Return On Environment (ROE) – A New Evaluation Of Filtration Systems

Jim Lauria, Vice President, Sales and Marketing
Amiad Filtration Systems, 2220 Celsius Ave., Oxnard, CA 93030

Abstract: As water supplies become increasingly scarce, alternative sources of water are becoming more common for irrigation use. Sources range from recycled wastewater to brackish groundwater – sources that until recently were not considered viable or economical. To make water from these sources suitable for irrigation, filtration is vital.

Filtration is also necessary for the successful long-term use of aquifer storage and recovery (ASR) systems, whose receiving formations must be protected from plugging with sediment. But filtration technologies themselves must be assessed for their environmental footprint – minimizing back flush water, reducing or eliminating chemical use, operating with a minimum of energy demand and requiring little infrastructure.

This paper will explore common filtration technologies in terms of their environmental footprint. Minimizing environmental footprint delivers a positive Return on Environment (ROE), which is an important companion to Return on Investment (ROI) in today's irrigation market.

Keywords: Filtration, suspended sediment, filters, environmental footprint, automatic self-cleaning, screen filters, microfiber filters, sand media filters, membranes, back-flush water, California Title 22.

The growing interest in alternative water resources – whether it's reclaimed irrigation or municipal wastewater, brackish groundwater, or the use of aquifer storage and recovery (ASR) systems – raises the bar for the performance of filtration systems. So does the growing use of more efficient irrigation systems, from high-efficiency sprinklers to microsprinklers and drip tape. We are drawing from increasingly challenging water sources and feeding ever more finely engineered systems – there is, literally and figuratively, no room for sediment or other contaminants.

Sediment, scale, algae and other contaminants in irrigation lines generate an array of costs for irrigators. Increased maintenance and costly clean-out of plugged heads, emitters or lines is easily identified as a direct cost. So is crop loss or turf damage from interruptions caused by plugged systems. But suspended solids in irrigation water can have other costs, too, such as tie-up of expensive fertilizers and other inputs, or higher-than-needed rates of acid or other cleaning solutions.

Adding to the challenge posed by lower-quality source water is the growing awareness of the ecological costs of supplying and treating water for irrigation. I refer to the Environmental Footprint of water treatment systems, which includes several key elements:

- Back flush water
- Chemical use
- Energy consumption
- Physical footprint.

Reducing the environmental footprint of a water treatment system means that irrigators need to consider not only their Return on Investment (ROI), but also their Return on Environment (ROE) – the balance between economy and ecology.

Time-Tested Options

The first step in evaluating filtration systems is reviewing the available options. For decades, agricultural and large-scale landscape irrigation systems have traditionally employed sand media filters. Simple and effective, this technology dates back to ancient times, and was modernized for use in municipal water systems in the early 1800s. Conventional screen filters are another choice for both small and large irrigation installations, though many require manual cleaning, which is labor intensive and may require a significant amount of water or chemicals.

The advent of automatic self-cleaning screen filters – which use the differential between pressure inside the filter and atmospheric pressure to push trapped particles out through suction nozzles – eliminated the labor requirement of conventional screen filters while operating much more efficiently than sand media systems.

The use of saline irrigation tailwater or brackish groundwater is also introducing membrane filtration to some irrigation operations. Membranes offer fine enough filtration to remove dissolved solids such as salt ions from water. They require high pressure and function best when they have a pre-filtration system – which could be any of the technologies mentioned above, or a microfiber or cartridge filter – to remove larger solids before the water enters the fine-, micro- or ultra-filtration stage.

Amiad is no stranger to protecting drip and other high-efficiency irrigation systems. The company was founded in the 1960s on an Israeli kibbutz, just as drip was being developed on nearby farms. As a desert nation with a highly intensive agricultural economy, Israel has long been at the forefront of water technology. Today, Israel leads the world in water recycling, re-using 75 percent of its water supply. (By comparison, the number-two water recycling nation, Spain, recycles 12 percent of its wastewater.)

Israel's leadership in water all aspects of water efficiency led Sandra Postel of the Global Water Policy Project to write, "Israel is the only nation that appears to have done what the world needs to do over the next 30 to 40 years – double water productivity in agriculture." The U.S. is at the cusp of that effort. Filtration will play a pivotal role in making it happen here, just as it has in Israel.

Environmental Footprint

We can gauge the Return on Environment by assessing the environmental footprint of a filtration system. Automatic self-cleaning screen filters use pressure to remove filter cake from their screens in a chemical-free process. Avoiding the need to store, handle and dispose of chemicals – whether they're cleaning agents or coagulants – is a significant environmental benefit. The ability of filters to optimize chemicals, as noted earlier, is also a factor of removing solids that can tie up chemicals in the system.

