
49th Annual WWOA Conference

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Outline

• Waukesha Plant Background
• Compliance Schedule

• Testing Summaries
  • Multi-Point Chemical Feed
  • BluePRO® Reactive Filtration
  • Full-Scale Hydraulic Stress Testing
  • SorbX-100 Full-Scale Testing

• Conclusions
Waukesha Plant Background

1. 1 mg/L P limit at least since early 1980s due to Illinois Fox River discharge.
2. c. 1975 tank and feed pumps for pickle liquor retrofitted to 1960s era trickling filter plant.
4. Mid-80s, convert alum to ferric chloride due to inadequate removal.
Waukesha WWTP after 1977-82 upgrade
Includes 1920s, 40s and 60s upgrades
Trickling filter secondary treatment
Waukesha Plant Background

- 1995 upgrade, plant converted to activated sludge with extended aeration for improved ammonia removal, no bio-P
- Increase filters from 6 to 8 cells
- Alternate feed point at end of aeration basins
- Average effluent TP 2005 – 2013 = 0.22 mg/L
Waukesha WWTP after 1992-95 upgrade
Conversion to extended aeration activate sludge
1920s, 40s and 60s treatment trains eliminated
Effluent P monthly average, 2005 - 2008

Maximizing P removal
Effluent P monthly average, 2009 - 2013

Save on chemical costs while still conservatively meet limit
Discharge Permit 2013-2018

- Permit issued 2013 includes compliance schedule for low level P with 0.7 mg/L interim limit
- Final limits to be 0.075 mg/L and 8.76 lbs/day as 6 month averages, 0.225 mg/L monthly average
- Waukesha Water Utility is pursuing Lake Michigan water
- If implemented, WWTP would be required to return water to Great Lakes watershed
- May affect P limits implementation; no variance for new discharge, and possibly lower limits
### Compliance Schedule for Fox River Discharge

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<th>Item</th>
<th>Due Date</th>
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<tr>
<td>Permit Effective</td>
<td>6/30/13</td>
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<tr>
<td>Operational Evaluation Report</td>
<td>6/30/14</td>
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<tr>
<td>Study of Feasible Alternatives:</td>
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<tr>
<td>Start</td>
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<tr>
<td>Status Report</td>
<td>6/30/15</td>
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<td>Preliminary Compliance Plan</td>
<td>6/30/16</td>
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<tr>
<td>Final Compliance Plan</td>
<td>6/30/17</td>
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<tr>
<td>Achieve Compliance with WQBEL</td>
<td>6/30/2020</td>
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Testing Summaries

Multi-Point Chemical Feed

 Reactive Sand Filtration

SorbX-100

Full-Scale Hydraulic Stress Testing
Multi-Point Chemical Feed
Influent

Screening and Grit Removal

Primary Clarifiers

Activated Sludge Aeration Basins

Secondary Clarifiers

Coag. Basins

Tertiary Clarifiers

Tertiary Sand Filters

UV Disinfection and Post Aeration

39 MGD (PH)
55 MGD (PI)

Influent

To Landfill

PS to Digestion

WAS to Digestion

Recycled Chemical Sludge

Ferric Chloride

Bypass

Recycled Chemical Sludge

Fox River

PH = Peak Hourly
PI = Peak Instantaneous

31.46 MGD
39 MGD

RAS

Bypass
Multi-Point Chemical Feed Proves Successful on Limited Occasions

12/1/2014 – 4/26/2015
(not including 1/15/2015 – 1/30/2015)
66 gal/mgd ferric chloride
0.09 mg/L effluent TP average
Reactive Filtration Pilot Using BluePro Filters
BluePRO Single-Pass Pilot Test Results

Average results consistently met 0.075 mg/L goal.
BluePro Two-Pass Pilot Test Results

Two pass system consistently met 0.03 mg/L target effluent Phosphorus.
Full-Scale Hydraulic Stress Testing to Test Filter Performance
Full-Scale Hydraulic Stress Testing Results

Filter Hydraulic Loading vs. Effluent Total Phosphorus (mg/L)

- Filter Hydraulic Loading in gpm/sq ft
- Effluent Total Phosphorus in mg/L

Date Range: 12/1/2014 to 4/15/2015

Key Dates:
- 12/16/2014
- 12/31/2014
- 1/15/2015
- 1/30/2015
- 2/14/2015
- 3/1/2015
- 3/16/2015
- 3/31/2015
- 4/15/2015
Effluent P Increases with Increased Hydraulic Loading

$$y = 0.0788x - 0.0703$$

Filter Design Loading Rate at Average Flow
SorbX-100

- Mixed rare earth chloride
- 31% - 35% w/w
- Strong attraction to phosphorus
- Reduce amount needed
- Generate less chemical sludge
- Higher pH with less corrosive impact
SorbX-100 Full-Scale Test

- Discontinued all coagulant for 2 weeks prior to starting test.
- Started dosing SorbX-100 to the tertiary clarifiers on 5/7/15
- Continued with only SorbX-100 for 2 weeks.
- Initial feed at 225 gpd, increased to 300 gpd, then 330 gpd 5/11
- Started dual-chemical feed (SorbX-100 to tertiary clarifiers and ferric chloride to mixed liquor) on 5/21/15.
- Started feed at 165 gpd Sorb-X and 275 gpd ferric.
- Increased to 165/325 on 6/9/15, then to 190/370 on 6/16/15
SorbX-100 Significantly Reduced Effluent P

Waukesha WWTP SorbX-100 Pilot Test

- Effluent Target
- Effluent TP
- Coaf Eff Ortho P
- Ortho P Rolling Average

Phosphorus (mg/L)


R² = 0.5021
Conclusions

- Multi-point chemical feed can meet the future effluent limit; however, filtration capacity is insufficient for long-term compliance. SNRP must be reasonably low.

- Reactive filtration can meet the future effluent limit of 0.075 mg/L in a single-pass. It could meet a goal of 0.03 mg/L in a two-pass configuration.

- Full-scale hydraulic stress-testing proved limited hydraulic capacity in the sand filters.

- SorbX-100 did not perform better than ferric chloride in full-scale tests.
Next Steps

• Upcoming ballasted filtration pilot test using ACTIFLO.
• Continued evaluation of various alternatives to meet effluent limits.
• Several viable alternatives still available.

• Win = alternative with best fit for facility needs and economic (capital, operating, and biosolids disposal) constraints while providing regulatory compliance.