



## Improving Wastewater Treatment with Air Flow Instrumentation

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# Tech Article

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In wastewater treatment plants, a variety of processes are employed to eliminate organic pollutants from water to ensure its safety and release for future uses. One of the most common processes is the activated sludge method, which biologically treats the wastewater through the use of large aeration basins. This process requires the pumping of compressed air into the aeration basins where a diffuser system ensures the air is distributed evenly for optimum treatment.



**Typical Wastewater Treatment Plant**

Tiny micro-organisms in the aeration basins decompose biologically degradable organics in the wastewater. These micro-organisms require air to survive and depend on the aeration system to provide the right amount of air necessary for them to thrive and consume the organics in the wastewater. Eventually, over a period of time, they flocculate into a mass with the non-biodegradable solids that settle to the bottom of the basin.

Large amounts of compressed air are required to ensure this process operates effectively to treat the water adequately before it can be moved along to clarifying basins, filtering, disinfection and other treatment processes. Controlling the proper amount of air that is released into the

aeration basins is essential because the air flow controls the growth of micro-organisms that treat the wastewater. Flow meters are typically installed in the aeration system piping to measure the amount of air flow and the meters' analog or digital outputs run to the control system

In wastewater facilities, as well as industrial plants, air compressor operation is one of the largest energy expenses. The cost of energy to produce compressed air continues to rise along with fuel costs. So, optimizing the aeration process by measuring and controlling the aeration system's air flow with a suitable flow meter also reduces energy costs.

In most plants, each of several aeration basins is configured with numerous diffuser systems. Individual air flow monitoring and independent control is generally required for each diffuser system. The compressor system must run 24-x-7 to maintain the optimum amount of air flowing to the diffuser systems and the aeration basins, but demand for air changes throughout the day to accommodate a variety of climatic and other factors.

In evaluating and selecting flow meters for the aeration process or any other wastewater treatment air or gas flow measurement application, there are five important factors to consider:

- Flow Sensor Technology
- Range and Accuracy
- Operating Environment
- Ease of Installation
- Maintenance and Life

## Flow Sensor Technology

Three flow sensor technologies have typically been in use in aeration air flow monitoring applications in wastewater treatment plants:

- Differential pressure (orifice plates)
- Vortex shedding technologies
- Thermal dispersion (mass flow)

Differential pressure (orifice plates) and, to a limited degree, vortex shedding technologies have an installed base. While, orifice plates have been in use for many decades in water treatment plants and vortex shedding is recognized for its high accuracy, thermal dispersion flow measurement now has the largest installed base for this application for several important reasons. Thermal dispersion has grown in popularity because it offers direct mass flow measurement, offers a wider turndown ratio, has no holes or moving parts to foul or clog, is an insertion style meter that installs in a single tap and is the most cost effective technology applied for the pipe line sizes commonly found in the aeration distribution system.

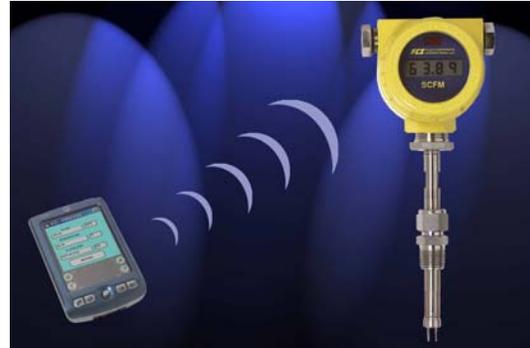
### Accuracy and Flow Range

At a typical large urban municipal wastewater treatment plant, one of the more common specifications for the aeration flow meter is to measure over a wide flow range from 1.5 to 150 SFPS (0.46 to 46 NMPS) with an accuracy of +2% of reading, +0.5% of full scale, with a repeatability of +0.5% of reading. Most aeration systems will operate with excellent efficiency at this level of accuracy. Flow meter manufacturers can provide products for higher accuracy specifications, however these products typically include extra features and functions that are unused in aeration application and they carry a price premium. It is also critically important to look at a flow meter's repeatability specification, which tells the user how reliably the device will maintain its specified accuracy level.

