Filtration meets Storage

With today's economy, water professionals need to look at the best way to achieve stringent National Pollutant Discharge Elimination System (NPDES) permit requirements at construction and operation costs that ratepayers can afford. The largest cost authorities face today is energy to operate their facilities.

By Scott Dunn

Modern-day trickling filters serve multiple purposes to help reduce energy consumption

The majority of treatment facilities today are using some type of aeration to achieve their secondary treatment. Activated sludge, sequencing batch reactors, oxidation ditches and lagoons all require aeration to operate their processes. Operating large blowers 24/7 takes a lot of energy and results in increased electrical bills. Fixed-film processes like trickling filters have been around for more than 100 years, with more than 23,000 currently in operation in the U.S. and Europe.

Fine-Tuning Trickling Filters

With the enactment of the Clean Water Act in 1972, requirements for municipal wastewater agencies have become more stringent. Since that time, there have been concerted efforts made to improve the performance of trickling filters. The original filters were simpler in design, typically using a basin filled with some type of media (usually rock), an underdrain system and some method to distribute the wastewater—either with sprays or rotary distributors. The only energy required is pumping the wastewater flow to the trickling filters. Some facilities distribute their trickling filter flow by gravity, in which case there is no energy required.

Over the years, there have been improvements to trickling filters. The introduction of random-dump plastic media provided more surface area for the microoganisms to attach to. Problems, including media failure and ultraviolet (UV) degradation of the media, were common in the early stages of trickling filter development. Media manufacturing methods have improved, and the media is now available with UV protection and can be purchased in different configurations of blocks depending on treatment requirements. The underdrain system has been replaced with a media support system to create small plenum to prevent blockages and improve the upflow of air through the media. Most of the spray systems have been replaced with rotary distributors with brakes (reverse thrusters), added to slow the rotational speed of the distributor arms.

By the early 1980s, trickling filters had gone through a transformation. At that time in Europe, the SK feed rate (Spulkraft rate) was introduced to the operation of the trickling filter. By slowing down the distributor arms and using a dosing feed rate, the removal performance of the filters increased significantly. Keeping the SK rate in mind, Orris E. Albertson developed a patented process to achieve the SK feed rate by flow, pacing the distributors and controlling it through a microprocessor-based, mechanically actuated distributor. The feed rates are set by mm passes with a standard feed rate and a flush mode (i.e., operate the filter at 0.1 rev/min or 40 mm/pass 90% of the time and 300 mm/pass 10% of the time).

One of the previous problems with the trickling filter was seasonal change slough-off of dead microganisms causing excess of suspended solid limits in many facilities. By flushing the filter media and removing the dead microorganisms, the media can be kept clean, resulting in improved airflow and allowing for increased reproduction of microoganisms and eliminating the suspended solids exceedences.

Wet-Weather Storage

We are always looking for ways to improve treatment processes. In the 20th century, NPDES permit requirements are getting tighter and sanitary sewer overflows (SSOs) and combined sewer overflows (CSOs) have became major obstacles for municipal agencies to overcome. Trickling filters can accommodate higher flows and shock loads without jeopardizing the filters' performance.

SKG Containment, LLC has taken the trickling filter to a new level in addressing the SSO/CSO problems plaguing many wastewater treatment facilities. Original trickling filters were designed to completely flood the media as a method to reduce the buildup of unwanted zooglial mass. This was achieved by constructing concrete basins to hold the media and wastewater. SKG's patented process takes this concrete structure and transforms it into a wet-weather storage system for a fraction of the cost of traditional methods such as remote storage or in-plant flow equalization.

Trickling filters can help municipal agencies address SSO and CSO events.

12_EF_1_Energy_0309.indd 12 2/24/09 4:32:23 PM

To create the storage area, a new support structure is built to hold the filter media at the height of the basin walls. A pre-manufactured tank is installed onto the original basin walls along with a flow control box.

When a treatment facility reaches peak flow and is hydraulically loaded, the recycle flows to the trickling filters are shut down and all forward flow is directed to the filters. The larger plenum under the filters is used to store storm water without disrupting the forward flow. In the event that there is more than one filter in operation, the last filter in the treatment train would be filled first.

