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Preface

This manual is intended to provide the onsite wastewater industry with a method to design subsurface drip dispersal systems that are simple, cost effective, and can meet the intention of automatic flushing. This methodology is called *continuous flush*. With this method of design the drip tubing is flushed each time the dripfield is dosed, preventing slime and debris build-up from occurring.

**Continuous Flush vs. Manual Flush:**

Manual flushing means that an operator must manually open the flush valve to scour the drip tubing network. Continuous flushing is intended to prevent the accumulation of material on the interior tubing wall. The defining difference between *manual flushing* and *continuous flushing* is that manual flushing has no flushing velocity during the dose cycle while continuous flushing has a minimum velocity during the dose cycle at all points in the network. The other difference is location of the terminal end of the flush line. With *Continuous Flushing* the flush line must terminate in the pump chamber where the dripfield dose pump is located. With manual flush, the flush line can terminate either in the pump chamber or at the beginning of the system, such as the inlet of a septic tank. (See illustration below).

Illustration courtesy of *Netafim USA*
Overview

Subsurface drip dispersal systems are designed to hydraulically accomplish two objectives:

- Deliver a set volume of wastewater to the receiving soil or media and
- Flush the interior of the drip tubing network to remove accumulated biological slimes or “re-growth”.

Most drip dispersal design manuals call for two distinctly different cycles - a dose cycle and a flush cycle. The two cycles are distinguishable by the position of a flush valve. When the flush valve is closed, the system will dose effluent into the dripfield at relatively high inlet pressure and low flow. When the flush valve is open, the system will flush the piping network at low inlet pressure and high flow rate.

In addition to the two types of cycles there are two traditional ways to accomplish the flush cycle: automatically or manually. Automatic flushing is accomplished using complex control equipment and electronic valves, synchronized with the pump. Flushing occurs automatically at prescribed time intervals. Manual flushing is accomplished with the use of simple ball valve(s) and requires an operator to periodically open and close the valve(s). A third option is called “continuous flush”.

With “continuous flushing”, both the minimum pressure for dosing and the minimum flow for flushing are achieved during every dose cycle, simultaneously. (The emitters used in this application must be pressure compensating. Pressure compensating means that within a given pressure range (7 to 60 psi) each emitter will discharge at the same rate, within a very narrow range. The flush valve position is static and does not require any adjustment between the dosing and flushing cycles. Flushing velocities can vary from each system design from 1 to 3 ft/sec. Differing velocities can be used depending on the cleanliness of the effluent or other design consideration.

Regardless of the flushing method (manual, automatic, or continuous) all systems must be designed to accomplish a dose and flush cycle. The number of emitters, zones, laterals within each zone and lateral lengths are all factors that determine the pump and supply line size and can affect the system’s ability to adequately prevent or remove slime build-up from the interior walls of the piping network.

The Lowridge continuous flush process has several basic parameters for design and operation. For virtually all single family residence designs, the same headworks, pump, and dripline 0.42 gph Netafim Bioline® are used.

**Pump:** The same sized pump can be used when the maximum number of emitters is limited to 1000 per zone. One type of pump that fits most residential application is a 20 gpm turbine pump, such as an Orenco PF200511. This pump can deliver the flows necessary for flushing and simultaneously supply the minimum pressures needed for dosing.
Design Aids:

**Residential Calculator:** The calculator is an .xls format design aid that allows the engineer/designer to manipulate a number of input design variables to determine the total amount of tubing and emitters, minimum and maximum number of laterals, length of tubing per lateral, pump “on” and “off” times per cycle per zone, dripfield area requirements, and pump flow rates and total dynamic head (TDH) while maintaining minimum scouring velocity throughout the piping network. The calculator produces TDH and flow values for both dosing and flushing, simultaneously. The calculator can be found at [www.lowridgetech.com](http://www.lowridgetech.com). Click on the “Drip Dispersal” link.

In the appendices of this manual, you will find a worksheet for hand calculations and two design examples. It is suggested to master the *continuous flush* design method by hand before trying to use the .xls calculator.

