AquaPrime Cloth Media
Filtration

John Dyson
Product Channel Manager
Presentation Outline

• Applications
• AquaPrime Cloth Media Filter Design
• Pilot and Full Scale Testing
• Frequently Asked Questions
• Summary
Technology Timeline
Cloth Media Filtration

- 3,000+ Cloth Media Filters Worldwide
- New Plants and Retrofits

- Size Ranging from 0.1 to 300+ MGD
OptiFiber® Pile Cloth Media

Pile Fibers

Support Backing
Primary Filtration & Primary Effluent Filtration
Primary Influent & Effluent Filtration

Wastewater → Screening → AquaPrime (CMF) → Biological Treatment → Secondary Clarifier → Tertiary Filtration (CMF) → Disinfection → Discharge

AquaPrime (CMF) → Primary Sludge

Blowers → Biological Treatment → Return Activated Sludge

Secondary Clarifier → Waste Activated Sludge

Secondary Clarifier → Digester Gas

AquaPrime (CMF) → Thickener

Thickener → Anaerobic Digester → Digested Sludge

Return Activated Sludge → Waste Activated Sludge

Primary Sludge → Digester Gas

Waste Activated Sludge → Discharge
Primary & PEF Filtration

Where to Apply?

• Qualifies as a Green Technology

• Energy saving, less blower energy, more gas produced

• Replace/Retrofit existing primary clarifiers
  • Plant expansions
  • New construction, space savings

• Increased Capacity
  • Nutrient removal in the same basin
  • Increase hydraulic capacity
AquaPrime
Cloth Media Filter Design
AquaPrime
Basics - Differentiation

Floatable Zone

Filtration Zone

Solids Zone
AquaPrime
CMF Adaptations

- Elevated Tank Height
- Influent Baffle Relocated
- Raised Centertube
- Redesigned Solids Collection Manifold
- Redesigned Hopper Bottom
- Floatable Added
AquaPrime

CMF Adaptations

- Floatable Weir Added
- Elevated Tank Height
- Raised Centertube
- Redesigned Solids Collection Manifold
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AquaPrime

CMF Adaptations

- Elevated Tank Height
- Influent Baffle Relocated
- Raised Centertube
- Redesigned Solids Collection Manifold
- Floatable Weir Added
- Redesigned Hopper Bottom
Mechanical Configurations
Mid-sized to Large Flows
Primary & PEF
Pilot and Full Scale Testing
Primary Effluent Filtration
Linda County WWTP, CA

- Funded by California Energy Commission CEC
- Ran for 2 years with 99% uptime, no cloth wear
- Flux of 4.0 gpm/sf sustainable
- Influent TSS 80-160 mg/L
- TSS removal 50-60%
- Reduce load to aeration basin
- Increase quality of solids to anaerobic digestion
Pilot Testing
Linda County WWTP, CA

- Filter influent TSS 80-160 mg/L
- Filter TSS removal about 50-60%
- Filter effluent TSS 40-60 mg/L
- Backwash approximately 5-6%

<table>
<thead>
<tr>
<th></th>
<th>Influent</th>
<th>Effluent</th>
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<tbody>
<tr>
<td>TSS (mg/L)</td>
<td>120</td>
<td>60</td>
</tr>
<tr>
<td>VSS (mg/L)</td>
<td>110</td>
<td>50</td>
</tr>
<tr>
<td>BOD (mg/L)</td>
<td>180</td>
<td>130</td>
</tr>
<tr>
<td>COD (mg/L)</td>
<td>160</td>
<td>120</td>
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</table>
Primary Filtration

Test Results: Example of Energy Management

10 MGD - Annual Aeration Energy
($0.1054/kw-hr)

$400,000
$350,000
$300,000
$250,000
$200,000
$150,000
$100,000
$50,000
$-

$370,000  $260,000  $170,000

- No Primary Treatment  - Primary Sedimentation  - Primary Filtration
OptiFiber® Pile Cloth Media

