TUNABLE DIODE LASERS AS A KEY SOLUTION FOR SAFETY IN COMBUSTION PROCESSES

Combustion in fired heaters has primarily been controlled to increase efficiency, thereby lowering fuel consumption and related costs. This control is achieved by balancing the levels of excess oxygen (O_2), and combustibles, generally carbon monoxide (CO).

Zirconia sensors provide the accurate, continuous O_2 measurements required, and some manufacturers offer a combined O_2 and combustibles sensor integrated within the same analysis solution.

However, in recent years traditional Zirconium Oxide cell technologies have been challenged by the introduction of Tunable Diode Laser (TDL) technologies, which deliver some significant performance advantages.

In a number of studies comparing TDL and Zirconium Oxide analyzers, the O_2 measurements for both technologies were found to be relatively comparable, while the TDL measurement for CO showed a faster speed of response than alternative methods such as Thick Film Calorimetry.

Safety has always been an important factor in combustion control, but that importance has increased because of recent changes in furnace operation and design.

The use of low-NOx burners has greatly increased; these are highly effective at reducing unwanted NOx emissions, but operate with a cooler, larger flame which is inherently less stable.

Flame instability has increased the need for improved flame-out detection, via CO and CH_4 detection. This has moved CH_4 analysis from a largely ignored measurement to a key safety monitoring requirement.

As well as flame instability, there is now greater industry acceptance that a potentially explosive fuel-rich, CO and CH_4, environment cannot be monitored by a combustibles sensor designed for CO trim control.

Advantages of TDL technology

Increasing safety demands mean that TDL technology has become a key measurement solution in combustion applications, especially for operators using natural gas as a fuel.

Unlike the point measurements offered by other techniques, TDL takes an average, cross-stack measurement across the process. This allows the analyzer to detect a flame-out situation across the entire pathlength.

Servomex provides a compact TDL analyzer, the SERVOTOUGH Laser 3 Plus Combustion, which can be optimized to measure CH_4 and CO at the same time. It is highly specific to these compounds, and so provides a detailed and reliable analysis of the process, improving safety.

In addition, the measurements it provides are taken across the full temperature range of the furnace, from start-up to operation, which is increasingly being recognized as important in safety systems.

Since TDL sensing provides a light-based measurement with no sample extraction, the Laser 3 Plus provides a very fast response to changes in the boiler condition.

This speed of response is vital, since the boiler can move from a safe to unsafe condition within seconds, so the faster the analyzer can respond, the more time the operator has to take corrective action.

Laser 3 Plus analyzers also incorporate "Line Lock" technology to prevent the analyzer measuring an adjacent line if the measurement gas is absent. This ensures that readings are correct and locked on the intended measure gas at all times – a clear advantage for safety systems.

Using TDL in safety systems

Boilers running in a steady state are very safe, and can be trimmed and controlled using O_2 and CO. For safety, it is important to monitor during start-up, when flame-out, causing high CO, CH_4 or reducing conditions may occur.

Good analysis at this stage can also provide a greater understanding of furnace conditions, potentially speeding up the start-up process.

It is also critical to monitor for changes in the furnace during operation. If the flame goes out or its profile alters, a pocket of methane may be created, undetectable by point measurements.

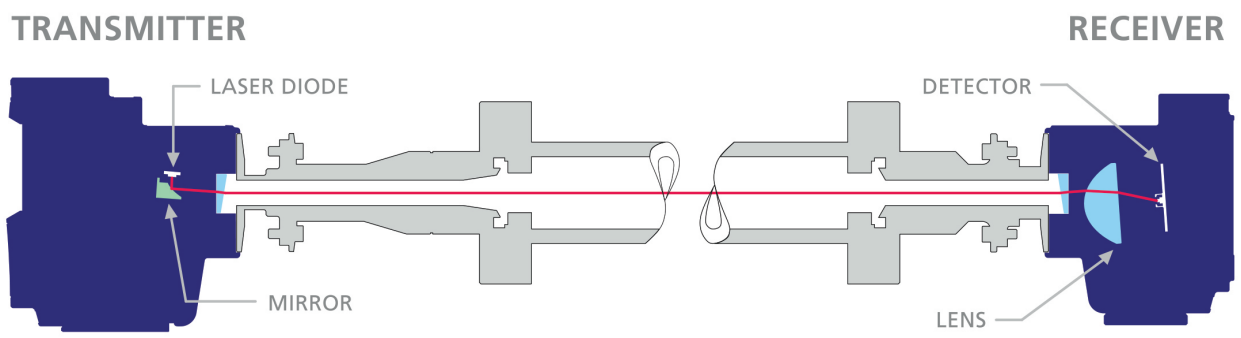
By measuring across the process, a TDL analyzer can detect a bank of burners that are not combusting correctly, allowing corrective action to be taken.

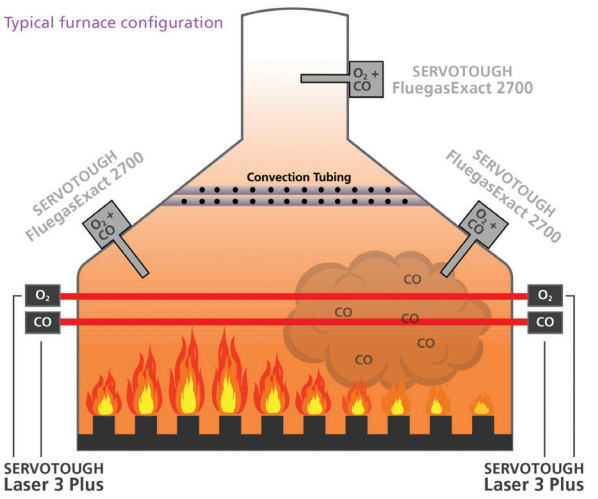
The TDL analyzer is only part of the overall control system. However, a robust, reliable and repeatable measurement is essential to avoid false highs (shutting the process down at a high cost) or false lows (failing to monitor an unsafe condition).

An overall safety system on a plant is designed to a particular Safety Instrumented Systems (SIS) level. The Laser 3 Plus meets Safety Integrity Level (SIL) 2, a high level of reliability and robustness, which reflects in a high level of confidence in the measurement.

It is, generally, the last factor in the protection cycle. It detects the breakthrough of the hydrocarbon while all other elements in the safety system look to prevent that breakthrough, making it an essential back-up to the primary safety system.

For more information visit servomex.com/l3plus.





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