SIERRA CLEAN ENERGY GUIDE

CLEAN ENERGY

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The Big Sur Coast in Monterey County, California, home to Sierra's Global Headquarters

Think Ahead

Matthew J. Olin
President,
Sierra Instruments

It's predicted that the clean energy industry will be the third largest global industrial sector by 2020. Sierra is passionately committed to supporting the visionaries that will make that happen.

A global leader in flow measurement and control for over 35 years, Sierra Instruments designs and manufactures high performance flow instrumentation for gas, liquid and steam applications commonly found in the environmental, scientific research, energy, semiconductor, petrochemical, aerospace, and general manufacturing industries. With over 150 offices in 50 countries, Sierra is uniquely positioned to provide our innovative products and lifetime support for the leading companies of today and the growth enterprises of tomorrow.

Located amid the scenic beauty of the Monterey and Big Sur, California coastline, Sierra has long demonstrated a deep appreciation for the environment and a commitment to a sustainable future. As a part of that commitment, we have partnered with customers from all over the world to develop a host of solutions to some of today's most pressing environmental problems. From high performance flow measurement instrumentation that helps create biofuel to unique measurement solutions for environmental research on global warming, Sierra is pioneering the way.

This *Sierra Clean Energy Guide* introduces you to some of our most innovative partners, and the unique solutions we have developed by Thinking Ahead...together. You can find more information on Sierra, our product line and a wide range of application stories at **www.sierrainstruments.com/cleanenergy**.

The Promise of Geothermal Power

Since the dawn of humankind, geothermal resources have been used for healing and physical therapy, cooking and heating. The first geothermal power plants in the United States were built in 1962 at The Geysers dry steam field in Northern California, which is still the largest producing geothermal field in the world. Today, geothermal power plants are producing over 8,200 megawatts of electricity that supplies over 60 million people in 21 countries.

In a typical steam field, the geothermal reservoir rock consists of fractured greywacke and greenstone heated to a temperature of 460°F to 480°F. The fractures are filled with superheated steam at pressures that, depending on location, can vary from 100 to 240 psig. This superheated steam is collected at the wellheads and sent to an electrical generating station that consists of a heat exchanger and a turbine and generator set. Steam is typically delivered to the turbine at 70 psia and 300°F to 350°F, at a flow rate of approximately 870,000 lbs/hr at maximum capacity.

Because of high temperatures and varying pressures, measuring steam flow is a significant challenge. Historically, geothermal power plants used differential pressure devices (dP) such as orifice plates, venturis, and pitot tube arrays to measure steam flow, but power station operators discovered major weaknesses with these devices. The dP devices are particularly sensitive to the formation of scale and frequent plugging, have a low turndown ratio (4:1), which may deliver erroneous readings at low pressures, and require compensating devices to measure the mass flow rate. In an effort to reduce cost and lower risk, some geothermal power producers are upgrading steam flow measurement and control technology to improve their bottom line.

SIERRA'S SOLUTION

Since 2002, Caithness Energy Company has partnered with Sierra and installed Innova-Mass® 241 Multivariable Mass Vortex meters to replace failing and corroded differential pressure devices. With the introduction of the multivariable mass vortex flow meter, improved accuracy and more reliable performance at a lower installed cost has delivered the efficiencies that Caithness sought.

Unlike traditional dP devices, Sierra's Innova-Mass® vortex flow meters provide the high temperature and pressure capabilities (330,000 lbs/hr), durability, accuracy and wider turndown (30:1) required for steam flow monitoring. The relatively small surface area of the insertion-type sensor in big pipes eliminates the large pressure drop associated with differential pressure metering devices. This ensures that dissolved solids will stay dissolved and won't precipitate onto the piping surface. The sensors small surface area also equalizes quickly with the surrounding steam temperature, thereby eliminating scaling due to temperature differentials.

With over 150 installations in the United States, Sierra's meters are rapidly becoming the flow measurement standard for geothermal fields across the country.

Sierra's Innova-Mass® 241 in a steam line

Here's what makes Sierra's Innova-Mass® 241 an ideal choice:

- Sierra was first to introduce multivariable mass vortex to the market in mid-1990's
- Measures five variables (mass flow, volumetric flow, temperature, pressure and density) with a single installation point for accurate direct mass flow measurement
- With no moving parts to replace and no ports exposed to the process, clogging is eliminated and maintenance costs are significantly reduced
- 30-to-1 turndown ratio improves power-generation turbine control by maintaining specified accuracy over varying velocities
- Insertion meters may be hot-tapped for easy cleaning and retrofitting
- Steam tables are programmed into the device

Bringing New Efficiencies to Solar Photovoltaic Manufacturing

According to a new report by the Renewable Energy Policy Network, more than 50 percent of the newly installed power capacity in the U.S. came from renewable energy sources. Solar photovoltaic installations now generate power in more than 100 countries and continue to be the fastest-growing type of electricity generation in the world. Over seven gigawatts of grid-tied solar photovoltaic power were added globally in 2009, with the U.S. accounting for around 470 megawatts of that new capacity.

Due to the growing demand for renewable energy sources, manufacturing of solar cells and photovoltaic arrays have advanced dramatically in recent years. Solar photovoltaics are arrays of cells containing a material that converts solar radiation into volts, creating direct current electricity.

Physical vapor deposition (PVD) or sputtering is commonly used for creating the films used to construct photovoltaic panels. In the PVD process, a negatively charged electrode is slowly disintegrated by molecular bombardment. The PVD medium is typically argon because this gas generates sufficient momentum to free atoms from the target. In a vacuum environment, these free target atoms deposit themselves on the surface of the material and form the desired coating or plating.

Maintaining a precise gas mass flow rate to the vacuum chamber is critical during the PVD process. Since there is so little pressure drop to work with, PVD processes require flow control devices that are relatively insensitive to the absolute pressure in the chamber. This rules out differential pressure (dP) devices like orifice plates that require a large pressure differential to operate efficiently.

Physical Vapor Deposition (PVD) is used to create photovoltaic panels

SIERRA'S SOLUTION

With an installed base of 100,000 instruments worldwide, Sierra's Smart-Trak®2 with Compod™ are also bringing precise measurement to the PVD process.

Unlike traditional differential pressure (dP) devices, Sierra's Smart-Trak®2 with Compod™ operates accurately in the high vacuum PVD environment, automatically compensating for changes in system pressure (vacuum pump fluctuations) or loss of pressure from the gas source (cylinder depletion). Since the layers deposited by PVD processes can, in many cases, be only molecules thick, very precise delivery methods of the doping gases are required. Inaccuracies in gas measurement in this doping process can account for thousands of dollars in lost product and increased gas costs due to inefficiencies.

Smart-Trak®2

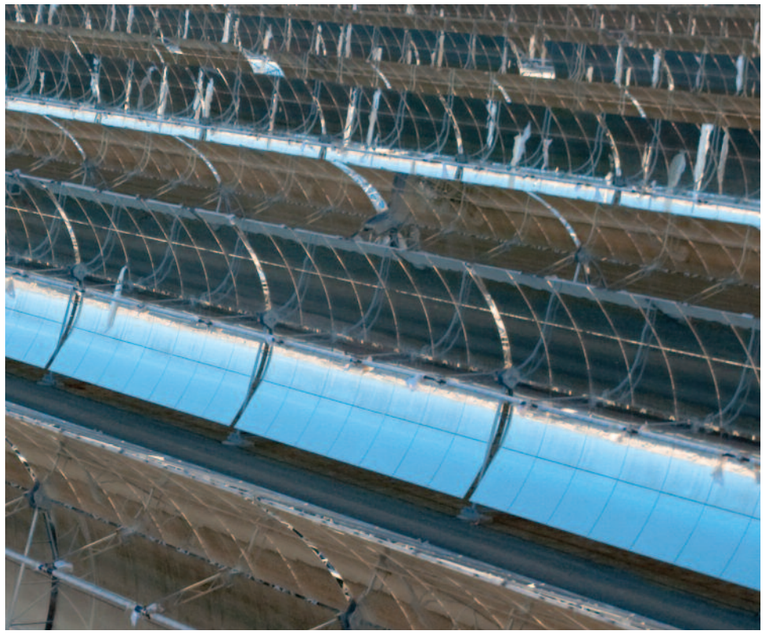
Smart-Trak®2 with face-mounted Compod™

The Smart-Trak®2 with Compod™, with its Laminar Flow Element and proprietary frictionless-hovering control valve, delivers a precisely controlled gas mass flow rate to the vacuum chamber to increase gas delivery efficiency and ensure a quality product.