Test Results: Implications

Settling Basin

Aqua MegaDisk Filter

Dimensions:
- Length: 60 ft
- Width: 40 ft
- Height of Settling Basin: 20 ft
- Height of Aqua MegaDisk Filter: 12 ft
Pilot Testing
Rock River Water Reclamation District, IL

Raw Sewage → Screen (¼ inch openings) → Grit Removal → Primary Clarifier → Filtration
Pilot Testing
Rock River Water Reclamation District
Pilot Testing
Rock River Water Reclamation District

- 24/7 operation
- Side-by-side testing with primary clarifier
- Flux rates 3.25 – 4.0 gpm/sf-day
- Filter influent TSS averaged 236 mg/L (104 – 526 mg/L)
- Solids loading rates approximately 9 – 10 lb/sf-day
- No chemical addition for most runs
Pilot Testing
Rock River Water Reclamation District

OptiFiber PA2-13®
(Apr – May 2014)

OptiFiber PES-14®
(May – Sep 2014)
Pilot Testing
Rock River Water Reclamation District

<table>
<thead>
<tr>
<th>TSS Removal (%)</th>
<th>Primary</th>
<th>PA2-13</th>
<th>PES-14</th>
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<tr>
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<td>66.4</td>
<td>80.4</td>
<td>87.5</td>
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<table>
<thead>
<tr>
<th>BOD Removal (%)</th>
<th>Primary</th>
<th>PA2-13</th>
<th>PES-14</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>43.6</td>
<td>54.2</td>
<td>64.2</td>
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</table>
Pilot Testing
Rock River Water Reclamation District

OptiFiber PA2-13

- Influent
- Effluent

TSS Concentration (mg/L)

Test Day

[Graph showing TSS concentration over test days]
Pilot Testing
Rock River Water Reclamation District
Pilot Testing
Rock River Water Reclamation District

![Bar chart showing Influent BOD and Effluent BOD concentrations for Primary, PA2-13, and PES-14. The chart illustrates a reduction in BOD concentrations.](image-url)
Pilot Testing
Rock River Water Reclamation District
Pilot Testing
Rock River Water Reclamation District

- One test with chemical addition on August 28, 2014
- PES-14 cloth media
- 5 mg Fe$^{+3}$/L and 0.1 mg/L of polymer
- 120 NTU $\rightarrow$ 7 NTU
- TSS less than 10 mg/l
- Did not test for UVT
- Chemical free option preferred
Primary & PEF
Pilot Test Summary
Oak Hill, WV Testing & Results

• Oak Hill, WV has been asked to take on additional flow from a neighboring town

• To bring this town online, the plant capacity needs to increase.
Oak Hill, WV
Pilot Setup

Raw Sewage $\rightarrow$ Screen $\rightarrow$ Grit Channel $\rightarrow$ Filtration

• 2.0 – 3.0 gpm/ft² / No chemical addition
Oak Hill Results

Backwash
Influent
Effluent
Oak Hill Results

Total Suspended Solids

- 178 mg/L Influent TSS
- 32 mg/L Effluent TSS
- 81% removal

Total Suspended Solids (mg/L)

- Influent
- Effluent
- avg Effluent
- avg Influent

• 246 mg/L Influent BOD
• 155 mg/L Effluent BOD
• 44% removal
Ashville, NC
TSS Results

Test
Influent
Effluent
avg Effluent
avg Influent

Total Suspended Solids, (mg/L)
Ashville, NC
BOD Results

- Inf. BOD
- Eff. BOD
- Inf. COD
- Eff. COD
- Avg. Inf. BOD
- Avg. Eff. BOD

Test Run:
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

BOD (mg/L):
0 50 100 150 200 250 300 350 400
Ashville, NC
Removal Efficiencies

- %BOD5 Removed
- Average %BOD Removed
- %TSS Removal
- Average %TSS Removed

%Removed:
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Typical Questions

• **Backwash & Solids Waste**
  
  • Ranged from 12 to 13% of the applied flow
  
  • Send to thickener prior to digestion

• **Cloth Wear**
  
  • Two year PEF operation – no visible wear
  
  • Nearly half year PF operation – no visible wear

• **Fats, Oils and Grease (FOG)**
  
  • Did not affect the operation or removal performance
  
  • Removal considerations in full scale design

• **Grit Was Not a Problem**
  
  • Includes removal in tank bottom
TRA – Central WWTP, TX

PI Removal Efficiencies

Figure 1
Primary Influent Study
Overall Average Filter Influent and Effluent TSS Levels

