Media Filters

Ted L. Loudon
Michigan State University

Terry R. Bounds
Vice President, Orenco Systems Company

James C. Converse, Professor
University of Wisconsin, Madison

John R. Buchanan
University of Tennessee, Knoxville

University Curriculum Development
for Decentralized Wastewater Management
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Citation

Media Filters

Introduction

- Media Filters (PBF) are secondary treatment units
- Designed to follow primary treatment in a septic tank
- PBF’s are fixed film treatment systems
- A passive aerobic system
- One example is a sand filter
- The basic assumption in this module is that MF effluent goes to soil dispersal
MF Treatment Process

- Wastewater applied in small doses
- Percolates over media in thin film
- Organisms on media contact wastewater
- Air is maintained in media pores
- Oxygen is transferred into the thin film and to organisms
- Aeration may be active or passive
Fixed Film Treatment

Processes at Work

- Liquid Wastes
- Organics
- Media
- Biological Mass
- Pathogens
- Excess Cell Mass
- End Products
- Air
- B.O.D.
- SS
- Nutrients
Theory of operation

- Organisms are “fixed” on the surfaces of media
- WW effluent is “micro-dosed” to the filter
- WW is treated as it moves over media surfaces in contact with organisms
Modes of Treatment

- Filtration and trapping
- Adsorption
- Biological decomposition
- Biochemical transformation
## Typical Concentrations of Effluent from Septic Tanks and MF’s

<table>
<thead>
<tr>
<th></th>
<th>BOD Mg/L</th>
<th>TSS mg/L</th>
<th>Nitrate-N mg/L</th>
<th>Ammonia-N mg/L</th>
<th>D.O. mg/L</th>
<th>Fecal Coliform Org./100 ml</th>
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</thead>
<tbody>
<tr>
<td>Septic Tank</td>
<td>130 - 250</td>
<td>30 - 130</td>
<td>0 - 2</td>
<td>25 - 60</td>
<td>&lt;2</td>
<td>10⁵ – 10⁷</td>
</tr>
<tr>
<td>MF</td>
<td>5-25</td>
<td>5-30</td>
<td>15-30</td>
<td>0-4</td>
<td>3-5</td>
<td>10² - 10⁴</td>
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</tbody>
</table>
Media Filter Effluent
in comparison to septic tank effluent

- Low in Oxygen demand (BOD5) -- >90% removed
- Low in total solids (TSS) and volatile solids (VSS) -- > 90% removed
- Will not form a significant biological clogging mat in soils
- Low in pathogens -- > 99% removed
- Significantly reduced Total Nitrogen
  - Typical removal range is 40-60% removed
  - Up to 80% removal with certain process designs
Uses of Media Filters

- Environmentally sensitive areas
- Soils that are not acceptable for septic tank effluent
  - Hydraulically slow
  - Inadequate vertical separation
- Systems with large flows
  - To mitigate impact of subsurface dispersal
  - Allow a higher application rate to soils
  - Where irrigation of effluent is desired
Benefits of Media Filters

- Reduce organic matter, pathogens, some nutrients
- Produce an effluent that:
  - Reduce biomat in soil absorption systems when applied at reasonable rates
  - Can be subjected to tertiary treatment, if needed, and surface discharged
    - Further nutrient removal
    - Disinfection
  - Can be further treated rapidly in soil
  - Can be applied to a wider range of soils than septic effluent
  - Can be applied to soil at higher loading rates
Two Major Categories of MF

- Single Pass
- Recirculating
Media Types

- Natural and mineral media
  - Sand and gravel
  - Expanded shale
  - Cinders
  - Limestone
  - Activated carbon
  - Peat or peat fiber
Manufactured Media Types

- Textile fabric
- Open cell foam cubes
- Hard plastic
- Crushed recycled glass
- Chipped recycled tires
- Processed slag
Sand and Gravel Filters

- May be designed and constructed to operate in either single pass or recirculating mode
- Sand/Gravel media must meet a specific specification
- Must (generally) be processed to provide the right gradation
  - Sometimes crushed
  - Screened for proper gradation
  - Washed
- Must be handled carefully after processing to maintain the specification and remain free of fines
Biofilm forms on sand grains