For design flows greater than a single family residence, contact *Lowridge Onsite Technologies, LLC* for assistance.

**Headworks Operation:** The *Lowridge Onsite Technologies, LLC Continuous Flush Headworks* will forward flush the dripline while maintaining the designated flushing velocity during each dose event. To adjust the headwork for continuous flush operation, use the following steps:

1. Open the field flush valve and flush the entire piping network of construction debris by running the pump for several minutes.
2. Shut off the pump and clean the disk filter of accumulated debris and replace disc cartridge. It may be necessary to repeat this step to insure there is no debris accumulating on the disk cartridges.
3. Turn the pump on. With the pump running, slowly close the field flush valve. Once the needles on the pressure gauges stabilize, record the flow rate through the flow meter for one minute. This will be the actual dose flow rate of the drip tubing and this flow rate will be needed to calculate the dose volume settings.
4. Calculate the flushing flow rate by multiplying the number of supply manifold connections by the flushing flow rate factor: 1.6 gpm (2 ft/sec) for septic tank effluent or 0.8 gpm (1 ft/sec) for secondary treated effluent. Add the dosing flow rate from step 2 to the flushing flow rate. This new accumulative, minimum flow rate is the minimum flow rate needed to achieve adequate scouring velocity in the entire system when the system is dosed.
5. With the pump running, open the field flush valve slowly until the return pressure gauge reads 10 psi.
6. Record the flow rate through the flow meter. It should be greater than the new accumulated flow rate required in step 3. More is better.
Lowridge Onsite Technologies’ Continuous Flush Headwork

The main components of the headworks are:
- 1” disk filter with 120 mesh, 130 micron rings
- Three pressure gauges
- Flow meter
- One ball valve

The disk filter has been upsized from what would normally be required for up to 1000 emitters at 0.42 gph flow rate for better performance. Upsizing the filter also increases the service interval and mitigates the need to “backflush” the filter between service calls.

Appendix A

O&M Requirements:

Operation and maintenance shall be provided at twelve (12) month intervals. Servicing shall include:
1.) Physically removing filter cartridge and washing all debris from all disks whenever the pressure differential across the filter is 5 psi or greater,
2.) Flushing the dripfield,
3.) Verifying dosing flow rate,
4.) Checking for wet spots in dripfield,
5.) Checking operation of air relief valves,
6.) Verifying and checking operating pressure.
The service provider must have been trained in servicing procedures for this particular headworks and system arrangement.

Appendix B

Design Guide for Residential Applications

Design Flow: __________ gpd
Soil Type: __________
Number of Emitters: __________
Emitter spacing: _____ ft.
Total Drip line: ______ (# of emitters x emitter spacing in feet)
Number of Zones: _____
Number of Emitters per Zone: ______ (total number of emitters / number of zones)
Emitter discharge rate per Zone: _______ gpm (emitter discharge rate gph x # emitters / 60)

Select Inlet Pressure and Max Lateral Length: ______ psi, lateral length: _____ ft. (see Bioline Flushing Chart on page 14).
Determine Maximum Number of Laterals: ______ (pump discharge rate – zone discharge rate gpm) / 1.6 for septic tank effluent or 0.8 for treated effluent.

Pump Selection:
TDH
Dripfield pressure (psi x 2.31= ft head): ______ ft. head
Disk Filter loss: ______
Elevation: ________
Friction loss through pipe network: _________
Valves (hydrotech): _________

Total head loss: __________
Flow rates:

Dosing: __________ gpm (from above)
Flushing: _________ gpm (# of supply manifold connections x desired flow rate)
Total flow: _________ gpm (dosing + flushing flow rate)

Appendix C

Maximum Emitter Discharge Rate Table

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Max emitter discharge rate/day (GPD)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<tr>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>0.8</td>
<td>0.8</td>
<td>0.5</td>
<td>0.25</td>
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Appendix D