Here's what makes Sierra's Smart-Trak®2 with Compod™ an ideal choice:

- Reduced capital equipment and installation costs by automating complex gas process with the Compod™– no need for external PLCs or computers
- With a Compod™, Smart-Trak®2 becomes a fully network-enabled multi-drop RS-485 / Modbus RTU device
- Daisy-chain multiple MFC's on a single network, then send and receive data, alarms and commands or perform remote diagnostics and data logging
- Inherently linear Laminar Flow Element provides accuracy of +/- 1% of full scale which improves product quality

Generating Thermal Energy from the Sun



A parabolic trough power plant

With the rising cost of electricity from fossil fuels, solar thermal energy (STE) currently leads the way as the most cost-effective solar technology. Major solar thermal power industry players are striving to make the economics of solar power a mainstream renewable energy source. While only 600 megawatts of solar thermal power was up and running worldwide in October 2009, another 400 megawatts is under construction and there are 14,000 megawatts of similar solar thermal projects being developed.

Solar thermal electric energy generation concentrates the light from the sun to create heat, and that heat is used to run a heat engine, which turns a generator to make electricity. Various methods exist to concentrate the solar radiation, including parabolic troughs, power towers with mirrors that track the sun, parabolic dishes, and Fresnel reflectors. A fluid (also called heat transfer fluid) like synthetic oil, molten salt and pressurized steam passes through the receiver and becomes very hot. The fluid containing the heat is transported to a boiler to produce steam which can then be used in the process or to generate electricity.

SIERRA'S SOLUTION

In California, a national brand of wheat snack chips is embracing solar thermal energy as an efficient and viable energy source for its factory. The installation of Sierra's Innova-Mass® 241 Multivariable Mass Vortex meters has greatly increased the efficiency of their thermal energy production, proving that investing in renewable energy directly impacts the bottom line.

The solar collector field at the chip manufacturing plant is comprised of a huge array of concave mirrors. These mirrors track the position of the sun throughout the day, focusing the sun's energy on a black tube that runs along the focus of the array. This black tube is surrounded by a second glass tube vacuum chamber that protects it from the air, allowing it to absorb solar energy more effectively.

As super-heated water passes through the black tube, the solar energy heats it up to 450°F. This is where Sierra's 241 takes over to measure hot water, steam and condensate flow in the system. The water then runs through a boiler system that uses its heat to generate steam. The steam cooks the wheat and heats the cooking oil used in the manufacturing process. Cooled water flows back through the tube to the solar concentrator field to repeat the process.

Innova-Mass® 241 vortex meters are optimized for high temperature and saturated steam applications up to 330,000 pounds/hour. The ability to sense all process conditions in a single installation location greatly improves measurement accuracy and eliminates the costly requirement for additional line penetrations associated with traditional mass flow measurement systems.

With a +/- 1.5% accuracy for gases and a 30:1 turndown ratio, the Innova-Mass® captures an industry edge for most steam generation and distribution applications.

Sierra's Innova-Mass® 241

Here's what makes Sierra's Innova-Mass® 241 an ideal choice:

- Measures mass flow directly with one meter to measure five process variables
- Able to handle high temperatures and pressures whereas dP devices give erroneous readings in environments with varying pressure conditions
- Onboard diagnostics and field configuration
- Insertion design makes installation easy

Unlocking our Carbon History in Antarctic Ice

No greater challenge faces our planet right now than determining conclusively how we are impacting the environment and what can be done to arrest and reverse global warming. One important method for measuring the rising level of CO_2 in earth's atmosphere is to look back through time by measuring the amount of CO_2 locked in Antarctic ice. To deepen our understanding, Stanford researcher David Mucciarone spends two months in the Antarctic every year measuring the breakdown of inorganic carbon in both sea and ice to learn how much carbon dioxide the ocean can effectively digest.

Mucciarone uses a device called a carbon analyzer to measure the carbon locked into the ice and ocean water. This device requires precise measurement and control of sample flows in order to be effective.

SIERRA'S SOLUTION

With just days left before Stanford researcher David Mucciarone was to leave for Antarctica, the mass flow controller in his carbon analyzer failed.

His instrumentation supplier recommended that he make the transition to Sierra. Heeding that advice, he purchased a Sierra Smart-Trak®2 Digital Mass Flow Controller just prior to boarding ship. He installed it on the trip down to Antarctica, and it worked...perfectly. But fierce trials lay ahead as the icebreaker Mucciarone was travelling on plunged through hundreds of miles of thick ice before delivering him to one of the most severe environments on the planet.

Smart-Trak®2

Despite the challenges, the Smart-Trak®2 never faltered. "We're very happy and that's the bottom line," says Mucciarone.

Based on his success with the carbon analyzer, he plans to employ additional analyzers on ocean reef and other ecosystems around the world—each containing a Sierra Smart-Trak®2 mass flow controller.

Here's what makes Sierra's Smart-Trak®2 an ideal choice:

- Patented, inherently linear Laminar Flow Element (LFE) design
- Provides smooth and flexible valve performance
- Pilot Module allows user to switch between ten pre-programmed gases, change setpoint value and source, set zero, span and full scale, modify engineering units, choose output signal...and much more
- Has more robust electronics than other industry mass flow controllers

Investigating the Impact of Ocean Acidification on Marine Life

The Monterey Bay Research Institute (MBARI) is located on one of the most spectacular coastlines in California, with Big Sur to the South and San Francisco to the North. It also sits on the precipice of a giant underwater canyon. Beneath the surface of the Monterey Bay, the ocean conditions are changing rapidly due to the influx of CO_2 in our atmosphere. According to Dr. James Barry, a Benthic biologist and senior scientist at MBARI, about a third of the human CO_2 gas emissions in our atmosphere is absorbed by the ocean, making the ocean 30% more acidic than just 100 years ago—a process known as "ocean acidification."

In his experiments, Dr. Barry and his team use mass flow controllers to control mixtures of O_2, N_2 and CO_2 that flow into his aquarium tanks. Conditions are varied to simulate past, present, and future ocean conditions. The O_2 levels vary from 1% to 20%, N_2 from 80% to 99% and Co_2 levels from 180 to 1500 parts per million, depending on the desired atmosphere or ocean condition Dr. Barry wants to create. He measures development, growth and physiological responses to the CO_2 stress of the marine animals in these aquarium tanks.

Early in his experiments, Dr. Barry was frustrated with the inconsistent data he was getting from his flow meters. Precious research time was lost recalibrating the instruments and laboriously adjusting flow rates on a daily basis.

