HOW DIGITAL MEASUREMENT CAN OPEN NEW OPPORTUNITIES FOR ENHANCED WASTEWATER TREATMENT

The need to better manage and conserve the world's water supplies requires new levels of insight into how water is treated and discharged. In this article we look at how developments in digital measurement technologies can provide the data needed to maximize water quality in wastewater treatment processes.

ABB's AWT420 digital dual-channel transmitter enables measurement of a variety of parameters in a single device

Wastewater treatment is a multi-stage process that involves a wide range of measurements needed to make sure that both the quality and quantity of discharged water meet increasingly strict regulatory requirements.

The process of restoring wastewater to an appropriate condition, fit for discharge, requires knowledge of the condition of that water as it travels from the treatment plant inlet to the point of final discharge.

Whilst previous measurement techniques have varied in their accuracy and effectiveness in being able to provide a reliable indication of conditions, the latest generation of digital continuous instruments and analyzers are helping to transform measurement performance. Collecting and transmitting a range of operational and diagnostic data, these devices offer the opportunity to get a clearer indication of process conditions that can be used to optimize treatment performance and demonstrate regulatory compliance.

Environmental advantages

Continuous water quality analyzers are providing the data to make sure that environmental regulations are met. Regulations designed to manage water quality that protect the environment, encompass everything from tackling the spread of invasive species to minimizing chemical and nutrient pollution. Both chemical and bacteriological pollution can tip the balance of aquatic ecosystems, affecting the full spectrum of aquatic life, from fish and amphibians through to plants.

The importance of returning high-quality water to the water cycle provides maximum availability when utilities withdraw water. The treatment and distribution of water are energy intensive. An important aspect of protecting the environment is optimizing processes and cutting carbon emissions in the treatment and distribution cycle.

Digital measurement and analysis of the wealth of data provided helps to assess current performance and identify ways that it can be improved to help companies minimize their environmental impact and comply with relevant rules and regulations.

Operational advantages

Digitalization gives a better overview of processes, enabling improved decision-making. Systems running analytical programs provide insights into key operations such as pH measurement and control. This analysis offers the ability to anticipate changing process trends, deal with potential anomalous conditions as they occur, and help the organization achieve higher-level operational and business objectives.

Maximizing the value of the data is increasingly enabled by advances in artificial intelligence and machine learning. Multiple streams of data are collected and analyzed to establish patterns of behavior and trends. These patterns and trends predict future outcomes, allowing utilities to operate more efficiently.

Online measurement is the most common type of measurement used by water companies today. One of the great advantages of online continuous water analysis is the ability to respond quickly to changing conditions. This can deliver large-scale efficiencies for water treatment works by enabling them to identify processes that may not be performing at their optimum and take necessary measures to address any problems.

Digital measurement and sensing equipment, together with advanced data processing techniques and increasingly capable computers, are creating what is effectively a 'digital brain'. As utility companies have upgraded instruments and systems over time, there has been scaled investment in the infrastructure to maximize the value of the data.

It is not only environmental legislation that motivates the use of continuous water analyzers. At the most basic level, plant managers can implement digitalization to improve their snapshot view and gain an understanding of what's happening in their current operations. At the highest levels, the data is used strategically for improving customer satisfaction, balancing the allocation of capital, and supporting better decision-making in day-to-day business, financial, and operational activities. In all cases, digitalization provides a platform for enabling more consistent operations without burdening users with the overhead or technicalities of a large data processing structure.

With digital instrumentation being used to measure an extensive

Online measurement using digital sensors helps to provide a wealth of real-time data that can be used to optimize water treatment processes and ensure regulatory compliance

range of parameters from dissolved oxygen in the aeration process to chlorine and turbidity, continuous water analyzers help to eliminate the delays and added uncertainties associated with extractive testing methods.

Digital measurement technology is making accurate water quality measurement easier, with data being used to meet and exceed regulatory requirements as well as identifying ways to optimize process performance.

Cost

Wastewater treatment is an expensive process. Huge amounts of energy are needed to shift water between the various stages as well as treating water in processes such as aeration, which can often account for over 50 percent of a typical site's total energy burden.

Another significant cost is that of chemical consumption. Many of the processes in wastewater treatment consume chemicals, either directly through dosing or indirectly for purposes such as producing the chemical reactions in measurement instruments needed to assess water quality.

Using instruments that can measure to the highest levels of accuracy is therefore key to reducing the risk of errors that might require costly re-treatment of wastewater flows. By enabling problems to be quickly spotted, the latest generation of measurement instruments and analyzers allow timely action to be taken before any problems can escalate.

Maintenance

Water treatment works in isolated and difficult-to-reach locations can be expensive and difficult to routinely maintain. The advantages of digital measurement technology for maintenance management are well documented across the process industries but are more recognized in industries that may have to send maintenance staff on long road journeys to reach their destination.

As the front line in any water quality measurement scheme, continuous water quality analyzers need to be kept in good working order to provide accurate, reliable, and repeatable performance.

In these instances, predictive maintenance allows maintenance workers to schedule their work to make sure sensors are functioning properly. Combining preventive maintenance and predictive maintenance helps maximize process efficiency and guarantee that everything is operating as it should.

