

APPLICATION: Biofiltration

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Turning to Filtration

A deep-bed biofiltration system maintains nitrate/nitrogen compliance despite rapid service expansion

Management at the 7 million gal per day (mgd) wastewater treatment plant and water reclamation facility in Smithfield, N.C., credits a deep-bed biofiltration system as the key contribution to the utility's continued compliance with state regulations for total nitrogen discharge limits in spite of ongoing rapid growth in its service demand.

In 2006, the plant's total nitrogen discharge to the Neuse River Basin was only 23,000 lb, against an annual mass limit of 67,467 lb. A \$22 per lb fine is mandated for exceeding that limit.

Denitrification system

The special deep-bed biofiltration system, which started up in 2003, is the Leopold elimi-NITE denitrification system. The system's filtration capacity, which was increased as part of the plant's expansion to 7 mgd, is to be increased again in 2007 as part of a further plant expansion to 9.5 mgd.

"When nitrogen limits first started in the 1990s, we were able to comply through addition of aeration basins during plant expansions," said Dan Wall, wastewater facility manager for Central Johnston County. "Then, to achieve a 30% reduction in total nitrogen by 2003, we made an anoxic zone out of one of the basins and operated a recirculating pump from there to the remaining aeration basins."

However, additional growth was expected in the plant's service demand. "We knew we needed further reduction and turned to filtration," Wall said.

Methanol feed

In filter operation, methanol is added to the filter influent to provide an organic substrate for a denitrifying microbiological culture in the filter media. The culture metabolizes the nitrified stream, eventually changing it to nitrogen gas that becomes embedded in the filter bed. Nitrogen bubbles are trapped by the media, filter downward flow and accumulate in the media. A short "bump" backwash cycle of about 1 minute then releases the bubbles to the atmosphere. A complete backwash cycle to clean the media occurs every 48 to 60 hours, depending on solids loading.

Dissolved oxygen (DO) is typically 4 to 6 mg/L entering the filter channel. With the addition of methanol, it is reduced to about 1 mg/L prior to discharge to the filters, and then to less than 0.3 mg/L in the filter bed. The plant has a daily limit for DO discharge to the Neuse River of 6 mg/L or higher. This is achieved with use of a cascade aerator prior to discharge, which provides for typical readings from 6.5 to 9 mg/L.

Biochemical oxygen demand (BOD) enters the filters at 5 to 8 mg/L and exits at about 3 mg/L. The plant effluent from April to October is about 3 mg/L, meeting the permit limit of 5 mg/L; and it is less than 5 mg/L from November to March, when the permit limit is 10 mg/L.

Thomas M. Getting, P.E., DEE, Leopold's project engineer for the Smithfield installation, noted, "The system handles wide swings in solids loading while providing for long filter runs."

He added that the filter designs are not restricted to one type of layout or maximum allowable width due to underdrain design limitations. System designs can be customized for a variety of site conditions, including existing filter basins. **WWD**



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