Energy use is minimal. Because there is little loss of head pressure, the irrigation system's pump or pressure is generally enough to operate the filter, and most of the systems have just a fractional-horsepower electrical motor to turn the suction nozzles in a spiral that cleans the entire screen. Some of the automatic self-cleaning filters are hydraulically operated, which means no electricity is necessary for their operation. That makes them extremely efficient, as well as well-suited for portability and isolated installations.

Physical footprint is another factor in environmental impact. Large installations – like those necessary for sand media filtration systems – take land out of production. They require concrete, rebar, pipe and other infrastructure, each element of which has its own environmental footprint. Utilizing a compact filtration system minimizes the need for infrastructure.

Certainly the most dramatic environmental footprint of a filter is the back flush water it produces to keep itself clean. Minimizing back flush water has always been important, and it is growing more critical today, especially in markets where water is scarce.

Many areas have enacted tight restrictions on what may be introduced – or returned – to surface water sources, whether reservoirs, ponds, creeks or canals. The result is that many irrigators find themselves required to build impoundments to capture their back flush water and let it infiltrate into the soil. Obviously, the greater the volume of back flush water, the larger the impoundments must be, and the more likely they will need more maintenance. There is also a significant public perception issue – neighbors and passers-by may be disturbed to see a large volume of water being disposed of, especially in areas or times of water use restrictions. That is no small matter in a world where water is a hot social, political and economic issue.

The benefit of automatic self-cleaning filters high efficiency – they produce just 25 percent of the back flush water that sand media systems do, or less than 1 percent of the flow – becomes extremely important in the context of back flush water's environmental footprint.

Managing Aquifers

Aquifer storage and recovery (ASR) systems offer a new option for managing water – "banking" supplies by injecting them into an underground reservoir for withdrawal when needed.

ASR systems have plenty of benefits. Banked water is protected from evaporation as well as contamination by animals or surface chemicals; its presence in the aquifer can also ward off intrusion by less desirable water, such as encroaching saltwater in many over-pumped coastal areas. And because all the public sees is a pump, the water is out of sight.

But pumping water into the ground cannot be "out of sight, out of mind," a lesson we have learned through our experience in the oil and gas industry. Produced water – wastewater – from oil and gas wells is typically disposed of underground in much the same way that ASR water is managed.

It is vitally important that solids are removed before the water is pumped into the aquifer, to avoid plugging the pores and cracks in the receiving formation that accepts water from the injection wells. Failing to adequately maintain the receiving formation can result in the need for costly cleanouts of the well or the need to drill new injection sites.

In many cases, water intended for ASRs also requires disinfection. As with multi-stage industrial water treatment processes, pre-filtration is an important step in maintaining the efficacy and efficiency of disinfection. UV systems are widely used to disinfect ASR water before injection. UV systems benefit tremendously from pre-filtration, as suspended solids can decrease transmittance of the UV rays, coat lenses, and even cast protective shadows over pathogens.

Injection systems have had excellent success with automatic self-cleaning filters, or – where the receiving formation is fine – with automatic microfiber (AMF) filtration systems. AMF technology allows filtration down to the two-micron level, using specially designed plastic cartridges wound tightly with microfiber. The fibers capture suspended sediments. When a pressure differential is reached between the inlet and outlet side of the filter, a high-pressure stream of water is directed at the plastic cartridge, which is grooved to deflect the stream through the fibers and carry away the particles. Like the automatic self-cleaning screen filters, the AMF produces relatively little back flush water, consumes, minimal energy and requires very little maintenance.

The 20-micron AMF system was recently approved by the State of California for achieving the turbidity level required under its Water Recycling Criteria, also known as Title 22. Coupled with an approved disinfection technology, the AMF can be used to treat wastewater for release into the environment in California.

Conclusion

The idea of treating wastewater – for release or for re-use – will become more commonplace in the years to come. The practice of achieving that treatment with the smallest possible environmental footprint will be a key factor in our success as we tap into alternative sources of irrigation water and use every possible drop well – and more than once. That will allow irrigation professionals to deliver a strong Return on Environment (ROE) as well as a healthy Return on Investment (ROI).

About the Author

Jim Lauria is Vice President of Sales & Marketing for Amiad Filtration Systems, a manufacturer of clean technology water filtration systems for agricultural, industrial and municipal applications. He has over thirty years of experience in liquid/solid separation processes and water treatment. Prior to joining Amiad Jim owned Team Chemistry LLC, a consultancy that focused on developing new business opportunities for clients' water treatment technologies and was president of an $80M filter media company. During that time he provided peer review for the World Health Organization's publication on drinking water treatment and in partnership with a university led a team that pioneered arsenic reduction in drinking water. He holds a Bachelor of Chemical Engineering degree from Manhattan College.