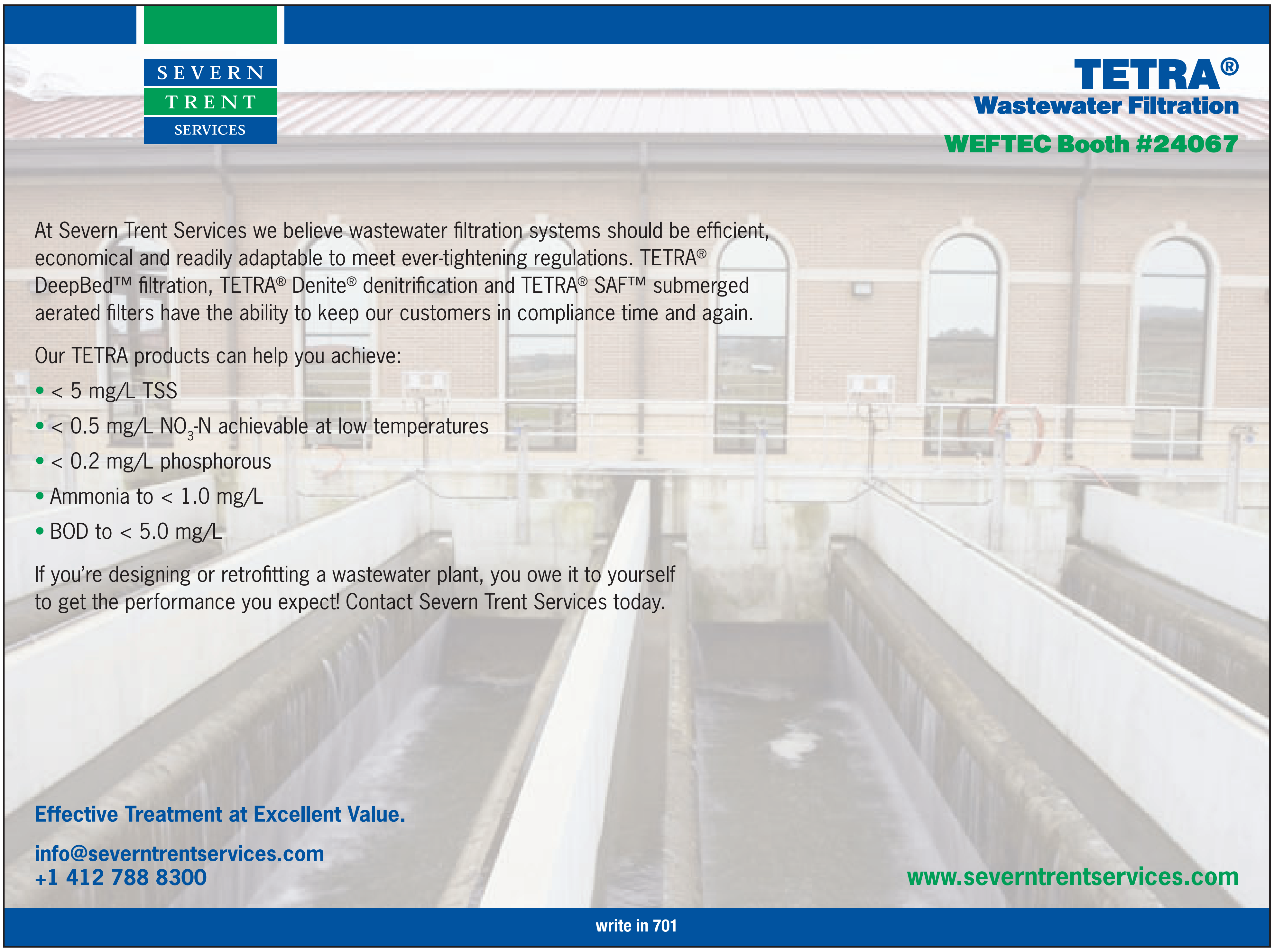
All forward flow is directed to the filters and a series of control gates are closed to restrict the flow, allowing a portion of flow to be stored in the plenum. The gates are adjusted so that an amount of flow equal to the maximum pumping capacity of the trickling filter pumps or maximum discharge limit from the treatment plant is allowed to flow from the filter. Flows entering the filter in excess of this rate are stored in the filter plenum.