Oxygen around the film promotes aerobic activity

Many species are present at all times

Most are in the upper 12 inches

Insufficient food and oxygen limit aerobic organisms in lower layers

Most BOD removal occurs in the top few inches

Organic matter is consumed by microbes in the biofilm
Important Biological Design Parameters

- Choice of media
  - Surface area
  - Void space
- Provision for aeration
  - Active
  - Passive
- Small doses of wastewater applied uniformly
  - Keeps flow in the biofilm – i.e. unsaturated flow
  - Provides residence time in thin films on surfaces
  - Prevents displacing air from voids
More on Biological Processes

- Nitrogen removal is a biological process
- Nitrifying bacteria convert ammonium-N (NH$_4$) and organic-N to nitrate-N (NO$_3$)
- Most conversion to NO$_3$ occurs in the top 12 inches
- In small pores and lower in the filter, oxygen concentrations are reduced and some Denitrification can occur in smaller saturated pores, releasing nitrogen gas (N$_2$)
Any of the media options may be used in either single pass or recirculating mode.

- Natural/Mineral media are more likely to be used in single pass mode.
- Manufactured media are usually used in recirculating mode.
Single Pass Sand Filters

- Several designs are in use
  - Free access
  - Buried single pass
  - Pressure dosed single pass
Free Access Sand Filters

- Oldest form – most often used for communities
- Used for community wastewater treatment in Massachusetts in the late 1800’s
- May be large – several acres in size
- Depth ranged from 3 to 8 feet
- Wastewater is pump or siphon dosed to the filter, discharged at a single point
- Gravity flow over the surface of the filter
- Require frequent maintenance of the surface to break up or remove accumulated solids
- Largely historic, but some still being designed and used in the northeastern states
Two Cell Free Access Sand Filter

Plan View

Cross Section

Dose Pump
Valve Box
Dose Tank

Top of Container Wall
Top of Media Treatment
Splash Plate
Sand Treatment Media
Drain
Buried, Gravity Fed Single Pass Sand Filters

- Used as single home systems
- Some have surface discharge after disinfection
- Effluent “distribution” is through 4-inch diameter pipe with large (1/2” +) perforations
- Septic tank effluent flows by gravity to the filter at whatever rate it flows from the tank
- Poor distribution limits the life and performance
Buried Gravity Flow
Single Pass Sand Filter

Plan View

Cross Section
Pressure Dosed Single Pass Sand Filters (SPSF)

- The preferred system – uniform application
- Pump control can include a timer so that effluent can be “micro-dosed” to the sand filter uniformly over time as well as space
- Provides the ultimate in slow, unsaturated flow
  - Assures film flow
  - Long residence time for biological reactions
  - Air remains in pores for oxygen diffusion into the moisture films on surfaces – to microbes
Single Pass Pressure Dosed Sand Filter With Pump Basin – Cross Section

- Geo-Fabric
- Loamy Sand or Decorative Rock
- Stone (2” Over Pipe)
- Filter Sand (See Specifications)
- Pea Gravel
- 30 MIL PVC Liner
- Liner Support (1/2” Plywood)
- PVC Lateral w/ Orifice Shields
- Flushing Valve
- Valve Box
- Pump Basin
- 2” Sand Leveling Layer
- Optional Lateral/Flushing Valve Connections
- Sweep
- 2 - 45° Sweep
- Sand Backfill
- 6’ x 2’ x 6”
- Leveling Layer
SPSF Design Criteria

- Surface area loading = 1 – 1.25 gpd/ft² (design Q)
- Media depth 24 inches
- Media specification
  - Typical: \( d_{10} = 0.3 – 0.6 \text{ mm, C.U. (i.e. } d_{10} / d_{60} \text{) = 4 +/–} \)
  - For colder climates: \( d_{10} = 0.4 – 0.9 \text{ mm, C.U. < 4 See curve.} \)
- Maximum soil cover 8 – 12 inches
- Texture of soil cover: sand or loamy sand
- Bottom layer: 6 – 8 inches of pea stone around drain
- Maximum flow distance to 4” slotted drain: 15 ft
Importance of Media Specification

