Automatic Self Cleaning Filters for Drinking Water Treatment

Clean Water. Clean Technology.

By Jim Lauria

In response to consumer demand, municipalities are being tasked to provide the safest, most cost-effective water with the least environmental impact.

A multi-barrier approach to filtration is becoming increasingly important as regulatory requirements, community demands and the need to protect increasingly complex and costly systems mount. However, adding the parameter of 'least environmental impact' has a significant effect on the technologies that best fit multi-barrier systems. Operators and other water suppliers must evaluate water treatment options not only for their efficacy at removing a wider array of contaminants—which are continually being detected at ever-lower levels—but also on clean technology criteria.

This means drinking water processes must conserve energy, use minimal chemicals, occupy less space and generate less waste. The US EPA has just endorsed this imperative in a new guide, *Ensuring a Sustainable Future: An Energy Management Guidebook for Wastewater and Water Utilities*, which also includes strategies to optimize all resources.

Originally developed in Israel for irrigation applications, automatic self cleaning filters are extremely efficient overall. Only recently have they been recognized for their clean technology benefits in drinking water treatment.

Minimizing energy and water consumption

The automatic self cleaning filters integrate a set of screens to provide a balance of strength, filtering capacity and fine filtration. When sediment builds up on the inside of the filter, a self cleaning mechanism of small nozzles is engaged to allow the filter cake to exit the filter in a concentrated stream. Water loss to backflush is minimal (typically less than one percent of the flow) and the filter continues operating during the self cleaning cycle.

Operating an automatic self cleaning filter demands minimal energy. A fractional horsepower motor, which draws just 0.5 amps at 220/440 VAC 3-phase power, is all that is required to rotate the cleaning scanners. Because these filters are highly focused and efficient, they yield minimal initial head loss compared to media filters. This translates into significant energy savings: better than 50 percent compared to sand media filters that require more pumping to restore head pressure after filtration.

Water consumption is also minimal with automatic self cleaning filters. Backwash water is less than one percent of the total flow through the filter; therefore, automatic self cleaning filters consume less than one-quarter of the backwash required to clean a media filter with the same filtration capacity.

In addition, no polymers, filter aids or flocculating chemicals are required, reducing costs, maintenance time and employee exposure to chemicals. Their filtration efficiency also often allows water treatment providers to add less chlorine to maintain a target disinfection residual.

Reduced footprint (per volume of water filtered) is another significant benefit. Automatic self cleaning filters do not require storage tanks for water or sand media, so they can deliver equal filtration capacity on a small fraction of the footprint required for other filtration technologies. Besides taking up less space, these filters require less demand for costly structural materials, like concrete and steel, for the same amount of filtering capacity.

The versatility of these filters, in terms of the particulates that they can filter, the clean technology benefits they deliver and the scalability of the systems, can be seen in how they provide the clean technology benefits in three different types of drinking water systems.

Complimenting or replacing media filters

In municipal water treatment plants, automatic self cleaning filters are replacing or complimenting media filtration, offering lower levels of disinfection byproducts and reduced energy demand.

Prefiltration with these filters significantly reduces turbidity (measured as both TSS and NTUs) of influent water with minimal space requirements, energy consumption and water used in backwashing. The result is a cleaner, more efficient operation of the main filtration system, lower labor requirements, reduced use of chemicals and significant reduction in the release of media filter backwash water. Labor and maintenance

costs are similarly reduced.

Managers of one small drinking water treatment plant in northern California conducted a trial of an automatic self cleaning filtration system as a prefilter to its (anthracite/sand/gravel) media system in 2005. Algae, aquatic weeds, crustaceans and turbidity are significant challenges in the community's reservoir.

The media filters must be taken offline during backflushing. During periods of high turbidity, the community's demand for water prevented managers from scheduling backflushing of the media filters frequently enough. Before prefiltration was introduced, the plant's crew also had to conduct a manual 'firehose cleaning' every 10 hours.