Flush Velocity vs. Flow Rate per Lateral

<table>
<thead>
<tr>
<th>Type of System</th>
<th>Recommended Flush Velocity</th>
<th>Add'l. flow Required per Lateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septic Tank</td>
<td>2 FPS</td>
<td>1.6 GPM</td>
</tr>
<tr>
<td>Treatment System</td>
<td>1 FPS</td>
<td>0.8 GPM</td>
</tr>
</tbody>
</table>
Appendix E

**FRIC TION LOSS CHARACTERISTICS**

**PVC SCHEDULE 40 IPS PLASTIC PIPE (1120, 1220)**

*C = 150*

Sizes ½" to 6"

Flows 1 to 900 GPM

---

### Chart courtesy of Netafim USA
Appendix F: Sample pump curves.

Appendix G: Design Steps

Properly sizing a drip dispersal system requires addressing a number of factors: total number of emitters, inlet pressure, number of zones, number of laterals within each zone, and desired flushing velocity. Use Appendix A as a guide for the steps listed.

Step 1. Determine the Number of Emitters:
The number of emitters is determined by soil type and design flow rate in gallons per day.

Step 2. Determine Maximum Lateral Lengths:
Refer to Netafim’s design manual. Always use the flushing chart to determine lateral lengths. **DO NOT USE** the Dosing lateral laterals!
Step 3. Calculate the Number of Laterals:

The number of laterals is determined by dividing the lateral length into the total amount of tubing within the zone. For all fractional results, round up to the next whole number. An adjustment to the lateral length as a function of the number of laterals will be required. Divide the number of laterals into the total number of emitters required will result in a new, shorter, lateral length.

Step 4. Calculate Minimum Flow Rate:

Two flow rates, dosing and flush, are combined to determine the minimum flow rate.

Dosing flow rate:

\[
\text{Total number of emitters in one zone} \times \text{emitter discharge rate (gph)} = \text{dosing flow in gpm}
\]

60 minutes/hour

Flushing flow rate for 2 ft/sec:
Number of laterals per zone \( \times 1.6 \) gpm (septic tank effluent) = flushing flow gpm

or

Number of laterals per zone \( \times 0.8 \) gpm (treated effluent) = flushing flow gpm

**Minimum flow rate** = flushing flow + dosing flow

Step 5. Determine Friction Loss in Supply Line and Supply Line Size:

Refer to friction loss chart in the appendix. Select the pipe size that provides between 2 to 5 ft/sec velocity. Note the fiction loss.

Step 6. Calculate Total Dynamic Head (TDH):

Add the values for:
- Inlet pressure
- Elevation lift
- Supply line friction loss
- Misc. fittings and valves

Step 7. Select pump:

With the values in Steps 4 and 6 (minimum flow and TDH), select the pump that best matches the flow and pressure requirements.

Examples of the basic design for continuous flush:

**Example 1:**
Four (4) bedroom design flow, 480 gpd.
Soil type 5 (0.5 g/emitter/day)
Supply line length 60 ft.
Elevation change, 25 ft.

Step 1. Determine total number of emitters:

480 gpd/ .5 gpd/emitter (see appendix H) = 960 emitters @ 12” spacing = **960 ft.**

Step 2. Maximum lateral length:

Use the 0.42 gph emitter discharge rate at 12” spacing. Select **35 psi** inlet pressure from *Bioline Flushing Chart* (page 14). Maximum laterals length is **260 ft.**

Step 3. Calculate the number of laterals:

Number of laterals = 960 emitters / 260 ft = 3.69 laterals, round up to **4**.

Lateral lengths = 960 ft / 4 = **240 ft.**

Step 4. Calculate minimum flow rate:

Dosing flow rate = 960 emitters x 0.42 gph / 60 minutes / hour = **6.72 gpm**

Flushing flow rate = 4 laterals x 1.6 gpm/lateral = **6.4 gpm**

Minimum flow rate = **6.72 gpm** + **6.4 gpm** = **13.12 gpm**

Step 5. Determine friction loss in supply line and supply line size:

To achieve between 2 and 5 ft/sec velocities in the supply line, see appendix F. At 13.12 gpm (rounded up to 14 gpm) a **1.25”** diameter pipe provides a velocity of **3 ft/sec** and a fiction loss of 1.18 psi (**2.7 ft** of head) per 100 feet.

