An informal research review of dripline flushing velocity
By Freddie Lamm, resummarized 2-19-2004.

The following forms the basis of an informal review of all references I could find for dripline flushing velocity up though February 2001. Portions of this message were sent to Trickle-L discussion list March 6, 2001.

I initiated a discussion in Jan. 2000 to help with the search for the origin of velocity values for flushing. In my email messages of that period, I pointed out there could easily be a difference between a ***flushing velocity*** and a ***scouring velocity***. Many participants of Trickle-L personally contacted me with information. In some cases, the underlying theory of the respondants differed. I believe some of those differences dealt with the issue of "flushing" vs. "scouring". Some believe it was entirely a sedimentation issue. Some believe it was related more to the Reynolds No of flow. Granted, both rationale have "some" interconnection. Here's a partial summary.

I personally hold this topic up as a good example of where sometimes the original reasons behind a value is lost??? or maybe misinterpreted???. I totally agree with Rodney Ruskin that ASAE EP- 405.1, section 3.7.2 indicates a minimum flushing velocity of 1 ft/sec. I also agree that the Jensen 1980, ASAE monograph "Design and operation of farm irrigation systems", Page 709, indicates 1 ft/sec.

In Jensen,1980, the source for the 1 ft/sec is credited to Shearer, N.M. 1977. Minimum screening and automatic flushing. In proceedings of the 4th Annual Int. Drip Irrigation Association Mtg, Fresno, CA. pp 32-36.

Similarly, Dale Bucks and F.S. Nakayama at the 3rd. Int. Micro Irrigation Congress, Fresno, CA Nov. 18 -21 1985 page 125: "A minimum flow velocity of 0.3 m/sec.(1ft./sec.) is needed for flushing lateral lines. They also credit the Shearer 1977 paper in addition to one other paper McElhoe, B. A. and H. W. Hilton. 1974. Chemical treatment of drip irrigation water. Proc. of 2nd Int. Drip Irrig. Congr. San Diego, CA. pp 205-220.

Actually the Shearer paper is incorrectly referenced since date is actually 1976. At least that's what Marvin Shearer indicated to me in personal correspondence. The copy he sent to me indicates the conference was in Fresno on October 5, 1976. Furthermore, reading of the paper suggests this paper would not be a very "solid reference" for the value. The "paper is solid", it's just that the paper does not discuss 1 ft/sec. The only reference to 1 ft/sec is in a graph describing a valve. I believe this was just listed as an original reference by mistake.

I believe a better reference by Marvin N. Shearer is Shearer, M.N. 1975. Removing suspended solids from irrigation water. Proceedings of the 1975 Drip Irrigation Convention, International Drip Irrigation Association, October 20-22, 1975. pp 124-126.

I'm sorry I don't have the location of the conference. Perhaps someone can provide me with that information. This reference also does not discuss 1 ft/sec flushing velocity but does indicate that the problem is sedimentation in the approximately last 200 ft of 5/8" dripline (0.27 gpm/100 ft) due to transition to laminar flow during the normal irrigation cycle.

The McElhoe and Hilton reference is also slightly wrong in that the pages are 215-220. Additionally, I can find no reference at all to 1 ft/sec or any flushing velocity in that paper.

One other paper M.N. Shearer provided is Gibson, Warren and Uyen Bui. Flushing valve for drip irrigation water. pp 131-136. Paper No 375 in the J. series of the Exp. Stat.,Hawaiian Sugar Planters' Association. I do not have a date or when and where it was presented. I'd appreciate any help anyone can provide on this reference also. I suspect it may be around 1973-1977 and probably at an international drip association meeting. This reference makes the following statement "It was determined from tests, using clear plastic tubing, that a minimum water velocity of 1 foot per second (1 fps) is desirable for good flushing."

OK, now up to more modern day. In various sources, the flushing velocity for microirrigation laterals is listed generally from 1 to 2 ft/sec. Some of the differences appear to be related to larger particle sizes and the higher velocities required to remove them from dripline. In other cases, it appears there's a safety factor approach taken, where maybe there is a concern about how scientifically solid 1 ft/sec. really is. Others consider Reynolds numbers and sedimentation issues. Many respondents pointed out Civil Engineering and Wastewater Engineering Books. Unfortunately, some of those were out of print. I don't know about the recent reference posted in the last couple of days to Trickle-L "Civil Engineering Design Manual" by Michael R. Lindeburg.

For those wanting further web reading:

Flushing procedures for microirrigation systems by A.G. Smajstrla and B.J. Boman
http://edis.ifas.ufl.edu/WI013 This reference readily admits that there's disagreement of what the appropriate number is, but does point out ASAE Ep-405.1 and the Jensen 1980 book.

Maximizing the life of drip tape by B.R. Hanson
http://www.irrigation.org/ia/ibt/ibt2_99/p28.html

Keep microirrigation systems clean by Robert G. Evans
http://www.goodfruit.com/archive/Feb15-98/special10.html

Flushing velocities for sewage effluent disposal and/or reuse using subsurface drip techniques by Rodney Ruskin
http://www.geoflow.com/wastewater/FLUSHING%20VELOCITIES%20FOR%20SEWAGE%20%20EFFLUENT%20DISPOSAL%20AND.htm

And these two on Microirrigation Forum itself.
Microirrigation Flushing Procedure and Requirements by F. Hassan
http://www.microirrigationforum.com/new/archives/flushreq.html

Optimum Velocity Required to Flush
http://www.microirrigationforum.com/new/archives/opti-flush.html

Rodney Ruskin also had an email message, Jan 03, 2000 discussing "Turbulent flow and Line Flushing" by Dr. Alvaro Sanjines. I don't know if this has been published or not on any website.

In closing this message, I don't necessarily dispute anyones' values. However, I personally don't think the science paper trail is very convincing on this issue. Some might say that if a value seems to work, that's fine and I agree to a point. However, when the rationale behind the value gets lost, its more difficult to dispute that "rule of thumb", because you may not know what theory you can supersede with a better idea. For example, scouring (removing a coating of debris from pipe wall) probably has different physics and dynamics science requirements than flushing (moving debris along a pipe). Additionally, some materials would have greater sedimentation velocities and drag coefficients.

If you know of other paper trails, please let me know.
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