Ensure Reliable, Continuous NO_x Emissions Monitoring with a Laser-Based Analyzer Solutions

Application Note

Process Overview

Nitrogen oxides (NO_x) emissions are heavily regulated around the world. Industrial combustion sites are required to report the amount of NO_x exiting their stack and often implement processes like DeNOx to reduce these emissions. The measurement of NO_x is therefore an indicator of process quality and plays a significant role in continuous emissions monitoring applications and compliance with environmental regulations.

As a major pollutant, NO_x emissions require increasingly strict, continuous measurement reporting with high sensitivity and accuracy. There is a growing need for reliable measurements with repeatable precision and a low cost of ownership.

Measurement Challenges

Operators are continually aiming to improve the efficiency of operation and comply with environmental regulations. However, traditional technologies for NOx measurement use high levels of consumables, moving parts and complex sample treatment. They also lack precision as they require the conversion of NO_2 to NO for measurement or the calculation of the NO_2 content based on an assumed NO : NO_2 ratio. In addition, common methods for measuring NO_x can be susceptible to cross-interference effects as measurement can be influenced by other gas components in the sample.

Operators are challenged to find robust measurement solutions that offer highly accurate measurement and direct analysis of NO and NO_2 with high availability and minimal maintenance and calibration requirements.

Processing plants are also challenged with upgrading a large installed base of aging analyzers that are increasing manual interventions and labor cost. And with limited capital for upgrade projects, there is an even sharper focus on the efficiency of capital allocated to process improvement initiatives. Operators are seeking a technology that is compatible with existing plant infrastructure to simplify integration and replacement and lower costs.

The Emerson Solution

Laser Absorption Spectroscopy is a gas analysis method that provides direct detection of gas molecules and identifies their concentrations at parts per million sensitivity levels. Rosemount™ Quantum Cascade Laser (QCL) Analyzers are continuous gas analyzers that utilize a unique hybrid laser spectroscopy technology which combines Quantum Cascade Lasers (QCL) with Tunable Diode Lasers (TDL). The lasers are optimized to the specific wavelengths required to target NOx emissions, providing fast, direct and highly selective detection of both NO and NO_2. The result is a more precise measurement of total NO_x for reliable, continuous emissions monitoring. The direct laser absorption spectroscopy also enables detection of individual gas species, free of the influence of CO_2 and other gas components in the sample.

As an upgrade to existing technologies or end of life replacement, Rosemount analyzers can be easily integrated into existing infrastructure, offering superior performance and reliability. In addition, plug and play technology and minimal service needs reduces analyzer downtime and enhances plant efficiency.

Rosemount CT4400 – A Plug & Play Solution for NO_x Measurement

The Rosemount CT4400 Continuous Gas Analyzer is a standardized spectroscopic solution designed to measure NO, NO_2 in dry/cold applications. It can also

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measure SO_2, CO, CO_2, and O_2 depending on selected configuration. It is available in a half-rack and full 19'' rack enclosure, allowing easy replacement of legacy analyzers and integration into existing plant infrastructure without costly consumables or maintenance maintenance.

The Rosemount CT4400 can hold up to four laser modules and measure multiple components simultaneously with enhanced dynamic range from sub parts per million (ppm) to percent levels.

Figure 1 *Designed for safe areas and cold/dry applications measuring standard components, the Rosemount CT4400 Continuous Gas Analyzer is available in half-rack and full 19'' rack enclosures.*

Figure 1 - NO and NO_2 Standard Measurement Ranges

Measurement Specifications for Standard Ranges [1]			
NO Performance [2]		**NO_2 Performance**	
Range (ppmv)	**LOD (ppmv)**	**Range (ppmv)**	**LOD (ppmv)**
0–50 ppmv	0.3 ppmv	0–50 ppmv	0.15 ppmv
0–350 ppmv	0.3 ppmv	0–120 ppmv	0.15 ppmv
0–750 ppmv	0.6 ppmv	0–300 ppmv	0.4 ppmv
0–850 ppmv	0.8 ppmv		
0–1500 ppmv	1.2 ppmv		

(1) Repeatability is ±1 % of reading or the Limit of Detection (LOD), whichever is greater
(2) Additional NO and NO_2 measurement ranges are available on request. Please consult an Emerson application specialist.

Reliable Monitoring of Combustion Flue Gas Using the Hybrid QCL/TDL Gas Analysis Technology

Whether operators need to measure just NO_x or a suite of gas components, the Rosemount Quantum Cascade Laser Gas Analyzers deliver sophisticated industrial gas sensing with minimal operational cost for a wide range of emissions monitoring applications because they allow simultaneous, multi-component gas analysis using one instrument, reducing the need for multiple analyzers.

As the world's only hybrid QCL and TDL analyzers, Rosemount Quantum Cascade Laser Gas Analyzers broaden insight and monitor both the near and mid-infrared range of spectroscopic light. This hybrid approach leverages:

- QCLs to detect and identify gas molecules in the mid-infrared wavelength range, allowing the strongest absorption lines and highest sensitivities
- TDLs which work in the near-infrared spectral region where laser sources exhibit higher performance

The results of this hybrid approach are a highly selective identification of the desired molecules and high-resolution measurements with very fast response times. With an update time of less than one second, these gas analyzers deliver critical monitoring information and ensure the mandated availability of continuous emissions monitoring systems (CEMS).

Implementing a laser-based analyzer solution for monitoring NO_x emissions enable:

- Direct, independent and inherently stable measurement of NO and NO_2 using the fundamental principles of direct absorption spectroscopy
- High gas selectivity and sensitivity down to sub-ppm concentrations, delivering accurate and repeatable measurements in real time and ensuring compliance with environmental regulations
- Elimination of NO_x convertors or ozone generators as part of sample pre-treatment, minimizing cost and maintenance
- Operational simplicity and low maintenance, ensuring higher reliability and analyzer availability
- Easy replacement of legacy analyzers with minimal disruption or additional expense because they are compatible with existing plant infrastructure
- Fast and easy installation, commissioning and upgrades thanks to a rugged, modular design and components

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