SIERRA INSTRUMENTS
THE MASS FLOW COMPANY

Why Mass Flow?
White Paper Series

Municipal Wastewater Treatment

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About:
Today, hundreds of industries use gas mass flow meters to optimize their processes. Why? Because on the process line and the bottom line, mass flow makes sense.

The Why Mass Flow White Paper Series is an industry by industry summary of the advantages mass flow meters and controllers offer industry.

Thermal mass flow meters are widely used by municipal wastewater treatment plants in a variety of applications. The mass flow meter's accuracy, repeatability, and wide turndown help reduce operating costs and ensure safety and quality.

This application guide describes how the thermal mass flow meter is used in digester gas and aeration basin airflow measurement operations, and discusses the benefits derived from this technology.

Aeration Basin Air Flow Monitoring

The activated sludge process removes about 85% of the organic matter in sewage using bacteria that decompose biologically degradable organics. After the sewage leaves the settling tank in the primary stage, it is pumped into an aeration tank where it is mixed with air and bacteria-laden sludge. The sewage remains in the aeration basin for several hours, while the microorganisms do their work.

Controlling microorganism growth.

Microbial growth and activity in the breakdown of organic matter in the activated sludge process depends on the dissolved oxygen (DO) level in the aeration basin. The microorganisms utilize DO during the process of oxidizing the organic material in the waste for endogenous respiration (micro-organisms eating other micro-organisms) and from nitrification (conversion of ammonia to nitrate).

In a typical application, DO is delivered to the microorganisms in the aeration basins through air supplied by blowers and dispersed by fine bubble diffusers. The blowers supply air to each aeration basin through separate headers. A single airline from the main header supplies air to each of the diffuser system in the basins. The main header and each airline typically have their own butterfly valve and flow meter for air control.

It is critical to the health of the biological process that the precise *mass flow* of air (and hence oxygen) into the process be controlled to maintain correct DO content. Failure to do so can result in destruction of the culture and inadequately treated effluent discharge, leading to potential fines and environmental damage.

Improving energy efficiency.

In a typical wastewater treatment plant, 45 to 50% of operating costs are associated with the electric power required to run the aeration system. By carefully monitoring the mass flow of air to the basins, electricity costs can be reduced substantially.

In one case, the aeration DO system was automated (with the Sierra 640S as a key input into the control loop) in a 7.8-mgd plant that treats both industrial and domestic wastewater**.** In doing so, the company **saved $50,000/year** in aeration costs and, as an added benefit, reduced chlorination and pH adjustment costs. Nearly total nitrogen removal was also accomplished and resulted in improved effluent suspended solids.

Application*:* The typical aeration flow monitoring application utilizes air at ambient temperatures and moderate pressures with relatively high flow rates. Sierra's **Steel-Mass™ Model 640S** is widely used in this application.

Digester Gas Flow Measurement

Another critical wastewater treatment operation is the removal and disposal of solid waste material. These solids are kept for 20 to 30 days in large heated digester tanks. Here, bacteria break down (digest) the material, producing large amounts of CO2 and CH4 in the process. This CO2/CH4 mixture is known as digester gas, and is often used as fuel for process heating and/or electrical power generation, or is disposed of in a flare stack.

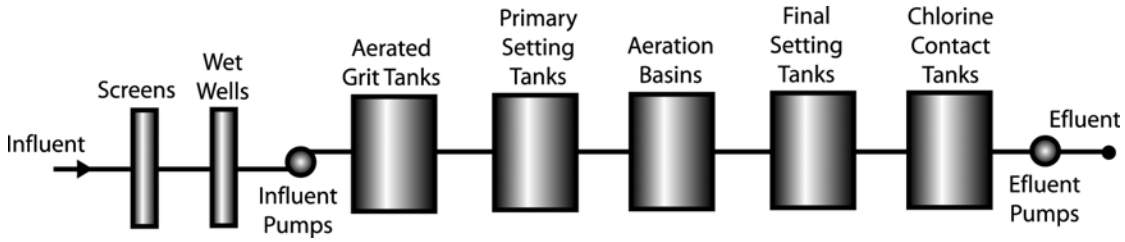
Why Mass Flow?

Methane is a primary component of anaerobic digester gas (ADG), an abundant byproduct of the sewage treatment process. A large wastewater treatment plant can produce roughly one million cubic feet of this biogas each day.

Most wastewater treatment plants use some of this gas to heat boilers and flare off the excess. Other options for biogas usage include fuel for combustion engines to generate electricity, fuel for natural gas vehicles, sale and distribution to neighboring industries for power generation or residential space heating, or using fuel cell technology for electrical generation.

By using this “waste” gas in such applications, **energy savings of approximately $100,000 per year may be realized**. Obviously, in order to quantify such savings, provide custody-transfer monitoring of digester gas to third-party users, or optimize combustion control schemes, an economical mass flow meter is preferred.

Application*:* The typical digester gas application requires mass flow measurement of a mixture of CH4/CO2 at relatively low pressures and low flow rates. The **Steel-Mass™ Model 640S** or **Flat-Trak™ Model 780S** are the instruments of choice for this application.



WHY THERMAL MASS FLOW MEASUREMENT?

Monitors mass flow directly

Most chemical and industrial processes require mass flow measurement. Thermal mass flow meters monitor mass flow directly, eliminating calculation errors.

No external P & T corrections required

Standard differential pressure systems measure only volumetric flow and require a separate pressure transducer, thermocouple, and flow computer to deliver a compensated mass flow reading.

Lower installed cost

While an orifice meter may offer a lower initial cost, the total installed cost will generally exceed that of a thermal mass flow meter by approximately $1500.

Lower cost-of-ownership

Thermal flow meters require only one process connection, have no moving parts, and require very little maintenance. Contrast this with a compensated differential pressure system and the maintenance and calibration requirements of several installed devices.

Outstanding rangeability

The instrument's outstanding low flow sensitivity improves measurement accuracy over a wide range of conditions. The instrument provides 2% of reading accuracy and 1% reapeatability over a 40:1 turndown range.

Low pressure drop

Most digester gas applications operate at relatively low pressure. A thermal meter creates virtually no pressure drop and can be used to accurately measure these flow rates, whereas an orifice plate could not be used at all.

Rugged, low-maintenance design

In dirty wastewater treatment processes, oils and particulates may be present in compressed airstreams, and heavy carbon buildup can occur in digester gas streams. This can plug orifice plates and turbine meters, resulting in periodic shutdowns for maintenance and cleaning. Thermal meters are relatively immune to such buildup and offer significantly lower service requirements.

Safety approvals

Sierra thermal mass flow meters are FM, CSA, and Cenelec approved for operation in hazardous areas and housed in NEMA 4X enclosures.

Why Sierra?

Sierra thermal mass flow meters have demonstrated their accuracy, flexibility, reliability, and low cost-of-ownership in hundreds of wastewater treatment processes around the world.

Sierra thermal mass flow meters ability to withstand extreme outdoor conditions, provide direct mass flow measurement with a single pipe penetration, interface with distributed control systems, measure a wide range of flows, and tolerate system pressure drops has made them the instrument of choice in aeration flow monitoring and digester gas flow measurement applications.

For more information on Sierra thermal mass flow meters, please visit our website at www.sierrainstruments.com, email us at info@sierrainstruments.com, or call us toll-free today at 800/866.0200.