- Correct media is an important factor in determining the useful life of a SPSF
- Media availability is an issue in some areas
- If material that fits the media spec is not available, error on the coarse side.
  - If media is too fine – filter will clog with biomat
  - If media is too coarse – effluent quality may be reduced, but only slightly
- Smaller, more frequent doses can partially compensate for somewhat coarser media
SPSF Media – Typical Specification
Grain Size Distribution Curve Envelope

Sand Gradation Range for Single Pass Sand Filter Systems
Loaded up to 1.25 gpd/ft²* (D₁₀ = 0.3 to 0.5 mm; Cu = 1 to 4)

Note: Sand must be properly washed as excessive fines will cause plugging. To ensure the sand consolidates sufficiently, keep it wetted while placing.
In cold climates, winter decomposition of organic solids within the media is slowed.

The typical media ($D_{10} = 0.3-0.5$, C.U. = 1-4) may clog prematurely.

Some states have adopted a coarser media specification of $D_{10} = 0.4-0.9$, C.U. = 1-4, to reduce this tendency.
Small Diameter, Low Pressure Pipe Network

- Lateral pipe diameter for an individual home system
  - Typically ¾” or 1” schedule 40 PVC
  - Typically 1/8” orifices spaced 1.5 – 2.5 feet
  - Typical pipe spacing is 1.5 – 2.5 feet
  - Several sources offer software for the hydraulic design of the pressure network.
  - The Hydraulics Module provides guidance for pipe network design
Plan View – Single Pass Pressure Dosed Sand Filter

- 30 MIL PVC Liner
- 1/2 Orifice Space
- PVC Lateral
- Orifice Shield
- Pump Basin
- To Pump Control Panel
- Discharge Line
- Flushing Valve & Enclosure

From Septic Tank

To Soil

1.5-2.5'

1/2 Lateral Space

As Required
Pressure Distribution Network

Illustration courtesy of GAG Sim-Tech Filter, Inc.
Pressure Distribution Network
Hydraulic and Organic Loading - SPSF

- Typical design hydraulic loading is 1 – 1.2 gpd/ft²
- Maximum organic loading is .002 lb BOD/ ft²/da
  - Calculate from: O.L. = 8.34 x 10⁻⁶ Q gpm x BOD mg/L
  - Lower value recommended for cold climates
- For cold climates, keep hydraulic load < 1.0 gpd
- Dose volume < 0.5 gal/orifice/dose
- Typical doses per day = 18 – 24
Orifice Orientation

- **Upward directed orifices**
  - Less prone to clogging
  - Less flow as the network fills and pressurizes
  - Require special provision for drainage
    - Network set to drain back to pump chamber – no check valve
    - Some orifices placed in the bottom of the pipe – a less positive solution because these orifices are prone to clogging

- **Downward directed orifices**
  - More prone to clogging – alleviated with good orifice shields
  - More prone to clogging

- **Orifices directed to the side (3 and 9 O'clock)**
  - Less clogging than downward orifices
  - Adequate drainage
  - A bit more flow released as orifices fill
Design for Maintenance

- Monitoring tubes
  - To infiltrative surface
  - To the bottom of the filter, the liner
- Provide for flushing of distribution laterals
  - Access to dead end laterals
  - Continuous, low rate flushing
  - Alternating flow direction
- Provide for aeration
  - Regular, continuous
  - Catastrophic rejuvenation
- Prevent storm water infiltration
Maintenance or SPSF

- Maintenance should be performed at least annually, preferably more often.

- Owners should hire knowledgeable maintenance provider.

