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We learn from the customers we serve

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Delivering on each and every customer promise

Dear Reader,

As we kick off 2016, remaining steadfast in our journey to become one of two pre-eminent suppliers in the process control and automation industry, I am excited about all that we continue to learn along the way. Every day we are faced with new challenges and new opportunities. What ultimately determines how successful we are in today's ever changing business climate is how well we understand, respond, adapt and change to better meet the needs of our growing customer base.

Our customers rely on us more than ever to provide solutions that enable them to thrive in today's dynamic business environment. That is why it is so critical that we as an organization deliver on our promises to our customers by anticipating their growing needs. To anticipate these needs, we have developed and invested in mid-to long-term strategic resources to ensure that we deliver on our promises.

As we continue to learn, change and grow with our customers, it is paramount that we not only anticipate their needs but continuously challenge ourselves to better understand our customers in order to view our operations from their perspective. This is a challenge every member of our organization has accepted. We have begun rethinking every customer interaction to identify ways we can transform in order to become a more valuable partner.

In 2016, we are committed, dedicated and determined to make it easier for our customers to do business with us through developing a deeper knowledge of their business operations and adapting our processes to better meet their needs. We want our customer's challenges to be our challenges, we want our customer's priorities to become our priorities and we want our customer's goals to ultimately become our goals.

Looking ahead, this is just the beginning to a cultural-shift and longer-term program that will provide even greater value for our customers – and we will never be satisfied. We will take each and every challenge as an opportunity to grow. Our goal in 2016 is not only to tackle these barriers but to also make it a priority through each device we sell and with each interaction with our customers to radically exceed our customers' expectations.

On behalf of the entire Leadership Team and all of us at Endress+Hauser, we want to thank our customers for their business and continued support.

Sincerely,



Todd Lucey
General Manager, Endress+Hauser, Sales Center U.S.



Calibration management results in huge savings

Chobani® reduces maintenance costs and downtime by partnering with a total calibration solution provider



Jose Trelles
Maintenance Manager



Chobani plant located in Twin Falls, Idaho

After moving to New York from his native Turkey, Chobani's founder and CEO Hamdi Ulukaya found that in America, yogurt just wasn't as delicious and widely available as it was back home. He believed everyone deserved better options, so he set about making delicious, nutritious, natural and accessible Greek yogurt right here in the United States.

"Better food for more people." It's a simple precept, but one that drives Chobani forward every day. From

that first revived yogurt factory in New Berlin, New York, to a gleaming state-of-the-art facility in Twin Falls, Idaho, to an international foothold in Dandenong, Australia and beyond – in the few short years since its debut, Chobani has climbed to the top of the yogurt category and turned Greek yogurt into a household staple.

"Working with Endress+Hauser was easy and Endress+Hauser met all of our needs in a flexible way. Endress+Hauser technicians were

easy to work with, very knowledgeable and efficient in execution. From start to finish, Endress+Hauser provided us with all the necessary tools to succeed – from quality, execution, materials, training, knowledge of instrumentation, calibration, and more – Endress+Hauser proved to be a total calibration solution provider."

Jose Trelles
Maintenance Manager
Chobani, LLC
Twin Falls, Idaho
USA

Calibration management leads to reduced costs and downtime, and quality improvement.

The challenge Chobani was looking for a calibration management solution to increase the quality of their processes to the highest standard possible, in accordance with internal and external quality standards like SQF (Safe Quality Foods).

Chobani's desire was to be able to manage and execute calibrations internally. Besides quality improvements, the calibration solution needed to increase the overall efficiency and should be easily scalable to other production locations.

Number one in the USA for Greek yogurt, Chobani was looking for "the" partner to support all of their needs. The partner needed to be knowledgeable and competent in calibration processes and management, able to execute calibrations with their experienced calibration technicians according to SOPs ensuring repeatability and consistency of the quality, and able to train Chobani's technicians on-site.

In the end, the produced calibration certificates need to be traceable to NIST and manageable in such a way that information could be efficiently retrieved and analyzed by Quality Management or auditor's request.

Our solution First, it was important to understand all the measuring instruments available in the plant. To save on project costs, it was decided to perform calibrations of all measuring instruments to establish a baseline. At the same time, important instrument data was captured along with calibration specific information, such as criticality and MPE recommendations.

The collected data was provided to Chobani in electronic format which will be used for the future Calibration Management Solution. The instrument information with calibration certificates were stored in Endress+Hauser's Documentation Management System W@M®. The future Calibration Management System will interface with the Documentation Management System W@M and the existing work order system INFOR enabling "going paperless" which results in efficiency gains and reduces errors.

Additionally, Endress+Hauser provided Chobani with SOP's for consistency and repeatability of the calibration work, and trained Chobani's technicians in order to ensure upkeep of the calibration work and installed base data.

The result

- Increased productivity, efficiency and consistency due to an improved preventative calibration plan supporting the audit efforts
- Reduced downtime – Through a greater level of confidence, Chobani technicians are effectively handling critical items on the product lines during (un)planned shutdowns, resulting in downtime reduction with a savings of a minimum of \$7,500 per incident

- Product loss reduction and quality improvement - Calibrations identified deviations in critical measuring points that caused "production yield" losses


Main steps of the project

1. **Calibration Management Workshop**
Endress+Hauser conducted a process workshop to determine the critical steps needed to provide Chobani with a total integrated Calibration Management Solution that met Chobani's requirements and expectations.
2. **Standard Operating Procedures (SOP)**
Endress+Hauser created SOP's for 5 measuring principles ensuring consistency and repeatability for all performed calibration work.
3. **Calibrations, on-site data assessment**
Endress+Hauser performed calibrations together with an on-site Installed Base Assessment to gain a complete overview of the measuring instruments within the Chobani plant. The outcome provided Chobani with a complete and consistent measuring instrument information overview, improved audit trail and improved preventative maintenance. Endress+Hauser then assessed and categorized all instruments by critical importance to determine calibration parameters such as maximum permissible error, calibration frequencies, criticality, etc.
4. **Documentation Management System W@M**
The assessed instrument information with calibration certificates are stored in Endress+Hauser's documentation management system W@M. This provides a place to locate critical information quickly. In the next phase it is planned that the W@M system will interface with the calibration management solution.
5. **Training**
Endress+Hauser provided training to Chobani employees ensuring upkeep of the calibration work and the installed base information. This provides Chobani with greater quality assurance increasing certainty and clarity in audits.
6. **Next phase - Implementation of Calibration Management Solution**
The next steps for Chobani will be to implement the Calibration Management Solution as recommended from Endress+Hauser. First Endress+Hauser's Calibration Management System CompuCal will be put in place. This system will interface with Endress+Hauser's Documentation Management System, W@M and Chobani's work order system, INFOR, creating a paperless calibration management system resulting in efficiency gains and error reduction. At the same time Chobani will have quick access to asset information reducing time and cost needed to obtain critical information.



City of Reading, Pennsylvania

City of Reading wastewater treatment plant is owned and operated by the City of Reading, PA. It receives wastewater from the city and 11 surrounding communities. There are four remote pumping stations which pump wastewater to the plant. The plant is designed to process 28.5 million gallons per day (MGD). Overall plant instrumentation consists of 90–95 percent Endress+Hauser equipment, consisting of level, pressure, flow and recorders.



Ultrasonic Flow Measurement System saves \$72,500 annually

City of Reading, PA lowers fuel, labor and maintenance costs

If the wastewater treatment plant serving Reading, PA, and 11 surrounding municipalities has a mission statement for its day-to-day operations, it couldn't be simpler or more critical: "95°F." That's the optimal temperature at which the anaerobic bacteria in the facility's three 800,000-gallon digesters can most efficiently process the waste stream of up to 28.5 million gallons per day (MGD).

At 95°F, the digesters generate a wet biogas flow that averages 3,500 standard cubic feet per hour (SCFH), with a methane fraction of 65 to 70 percent. The methane is drawn off to burn in three 70-horsepower boilers. Each boiler is paired with a digester, providing the heat needed to keep the temperature constant, even in subzero winter weather.

These days, the plant can usually maintain a closed-loop system to optimize the digester bacteria processing.

