FLUSHING VELOCITIES FOR SEWAGE EFFLUENT DISPOSAL AND/OR REUSE USING SUBSURFACE DRIP TECHNIQUES

By: Rodney Ruskin, CEO, Geoflow, Inc.
rr@geoflow.com

Introduction:

There is confusion in the field as to the minimum requirements to flush a polyethylene tube used to carry and dispose of sewage effluent. Part of the reason behind this is that there are very few independent field studies or published standards by reputable organizations. A second factor is that different products have different tendencies to grow bacterial slime which results in commercial companies recommendations of different standards. It is reasonable to expect that any commercial company will do its best to influence regulators, engineers and others involved in decisions in order to minimize the advantages of a competitor while maximizing any advantages to themselves.

Independent Standards:

After communication with Geoflow's licensees in Israel, Spain, Italy and Australia the author has found only one published standard for field flushing, from the American Society of Agricultural Engineers. Engineering Practice number 405 of the American Society of Agricultural Engineers (ASAE) Standards recommends a flow capacity of one foot per second for flushing lateral lines.

Manufacturer's and their Distributor's Standards:

While there are about ten drip irrigation companies in the U.S. only two companies offer products specifically designed for the sewage effluent disposal markets.

Geoflow's WASTEFLOW and other bactericide-lined tubes made under license to Geoflow, are probably the most widely used products in the marketplace. Netafim's Bioline is also sold into this market.

Geoflow and it's distributors and licensees offer a dripline, usually called WASTEFLOW®, in which the polyethylene tube has a bactericide lining as well as bactericide protection of the dripper. Geoflow's literature does not make any specific requirements for minimum flushing velocity. Geoflow however does require that the system be periodically flushed. Because of the bactericide lining they teach that all that is necessary is to move out the fine particles of less than 100 microns (145 mesh) which have passed through the filter and which will accumulate on the bottom of the tube at the end of each lateral. Because all pumps deliver more volume given less resistance to flow, just opening the flush valve will achieve this degree of flushing.

(Note: One can visualize unusual circumstances in which the pump and field are both below the height of the treatment plant (or septic tank), where one may have to increase the pump size to ensure that there is any flush flow at all. The author has never actually encountered such circumstances.)

When pressured by regulators or others to state a standard Geoflow's position is to use a flushing velocity of 0.5fps.

Netafim manufactures Bioline. Israeli manufactured emitters impregnated with a bactericide, are imported to the U.S. These emitters are inserted into a standard agricultural polyethylene tube, which is pigmented purple instead of the standard black. The main distributors of Bioline are Wastewater Systems of Georgia and American Manufacturing Company of Virginia, whose literature and presentations teach a minimum "scouring" velocity of 2 ft./sec.

The Design Factors:

In addition to raising the question of what is a reasonable safe flushing rate, regulators and engineers need to know how to design in order to meet minimum desired flush rates.

The author proposes two methods of design to meet a minimum flow rate requirement.

Quick and Easy Method Using Tables and Charts:
It is easiest to demonstrate this method by way of examples using the most frequently specified WASTEFLOW parameters.

Example 1: Tube 0.55" I.D. with pressure compensating drippers giving 0.53 gph spaced at 24. The flush rate desired is 1 ft./sec.
1ft./sec. -> 0.75 gpm = 45 gph -> flow from 85 emitters -> an extra 170' of dripline.
Add 170' of dripline to each drip lateral and recalculate the pump selection.
If using Geoflow's maximum length of run tables, then reduce the maximum length of run by 170'.
This method is conservative to the extent of a little less than 2 psi because of the effect of the friction loss of the tube and the barbs in this notational extra 170'.

Example 2: Tube 0.550" I.D. with pressure compensating drippers which flow at 0.53 gph, spaced 24" apart. The flush rate desired is 2 ft./sec.
2ft./sec. -> 1.50 gpm = 90 gph -> flow from 170 emitters -> an extra 340' of dripline.
Add 340' of dripline to each drip lateral and recalculate the pump selection.
If using Geoflow's maximum length of run tables, then reduce the maximum length of run by 340'.
This method is conservative to the extent of 7 psi because of the effect of the friction loss of the tube and the barbs in this notational extra 340'.

The maximum length of run in Geoflow's tables under the above circumstances, without allowing for flushing, is 651' -> with flushing at 1.43 gpm this is reduced to 311' with a 7 psi extra safety factor.
Note: Geoflow's maximum length of run is based upon a maximum variation from dripper to dripper of plus minus 5%. Several regulators allow a larger margin than this.

Method of Basic Calculation Using an Excel Spreadsheet.
An example of this method using the Hazen-Williams friction formula is attached to this document in Microsoft Excel 2000.

Comparison of Methods:
From the Excel spreadsheet;
maximum length of run with an inlet pressure of 45 psi and a flush rate of 1.43 gpm = 350'.
Allowing for the 7 psi conservative factor in the quick and easy method, the two methods are consistent with one another.

Advantages and disadvantages of a dripline without a bactericide lining flushing at 2 ft./sec. vs. a dripline with a bactericide lining flushing at 1 ft./sec.:

Disadvantages of bactericide lining:

- Initial cost of tubing is higher.
- Supply of product is limited to Geoflow and its licensees.

Advantages of bactericide lining:

- Maximum recommended length of run is approximately 170' longer – or the uniformity of distribution of the effluent is much better. This will often result in lower installed cost.
- A smaller pump, hence capital expense is lower.
- Lower operating costs are due to less power consumption