- First visit MUST be within the first few weeks of use:
  - To catch construction damage or errors.
  - To be sure controls are set correctly for the use pattern.
  - To check for leaks, including leaky tanks.
  - To advise owner/resident on SPSF use.
  - To be sure landscaping does not add depth, compact or cause other damage.
Maintenance Routine for the SPSF

- The septic tank(s) should be inspected periodically (not every visit) and pumped as needed
- Flush pressure pipe network
- Check pressure at end of laterals: compare with previous
- Check sand filter for ponding (in monitoring tubes)
- Check pump controls for proper operation
- Read pump run-time meter and event counter
- Check pump voltage (off and while pumping) and amp draw while pumping
- Pull and observe the final effluent in a clear sample bottle checking for clarity and odor.
Drainfield Check as Part of Maintenance visit

- Check for wetness around the drainfield
- Note vegetation patterns
- Note ponding level in observation tubes
- Observe surface flow patterns
  - Be sure surface runoff is directed away from drainfield and SPSF
  - Roof water/downspout drainage away from system
This drawing shows an air coil added underneath the sand treatment media so that air can be introduced from below to enhance biological digestion of a clogging mat that might form on the top of the media.

Fig. 5. Plan view of a single pass sand filter with an internal pump chamber. Other configurations are possible (Adapted from Orenco).
Recirculating Systems

- Recirculation is used in many wastewater treatment processes, usually to retain organism populations.
- Recirculating sand filter concept was introduced by Hines and Favreau in the 1970’s.
- Recirculating systems involve mixing a portion of the filtered effluent with incoming septic tank effluent.
- This blended effluent is applied to the coarser filter media at higher loading rates.
Recirculation Mechanisms

- Pump in a recirculation tank is operated by a timer
  - Timer is set to deliver a daily flow to the filter of:
    \[ Q_f = Q_i(R_r + 1) \]
    Where, \( Q_f \) is the daily quantity to the filter
    \( R_r \) is the recirculation ratio
    \( Q_i \) is the daily inflow to the filter

- Recirculation ratio is defined as the ratio of daily quantity of flow returned to the recirc. tank, \( Q_r \), divided by the daily inflow, \( Q_i \)
Recirculating Media Filter Schematic

- From House
- Septic Tank
  - Effluent Filter
- Recirculation Tank
  - Float Valve in Tank
  - Dosing Pump
- Recirculating Media Filter
  - Filter Drainage
- Final Effluent Tank
  - Effluent Pump
- To Soil
Achieving Recirculation

- Drainage from the filter is directed through a flow divider
  - One part is sent to final dispersal
  - 3 – 5 parts, more or less, are returned to the recirc. tank for another pass through the filter

- The pump control timer is set to deliver the desired total quantity of flow to the filter daily

\[ Q_f = Q_i (R_r +1) \]
Recirculation Ratio Definition

\[ R_r = \frac{Q_r}{Q_i} \]
\[ Q_r = R_r \cdot Q_i \]
\[ Q_f = Q_r + Q_i = (R_r + 1)Q_i \]

Where:
- \( R_r \) is the recirculation ratio
- \( Q_r \) is the daily flow returning to the recirc tank
- \( Q_f \) is the daily flow through the filter, in gpd.
- \( Q_i = Q_e \) is the daily forward flow

\[ \begin{align*}
Q_{e} & \rightarrow \\
Q_r & = R_rQ_i \\
Q_i & \rightarrow \\
R_r & = \text{recirc-blend ratio} = \frac{Q_r}{Q_i} \\
Q_e & = Q_i \\
Q_f & = (R_r + 1)Q_i
\end{align*} \]
Simple Float Valve Illustration

- Valve is mounted in the recirc. tank on the filter drain return line
- When the valve is closed, all the flow is sent to final dispersal
- When the valve is open, all the flow drops into the tank
- By setting the timer for the correct total daily flow to the filter, the system provides the proper recirculation ratio.
A baffle downstream from the vertical stem forces flow to exit the return pipe in such a manner that a preset amount of flow, depending on the number of overflow pipes that are uncapped, will return to the recirc. tank even when the float vale is closed.
Another Flow Splitting Option

Flow Control Orifices In Removable Standpipe

Side View - Flow Splitter Basin

Top View - Flow Splitter Basin

Screened Influent

Discharge

L.L.

2" Typ.

