EDITOR'S FOCUS

The Frankfort, Ill., Regional WWTP currently serves a population of about 18,000. Faced with an anticipated population surge, Frankfort opted to expand its regional WWTP from 0.75 to 3 mgd. (All photos courtesy of Robinson Engineering.)

It was necessary to add tertiary filtration to meet state anti-degradation standards when expanding the Frankfort, Ill., Regional Wastewater Treatment Plant (WWTP). Evaluation of several types of tertiary filtration systems led to the plant’s adoption of innovative disc-filter technology.

An Illinois WWTP meets stringent TSS effluent limits using disc-filter units for tertiary filtration

By Todd Hathaway & Andy Szekeress

Tertiary Treatment Today

By Todd Hathaway & Andy Szekeress

It was necessary to add tertiary filtration to meet state anti-degradation standards when expanding the Frankfort, Ill., Regional Wastewater Treatment Plant (WWTP). Evaluation of several types of tertiary filtration systems led to the plant’s adoption of innovative disc-filter technology.
The Frankfort WWTP currently serves a population of about 18,000 located in the western part of Frankfort and the northwestern section of Frankfort Township, an area south of Chicago.

With its proximity to Chicago, Frankfort and the surrounding area has become the 36th fastest-growing suburban area in the U.S. Its population jumped 63% between the 2000 and 2006 census. Faced with this population surge, Frankfort opted to retire the oldest of its four WWTPs and expand its regional WWTP from 0.75 million gal per day (mgd) to 3 mgd.

“The plan was originally for the regional plant to be expanded in incremental phases,” said Jim Czarnik, senior engineer for Robinson Eng., Ltd., the consulting engineer authorized by the village board to give expansion recommendations. “But due to the growth boom in the area and the decision to retire the oldest plant, we determined it would be most cost-effective to go right to a design average flow of 3 mgd with a peak flow capacity of 9 mgd.”

The existing regional WWTP was an oxidation ditch system with its outer two rings utilized for sludge storage. With the plant expansion, which included the addition of phosphorus removal, all rings of the ditch are now utilized, converted into aeration channels equipped with variable frequency drive-operated shafts. Chemical addition for phosphorus removal was also added as a backup, and two more digesters were added along with a new sludge building that houses new storage tanks and a centrifuge. A post-aeration tank was also added.

**Required: Tertiary Filtration**

As part of the plant expansion, it was also necessary to add tertiary filtration in order to meet state of Illinois anti-degradation standards. “The standards mandate that a plant undergoing expansion cannot adversely affect the environment in any manner,” Czarnik said, “nor can it discharge any more pollutants to the environment than what was discharged prior to expansion.”

An environmental study determined that to meet the anti-degradation standards, the expanded plant would require discharge limits of 8 mg/L biochemical oxygen demand (BOD) and 10 mg/L total suspended solids (TSS). In order to meet the TSS limit, the plant added tertiary filtration, and to meet the BOD demand, it added post-aeration.

Czarnik analyzed a wide variety of tertiary filtration system configurations. Conventional options included single or multiple-media filter beds, shallow or deep beds and pressure- or gravity-operating modes. Another option analyzed was disc-filter technology.

**Disc-Filter Technology**

Disc-filter technology uses fabric membranes instead of granular media to filter the effluent. As more wastewater treatment facilities upgrade to tertiary filtration, the use of disc filters is becoming more common. This is partly because they often provide improved effluent quality and lower backwash rates than conventional filtration technologies and have a smaller footprint.

Both of the disc-filter systems analyzed were Title 22-approved gravity flow-through systems. The specific operating process and filtration cloth of both systems are different. A major operational difference involves the submergence levels of the filter media. The filter media is fully submerged in one of the systems, whereas in the Kruger Hydrotech Discfilter, the filter media is 60% to 65% submerged during normal operation. This results in a lower side water depth and tank height. Because the backwash cleaning system is above
the submergence level, the effluent collection tank does not need to be drained for routine maintenance or cleaning or replacement of the filter media. Additionally, this allows for flow through the filter to remain continuous, even during backwash cleaning cycles. The solution also has a lower backwash pressure requirement, resulting in lower installed horsepower.

Following the analysis of the technologies, the Discfilter was selected based on cost, reliability and performance. The technology operates under gravity to force water from a center drum through partially submerged vertical disc segments attached to the drum, and each disc consists of eight filter segments. Solids are separated from the water by woven polyester cloth with a 10-micron pore size mounted on the two sides of each segment. The solids, once separated, are rinsed off into a collection trough from which they are discharged. The unit uses filtered effluent for backwashing the media. This occurs during the process of filtering effluent, thereby allowing for continuous operation as well as continuous cleaning. Backwash operations are automatic. As the solids collect on the filter media, impeding the flow of water through the disc, the water level inside the discs begins to rise and automatically triggers backwash operations as the disc is rotated. The backwash cycle is completed using one pump and one drive motor; it does not require any actuated valves.

Meeting Standards

For the Frankfort WWTP expansion project, three HSF2216-1F Discfilter units in stand-alone stainless steel tanks were installed. The site’s new filter building also includes an additional bay for a fourth unit, accommodating for future expansion. Czarnik said this is a designed redundancy in order for the facility to meet the Ten States Standards, which have been developed by the Great Lakes Upper Mississippi River Board of State and Provincial Health and Environmental Managers to provide a set of standards for wastewater treatment facilities.

“Tertiary filtration per Ten States Standards calls for a maximum of 5 gal per minute per square foot at peak flow when the largest unit is offline. This is the loading rate that must be applied to the filters, thereby requiring the installation of three Discfilter units at the plant,” Czarnik said. “But the filters can actually run at a much higher rate, and the plant can operate quite adequately using two units.” The Ten States Standards also require a TSS limit of 5 mg/L for tertiary filtration.

The performance of the new tertiary filtration system since startup in April 2008 has been very good, according to Mark McCluskey, wastewater superintendent for Frankfort’s regional treatment plant.

“The Discfilters have a straightforward automated control system. During high solids loadings and backwash cycles, the units consistently produce final effluent that meets our strict permit requirement for TSS,” McCluskey said.

Raw water to the plant for the final six months of 2008 averaged 81.66 mg/L, while Discfilter effluent has averaged 4 mg/L.

Ease of maintenance has been another positive factor. The units contain a minimal amount of mechanical and other ancillary equipment, resulting in less maintenance and lower operational costs.

“Everything on the unit is very accessible, which is important,” McCluskey said. “Because the filter media is only partially submerged, it allows easy access for routine inspection and maintenance.”

Another key advantage is the system’s ability to quickly achieve steady-state during plant-upset conditions. For example, when remnants of Hurricane Ike moved into Illinois in September 2008, the plant was forced to partially bypass the filters.

“The plant’s flowmeter showed more than 9 million gal going through—we were way over capacity,” McCluskey said. “The extreme hydraulic loading rates bound the filters a little bit, but we partially bypassed them for about a day. They stabilized quickly, and within a 24-hour period we had them back into full service with no problems.”

The decision to install the compact systems for tertiary filtration treatment has enabled the Frankfort treatment plant to not only meet stringent standards for providing greater volumes of high-quality effluent, but also to do so reliably and cost-effectively.

Todd Hathaway is product manager and Andy Szekeress is regional sales manager for Hydrotech Filtration, I. Kruger, Inc., a Veolia Water Solutions & Technologies Co. Hathaway can be reached at todd.hathaway@veoliawater.com. Szekeress can be reached at andy.szekерess@veoliawater.com.