Here's how it works: A steady flow of wastewater sludge is fed to the digester, where it is consumed by bacteria that thrive in an oxygen free environment. The bacteria generate biogas, which consists mainly of methane and carbon dioxide along with a very small fraction of other gases. The methane then fuels the digester's boiler, which heats the digester, keeping the bacteria productive. Not long ago, however, that closed-loop was much more elusive than now, costing the city lots of money.

The challenge Lack of real-time operating data leads to operational latency and high costs According to John Gerberich, the facility's chief electrical engineer, optimizing the digester cycle requires constant monitoring of the gas flow, temperature, and methane fraction. "That's to ensure all three are within our preset operating parameters," he explains. "Based on this data, operators feed sludge to the digesters."



Not long ago, however, the plant was using an outdated pressure transducer to monitor its biogas flow via its SCADA telemetry network. “Frankly it wasn’t very accurate and we often had false readings,” Gerberich recalls. Temperature was monitored manually, while the facility’s lab had to analyze gas samples to determine the methane fraction. The latter took up to 4 hours a day in technicians’ time.

The daily analysis caused large latencies in adjusting the sludge flows into the digesters. Sometimes the methane fraction would drop below 20 percent and the temperature would fall to 80°F. Not only would this slow the plant’s throughput, but it also would raise costs – a lot.

“When these conditions occur, a digester can sour, causing the bacteria to produce higher levels of other gases that can accelerate the corrosion of all our plumbing’s metal parts – the piping, controls, regulators, and so on,” Gerberich says. “What’s more, if the methane fraction falls too much, we have to tap external sources of natural gas to fuel the boilers. That can cost us up to \$16,000 a month.

Our solution Gain real-time, multipoint data via the Endress+Hauser Proline Prosonic Flow B 200.

To stay current professionally, Gerberich keeps watch on advancements in process and instrumentation technology. He knew that a thermal mass flowmeter, also known as a thermal dispersion flowmeter, would be an improvement over the plant’s pressure transducer, but it would not be ideal for his requirements.

“Thermal mass flowmeters are great for measuring dry gas flows, but not the kind of wet, dirty biogas we get from our anaerobic digesters,” he says. In fact, the plant’s biogas could cause condensation on a thermal mass flowmeter’s two sensors, which measure the flow rate by monitoring the cooling differential between the temperature sensor that’s heated and the other that’s not.

Condensation on the sensors, in turn, could cause inaccurate readings. In addition, the condensation coupled with trace acid vapor and particulate matter could foul and corrode a thermal mass flowmeter’s sensors, requiring periodic maintenance and eventually replacement.

“We also needed more data from our gas flow,” Gerberich says. “I really wanted a way to measure temperature and methane fraction in real time, so we could dispense with lab testing, which took us so much time.”

Then he learned about the Endress+Hauser Proline Prosonic Flow B 200. It’s an ultrasonic flow measuring system specifically designed for his type of application – real-time monitoring of wet, dirty biogas with a variable composition and low flow and pressure. In addition, it features:

- Greater accuracy: ± 1.5 percent of reading flow accuracy independent of gas composition
- Continuous calculation: Methane fraction, calorific value, and energy flow
- Maintenance-free: Robust, with no moving parts and “self-cleaning” ultrasonic sensors
- No pressure loss: Flowmeter is obstruction-free
- Energy-efficient: Low energy consumption with two-wire (loop-powered) device
- Flexible and easy to install: Versatile mounting by means of lap joint flanges





Results Precision biogas process control with \$72,500 in annual cost savings. With the Proline Prosonic Flow B 200 ultrasonic meter, the plant's operators get real-time measures of the digesters' biogas flow, temperature, and, most importantly, methane fraction. By monitoring the set points of this data in real time, technicians can adjust the sludge they feed the digesters much more precisely – without waiting hours for the lab's test results.

Gerberich figures that by saving hours in sampling and lab testing time, the plant's labor savings are approximately \$20,000 a year. That's time the technicians can devote to other tasks. In addition, because the B 200 helps them better gauge and control the methane fraction, corrosion and wear and tear on the boilers is less, so the plant has been able to cut tear-down maintenance in half, saving another \$15,000 a year.

The biggest savings, however, come from minimizing, if not eliminating, the need for external natural gas to fuel the boilers. Before, the plant would have to supplement its methane fuel in cold winter months at a cost averaging \$37,500 a year.

With total annual savings of \$72,500 a year, Gerberich says the B 200 paid for itself several times over in its first year. "The Proline Prosonic Flow B 200 from Endress+Hauser might at first seem expensive," he said, "but with the savings it can generate, it's really a no-brainer."



Safety solved through trusted partnership

Endress+Hauser provides global chemical and plastics distributor with “total turnkey solution”

nexeo[®]
solutions

Nexeo Solutions is the largest global chemical and plastics distributor with a centralized business model. With operations worldwide, Nexeo Solutions offers over 27,000 products used in a broad cross section of industries, including chemicals manufacturing, energy, paints and coatings, automotive, healthcare, and personal care.

www.nexeosolutions.com

“Doing business with Endress+Hauser as a total turnkey solution provider is invaluable. Having a trusted partner that gets our culture, understands our needs and has the deep level of technical expertise that Endress+Hauser has, truly doubled our capabilities. This allowed us to load trucks more quickly while ensuring the safety of our personnel resulting in faster time to market and efficiency gains. Doing business with Endress+Hauser is truly a win-win.”

Nexeo Solutions
USA



Results:

- One single point of contact for all project management needs
- Increased safety of personnel
- Increased productivity
- Faster time to market
- Increased efficiency
- Improved product quality resulting in satisfied customers

Customer challenge For Nexeo, traditional methods of managing a project meant contracting several different providers (outside engineering and programming, mechanical, electrical, purchasing equipment) in order to get a job done. Not only was this highly inefficient, this was also proving to be an issue with after installation support and resulting in inconsistent programming updates.

As part of a 2-year Health, Safety, Security and the Environment (HSSE) initiative, Nexeo Solutions required an accurate, consistent and repeatable truck loading automation solution that could easily be implemented across its 26 sites. Because implementing this type of initiative across 26 sites was an immense task, Nexeo needed to find a way to better streamline their project management process. But, this task could not be taken on by any partner; Nexeo needed a trusted advisor that they could depend on for all of their project needs.

To ensure safe loading of hazardous and expensive products, Nexeo first required accurate and reliable process measurements such as flow and level but also a correctly designed and implemented control system that would ensure the safe and timely loading of raw goods. Nexeo also needed a solution that could decrease truck loading times while guaranteeing product quality for its customers.



However, Nexeo needed more than just instrumentation and process control; they needed a “total turnkey solution” provider with a high level of expertise whom they could depend on to support their ongoing needs throughout the entire lifecycle of the project.

Solution By taking a team approach Nexeo, Endress+Hauser project managers, engineers and contractors partnered to deliver a “total turnkey solution” for truck loading, which included:

- Complete project management including General Contractor role
- Embedded on-site engineering resources
- Start-up services and training
- Around-the-clock support and troubleshooting
- Truck overspill protection (high level instrumentation)
- Safe truck mass flow metering skids
- Overall network engineering
- Rockwell Automation Allen Bradley® CompactLogix™ control system and panel view
- Facility wide emergency stop
- Integrated scale, pump, grounding and bonding
- Truck rack air ventilation system
- VPN remote service support

Partnership provides Nexeo with complete project management through engineering, installation, commissioning and training

Project Lifecycle



From start to finish, Endress+Hauser project managers and engineers managed the entire project, serving as the General Contractor role and single point of contact. Instead of Nexeo having to hire a Project Manager on their own to manage the job which would have taken time and money, Endress+Hauser stepped in and supported the entire lifecycle and all key components of the project – providing the highly skilled engineers, hiring and managing the contractors, procurement, design and fabrication, installation, overall engineering, startup, commissioning, and even training Nexeo site operators on how to use the new equipment and processes put in place.

“What differentiates Endress+Hauser from all other providers is – not only did they have a large team of technical experts and engineers to provide Nexeo with additional horse power we wouldn’t have had on our own – they truly have skin in the game,” Director of Engineering, Nexeo Solutions explains. “Endress+Hauser jumped in and was ready to problem solve and provided us with a solution that was unique to us.”