Watertight Grommet

Adapted from Orenco Systems, Inc. drawing
Typical RSF Cross Section

- Filter Sand (refer to gradation curve)
- 3/8" Pea Gravel Washed (1"-2" over laterals)
- 3/8" Pea Gravel
- 30 MIL PVC Liner
- 2" Sand Leveling Layer
- 4" Boot(s)
- Perimeter Support Frame (1/2" untreated plywood)

Option: Ag. Drain w/ RSF media all the way down

Adapted from Orenco Systems, Inc.
Note, this may not be the best drawing
Home RSF Nicely Landscaped
Benefits of Recirculation

- Diluted effluent is applied to the filter
  - Can apply effluent a greater forward flow loading rate
  - Less odor
- Smaller filter surface area required for a given flow
- Can withstand somewhat higher strength incoming wastewater
- Can cope with flow variations, including peak flows
- Provides a means for making adjustments for variations in flow and strength through varying recirculation ratios
RSF Media

- Effective Grain Size ($d_{10}$): 1.5 – 2.5 mm (or larger)
- Uniformity Coefficient: < 2
- Media Depth: Minimum of 24”
- Typical Void space: 30%
- Typical Moisture Holding Capacity: < 7%
RSF Media
Grain Size Distribution Curve Envelop

Sand Gradation Range for Recirculating Sand Filter Media
Loaded up to 5 gpd/ft\(^2\)\(^*\) (D\(_{10}\) = 1.5 to 2.5 mm; Cu = 1 to 3)

* Follow complete Recirculating Sand Filter design criteria.

![Graph showing grain size distribution curve envelop for RSF Media. The graph includes a scale for size of opening (inches) and number of mesh (U.S. standard). A table listing sieve sizes and corresponding percent passing is also included. The text notes that the sand gradation curve should fall within the shaded area.](image-url)
Typical RSF Media

- Fine gravel media with effective size of 2.5 – 3 mm
- Note lack of fines on the media
- This is a good material for an RSF for domestic effluent
Recirculation Tank Design

- **Size** – provide volume at least equal to daily design flow

- **Configuration**
  - Septic tank effluent and return flow from filter enter at same end of the tank to mix
  - Pump(s) to filter are at opposite end of tank
  - Provide long flow path to pump end
  - Pumps mounted up off tank floor
    - Preferably in a vault with effluent screen ahead of pump intake
    - Intake to pump at mid-depth of tank
RSF -- Recirculation Tank
Illustration
Home Size RSF – Training Center Demonstration
Unit is 10’ x 10’ with exposed stone surface, recirc. tank below
Some stone removed to expose distribution pipe and treatment media
RSF with Mix/Recirc. Zone in Chambers Under Media

Recirculating Sand Filter with Mix Zone Underneath

- Peastone or Drain Rock
- Pressure Laterals
- Framing Timbers
- Excavation Wall or Plywood Frame
- 2" Sand Cushion
- 9 - 12"
- 24" Min
- Peastone: 4" Over Chambers

See RSF Media Spec
Plan View – Mix Zone in Chambers Under Media

Effluent In

Chamber Connections

To Recirc Pump Tank
LPP Distribution Network on Community RSF
Multiple Cell Community RSF Makes Maintenance Easier
Laterals End with Constant Flow Out
Access to Dead End Laterals in the Middle of a Large RSF
Measurement of Pressure at the End of Laterals

- Head is typically 5-8 ft
- Clear tube that can be screwed in or attached to laterals allows easy determination of head
- Head increase over time may mean clogging of orifices
Alternative Distribution System

Upward Directed Orifices in Chamber

Sand Filter w/ Upward Directed Orifices in a Chamber

- Pea Gravel
- 2" Over Chambers
- 24" Min
- PVC Liner
- RSF Treatment Media
- Pea Gravel
Alternative Distribution System
Non-Clog Spray Nozzles in Chamber

- Sand Filter w/ Spiral Nozzles in a Chamber
- Pea Gravel
- 2" Over Chambers
- 24" Min
- RSF Treatment Media
- Pea Gravel
Sand Filter Frame Ready for Media
Sand Filter Drain Network
Residential Community RSF in Operation
RSF Effluent Quality
RSF Maintenance Tasks

