

Managing Drip Filter Backflush Water

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Abstract. *The paper discusses the principles of backflushing different types of filters, as well as pressure and flow requirements for proper backflushing of various filters. Additionally, it discusses options for what to do with the backflush water. A prototype ITRC design for cleaning and recycling backflush water is presented.*

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Secondary Keywords. Conservation, design, water treatment

Product Keywords. Drip/micro systems – agricultural; water filters, strainers & sand separators

Introduction

This paper will focus on three specific aspects of backflushing:

1. Principles of backflushing different types of filters
2. Backflush flow rate requirements versus pressure requirements
3. Disposal of backflush water

Principles of Backflushing

Filters are designed to catch solid particles and retain them, allowing cleaner water to pass through the filter and into the irrigation system. In partnership with filtration, backflushing is a mechanism in which a flow rate moves through the filter surface in reverse, removing the accumulated particles from the filter. That backflush water is isolated from the irrigation water, and is discharged into the air at some point.

Filters with No Backflush

Some filters do not have “backflushing”. One example of such a filter can be seen in Figure 1. The photo shows a perforated horizontal cylindrical screen, inside a housing, in which dirty water enters from the center and then passes through the screen, then between the screen and the housing, and then out of the housing. Many of these filters are cleaned by sending a high flow rate along the complete length of the filter and out the downstream end. There is no reverse flow in this case.



Figure 1. Typical horizontal cylindrical filter with a coarse, perforated stainless steel screen, typically used for sprinkler applications. Algae that passed through the screen can be seen on the downstream side of the screen. The complete screen has been removed from the filter housing. A 4" flush-through (not backflush) valve and hose manifold can be seen for each cylinder.

Automatic Self-Cleaning Filters

Automatic self-cleaning "vacuum-scanning" screen filters use a special type of backflushing. As with most screens, dirty water enters the center of a tubular screen, turns at right angles, and passes through the screen material, leaving the contaminants on the inside surface. These self-cleaning screens are often equipped with relatively fine mesh (100-150 mesh) fabric that is reinforced to withstand a large pressure difference when dirty.

Automatic screen filters have a rotating mechanism inside them that can "vacuum" the contaminants off the surface of the screen when it gets dirty. There is no actual vacuum, but rather a hollow rotating shaft with nozzles positioned very close to the dirty inside of the tubular screen. When the flush cycle is activated, water flows into the nozzles, then into the shaft, and is discharged into the atmosphere. The close tolerance between the wand inlet and the screen surface causes water to flow in reverse through the screen when the nozzle rotates past a point. The majority of the water continues to pass through the screen and into the irrigation system. These rotary cleaning tubular screens have been available for many years, but the new designs are far superior to previous ones.

There is a tight clearance between the nozzles and the screen, plus the “suction” holes in the spinning wands have small diameters. Therefore, excellent pre-filtration is absolutely required. A typical backflush flow rate is about 15-40% of the dirty water inflow rate.

