CONTROL

Top Tips

5 Expert Tips for Optimizing Combustion Processes With In-Situ Zirconia Analyzers

Many industrial organizations today strive to optimize their combustion processes to reduce both fuel costs and emissions. While the importance of maintaining the correct air-to-fuel ratio in fossil-fuel-powered boilers, furnaces, and fired heaters is well understood, achieving this can be challenging. Among other variables, too much excess air will increase fuel consumption; too little will result in incomplete combustion, increasing carbon monoxide and particulate emissions. The right process control technology can help, but only if accompanied by reliable flue gas oxygen (O_2) measurements. Here, in-situ zirconia oxygen analyzers that provide reliable O_2 measurements in high-temperature, often corrosive, exhaust flue gas have emerged as the technology of choice.

In this Top Tips with analyzer experts at Fuji Electric, a leading global supplier of gas analyzers and other industrial instrumentation, we offer the following brief tips to get you started in the right direction.

1 Employ the right analyzer technology.

Without accurate and reliable O_2 flue gas measurements, you can't optimize the critical air-to-gas ratio in your combustion processes. In-situ zirconia sensors provide the reliable O_2 measurements needed without requiring the complex and maintenance-prone external sampling and conditioning systems associated with extractive analyzers. And, unlike extractive analyzers, in-situ analyzers can provide the boiler stack O_2 measurements in near-real time to support closed-loop combustion control and regulatory reporting.

2

Don't assume that all in-situ zirconia analyzers are the same.

The zirconia sensors offered by most major instrumentation suppliers will do a good job of measuring the net oxygen percentage in the boiler flue stack gas. But the analyzer *design* can make a significant difference in both responsiveness and total cost of ownership. The latter is particularly true when it comes to maintainability and sensor replaceability.

Consider that the typical configuration for the in-situ zirconia sensor is to be mounted on a long (and vulnerable) tube inserted deep within the stack. With this configuration, when it comes time to replace a sensor, it's likely that you'd have to call in your system integrator to disassemble the analyzer, withdraw the insertion tube, remove the sensor, and send it out for a rebuild. Then, of course, you have to cross your fingers and hope your distributor has an appropriate replacement in local stock. This can all be costly, time-consuming, and disruptive to your operations.

In contrast, Fuji Electric mounts its in-situ zirconia O_2 sensor in an externally accessible service cap. This makes it relatively easy for in-house personnel to quickly and easily replace the sensor. (And at least one U.S.-based Fuji Electric distributor prides itself on its ability to provide replacement zirconia sensors quickly from local stock.)

This configuration also offers additional maintenance benefits, including an available automatic blowdown option to help keep the transfer tube clean and free of soot.

3

Consider site-specific installation, process, and regulatory constraints.

As with all industrial instrumentation, it's important to consider common installation- and electrical-related requirements such as physical dimensions, flanging, mounting brackets, and appropriate line power. This applies to both the detecting and smart converting/transmitting components.

But with in-situ zirconia O_2 analyzers, it's particularly critical to specify appropriate materials for the flow guide tube and any other components that will come in contact with the flue gas. Depending on the process (e.g., boiler, furnace, incinerator), fuel type(s) and grade(s), relative temperature, corrosiveness, and particulate concentration in the flue gas, conventional 304 stainless steel components might not provide appropriate service. In these cases, you'll need to specify 316 stainless steel or more exotic alloys. Failure to do so would almost certainly significantly impact the functionality and service life of your analyzer. Here, you'll probably want to check with your distributor for specific advice before placing your order.

Environmental and safety ratings are additional considerations. In addition to appropriate ingress protection (IP) ratings for external components, hazardous-area certifications may be required for use in explosive industrial environments such as petroleum refineries, chemical plants, gas plants, pulp mills, and bakeries.

To support closed-loop combustion control, make sure that your O_2 analyzer can interface seamlessly with your controller platform using standard protocols. In addition, determine in advance how easily (and securely) it would be to integrate analyzer measurements, status, and diagnostics into your plant networks to support today's data-driven operations.

4 Identify the "DIY" factor for both upfront implementation and long-term oxygen analyzer maintenance.

Analyzer technology can be fussy to commission and almost always requires regular maintenance. This can increase your overall cost of ownership and impact availability, particularly if you have to depend on specialized third-party resources to do much of this work. In-situ zirconia analyzers can help here since they eliminate the inherent complexity, fussiness, and cost of external sampling systems, making this more of a do-it-yourself (DIY) solution. The modular design of some in-situ zirconia analyzers, such as those from Fuji Electric, also enable in-house I&C staff to perform most installation, commissioning, calibration, and maintenance tasks. These include both automated blowdown and, if needed, sensor replacement — all without having to call in costly and often hard-to get third-party resources. In addition to reducing service costs, this DIY capability can often also help reduce costly process disruptions.

5 Don't forget about the "back-end."

In addition to accurate and reliable O_2 measurements in the front-end combustion stack gas to help minimize excess air in the fuel-to-air ratio, you'll also need accurate and reliable carbon monoxide (CO) and particulate concentration measurements in the back-end exhaust stack gas. These are necessary both to optimize overall combustion control and meet regulatory requirements for emissions. These "back-end" measurements require different analyzer technologies, such as infrared analyzers for CO and light scattering analyzers for particulates.

To simplify your ordering, service, and spare parts processes, you may want to consider standardizing on a single, full-line analyzer supplier, ideally one that has extensive expertise in both the front and back ends of your combustion control applications. Fuji Electric, for example, can provide any combination of analyzers and other sensors, controllers, I/O, software, and local or remote human interfaces, plus combustion control application expertise, if needed.