SIERRA'S SOLUTION

Intrigued by the Sierra Smark-Trak®2's unique Pilot Module with Dial-a-Gas® capabilities, Dr. Barry and his team made a switch to Sierra flow meters in 2005. With the stroke of a button on the Pilot Module, Dr. Barry was able to change his CO_2, N_2 and O_2 flow rates instantly and remotely, creating many varieties of oceanic atmospheres in his tanks with the same set of conditions—same water, temperature, and animals.

Now he was able to simply plug his remote handheld Pilot Module into any one of his nine Smart-Trak®2's, makes a change in the gas flow rate (thus creating another atmosphere), and his new gas flow settings deliver at a rate that will not deviate. If he wants to change his atmosphere again by entering new flow rates, it takes only seconds.

"With the Smart-Trak®2, it couldn't be easier—and faster," says Barry. And this is what scientists value most—time to concentrate on their research work, rather than adjusting instruments.

Sierra Smart-Trak®2 with remote Pilot Module

Here's what makes Sierra's Smart-Trak®2 an ideal choice:

- Control up to ten gases with a single instrument using the Dial-a-Gas® feature
- Pilot Module allows full read/set of all variables in the field
- Industry-leading powerful frictionless-hovering control valve for strength and flexibility
- Highly accurate digital mass flow control

Reducing the Carbon Soot that Threatens Clean and Breathable Air

A "brown cloud" over Shanghai

The U.S. government now recognizes that black carbon soot is the number two cause of climate change and the most important component of air pollution affecting our public health. This soot, caused mainly by the burning of fossil fuels and firewood, is often found in huge smog-like plumes known as "atmospheric brown clouds."

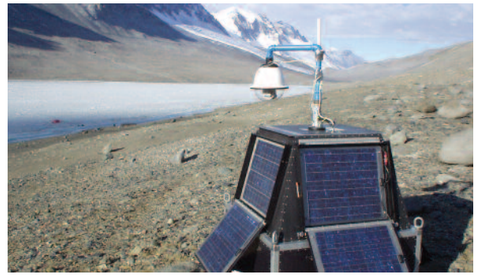
According to a report commissioned by the U.N. Environment Program, this emissions mix of carbon dioxide and other gases are the newest threat to the global environment.

In order to sample and collect scientific data from these clouds, there is a clear need for continuous, real-time optical measurement of the particles that make up these clouds at multiple wavelengths.

SIERRA'S SOLUTION

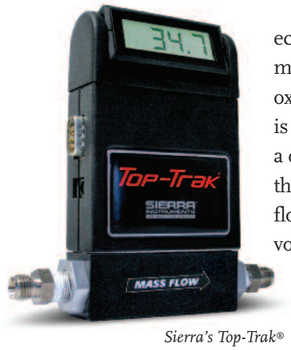
In 1994, Dr. Tony Hansen, the founder of Magee Scientific in Berkeley, California, developed a device called the Aethalometer® for soot particle collection and measurement. Magee Scientific's Aethalometer® is housed in a small case with a speed-controlled pump, Sierra Top-Trak® 824 Mass Flow Meter, filter, optical chamber and an LED light source. Users can punch in a mass flow rate from 2 to 5 minutes per liter on the Aethalometer's® screen.

Once the signal is set, the Top-Trak® measures the mass flow rate of ambient air pumping through the system, which is adjusted with a speed-controlled pump in a closed loop system. This provides a constant mass flow rate of ambient air. Dr. Hansen explains that "the computer in our instrument controls the speed of the pump, so we achieve closed-loop flow control."



The Aethalometer® at the South Pole

As this air stream is pumped through the optical chamber, black carbon particles collect on the filter and are optically measured, giving the real-time mass concentration of these carbon particles from tens of nanograms per cubic meter to hundreds of milligrams per cubic meter. Because he conducts end-to-end calibration on the entire Aethalometer® before it reaches his customers, Dr. Hansen attests that scaling accuracy of the meter is not as important as reliability. "It works great. What more can you ask for?" says Dr. Hansen of the Top-Trak®.



Sierra's Top-Trak®

Sierra was the first to introduce an accurate yet economical mass flow controller with an LED display in the mid-1980's for accurate mass flow measurements of air, oxygen and other common industrial gases. The Top-Trak® is small, removable and portable, so it can easily be moved to a different set of pipes when needed. Top-Trak® has become the standard in the industry for those wanting a low-cost mass flow meter as an alternative or replacement for lower accuracy volumetric variable-area flow meters.

Clean Coal Challenges in a Growing China

To keep pace with the electricity demands of its rapidly growing economy, China's coal-fired power plant construction is booming. China now uses more coal than the United States, Europe and Japan combined. Conscious of their environmental impact, China has emerged in the past several years as the world's leading builder of efficient, low polluting coal-fired power plants by mastering the technology and driving down the cost.

One imperative in efficiently operating a plant is to balance the fuel to air ratio. In a coal-fired plant, air is drawn from the atmosphere, pre-heated and then mixed with the pulverized coal and burned in the boiler. The more accurate the fuel to air ratio, the more efficient the boiler, and the less greenhouse gases are emitted.

Yiyang coal-fired power plant in Yiyang, China

Traditionally, older coal plants used averaging pitot tubes (annubars) or other differential pressure-type (dP) devices. In a dP device, the flow is calculated by measuring the pressure drop over an obstruction inserted in the flow. The dP flow meter is based on Bernoulli's equation, in which flow is proportional to the square root of the differential pressure. By measuring the static pressure in the tube and the dynamic pressure caused by the flow into the holes, the flow velocity can be determined.

Unfortunately, these holes are prone to plugging from the coal dust in the combustion air. Annubars are also mid-accuracy (1.5% of FC or +/- 1.5% of FS) and poor turndown devices (less than 4:1). They are also volumetric devices; they do not directly measure mass flow. Taken together, all of these issues lead to inaccuracies that have caused inefficient combustion and increased emissions.

SIERRA'S SOLUTION

Sierra meter measuring combustion air flow in duct

The Hunan Electric Power Design Institute's state-of-the-art coal-fired plant design for their 2008 Yiyang City installation provides a dramatic example of how Sierra is helping fill the demand for a cleaner process.

Building on the strengths of Yiyang I, built in 2001, Yiyang II required 16 high-precision mass flow meters for the measurement of combustion airflow to the boilers. After extensive testing of a wide variety of flow meters, the design engineers settled on Sierra's Steel-Mass™ 640S meter. Almost immediately upon installation, YiYang II demonstrated increased accuracy and the ability to operate reliably at temperatures as high as 400°C (750°F).

Accuracy is inherent in the Steel-Mass™ 640S sensor due to the use of Sierra's proprietary Dry-Sense™ Sensor Technology, a swaging process to press the velocity sensor into the thermowell. This creates a very stable sensor that does not require frequent calibration. Other thermal flow manufacturers use epoxies or glues to hold the sensing element in place, which can expand or contract over time creating "flow drift" that requires recalibration.

Sierra's mass flow measurement solutions have significantly increased efficiencies in the Chinese coal-fired sector, while reducing maintenance costs and emissions. In fact, the improvements in these areas have been so dramatic that Yiyang I is now scheduled to be retrofitted with Sierra instrumentation.

Here's what makes the Sierra's Steel-Mass™ 640S an ideal choice:

- Measures mass flow directly with no temperature or pressure compensation required
- Operates at high temperatures in the range of 400°C (750°F)
- Offers 100:1 turndown as compared to 4:1 turndown for traditional differential pressure devices
- Single point insertion means low installation costs and easy retrofitting
- Insertion meters may be hot-tapped for easy cleaning
- With no holes to get clogged, it operates smoothly in dirty flows, unlike more problematic averaging pitot tubes (annubars) and other differential pressure devices

Reducing the Cost of Engine Emissions Testing

In the early 1970's, the U.S. Environmental Protection Agency (EPA) was formed in response to growing national concern about air quality. It wasn't long before the EPA developed emissions regulations that targeted the carcinogenic impact of dirty engine exhaust, and set tough regulatory standards for engine manufacturers to develop much cleaner engines. Engine makers needed an instrument that could accurately measure the quantity of particulate pollution produced in engine exhaust to meet the regulatory standard. Throughout the 1980's, expensive and cumbersome full-flow constant volume sampling (CVS) systems, the size of a city bus, were the only measuring device the EPA would accept data from.