The water district compared several screens to determine the optimum level of prefiltration. The district determined that a 50-micron screen automatically backflushed approximately every 20 minutes when influent turbidity ranged from five to seven NTUs. The automatic prefiltration system reduced TSS readings by approximately 71 percent and reduced NTU values by 21 percent. In addition, intervals between manual cleanings of the sand media filter were extended to more than 27 hours.

Prefiltration protects RO and UF membranes

Desalination and grey water reuse have put significant emphasis on ultrafine (UF) and RO membrane technologies.

In Japan, more than 3,000 grey water reuse facilities offered approximately 400,000 cubic meters of daily capacity in 2005, from building-scale systems to industrial/regional facilities. Desalination generates even more attention. According to *Nature* (March 2008), more than 40 million cubic meters of desalinated water are produced daily by approximately 15,000 desalination plants worldwide and production is expected to rise dramatically. In California alone, plans for at least 20 new desalination facilities are being explored.

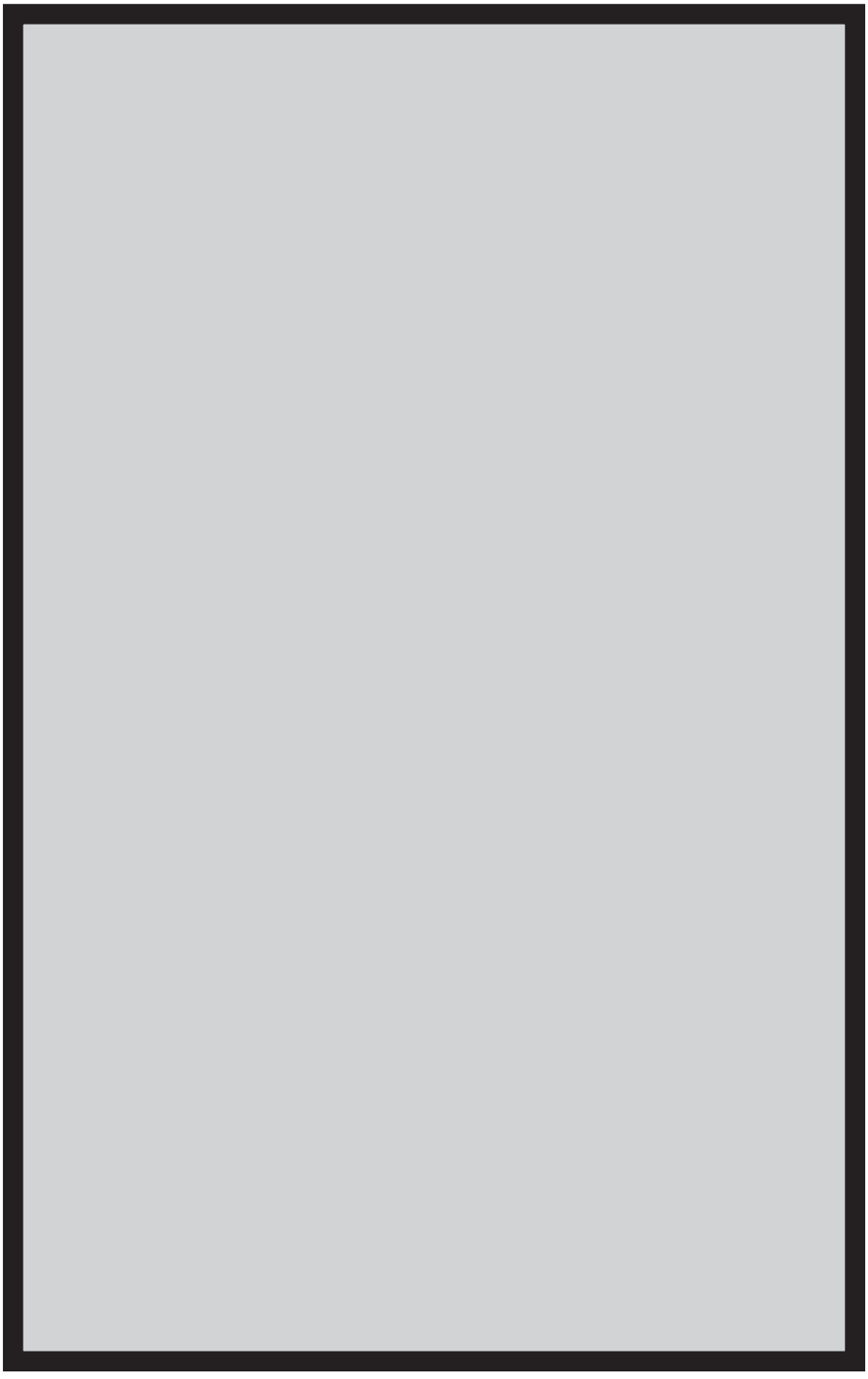
These outstanding systems are extremely effective at removing suspended particles and organisms down to the unicellular level, as well as dissolved solids; however, they can be compromised by larger particles, which reduce membrane life and efficiency and demand costly, chemical-intensive cleaning.