- Check observation sumps in S.F. for ponding
- Flush distribution system lines
- Check pressure to determine orifice clogging
- Clean orifices as needed
- Make sure drain(s) are not submerged and can “breath” air into filter
- Check pump controls for proper operation and adjustment
- Check pump voltage – off and while pumping
- Check pump amp draw while pumping
- Check Soil Absorption System observations sumps
- Check sludge and scum in septic tank(s) & pump tank
Manufactured/Prepackaged MF’s

- Several types of MF’s are packaged in modular units
- Sand filters have been packaged for local markets in some locations
- Three types are prominent nationally
  - Peat filters
  - Textile filters
  - Open cell foam filters
- These three materials have significant advantage
  - Large media surface area
  - High percentage of void space in the media
  - Light weight for shipping
  - Easier maintenance
  - Predictable, consistent, high quality material
Peat Filters

- Peat provides an excellent media for MF’s
- Used in several forms
  - Peat fiber
  - Peat moss
  - Peat pellets
  - Prefabricated peat bales
- Several manufacturers provide modular peat filters ready to set in place and connect up
- Typical components – all in a prefabricated container
  - Distribution system
  - Peat media
  - Drainage system
Peat Filters (con’t.)

- Typically used in single pass mode
- Peat is carefully chosen and, in some cases, processed
- Peat will house a wide variety of micro flora from bacteria to nematodes
- Peat will deteriorate over time and need to be replaced.
  - Peat fiber lasts long
  - Manufacturers estimate media life at 8 – 15 years
- Manufacturers have proprietary design criteria and specifications that must be followed
Peat Filter Modules Over Drain Stone
Peat filters have been found to provide good, long term performance. Effluent quality is similar to sand filters, but space requirement is less – about 1/6 as much. Having material pre-selected and prepackaged is a big advantage.
<table>
<thead>
<tr>
<th></th>
<th>BOD$_5$ Mg/L</th>
<th>NO$_3$-N Mg/L</th>
<th>NH$_3$-N Mg/L</th>
<th>Fecal Col MPN/100ml</th>
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</thead>
<tbody>
<tr>
<td>S.T. w/ Screen</td>
<td>116-132</td>
<td>2 - 3</td>
<td>33 - 39</td>
<td>6-7 x $10^5$</td>
</tr>
<tr>
<td>New Peat Filter</td>
<td>18</td>
<td>25</td>
<td>2</td>
<td>$6 \times 10^4$</td>
</tr>
<tr>
<td>After 4 Years</td>
<td>4</td>
<td>7</td>
<td>11</td>
<td>$2 \times 10^4$</td>
</tr>
</tbody>
</table>
Open Cell Foam Filters

- Developed for use in Ontario as the “Waterloo Biofilter™”
- The foam material is a polyurethane foam
  - Foam is in 2-inch cubes
  - Large surface area, large void volume percentage
  - Not decomposed by organisms in wastewater
  - Light weight for easy shipping and handling
- Wastewater is sprayed over the top
- Long retention time in the filter provides good treatment
- Sometimes requires forced aeration
Waterloo Biofilter – Home Size
Waterloo Biofilter Foam Baskets
Small Modules Containing Foam Cubes – “Aerocell™”
Scat™ System

- Alarm Panel
- 650 GPD SCAT unit
- Gravity Recirculation Device with Access Risers & Lid
- Effluent Filter Access Risers & Lid
- STEP System Package
- Carbon Filtered Vent
- Pressure Supply Line
- 80% Recirculation Line
- Versa-Tee Inlet Baffle
- A300-8x18-VC Effluent Filter
- 20% Discharge Line
- Filtered Pump Vault
AdvanTex™ Textile Based Filter
Recirculating Textile Filter Over a 1500 gal Septic tank
Network of Small Textile Filter Units at a School
Control systems for pumps and dosing are critical to proper operation.

Uniform distribution and small, frequent doses are required for best treatment.

Timer control for pumps is preferred.