SIERRA'S SOLUTION

Rob Graze, Senior Engineering Specialist at Caterpillar, contacted Sierra in 1991 with a proposition. Familiar with the successful relationship Sierra had forged with Caterpillar in the 1980's, Graze suggested a new exclusive instrument development partnership based on his new patented Partial Flow Dilution Tunnel design. With a strong background in particulate measurement and flow, Sierra saw great potential. Within twelve months, the new BG®1, a highly efficient and accurate Partial Flow Sampling System (PFSS) no larger than a household refrigerator, was testing non-road engines at Caterpillar for a fraction of the cost of traditional CVS systems.

Three years later, Sierra introduced the Model BG®2. Upgraded software greatly enhanced its ability to perform precise and accurate steady-state particulate measurements. In 2002, Sierra teamed with technology partners Caterpillar and CP Engineering again to successfully develop the BG®3, a revolutionary PFSS advancement that was aimed towards tougher 2007 and Tier 4 emissions standards that mandated both steady state measurements for non-road engines and transient measurements for the much larger on-road diesel market.

Sierra BG®3

MAKING HISTORY

Sufficiently impressed with both its accuracy and repeatability, the United States EPA certified Sierra's BG®3 in 2005 for use by Caterpillar in the certification and compliance of on-road engines to 2005 standards, thereby eliminating for the first time the need for expensive and cumbersome full-flow CVS systems.

The EPA worked exclusively over the last five years with Sierra on a BG®3 vs CVS multiple engine correlation study in an effort to get Partial Flow Dilution included in the Federal Register as a legal alternative method to CVS in 40 CFR part 1065. On November 8, 2010 a Direct Final Rule enabling this to happen was published in the Federal Register.

The Direct Final Rule will become law on January 7, 2011 and is considered to be an historic industry turning point by opening the door to greater engine testing productivity to all Heavy Duty as well as the Light Duty Vehicle manufacturers.

Here's what makes Sierra's BG®3 an ideal choice:

» A highly economical replacement for CVS systems; approximately 1/10th the cost
» Annual electricity usage versus a CVS is approximately 1/20th the cost
» Can be used on engines of any size and on any fuel, in both engine and chassis test cells
» Portable from cell to cell
» Zero-loss dilution tunnel
» Satisfies all ISO 8178, ISO 16183, 40 CFR 1065 and CFR part 98 requirements
» Ability to do simultaneous pre and post catalyst and/or diesel particulate filter research

New Green House Gas (GHG) Reporting Rule Affects a Wide Variety of Industries

In 2011, a new rule from the Environmental Protection Agency (EPA) (40 CFR Part 98) will go into effect requiring certain fossil fuel suppliers, industrial gas suppliers, manufacturers of vehicles and engines outside of the light-duty sector and certain downstream facilities that emit greenhouse gases to submit annual reports to the EPA. Companies affected are primarily large facilities emitting 25,000 metric tons of carbon dioxide equivalent ($mtCO_2e$) or more of GHG emissions per year.

The GHG's covered are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorochemicals (PFC), and sulfur hexafluoride (SF_6), as well as other fluorinated gases (e.g., nitrogen trifluoride and hydrofluorinated ethers). These gases are often expressed in metric tons of carbon dioxide equivalent ($mtCO_2e$).

The 25,000 mtCO2e limit was chosen because it is estimated that 80% of the CO_2 emitted comes from the 10,000 or so facilities that emit that much or more. 25,000 $mtCO_2e$ is equivalent to the annual greenhouse gas emissions from approximately 4,600 passenger vehicles consuming over 58,000 barrels of oil. In other words, these are big industrial facilities. 80% of the 10,000 facilities that will be affected are from the following categories:

- Big combustion boilers/kilns/heaters (more than 30 million BTU's): 3,000
- Landfills: 2,551
- Natural gas plants: 1,502
- Electrical generating stations: 1,108
- The rest (2,000 or so) are paper mills, auto plants, refineries, bulk gas companies, steel plants and other metal production plants

SIERRA'S SOLUTION

To be prepared to support the needs of customers affected by GHG legislation, Sierra initially developed the Boiler-Trak™ Mass Flow Meter in 2007 as a solution to the California Global Warming Solutions Act of 2006. This is the program that the new EPA reporting mandate is modeled after. To date, Sierra has over 2,000 Boiler-Trak's installed. It's proven itself as an optimal solution for measuring the fuel that is piped to gas-fired combustion boilers, kilns and heaters.

Sierra has now self-certified several of their meters to meet the requirements of the new EPA rule. Look for the GHG certified logo throughout Sierra's website to identify the GHG flow meters. In addition to new meters, Sierra can rapidly certify and recalibrate existing Sierra meters so that you can immediately meet the new requirements.

Sierra also has a large installed base of flow devices for the measurement of landfill gases, the second largest source category in 40 CFR Part 98. Sierra's Steel-Mass® 640S provides an optimal solution (see page 26-27 for more). In addition, Sierra routinely supplies their 640S and 780S series immersible thermal mass flow meters to the gas production and electrical generation sectors to measure the full list of greenhouse gases.

Sierra Boiler-Trak™

All Sierra meters referenced above have been optimized to meet 40 CFR part 98 and provide the following benefits:

- Direct mass flow monitoring eliminates need for separate temperature and pressure inputs
- Optimized for methane (CH_4) as well as N_2O, SF_6, HFCs, PFCs and CO_2, per the EPA mandate
- 100:1 turndown accurately measures both low and high flows
- Contains no moving parts which prevents clogging and lowers maintenance costs
- Minimal pressure drop and patented Dry-Sense™ Sensor Technology increases accuracy (+/- 1% of reading plus 0.5% of full scale)
- 640S & 780S are backed by a lifetime sensor warranty

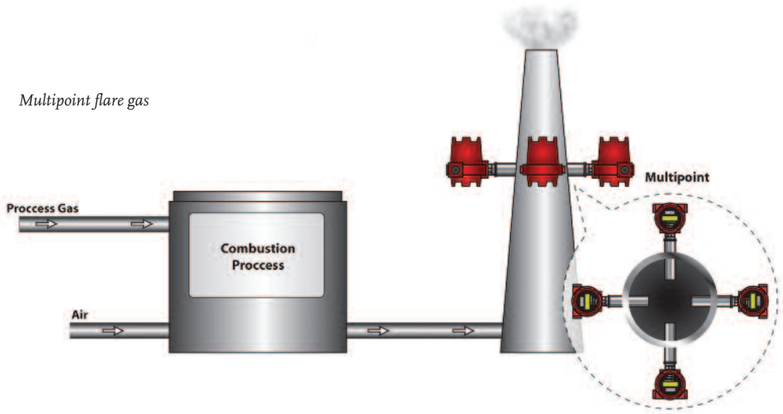
Visit sierrainstruments.com/greenhouse.html and look for our GHG logo

Using Multipoint Systems to Measure Flare Gases for Green House Gas Reporting

The World Bank estimates that over 150 billion cubic meters of natural gas are flared or vented annually, an amount worth approximately 30 billion dollars. And ten countries account for 75% of the flare gas emissions. To reduce these emissions, the new 2011 Environmental Protection Agency (EPA) rule (40 CFR Part 98) requires companies like landfills, refineries, and water treatment plants to report annual flare gas emissions to the EPA. (See page 20 for more.)

