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Irrigation Filtration 101

Here's what to look for when selecting a filtration system for irrigation water.

By FRED AHNERT

In many cases, the success or failure of a filtration system is determined before water is even pumped into the system. If the wrong product is selected or if the equipment is sized incorrectly, the filtration system will generally not provide optimum performance. More maintenance is usually required and water and energy resources may not be used efficiently.

In drip and sprinkler irrigation, the quality of the water being pumped into the irrigation system is the single most important factor to evaluate the product selection. When evaluating water quality, the source water, fluctuation in the source water quality, contaminant loading, water chemistry problems and suspended solids loading should be considered.

After an analysis of the water quality is accomplished and the proper product is selected, the filtration requirements of the emitting device need to be determined. The last item is sizing (flow and pressure) of the system selected. Each of these important factors will be discussed in detail.

Water quality analysis

The water analyzed should be representative of the *poorest* water quality of the year. Analysis should focus on the type of contaminant loading. Is the contaminant organic (algae, snails, clams, fish, bacterial slimes), inorganic (sand, clay, dirt, silt) or both? Certain chemical contaminants in the water, such as iron, manganese or calcium, should be identified. The pH of the water should also be determined. The filtration equipment normally pro-

vided for irrigation water only removes suspended solids. Contaminants in solution, such as salt, will not be removed by the methods discussed here.

Generally, irrigation water is pumped from a source that is either ground water (well) or surface water (reclaim, reservoir, canal, pond or lake). Most surface waters contain both organic and inorganic contaminants. Additionally, the constituents of some surface waters, such as reclaim, contain chemical components that promote organic growth. Ground water contaminants will usually be inorganic. However, organic contaminants, such as bacterial slimes, may be found in ground water sources.

The source of the water is important in determining the proper product for the application; even more important, however, is where the water is stored before it is pumped into the irrigation system. As an example, if well water is pumped from the well into a holding pond and then into the irrigation system, the contaminant loading all of a sudden changes, in most cases, from inorganic to a combination of organic and inorganic.

Emitting device requirements

The finer the water passageway in the emitting device, the finer the requirements for filtration. Drip tape and tube products normally require 200+ mesh filtration. Microjets and sprinklers can generally tolerate a coarser filtration.

When considering the level of filtration required, a standard recommendation by irrigation designers is to remove all particles larger than one-sixth the size of the smallest orifice in the irrigation system. The proper level

of filtration will prevent overfiltering the water, which may cause excessive backwashing.

Filtration production selection

In addition to sand media and screen filtration, there are other methods utilized to reduce the loading of suspended solids in the irrigation water. Two of these are sedimentation and centrifugal separation.

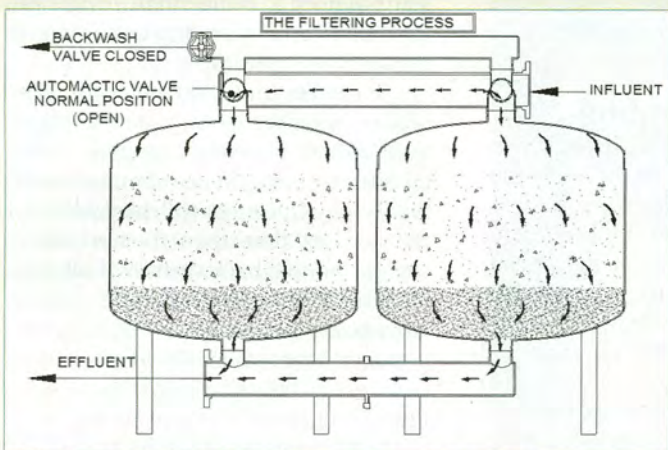
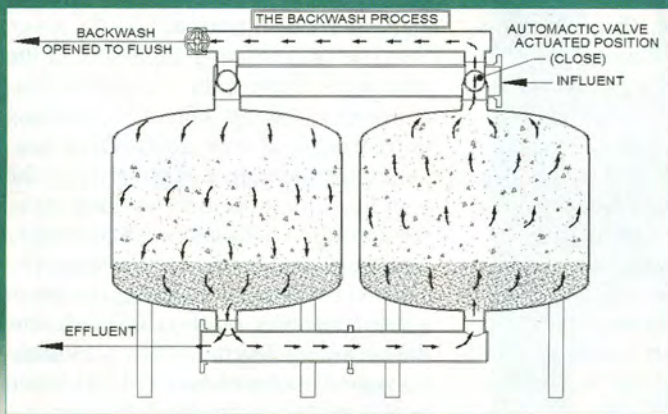
A *sedimentation basin* provides an area where the mixing action of the water is slowed. A properly constructed sedimentation basin will remove only coarse contaminants. A *centrifugal separator* requires set flow rates and will remove only the particles the system is specifically sized for. Because changes in flow rates can change how efficiently the separators operate, there is an element of inconsistency in terms of contaminant removal.

