Samplers Are Getting Smarter And So Can You

For over 40 years, the Clean Water Act (CWA) has been a primary force protecting our waters and dictating the work of treatment professionals. And, for just as long, samplers have been the tools that allow this work to be carried out. Just as the CWA has been amended over the years, so too have samplers undergone evolutionary changes to become more robust, effective, and convenient.

Many plants, however, have yet to embrace the advances in technology that are transforming one of their most fundamental tools. To help usher those plants into the modern age, Water Online spoke with Endress+Hauser's Steve Smith, senior analytical product marketing manager, and Tracy Doane-Weideman, marketing manager and analytics team lead, about how samplers have evolved to meet changing needs, how a plant can know if it's getting the most out of its device, and what they might be capable of in the future.

What water sampling requirements does the U.S. EPA currently impose?

In 1972, the Clean Water Act (CWA) established the basic structure for regulating the discharge of pollutants into the waters of the U.S. EPA-administered permit programs: The National Pollutant Discharge Elimination System (NPDES) is defined under 40 CFR part 122. This program serves as the primary mechanism for controlling discharges of pollutants to receiving waters. Effluent limitation guidelines and standards are established by the EPA.

In order to comply with the regulations, permit holders must either use on-line measurements where allowed or collect samples that are subsequently analyzed using laboratory methods. While manual sampling is acceptable, it is not an efficient use of personnel for many permit requirements such as composite sampling, flow-paced sampling, or remote location sampling. These, among others, established the need for automated sampling devices.

The EPA publishes a 400-plus page guidance document called, "Handbook for Sampling and Sample Preservation of Water and Wastewater." This document covers a range of topics such as sample preservation, sampling programs, statistical approaches to sampling, and application of flow to sampling. When considering automatic sampling, items such as suction lift, sample volumes, specifications on sample transport (tubing size, sample velocity, and line purging) and sample storage (sample storage volume, storage temperature, and collection bottle material), and control methods are outlined in the handbook.

How have samplers moved beyond simply meeting these requirements?

Historically, samplers were designed to do one thing — that is to draw a sample of liquid from a process at a specific frequency or timeframe, and place it in a container. To accomplish this task while meeting the minimum EPA requirements, all a sampler needed was a pump, controller, containers to hold the sample, and potentially a refrigeration system.

Today, samplers are moving beyond just meeting EPA requirements to their evolution as sophisticated "measurement stations." To make this evolution, the simple controller has developed the incremental ability to integrate sensors and communicate with a range of digital protocols. Expansion in sampling routines, multiple pumping technologies, and intelligent cooling systems have all contributed to functionality well beyond EPA requirements.

Do most treatment plants use samplers to their full potential?

The answer to this question is dependent on the functionality available in the treatment plant's sampler. As outlined above, many samplers are designed simply to draw a sample and place it in a container; therefore the plants with a very basic sampler are using it to its full potential. What treatment plants should be asking is, "Is there sampler technology out there today where I can expand the benefits I receive from the system?"

For example, newer sampler technology, such as the Liquistation CSF34, allows you to connect multiple analytical sensors to the sampler, leveraging the electronics while reducing capital equipment costs by increasing the functionality to include the addition of multiple, advanced process sensors and reducing the need for additional sensor electronics. Additionally, the sensors connected to the sampler can be used to trigger unique sampling programs and place the sample in a specific container. This approach allows treatment plants to use the sampler to diagnose excursions, resolve process issues, and collect the obligatory composite samples for regulatory purposes.

What treatment plant data is a modern sampler capable of collecting?

A modern sampler is capable of collecting a range of data. Not only can the sampler provide detailed information about the sample collection process, but the smart electronics can track and log events, diagnostic messages, and external sensor data. With the ability to connect up to four separate analytical sensors, the modern Liquistation CSF34 sampler can collect process measurement data and log that data while transmitting it to a SCADA system for process monitoring and control.