To mitigate greenhouse gas emissions, many of these companies reuse their biogas for cogeneration, but the amount of biogas produced often exceeds the amount needed for cogeneration. In such cases, it is often not economical to purify, compress and store the gas for later use, so it is flared off. Accurate mass flow instrumentation is essential for these companies to comply with the new EPA requirements.

Multipoint flare gas



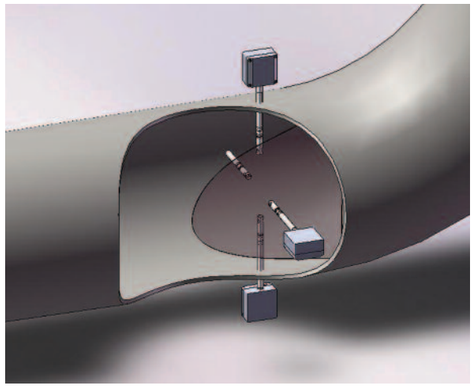
Measuring the mass flow of flare gases presents several challenges:

- Depending upon the process, the flare itself may be in a large diameter stack or duct with distorted or swirling flow profiles, making it difficult for mass flow instrument to get an accurate reading
- Flows may be very low to very high depending upon the time of day, which makes differential pressure (dP) devices inaccurate because of their poor turndown (4:1)
- Flows may be dirty, wet, hot gases of mixed compositions which plug the holes in dP devices like annubars, thereby increasing cost-of-ownership
- Stack piping may be difficult to access

SIERRA'S SOLUTION

Sierra's innovative Multi-Trak™ is specially equipped to help companies accurately report flare gas emissions for the EPA (CFR Part 98) requirements. The Multi-Trak™ performs optimally in dirty gas streams, has a high 100:1 turndown, and gives accurate measurements in applications with wide temperature ranges up to 400°C (750°F) and rapid velocity changes.

The Multi-Trak™ 670S provides high accuracy in large ducts or stacks that have non-uniform velocity profiles. It consists of up to four Model 640S flow meters linked via Modbus, one control panel with touch-screen Human Machine Interface (HMI) and 4-20mA/0-5VDC output, and the associated cables for daisy-chaining the 640S flow meters. With this multipoint configuration, the Multi-Trak™ dynamically compensates for changes in the flow profile in large pipes to instantaneously measure average mass velocity. It also allows users the ability to compensate for flow profile distortions by positioning the sensors in optimal locations.



Sierra's Multi-Trak™ 670S in a large duct after a sharp bend

Unlike most other multipoint systems, the individual sensor points of the 670S can be removed for service or repair without shutting down the system, which saves time and money on operating and maintenance costs.

Here's what makes Sierra's Multi-Trak™ 670S an ideal choice:

- Dynamically compensate for non-uniform flow profiles with user-friendly Human Machine Interface (HMI)
- Has 100:1 turndown providing accurate readings at very low and high flows
- Probes may be removed for service or cleaning without loss of measurement to lower cost-of-ownership
- Direct mass flow measurement
- No moving parts to clog decreases maintenance costs
- Patented Dry-Sense™ Sensor Technology holds calibration over time

Maintaining Switchgears in Electricity Distribution and Reducing Environmental Impact

High voltage switchgear

Just like a main circuit breaker in your home or apartment, town and city grids have main on/off switches called switchgears. When these high voltage switchgears (in substations of 100 to 400 kilovolts) open or close, huge "lightning-like" arcs of electricity are created. If not maintained and managed correctly, these sparks can cause widespread power outages and pose a safety risk. To avoid these dangerous sparks, power companies have traditionally filled the sealed vessels that house these switches with oil. In an effort to substantially reduce the environmental footprint and cost of switchgears, they introduced the use of SF_6 (Sulphur Hexafluoride), a highly effective insulator. Unfortunately, SF_6 is a costly, maintenance intensive and potentially environmentally damaging solution.

Over the years, installations have started to show signs of SF_6 breakdown, decomposition and leakage. Given the fact that SF_6 is also a potent greenhouse gas, 22,000 times more dangerous to the ozone layer than CO_2, power companies are now required by law in the European Union, under the Kyoto Protocol, to monitor vessel top-off and leakage.

SIERRA'S SOLUTION

EMT Assero SF_6MFU with Smart-Trak®2

Responding to this challenge, Sierra worked in partnership with Energy Maintenance Technologies (EMT), in Luton, England, the leading supplier of predictive maintenance test solutions for the utilities industry to develop a comprehensive solution. The resulting EMT Assero SF_6MFU is a portable, fully-automated SF_6 top-off and fill operation system.

This device is the size of a small suitcase, battery operated, and has many alarm options. Data logging includes SF_6 used and end pressure stored on a CF card for traceability. Data can be sent to a website via a General Packet Radio Service modem.

The key to the SF_6MFU's performance is an accurate mass flow controller to regulate the SF_6 entering the vessels. Every SF_6MFU includes a Sierra Smart-Trak®2 mass flow controller, a pressure transmitter, a battery monitor and guarding system, overshoot pressure protection, a data logger with CF card and/or GPRS modem. These are all controlled by Sierra's HMI touch screen management system. All internal communication takes place over a Modbus network which eliminates drift and transfers all information quickly and reliably.

Sierra's Smart-Trak®2

In the utilities sector, the EMT Assero SF6MFU has proven to reduce labor costs by fully-automating the SF_6 top-off and fill process and help utility companies comply with the strict greenhouse gas regulations of the Kyoto Protocol.

Here's what makes Sierra's Smart-Trak®2 an ideal choice:

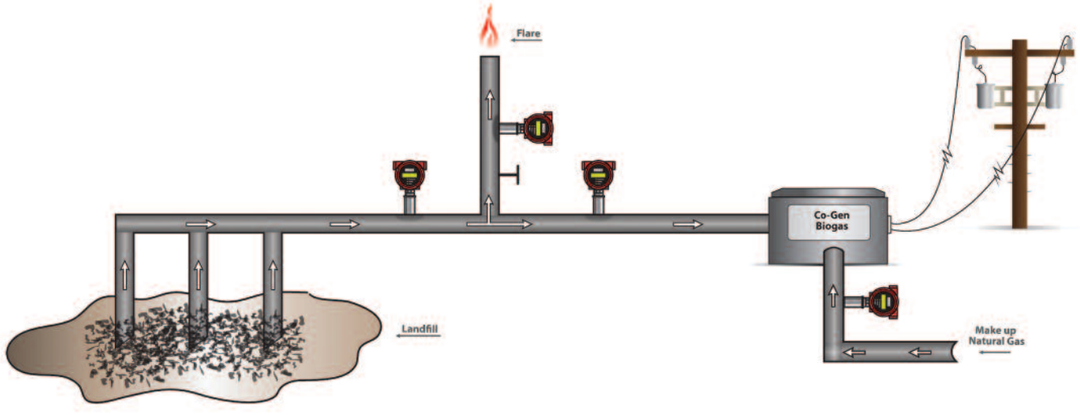
- OEM workhorse with its excellent performance results from a patented, inherently linear Laminar Flow Element (LFE)
- Fast control of gas mass flow over a wide range of temperature and pressure with direct-acting control/shut-off valve
- Has more robust electronics to control a wide range of functions
- Dial-A-Gas® technology for true digital performance for up to ten pre-programmed gases in one unit (gas type list can be programmed on request)

Capturing Biogas from Landfills and Using it for Cogeneration

Each day, millions of tons of municipal solid wastes are disposed of in sanitary landfills and dump sites around the world. Globally, landfills are the third largest anthropogenic emission source, accounting for about 13% of methane emissions or over 818 million tons of carbon dioxide equivalent ($MMTCO_2e$). Over 1,200 landfills worldwide collect landfill gas which reduces greenhouse gas emissions and accrues emissions credits to meet the Environmental Protection Agency's (EPA) reporting standards. Many also use this captured biogas as a clean energy source in the cogeneration process.

