Ultra High Rate Compressible Media Filter (CMF)

Presented by Bill Kunzman
Vice President Business Development
Schreiber LLC
Key is the Media

• Durable Synthetic Fiber Balls
• Compress Media and Change Pore Size
• Pore Size Gradient thru Bed – 4 Microns
• Highest Filtration Rates
• Maximum Solids Storage Capacity
• Backwash w/ Influent & Air Scour
• Small Footprint
Filter Media

- 1.5” diameter synthetic fiber spherical balls
- Void ratio 80% to 85%
- Chemical & Temperature Resistant
Filter Strainer

Slotted strainer to retain large items (1/4" wide openings)

Removed for cleaning or Flushed as needed
Enclosed Vessel

1. Top of vessel is closed to:
   a) keep out sunlight which limits algae growth
   b) restrict bug access to the water level

2. The water in vessel:
   a) is filtered water except during short wash time
   b) has very short detention time before exiting filter < 2 minutes
Variable Porosity

Compression changes porosity in filter bed

More compression
= Smaller voids to capture
Small particles

Less compression
= Larger voids to capture
Large particles
Graduated Porosity Thru Bed (like a Multi Multi Media Bed) Washes as Mono Media

Media Compression Gradient

Chart 3: Comparison Of Overall W/W Bed Compressions By Section

- 19% Bed Compression
- 37% Bed Compression
- 50% Bed Compression

8% at inlet - bottom
34% at outlet - top
Media Performance

• Removal - 4 micron particles
• Storage - 1.2 lbs solids / cu. ft of media
• 30” Media Bed Depth
• 0% to 40% Compression
• Life - 10+ years
Typical Industrial Filter Sizing
Granular & Cloth Filters @ 4 to 12 GPM/SF
CMF operates @ 45 GPM/SF

High Rate = Less Area

Approved in:
10 State Standards locations
&
Water Reuse Title 22 Acceptance
Typical Design Loadings

- Hydraulic Loading – 30 GPM/ft\(^2\) Sizing, 45 GPM/ft\(^2\) Maximum (50% Reserve Capacity)
- Influent Solids – Average 10 – 20 mg/l w/ spikes to 100 mg/l
- Solids Capture – 1.2 lbs./ft\(^3\) of Compressed Media Volume
Footprint Comparisons @ 1.0 MGD

- **CMF**
  - 25 ft² @ 30 gpm/ft²
  - 5' x 5'

- **Continuous Wash Filter**
  - 115 ft² @ 6 gpm/ft²
  - 10' x 11.5'

- **Traveling bridge Filter**
  - 174 ft² @ 4 gpm/ft²
  - 12' x 14.5'
1.0 MGD – 5’ x 5’ Unit

A 5 ft. x 5 ft. CMF with 25 sq. ft. of media area has a design flow rate of:

1.0 MGD @ 30 GPM/sq. ft.
Filtration Cycle

- Automatic Controls – PLC & HMI
- Actuated Valves
- Feed - Gravity or Pumped
- Max Pressure 8 psi
- Variable Flows Acceptable
- 8 – 24 Hour Runs Typical
Typical -Up Flow Filter System

Filtration Cycle

- Influent
- Media
- Compressible Media – 30"
- Effluent

FILTRATION CYCLE
Wash Cycle

- Initiation – Time or Pressure
- Raise Compression Plate
- Reduce Influent Flow – No Clean Water
- Air Scour Media-15 cfm/SF @ 8 psig
- Wash 30 minutes
- Wash Water Volume < 2%
- Wash Frequency - 8 to 24 hours
Wash Cycle

- Influent (Washing Water)
- Fixed Plate
- Media
- Compressible Media
- Movable Plate
- Actuator for Movable Plate
- Wash Water
- Washing Air
Wash Cycle

10 GPM / ft^2
410 L / m^2 / min.

Installed Unit

Demo Unit
Wash Results - Dirty filter prior to wash
Wash Results - Same filter after wash
Purge Cycle

- Lower Plate to Compression Setting
- Change to Filtration Rate—30-40 GPM/sqft
- Filtered Influent Displaces Dirty Water
- Duration—Approximately 5 to 8 minutes
- Effluent Valve Opens
Flush Cycle

Actuator for Movable Plate

Flush Water

Movable Plate

Influent

Media

Compressible Media

Fixed Plate
Headloss Through Clean Media Relationship of Flow & Compression
Developed Headloss Through Media Relationship of Flow & Compression
Maximum Operating Headloss

- Solids Accumulation
  - Typical Headloss: 36”
  - Operating Headloss: 48”

- Clean Media
  - Maximum Headloss: 12”

Diagram:
- Wash Water
- Media Bed
- Influent
- Effluent
Initial Performance Validation

- UC Davis – Dept. of Civil & Environ. Engineering
- Dr. G. Tchobanoglous & Dr. O. Caliskaner
- Secondary Effluent – Activated Sludge Process
- 0.5 Square Meter Pilot Filter
- 1995 Study and Comprehensive Report
Objectives of Testing at University of California - Davis

