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Small Package, Big Result

AN IFAS PROCESS HELPS A COLORADO SANITATION DISTRICT MEET THE CHALLENGE OF A TOUGHER PERMIT LIMIT ON EFFLUENT AMMONIA

By Scottie Dayton

In April 2005, the Fairplay (Colo.) Sanitation District's permit limit for effluent ammonia dropped from 25 mg/l to 10 mg/l. The three-cell, 7.4-million-gallon surface aeration lagoon could not meet that limit, as half the year the water was frozen or so cold that nitrifying bacteria perished.

In September 2006, the state EPA issued a cease-and-desist order. It also fined the district \$112,000 because effluent discharged to the Middle Fork of the South Platte River, a high-quality trout stream, exceeded ammonia limits.

The district board decided to build a new plant and charged David Stanford, contract wastewater operator, and an attorney to write a request for proposals for a design-build team.

"The RFP was very specific and tough," says Stanford. "The plant had to meet present and future ammonia standards, be expandable, address future nutrient issues, and fit in a small footprint. The design had to have a two-year process warranty, and be operated and maintained by one man."

The board chose the team of Burns & McDonnell Engineering Co. in Centennial and Moltz Construction from Salida. Andrew Waddoups, P.E., project manager from the engineering firm, met the challenge by specifying the AnoxKaldnes Hybas system from Kruger USA in Cary, N.C.

"Adding media to the aeration basins makes it possible to maintain nitrifying biomass in a much smaller footprint than with conventional activated sludge systems. We increased our nitrification capacity without increasing the solids loading rate to the clarifiers."

DAVID STANFORD

COLD AND CLEAR

"We selected integrated fixed-film activated sludge (IFAS) reactors because they can remove ammonia at cold temperatures," says Waddoups. "A primary goal was to treat the wastewater quickly, before it had time to cool off further."

The 72- by 73-foot plant received influent in late November 2008. By Jan. 1, 2009, ammonia levels were less than 1 mg/l. By summer 2010, BOD was 2 mg/l, TSS 5 mg/l, *E. coli* well in compliance, and ammonia averaged 0.10 mg/l.



PHOTOS COURTESY OF H2O CONSULTANTS LTD.

During construction, the contractor's biggest challenge was finding small enough forms to pour the concrete treatment basins and two 100,000-gallon rectangular clarifiers, one on either side of the basins, as one unit.

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That fall, the Fairplay Wastewater Treatment Facility received an award from the American Council of Engineering Companies in the water and wastewater category, and a 2010 Design-Build Award from the Design-Build Institute of America.

Winter temperatures in Fairplay, elevation 9,800 feet, reach 20 degrees below zero, sending frost 11 feet deep. Influent entered the 400,000 gpd lagoon system at 40 to 42 degrees and discharged at 32.5 degrees. The first cell held 3.5 million gallons, the second 1.5 million gallons, and the third, a polishing pond, held 800,000 gallons.

The original system, built in the 1970s, was designed around residents leaving their taps open in winter to prevent the shallow water mains from freezing. When the town installed new mains eight feet deep, the winter access flow was eliminated, allowing Waddoups to downsize the facility to 300,000 gpd based on a 20-year population projection of 1,200.

CHALLENGING INSTALL

Project manager Cole Phillips and crew from Moltz Construction backfilled the three cells. Their biggest challenge was finding small enough forms to pour the concrete treatment basins and two 100,000-gallon rectangular clarifiers, one on either side of the basins, as one unit. The clarifiers would be outside the building and covered.

When the work was completed, wastewater entered the headworks through a 3-mm spiral bar screen and grit removal unit, then flowed into the anoxic reactor. The dual trains of the aeration system each have two aerobic reactors containing AnoxKaldnes K1 media, secondary clarification, and UV disinfection.

"Moltz rebuilt the polishing pond as a 400,000-gallon aerobic digester for waste activated sludge," says Stanford. "Our volume was so limited that it wasn't financially viable to install a belt press." Moltz lined the pond and installed floating aerators.

The 15-foot-square reactors are 16 feet deep with media levels in the first and second at 65 and 38 percent full. The design mixed liquor suspended solids is 3,000 mg/l. The biological system treats screened influent down to

10 mg/l BOD and 1.0 mg/l effluent NH-N. The return activated sludge (RAS) rate has a maximum of 150 percent of influent flow, and the internal recycle design rate is 70 percent.

HOW IT WORKS

The process uses stainless steel retention screens to keep 6,427 cubic feet of non-clogging high-density polyethylene media inside the basins. The media does not require backwashing and has a low headloss. Mixed liquor passing through the screens settles in the secondary clarifiers.

"Adding media to the aeration basins made it possible to maintain nitrifying biomass in a much smaller footprint than with conventional activated sludge systems," says Stanford. "We increased our nitrification capacity without increasing the solids loading rate to the clarifiers."

The pre-denitrification zone combines nitrified internal recirculation, raw influent, and RAS to achieve total nitrogen removal and partial BOD reduction. "Our flows average 100,000 gpd, so we don't detain the water for very long to retain its residual heat," says Stanford. "During cold weather, we increase the sludge to achieve the desired ammonia removal. Right now, the flows are so low that I'm using only one clarifier, and keeping the balance of food-to-microorganisms ratio to a three-day sludge life."

The alkalinity reaching the plant was a concern, as it averaged just 120 to 150 mg/l. In 2007, the district hired Insituform to line 50,000 feet of clay tile sewers to solve inflow/infiltration problems. "It made a dramatic difference," says Stanford. "Alkalinity numbers jumped to 350 mg/l, which meant we didn't have to add any to the process."

The project was budgeted at \$5 million and came in at \$4.7 million. **tpo**

LEFT: A worker adds media to an aeration basin. The media made it possible to maintain nitrifying biomass in a much smaller footprint than with conventional activated sludge systems. BELOW: Plant operator David Stanford samples for ammonia.



The covered clarifier basins behind the treatment plant.