Before RO and UF membranes, automatic self cleaning filters offer valuable protection by removing biological organisms, organic matter and inorganic compounds, such as precipitated salts, metal hydroxides, clay, silt and other silica-based materials. Acting as a prefilter, they increase recovery rates and lessen chemical consumption and disposal for membrane cleaning.

In addition to the reduction in chemical cleaning needs, automatic self cleaning filters provide a clean technology solution by reducing the prodigious energy budget of the desalination process. A test program conducted in California by the Affordable Desalination Collaboration (ADC) on six membranes in seven element pressure vessels determined a most affordable point (MAP) average value of 12.4 kWh/kgal. Of that figure, more than nine percent (or 1.15 kWh/kgal) was the MAP average value for energy for prefiltration. The more efficient the prefiltration system, the more the energy budget can be trimmed, bringing affordable desalination closer to reality.

Building-scale systems

In urban environments, automatic filters are serving as POE filtration sys-



tems to protect water and HVAC systems in critical environments (such as hospitals) and as prefiltration for POU purification systems in high-rise buildings.

Most cities' municipal water is of excellent quality; however, aging infrastructure and common sediments in urban plumbing systems, primarily silt and pipe scale, can degrade water quality after treatment. For instance, New York City's celebrated tap water from its reservoir systems had turbidity readings of 0.8 to 1.5 NTUs in 2006. Yet a run through the aqueducts, underground mains and building plumbing can lead to far more particulate contamination. Turbidity problems can be exacerbated by the high velocities caused by firefighting efforts or by work on the water system.

In some cases, such added turbidity can be a matter of life and death. For instance, after episodes of high turbidity severely impacted its cartridge filter system and upset flow to key systems, a Virginia hospital installed an automatic self cleaning filter to protect its plumbing system and critical patient-care equipment such as sterilizers and X-ray developers.

Soon afterwards, a three-car fire in the hospital's garage caused the local fire department to draw from hydrants on the hospital grounds and agitate settled sediments in the system's mains. The 10-micron automatic prefiltration system went through 20 self cleaning cycles over the course of the event and the hours that followed, safeguarding the system to the extent that the maintenance manager reported no additional load in the cartridge filters that the prefilter protected.

Even where health is not at risk, consumers are increasingly demanding bottled-water-quality tap water. (In fact, the most environmentally conscious of those consumers are eager for tap water that tastes and tests clean, so they can reduce or eliminate their consumption of plastic bottles.)

To address that demand and gain a competitive advantage, some high-end metropolitan developers are installing POE prefiltration systems in luxury high-rises. This 'twice-filtered water' is the best tap water a city dweller can drink and outperforms bottled water in taste, cost and sustainability comparisons. It also enables residents to maintain individual tap water filtration systems, such as carbon filtration units, with minimal disruption.