By embedding the necessary Endress+Hauser engineering resources on-site, Nexeo was able to substantially:

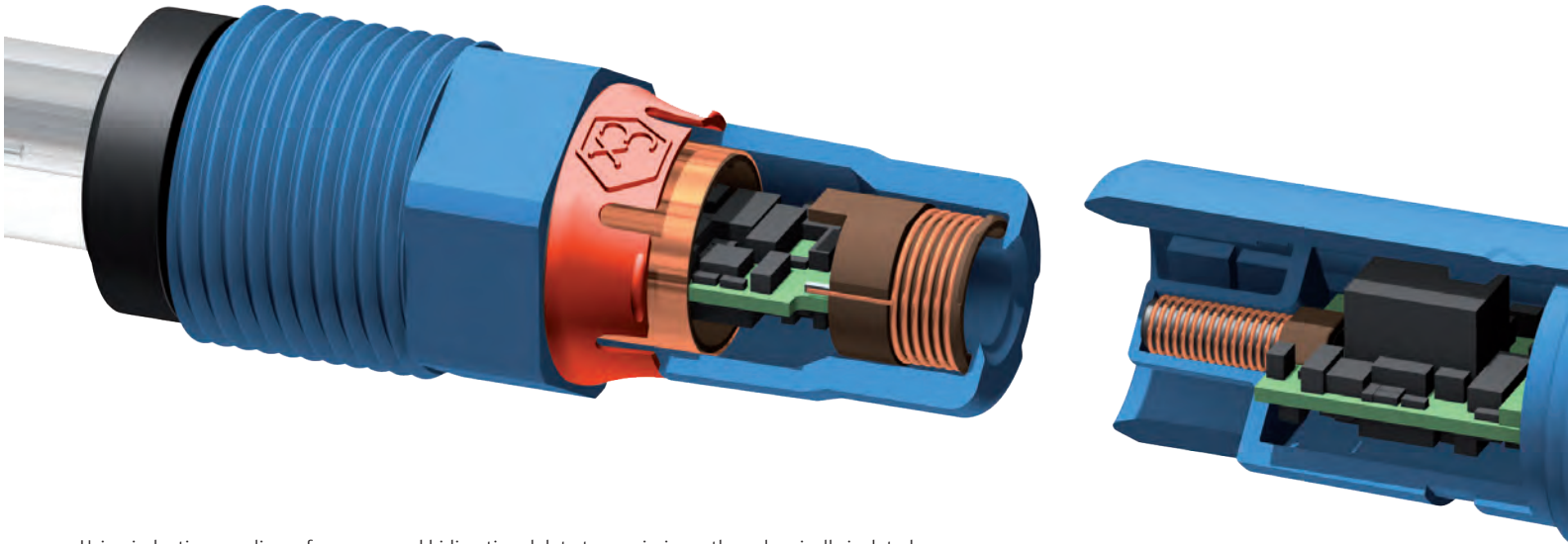
- Reduce project overhead costs
- Speed up the project timeline resulting in faster time to market
- Mitigate risks
- Increase efficiencies by quickly responding to day-to-day hurdles and adapting to change

Safe truck loading

To ensure best practices for the safe loading of expensive, flammable liquids into trucks, Endress+Hauser incorporated safe truck mass flow metering skids and truck overspill protection into Nexeo’s loading process in order to mitigate any associated risks and increase efficiencies.

At Nexeo, safety is always priority #1. “We take great pride in constructing a safety-conscious culture,” says Nexeo Solutions. “In selecting a solution provider, it was important we partnered with a business that shared these same values – Endress+Hauser truly lived and breathed the same culture so it just made sense.”

Endress+Hauser fully integrated all scales, pumps, grounding and bounding, and high level instrumentation with the necessary emergency stops, pump shutdown and alarm to safeguard against any static discharge or overflow events during loading. New truck rack air ventilation systems were also upgraded and installed where needed resulting in improved working environments for operators while ensuring compliance.



Using inductive coupling – for power and bidirectional data transmission – the galvanically isolated Memosens digital sensors tackle the major problems associated with pH measurements at their roots such as moisture and corrosion.

From supplier to partner

The Dow Chemical Company tremendously enhanced the quality of their pH measurements and substantially cut costs in their processes. All thanks to the trusted relationships formed with Endress+Hauser.

Several thousand people work for Dow in Freeport, Texas, one of the world's largest integrated petrochemical complexes. Three people in Freeport play a very special role: they work for Endress+Hauser. Based on a particular service contract, they look after the maintenance of pH measuring points at various plants of the complex.

In 2009, the economic crunch impacted U.S. manufacturers in many areas, including employment. Also Dow had to cut back and further

stretch their resources. "With the shortage of analyzer experts putting a burden on our workforce, we needed help finding the right people resources," explains Paul Coram, who is responsible for Process Analyzer Reliability in Dow.

Endress+Hauser, having the know-how in the field, recognized this as an opportunity to partner with Dow. "We approached the customer and looked for ways to cut costs," says Todd Lucey, Managing Director of

Endress+Hauser USA. "We quickly found that there is a huge potential for improvement at the pH measurements." High maintenance expenses and low reliability and availability marked the situation on-site. "We offered to handle the pH measurements on our own – with the measurement, in a way, becoming a service."

End of troubles The chlor-alkali process was the first to be tackled. The pH value is considered crucial in

MEMOSENS



Thanks to the sensor electronics, Memosens probes can be pre-calibrated in the laboratory under ideal conditions, to be exchanged quickly and easily on-site. In addition, the smart sensors permanently deliver information on their state. This allows to replace the probes if and only if necessary and to clean and regenerate them in the lab if reasonable. Gary Cowart Jr., Process Analyzer Leader for Dow's Houston Hub operations, sees key benefits in the concept of preventative maintenance. "We could even increase our safety efforts by reducing the time personnel are spending in the field."

The number of pH loops at Dow that are supported have increased by a factor of 5, and now count several hundred. Today, Endress+Hauser service technicians look after three plants in Freeport, four more technicians are stationed on production sites in Deer Park, Texas, and Texas City. "For Dow, we've

evolved from a supplier to a true business partner," states Todd Lucey.

More than just a contract The options and opportunities offered by the collaboration are far from exhausted. "We've triggered a continuous improvement process," says Tracy Doane-Weideman. In due course, all measuring points will gradually be retrofitted with wireless signal transmission using WirelessHART™ technology. "We want to get to the point where we centrally analyze all the sensor status information to improve maintenance management even further."

"Endress+Hauser provided Dow with more than just highly reliable and accurate instruments, and exceptional service," explains Gary Cowart. "The relationships formed throughout the program gave us a partnership with a supplier that we could trust – a win-win for all parties involved."

the proper control of the electrolysis. "The analog measuring points caused a lot of trouble there," reports Tracy Doane-Weideman, Endress+Hauser's Product Manager for analytics. "The high-resistance signals are susceptible to faults and malfunctions." This caused the maintenance team to put in plenty of nonscheduled working hours.

The first step Endress+Hauser took was to fit all measuring loops with digital Memosens® technology. "This gave Dow the opportunity to upgrade to new, cutting-edge technology on a common platform," explains Tracy Doane-Weideman.

Bunch of benefits The advantage of Memosens: the measured value is converted to digital signals right inside the sensor. Memosens probes rely on magnetic induction, both for signal transmission and power supply. "This tackles the major problems in pH measurement at their roots."

Liquiline CM44



Liquiline M CM42

Liquiline CM44R

Endress+Hauser's Liquiline® platform – Liquiline M CM42 two-wire transmitter for pH/ORP, conductivity or oxygen measurements; Liquiline CM44 multiparameter transmitter; Liquiline CM44R DIN-rail device – both support all Memosens protocol sensors available on the market today and in the future.

"Endress+Hauser provided Dow with more than just highly reliable and accurate instruments, and exceptional service."

Gary Cowart Jr., Process Analyzer Leader
The Dow Chemical Company

How to use a liquid monitoring and sampling station to increase process efficiency

Sampling stations have improved over the years and now can be used for much more than just satisfying EPA regulations

Tracy Doane-Weideman, Endress+Hauser, Product Marketing Manager, Analytics

Water sampling has been required by the U.S. EPA since the 1980s. Every water and wastewater utility or business holding a NPDES permit employs some kind of technique or equipment to acquire water samples, and a method to analyze the samples according to EPA guidelines. While some plants still take manual samples, in many cases, automatic water samplers are used.

