WHY SAMPLING SYSTEMS HAVEN'T IMPROVED – THREE MAIN REASONS

In the past 50 years, process analyzers of all kinds have gotten better and better, but sampling systems have not. This is a strange set of developments.

Many process analyzer sampling systems in today's plants are not fulfilling their intended purpose, which is to deliver an uncontaminated, representative sample to the analyzer without excessive time delay.

The result is compromised or inaccurate analyzer readings and, by extension, chemical and petrochemical products that are not within specifications. There is also the potential for safety issues associated with improperly designed sampling systems.

The reasons for this situation are complex but can be boiled down to three main ones:

1. A lack of training and learning opportunities
2. Not seeing the whole picture
3. Making unauthorized, undocumented, and/or improvised changes to the sampling system

Let's review each of these reasons and some solutions that are well within reach for all plants, technicians, operators, and engineers.

Lack of Training and Learning Opportunities

To our knowledge, there are no university programs that provide courses dedicated to sampling system engineering. Most training institutions scarcely scratch the surface of this important area. In addition, there's little opportunity to learn on the job, and few engineers and technicians can spare the time to attend even a one-week training course.

As a result, many major industrial companies have reduced their sampling system engineering staffs and outsourced those needs to system design and fabrication specialty firms. However, even these firms have few people with the necessary skills.

Inexperienced design engineers can make mistakes that may survive the review process simply because the reviewing engineer knows even less about the system. Then, if the system doesn't work and the operators make on-site adjustments, the designer may never learn from his or her mistakes.

To overcome knowledge gaps in sampling system design, engineers, integrators, technicians, and other industry professionals are encouraged to seek qualified training programs that address the complexities and underlying design principles of sampling systems and subsystems.

Swagelok offers sampling system training courses for all levels and interests, each taught by industry experts with 30-plus years' experience. To learn more, click here.

Failure to See the Whole System

An installed process analyzer is part of a complex, interrelated system that includes the analyzer itself, the sampling system, the environment, and the process. Within this complete system, plants often consider a sampling system to be an add-on module that can be plugged into a larger system – very simply and without much thought.

But, in reality, that's not the case. A system of process taps must connect to a sampling system enclosure by way of transport lines. The measured sample must flow through a series of vessels, tubes, and devices that ensure the sample is in a condition suitable to the analyzer. Depending on the climate and the processes occurring in the sampling system, temperature control may be an issue. Flow through these systems must occur within a specified period of time and without changing the sample.

At any point along the way, a single error can bring the whole system down, producing an inaccurate or unhelpful result from the analyzer. (Further, it may not be readily apparent the result from the analyzer is incorrect.)

Therefore, if we focus only on the sampling system design – apart from other connecting points – we leave ourselves open to a wide array of mistakes in other parts of the system.

To ensure success, the analyzer engineer should evaluate every part of the system, including the processing itself, the location and design of sampling taps, probes, transport lines, and other critical components. Proper training will prepare the engineer to recognize and correct any problem areas.

Six Goals of Sampling Excellence

Analytical Goals	
Compatible	Obtain a compatible sample that will not harm the analyzer or prevent it from producing a reliable analytical result.
Timely	Secure a timely sample with an acceptable delay so the measurement is received while there is still time to act upon it.
Representative	Deliver a sample that accurately represents the product in the process line. A representative sample ensures a meaningful analytical result that is useful for its intended purpose.
Operational Goals	
Reliable	Produce a timely and representative analysis every time so accurate measurements are always available when needed.
Cost-Effective	Reliably produce all the desired benefits at the lowest overall cost.
Safe	Pose no threat to personnel, the environment, or process operations.

Making Unauthorized Changes

A sampling system with severe design deficiencies may work well enough to survive its original commissioning and acceptance. Any shortcoming may not be evident until the plant is at full capacity, the control loop is closed, or the laboratory results are available. If any issues arise, the sampling system will require some design changes.

Most industrial plants have a Management of Change (MOC) procedure that forbids ad hoc changes to system designs. However, supervisors often push maintenance technicians to make adjustments. In this case, technicians may experiment with sampling system changes until the system seems to work better. But if the sampling system never really worked in the first place, these unauthorized changes can cause more problems than they solve.

Therefore, plants are better served by enforcing the MOC and holding the sampling system designers responsible. Those designers will need to step in and fix the system to ensure proper operation. In doing so, plants should allow their technicians to be part of this process so they, too, can learn from the experience.

The Path Forward

So how can plants improve the quality of their sampling systems and, therefore, improve plant efficiency and product quality?

- They can make a commitment to in-depth education and training that covers the underlying principles and fundamentals of sampling system design.
- They can reach out to sampling system experts who can survey and troubleshoot existing systems.
- They can hold design firms responsible when newly installed sampling systems do not work or are unreliable.

Doing the above will help the industry ultimately realize sampling system excellence, and Swagelok can help in many of these areas.

Learn more about Swagelok's training courses in sampling systems.

Learn more about Swagelok's on-site surveys of sampling systems.