Where green construction is the goal, developers are integrating automatic self cleaning filters with UV disinfection equipment to treat collected stormwater runoff for reuse. Such practices are being specified as integral components of the next generation of urban water treatment systems with LEED certification for green building applications. (*Editor's note: visit www.usgbc.org for more on LEED certification.*)

Thread filters provide finer filtration

Another, more advanced class of self cleaning filters are automatic thread filters that offer surface and depth filtration in a compact design. The advanced microfiber technology removes suspended and colloidal foulants better than conventional treatment.

Typically, cartridges are used to remove solids in the two-to-10-micron range to protect membranes. Based on the unique microfiber cassettes and their automatic cleaning cycles, these thread filters act as a 21st century version of the cartridge filter. Automatic thread filters eliminate much of the total cost of cartridge use, including replacement cost, labor costs for change-outs and the costs for transport, storage and disposal of consumables.

Automatic thread filters can reduce the chemical cleaning requirement of RO membranes by a factor of four compared to using standard cartridge filters before an RO system. Because of the downtime

during membrane cleaning, increased time between cleanings translates into greater water recovery.

Conclusion

Improvements in filtration performance—especially with regard to increasing throughput, improving selectivity and reducing clogging—have a major impact on the economics of existing filtration applications and on their sustainability as well. Automatic self cleaning filters should be considered a clean technology choice for anyone looking for a multi-barrier approach to their filtration process.

About the author

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About the company

♦ *Access to clean water is one of the world's greatest challenges—for drinking, for industry and for irrigation. For more than 40 years, Amiad has helped meet this vital need by providing outstanding filtration technology to industrial, municipal and irrigation users around the world. Amiad filtration systems are more than just effective and reliable, they're environmentally sound: no chemicals, no polymers, a bare minimum of backflush water and reduced energy demand. Many of our systems don't even require electricity and their small footprints save valuable installation space. It's all part of Amiad's pledge to deliver clean water using clean technology. Amiad Filtration Systems is located at 2220 Celsius Avenue, Oxnard, California 93030 USA, telephone (800) 969-4055, fax (800) 776-3458, website www.Amiadusa.com.*

Automatic Self Cleaning Technology

Among the principle benefits of automatic self cleaning filters is the capability of the filter to clean itself when needed, without demanding additional time and training on maintenance crews, requiring consumables such as cartridges or bags, or exposing workers to cleaning chemicals.

Suction-Scanning

Suction-scanning technology makes elegant use of simple physics. As the filter screen captures particles, the pressure differential between the inside surface (the inlet side) and the outside surface (the outlet side) of the screen increases. When that pressure differential reaches seven psi, the system opens an exhaust valve. The exhaust valve drains the suction scanner, a hollow 316 stainless steel tube tipped with nozzles just millimeters from the screen surface.

Opening the exhaust valve to the unpressurized outside environment causes water to flow in a high-velocity stream backwards across the screen into the nozzles, carrying the captured particles (or filter cake) with it.

The nozzles concentrate the suction effect on less than one square inch of screen at a time, creating a powerful and highly effective cleaning force—a phenomenon we call "focused backflushing." The suction scanner travels down the screen in a spiral pattern at a fixed speed, cleaning 100 percent of the screen surface in a 25-to-40-second stroke.

The suction-scanning cleaning cycle can be initiated by a pressure-differential switch or by a timer.

Automatic Microfiber Technology

A new level of automatic self cleaning filtration capacity is the automatic microfiber system.

Wound around a rigid cassette with a specially grooved base plate, densely placed polyester threads capture tiny particles as water flows across them toward collector pipes.

As dirt builds up on the filter threads, the pressure differential between inlet and outlet sides of the stream increases. At a pre-set pressure differential, a high-velocity cleaning stream is directed through the threads. The stream bounces off of the specially grooved base plate, pushing the high-velocity water back through the threads and taking the particles with it to a drain valve.

These automatic self cleaning thread filtration systems are excellent for drinking water filtration—including the removal of *Cryptosporidium*, *Giardia* cysts and *Legionella*—as well as cooling-tower, side-stream filtration, swimming pool filtration and protecting RO systems.