Water Filtration for Propagation Systems

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In standard irrigation practice, filtration is regrettably often one of the last components of the irrigation system considered. In propagation irrigation, it is vital that it be considered first. Filtration protects any system against pitting, corrosion, and plugging of irrigation emission devices, and, in so doing, leads to greater uniformity and more even distribution patterns of water and nutrients for any crop. The most sophisticated irrigation system cannot perform adequately if the drippers, sprayers, misters, or sprinklers are clogged. In standard, crop irrigation applications, clogging can result in lower yields for the grower. The grower will realize something less than 100% of the potential crop and suffer a concomitant loss of income. In propagation applications, where the crop value is inordinately high, if the distribution patterns and uniformity are compromised by emitter clogging the cost is potentially much greater. The propagator may realize a total loss of an extremely valuable crop and the investment that went into developing the crop. The intensive, propagation "season" requires an irrigation system operating at peak performance at all times. Short periods of inadequate or uneven watering and applying of nutrients are unacceptable.

In irrigation practices today there are three major types of filtration elements: screens, disks, and media. All three types serve as traps for debris or "filter cake". During the filtration process, filter cake builds up on the filter element, a pressure differential is created, and then, the element requires cleaning which can be done manually or automatically.

Criteria for acceptable filtration are: 1) that the filter element be reliable (i.e., that it does indeed trap the filter cake and prevent it from going downstream), 2) that the element not require abundant maintenance, and 3) that the filter be durable and, therefore, economical. All three above-mentioned filtration elements are reliable means of trapping filter cake. They are all relatively durable as well. Where the three different methods of filtration differ significantly is in their performance in various applications. When a filter is improperly applied the level of maintenance and, conversely, the level of inefficiency rises.

When is it best to recommend either a screen, disk, or media filter? First of all, a short description of the process of media filtration is in order. Media filtration is generally constructed of large (24 to 48 in.) carbon steel, stainless steel, or fiberglass tanks in which finer and coarser grains of sand are layered to various depths. The individual sand particles are faceted and three dimensional. When organic contaminants (algae or bacteria) pass through this medium they adhere to the facets of the grains of sand. When enough algae have attached themselves to the sand the water's path becomes obstructed and a pressure differential is created. Then, either automatically or manually, a backflush command is given that reverses the flow of water expunging the algae to the atmosphere.

Media filtration is an excellent means of trapping organic matter. However, in order to insure that the facets of the sand are always sharp and capable of providing the surface area necessary for trapping the algae, it becomes necessary to replace the media (the edges of which have become rounded due to the continual flow of water at a high velocity) periodically, as frequently as once a year. It is also very important to maintain the solenoids, valves, and electronic controllers of the automatic backflush system as well. If the automatic system fails or if the backflush system is not initiated manually at proper intervals a high pressure differential is created across the media. At high pressure differentials the water has a more difficult time passing through and "tunneling" or "channeling" results. When such tunneling occurs, the media becomes impacted, the backflush system becomes ineffective, and it becomes necessary to extricate the cement-like media and replace it. It is not uncommon, in these circumstances, to be left no choice but to cut off the top of the tank, remove and replace the sand, and then weld on a new lid.

Media filtration is not an efficient means of trapping inorganic matter. It is not advisable to filter sand with sand. Inorganic particles do not have the sinewy, adhesive nature of algae. Inorganic matter will not penetrate the middle or lower layers of the media tank and will instead coat the uppermost layer of the media bed. As a result, a pressure differential is quickly created and frequent flushing becomes necessary.

Disk filtration was designed to imitate sand-media tanks. Disk elements are cartridges of polypropylene grooved rings that resemble poker chips. They are compressed together during service and the flow of water is directed from the outside of the disk toward the center. The grooves of the disk element serve to trap the algae in much the same way as the facets of the sand trap organic matter in media tanks. When substantial levels of organic matter have been trapped by the disk, a pressure differential is created. The disks must then be loosened and separated. High pressure water is then applied from the outside of the disk cartridge toward the middle, spinning the disks, in order to fully clean the element. Periodic bathing of the disks in an acidic solution is recommended. Just as the sand media tank is limited in its applicability, so are disk filters. Inorganic matter does not penetrate through the grooved disk and only coats the outer surface. A pressure differential is quickly created and frequent flushing becomes necessary.