Solid wastes from households, commercial and industrial activities enter a landfill, where methanogenic bacteria decompose the organic material. A by-product of the bacterial decomposition is biogas, composed of 50% methane and 50% carbon dioxide. To collect this landfill gas, a series of pipes are embedded within the landfill and a "flare" is used to burn off the collected gas. For cogeneration, this gas is compressed and mixed with natural gas, which in turn can be used to run a power generator.

Landfill gas is very humid, at low pressure (20-40 mBarg) and about 40-60°C (100°F) when it is produced by the landfill. Most companies are interested in measuring the biogas as it leaves the landfill, but this is difficult. Low pressure makes differential pressure (dP) devices like orifice plates unsuitable since they require a fairly large differential pressure to operate. Also, the landfill gas is often very dirty with a high moisture and particulate content. This can clog up devices like annubars and orifice plates and gum up turbine meters and similar instruments that have moving parts.



Biogas produced by the landfill

SIERRA'S SOLUTION

With an installed base of over 40,000 instruments, Sierra's Steel-Mass™ 640S is helping companies accurately measure biogas for EPA reporting and control gas blending for cogeneration. The insertion design eliminates pressure drop, has no moving parts, and can measure both high and low flows with a 100:1 turndown.

With no moving parts to clog with dirty, particulate laden gas and a self-cleaning purge option for dirty flow environments, the Steel-Mass™ 640S maintains accuracy and lowers maintenance costs. The Steel-Mass™ sensor automatically corrects for changes in gas temperature and pressure, eliminating the need for separate temperature and pressure transducers.

Sierra's Steel-Mass™ 640S is the flagship of North America's best-selling (1) thermal mass flow meters.

(1) 2009 Flow Research Study, Yoder

Sierra Steel-Mass™ 640S inserted into landfill flare

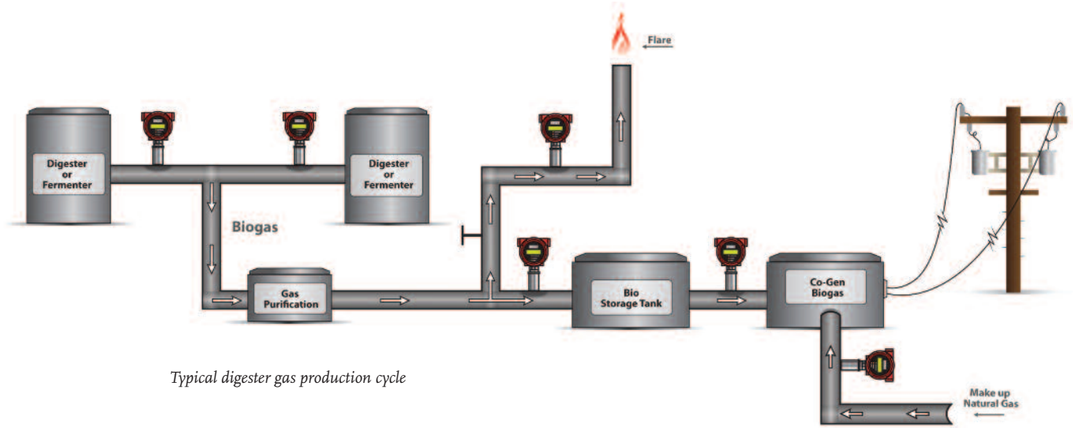
Here's what makes Sierra's Steel-Mass™ 640S an ideal choice:

- Optimized for methane (CH_4) as well as N_20, SF_6, HFCs, PFCs and CO_2, per the EPA mandate
- Generates nominal pressure drop across the immersible sensor probe
- Measures mass flow directly with one instrument
- Has a 100:1 turndown to measure low and high flows
- Self-cleaning purge option for dirty flow environments
- Easy, hot tap installation with a low cost-of-ownership
- Backed by a lifetime sensor warranty and proprietary Dry-Sense™ Sensor Technology

Producing Biogas from Solid Wastes and Using it for Cogeneration

Santa Cruz Wastewater Treatment Facility, located in Santa Cruz, California, generates the majority of its own electric power by using internal combustion engines that burn a mixture of methane gas produced by the sewage digestion process and purchased natural gas, producing 7.4 million kWh of electric power per year.

Producing abundant, healthy amounts of biogas each day in their digesters is the cornerstone of Santa Cruz Wastewater's unique renewable energy program. Acting like a large stomach, the solids from the wastewater treatment process are "digested" in four large domed digesters and heated to 98 degrees for optimal digester gas production. When methane forming bacteria break down the acids in the digester, large amounts of anaerobic digester gas, made up of 60% methane and 40% CO_2 are produced. Once cleaned, compressed and mixed with natural gas, this biogas becomes a valuable fuel for the plant's co-generators, which produce enough electricity to meet over 50% of the plant's electrical needs.



Typical digester gas production cycle

SIERRA'S SOLUTION

Since digester gas applications operate at pressures just slightly above atmospheric, it is essential that instrumentation has the ability to measure and remain accurate even at these low pressures. This is problematic with a traditional differential pressure (dP) device which requires a pressure drop to make the measurement.

By 2007, Santa Cruz Wastewater, had replaced all of its meters with Sierra's 640S/780S immersible thermal mass flow meters to achieve the increased accuracy they required for cogeneration. Sierra's design features an insertion probe with two small diameter sensors to measure gas temperature and velocity and nominal pressure drop.

Sierra's Flat-Trak™ 780 at Santa Cruz Wastewater

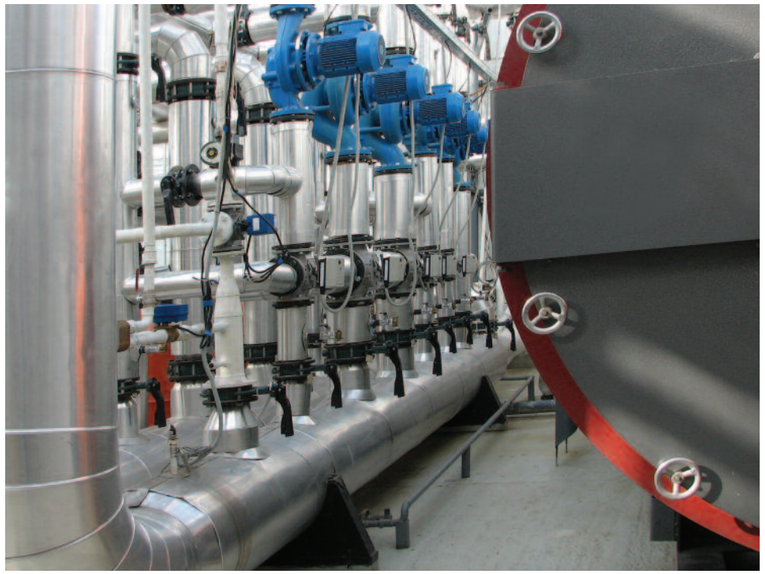
Digester gas is also produced at low flow rates, so meters that can measure very low flows are required. Low flows create a very small differential pressure across a dP device such as an orifice plate or annubar, so the flow signal often becomes lost in the noise of the measurement. The high turndown (100:1) provided by the 640S and 780S overcomes the inherent limitations of dP. With Sierra's thermal technology, Santa Cruz Wastewater can measure true mass flow directly with outstanding rangeability at virtually no pressure drop.