Once the trickling filter storage system is configured, the influent flow to the primary systems at the head of the plant can be increased to maximum capacity (i.e., all recycle closed, 12 million gal per day [mgd] influent, 12 mgd effluent, set trickling filter control gates to 12 mgd, increase pumping at headworks to 14 mgd and basin will fill at a 2-mgd rate).

After the storm event is over, the rest is simple. The basin will empty itself as the flow to the facility recedes. Because forward flow is never interrupted, there will be a negligible amount of settled solids left in the bottom of the basin and the normal flow of the trickling filter will clean the basin itself. SKG's containment system is totally maintenance free, using no additional energy.

▲ A support structure helps combine the benefits of wet-weather storage and filter media.

▶ The system's forward flow is never interrupted.



Case Study

The Municipal Authority of Bethel Park (MABP) in Pittsburgh has two trickling filters and incorporated the SKG containment system into its 2007 trickling filter upgrade project. By using the containment system, MABP was able to obtain 1,600,000 gal of in-plant wet-weather storage for less than $500,000. Bethel Park already operates a 3,000,000-gal EQ facility that cost MABP $4.6 million in 1996. The new system was put into operation in August 2008, and the authority has been pleased with the new storage system's capability to capture and store a 24/2-in. rain event without overflowing the facility.

An added benefit of the SKG containment system was discovered upon completion of the Bethel Park project. Although provisions were made for the addition of supplemental air blowers to enhance the airflow from the plenum through the media, it was found that the increased plenum size provides sufficient airflow through the media and, in the long run, will save the cost of additional capital improvements and energy usage. Using the SK feed rate, the distributor arms are moving so slowly that the water displaces the air in the plenum and forces it upward through the filter media, producing a more than adequate airflow for microoganisms' reproduction.

One of the disadvantages of trickling filters is performance in the winter months. Cold air entering the filter media slows down the activity of the microoganisms and hampers performance. By having the large storage plenum, this is no longer a problem. Typically, wastewater is not less than 55°F in the winter months. Because the plenum is closed for the ability to store storm water, there is no cold air entering it. The MABP staff has been tracking temperatures in the plenum and filter performance throughout the winter months, and they have reported that the air temperature in the filter plenum has not dropped below the influent wastewater temperature.

Even at -8°F, the Bethel Park facility has a carbonaceous biochemical oxygen demand (CBOD) limit of 10 mg/L in summer and 25 mg/L in winter and an NH_3 limit of 2 mg/L in summer and 4 mg/L in winter. Throughout the months of December 2008 and January 2009, Pittsburgh had extreme weather conditions, starting with unusually wet weather changing over to heavy snow and adverse cold temperatures. MABP staff reported in December that they achieved 11.25-mg/L CBOD and 1.41-mg/L NH_3 in the facility's effluent and are seeing the same results for January.

The trickling filter process has proven to be a reliable treatment process, but like any process, had its limitations. Improvements to trickling filter technology, including the recently developed SKG system, have once again made the use of trickling filters a viable option in not only meeting NPDES permit requirements but also controlling wet-weather flows entering treatment facilities. Trickling filters still remain one of the simplest energy- and cost-effective systems to operate and maintain and meet today's regulatory standards. WWD

Scott Dunn is president of SKG Containment, LLC. Dunn can be reached at 412.400.2972 or by e-mail at support@skgcontainment.com.

For more information, write in 1101 on this issue's Reader Service Card.

WEBresources>>>

Related search terms from www.waterinfolink.com: energy efficiency, power factor, VFD

For more information related to this article, visit www.wwdmag.com/lm.cfm/wd030901