Step 6. Calculate Total Dynamic Head (TDH):

- Inlet pressure = **35 psi = 81 ft**
- Elevation lift = 25 ft
- Supply line friction loss (.6 x 2.7 ft) = 1.6 ft
- Misc. fittings and valves = **10 ft**  Total= **117.6 ft.**

Step 7. Select pump:

With the values in Steps 4 and 6 (minimum flow and TDH), select the pump that best matches the flow and pressure requirements.
TDH = 117.6
Minimum flow= 13.12 gpm

Refer to appendix I, sample pump curves.

Example 2.

Four bedrooms, 480 gpd flow rate
Soil type 2, 1.0 gal/emitter/day
Elevation difference = 45 ft.
Supply line length, 120 ft.

Step 1. Determine the number of emitters:

\[
\frac{480}{1.0 \text{ g/emitter/day}} = 480 \text{ emitters}
\]

Step 2. Determine maximum lateral lengths:

15 psi inlet pressure, maximum lateral length, 115 feet

Step 3. Calculate the number of laterals:

\[
\frac{480 \text{ feet of Bioline}}{115 \text{ ft}} = 4.17, \text{ round up to 5 laterals}
\]

New lateral length, \( \frac{480}{5} = 96 \text{ ft.} \)

Step 4. Calculate minimum flow rate:

Dosing flow rate:
\[
480 \text{ emitters} \times 0.42 \text{ gph/ 60 minutes/hour} = 3.36 \text{ gpm}
\]

Flushing flow rate for 2 ft/sec:
\[
5 \text{ laterals} \times 1.6 \text{ gpm/lateral} = 8 \text{ gpm}
\]

Minimum flow rate = 3.36 + 8 = 1.36 gpm

Step 5. Determine friction loss in supply line and supply line size:

A 1” diameter pipe at 11.36gpm rounded up to 12 gpm has a velocity of 4.45 ft/sec and a friction loss of 4 psi or 9.3 ft of head.

Step 6. Calculate Total Dynamic Head (TDH):
Add the values for:
Inlet pressure = 35 ft.
Elevation lift = 45
Supply line friction loss = 9.3 ft.
Misc. fittings and valves = 5 ft.

\[ \text{TDH} = 94.3 \text{ ft head} \]

**Step 7. Select pump:**

Minimum flow = 11.36 gpm
TDH = 94.3

In the examples given, the number of emitters and laterals are significantly different. Yet, the flow and head requirements are met by the same pump curve.

<table>
<thead>
<tr>
<th>Dripper Spacing</th>
<th>0.4</th>
<th>0.6</th>
<th>0.9</th>
<th>0.4</th>
<th>0.6</th>
<th>0.9</th>
<th>0.4</th>
<th>0.6</th>
<th>0.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dripper Flow Rate (GPH)</td>
<td>12&quot;</td>
<td>18&quot;</td>
<td>24&quot;</td>
<td>12&quot;</td>
<td>18&quot;</td>
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<td>24&quot;</td>
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<tr>
<td>flush</td>
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<td>0.9</td>
<td>0.5</td>
<td>0.9</td>
<td>0.5</td>
<td>0.9</td>
<td>0.5</td>
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<tr>
<td>25</td>
<td>369/315</td>
<td>296/258</td>
<td>228/203</td>
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<td>387/350</td>
<td>790/683</td>
<td>635/559</td>
<td>491/441</td>
</tr>
</tbody>
</table>

**Flow per 100' (GPM/GPH)**

- 12": 0.63/0.40, 1.22/0.61, 1.13/0.92
- 18": 0.46/0.26, 0.68/0.41, 0.66/0.41
- 24": 0.40/0.23, 0.52/0.36, 0.51/0.37

Table 11 - Maximum Length of a Single Lateral of Bioline Based on Flushing Velocity