With accurate biogas measurements and gas blending for cogeneration, the 640S and 780S have helped Santa Cruz Wastewater become a flagship renewable energy facility. By reusing its methane, Santa Cruz Wastewater prevents 41 tons of CO2 emissions per year from polluting our atmosphere, and through the cogeneration process the facility can supplement its energy supply. Operators like Mike Meyers of Santa Cruz Wastewater make energy saving decisions every day. "The bottom line for us is power," Meyers said. "It's an energy savings balancing act."

Here's what makes the Sierra's 640S and 780S an ideal choice:

» Measures mass flow directly with one meter
» 100:1 turndown for accurate monitoring of peak and low flow situations
» In-line flow conditioning eliminates piping straight-run requirements
» Removable probe for easy cleaning
» Generates minimal pressure drop across the instrument

District Heating Promises Lowest Carbon Footprint



According to recent research, district heating is one of the cheapest methods of reducing carbon on the planet and has one of the lowest carbon footprints of all fossil fuel generation plants.

District heating is a system for distributing heat generated from a centralized location to be used for residential and commercial heating requirements such as space heating and water heating. The heat is often obtained from a cogeneration plant that burns fossil fuels, but increasingly these plants are transitioning to biomass. District heating plants can provide higher efficiencies and better pollution control than localized boilers.

Traditionally, many campuses, universities, hospitals, and corporations have estimated steam flow by measuring condensate or using turbine meters to measure the total output of steam generated and distributed to each building. In this era of rising energy costs, it is critical to have more accurate steam usage numbers so that energy managers can control energy costs and bill end users accurately. Facility managers have long known that the condensate method lacks accuracy. In addition, the rotors on turbine meters tend to break, thus requiring periodic replacement—a costly and time-consuming process.

SIERRA'S SOLUTION

With the capability of measuring five flow parameters with one process connection and calculating true mass flow directly with integral temperature and pressure sensors, Sierra's Innova-Mass® vortex meters provide an optimal solution. Sierra was the first to invent a multivariable mass vortex flow meter in the late 1990's. By capturing over 80% of the district energy market worldwide in the last decade, Sierra's Innova-Mass® has become the "steam meter" for industry. As a member of the International District Energy Association (IDEA), Sierra has also played a leading role in improving district energy technology.

The Innova-Mass® installation at the University of Toledo is an example of one of thousands of successful applications. The University has installed eleven Innova-Mass® meters throughout the UT campus. Innova-Mass® measures five process parameters with one process connection and calculates true mass flow directly, without separate temperature and pressure sensors. With its easy-to-use menu, changing ranges, outputs and engineering units is easily accomplished, either locally at the meter or remotely using HART or MODBUS.

With the Innova-Mass®, the University of Toledo is now able to effectively measure the total steam output from its central steam plant and submeter the amount of steam to each building. Operators at the University of Toledo report that the Innova-Mass® has been responsible for substantial savings of both energy and maintenance costs.

A Sierra Innova-Mass® on a process line

Here's what makes Sierra's Innova-Mass® an ideal choice:

- Insertion available for economical installation on large pipe sizes up to 72"
- Direct measurement of five process variables (pressure, temperature, mass flow, volumetric flow, density)
- 30:1 turndown range for accurate flow measurement at low and high flows
- Fully field-configurable
- Loop powered and onboard diagnostics
- No moving parts to clog

Smart Compressed Air Measurement Delivers Cost and Resource Savings

Air may be free, but compressed air certainly isn't. Every day, leaks and inefficient compressors cost companies money and lead to more electricity usage. As air compressors churn away 24/7, endlessly maintaining the air pressure in compressed air distribution lines, dollars leak away from the bottom line.

Measuring compressed air can be a big challenge. In many manufacturing companies that depend on reliable compressed air to run their processes, usage varies widely throughout the day from very heavy at times of peak manufacturing to small flows (perhaps due to leakage) when most production is on standby. With accurate compressed air usage measurements, companies are putting a price tag on compressed air and making educated choices that lead to cost savings.

SIERRA'S SOLUTION

Sierra's experience with Air Compressor Supply, Inc. (ACS), located in Tulsa and Oklahoma City, is a good example of how we are helping customers accurately measure compressed air. ACS, an authorized dealer for Gardner-Denver, one of the world's largest air compressor manufacturers, offers businesses a tangible way to cut costs by lowering their air compressor amperage output and in turn optimizing energy efficiency.

Sierra's Fast-Flo™ 620S

Both ACS and Gardner-Denver strongly recommend using Sierra's meters to accurately measure the mass flow rates of compressed air for their customers. In 2002, Cary Carlisle, a seasoned ACS technician, took Gardner-Denver's advice and partnered with Sierra. When he assesses the compressed air efficiency of a plant, he always begins with a compressed air audit using Sierra's Fast-Flo™ 620S.

Sierra's 620S thermal mass flow meter was specifically developed to accurately measure the mass flow rate of compressed air usage so that industrial users could build and maintain air usage profiles. With 100:1 turndown, Sierra's thermal mass flow measurement technology has major advantages over volumetric or non-compensated meters, in which even a small change in operating temperature causes a 5% to 10% reduction in accuracy. Sierra's smart interface software, standard with all 620S meters, gives customers actual verification that the meter has not drifted over time.

Carlisle has reported that customers have experienced a $7,500 to $44,000 annual savings through improved compressed air system management and/or replacing their compressors with more energy efficient units —a substantial cost-cutting investment with relatively short-term payback.

As a result of superior instrument performance and customer support, Sierra meters have become the first choice of ACS and Gardner-Denver for accurately measuring compressed air.

Here's what makes Sierra's Fast-Flo™ 620S an ideal choice:

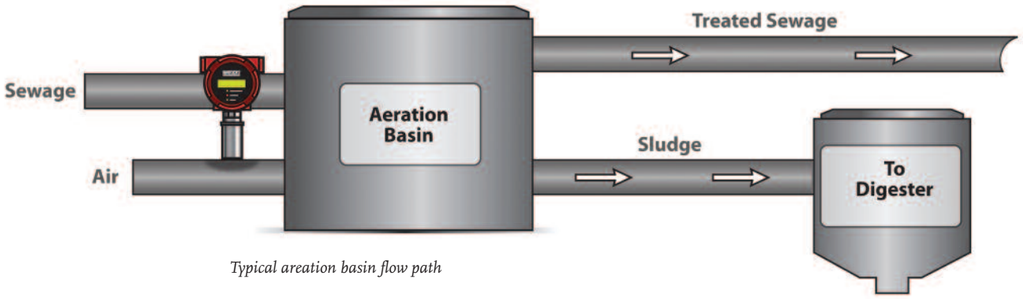
- Direct mass flow measurement requires no pressure or temperature compensation
- Can save companies between $7,500 to $44,000 annually with improved compressed air system management
- Insertion probe very easy to install
- Operates over a wide range of temperatures and pressures
- Onboard field validation and diagnostic software

Optimizing Air Flows to Aeration Basins to Accelerate Clean Water Production

As a result of clean energy mandates and the rising cost of energy, wastewater treatment facilities around the country are retrofitting their instrumentation to run highly efficient, cost-effective, clean facilities. To reduce emissions and produce clean energy, solid wastes are often digested in large digester tanks to reduce the volume of waste (sludge) and produce more biogas, which is then used as fuel in the cogeneration process (See pages 28-29 to learn more). However, a clean environment calls for not just clean air and clean energy, but clean water as well, and Sierra is a leading supplier of flow measurement solutions that help accomplish this.