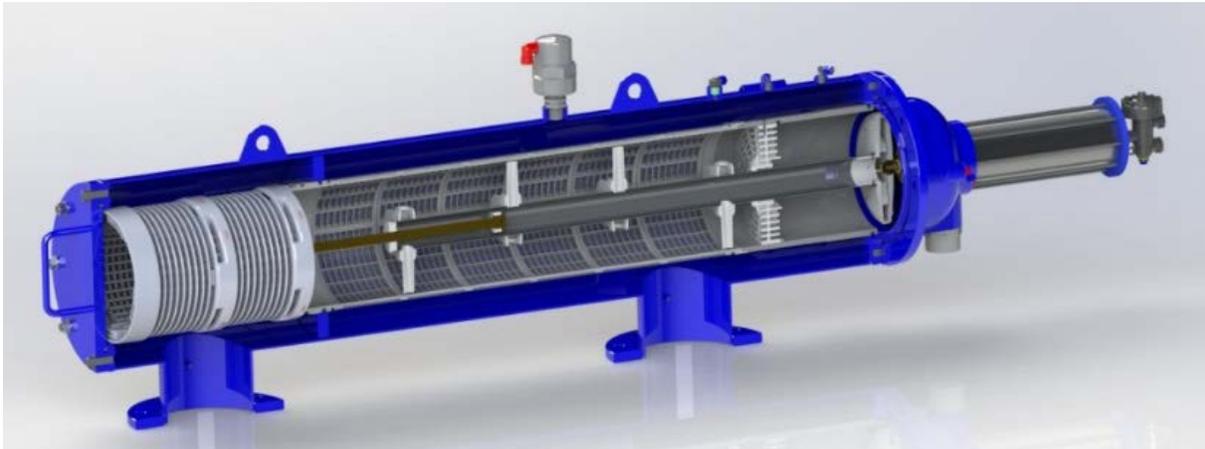


Figure 2. Example of a rotating wand design for a screen. Courtesy of Amiad.

Media Tanks and Disc Filters

Media tanks and disc filters require a substantial reverse flow rate during backflush. A typical backflush flow rate per tank is about the same as the dirty water tank filtering flow rate. Figure 3 illustrates the concept of backflushing of media tanks.

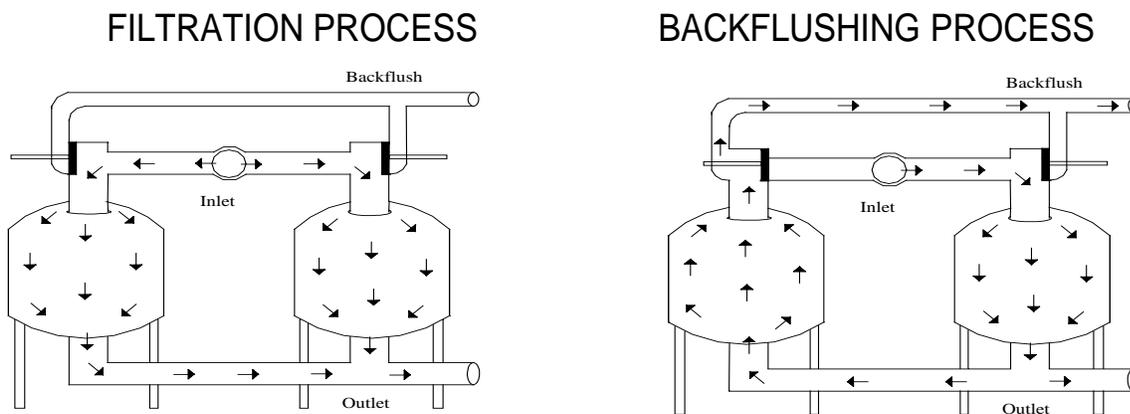


Figure 3. Filtration and backflushing processes with media tanks. Sketch courtesy of Yardney.

Backflush Flow Rate Requirements versus Pressure Requirements

In many drip/micro systems, the pressure requirements for backflushing will define the pressure requirement from a pump.

For example, the suction-scanning screens require 30-38 psi in the filter to overcome the friction loss that will occur through the screen, nozzle, shaft, and valve pathway with the required backflush flow. The concept is relatively simple: the water that backflushes through the screen must have sufficient velocity to clean the screen. Given the pathway sizes, lengths, and configurations, a certain amount of friction will occur at that flow rate. Some vendors have supplied booster pumps that are attached to the discharge of the backflush valve. The idea is

that if the booster pump can exert a suction of 15 psi, as an example, the filter backflush will function well with only (38 psi – 15 psi = 23 psi) inside the filter body.

Disc filters are somewhat similar to the suction-scanning screens in that a certain internal pressure is needed to expand the filter discs and move the water through the manufactured pathways. Many disc filters require 30-35 psi inside the filter to achieve effective backflushing flow rates.

Media tanks have been sold for years with an understanding that they also require 30-35 psi for backflushing. However, that is completely erroneous if the media tanks backflush settings are correctly adjusted, and if the backflushing piping is reasonably sized. As with all backflushing, the key is to obtain a sufficient flow rate. In the case of media tanks, the flow rate must be sufficient to expand the media (sand) and move the contaminants upward and out of the tank backflush valves. Extensive media tank testing by the Cal Poly ITRC has conclusively shown that backflushing a hydraulic pathway through the tank, underdrain, media, and backflush filter may require as much as 13 psi with a very restrictive valve; most designs require about half of that.

