by Bob Steinberg

Thermal Mass Flowmeters for Water & Wastewater Treatment

New Features Help Users Improve Overall Plant Efficiency

Thermal mass flowmeters offer many new feature to benefit the operators of wastewater treatment plants (WWTPs). As a result, there are numerous applications as the WWTP where thermal flowmeter technology can be employed. For example, thermal mass flowmeters can be used to measure direct mass flow of air to oxygenate aeration basins; they can measure a digester gas, waste gas or bio gas, mixed gas, and natural gas; and they can be used to monitor oxygen flow for odorizer systems. In addition, thermal mass flowmeters do not require separate temperature or pressure devices, they are extremely accurate, and they are cost effective. Furthermore, their extreme low-end sensitivity (velocities as low as 10 SFPM), negligible pressure drop, long-term stability, and ease of installation are important features that improve overall efficiencies at the plant.

Given some of the recent enhancements of thermal flowmeter technology, it is important for users to have a clear understanding of the capabilities and features of the latest generation of thermal flowmeter products when specifying such an instrument for purchase. The following outlines some of the key characteristics of thermal flowmeter technology and highlights some new features users should be looking for when specifying a thermal mass flowmeter for a WWTP application.

General Characteristics

The concept of thermal mass flowmetering is based on the principle of conductive and convective heat transfer. Thermal mass meters essentially pick up the movement of gas as the molecules of gas cool off the heated sensor. As such, they are extremely accurate devices (typically +/– 1 percent of rate) and have extraordinary low-end sensitivity, detecting even the slightest flow of gas. They are temperature-compensated, have negligible pressure drop, and are resistant to contamination. The latest generation of devices can tolerate wide gas temperature fluctuations. They use reference-grade platinum RTD windings as the sensors to provide stable measurements over time. Typical thermal mass flowmeters have at least 100-to-one turndown.

Thermal meter monitors wastewater treatment plant blower airflow rate.

Configuration & Installation

Thermal flowmeters are easy to install. Most manufacturers provide ½" or ⅛" diameter probes that are easy to insert into existing pipes from two inches to 24 inches (or for small pipes, in-line styles with NPT fittings are available). Merely tap a hole, weld a half coupling, and insert using a manufacturer-provided isolation valve assembly or a compression fitting. Most manufacturers provide guidelines on how far into the pipe to locate the sensor, and some manufacturers offer a variety of strategies, even if the flow profile is not ideal — a condition typical of the drop lines in an aeration basin where the flow profile depends on a number of factors, the most important of which is the length of unobstructed straight run prior to the flowmeter. Thermal mass flowmeters are available with integral or remote enclosures that are powered from either 24 VDC or 115 VAC.

Readouts & Outputs

Thermal flowmeters will report gas mass flowrate in SCFM, SCFH, LBS/Hr., or other measurement units without requiring external temperature or pressure devices. The devices will also totalize the ongoing gas consumption (SCF or LBS). The flowrate is reported over four to 20 mA outputs, as well as on a display (LCD or LED depending on the manufacturer) and can also be accessed on a laptop. Some manufacturers provide the ability for the totalizers to be reset externally by a simple contact closure or by utilizing menus accessed by a keypad or via RS232 and a laptop. In some models relays are available that can be configured as pulsed outputs, and a remote counter can then be used to independently report consumption.

New Features of Thermal Mass Flowmeters

✓ Some thermal mass flowmeters offer (as a standard feature) remote enclosures that contain all electronics and display flowrate, temperature, and total, eliminating the need for any electronics at the sensor location. In this type of configura-

tion, the sensor often has a weather-proof and explosion-proof junction box for thesix-conductor cable, but no electronics — a major advantage in very hot or cold climates where electronic components may be degraded or susceptible to failure. A NEMA 4X remote electronics enclosure can be mounted up to 2,000 feet away, and thus can be mounted indoors, or at least in a cabinet, where the ambient temperature is not severe. Neither the cable length nor cable temperature affect the meter's accuracy since the circuitry in the remote enclosure has lead-length compensation, thus maintaining the original factory calibration, regardless of cable length.

✓ Another recent advancement is the ability to calibrate for a number of different gas mixes and store calibrations as separate ranges or channels. This feature is particularly useful for cogeneration facilities where many different gas mixtures need to be measured. In fact, a multiple-channel insertion meter can serve as a spare for different applications, allowing users to select the appropriate calibration channel, enter the pipe area in a menu item, and set the desired full scale. Or perhaps the multiple-channel meter can also serve as a spare for the waste gas or air flowmeters for the aeration basins.

✓ Also, recently introduced, is the ability for these ranges to be selectable in the field by a touch display screen keypad, laptop, or even remotely selectable with contact closures. With a touch display keypad, the cover does not have to be opened to activate the menu system.

✓ Some thermal mass flowmeters offer a routine to check the calibration of the meter by utilizing zero flow as a test point and comparing it to the original factory calibration, which is furnished upon shipment. This routine also verifies if the sensor is clean and ensures that the meter is still in calibration, thus eliminating the need to send meters back to the manufacturer for expensive recalibrations.

✓ In extreme situations where moisture is present (although it is best to eliminate excess moisture with traps, dryers, and filters), splash guards are available with some thermal flowmeters to minimize the effect of moisture on the flow sensor.

✓ Finally, new strategies for temperature compensation have become available where there is no effect at all from the extremes of seasonal temperature variations — i.e., the flowmeter holds its accuracy regardless of the temperature of the gas being monitored. FC

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