phosphorus Removal

- Ortho-P (dissolved) is “reactive”
- Removing Ortho-P with chemical has diminishing returns
Chemical Phosphorus Removal in Secondary (single point dose)

- Can reliability treat under variable P loading
- Higher phosphorus content of secondary sludge (and effluent TSS)
  - Effluent TSS of 4% to 5% P
  - 10 mg/l effluent TSS → 0.4 mg/l P
- Requires low effluent solids concentration to achieve low effluent total P
Chemical addition for polishing

- BPR + chemical working together
  - Focus on two areas of chemical interaction
Dose point interaction

Chemical floc grows and adsorbs reactive phosphorus
In-basin interaction

Chemical floc continues to adsorb reactive phosphorus

Mass of chemical floc depends on operating SRT
Biological + Chemical

BPR interaction

PAOs continue to have an advantage – BPR stays healthy

Chemical lowers P
P still present for PAO uptake
Chemical interaction

Chemical dosing occurs at low P providing high dosing ratio

Chemical dose point provides best opportunity for optimization
Ortho-P Analyzers
Ortho-P Analyzers

- Effluent phosphorus concentration can vary widely over 24 hours
  - Composite sample doesn’t always tell the story
- Optimization requires more information
  - Real-time feedback = online analysis
- Monitoring probes have improved dramatically, but a phosphorus probe isn’t being sold yet
Ortho-P Analyzers

Ortho-P analyzers utilizing wet chemistry have become numerous in Wisconsin WWTF’s

- Can be used in multiple flowstreams, but most common is effluent

WI Installations

- Sheboygan
- Kiel
- New London
- Manitowoc
- Mayville
- Rib Mountain
- Racine
- Fond du Lac
- East Troy
- Green Bay
- De Pere
- La Crosse
- Beaver Dam
- Watertown
- Jackson
- Brookfield
- Black River Falls
- Kenosha
- Sun Prairie
- Superior
- Medford
Ortho-P Analyzers

Manufacturers

- ASA Analytics
- Hach
- YSI
- Endress+Hauser
Case Studies
Brookfield Background

- Fox River Water Pollution Control Center
  - Treating 9, permitted for 12.5 MGD
  - BPR with chemical polishing (Alum)
  - 0.075 mg/L WQBEL by September 2021
  - Currently working on OER action items for phosphorus optimization
    - Installed an Ortho-P analyzer in 2014 to control chemical polishing
Control using Ortho-P analyzer started June 2014

- Alum Average of 220 gpd
- Alum Average of 170 gpd
Control using Ortho-P analyzer started June 2014

- Alum Average of 220 gpd: Average 242 lb-P/d removed
- Alum Average of 170 gpd: Average 246 lb-P/d removed

23% Chemical Savings
Brookfield FRWPCC

- Alum dosing automated based on real-time effluent Ortho-P
Alum dosing automated based on real-time effluent Ortho-P

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Alum Use</td>
<td>220 gpd</td>
<td>170 gpd</td>
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<tr>
<td>Alum Cost (6 months)</td>
<td>$45,770</td>
<td>$35,520</td>
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<tr>
<td>Effluent Total P</td>
<td>0.71 mg/L</td>
<td>0.71 mg/L</td>
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23% Chemical Savings
$10,250 saved in 6 months
Sheboygan Background

- Sheboygan Regional WWTP
  - Treating 11 mgd, Design 18 MGD
  - BPR with chemical polishing (Ferric)
  - Facing 0.6 mg/L Lake Michigan interim limit
  - Installed Ortho-P analyzer in 2010 to control chemical polishing
Ferric dosing automated based on real-time effluent Ortho-P

- Between $30k and $45k annual chemical savings

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual Ferric Chloride Cost</th>
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<tbody>
<tr>
<td>2009</td>
<td>$156,340</td>
</tr>
<tr>
<td>2010</td>
<td>$149,260</td>
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<tr>
<td>2011</td>
<td>$104,150</td>
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<tr>
<td>2012</td>
<td>$106,770</td>
</tr>
<tr>
<td>2013</td>
<td>$121,200</td>
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<tr>
<td>2014</td>
<td>$108,702</td>
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25% Chemical Savings
$38,000 saved per year
Manitowoc Background

- Manitowoc WWTF
  - Treating 6, permitted for 15.5 MGD
  - Fixed film (trickling filters) facility with chemical P removal (ferric chloride)
  - 0.6 mg/L Lake Michigan interim limit caused an increase in ferric chloride dosing/costs
  - Purchased Ortho-P analyzer in 2012 and automated the ferric dosing to keep Ortho-P below 0.4 mg/L
Chemical savings paid for analyzer in 4 months

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual Ferric Chloride (gal)</th>
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<tbody>
<tr>
<td>2010</td>
<td>142,960</td>
</tr>
<tr>
<td>2011</td>
<td>140,750</td>
</tr>
<tr>
<td>2012</td>
<td>106,190</td>
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25% Chemical Savings
$30,000 saved in 2012
Tyson Foods Background

- Formerly Hillshire Farms in New London
  - Treating 1 MGD
  - Highly loaded facility
  - 0.075 mg/L WQBEL by January 2019
  - Working on OER action items for phosphorus optimization
    - Installed temporary BPR in 2014 - baffle curtain and mixer for A/O process
    - Installed an Ortho-P analyzer in 2014
## Tyson Foods

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<tbody>
<tr>
<td>Ferric Chloride Use</td>
<td>337,000 gal</td>
<td>108,000 gal</td>
</tr>
<tr>
<td>Ferric Cost</td>
<td>$66,220</td>
<td>$21,310</td>
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<tr>
<td>Effluent Total P</td>
<td>0.41 mg/L</td>
<td>0.42 mg/L</td>
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68% Chemical Savings
$45,000 saved in 6 months
Other stories

➢ Beaver Dam, WI – published info from Hach
  ▪ Automated dosing system showed 56% savings on ferric chloride feed

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<thead>
<tr>
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<th>Before</th>
<th>After</th>
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<tbody>
<tr>
<td>Dose</td>
<td>12.5</td>
<td>PRTC Dose (average)</td>
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<tr>
<td>Gallons Consumed</td>
<td>48,000</td>
<td>Gallons Consumed</td>
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<tr>
<td>Gallons Saved</td>
<td></td>
<td></td>
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<tr>
<td>% Saved</td>
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Other stories

- Black River Falls, WI – provided by Xylem
  - Automated dosing system showed 95% savings on ferric chloride feed

![Graph showing ferric chloride usage and effluent total phosphorus over time. The graph highlights a 95% reduction in chemical feed with the OSCAR real-time control system.]
Wrap-Up

- Composite samples don’t always tell the story
- Optimization requires more information
  - Real-time feedback = online analysis
- Ortho-P analyzers can provide that real-time feedback
- These success stories illustrate the benefit
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