• Water reuse of WWTP effluent - Title 22
  • Achieve 2 ntu’s turbidity out of the filter
  • No chemical addition

• Validation of design flow rates
  • 30 GPM / ft$^2$ and greater

• Comparison to other filters tested
  • More than 6 granular media systems
Comparison of CMF to Other Filter Systems

![Graph comparing effluent turbidity to influent turbidity for various filter systems including Upflow, Traveling Bridge, Dual-Medium, Deep-Bed, ABW MM, and ADW DM. The graph also highlights the performance of a Fuzzy Filter at 20 gal/ft²·min and 30% compression, as well as at 30 gal/ft²·min and 30% compression.](image)
Conclusions:

- Effective for the filtration of the effluent from an activated sludge process
- Ability to compress the media is significant - Porosity of the bed can be modified
- Higher filtration rates can be used - Because of the high porosity
- During testing optimum filtration rate appeared to be in the range of 20 to 30 GPM / sq. ft.
- Effluent turbidity values will be equal to or lower than 2 ntu’s for influent turbidity values up to 8 ntu’s (about 18 mg/l TSS)
- The filter compared very well to the performance of granular filters that had been previously evaluated by UC Davis – Dr. Tchobanoglous
Above Ground Installation

- **Location:** Georgia
- **Operational:** Fall 2001
- **Number of:** 5 filters
- **Size:** 7 ft x 7 ft
- **Capacity:** 10,425 GPM, 15 MGD
- **Flow Rate:** 42 GPM / ft² based on side-by-side pilot testing
- **Application:** Tertiary
In-Ground Installation
Georgia CSO Facility

- Operational: July 1995
- Number of: 6 filters
- Size: 8 ft x 8ft
- Capacity: 14,580 GPM
- 21 MGD
- Flow Rate: 38 GPM / ft²
- Application: CSO
- Downflow filters following swirl concentrators. Discharge to UV disinfection.
Filter Vessels

Factory Fabricated Vessels:

**Standard Sizes:** 18” x 18” up to 8 ft. x 8 ft.

**Vessel Materials:**
- Hot Dip Galvanized Steel – up to 4 ft. size
- Epoxy Coated Carbon Steel
- 304 Stainless Steel
- Special Materials for Industrial Applications

Concrete Vessels (Constructed by GC):

**Typical Sizes:** 8 ft. x 8 ft. individual cells

**Groups of:** 8 ft. x 8 ft. cells
# Fuzzy Filter Sizing @ 40 GPM/ft²

<table>
<thead>
<tr>
<th>Model</th>
<th>Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.13 MGD</td>
<td>87 GPM</td>
</tr>
<tr>
<td>0.22 MGD</td>
<td>156 GPM</td>
</tr>
<tr>
<td>0.51 MGD</td>
<td>351 GPM</td>
</tr>
<tr>
<td>0.90 MGD</td>
<td>624 GPM</td>
</tr>
<tr>
<td>1.40 MGD</td>
<td>975 GPM</td>
</tr>
<tr>
<td>2.08 MGD</td>
<td>1404 GPM</td>
</tr>
<tr>
<td>2.82 MGD</td>
<td>1911 GPM</td>
</tr>
<tr>
<td>3.59 MGD</td>
<td>2496 GPM</td>
</tr>
</tbody>
</table>
Modular Concrete Filters
Multi Cell - Fuzzy Filter Layout
Separate Cell Operation
CSO - Georgia

- Operational: 2006
- Number of: 12 filters
- Size: 8 ft x 8 ft
- Capacity: 13,900 GPM = 20 MGD
- Flowrate: 18.1 GPM / ft^2
- Application: CSO filtration after clarifiers
85 MGD CSO
48 Cells @ 8’ x 8’
8 Groups of 6 Cells
Applications & Installations
Municipal Filtration Applications

- Tertiary treatment
- Water reclamation/reuse
  - Title 22 Acceptance
  - 10 State Standards Acceptance
- CSO/SSO systems
- Pre-filtration for membrane systems
- Membrane back wash
Industrial Filtration Applications

- Power Generation – cooling water, pre-RO, wastewater, river & lake water
- Pulp & Paper – wastewater & river water
- Steel – furnace cooling water
- Meat & Poultry Processing – wastewater, wash water
- Chemical Processing – storm water, wastewater, wash water
- Petroleum – cold lime softening, wastewater
- Mining – wastewater, acid mining drainage
### Sample of CMF Applications

