



## Thermal Flow Meter Improves Digester Gas System Fueling Boilers for Plant Steam and Hot Water

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**A**ccurate, repeatable air/gas flow measurement under harsh outdoor conditions is essential to successful wastewater treatment operations when used in aeration or digester biogas applications. The challenge for plant engineers when it comes to measuring reactor air and digester gas flow is that a relatively small number of flow meter technologies are capable of reliable measurement under the variable climate and dirty operating environments encountered at wastewater treatment plants.

No matter which treatment method is in use, wastewater is a damp, dirty, sticky, corrosive fluid process with outdoor weather conditions that range from freezing to frying. In addition, a plant's demand for treatment services can experience wide swings depending on the seasons of the year and other factors. While there are at least six to eight major air/gas flow sensing technologies, very few of them are effective under these restrictive process and environmental conditions.

In arid southern Arizona the plant engineers at the Pima County Regional Wastewater Reclamation Department take their role seriously, including flow instrumentation, when it comes to public health, safety, water re-use and conservation. They are responsible for the design, management and maintenance of 3,500 miles of the county's sanitary sewer (conveyance) system serving the city of Tucson and six sub-regional water reclamation facilities. This infrastructure includes a significant number of air/gas meters.

The wastewater plant engineers in Pima County are doing their part to protect the environment by recycling precious water resources in a desert environment. The department along with Tucson Water reclamation system uses its highly treated recycled, or reclaimed water, in a myriad of ways including the irrigation of County parks, golf courses and ball fields, as well as re-charging the Santa Cruz River basin.

Utilizing reclaimed water for irrigation is a highly sustainable activity that saves Arizona groundwater and Colorado River water for drinking. Reclaimed water is also used to sustain and improve aquatic and wildlife habitats, for dust control and for long-term storage in underground aquifers. The county and city are frequently visited by water experts who study its regional reclaimed water system, which demonstrates effective water recycling techniques in the desert.

The Tres Ríos Water Reclamation Facility (*Figure 1*) serves the metropolitan Tucson area and treats approximately 30 million gallons of wastewater per day (MGD). This recently modernized treatment plant complies with stringent regulatory requirements



*Figure 1: Tres Ríos Water Reclamation Facility*

on effluent nutrient reduction and has a permitted capacity to treat 50 MGD, which is expected to meet the county's projected population needs to the year 2030.

The Tres Ríos facility operates 24-hours per day, 365 days a year. It is the main collection and treatment facility downstream, a scalping plant for the city of Tucson. At Tres Ríos, the activated sludge aeration treatment method is used. The facility is permitted for A+ reclaimed water through Arizona Department of Environmental Quality (ADEQ).

### The Problem

The plant engineers at the Tres Ríos facility have been considering an upgrade of their existing FCI thermal gas flow meters. They have been in service for over a decade measuring the biogas feeding the burners heating multiple hot water boilers. The meters measure collected methane from multiple biogas digester tanks that fuel the boilers to provide the facility with hot water and steam.

Wastewater treatment digester gas is a combination of methane (CH<sub>4</sub>) and carbon dioxide (CO<sub>2</sub>) with a small percentage of other trace gases. The gas composition can vary with the process and temperature (seasonally), but the engineers at the Tres Ríos facility needed their new flow meter calibrated to: 61% CH<sub>4</sub>, 33% CO<sub>2</sub>, 5% H<sub>2</sub>S and 1% water vapor.

The new meters sought by the Tres Ríos plant engineers would be installed on existing 8-inch diameter pipes, Schedule 10S. They would need to measure both the flow rate and totalized flows. The specified flow range desired was 37 SCFM to 500 SCFM, with 170 SCFM typical, at temperatures ranging from 78 °F to 110 °F, with 95 °F normal and at pressures of 30 psig.

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Accurate, consistent flow measurement is essential to report biogas production and for overall plant process control. Local, state and federal authorities generally require gas production data for regulatory monitoring purposes to ensure environmental compliance for greenhouse gas reporting as well.

### The Solution

With this facility's long history of utilizing thermal mass flow meters from Fluid Components International (FCI), the plant contacted the flow meter supplier through its local sales and service engineer Joe Garcia of Phoenix Instrumentation. The Tres Rios facility currently has over 60 FCI meters supporting its existing aeration process, digester biogas process and odor control operations.

After reviewing the application requirements, the FCI Applications Group recommended the installation of FCI's new ST80 Series thermal flow meter (Figure 2). This meter features Adaptive Sensor Technology™ (AST™), which offers enhanced accuracy and repeatability in demanding application environments such as wastewater treatment.

This meter is designed with a hybrid sensor drive that combines the industry's constant power (CP) and constant temperature (CT) thermal dispersion sensing technologies. When in AST mode, the meter measures in CT during start-up and through the lower flow ranges and then seamlessly shifts into CP mode at the mid-range and at the higher flow rates. The result is a fast response meter with extended measuring ranges at low power consumption to maximize sensor reliability and reduce instrument energy expenses.

These thermal flow meters are designed with a rugged non-clogging, no-moving parts flow element, which provides direct mass flow measurement with just a single process penetration. No additional temperature and pressure sensors are needed to calculate gas mass flow, which reduces component, installation and maintenance expenses over the life of meter.

The Tres Rios engineers were pleased with the meters accuracy of  $\pm 1\%$  of reading,  $\pm 0.5\%$  of full scale and repeatability of  $\pm 0.5\%$  of reading that met their specifications. The turndown ratio is a minimum of 2:1 up to 100:1, which accommodates wide swings in demand. The flow range also met their biogas application needs with the insertion configuration measuring flow from: 0.25 SFPS to 1000 SFPS [0,07 NMPS to 305 NMPS].

While a single calibration is sufficient for many processes, these meters can optionally provide two unique calibration



Figure 2: FCI's ST80 Series thermal flow meter

groups. For example, the meter can be calibrated for two different compositions of mixed biogases or two completely different gases (biogas and natural gas). This is especially helpful in processes that are seasonally affected by environmental temperature changes, such as wastewater treatment digester gas.

The new meter features multiple outputs to interface with popular industrial control systems and/or set-up or configuration devices. The standard configuration includes: dual 4-20 mA, NAMUR NE43 compliant analog outputs, HART (version 7) and Modbus 485. Optionally available are: Foundation Fieldbus and PROFIBUS PA.

The plant engineers at Tres Rios were especially pleased with the meter's easy-to-use display with through-the-glass user programming buttons (Figures 3 and 4). The standard display is a backlit informational LCD. It provides both a digital and bar graph readout of the process flow rate and temperature, totalized flow, alarm conditions, diagnostics feedback and even a user defined label field.

The meter's transmitter enclosure is NEMA 4X/IP67 rated and comes in both aluminum and stainless steel for heavy duty wastewater treatment environments such as the Tres Rios facility. NPT or metric conduit port threading is provided. Global HazEx approvals are available on the full instrument, which is a SIL 1 device.

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### Conclusion

The first new ST80 Series thermal flow meter was installed successfully in the digester building at Tres Rios to replace an existing meter and has been operating without any issues for nine months. The plant engineers are especially impressed with the ease of use of the new meter based on its touch-screen display, which includes full diagnostic capabilities that simplifies their tasks. They plan to standardize on this meter going forward as they upgrade the other meters in the digester building and elsewhere in their aeration and odor control operations. ■



Figure 3: Installed ST80 flow meter in co-gen building



Figure 4: Close-up image of meter display screen