When contaminant loading in the water source is heavy, one or both of these methods will reduce the loading on the actual filtration system. However, neither should be considered as a substitute for primary filtration.

Before specifically discussing sand media and screen filtration, four key items that apply to filtration in general need to be addressed:

- **There are no industry standards relative to the design or sizing of filtration equipment.** The amount of surface area available for filtration as well as the manufacturer's sizing of the equipment in gallons per minute per square foot of surface filtration area are very important.

The sizing affects the pressure loss through the system, as well as how frequently the system will require cleaning.



Figures 1 and 2 detail the filtering and backwashing processes of the sand media filter.

- **No one filtration product is suited for all applications.** The water source, contaminant loading and emitting device requirements of each application should be evaluated before product selection. Even though a filtration product may be working successfully on one installation, there is no guarantee it will work successfully on another unless the operating conditions are essentially the same.

- **Cheaper is not always better.** While price is an important consideration, it should be just that—a consideration. A system that has a cheaper initial acquisition cost may end up costing more in the long run due to maintenance problems and system downtime.

- **Once the equipment is installed, preventative maintenance must be ongoing.** With ongoing preventative maintenance, in most cases, the system will operate for its expected useful life. Even if the equipment is automatic, the user cannot “set and forget” the system. Lubrication of the valves and checking the gauges and filtering medium (sand or mesh) must be performed on a routine and consistent basis.

One simple and easy way to determine if the system is being adequately purged of contaminant is to ensure that if a clean system has a 4 psi pressure differential, after the system is cleaned the differential is back to 4 psi. If not, a residual contaminant build-up is occurring in the system and must be investigated and resolved immediately.



Filters composed of stainless and carbon steel—and illustrated in Figures 1 and 2—are cut away to show the inner workings.



Screen filtration

Screen filter products are popular because they are inexpensive, easy to install and take up less space than a sand media filter. They come in various shapes and sizes, although most are horizontal cylinder types. Screen filters can be used as primary or secondary filtration and can be operated either by manual or automatic controls.

Mesh-type screen filters usually work well with a low to moderate loading of inorganic contaminants and where there are virtually no organic or chemical contaminants. Certain chemical contaminants in the water source, such as iron or calcium, may create problems if they precipitate out of solution before entering the filtration system. Generally, however, mesh-type screens can be used effectively on well water sources.

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Screen filtration is considered single plane or surface filtration. By design, screens have limited capability to store contaminants before the system will require cleaning. If organic contaminants are present in the water source, in many cases, they will mix with the inorganic contaminants and blind the filtering mesh.

During cleaning of the system, this contaminant does not readily release or vacuum from the mesh. The result will be frequent and excessive flushing. Even with automatic or self-cleaning units, manual cleaning of the cartridge will still be required.

Once you've determined that a screen filter is suitable for the application, the following should be considered during product selection:

- The ability to repair and perform maintenance of the unit on site versus returning the unit to the manufacturer. If there are working parts inside the screen filter, they can and do, in many cases, become maintenance items.

- The amount of surface area available for filtration.