In the critical secondary stage of wastewater treatment, blowers aerate the basins, removing about 85% of the organic matter by making use of the bacteria living within it. Municipalities need precise mass flow measurement instrumentation to bubble the exact amount of air into these aeration basins for the bacteria to flourish.

In the 1980's, many municipalities used differential pressure (dP) devices to measure the mass flow rate of air delivered to their aeration basins, but these devices proved to be expensive to maintain, clogged easily, measured only volumetric flow, and required a separate pressure and temperature transducer and flow computer to deliver true mass flow. Because of these pitfalls, municipalities began searching in the 1990's for an alternative to these costly and inefficient dP devices.



Typical areation basin flow path

SIERRA'S SOLUTION

In 2003, a large western city retrofitted their aeration basins with Sierra's Steel-Mass™ 640S to precisely measure the mass flow rate of air bubbling into the aeration basins in their secondary stage of waste treatment.

By automating their aeration with the Model 640S as a key input into the control loop in a 7.8 million gallon/day plant, the company saved approximately $50,000 a year in aeration costs and reduced chlorination and pH adjustment costs as an added benefit. Nearly total nitrogen removal was accomplished, resulting in improved effluent suspended solids.

Sierra Steel-Mass™ 640S on a digester tank

Sierra differentiates its thermal mass flow meters with patented Dry-Sense™ Sensor Technology. Unlike other thermal mass flow meters, Sierra's sensors use no organic fillers or cements in device construction. With the thermal expansion and contraction that is common to thermal mass flow technology, organic or "wet" sensors crack and shift over time, changing the "skin resistance" of the thermal sensor, and thereby causing drift or outright failure. By design, Sierra's proprietary "dry" sensor technology is extremely accurate, stable, and holds calibration accuracy for the life of the product. Sierra has backed up those claims by being the only company to offer a lifetime limited warranty on its thermal sensor technology. Sierra's validation software also allows the end-user to validate instrument accuracy onsite periodically. If the validation ever fails, Sierra will replace the sensors and recalibrate the instrument free of charge.

With an installed base of over 10,000 instruments in wastewater applications globally, Sierra is a proven leader in helping cities around the country measure true mass flow directly with one instrument which provides greater turndown, improved accuracy, and a lower cost-of-ownership.

Here's what makes Sierra's Steel-Mass™ 640S an ideal choice:

» Highly accurate calibration to precisely match the application conditions
» Installed base of 10,000 instruments in wastewater applications
» Provides savings up to $50,000 a year in aeration costs
» Patented Dry-Sense™ Sensor Technology prevents sensor drift
» Field validation of accuracy and instrument health
» Lifetime sensor warranty

New Green House Gas Rules Increase Use of Ozone in Water Purification

Traditionally, chlorine has been used to disinfect water for drinking. Because chlorine produces carcinogenic by-products called trihalomethanes (THM's) when it reacts with organic substances in surface waters, ozone use has become the preferred treatment option in a growing number of American cities. The recent adoption of the Surface Treatment Rules by the United States Environmental Protection Agency (EPA), places strict limits on chlorine. Because ozone produces fewer disinfecting by-products, the EPA, along with the American Water Works Association, has emphasized the use of ozone as a highly desirable water treatment alternative for small communities as well as large.

Ozone has been used for more than 100 years to purify water by oxidizing minerals such as iron, manganese and hydrogen sulfide and by destroying bacteria, viruses and cysts. It is more than 3,000 times faster than chlorine and is the most powerful microbiocide commonly available for water treatment.

Man-made ozone is formed by passing dry ambient air or oxygen through a high voltage field called a corona, which is produced inside an ozone generator. The high voltage breaks apart the oxygen molecules and causes them to reform as ozone, which is up to 13 times more soluble in water than oxygen. Ozone generators require a known mass flow rate of the oxygen or air fed into the device. This measurement is required to prevent the device from becoming saturated so that the amount of ozone produced can also be measured.

SIERRA'S SOLUTION

As the EPA's rules on disinfecting by-products get stricter, more water treatment facilities are opting to use ozone systems for water purification instead of chlorine. Sierra's Innova-Mass® helps water treatment plants precisely measure the flow rate of oxygen entering these ozone generators.

Measuring the amount of ozone produced by the ozone generator is problematic since the ozone has a short lifetime. It cannot be stored and needs a short "residence time" in the piping and flow meter. The Sierra Innova-Mass® 240 vortex meter is an in-line device that is fully flow-profile compensated, so that minimal straight-run piping is required. Ozone is also produced at low pressures, so pressure drop losses must be minimized. The Sierra Vortex meter does not appreciably obstruct the pipe so pressure drops are also minimal.

The generator requires a robust flow device that is well shielded from the Coronal discharge that produced the Ozone. Housed in an explosion-proof enclosure, the Sierra Innova-Mass® 240 vortex meter is virtually immune to the heavy electromagnetic interference (EMI) an ozone generator can produce.

Here's what makes Sierra's Innova-Mass® 240 an ideal choice:

- Provides five process variables (mass flow, volumetric flow, pressure, temperature and density) at a single measurement point
- Built-in pressure and temperature and flow profile compensation
- All parameters are field adjustable and include complete field diagnostics
- Approved for FM, CSA and ATEX
- Easy to install with hot-tap installation

Sierra Innova-Mass® 240

Reducing the Costs of Rural Water Treatment and Increasing Conservation

According to the Department of Water Resources, California is facing the most significant water crises in its history. Over the last decade, reserves have remained desperately low. As a result, many Californians face mandatory conservation orders. Periodically, many water districts and cities have been forced to impose high fees on water use or restrictions on development.

Large regional water companies, like California American Water Company, which services the central coast of California, have already invested in high performance flow measurement instrumentation to better understand its usage.

Most Americans receive water service from community water and wastewater utilities. It is less known that private water companies own nearly 16% of the nation's community water systems. Carmel Riviera is one such small rural water company. The company serves up to 600 homes located along California's beautiful and rugged Big Sur coast.

Historically, Carmel Riviera Mutual Water Company estimated its annual water loss rate through leaks, waste, evaporation and other losses at around 30% of the total produced. The company budgeted almost $60,000 per year in initiatives to reduce these leaks, including labor and materials for surveys and expensive repairs.

SIERRA'S SOLUTION

In their efforts to expand operational efficiency, Carmel Rivera investigated using Sierra's Innova-Sonic® 205 Clamp-on Ultrasonic Flow Meter. It promised to help determine water-loss percentage, improve production efficiency, improve water quality (reducing back flush) and more accurately identify over-users. The versatility of the clamp-on ultrasonic meter made it a perfect tool for the small, often cash-strapped, water company. Simply clamp the sensors onto the outside of the water pipe and extremely accurate measurement was now possible–no need for costly system shut downs, pipe cutting and plumbing.

After six months of using the Innova-Sonic® 205, Carmel Riviera found their actual loss rate to be only 12% of their production – uncovering an 18% discrepancy in original water loss estimates. The improved production and usage figures derived from the Innova-Sonic® enabled the company to significantly reduce their $60,000 annual maintenance and operations budget to target more funding on improving conservation and efficiency.

Sierra Innova-Sonic® 205

Here's what makes Sierra's Innova-Sonic® 205 an ideal choice:

» Highly accurate (+/- 0.5% of reading) and economical flow meter
» Reduces maintenance costs by providing accurate usage rates
» One meter for pipes 2" to 200"
» Clamp-on sensors are very easy to install with no pipe intrusions
» Includes complete data logging and analysis tools

Experience Our Passion for Flow!

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