Attention to Aeration

By Stephen Cox

A fast-growing city in the arid desert of the western U.S. recently addressed the need to expand its municipal service for new residents and subdivisions. In recent years, the city's residential demand for wastewater treatment tripled from less than 1 million gal per day (mgd) to more than 1.5 mgd. In planning for the wastewater treatment plant's (WWTP) expanded capabilities, the city's water engineers identified minimizing aeration basin compressed-air energy costs as a goal.

Flowmeters improve wastewater processing

Wastewater Treatment

In WWTPs, a variety of processes are employed to eliminate organic pollutants from water and ensure that it meets sanitary requirements for future use. One of the most common processes is the activated sludge method, which biologically treats wastewater through the use of large aeration basins. This process requires pumping compressed air into the aeration basins, where a diffuser system ensures the air is distributed evenly for optimum treatment. The energy needed to provide compressed air is a significant operational cost to a WWTP.

Tiny microorganisms in the aeration basins decompose biologically degradable organic solids in the wastewater. These microorganisms depend on the aeration system to provide the right amount of air necessary for them to thrive and consume the suspended solids in the wastewater. These solids eventually are removed downstream of the aeration basin and can be digested to create energy at the plant.

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Large amounts of air are required to ensure that the aeration process operates effectively to treat the wastewater adequately before it can be moved to clarifying basins, filtration, disinfection and other treatment processes. Controlling the amount of air released into the aeration basins is essential because air flow controls the growth of the microorganisms that treat the wastewater. Flowmeters typically are installed in the aeration system piping to measure the amount of air flow, with their analog or digital output connected to the facility's control system.

In most plants, each of several aeration basins is configured with numerous diffuser systems and individual air flow monitoring with independent control is generally required for each diffuser system. The compressor system must run at all times to maintain the optimum amount of air to the diffuser systems and the aeration basins, with flow rates changing throughout the day based on demand.

Air/Gas Flowmeters

The engineers at the city plant needed to place air flowmeters in a rugged area of the facility with an underground vault that required remote access. Further challenges at the installation site included straight pipe run limitations, the presence of hazardous gases, a wet and dirty environment and fluctuating wastewater levels.

The flowmeters needed to be installed in a 24-in. line for blower air flow into the aeration basins. Accurate air flow measurement was necessary for the control system to maintain the correct level of dissolved oxygen in the aeration basins and proper treatment of the wastewater. The meters also needed to provide accuracy over a wide flow range because the facility requires flow rates to increase from 0.5 mgd to 3 mgd with future growth.

After reviewing various flowmeter technologies, the city's plant engineers selected the ST98 flowmeter from Fluid Components Intl. (FCI) because of its accurate performance over a wide flow range, ease of installation and low maintenance requirements. This flowmeter is designed with a thermal dispersion mass-flow-sensing element that provides accurate measurments in harsh environments. To compensate for flow disturbances resulting from limited piping upstream, VIP Vortab flow conditioners were installed to ensure flowmeter accuracy. The flow conditioners remove both swirl and distorted velocity flow profiles to

support accurate flow measurement by the meter at all velocities under these challenging conditions.

The flowmeter also includes an integral two-way HART protocol interface for direct communication with the plant's distributed control system. The interface allowed the plant engineers to receive multiple process variables and configure the flowmeter remotely from the safety of the control room. HART's field-proven communications protocol provides reliable two-way communication as part of the existing 4-20-mA wiring.

Using the communications protocol, the city's process engineers have simplified control and access to important flowmeter flow data, including diagnostics, calibration and configuration information.

The highly stable constant-power flow sensor design allows the meter to be used in applications where upset flow conditions, such as sudden changes in flow, temperature or moisture, are present. With its reliable thermal mass sensing element, the flowmeter delivers precision mass flow rate, totalized flow and temperature measurements to the city's engineers. It is ideal for air/gas flow measurement in wastewater treatment applications and offers high accuracy to ±1% of reading, 0.5% of full scale. Repeatability is ±0.5% of reading.

This insertion-style flowmeter can be installed without shutting down the process by using a simple NPT fitting. The flowmeter operates at a wide flow range—from 0.75 to 600 sq ft per second—and the turndown ratio is factory preset from 10:1 up to 100:1. The flowmeter operates at pressures up to 250 psig.

The flowmeter's thermal mass-sensing element is comprised of two all-welded 316L stainless steel thermowells that protect two matched platinum precision resistance temperature detectors (RTDs). With a reliable no-moving-parts solid-state design, one RTD is slightly heated relative to the reference RTD, and the temperature difference between the two is proportional to changes in the gas flow rate.

The flowmeter's transmitter features, microprocessor-based electronics and can be integrated with the sensor or remote mounted up to 1,000 ft away. NEMA Type 4X (IP66) rated and explosion-proof Division 1-rated enclosures are available for the toughest environments.

City engineers also installed Vortab VIP flow conditioners to provide repeatable and symmetric velocity flow profiles at the metering location to reduce pipe straight-run requirements. The flow conditioner was installed three pipe diameters downstream from the flow disturbance to provide symmetrical and swirl-free repeatable laminar flow, which ensures that the flowmeter meets the city's accuracy and repeatability specifications. The standard flow conditioner is manufactured with 316L stainless steel in sizes for installation in pipes from 2- to 40-in. diameters. Other materials and larger line sizes also are available.

Conclusion

In wastewater treatment facilities and industrial plants, the cost of air flow can be one of the largest energy expenses. The cost of energy to produce compressed air continues to rise along with fuel costs. Optimizing the aeration process by measuring and controlling the aeration system's air flow with an accurate, reliable flowmeter reduces energy costs and overall plant operational costs. The flow conditioner also can reduce piping costs, and the low-pressure drop characteristics minimize compressor/pump power requirements.

As with this city's plant, outfitting wastewater treatment aeration systems with a mass flowmeter can result in improved process effectiveness and reduced energy consumption. Looking carefully at measuring accuracy and range needs, installation conditions and maintenance requirements will assist in selecting the most cost-effective flowmetering solution. WWD

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The STAR ZoneScan solution saves time by automating the process of collecting and transmitting data about the water system. It also encourages practical water conservation by helping utilities identify and fix leaks before they become costly, water-wasting emergencies. **For more information, please contact us at STARZoneScan@aclara.com or visit us at bit.ly/STARZoneScan.**

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