Screen filtration serves to trap both organic and inorganic matter. Screen elements have much larger "effective filtration areas" than do disk filters. Here it is necessary to define two terms: 1) "filtration area" and 2) "effective filtration area". Imagine a screen element. Take a knife and slice one side of the element so that it could now be spread flat onto a table. Solve for the area of that surface and that represents the "filtration area". Now, take that same element and eliminate the plastic or steel construction, the mesh itself, seals, etc., so that all that remains is the space or holes. Measure those holes and that represents the "effective filtration area". When you hold up a disk or screen filter of the same size and mesh you can see through the screen filter and cannot see through the disk element. That is simply because the screen element has a much greater effective filtration area. If the particles are inorganic and cannot penetrate the disk element or the sand media, i.e., the matter cannot avail itself of the third dimension that sand media and disk elements provide, then an element with a greater effective filtration area will hold that many more inorganic particles. The result is that a much greater interval will be created between occasions when a pressure differential is created. Generally speaking, given two identically sized elements, a screen element will require cleaning one-third as often as a disk element when the filter cake consists of inorganic matter. The converse is also true. A disk filter will have to be cleaned one-third as often as will a screen when the contaminant consists of organic matter.

Since the potential loss of a propagation crop is so high, it may not be economical or wise to depend on manual labor to clean the filter elements. That is to say, while it is recommended to clean a filter when the pressure differential reaches 7 psi, if one relies on manual cleaning of the element on any regularly scheduled basis then the chances are great that the filter will either not be cleaned frequently enough leading to potential problems downstream or the filter will be cleaned too frequently leading to unnecessary expenditure.

If the water source is domestic and the filter's prime purpose is really for "insurance" purposes, then cleaning the element on a scheduled basis may be sufficient. However, if the water source is less than tertiary-treated and if the level of debris in the water changes over time as a result of weather conditions, demand on the line, or seasonal variations, then the filter will require cleaning on an irregular basis to insure that a dangerously high pressure differential is not created.

The rapidly growing dependence on effluent or reclaimed water for irrigation purposes has resulted in more frequent filter flushing in general and has demanded of the filtration industry products that are reliable in heavily contaminated conditions and that require minimal amounts of flush water per flushing cycle.

Media filtration is maintenance-laden and requires as much as 5% of the total capacity of the irrigation system's delivery system for flush water. One of the most successful alternatives to media filtration is the self-cleaning screen filter. Compact in size, automatic self-cleaning screen filters consist of a durable, multi-layered screen element with a "suction scanner" within the element itself. When a pressure differential is created the scanner rotates inside the screen and, because it is hollow and connected to the exhaust valve, acts like a vacuum and sucks the debris off the filter element. One self-cleaning filter can replace a bank of seven or eight media tanks. The total flush water is less than 1% of the irrigation system's delivery capacity. For example, a battery of eight media tanks will flush for a period of 10 to 15 min where an automatic self-cleaning filter will flush for 40 to 50 sec. The bank of media tanks will flush approximately 2500 gal water and the self-cleaning screen filter will flush approximately 140 gal.

Sizing the filter for any irrigation system requires answering a regimen of questions. The most important question that needs answered, and which will go the furthest in determining the estimated cost of the filter, is that of "flow rate". Once maximum flow rate is determined, then it is necessary to gauge the quality of water, its chemical and biological makeup and source(s). Finally, it is imperative to consider the orifice size of the irrigation emitter. Filter manufacturers measure their filter elements by "micron" and "mesh" and may also have tables in millimeters and inches. A general rule of thumb that can be used to determine the degree of filtration necessary for any irrigation system is as follows: sprinkler type emitters should have filtration elements equivalent to one-third of their orifice and drip emitters should have filtration elements equivalent to roughly one-fifth to one-sixth the size of their orifice. Propagation mister and fogger emitters generally require 100 to 130 μm screens.

In summary, improper maintenance of irrigation filters for propagation applications can be devastating for the grower. It is important to identify the nature of the filter cake that is to be trapped and to install the proper element. Manually cleaned disk filters and media filters are reliable methods of trapping organic matter. They are not efficient methods of filtering inorganic matter, and media tanks, in particular, are maintenance intensive.

Screen filters are efficient means of trapping inorganic matter and self-cleaning screen filters are reliable alternatives to media tanks and capable of effectively filtering both organic and inorganic matter. Although a self-cleaning screen filter will flush more frequently than a bank of media tanks, the reduction in exhaust water and the negligible pressure loss during flush make it energy efficient and environmentally friendly.