

Control Ammonia Slip and Nitrogen Oxides (NO_x) with Quantum Cascade Laser (QCL) Gas Analyzers

Process Overview

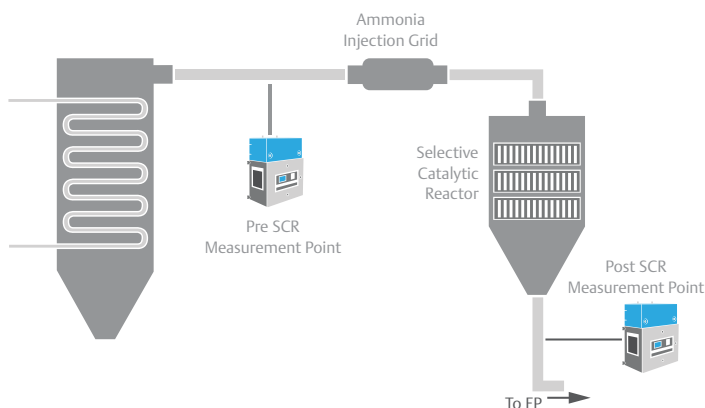
Nitrogen oxides (NO_x) result from the combustion process in turbines, crackers, combustion engines, boilers, and other locations within a plant. As a powerful pollutant, it is important to control and contain NO_x emissions. Selective Catalytic Reduction (SCR) technique is used worldwide to reduce NO_x emissions. This technique consists of converting the NO_x to nitrogen (N₂) and water (H₂O) by the reaction of NO_x and ammonia (NH₃). This reaction is sometimes referred to as DeNO_x.

Measurement Challenges

The SCR process can result in a byproduct of unreacted ammonia because the reaction between NO_x and NH₃ is never perfect, although it can achieve efficiency rates often higher than 95%. There is a waste stream of unreacted NH₃ that goes into the atmosphere. This excess NH₃ is known as Ammonia Slip.

To adhere to environmental guidelines, operators must use the precise amount of ammonia – too much results in waste, not enough can lead to NO_x emissions. Having a reliable, continuous measurement and monitoring of ammonia slip is important, especially in high dust, high-temperature applications where maintaining sample integrity can be a challenge.

Figure 1 - Typical NO_x Reduction Process



The Emerson Solution

Laser Absorption Spectroscopy is a gas analysis method used to detect gas molecules and identify their concentrations. 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) to provide fast, direct, and highly selective measurement of ammonia slip.

Combining QCL with TDL spectroscopy in a single instrument enables Rosemount Quantum Cascade Laser Gas Analyzers to broaden insight and monitor both the near and mid-infrared range of spectroscopic light. This hybrid approach uses QCLs to detect and identifies gas molecules in the mid-infrared wavelength range, allowing the strongest absorption lines and highest sensitivities in addition to TDLs which work in the near-infrared spectral region where laser sources exhibit higher performance. The result is a highly selective identification of the desired molecules and high resolution measurements with very fast response times.

Implementing a Rosemount Quantum Cascade Laser Gas Analyzer delivers highly accurate measurement (0–15 ppm) of ammonia in real-time, ensuring optimal production and mitigating ammonia overdosing issues, as well as associated economic and environmental problems. Another benefit of using Rosemount QCL Gas Analyzers is the ability to extract and measure the sample in a hot wet condition, eliminating the need to remove moisture content.

Table 1 - Typical Measurement Ranges

Component	Measurement Range	
	Ranges	LOD
NO	0-20 ppm to 0-500 ppm	<1 % of range
NO ₂	0-15 ppm to 0-500 ppm	<1 % of range
NH ₃	0-15 ppm to 0-100 ppm	<1 % of range

Other ranges, LODs and components available. Consult Emerson for more information.

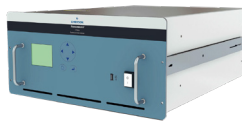
Emerson's solutions for ammonia slip include the Rosemount CT5100 and CT5400 Continuous Gas Analyzers. The Rosemount CT5100 is housed in a purged and pressurized enclosure suitable for hazardous areas, while the Rosemount CT5400 is housed in a 19-in. rack enclosure suitable for safe areas and is ideal for incorporation into existing infrastructure.

Tap into Emerson's application expertise to specify the right analyzer, design and deliver complete solutions that ensure:

- The measured gas reaches the analyzer for analysis
- The ammonia reaches the analyzer by preventing adsorption of ammonia onto surfaces
- The analyzer can handle gas sample temperatures up to 374 °F (190 °C) to stay above acid dew point and keep ammonia in vapor phase



Rosemount CT5100
Continuous Gas Analyzer



Rosemount CT5400
Continuous Gas Analyzer

Benefits of the Hybrid QCL/TDL Gas Analysis Technology

Using the latest gas analysis technologies enables plant operators to access performance data to stay ahead of environmental excursions and predict problems before they lead to failure. As the world's only hybrid QCL and TDL analyzers, Rosemount Quantum Cascade Laser Gas Analyzers deliver the most sophisticated industrial gas sensing and analysis, enabling plants to mitigate the emission of ammonium chloride and gaseous ammonia, as well as the formation of damaging ammonia salts downstream.

Benefits of Rosemount QCL technology include:

- Analyzing thousands of measurements per second using patented laser chirp technique to ensure identification of even trace levels of ammonia
- Reliable, direct measurement without the need for converters
- Interference-free monitoring of the presence of ammonia slip in the toughest environments
- Real-time measurement and analysis for dependable ammonia slip detection and insight into the efficiency of the plant's NO_x reduction system
- Rugged, modular design delivers measurement stability and reliability in extreme operations
- Compact system operating at high cell temperatures (up to 374 °F/190 °C) brings the analyzer close to the sample probe for speed and added reliability
- No consumables, in-field enclosures or shelters reduce cost and simplify maintenance and upgrades

Emerson.com/RosemountGasAnalysis

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