Figure 2
Primary Influent Study
Daily TSS Removals
TRA – Central WWTP, TX

PE Removal Efficiencies

Figure 3
Primary Effluent Study
Overall Average Filter Influent and Effluent TSS Levels

Figure 4
Primary Effluent Study
Daily TSS Removals
TRA – Central WWTP, TX

**SLR**

**Figure 9**
Primary Influent Study
Daily SLRs

**Figure 10**
Primary Effluent Study
Daily SLR
## Pilot Test Summary

### TSS Removal

<table>
<thead>
<tr>
<th>Media</th>
<th>Influent (mg/L)</th>
<th>Effluent (mg/L)</th>
<th>Removal (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RRWRD PA2-13</td>
<td>253</td>
<td>44</td>
<td>80%</td>
</tr>
<tr>
<td>RRWRD PES-14</td>
<td>221</td>
<td>26</td>
<td>88%</td>
</tr>
<tr>
<td>Oak Hill, WV PES-14</td>
<td>176</td>
<td>31</td>
<td>81%</td>
</tr>
<tr>
<td>The Dalles, OR PES-14</td>
<td>206</td>
<td>40</td>
<td>80%</td>
</tr>
<tr>
<td>Asheville, NC PES-14</td>
<td>188</td>
<td>24</td>
<td>87%</td>
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</table>
## Pilot Test Summary

### BOD Removal

<table>
<thead>
<tr>
<th>Location</th>
<th>Media</th>
<th>Influent (mg/L)</th>
<th>Effluent (mg/L)</th>
<th>Removal (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RRWRD PA2-13</td>
<td></td>
<td>220</td>
<td>95</td>
<td>54%</td>
</tr>
<tr>
<td>RRWRD PES-14</td>
<td></td>
<td>169</td>
<td>59</td>
<td>64%</td>
</tr>
<tr>
<td>Oak Hill, WV PES-14</td>
<td></td>
<td>242</td>
<td>149</td>
<td>40%</td>
</tr>
<tr>
<td>The Dalles, OR PES-14</td>
<td></td>
<td>168</td>
<td>65</td>
<td>59%</td>
</tr>
<tr>
<td>Ashville, NC PES-14</td>
<td></td>
<td>184</td>
<td>112</td>
<td>40%</td>
</tr>
</tbody>
</table>
Primary & Primary Effluent Filtration

Typical Questions

• Carbon for Biological Nutrient Removal
  • Smaller, uniform particle size would benefit BNR
  • Stage feed will compensate
  • CEC Study 2 will specifically address this issue

• Backwash
  • Ranged from 12 to 13% of the applied flow
  • Send to thickener prior to digestion
Primary & Primary Effluent Filtration

Typical Questions

• Cloth Wear
  • Two year PEF operation – no visible wear
  • Nearly half year PF operation – no visible wear

• Fats, Oils and Grease (FOG)
  • Did not affect the operation or removal performance
  • Removal considerations in full scale design

• Grit Was Not a Problem
  • Will include storage at the tank bottom
Testing Capabilities
Primary Filtration Piloting

- Rapid Mix Tank
- 2-Stage Floc Chamber
- In-line TSS, Flow
- Lab
- SCADA
- Class 1 Div 2 Group D
Primary Filtration Piloting
Summary
Summary

• Primary filtration and wet weather filtration are rapidly emerging technologies in the industry.

• Cloth media filtration technology is uniquely suited for primary filtration and wet weather filtration.

• Aqua-Aerobic Systems has done and continues to do extensive testing to answer questions regarding the technology.

• The technology operates on similar principals to tertiary filtration with improvements to filter design for the primary environment.
Questions