For example, one sampler could be connected to a pH probe, UV nitrate probe, ion-selective electrode technology for ammonium, and optical dissolved oxygen for aeration control, just to name a few sensors for one application. With its digital communications capability, this sampler could easily transmit all the measured values back to a control system using digital communications.

How can a plant utilize this data to increase efficiency?

One way data makes you more efficient is by sending you the information in real time. By connecting multiple sensors to a sample you can expand your knowledge of the process, allowing you to make adjustments for increased efficiency. With smart electronics also come the ability to access the sampler remotely using web browser-enabled interfaces. If the sampler contains Ethernet communications, the ability to access and monitor the sampler is available any place where you have network interconnectivity. Through the web browser interface you can monitor the system's health and make real-time decisions without needing to be in front of the sampler. Problems can be identified remotely with the efficient deployment of resources to address the issue.

What different transport technologies do samplers offer and what are the advantages of each?

There are two basic transport technologies available today in samplers: peristaltic pump or vacuum pump. Most sampler suppliers today only offer peristaltic pumping technology. Some suppliers offer vacuum. There are sampler offerings on the market today, such as the Liquistation, that can offer either pumping technique, with the ability to easily retrofit the system in the field.

Peristaltic pumps rely on a section of tubing and a roller assembly that moves over the tubing, squeezing the fluid through the tubing and delivering it to the collection vessel. This makes it suitable in situations where volatile organic compounds (VOCs) are a measured constituent. However, due to the mechanical wear on the rollers and tubing, this approach requires more routine maintenance than a vacuum pump.

Vacuum pumps use a vacuum to draw a sample into a chamber that fills to a predetermined level. Once filled, the chamber contents are discharged into the collection vessel. This makes the vacuum system ideal for samples with large particles; and with the increased head height, transport speeds can easily be maintained when the sampling point is farther away from the sampler. With no moving parts, the vacuum pump approach has lower maintenance requirements and does not macerate the sample.

Why is event-based monitoring such a major change for samplers?

If a sampler is activated by a simple timer-based controller it can do nothing more than collect samples at predetermined intervals. If a process interruption were to occur between sampling times the facility would have no way of knowing the process disruption occurred and would have no information to help diagnose and address the issue. With event-based monitoring, an external sensor can connect directly to the sampler, providing real-time data. If a process disruption is measured using an analytical sensor the data can be used to initiate a sample and collect a sample in a specific collection bottle. This is a major change for samplers as it turns them from being "dumb" sample collectors to "smart" process monitoring systems.

How do digital communication and remote access make a plant operator's workday better?

We all have ready access to virtually unlimited information and resources using the internet and we have incredible mobility when doing so. When process instruments are equipped with digital communications the level of information available to us increases substantially. Combining the wealth of information with remote access using tools such as web interfaces and the internet, we now have valuable information about our process anytime and anywhere.

An operator's workday improves because they don't need to be in front of the instrument to interrogate the device and address issues. They can save time and make better use of resources when they can quickly and easily understand instrument performance simply by accessing the device over a digital interface.

How are flow measurement and sampling related and what's the advantage in bundling them?

It is not uncommon to tie sampling to flow measurement. As the flow rate of a process stream increases, it may be necessary to increase the frequency of sampling, and if the flow slows down the frequency of sampling may need to slow down. This "flow-paced" approach to sampling allows the user to obtain truly representative samples regardless of the flow rate. The vast majority of samplers today have flow-paced sampling capability.

What's going to be the next big thing for samplers?

This is an excellent question and I wish I had a good answer for it. While my crystal ball is not that clear, I can say that instruments, and samplers, continue to get smarter, they continue to be more interconnected to the process, and we continue to desire less involvement with their operation due to built-in health checks and advanced diagnostics. We hear a lot about the interconnected enterprise and how the Internet of Things is evolving with the potential to significantly impact our lives. Samplers could be part of this by not only taking a sample, but performing some analysis and automatically making adjustments without any human involvement. ■