The State of Enhanced High-Rate Treatment in Ohio

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### What is EHRT?

**Settling-Based**

1. Conventional Settling - Rectangular, Circular, Square, RTB, Shaft
2. Vortex (Swirl Concentrator)
3. Lamella Settler
4. Chemically Enhanced Settling
   a. Conventional Basin
   b. Sequencing Batch - e.g. ClearCove Flatline EPT
   c. Lamella Settler
   d. Solids Contact / Recirculation - e.g. DensaDeg®, CONTRAFAST®
   e. Ballasted Flocculation - Microsand (e.g. ACTIFLO®, RapiSand™) - Magnetite (e.g. CoMag™)
5. Suspended Growth Contact - BIOACTIFLO™, BioMag™, Bio-CES

**Filtration-Based**

1. Shallow Granular Media
2. Deep Granular Media
3. Microscreens, Woven Media - Salsnes Filter, Eco MAT™ Filter
4. Floating Media - MetaWater HRFS, BKT BBF-F
5. Pile Cloth Media - Aqua-Aerobic Systems
6. Compressible Media - Fuzzy Filter™, WWETCO FlexFilter™
7. Fixed-Film Contact - Biological Aerated Filter (BAF), BioFlexFilter™

**Flotation-Based**

1. Conventional Floatables Removal - Skimmers, Scum baffles
2. Dissolved Air Flotation (DAF)
3. Polymer-aided DAF - Various suppliers
4. Biocontact + DAF - Captivator®

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**Primary Removal Equivalent** *

**Small Footprint (High-Rate Treatment)**

**Enhanced Removal**

* If coagulation/flocculation provided, HRT → EHRT (in some cases)
Augment Existing WRRF with EHRT

At WRRF..... or Decentralized

1.5 - 4Q_{avg}

Q_{peak}

Q_{aux}

Biological Treatment Facilities

EHRT

Flow Control
Screening
Grit Removal (Optional)
Clarification
Effluent Disinfection

Receiving Waters
ROAD TRIP!

- NEORSD - Chemically Enhanced Primary Treatment + High Rate Disinfection
- Toledo - High Rate Clarification
- Springfield - High Rate Filtration
- Cincinnati - Chemically Enhanced Settling & Emerging Technologies Piloting
NEORSD Westerly WWTC & Full-Scale CEHRT Plan

Credit: Brown and Caldwell (2016)

100-mgd Activated Sludge WRF Area

Future Full-Scale CEHRT Treatment in CSOTF

Potential Location for Future Full-Scale CEHRT Structures and Equipment

Existing Wet Weather Overflow/Bypass (CSO-002)

Existing Plant Property Boundary
SIMCED Trial Included

Credit: Brown and Caldwell (2016)
NEORSD – Westerly CEHRT Pilot Plan

Credit: Brown and Caldwell (2016)
Major Findings

- Successful CEPT operation at SOR of 10,500 gpd/sf
- Consistent CEPT effluent TSS of <30 mg/L achieved over wide range of operations
- Simultaneous CEPT and HRD in single tank with no reduction in TSS removal performance

CEHRT successful at achieving NEORSD CD goals over wide range of operating conditions

Credit: Brown and Caldwell (2016)
100 mgd EHRT Facility
Compressible Media Filter
High-Rate NaOCl/NaHSO₃
Effluent Pumping
Headworks
Equipment Upgrades
Wet Weather Headworks
Channel and Rock Box
Flow Splitting
Horizontal Bar Screens
Primary/Secondary Digester
Final Clarifier
232 mgd EHRT Facility
Vortex Grit Removal
HRC - Ballasted Flocculation
Reaeration
Chlorination
Dechlorination
25 MG Storage Basin
195 mgd Activated Sludge WRF
195 mgd Activated Sludge WRF
Toledo Bay View WRF
High Rate Clarification with Solids Recirculation

1. Coagulating Agent
2. Flocculating Agent
3. Air
4. Grease and Scum Draw-off
5. Treated Water
6. Sludge Recirculation
7. Grit Draw-off
8. Thickened Sludge Draw-off
## Performance of Toledo EHRT

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Influent Concentration</th>
<th>Effluent Concentration</th>
<th>Percent Removal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range mg/L</td>
<td>Average mg/L</td>
<td>Range mg/L</td>
</tr>
<tr>
<td><strong>Primary &amp; Excess Flow Treatment (Units 2-6)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonia</td>
<td>1.8 – 3.2</td>
<td>2.4</td>
<td>1.8 – 3.1</td>
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<tr>
<td>TKN</td>
<td>2.9 – 12.9</td>
<td>6.3</td>
<td>2.0 – 7.0</td>
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<tr>
<td>CBOD</td>
<td>20 – 77</td>
<td>42</td>
<td>10 – 27</td>
</tr>
<tr>
<td>Suspended CBOD</td>
<td>10 – 66</td>
<td>31</td>
<td>2 – 21</td>
</tr>
<tr>
<td>TSS</td>
<td>19 – 440</td>
<td>131</td>
<td>9 – 66</td>
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<tr>
<td>Total P</td>
<td>0.6 – 2.1</td>
<td>1.1</td>
<td>0.2 – 0.5</td>
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</tbody>
</table>