For single pass systems, timers can be turned on and off by floats.
Pump in a recirc. tank with floats to control the timer, alarms, and a second pump.
Float Type Controls

- Floats may contain mechanical or mercury switches
- Should be mounted on a separate bracket or float “tree”
  - Separate from pump discharge pipe
  - Removable as a unit for float position adjustment
  - Allow pump removal without disturbing floats
- Floats must be positioned so as not to become inhibited by cords, other floats, or piping
Determining Timer Settings

- Dosing frequency (DF) and cycle time (CT) are terms that are used to mean the same thing.

- Cycle time includes pump on or dose time ($T_d$) and pump off or rest time ($T_r$)  
  \[ DF = CT = T_d + T_r \]

- If the pump is expected to run all the time, 24 hours (1440 minutes) per day:
  \[ n_d = \frac{1440}{DF} \]

  where $n_d$ is the number of doses per day.

  \[ n_d = \frac{Q_f}{T_d q_f} \]

  $Q_f$ = the daily flow to the filter

  $q_f$ = the flow rate to the filter while the pump is running.
SPSF Timer Setting Example

- Consider a single pass sand filter having a flow rate, $q_f$, of 40 gpm, $T_d = 30$ seconds, and a daily flow, $Q_f$, of 200 gpd.

- It is desirable to set the timer so that the daily flow can be dosed to the filter in less than 24 hours, say 18 hours to provide some buffer for a high flow day.

  \[ n_d = \frac{1440 \times (18/24)}{DF} = \frac{Q_f}{T_d} q_f \]

  \[ n_d = \frac{1440 \times (18/24)}{DF} = 200 / 0.5 \times 40 \]

  \[ [1440 \times (18/24)/DF] = 10 \]

  \[ DF = 108 \text{ minutes} \]

  \[ T_r = 108 - 0.5 = 107.5 \text{ minutes} \]

So, to discharge 200 gpd, in 18 hours of the day, the pump should be set to run 30 seconds and rest 107.5 minutes. For about 6 hours in the middle of the night, the pump is off.
Pump Selection

- Pumps used are usually submersible
  - High head turbine pumps – a converted well pump
  - Effluent pumps – higher flow, low head

- Turbine pumps are desirable for feeding distribution systems with small holes (typical 1/8”)
  - Steep curve assists in providing self cleaning
  - Head increases rapidly as flow is reduced

- If effluent pumps are used, in-line screens can be added to help protect against orifice clogging

- Both types of pumps, if selected for effluent applications, will provide long service life

- Liquid levels should be designed to keep pumps submerged.
System Monitoring and Maintenance

- MF’s of all types must be designed so that maintenance personnel can easily monitor condition and performance
- Easy access to screens, pumps, floats and other controls
  - Risers to grade
  - Easily reachable quick disconnects for pump removal
  - Floats on a separate, easily removable mount
  - Control boxes within sight of pump chamber riser
- Monitoring tubes to critical levels in filters
- Distribution laterals easily accessible for cleaning
- Convenient sampling locations for obtaining effluent samples for analysis
An Example Maintenance Routine

- Check sludge and scum levels in the septic tank
- Check septic tank effluent screen, and clean if necessary.
- Flush Media Filter distribution laterals.
- Check pressure at the distal end of the laterals
- Note readings on pump run-time meter and event counter and compare with previous readings.
- Check pump voltage (off and while pumping) and amp draw while pumping.
- Check pump control floats for proper operation and proper elevation adjustment.
- Check for ponding at the media infiltrative surface and the bottom of the filter through observation tubes.
- Pull and observe the final effluent in a clear sample bottle checking for clarity and odor.
- Check for wetness around the drainfield and observe ponding in observation tubes
Concluding Comments

- Media Filters are capable of providing reliable, long term service and excellent effluent quality if they are:
  - Properly sited
  - Properly designed
  - Properly used by the owner/occupant
  - Properly maintained on a regular basis

- The greatest challenge to be addressed before widespread adoption of technologies like PBF’s can be commonplace is the development and public acceptance of management organizations and fee structures to assure that the systems are properly maintained on a regular basis.