<table>
<thead>
<tr>
<th>Location</th>
<th>Application</th>
<th>Number of &amp; size</th>
<th>Capacity (MGD-M³/D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kentucky - Drinking Water</td>
<td>Membrane Backwash</td>
<td>1 – 5 ft</td>
<td>1.08 4090</td>
</tr>
<tr>
<td>Colorado – Cheese Plant</td>
<td>WW Tertiary Filtration</td>
<td>2 – 7 ft</td>
<td>4.23 16010</td>
</tr>
<tr>
<td>Quebec, Canada - Mining</td>
<td>Acid Mining Drainage</td>
<td>3 – 7 ft</td>
<td>6.32 23920</td>
</tr>
<tr>
<td>Arkansas – Ammunition Plant</td>
<td>Rinse and Process Water</td>
<td>2 – 4 ft</td>
<td>0.72 2725</td>
</tr>
<tr>
<td>Illinois – Muni WWTP</td>
<td>WWTP Tertiary Filtration</td>
<td>7 – 7 ft</td>
<td>16.0 60560</td>
</tr>
<tr>
<td>Michigan- Lunch Meat Manufacturer</td>
<td>WW Tertiary Filtration</td>
<td>1 – 6 ft</td>
<td>1.56 5892</td>
</tr>
<tr>
<td>Michigan- Muni WWTP</td>
<td>WWTP Tertiary Filtration</td>
<td>2 – 3 ft</td>
<td>0.78 2946</td>
</tr>
<tr>
<td>Texas- Chemical Plant</td>
<td>Cooling Tower Water</td>
<td>1 – 4 ft</td>
<td>0.69 2612</td>
</tr>
<tr>
<td>Pennsylvania – Power Plant</td>
<td>Pre-RO – Potable Water</td>
<td>2 – 6 ft</td>
<td>3.12 11784</td>
</tr>
<tr>
<td>Ohio - Refinery</td>
<td>Cold Lime Softening</td>
<td>3 – 6 ft</td>
<td>4.67 17675</td>
</tr>
</tbody>
</table>
Application: Tertiary Arizona Municipal

Two (2) 5’ x 5’
2.5 MGD
34.7 GPM / ft²
Arizona Municipal WWTP

- Water reuse application for green areas
- Has been operating since August 2004
- Meets Arizona Water Reuse requirements—2 NTU
- Preventative and operating maintenance only
- Daytime temperatures can exceed 120 deg F
Application:
Membrane reject water for solids concentration

Kentucky

Two (2) 6’ x 6’
2 MGD
19.3 GPM / ft²
Membrane Backwash Water Application – Potable Water Plant
Kentucky Drinking Water Plant

- Filtering membrane backwash water
- Reclaim by sending filtered water to lagoon
- Water is pumped from a river 18 miles.
- The only loss is the FF wash water to waste
- Has been operating since November 2002
Application: Tertiary
Georgia Municipal WWTP

Nine (9) 7’x7”
30 MGD
42 GPM / ft\(^2\)
Georgia Municipal WWTP

• Needed to meet low Phosphorus limit of 0.17 mg/l
• Original 5 filters started operating in Dec. 2001
• Original limit was 0.3 mg/l for Phosphorus
• Demonstrated less than 0.2 mg/l for a year
• Added chemicals into the clarifiers only
• Expanded to 9 filters that started in July 2007
• Added flocculation tank for chemical addition
Oklahoma Paper Mill

Two (2) 7’ x 7’ Filters
Wastewater Reuse
4.3 MGD
Start – Jan 10, 2005
Oklahoma Paper Mill
Two (2) 7’ x 7’ Filters

- Environmental Federation of Oklahoma – 2005 Frank Condon Award for Environmental Excellence – reduces fresh water use by 800 million gallons/yr
- Parent Company - 2005 Environmental Excellence Award – Reduces 1.3 billion gallons/yr discharge to Arkansas River
Application: Tertiary
Florida Muni WWTP
Four (4) 7’ x 7’
8 MGD
28.3 GPM / ft²
Application: Tertiary
Georgia Muni WWTP

- (4) 6’ x 6’
- 5 MGD
- 32.1 GPM / ft²
Pulp Mill – River Water Filtration
Pulp Mill – Cleaning Media
Pulp Mill – Media After Washing
Winner – WEFTEC 2004
Innovative Technology Award

High-Rate Compressible Media Filter

Winner - WEFTEC 2004
Innovative Technology Award

Features
- High Flow Rate (10 to 40 GPM/ ft²)
- Space Savings
- No Media Loss
- Ease of Installation
- Low Operating Cost
- Low Wash Water Usage (@10 GPM/ ft²)
- Completely Enclosed Structure
- High Suspended Solids Capture
- In Depth Filtration
- Flexibility Through Media Compression
- Accepted for California Water Recycling Criteria (Title 22)

Applications
- Tertiary Treatment
- Water Reclamation / Reuse
- Pre-Filtration for Other Systems
- Wet Weather Flows (CSO/SSO)

Schreiber
Improving Water Through Technology

www.schreiberwater.com
205-655-7466
Superior Filtration Technology

- High Flow Rate/Unit Area (30 to 45 GPM/sq ft)
- Adjustable Pore Size thru Changes in Media Compression to 4 Microns
- Small Footprint – Foundation, Piping & Valve Savings
- No Media Loss & Excellent Longevity – 10+ years
- Use Influent for Backwashing at 1% to 2% Wash Water Volume-no extra tank & pumps
- Very High Solids Storage - 85% Void Volume Available
- Proven Technology – 20 Years & 200+ units installed