The vast majority of existing stationary automatic water samplers are used mainly to meet EPA NPDES permit requirements. These samplers are designed to minimize effects on the chemical and physical integrity of the sample, and to ensure adequate storage conditions until they can be analyzed in the laboratory.

Most of the stationary units available on the market today use peristaltic pumps as the sample transport method. These units periodically take samples and combine them into a single bottle that's stored in the sampler at 4°C. Lab technicians remove the sample bottles, and take them to the laboratory for analysis and subsequent reporting to the EPA.

In recent years, automatic samplers have improved to the point where they can be used for much more than just meeting EPA regulations. Today, several robust automatic sampling transfer methods and systems are available to meet a wide variety of matrix and sample compositions. Advanced features provide data which can be used for increasing the process efficiency of water and wastewater plants.

Sampling the samplers

Automatic sampling systems offer various means of obtaining water samples from basins, closed tanks and pipes. Typically, this involves the installation of a line from the basin, pipe or vessel made from Teflon® or C-Flex® pump tubing from the pipe to the sampling pump. Three types of sample transfer configurations are available:

Peristaltic pumps These pumps meet the EPA recommended line velocity of at least 2 feet/second at head heights up to 26 feet. Peristaltic pumps are the most common method used for sampling, and are good for toxic applications.

Vacuum pumps These pumps also meet EPA requirements, and have no internal tubing that must be cleaned and maintained. Vacuum pumps can transport samples faster, reducing the time particles have to settle. The lack of compression from tubing avoids particle shearing. This is especially important when determining the dewatering of sludge, the permeation rate of water through membranes, or the head loss in granular media filters. These pumps work well in industrial applications where particle size and shape are important quality parameters.

Closed pipe systems These are used on high-pressure pipes or vessels, and no sample pump is required. A pneumatic probe protrudes through the wall of the pipe or vessel, and extends a plunger into the stream to collect a sample. The sampler can be used on pipes or vessels at pressures up to 87 psi. Some closed-pipe samplers are available with automatic cleaning systems to reduce maintenance of the sample probe.

Monitoring water quality

While the EPA-required analysis of the samples is done in a lab, modern sampling systems can have their own sensors to provide event-driven, online monitoring. These online and real-time measurements can be fed to automation systems to improve process control.

For example, the Endress+Hauser Liquistation sampler (Figure 1) can accept inputs from up to four industrial grade sensors including pH/ORP, conductivity, total suspended solids/turbidity, dissolved oxygen, SAC and nitrate, ammonium/nitrate and free chlorine—in addition to analog inputs from flow or level devices. With

the ability to combine sequential sample collection with composite sampling in one system, it's possible to provide the obligatory EPA sample, and collect samples based on events.

Data from the sensors can be stored internally in logbooks or on an industrial SD card, displayed locally on an LCD, and transmitted in real-time via standard industrial networks including EtherNet/IP™, HART®, Profibus® DP, Modbus RS485 and Modbus TCP.

Data collected typically includes measured values with date/time stamps, and information regarding calibration, configuration and diagnostics. Some systems come with

built-in web server capability, allowing access to the data from any web browser. With such access, an operator or engineer can check sampler status, read measurement values or change sampling programs remotely from a smartphone, a tablet or a PC.

While most automatic sampling systems are used to meet EPA regulations, and are therefore installed on the output side of a water and wastewater plant, samplers can be installed anywhere in the process as required to control, monitor and improve operation.

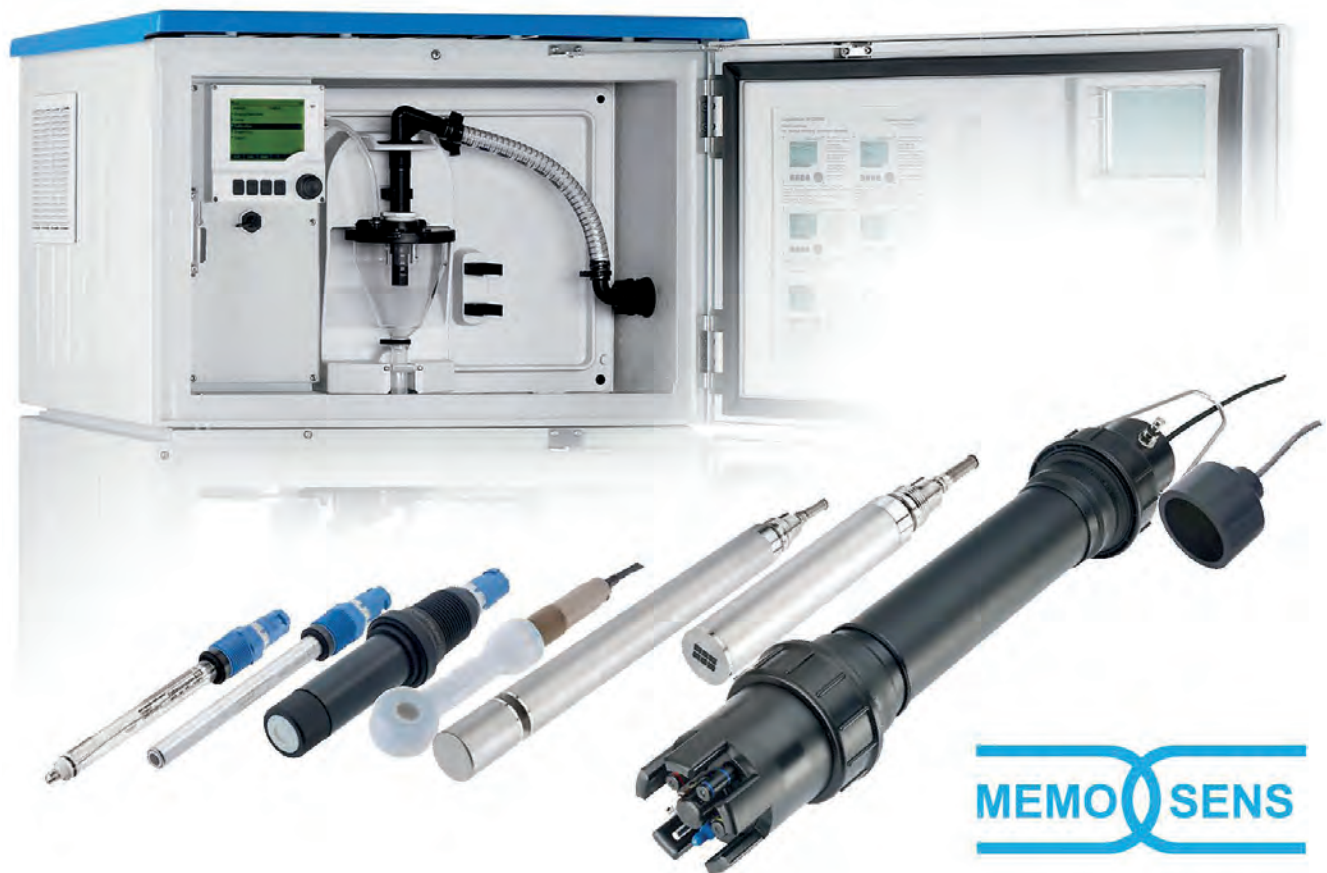


Figure 1: A modern sampling station, such as this Endress+Hauser Liquistation, can accommodate up to four additional process sensors, such as pH, conductivity, total suspended solids/turbidity and dissolved oxygen, to provide information that the W&WW plant can use to control processes.





Controlling processes

When sent to the plant's automation system in real-time, water quality data from the sampling system can be used to monitor and control various treatment processes such as chemical dosing, aeration, sludge activation, carbon load entering the plant, nitrogen in wastewater, load spikes, denitrification, recirculation, carbon in the biological treatment, and dosing of precipitants.

Water from different sources carries with it different loads. For example, water from springs and wells contains particles; surface water contains biologically active elements; and water from industrial processes contains chemicals. Using an automated sampler with analyzers helps determine the quality of untreated raw water, which allows the automation system to adjust processes accordingly.

Event monitoring at the inlet of a treatment plant identifies excursions of effluent entering the plant, such as a large influx of TOC, or a large shift in pH or turbidity, each of which can occur due to accidental discharges by industrial entities upstream of the plant.

Continuous monitoring of the discharge values ensures safety. Complete documentation can be used as proof of wastewater treatment performance to authorities, and for internal monitoring purposes. For example, if the sludge profile is monitored, changes caused by a heavy downpour can be detected quickly, and countermeasures can be taken.