### Operating Environment

The amount of air required to maintain the treatment process varies throughout the day and is dependent on environmental and climate conditions. Flow meters for such applications must be able to tolerate significant drops in pressure throughout the

system from 0.8 to 17.6 psig [0.6 to 1.2 bar (g)], which means the flow meter must be have a wide turn-down range and this can be a problem for mechanical devices with moving parts that wear over time. Temperatures can vary widely from -68 to 150°F (-20 to +65°C). This is also a rugged, dirty environment that can be a maintenance issue with devices with holes that may plug or foul, and the device may require an approval rating matched for installation location.



**ST50 Thermal Mass Flow Meter With Wireless Communication Option**

### Ease of Installation

When it comes to installation, some flow meters are more straightforward than others. Be sure to ask if the flow meter that you are considering can be inserted directly into the process pipe or if it requires an inline configuration that will require you to cut and splice your pipes in multiple places. To accurately measure flow, meters require some length of unobstructed pipe straight-run upstream and downstream from the meter to achieve their specified accuracy.

If your plant is short on real estate or if valves or elbows have to be placed near your flow meter, a flow conditioner will reduce the straight-run needed to ensure the flow meter is measuring accurately. Tabbed type flow conditioners, such as those provided by the Vortab Company, have proved successful in these applications. Other flow conditioning technology choices including tube bundles, honeycombs, and perforated plates, may also be considered depending upon the specifics of the application and obstructions.

## **Maintenance and Life**

Be sure to ask about the maintenance requirements for your flow meter. Some flow meters need more frequent recalibration, and/or cleaning which can be time-consuming or, worse, require you to remove the meter from service. For wastewater aeration applications, the ideal flow meter will have no moving parts to wear out and no routine cleaning requirements to minimize maintenance cost and provide many years of service. When calculating the cost of a new flow meter, be sure to look beyond the purchase price to determine what it will cost to maintain and how long it will provide service before you make a final decision.

## **Realizing Energy Savings**

The cost of compressed air to support wastewater treatment operations is dependent on a number of major variables. These include the plant's physical climate, the layout, the volume of waste, the equipment in use (including the diffuser, compressor and control system), the piping configuration, the flow instrumentation and the energy supplier.

In the perfect world, all of these variable factors would work together to promote the optimum micro-organism growth rate needed to treat the water in the shortest amount of time. While perfection is beyond most of us, improvement is possible and valuable. If your energy costs seem high, be sure to consider all the variables, including the type of the flow meters, where they are placed in the pipeline and their calibration for your application.

Selecting the wrong type of flow meter or improper calibration or improper installation can all result in less than optimum compressor efficiency and higher energy costs. To determine the potential savings, consider the amount of compressed air consumed daily and then look at what a small percentage improvement in compressor efficiency is worth. Then ask your flow meter supplier to help you review the performance of the instrument in the actual application.

## **Conclusions**

Outfitting wastewater treatment aeration systems with the proper flow meter will result in improved process effectiveness and reduced energy consumption. Looking carefully at measuring accuracy and range needs, installation conditions and complexity, and maintenance requirements will result in selecting the most cost effective flow metering solution.

Over the past three years a number of flow meters from multiple manufacturers have been developed to better meet the needs of air flow measurement and other gases such as digester gases, applications found throughout wastewater treatment facilities. At Fluid Components International, for example, we have designed a broad range of new and enhanced flow meters within the past 12 months that better meet the need for aeration flow measurement and other applications within in wastewater treatment.

Our newest flow meter, the ST50 is designed specifically and optimized for aeration and blower air applications in wastewater treatment facilities. The ST50 incorporates thermal mass flow sensor technology for a no-moving parts insertion style element with optional wireless IR communication, which is easy to install and requires virtually no maintenance. Its transmitter electronics include dual analog outputs and optional digital readout all housed in a small, rugged, metal enclosure for long service life regardless of installation of environment.

When you are evaluating flow meters for your next project, be sure to look beyond accuracy, which while important, can be misleading in terms of overall performance, reliability and low life-cycle costs. You can also avoid a lot of headaches if you ask about how well the flow meter will operate within your specific environment. Don't forget to consider the ease of installation and think ahead about maintenance. To evaluate your true total investment cost, look beyond the initial cash outlay to include the cost of operating your next flow meter over its lifecycle.