Excellent TSS and Phosphorus Removal
100 mgd EHRT Facility

Wet Weather Headworks
Channel and Rock Box
Flow Splitting
Horizontal Bar Screens

Springfield WWTP

25-mgd ADF Activated Sludge WWTP

Wet Weather Headworks
Channel and Rock Box
Flow Splitting
Horizontal Bar Screens
Compressible Media Filtration

- Synthetic fibers bundled together into ~1.5” spheres
- ~30” bed depth
- Porosity altered by compression
- Removal down to 4 microns
- 10+ year filter media life
100 mgd EHRT Facility

Compressible Media Filter
High-Rate NaOCl/NaHSO₃ Effluent Pumping

Headworks Equipment Upgrades

Wet Weather Headworks Channel and Rock Box Flow Splitting Horizontal Bar Screens

Primary/Secondary Digester Final Clarifier Effluent Pumps

10 Minute NaOCl Contact Tank Backwash Pumps Backwash Blowers Sampler Electrical/Control Room

NaOCl and NaHSO₃ Storage and Feed

100-mgd in 120’ x 320’
### Performance of Springfield EHRT

**Excellent Effluent Quality and Disinfection**

<table>
<thead>
<tr>
<th>Effluent Averages *</th>
<th></th>
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<tbody>
<tr>
<td>TSS</td>
<td>mg/L</td>
</tr>
<tr>
<td>CBOD$_5$</td>
<td>mg/L</td>
</tr>
<tr>
<td>NH$_3$-N</td>
<td>mg/L</td>
</tr>
<tr>
<td>TP</td>
<td>mg/L</td>
</tr>
<tr>
<td>DO</td>
<td>mg/L</td>
</tr>
<tr>
<td>TRC **</td>
<td>mg/L</td>
</tr>
<tr>
<td>E. Coli</td>
<td>#/100 mL</td>
</tr>
</tbody>
</table>

* 42 events 3/3/15 – 5/12/16  
** NaOCl avg dose = 4 mg/L

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![Graph showing event averages of TSS and CBOD$_5$.](image-url)

- Influent TSS
- Effluent TSS
- 7-day Average Effluent TSS
- Influent CBOD$_5$
- Effluent CBOD$_5$
- 7-day Average Effluent CBOD$_5$
MSDGC EHRT – Chemically Enhanced Sedimentation

Tony Yee, PE & Jared Hutchins, PE
Combined Sewer Overflow 522

- Highly active CSO
- Community priority due to sewer debris and odors in residential setting
- Wide range of flows up to 1,400-mgd
- Targeted for Demonstration EHRT in Phase 1 WWIP
Disinfection Contact Tank
Mixed Mode
CES Train
FeCl₃, Polymer, NaOCl and NaHSO₃ Storage and Feed

Future Expansion
Influent Control Structure
Screenings Room
Influent Pump Station

Existing CSO 522 Location

106-mgd in ~150’ x ~250’
Influent Control Structure

- Dissipate energy
- Direct flows into facility up to peak treatment capacity, and release excess flows to creek
- Promote solids clean-up post event for odor control
- No dry weather flow
- Provides coarse screening and floatables control
Influent Fine Screens

- Chain and Rake
- ½” Aperture Size
- 2 x 53 mgd
- 40% Blinding Factor
- Direct Discharge to Screenings Container

Rugged Screening Equipment for High Leaf Loads
Influent Pump Station

- Submersible, non-clog
- Two large (35-mgd), two small (18-mgd), spare slot for 5th pump
- Level-controlled, adjustable speed
- Trench-style wetwell

Delivers flow to CES and Disinfection
CES and Disinfection/Dechlorination

- Individual, enclosed rapid mix, flocculation, sedimentation and disinfection zones
- Sedimentation 3:1 L:W, SOR 7,000 gpd/sf @ 35-mgd
- Disinfection 15 min CT @ 35-mgd, 10 min @ 53-mgd
- Mixed mode channel for fine screening and disinfection only
FeCl₃, Polymer, NaOCl and NaHSO₃ Storage and Feed

Influent Control Structure

Future Expansion

Influent Pump Station

Screenings Room

Existing CSO 522 Location

WWEHRTF Construction

Disinfection Contact Tank

Mixed Mode

CES Train

Werk Road

Westbourne Dr.
Emerging EHRT Technologies Pilot
Emerging EHRT Technologies Pilot Results

Pile Cloth Media
- 2.5 to 6.7 gpm/sf HLR
- Avg. effluent TSS 18 mg/L
- Avg. TSS removal 77%
- Relatively constant and effective TSS removal across wide range of events

Floating Media
- 16.9 to 27.6 gpm/sf HLR
- Avg. effluent TSS 56 mg/L
- Avg. TSS removal 51%
- More variable TSS removal during pilot study

Both systems appear capable of TSS removal at full-scale EHRT
BUILDING A WORLD OF DIFFERENCE

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