Automated samplers, therefore, can do more than just satisfy EPA reporting requirements. When combined with on-board analyzers, modern industrial networks, and supporting software—automated samplers provide vital data for controlling and optimizing water and wastewater processes.



Digital Technology – Smart sensors and the Internet of Things. From process to the lab and the control room

Steven Smith, Endress+Hauser, Senior Analytical Product Marketing Manager

“By the year 2023 it is projected that we could be connected to 3,000 to 5,000 smart devices each day. The Internet of Things is emerging and will change the way products create value, triggering a new wave in the value chain of manufacturing companies and change the way data impacts our lives.”

Steve Smith, Senior Analytical Product Marketing Manager
Endress+Hauser

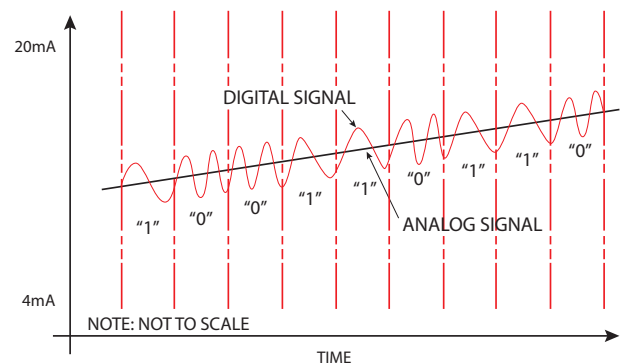
The Industrial Analog World

For years industrial process control has been based on conventional “analog” 4-20 mA signals. A 4-20 mA signal is transmitted over two wires from a sensor to a “controller” which would interpret this signal, based on scaling, and respond accordingly, often with a 4-20 mA signal to a valve, pump, or other controlled device. This method of communicating information from the sensor produces only a single measured value. The interpretation of that value only occurs at the controller, based on the user’s defined scaling, and the controller response was based on settings defined by the user. An analog approach to process control requires two wires from each device back to the controller. It requires that loop tuning, or trimming, to account for differences that exist between the value transmitted by the sensor and what is seen by the controller. It also requires tuning of the controller. In the “analog” world we actually know nothing about the device other than the process variable, and we don’t really know if the variable is correct, nor can we access the variable unless we are in direct contact with the loop.

HART[®] COMMUNICATION PROTOCOL

In the mid 1980’s Rosemount developed and introduced Highway Addressable Remote Transmitter (HART[®]) communications protocol. A HART device has a Bell 202 signal that is superimposed over its analog 4-20 mA output. By virtue of the frequency of the signal a series of ones and zeros are produced to provide a “digital” signal. HART is a bi-directional communications protocol that provides data access between the field instrument and a host system. HART allows for up to two “masters” - the control system console or a second device such as a handheld communicator. HART communication enables configuration of the device, reading of the device process variable and communication of information about the

health of the device. HART provided a method to access more than just a process variable from a field device and just as important at the time, it was compatible with analog loops that were predominant in industrial processes.



Rosemount coined the term “Smart Instrument”, along with HART, because now there was access to more than just a process variable, and it could be done with the existing analog loops. HART was primarily used as a point-to-point operation, but could also multi-drop and supports multivariable field devices. But, HART had a slow response time and was not originally designed for process control.

Industry is introduced to Digital Communications

Since the mid-80’s other industrial process automation protocols for process control were introduced by various manufacturers such as Modbus, Profibus[®], Asi Bus, DeviceNet, Foundation[™] Fieldbus, CAN, and the list goes on. These protocols and their wiring connections (physical layers) gave industrial processes access to not only process variables, but diagnostic and sensor information in virtually real time. Digital protocols, such as these, enable two way communications between the field instrument and the control system, enabling the monitoring of device health, which heralded the concept of “Life-cycle” or “Asset Management”, based on information contained in the sensor and the control system. Implementation of these digital protocols within instruments and control systems brought about a dramatic transformation to the conventional analog world in which many industrial processors were operating. Now a plant does not have to rely on point-to-point wiring, they have fast two-way communications between the field instrument and the control system, and they have access on a vast amount of information about the field instrument, which led to a better understanding of the process.

The Internet of Things (IoT)

The term “Internet of Things” was coined by British entrepreneur Kevin Ashton in 1999. With the IoT, virtually anything on the face of the earth becomes connected over the internet. The IoT increases machine-to-machine communications; built on cloud computing and networks of data-gathering sensors; it is mobile, virtual and has an instantaneous connection. This new internet will transform our lives, making everything in our lives “smart”, from how we are transported, to how we manage our healthcare. But how is this possible, what does this mean for our industrial processes, and how do Smart sensors play a significant role? What this means is that things can not only share their information with other things, but decisions can be made and actions can be taken as a result of the information. Therefore, “things” are given the ability to sense, communicate, and control over the Internet of Things. How is it going to be possible to have so many things communicating to one another in this Internet of Things?

IPv4 versus IPv6 - Internet protocol

An IP address provides a key link to a source of the data on the internet. An IP address tells a web browser where to go, providing that valuable link for information across the internet. Every web page has a unique IP address. Internet Protocol Version 4 (IPv4) was the first publicly used version of the Internet Protocol. IPv4 was developed as a research project by the Defense Advanced Research Projects Agency (DARPA), a United States Department of Defense agency, before becoming the foundation for the Internet and the World Wide Web. IPv4 included an addressing system that used numerical identifiers consisting of 32 bits. These addresses are typically displayed in quad-dotted notation as decimal values of four octets, each in the range 0 to 255, or 8 bits per number. Thus, IPv4 provides an addressing capability of 4.3 billion addresses.

Internet Protocol version 6 (IPv6) is the most recent version of the Internet Protocol (IP), the communications protocol that provides an identification and location system for computers on networks and routes traffic across the Internet. IPv6 was developed by the Internet Engineering Task Force (IETF) to deal with the long-anticipated problem of IPv4 address exhaustion. IPv6 is intended to replace IPv4.

Every device on the Internet is assigned an IP address for identification and location definition. With the rapid growth of the Internet after commercialization in the 1990s, it became evident that far more addresses than the IPv4 address space has available were necessary to connect new devices in the future. By 1998, the Internet Engineering Task Force (IETF) had formalized the successor protocol. IPv6 addresses are represented as eight groups of four hexadecimal digits with the groups being separated

by colons, for example 2001:0db8:85a3:0042:1000:8a2e:0370:7334, but methods to abbreviate this full notation exist.

IPv6 uses a 128-bit address, or approximately 3.4×10^{38} addresses, or more than 7.9×10^{28} times as many as IPv4, which uses 32-bit addresses and provides approximately 4.3 billion addresses.

Unfortunately, the two protocols are not designed to be interoperable, complicating the transition to IPv6. However, several IPv6 transition mechanisms have been devised to permit communication between IPv4 and IPv6 hosts. IPv6 provides other technical benefits in addition to a larger addressing space. In particular, it permits hierarchical address allocation methods that facilitate route aggregation across the Internet, and thus limit the expansion of routing tables. The use of multicast addressing is expanded and simplified, and provides additional optimization for the delivery of services. Device mobility, security, and configuration aspects have been considered in the design of the protocol.

Smart Sensors

Today many of us are working every day with a “smart sensor”. Take the phone that many of us carry. This smart device provides a range of capabilities, such as knowing where we are, it can understand what we say and has an eye on our environment. And, it can connect to a wireless network. There are many other smart devices entering our world, such as thermostats, lights, personal health monitors and cars that can all connect to a network and give us access from anywhere. In the industrial world we are also seeing the transition to smart devices that can connect to a network and give us valuable data, and that can be accessed from anywhere over the internet.

Industrial Smart Sensors

While many of physical industrial measurements are “analog” in nature, these fundamental measurements are being digitized and communicated and communicated to an Ethernet-based network. Endress+Hauser also offers a full range of products with digital communications in Flow, Level, Pressure, Temperature and Analytics.

Sensor data can be communicated to a control/SCADA system using a range of digital protocols, including Profibus, Modbus (TCP or 485), or EtherNet/IP™. When using Ethernet communications, data access is more readily available at the management level. Regardless of the digital protocol, access and control of the measurement systems can be accomplished through an IP-addressable web server for remote access.

