Technical Publication

Money Down The Drain: The High Cost Of Poor Air Flow Metering

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Activated sludge systems have been a cornerstone of wastewater treatment for over 100 years. This biological process uses suspended growth microorganisms to break down and consume organics and remove nutrients from the wastewater. The heart of the process takes place in aeration basins, where the microorganisms need to receive sufficient oxygen to stay alive.

While there are various methods of aeration, diffused air is the most common. Large blowers push compressed air through a pipe distribution and diffuser system. Bubbles rise from the bottom to the top of the basins, transferring oxygen to the activated sludge.

The energy costs associated with this process are often the largest non-labor-related expense a wastewater treatment facility has to bear, so it's imperative for operators to manage their airflow and optimize efficiency.

How Much Airflow Is Needed For Activated Sludge Treatment?

Operators typically maintain dissolved oxygen (DO) levels around 2 mg/L at the end of the aeration tank. The idea is to ensure adequate oxygen for the process without wasting electricity. But how much airflow is needed to maintain DO at the preferred level?

Engineers design aeration systems based on the actual oxygen requirement (AOR). The AOR depends on variables including biochemical oxygen demand (BOD) and ammonia loading from influent and sidestream flows. Oxygen demand also fluctuates based on diurnal and seasonal changes in temperature, flow, and influent parameters.

The AOR is then converted by formula to a standard oxygen requirement (SOR) based on factors including bubble size, temperature, pressure, and DO required. Another part of the aeration equation is the specific oxygen transfer efficiency (SOTE), which is dependent on the aeration device, output, diffuser depth, and layout.

All this information is required to calculate the required airflow in standard cubic feet per minute (scfm). Due to the variable conditions, recommended airflow rates are usually noted as minimum, average, and peak values.

The High Cost Of Inefficient Aeration

Optimizing aeration to control preferred DO levels not only improves plant operation, but greatly reduces electrical costs. Blowers typically use more electricity than other equipment at an activated sludge treatment plant. Figures often cited are that aeration accounts for 40 to 60 percent of a wastewater plant's energy usage.

Blower operation is specific to each individual treatment plant. Some plants operate the blowers based on a predetermined on/off schedule. Some run the blowers continuously at a constant rate. Most facilities run the blowers continuously and adjust blower operation on actual field measured DO readings. If the DO is too high or low, air supply is increased or reduced by adjusting blower speed, vane position, or valves. DO analysis and blower adjustment may be done manually at specific times each day or continuously with an automated system.

Airflow Measurement For Process Control

Most activated sludge plants have multiple blowers serving two or more aeration basins. Air is pumped through air header piping, which then branches out to each basin. Depending on the size of the plant, each basin may have multiple diffuser systems with individual drop lines feeding air to the diffusers.

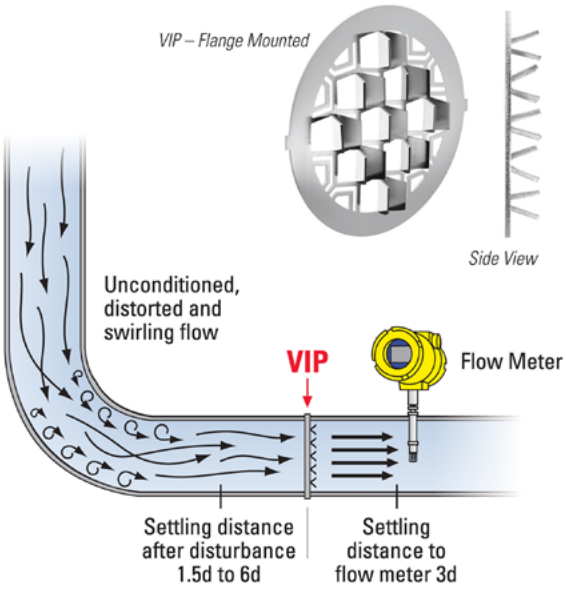
By monitoring airflow at various locations in the air piping system and feeding data back to a control system, air balance within the basins can be optimized. Balancing airflow throughout the plant improves the treatment process and reduces energy costs.

Choosing The Best Airflow Meters

Ensuring accurate and precise airflow measurement is critical for obtaining the operational and cost-saving advantages.

While several flow sensor technologies are available, thermal dispersion type flow meters are the most commonly specified, preferred solution. Thermal mass flow meters use heat to measure flow. Two precision RTD (resistance temperature detector) sensors, one heated and one a reference, are inserted into the flow stream. The mass flow rate is proportional to the differential heat dissipation between the two sensors.

Thermal mass flow meters are especially well-suited for use in activated sludge facilities for several reasons.



Easy To Install

To ease installation, look for thermal dispersion meters that require only a single tap with a ball valve for insertion and removal. For piping systems that lack a sufficient run of straight pipe, a common condition in aeration basins, flow conditioners can be installed to ensure accurate and repeatable flow measurement. Be sure to choose a flow conditioner with minimal pressure drop to avoid increased blower usage.

Rugged Construction And Low Maintenance

Wastewater treatment plants are tough environments for field-mounted instrumentation. It is therefore important to choose flow meters with flow sensor elements that are rugged and require little to no routine maintenance and have robust, weatherproof transmitters/electronics enclosures to ensure long service lives. Thermal mass flow meter sensors have no moving parts and no holes that can foul or clog. Look for models with heavy-duty metal enclosures that are rated IP65 or better.

Avoid flow meter technologies that require adding temperature and pressure sensors to compute mass flow. These additional sensors needlessly add to purchase and installation costs, as well as to maintenance. You should choose devices that measure the mass airflow directly to save time and money.

Accuracy Over A Wide Flow Range

Thermal mass flow meters are accurate and precise — typically ±1.0 to ±2.0 percent of reading and with repeatability of ±0.5 percent full scale. This meets or exceeds most specifications for airflow meters in activated sludge applications.

Due to the variability of conditions at wastewater treatment plants, meters must be able to measure a wide range of airflow rates. Thermal dispersion flow meters feature wide, 100:1 turndowns that enable them to cover flow ranges from low to high with a single meter. Look for thermal flow meters with quality temperature compensation circuitry to ensure accuracy is maintained throughout the temperature range to which the transmitter and its flow element will be exposed. And look for thermal flow meters that will be calibrated with NIST and/or ISO/IEC 17025 traceable equipment and at their actual temperature and pressure conditions.

Reduce Operating Costs And Improve Treatment

Rugged, low-maintenance thermal mass airflow meters are operator-friendly and best-cost investment. Their accuracy ensures optimal aeration control, resulting in excellent treatment with minimal electricity usage and cost. They are designed for use in wastewater treatment plants, with the ability to handle wide fluctuations in operating conditions.

Using thermal mass flow metering technology, wastewater treatment operators can optimize treatment and improve sustainability while saving costs. ■