Using online, real-time monitoring to safeguard water quality

Online instruments help water utilities control water treatment operations. CEO Rick Bacon of Aqua Metrology Systems explains how utilities rely on sensors to meet water quality compliance standards and optimize operational performance.

Fewer than 20 years ago, online sensors that allowed continuous, real-time monitoring of water quality and treatment system performance did not exist. Today, high-frequency data is playing an integral role in aiding water utilities to not only identify contaminant threats, but also in diagnosing critical treatment system performance after applying a solution.

The inefficiencies associated with minimum sampling frequencies, such as the time it takes to obtain results from lab analysis, are creating a need for online monitoring of arsenic, hexavalent chromium, trihalomethanes (THMs), and more. Through the use of more accurate diagnostic technologies such as online THM and trace-metal analyzers, utilities are now able to consistently deliver water below regulatory levels.

Meeting regulatory requirements

El Paso Water, a public utility that serves the city of El Paso, Texas, United States (US), is seeing first-hand how real-time, accurate, and reliable data is helping its Upper Valley Water Treatment Plant (WTP) manage changes in water quality, treatment processes, and ultimately deliver drinking water that meets the 10 parts per billion (ppb) regulatory requirement for maximum arsenic levels.

The treatment facility removes naturally occurring arsenic found within the 21 groundwater wells that make up the Canutillo well field. The plant treats up to 114 million liters (L) per day of groundwater for blending with up to another 114 million L per day of untreated groundwater to produce a finished product with an arsenic concentration of 8 ppb or less.

Upper Valley WTP uses a comprehensive testing scheme composed of online, benchtop, and external arsenic analysis to remain compliant and adequately control and optimize its treatment process and remediation system. The results from the three different testing methods are compared to determine water quality changes and necessary adjustments to the treatment processes.

Upper Valley WTP installed three ArsenicGuard™ automated online arsenic analyzers, an earlier version of the MetalGuard™ automated, online arsenic analyzers from Aqua Metrology Systems (AMS), based in Sunnyvale, California (US) and formerly TraceDetect. The analyzers provide high-frequency, real-time data on arsenic contaminant levels in 30 minutes with sensitivity down to 1 ppb. Two of the analyzers were put in place to monitor the plant's raw and finished water, and a third is located at the offsite clear well. The online analyzers take samples every two hours, checking arsenic levels in the plant's influent, and effluent, as well as at the bottom of the media bed. The plant also pulls daily samples from these three locations and inline analysis is performed on AMS SafeGuard benchtop analyzers. Twice per week, samples are sent to an external lab for analysis.

With online data, as arsenic levels fluctuate, the plant can turn certain wells on to further blend the water. Upper Valley WTP Superintendent Ray D. Shay says, "The online arsenic analyzers have been an asset to our facility and they have given us a peace of mind that was not possible before when we relied on more traditional analytical methods, which provided slower results. Staying on top of water quality changes and its impact on arsenic levels has allowed us to adjust our treatment process in real-time to remain in compliance with EPA arsenic regulations."

California's Hidden Valley Lake Community Services District and AMS personnel at the Cr(VI) remediation system pilot demonstration site, which has Cr(VI) levels of 18-22 ppb. Photo by AMS

Contaminant levels in real-time

In the US, California American Water delivers clean, safe water and wastewater services to 690,000 residents. Yet, more than 300 public water utilities across the state have elevated levels of Hexavalent Chromium [Cr(VI)]. At two of its well sites – Moonbeam and Oak Forest/Citrus Heights – the utility was experiencing elevated Cr(VI) levels in the 25 ppb range after well water was filtered with granular activated carbon (GAC) and before being stored at a 18,900-liter (5,000-gallon) hydro tank.

Extensive research didn't uncover the cause of the Cr(VI) load to the GAC filters and without timely and accurate chromium analysis, California American Water would not be able to keep these wells open. As a result, the utility turned to AMS's MetalGuard Chromium, a fully automated, online, multi-stream Cr(VI) analyzer, which allowed them to monitor and address critical steps in their remediation process.

The Cr(VI) analyzers were installed and connected to the motor starter of the wells — Oak Forest/Citrus Heights was installed in February 2017 and Moonbeam in February 2018. To date, the analyzers have collected 39,254 samples at Oak Forest/Citrus Heights and 20,493 samples at Moonbeam, and both site's analyzers have an uptime reliability of 99 percent. To ensure uncontaminated water, if the analyzers detect Cr(VI) at 10 ppb or above, the well is automatically shut off. An operator would then take a sample which is sent to a lab, and if the lab values correlate with the Cr(VI) analyzer values, the system is

El Paso Water's Upper Valley Water Treatment Plant installed three automated online arsenic analyzers, which provide high-frequency, real-time data on arsenic contaminant levels in 30 minutes with sensitivity down to 1 ppb. Photo by AMS

flushed and retested before being put back online.

Pilot treatment system evaluation

Utilities' reliance on real-time monitoring also is extending to pilot treatment system evaluation. The high-density, immediate results allow thorough and rapid evaluation of treatment technologies and permit monitoring of system adjustments.