The IP-addressable web page offers the ability to access the sensor operation at any time, from anywhere over the internet. The sensor becomes a “thing” in the Internet of Things. With remote access to a sensor and all its information, operation and maintenance of the device is enhanced, resulting in a more controlled process.

Summary

In the 1800's products were produced using mechanical devices and physical processes. Products are mechanical in nature and value chain activities are performed manually using analog information, paper processes and verbal communications. From the 1980s to 2000 digital communications technologies begin to emerge in industrial markets and the internet enables coordination and integration across the value-chain, as well as with customers, business partners and across geographies. But as we move beyond 2000, information technology will become more embedded in products themselves, which

allows them to be part of the Internet of Things. We will see more Smart connected products. It isn't the Internet that will feed the transformation, it is the smart products. The core is the products and the data they provide. By the year 2023 it is projected that we could be connected to 3,000 to 5,000 smart devices each day. The Internet of Things is emerging and will change the way products create value, triggering a new wave in the value chain of manufacturing companies and change the way data impacts our lives. It isn't the internet that will be doing this, it is the Smart sensors and their data that will fuel this transformation.



Know by 'Heart': Flowmeter technology of the future

Summary: Endress+Hauser's Flow Product Marketing Manager Nathan Hedrick and Environmental Industry Manager Alan Vance share the latest on the Promag 400 line of electromagnetic flowmeters featuring specialized sensor technology. The two served up details on the sensors' web capabilities, proprietary "Heartbeat Technology™," and advanced safety features.

As the eyes and ears of a treatment plant, few tools are as crucial in the water industry as sensors. It follows suit that any advantage you can get in sensing technology is one worth pursuing.



"Endress+Hauser's Heartbeat Technology will make a difference for water and wastewater customers"

Alan Vance, Environmental Industrial Manager, Endress+Hauser



"We are all looking to do more with less, to maximize the efficiency and effectiveness of our personnel resources, and Heartbeat Diagnostics helps our customers achieve this goal."

Nathan Hedrick, Flow Product Marketing Manager, Endress+Hauser

Alan Vance began his work with process control and instrumentation more than 31 years ago. He received his Bachelor's degree from Slippery Rock University. He went on to La Salle University where he received his MBA in Marketing.

He began his career working for Fischer & Porter, where he worked for seven years as a Product Manager for Recorders. From there, Alan went on to work for an instrumentation representative company for 22 years, where he focused on water and wastewater, power, mining, as well as the food and beverage industries in Florida.

In his current role with Endress+Hauser, he is responsible for the water industry. In this capacity, Alan does strategic planning and marketing of products used in the water industry. Along side of that, he is in charge of many operational activities like training, working with representatives, and meeting with customers. Alan has worked with Endress+Hauser for three years.

Nathan Hedrick has more than six years of experience consulting on process automation. He graduated from Rose-Hulman in 2009 with a Bachelor's degree in Chemical Engineering.

He began his career with Endress+Hauser in 2009 as a Technical Support Engineer. After two years in that position, Nathan became an Inside Sales Engineer. Later, he went on as a Systems Product Specialist supporting digital communications, such as HART, as well as engineering solutions, including RSLogix. After a few years, he went on to work as the Technical Support Team Manager for Temperature, Recorders, and Systems.

In 2014, Nathan became the Technical Support Team Manager for Flow where he was responsible for managing the technical support team covering the Flow product line. He has recently taken on the position of Flow Product Marketing Manager.

Q: What is an ideal type of facility or condition for implementing the Promag W 400 and L 400?

A: Our Water/Wastewater industry optimized sensor is the Promag L 400. Our typical recommendation is to use the Promag W 400 in subgrade applications when the flowmeter is mounted inside a vault or pit. So, Promag L 400 above-grade, Promag W 400 subgrade.

The Promag W 400 is a fully welded sensor design coated with an anti-corrosion paint for direct burial in the ground. Our engineering has developed a special anti-corrosive coating that we put on the sensor exterior which is a significant advantage over manufacturers who require the use of Denso™ Tape.

Q: What are the chief advantages of a sensor with integrated web capabilities?

A: First of all, it allows our customers a service interface with no special tools or software required. That means free and easy access, instead of purchasing interface tools that they have to keep track of and downloading and installing software, which ultimately requires IT involvement. That is actually a pretty big advantage. The customer simply needs a laptop with any of the most common internet browsers and a standard Ethernet cable. It's something we're all familiar with and can easily adopt and make use of.

Another advantage is the remote access that it grants. Flowmeters can actually reside on those same networks to allow a maintenance engineer to log into the device from the control room, to check diagnostics, perform an on demand verification against the magmeter's original wet calibration change settings, or download the configuration for storage or duplication onto another device.

Q: Can you describe the Heartbeat Technology™ that went into the sensors?

A: Our Heartbeat Technology has three aspects. First is Heartbeat Diagnostics (along with Heartbeat Verification and Heartbeat Monitoring), which is included on all devices. It continually audits the meter to ensure that it is operating at peak conditions. What's unique about our diagnostics capability, though, is how we classify and report events to our customers. Any event besides what we would call "System OK" or a "green light area" is provided with a suggested remedy. That prevents the customer from having to find the manual and dig through hundreds of pages just to find out what to do. Additionally, those diagnostics are classified into a number of categories, which help inform the customers as to how urgently they need to address the situation. We are all looking to do more with less, to maximize the efficiency and effectiveness of our personnel resources, and Heartbeat Diagnostics helps our customers achieve this goal.



Promag L 400



Promag W 400

Q: What is Heartbeat Verification and how does it help the customer?

A: Heartbeat Verification is an onboard traceable verification technique, which requires no special tools to run. It can even be performed remotely through the web server or through the customer's digital network. What makes our verification technique so unique is that we have an independent third party attestation. This means that no longer is it only the manufacturer telling you that their own meter is working.

We have attestation that offers confirmation to the claims we are making, which should offer our customers additional confidence. Why is this so critical? Well, there are four reasons that we have found that a customer wants to perform verifications. One, they have an internal quality policy which requires it. Two, they have a contractual obligation to do so. Three, it's part of their safety program. And, four, it's required for regulatory purposes. Now, these last three in particular all have one thing in common: the customer needs documented evidence that the meter is functioning properly. Heartbeat Verification gives our customers confidence that this is going to be the case, as a test to ensure that the meter is still performing within the original specifications that were provided when it left the factory.

On top of that, they can generate a certificate to prove it. Customers have a couple of different options as to how they can make use of it. They can either purchase it, so that it's an open option for their own use, or they can hire our trained and qualified service organization to accomplish this task for them. Particularly in cases in which they report this documentation, it's actually our recommendation that they mitigate their own responsibility and risk by using our service organization to complete verifications, print out the reports, and ultimately, there are spots for us to sign off on the reports prior to handing them over.

Q: How does web integration help the customer in this case?

A: The big thing with water and wastewater customers, especially with the verification, is when they install a meter today, they want to know six months or a year or two years from today that the meter is still verified to be within the original calibration information.

Now, on smaller meters, they could take the meter out, send it back to us, and we can calibrate it. Where this comes into play is on the bigger meters that are way too heavy and take too much time to pull out of a line. Our verification method requires no additional handheld device or calibrator that the customer has to purchase; everything is done through the web server.

Everything's going to have this integrated web server in it, and again, people understand having the laptop and the standard Ethernet cable. That really makes it simple for the end user. That's why we're moving in this direction, not only with our flowmeters but with other products as well.

That is probably the most popular way that technicians or operators perform the verification, through the web server. But the customer can also do it locally if that's their preference. They can also perform it through their control system.

Q: How has magmeter technology changed in recent years? How does the Promag take advantage of these innovations?

A: We all know that the municipal industry can be quite price-sensitive at times. It does seem that, over time, we've started to hear more and more that a mag is a mag almost like a commodity. But our Endress+Hauser magnetic flowmeters are quite different. Our USA manufacturing facilities located in Greenwood, IN completed a \$45m expansion last year adding over 200,000 sq. feet to our existing

facilities and are fully ISO 9001 certified. Endress+Hauser has the most accurate flowmeter calibration rigs in the industry that are ISO/IEC 17025 accredited as well.