Digital sensors and transmitters are offering additional data above and beyond their primary measurement that indicates instrument health. If readings are not as expected, digital instruments can feedback advanced self-diagnostics conforming to NAMUR NE107.

Regular calibration will have a material impact on the measurement accuracy of analyzers. In some cases, one-button sensor calibration saves time and money on routine maintenance. ABB Ability™ verification for measurement devices are becoming more widely available across the range of digital instrumentation that allows for online verification of measurement accuracy for reporting and compliance.

Compliance

Increasingly stringent regulations are being introduced to help limit the pollution of watercourses and make sure that those who do engage in polluting activity can be traced and penalized.

Different countries have their individual regulatory bodies that require organizations that discharge water to the environment, including utilities and industrial operators, to monitor the quality and quantity of their discharges and report them to the appropriate regulatory body.

Examples of how digital technologies are helping to transform water quality measurement

The following are some examples of how advances in digital measurement technologies are helping to open new possibilities for efficient and accurate measurement of a range of key water quality parameters.

pH / ORP

Being able to accurately measure levels of acidity and alkalinity is vital to ensuring the highest standards of water quality, safety, and environmental performance. pH levels must be correctly balanced at the point of discharge of effluent water into water courses or damage could be caused to the aquatic environment, potentially resulting in prosecution and severe penalties. It is therefore important to have accurate data, but also to be able to react quickly if that data indicates that pH levels are within levels set by regulators.

Digitization makes data easier to access and more visible to plant operators and production engineers by using customizable dashboards. Displaying key performance indicators on large touch screen displays allows plant operators to be more aware of process variations and respond to them faster. The same data can be run on smartphones and tablets via appropriate apps, making it easier for plant personnel to interact with plant equipment and analytic data.

Turbidity and Total Suspended Solids (TSS)

The clarity of the water in a stream, river or ocean is a key determinant in fostering a healthy and balanced aquatic ecosystem.
The clearer the water, the greater the ability of light to penetrate to aquatic plants that generate the oxygen required for aquatic life. Controlling the level of turbidity and suspended solids in treated wastewater discharged to the environment is vital in preventing damage caused by the depletion of dissolved oxygen levels.

ABB's ATS430 digital turbidity and TSS sensor and transmitter system

For this reason, turbidity and suspended solids concentrations of effluent discharges are tightly regulated and need to be carefully monitored to ensure regulatory limits are maintained. A build-up of particles or suspended solids in the water will scatter daylight passing through the water, reducing its intensity, and impeding efficient photosynthesis. ABB's ATS430 turbidity and TSS probe with adaptive TSS calibration provide operators with more reliable process data for improved process control and regulatory compliance. It is also MCERTS approved.

Systems that offer continuous monitoring of turbidity and total suspended solids are helping water companies to manage coagulant dosing and filtering effectively. Previously, additional chemical dosing may have been applied to compensate for measurement errors. An effective system for measuring and controlling the correct coagulant dosing levels both reduces chemical use and the maintenance burden caused by chemical overdosing causing blockages in filtration.

Digital performance enhances the advantages of online (i.e. real-time / near real-time) measurement compared with traditional laboratory techniques. Previously, material output samples were taken for analysis from the source but as this method was slower, the composition of the sample could change, showing inconsistent results.

Dissolved Oxygen

Dissolved oxygen is a key ingredient in the efficient treatment of waste in wastewater processes. When it comes to the control aeration processes, it is vital that levels of dissolved oxygen used to encourage the breakdown of bacteria are controlled as closely as possible. Both excessively low and excessively high levels of dissolved oxygen can be equally harmful to aquatic life, making it essential for water treatment plants that levels are as close to ideal as possible before water is discharged. Water operators need to keep a close eye on levels throughout the water treatment process, from the treatment of waste at the aeration stage to the point of final discharge.

The latest generation of optical sensors offers several key features that eliminate many of the limitations associated with other forms of dissolved oxygen measurement, such as electrochemical sensors. In contrast with electrochemical sensors, optical sensors have no membrane or chemical components. The most advanced dissolved oxygen sensors work on the 'dynamic luminescence quenching' principle, a light-based measurement technique. The patented signal processing within the sensor enables it to respond to changes in process conditions up to five times faster than other optical systems, allowing improved process control and maximum process savings. The use of the dynamic luminescence quenching principle also means that the sensor is not susceptible to drift, removing the need for frequent maintenance.

Getting more from data with digital transmitters

Digital transmitters provide secure access to data when and where it is needed. ABB's common HMI makes data access, calibration and troubleshooting, simple and intuitive. Software updates and sensor information can be accessed via a smartphone. Bluetooth technology provides up-to-the minute information and technical support via ABB's EZLink connect app. The transmitters allow for a mix-and-match of analog and EZLink digital sensors to be connected.

Summary

The increasingly urgent need to manage the world's water supplies more sustainability is putting the onus on both municipal and industrial users to optimize their wastewater treatment processes. With its ability to provide a clear and real-time picture of water quality, digital measurement can help operators to ensure that the quality of the water they discharge back to the environment meets the highest levels of quality and safety.

For more information, visit www.abb.com/analytical

ABB offers a range of MCERTS approved pH probes

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