California's Watsonville Public Works & Utilities, obtains 85 percent of its water supply from a groundwater source where Cr(VI) is a naturally occurring mineral. As a result of Cr(VI) dissolving into the water supply, eight of its 12 inland water wells contain elevated levels of Cr(VI) – averaging 13 ppb of Cr(VI). In coordination with the California Environmental Protection Agency (EPA) and the State Water Resources Control Board - Division of Drinking Water Programs, the utility worked with US consultancies Hazen and Sawyer and Corona Environmental Consulting to conduct pilot testing to evaluate different Cr(VI) remediation technologies for an economical and effective treatment process plan.

A reduction/coagulation/oxidation/filtration (RCOF) process was pilot tested under a variety of simulated operational conditions at four of the utility's eight affected water wells. An AMS MetalGuard Cr(VI) monitor was used to provide multi-stream analysis of influent and effluent chromium levels. Once the Cr(VI) monitor was validated, the analytical load for laboratory analysis was decreased.

During pilot testing the Cr(VI) monitor helped capture a high-frequency data stream, which was combined with other process data to simulate the impact of operational changes on contaminant levels and help validate the RCOF treatment methodology. Examples of operational changes include varying chemical feed dosing levels, contact time, and backwash frequencies. Furthermore, at the unattended Watsonville pilot, the online analyzer alerted to a dozing pump failure at 3 am on a Sunday when the next scheduled visit was two days later. The alert allowed for the system to be shut down – with repairs undertaken within hours – and brought back on stream quickly and efficiently.

Another benefit of the online Cr(VI) analyzer is that it enables engineers to monitor a Cr(VI) pilot remotely, avoiding the need for onsite sampling as well as the wait time for results. The benefits of accurate, reliable, and near-instantaneous chromium data extend from pilot to full-scale applications because online analyzers allow utilities to make immediate adjustments to ensure system optimization and compliance.

Regulatory control

Today, utilities are looking to better understand rapid changes in their water quality and the resulting effect on THM levels. Online THM and THM Formation Potential analyzers have played an important role in the compliance strategy of Aigües de Barcelona – the leading water utility in Spain and part of the Suez Group. Aigües de Barcelona provides drinking water to more than 3 million people across the Barcelona metropolitan area from its Sant Joan Despí Drinking Water Treatment Plant (DWTP). During the hot season, remote zones of the distribution network were experiencing THM values up to 80-90 microgram per liter (µg/L).

The utility selected AMS' online THM-100 predictive analyzer to continuously monitor THM levels in its drinking water supply network. One analyzer was installed at the exit of the DWTP and four more at strategic locations along the distribution network.

As a result of the continuous THM-level monitoring, the DWTP was able to optimize its treatment. During low, daily THM and THM-formation potential levels, treatment is adjusted so that a lower percentage of water is treated by the reverse osmosis (RO) line, producing an average cost savings of more than $35K per month.

In addition to providing the utility with contract compliance and process optimization data, THM readings are also used to submit regulatory compliance data. Aigües de Barcelona received accreditation to the ISO/IEC 17025:2005 Standard for use of the THM-100 analyzer in 2016 – a significant breakthrough in the application of online-based instruments for regulatory control of water quality.

Miguel Paraira Faus, water quality director of Aigües de Barcelona, says, "The value of online THM and THM-Formation Potential monitoring has been tremendous for Aigües de Barcelona. We have been able to not only optimize our treatment processes while improving water quality for our customers, but also improve the confidence of the regulators."

Mission critical data

Online analyzers are enabling a growing number of water utilities to gain real-time control of the performance of treatment systems, acting as a "canary in the mine" by providing alerts when these systems fail, in order to avert human and environmental health risks. Being in control of the "what if" scenarios to see the impact of multi-parameter operational changes on contaminant levels is empowering water systems and giving them confidence in their ultimate mission – to provide safe drinking water for all.

Intelligent systems integrate real-time sensing with remediation

Historically, water treatment systems – from the simplest to the most sophisticated – have had neither the capacity to determine whether they were under-treating or over-treating, nor the ability to identify performance issues in a timely fashion. The asset owner typically receives little support to optimize system performance and is often left to manage expensive system failures caused by a wide range of factors – including sudden and unpredictable changes in influent quality, unanticipated hardware component failures, operator errors, and seasonal and diurnal variations in temperature.

The advent of intelligent water treatments is shifting this paradigm. Intelligent water treatment systems incorporate real-time sensing to ensure optimized performance to avoid under- or over-treatment, and to signal any deterioration to permit timely remedial intervention.

AMS deployed the first intelligent water treatment system in the US – SafeGuard H2O™. The system integrates real-time sensing with a remediation system to address a range of trace metal contaminants, including Cr(VI), lead, ionic mercury, and selenium.

A pilot demonstration of the AMS SafeGuard H2O Cr (VI) remediation system is underway at California's Hidden Valley Lake Community Services District (HVLCSD). The system generates a stannous ion reagent insitu via an electrolytic process, and has been proven to remove Cr(VI) to less than 2 ppb under challenging conditions with high levels of contamination.

Intelligent water treatment systems like SafeGuard H2O offer cash-strapped municipalities an alternative to substantial capital investments. These systems also offer peace of mind, as utilities will no longer have the burden of manually monitoring and maintaining increasingly sophisticated treatment systems for which they struggle to recruit and retain the skilled labor required for their supervision and maintenance.