On the innovation side, we believe its primary innovation is how we get information from these devices into the plant's control system. The first component of that is how we interact with them. Our customers are always looking for a solution that is simple and easy to use, because they face resource limitations and have a need to accomplish a multitude of tasks that are not solely centered around instrumentation. We've improved our programming structure to make it more intuitive and only ask the customer to input the minimum amount of information, which covers the vast majority of applications.

We've also added flexibility to how and where the customer interfaces with these devices. They can use the local display, communicate to it through a digital network, and access it through the web server.

Q: What are the energy savings found in the Promag?

A: Compared to a leading competitor in electromagnetic flow, we can promote a power consumption of up to 45 percent less. Many customers have remote sites without power that use solar energy to power our Promag meters. However, I will also add that energy savings are not always about the power consumption of the meter itself.

There are inherent energy savings when using a full-bore meter such as a Promag meter over another measurement technology, because there's no pressure loss. It saves energy for the customer because they don't have quite the burden on the pumps. It reduces the pump usage.

Q: What is the expected lifespan for the sensor?

A: We rarely see sensor failures that are not caused by the process or some external factor. There are no moving parts, there's no restriction to the process flow, and with the Promag meter in particular, there's no regular maintenance required to keep it operational.

If the customer has an application in which buildup is expected, they would ideally pair it with Heartbeat Monitoring, so they know when to perform a cleaning cycle. But really, the sensor failures are generally not instrument-caused.

One thing I might add is that the 400 series will be our optimized transmitter for water and wastewater moving forward. The series before this is our series 50/53, which we still manufacture. Let's say that a customer with a magmeter had a lightning strike, or someone left the cover off the enclosure, water got in it, and the transmitter got damaged. Our new 400 series is backwards compatible to that sensor. The customer doesn't have to bear the cost of replacing the sensor, which can be quite expensive, especially in a larger size. They can keep the sensor in place, keep the same cabling, if it's remote, and just add a new 400 transmitter as well.

These magmeters will last a very, very long time. It's not uncommon to get well over 20 years out of a magmeter – or longer, really.

Q: How does touch control make it safer to operate a sensor?

A: The primary benefit of touch control is, of course, not needing to open the housing to perform programming directly at the device. This is particularly important in hazardous-rated areas, because you're ensuring that any potentially explosive gases are kept apart from the electronics.

Reducing false alarms allows for advanced warnings of problems

Newly-installed pressure transmitter increases reliability and stability



Benefits at a glance:

- Ability to see pending problems ahead of time as opposed to waiting for a failure to occur
- Elimination of false alarms
- Increase in stability and reliability
- Good price for unit
- Compact design

A U.S. power producer was having problems with pressure switches chattering and causing false alarms in its cooling towers. This was causing major headaches for the plant operators and management, meaning they needed a solution from someone they could trust and that was experienced in dealing with these kinds of situations.

Basics on cooling towers The function of the cooling tower is to remove heat from the water discharged from the condenser so that the water can be expelled, or recirculated and reused. Cooling towers are of two types, mechanical draft and natural draft towers. Mechanical draft towers use fans to force air through the towers whereas natural draft relies on temperature differences between inside and outside to naturally pull air through the tower. Cooling systems used to circulate the water across cooling towers and operate fans in forced draft units consume a significant amount of energy. Cooling tower assemblies are commonly made up of multiple motor, gearbox, and cooling fan assemblies. There is an elaborate system for lubrication with oil for bearings on fans. It is important to monitor pressure on lubrication oil, as a drop would indicate a leakage of some kind.

The challenge The plant was using pressure switches for monitoring lubrication oil for bearings on fans in cooling towers. The chattering of the switches created false alarms and tripped the cooling towers, making it a big problem for the plant operators and management. After the problem occurred multiple times, the operators then decided that they needed to replace the current pressure switches with ones that were more reliable.

Our solution Endress+Hauser supplied the company with the Cerabar PMC131 - a capacitive, oil-free sensor for absolute and gauge pressure measurement. The unit is compact in design and attractive in price. It is a direct system with a diaphragm seal and is diaphragm overload/vacuum-resistant. The plant operators closely monitored the newly installed units for several months - including the all-too-critical summer months. The operators were very pleased as the units performed flawlessly.

The results With the PMC131, plant personnel were able to see pending issues with lube oil pressure as opposed to waiting for a failure to occur. The units worked flawlessly in eliminating false alarms, while increasing reliability and stability of performance.



Cerabar T PMC131 - Pressure Transmitter
www.endressdirect.us/pmc131




Typical level switch, installed near top of a tank to detect possible overfill conditions. To perform a full proof test often requires removing level switch.


Reducing process functional safety risks and costs with Endress+Hauser

Craig McIntyre, Endress+Hauser, Industry Marketing Manager, Chemical

Those responsible for designing and managing process functional safety systems (i.e. Safety Instrumented Systems, Interlocks, etc.) are increasingly adopting the IEC 61511 (ANSI/ISA 84.00.01) Safety Instrumented Systems (SIS) performance standards. Other standards (i.e. API2350 Overfill Protection for Storage Tanks in Petroleum Facilities) now reference this SIS performance standard as well. Endress+Hauser supports these activities with a comprehensive family of functional safety SIL capable measurement devices and the important associated IEC61508 certified design, manufacturing, safety function manuals and other documentation needed by SIS practitioners.

An SIS may be one of several “layers of protection” used in a particular protection scheme. IEC 61511 (ANSI/ISA 84.00.01) performance standards provide some guidelines and methodologies for designers and operations to define and maintain SIS to prevent hazardous events that impact human safety, prevent damage to facilities, and protect the environment. It is important to understand the design and maintenance requirements of Safety Instrumented Systems and the requirements for maintaining their proper operation must be engineered to fit the SIL specification that is determined by the plant owner’s hazard analysis and risk tolerance.

 **Tank Farm Safety**
<https://youtu.be/uxOnVtBb8Y8>

 **Comply with API2350 and IEC61511**
https://youtu.be/2XyMJ3_Yp3w

 **Animation Liquiphant Safety**
<https://youtu.be/E96xPaDdhcg>



In a “bucket test,” a level switch is removed from the vessel and immersed in material from the process to test that it switches properly.

An example safety function is to prevent an overflow condition in a tank or vessel. Level measurement information is communicated to the attached logic controller which in turn gives appropriate acting instructions to an attached valve, motor or other safety shutdown actuator. Of course the appropriate level measurement device, installation and its application suitability must be determined. The choices here alone can impact risks and costs of an SIS design and operating lifetime.


Level measurement instruments, both switches and transmitters, have a given set of Safety Integrity Level (SIL) safety related parameters based on reliability, testing and certifications. These are consulted by the designer to help model/define the overall overflow prevention SIS design and to satisfy the assigned Safety Integrity Level (SIL).

If a level instrument fails to do its job, a tank may overflow, allowing hazardous fluids into the environment and possible injury to personnel. How can one verify that (a) level instrument(s) or any measurement subsystem can perform as designed after the design is reality in the field?


Addressing proof testing cost and risk

When an SIS has been designed and commissioned in the field, the components selected for it give it the capability to reduce risk to a defined level. Over time some of these components may contribute probabilistic errors resulting in the average Probability of Failure on Demand (PFDavg) of the SIS drifting above an acceptable design target (SIL, Risk Reduction). Proof testing the whole SIS or a component should “reset” or keep the PFDavg back below the SIS design PFDavg specification. Looking at an overflow prevention SIS again:

- Some proof test approaches require the de-installation of key SIS components such as a level instrument to conduct a test (i.e. a “bucket test”). Some likely cost (i.e. process down time, personnel time) and risk (i.e. possible introduction of systematic error from reinstallation damage) with this approach.
- Other proof test approaches require driving the process to a level that it is considered suitable for a function test. Likely one would find associated cost (i.e. process interruption) and risk (i.e. potential process upset) with this approach as well.
- In-situ partial proof testing is now another engineering option for SIS designers. Given that measurement sensors are now joined by intelligent measurement subsystems, SIS designers may find it possible to implement proof testing in ways not available in the past. Looking at our Overflow Prevention SIS again now with a level measurement subsystem and given high Proof Test Coverage (PTC) and high Diagnostic Coverage (DC) capabilities, one can consider in-situ proof testing that may reduce costs (i.e. possible extended proof test intervals) and risks (i.e. no equipment de/reinstallation).