- The manufacturer's sizing of the unit as it relates to flow per square foot of surface filtration area. Since there are no industry standards, sizing can range anywhere from 60 to 400 gpm/sq ft of filtration area. While this may appear unreasonable, there are products manufactured and sized in this range. The physical size of a screen housing can be misleading. If the inside cartridge area is designed with discs or working mechanisms, the area actually available for filtration is reduced.

A screen filter system should provide as much filtration area as possible and be easy to maintain. This will allow for a lower pressure loss through the system and provide extended system run times between cleaning cycles.

Sand media filtration

Sand media filters are usually more effective for filtration where the water source contains organic, heavy inorganic or certain chemical contaminants. A sand media filter offers the advantage of a bed of sand to provide depth filtration. Organic contaminants will more readily release from a sand bed than from a fabric or stainless mesh. In comparison to a screen filter, the sand media filter provides for longer system

run times between backwashing cycles, more filtration area, and the ability to achieve a finer filtration.

The backwashing capability of the sand media filter is the heart of the system. Once the dirt enters the filtering unit, being able to purge the dirt is necessary to maintain the integrity of the system. During the backwashing cycle, the sand bed is fluidized and the contaminant is purged from the system. The sand is retained in the filter by the use of a restrictor valve on the backwash line; the backwash flow rates control fluidization and cleaning of the sand bed. When setting backwash time and duration, the settings need to be adequate for the water quality and operating conditions of the specific application.

If you're not familiar with sand media filtration, here's quick explanation: When backwashing does occur, all filtering units do not simultaneously backwash. One unit will backwash for the specified time; then, the next unit in succession will backwash until all units have been cleaned. Also, there must always be at least two sand media filters in a system. During backwashing, a portion of the clean, filtered water from the other units is used to accomplish the backwashing process (see Figures 1 and 2).

The amount of irrigation water dedicated to each unit for filtering is referred to as "sizing". The sand media filter is usually sized in gallons per minute per square foot. Proper sizing of the sand media filter is critical to system performance. More or less capacity in a sand media filter may significantly impact system performance and, in fact, may be the difference between success and failure of the system.

In a screen filter, oversizing provides for more filtering capacity without impacting performance. Undersizing usually increases pressure loss and cleaning frequency of the system. In a sand media filter, oversizing may cause channeling in the sand bed and undersizing may cause coning of the sand bed.

It is generally accepted within the industry that the system should never be sized for less than 15 gpm/sq ft or more than 25 gpm/sq ft. Most drip applications are sized in the range of 17 to 21 gpm/sq ft, based on water quality, with an average sizing of 20 gpm/sq ft.

In a sand media filter, the sand controls the level of filtration. Sand is selected based on the filtration requirements of the emitting device. The sand in the system is a permanent medium and does not usually need to be replaced unless it is fouled by oil or

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chemical contaminants. The medium used is a crushed, sharp-edged silica sand. The manufacturer's recommendations for sand particle sizing and uniformity coefficient must be followed to provide required filtration and ensure system hardware integrity. Improper sand sizing and selection may contaminate and plug the underdrain structure, resulting in higher pressure losses and restriction of flow to the irrigation system.

One final comment regarding sand media filtration: There are no set industry standards for the design or construction of the filter vessels. When selecting a sand media filter product, the tank construction and field serviceability of the unit should be evaluated. Manufacturers use carbon steel, stainless steel (not recommended where the water source contains high salts and chlorides) and fiberglass in the construction of the filter vessels. Plastic and stainless steel are used in the construction of the underdrains. Some manufacturers recommend gravel packs over the underdrain for dispersion of the backwashing water, while others do not. These are all factors that should be considered when selecting a sand media filter.

Wrapping it up

When selecting a filtration system for your irrigation water source, taking the time to evaluate the water quality and product selection will generally result in saving time, money and system downtime. Sand media and screen filtration products have both advantages and disadvantages. The efficiencies of using one product over another should be weighed. If one understands the strengths and weaknesses of each product type and is well versed on the operating conditions of the specific application, it is more likely there will be a successful product application.

A properly selected, sized and installed filtration system is a valuable management tool. Understanding the equipment's capabilities and limitations will promote and enhance efficiency in the operation of the entire irrigation system while providing a return on the time and investment dollars spent.

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