The confusion about a high backflush pressure requirement for media tanks evidently arises from two things:

1. Some systems have very small backflush pipelines that may travel long distances and even uphill, without air vents. Therefore, a large amount of pressure is required to overcome friction, air locks, and elevation change. This is just a bad design.
2. When media tanks are improperly backflushed, the media can become almost cemented. People know that they can break the cemented media apart by using large pressures at the bottom of the underdrains.

Backflush Water – Reducing the Volume

Backflush water disposal can cause headaches for designers and operators. Dirty water combined with the need for fine drip tape filtration can produce situations that require very frequent backflushing – resulting in large volumes of water that needs to be disposed of.

The first step in backflush water management is to minimize the volume of backflush water needed, yet still attain the degree of filtration required. This is done in two ways:

1. Select a brand/model of media tank with a very efficient backflush operation. Some brands/models require up to three times as much backflush volume per day as others. Interestingly, the models that are least efficient will also discharge the most media along with the backflush water.
2. Use pre-treatment to reduce the dirt load entering the filters. For example, a typical 48" media tank will have a backflush flow rate of about 220 GPM, which only provides a velocity of about 0.04 feet/second above the media during backflushing. This certainly will not remove sand and many other contaminants. Sand is seen in backflush water with filters that have very non-uniform backflush flow patterns, in which much higher-than-average velocities occur in some "hot spots". Note: There are numerous ways to pre-filter water before it enters the media/suction-scanning/disc filters that are mean to be "polishing" filters. Those pre-filtration techniques will not be covered here.

A third option has evidently not been used in agricultural drip filtration. That option uses air to create additional turbulence during backflushing, which might result in less volume of water needed.

Backflush Water Disposal

One concern about backflush water disposal is the ultimate destination of chemicals that may be injected upstream of the filters. For most organic fertilizers and other compounds such as gypsum, a sure path to emitter plugging is to inject downstream of the filters. Therefore, one should consider two options:

1. Stop injecting the chemicals sufficiently early prior to backflushing. This can be accomplished with some commercial backflush controllers. Of course, if the filters are almost constantly in a backflushing mode this is a poor solution. See the comments on pre-filtration requirements.
2. Recirculate the backflush water after cleaning it.

There appear to be four common ways to dispose of backflush water:

1. Dump the water into a field or into a drainage ditch. For many areas, there simply is not enough water available for this to be a viable option.
2. Dump the filter backflush water into the supply canal. Let your downstream neighbor deal with it. This is a common practice in California.
3. Recirculate the backflush water into the reservoir from which the original water came. Hope that some miracle will cause the backflush water to clean itself in the reservoir even though that didn't happen the first time.
4. Clean the backflush water with a specially designed automatic overflow screen, and pump the relatively clean water back into the system, upstream of the drip system filters. An example of this is seen in Figure 4.



Figure 4. A media tank filtration system that uses a small commercial (FV&C) overflow screen to clean the backflush water before recycling it

For the cases in which the backflush water is returned to a reservoir or a canal, ITRC has experimented with a "mushroom" or "turbulent fountain" screen through which the backflush

water must pass. This design is common for cleaning canal water prior to entering center pivot systems in the Pacific Northwest, albeit with a much coarser screen. The screen seen in Figure 5, which was an early prototype by ITRC, used a 150 mesh stainless steel screen.



Figure 5. ITRC mushroom screen for cleaning and recirculation of filter backflush water.

Unfortunately, the 150 mesh screen did not work well in the field. Over time, it plugged up and much of the backflush water simply flowed over the outer edge of the screen unless it was cleaned before every backflush cycle. ITRC plans to experiment with some revised designs. It appears the commercial designs with bottom-side spray wands – minus the pump that is used to re-pressurize the water – may be the best solution.