Sustainability through optimisation

The LaserGas iQ² analyser is the first to measure up to four gases (O_2, CO, CH_4, H_2O) and temperature, which eliminates the need for multiple units for combustion analysis.

Stephen Scholtz of RTS Africa, the approved distributor and service agent for NEO Monitors in sub-Saharan Africa, argues that sustainability involves more than simply monitoring and reporting on emissions. It requires understanding and control of each step of a process, along with prolonged maintenance and support.

"Sustainability involves more than monitoring and reporting emissions. Understanding and controlling the entire process chain is crucial for prolonged maintenance and support. Through optimisation, we can directly increase product quality and profit margin; however, an often overlooked, secondary effect is the reduction in pollutant generation," begins Stephen Scholtz of RTS Africa.

"With regard to combustion, one of the most important industrial processes for providing heat and power to operations, the primary goals of plant operators are fuel efficiency and safety. Optimising the combustion process not only increases both these factors, but the generation of pollutants such as COx and NOx is also greatly reduced," he says.

Gas analysers based on Tunable Diode Laser Absorption Spectroscopy (TDLAS) have been used for many industrial process control and emission monitoring applications. However, the use of TDLAS for combustion analysis has always been a challenge. Balancing operator goals requires carbon monoxide (CO) measurements to be made across a high dynamic range. PPM readings need to be measured with high sensitivity for clean combustion while safe operation relies on accurately monitored percentage CO levels. Gas concentration is determined by scanning a laser with a known wavelength across a spectral region where the gas to be measured absorbs light. The laser is directed across the column of gas towards a photodetector where the light emitted from the laser is processed and monitored. The gas concentration is calculated using a function based on absorbed light and known process parameters, such as optical path length, temperature and pressure. With the gas' light absorption capabilities proportional to the concentration, less light received by the photodetector translates into a higher concentration of the target gas. Scholtz elaborates on the principle TDLAS: "In TDLAS, the wavelength of a laser is scanned across a narrow spectral region where the gas of interest absorbs light. As the laser light propagates through the gas, a fraction will be absorbed, which causes a dip in the transmission that can be quantified by collecting the laser light on a photodetector and monitoring its response. As the name implies, laser absorption spectroscopy measures the characteristic absorption profile (or transmission profile) of a gas from which the concentration can be calculated given knowledge of the measurement conditions (optical path length, temperature, pressure, etc).

Considering the abovementioned narrow spectral region, all gases have absorption lines at different wavelengths. When implementing TDLAS, it is crucial to select an absorption line that is not shared by gases that may present in the process stream. When scanning for CO there are several available absorption regions to choose from. However, each has its own limiting characteristics. Dr Peter Geiser, *et al*, 2019 writes: "While the band around 1.5 µm is too weak to achieve the desired sensitivity, the band around 4.6 µm is too strong and thus limits the upper boundary of the measurement range. This leaves the 2.3 µm band, where not only methane (CH_4) has strong absorption bands but some water vapour (H_2O) absorption lines are very strong at high temperatures."

To combat this challenge, NEO Monitors has developed a single combustion analyser, combining a new signal processing technique with two lasers in a single compact unit. One laser is responsible for measuring O_2 and temperature, with the additional second laser measuring the remaining process stream constituents: CH_4, CO and CO_2. In addition, the ability to monitor CO levels at the high dynamic range has allowed the inherent benefits of general TDLAS to be used fully across burner applications. The in-situ, cross stack measurement, when compared to extractive sampling, is superior for accurately representing the entire combustion zone, while fast response times are essential for detecting rapid concentration changes in highly dynamic combustion processes.

Unlike alternative technologies, TDLAS technology can continuously measure target gases without the presence of other gases, providing critical feedback on safe/unsafe operation while ensuring optimum air-fuel ratio control.

"NEO Monitors' LaserGas™ iQ² can therefore provide cost-effective and reliable fine control of the entire combustion process, contributing to a reduction in unwanted emissions and, most importantly, a safer environment capable of operating well into the future," concludes Stephen Scholtz. RTS Africa is the approved sub-Saharan Distributor and Service Agents for NEO Monitors.

www.rtsafrica.co.za

References

- Geiser P, Avetisov V, Wang J, and Sieker L: Smart combustion analysis; Hydrocarbon Engineering, December 2019, pp. 54-58.
- The key to Optimal Combustion Control NEO Monitors; https://neo-monitors.com/lasergas-iq²/ accessed: 12 July 2023.

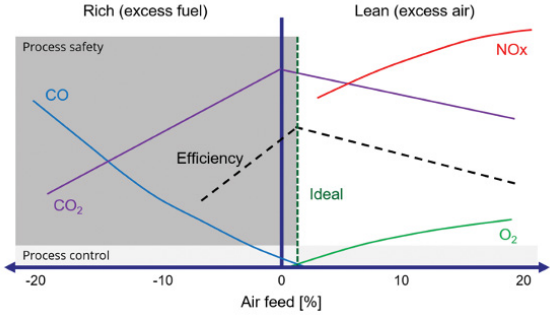

Figure 1: A combustion optimisation diagram. Optimising the combustion process not only increases fuel efficiency and safety, but the generation of pollutants such as COx and NOx is also greatly reduced.