Refinery power plant gets tighter control of ammonia (NH_3) slip

RESULTS

- Increased plant efficiency and ensured process control with reliable, direct ammonia measurement
- Saved more than $150,000 U.S. in operating costs annually due to reduction of ammonia overdosing
- Ensured regulatory compliance and prevented costly fines of up to $175,000 U.S.

Plant operators turned to Rosemount CT5100 Quantum Cascade Laser gas analyzer to ensure repeatable, reliable measurement of ammonia and optimized SCR performance. This led to significant cost reductions through highly accurate ammonia dosing and reduced maintenance costs.

APPLICATION

Ammonia slip at Fluidized Bed Combustion (FBC) boiler

CUSTOMER

Hyundai OilBank, a petroleum and refinery company with its headquarters in Seosan, South Korea

CHALLENGE

To adhere to environmental regulations, plant operators must control and contain nitrogen oxide (NOx) emissions. NOx emissions result from the combustion process in turbines, crackers, combustion engines, boilers, and other locations within a plant. Both selective catalytic and non-catalytic reduction (SCR and SNCR) are techniques used to remove NOx. However, this process can result in a by-product of unreacted ammonia or ammonia slip. Operators must balance using the precise amount of ammonia – too much results in waste, not enough can lead to NOx emissions.

The efficiency of the SCR/SNCR reactor is determined by monitoring the outlet for excess ammonia. Continuous measurement and monitoring of ammonia slip can be a challenge to ensure sample integrity is maintained, especially since the gas sample at the measurement point is hot, wet, and laden with dust.

Ammonia slip can shorten the life of the SCR reactor, cause increased corrosion, contaminate the fly ash, increase ammonia salts build-up in the preheater, and increase ammonia release to the atmosphere.

The plant's fluidized bed combustion boiler previously relied on a traditional continuous gas analyzer that was installed at the outlet of the SCR. This analyzer didn't deliver the needed, consistent measurement and control of ammonia in the 1-2 ppm range to ensure SCR performance is at its optimum, so the plant relied on periodic validation of the analyzer and used lab reference values to inject ammonia. This caused ammonia overdosing issues that resulted in both economic and environmental problems.

EMERSON

Fluidized bed combustion boilers particularly have unpredictable moisture content, so process optimization is critical to lowering ammonia slip levels. The traditional gas analyzer couldn't perform the measurement on a hot and wet basis and required a complex sampling system with a cooler to remove water content, but the ammonia analysis problem remained.

SOLUTION

The problem was solved by installing a Rosemount CT5100 Quantum Cascade Laser continuous gas analyzer. With its hybrid Quantum Cascade Laser (QCL) and Tunable Diode Laser (TDL) technology, the Rosemount CT5100 provides sub-second response time for real-time measurement and analysis. Thousands of measurements per second are recorded using Emerson's patented laser chirp technique to ensure identification of even trace levels of ammonia, providing direct measurement without the need for converters. This fast, high-resolution measurement delivers the needed precision (0–20 ppm) with an NH_3 limit of detection down to 0.1 ppmv (parts per million by volume) and repeatability of ±1 percent to ensure the efficiency of the SCR performance. This helped the plant achieve savings of more than $150,000 U.S. in operating costs annually due to reduction of ammonia overdosing.

In addition, the analyzer is a compact system capable of handling high sample gas temperatures (up to 374 °F/190°C), which helps bring the analyzer closer to the sample probe for speed and added reliability. With its inherent calibration stability, the Rosemount CT5100 reduces the need for frequent calibration. It demonstrates practically no span drift, is easy to install, simplifies maintenance, and provides 100 percent data capture to satisfy reporting requirements.

The Rosemount CT5100 also helped the plant prevent the formation of ammonia salts, which could plug or corrode downstream components. It allowed operators to move away from costly consumables and complex sample treatment associated with legacy measurement systems, leading to improved gas detection sensitivity, selectivity and specificity in ammonia measurement and, ultimately, reduction of NOx emissions. This reliable measurement accuracy also reduced the potential for unexpected shutdowns and costly regulatory fines of up to $175,000 U.S. that could be levied under the Seoul Air Act.

RESOURCES

Rosemount Quantum Cascade Laser Continuous Gas Analyzers

Emerson.com/RosemountQCLAnalyzers

Linkedin.com/company/Emerson-Automation-Solutions
Twitter.com/Rosemount_News
Facebook.com/Rosemount
Youtube.com/user/RosemountMeasurement

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