 **To read a more detailed paper about this subject visit:**

www.us.endress.com/proof-testing-level

 **To obtain Endress+Hauser device IEC61508 safety parameters (and functional safety manuals if these are not already available in your SIS design tools) visit:**

www.endress.com/sil-documentation



iTHERM TM411 in process (3D animation)

Temperature measurement

Why accuracy and response time really matter

Chr. Hansen is a large Danish ingredient company in the Food & Beverage industry. Chr. Hansen supplies leading food producers with large quantities of bacterial cultures which are used for sour milk products such as yogurt. They use temperature sensors from Endress+Hauser within their processing plants. And, have now started using the latest model - iTHERM® TM411 - with innovative QuickSens and QuickNeck technology in the production facilities with great success!

Temperature measurement is a key parameter for quality

Both accurate temperature control and fast response on temperature changes is critical for an efficient and safe production of bacterial cultures.

Tommy Mikkelsen, a metrologist at Chr. Hansen, works to ensure that instruments used within his facility meet the stringent quality requirements of the company's large processing plants.

He has performed extensive testing of Endress+Hauser's latest temperature sensors - the iTHERM TM411 - with convincing results.



A smart feature of the iTHERM TM411 is the so-called QuickNeck where you can separate the sensor from the process with a simple twist. Tools are not required.

Response time as a matter of safety

In order to eliminate any contaminants, which could pollute or destroy the final product, the nutrient solution is sterilized by UHT (Ultra High Temperature) treatment before it is transferred to the fermenter.

In the UHT process, the medium in question is exposed to temperatures above 139°C for a defined time span – usually for several seconds. A safe sterilization can only be guaranteed, if the temperature does not fall below the minimum temperature at any time. So, if the temperature drops and comes close to the minimum required temperature, a quick reaction of the control system is necessary to counteract the temperature decrease and to heat up the system again. In order to achieve this quick reaction, a temperature sensor with a very fast response time is needed.

The new iTHERM TM411 temperature assembly from Endress+Hauser with QuickSens technology is the perfect choice for this application. Its unmatched response time allows continuous monitoring of the process and keeping the temperature constant within a very small range.

Tommy Mikkelsen has conducted response time tests with various temperature sensors which revealed that the latest model with iTHERM QuickSens technology could reduce response times by more than 50% when compared to older sensors! For Chr. Hansen this means a distinctive quality improvement of the whole process.

Accuracy and fast recalibrations – conflicting goals?

But response time alone is just one half of the story. Obviously it is just as important that the measurement is also highly accurate. To ensure this, each temperature assembly is usually calibrated several times a year.

There are basically two different types of temperature assemblies available – with or without thermowell. A thermowell is the part of the temperature assembly which hosts the actual sensor (also called insert) and protects it from potentially harsh process conditions. Of course, this additional barrier between the sensor and the process medium usually negatively affects the performance of the sensor. In order to quantify this expected negative impact on measurement performance, Tommy Mikkelsen conducted test calibrations of the new iTHERM 411 sensors both with and without a thermowell.



TM411 Videos available on the Internet

www.youtube.com/watch?v=H59Sjz3iUxs

In this case, Endress+Hauser's TM411 has shown very good results with measured deviations below 0.1°C – no matter whether there is a thermowell or not (see tables)! The expected negative impact of the thermowell on the overall accuracy was hardly detectable. For Chr. Hansen this means another huge benefit. It allows them to use thermowells without negative effects on the accuracy of their measurements. This means that during recalibrations the process can be kept closed as the thermowell remains in the plant while the sensor itself is being removed to perform a calibration. In this way, the new iTHERM TM411 thermometers help increase plant availability and save additional CIP cleaning procedures after recalibrations.

The new Endress+Hauser sensor also offers the most simple and quick removal of the sensor from the thermowell. The aptly named feature QuickNeck allows the tool-free removal of the complete upper part of the sensor from the thermowell with just one twist. (see image on page 28) No need to open the housing or to disconnect any wires – simple, safe and fast.

Little instrument with big effect

The new iTHERM TM411 thermometers from Endress+Hauser provide faster response time, higher accuracy and easier handling than ever before. For Chr. Hansen, this results in higher product quality, higher safety and reduced maintenance costs at increased plant availability. What else could one expect from just a “simple” instrument?



Test conditions

for TM411 with measuring range 0 °C to 150 °C

TM411:

read from the computer via Field Care

Reference:

DTI-1000

Calibrator:

ATC-250, with oil

Calculated measurement error:

± 0,045 °C (K=2)

TM411 with thermowell

Calibrator	TM411	Reference	Deviation
50°C	49.81°C	49.78°C	0.03°C
100°C	99.47°C	99.45°C	0.02°C
149°C	148.18°C	148.24°C	-0.06°C

TM411 without thermowell

TM411	Reference	Deviation
50.06°C	49.97°C	0.09°C
99.88°C	99.81°C	0.07°C
148.68°C	148.63°C	0.05°C

Endresslistens.com

We learn from the customers we serve

It is important to us to ensure we are always focused clearly on what matters most to our customers. With Endresslistens.com our customers can let us know how we're doing anytime. We immediately get the feedback and are able to act upon it accordingly. This feedback helps us to always reach for higher standards of excellence, pinpoint service issues, and in general better support our customers. Thank you to everyone that has given us feedback – it plays a significant role in our success. Below we've highlighted just a few pieces of feedback we've received – keep it coming!

"Toni in your service department was very helpful, patient and informative. This was the first Proline flowmeter I had installed and Toni walked me through every step of wiring the meter to the truck power. A+ service."

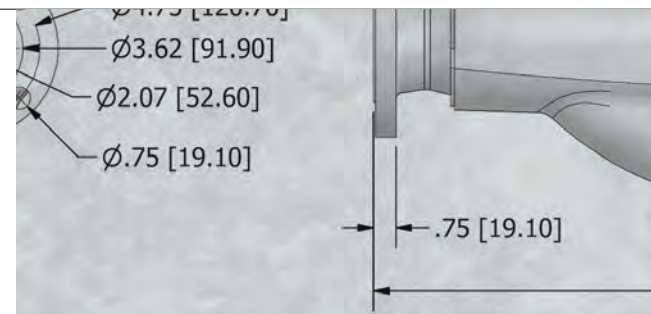
"Over the course of my 35 year career, I have had the opportunity to deal with many customer support teams and individuals. In my opinion, your group is by far the best!"

"We purchased a replacement flow sensor so no further technical information was requested or needed. What really impressed us was the way the instrument was packed, very well protected, with all the needed information handy."

"Endress+Hauser has the best technical service I've seen in any company. Most companies only care about selling their products, but once sold, don't ever respond again. But what builds the confidence and customer relations in a company is the quality of the products and technical support. Endress+Hauser set itself apart from the rest."

"I want to thank Kyle for helping me find a solution to our UV absorbance dip problem whenever the transmitter was over the limit. He went to great lengths to solve our problem and had a great attitude!"

"My experience with Endress+Hauser was one of the best customer service experiences I have encountered! I have 30 years of customer service under my belt; you folks are absolutely fantastic!!!! "



Endress+Hauser

People for Process Automation

"Thanks for taking a moment to strive to deliver the best service. Our teams receive your feedback to make improvements and it's much appreciated."

"I received a quick and excellent response by Adam to help us troubleshoot a pH probe issue (which was actually a meter issue). Adam also sent us tracking information on an order that was being shipped at the time. The new parts helped us complete the repair process and our equipment was back up and running the next day! I really appreciated the great customer service!"

"I spoke with Adam in tech support concerning PID control for a chemical additive pump from the Liquiline CM442. He sent a white paper and a powerpoint document that really gave me insight into my application. The important point is that he understood my issue and went above and beyond to ensure I understood it as well."



"Endress+Hauser has been such a vital part of all my large scale brew house projects. I trust the quality and ease of use that the products have built into their designs."

"Endress+Hauser tech support engineers were extremely helpful and provided me with a solution in only a matter of days! The replacement pressure transmitter is now working flawlessly. Please pass on my appreciation for a job well done to everyone who helped make this happen."

"We had a situation where we needed our 3" ultrasonic meter back from calibration earlier than expected. I called Michelle and explained our problem and she handled the situation with great professionalism and excellent response time. Because of this, we were able to complete our project on time. I would like to thank Michelle and Bryan for their great work."

"I have always been treated professionally and tech support has been my life saver on many occasions. Thank you for answering the phone whenever I need you!"

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