Emissions Monitoring and Detection

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Requirements for reducing air pollution emissions have been evolving over the past couple of decades and today, are an intricate mix of limits, targets, and caps. In many parts of the world, industries emitting pollutants must not only comply with rigid emission limits, but also need to provide emissions data to numerous different agencies and bodies in order to comply with disparate legislative formats and reporting systems at the regional, national, and international level — and legislation is going to get increasingly stringent. The global community is working to improve cooperation between emitting sources and monitoring systems, and the legislation these systems support, in order to reduce the number of serious pollutants being released into the air, soil, and water. This collective action will help mitigate the negative impacts of emissions on human health and their adverse affects on the environment in coming years.

What this means for industry is that more pollutants will require monitoring from a greater number of emitting sources. For example, mercury (Hg) is rapidly moving up the agenda in the European Union (EU), the US, and Asia in advance of the legally binding United Nations EP Global Treaty on Mercury to be implemented in 2013. Advanced systems and methods will be required to measure lower and lower concentrations of pollutants as emission limits tighten. Increased accuracy will become paramount as pollutants, such as nitrous oxide (N_2O), methane (CH_4), and possibly Hg, are introduced to trading markets in the EU and US. Once a monetary value comes into play with trading, measurement accuracy becomes an economic target as well as an environmental one.

For those industrialised member states, including energy and emissions giant Russia, the Kyoto Protocol has already established legally binding commitments for the reduction of greenhouse gases (GHGs) down to 1990 levels by 2012. The Protocol also established a global carbon trust incorporating market-based mechanisms that can assign concrete financial values to each tonne of GHG emission. Although countries such as Russia still lack longer-term energy strategies to enable them to participate fully, the potential to benefit financially from selling surplus emission reduction credits to the EU and other member states internationally places even greater importance on emissions measurement and evaluation.

In March of 2009, the US Environmental Protection Agency (EPA) proposed the implementation of the first mandatory national carbon emissions reporting program to ensure a reduction of carbon dioxide and other GHGs produced by major sources in the US. GHGs, like carbon dioxide (CO_2), are produced by burning fossil fuels and through industrial and biological processes. Approximately 13,000 facilities, accounting for about 85–90 percent of GHGs emitted in the US, would be covered under the proposal. The new reporting requirements will apply to suppliers of fossil fuel and industrial chemicals, as well as large direct emitters of GHGs, with emissions equal to, or greater than, 25,000 metric tons per year. The direct emission sources covered under the reporting requirement would include energy intensive sectors such as cement production, metallurgy production, and electricity generation, among others. The first annual report will need to be submitted to the EPA in 2011 for calendar year 2010.

This type of initiative is being repeated at various locations worldwide to address climate change head on — in a straightforward manner with immediate financial incentives to drive rapid and economy-wide adoption of carbon reduction and market-based trading.

In 2005, the European Union published its Thematic Strategy on Air Pollution, which set out clear objectives for the reduction of a number of important air pollutants. While industrial emissions have decreased over the past few years they continue to have a significant impact on the environment and need to be reduced further. The largest industrial installations still account for a considerable share of total emissions of key atmospheric pollutants: 83 percent for sulphur dioxide (SO_2); 34 percent for nitrogen oxides (NOx); 43 percent for dust; and 55 percent for volatile organic compounds (VOCs). Recognizing that EU member states' projected air emissions would greatly exceed the 2020 targets of the Thematic Strategy on Air Pollution, more action was taken.

In 2007, the EU adopted new legislation to strengthen the provisions already in force and reduce further industrial emissions. The new directive aims to improve the uptake and implementation of Best Available Technologies (BAT), which maximize the use of technology in plant design, build, and operation in order to drive down emissions. Critically, it also tightens current minimum emission limit values for large combustion plants and introduces minimum provisions on environmental inspections of installations and incentives for the development and employment of environmentally-friendly technologies.

As legislation and action plans grow in number and stringency, the importance of monitoring and quantifying emission pollutants in an accurate and transparent manner is becoming a priority. Real-time and on-line reporting systems will be the aim for most large sources. As Lisa P. Jackson, Administrator for the EPA stated, "Our efforts to confront climate change must be guided by the best possible information. Through this new reporting, we will have comprehensive and accurate data about the production of GHGs. This is a critical step toward helping us better protect our health and environment."

EMISSION MONITORING TRENDS

Stephen Harrison, Global Head of Specialty Gases and Specialty Equipment at Linde Gases, says environmental concerns have come a long way since the 1970s, when acid rain caused by sulphur dioxide and nitrogen oxides prompted power stations to install sulphur dioxide scrubbers and selective catalytic reduction units (SCRs) for nitrogen oxide reduction, and motor vehicles were fitted with catalyzers.

"While these issues remain, global warming, GHGs, and CO_2 emissions have become the concerns of the 21st century, bringing with them the requirement to measure emissions at progressively lower levels and with greater accuracy," says Harrison. "We're trying to achieve clean air and a better quality of life for future generations.

"Up until quite recently, emissions measurement was carried out for compliance, resulting in fines for those who overstepped the mark. Now, however, day-to-day emissions measurement has financial implications and this shift from compliance to measurement is absolutely critical."

Harrison says the automation enabled by technological advances favors Continuous Emission Monitoring Systems (CEMS), while emission measurement instruments are becoming smaller and less expensive. This has heralded the way for gas phase measurement and gas phase calibration from gas cylinders, with a move away from manual and people-intensive "wet chemistry" measurement.

"Where government institutes used to carry out a lot of emission measurement themselves, today they have outsourced this function to a large extent," he says. "They retain control, however, by checking that industry complies with the standards. What we're seeing is a definite trend moving from control to compliance. Today, metrology has been commercialised and establishment of primary calibration standards has moved out of the government domain into that of the major gas companies. This development has been enabled by improved international standards and by global recognition of these standards, such as ISO 17025 and the emerging Guide 34. However, many pockets of local, national, and regional requirements are still in place, for instance the GBW standards in China and the US-centric EPA."

TECHNOLOGY FOR EMISSIONS MONITORING AND DETECTION

With the growing importance and prioritisation of monitoring and quantifying emissions, accuracy and reliability in measurement calibration is critical. The demand for stable, accurate measurement is the cornerstone of emissions analysis. However, calibration standards of low-level reactive mixtures, typically those with levels below 5 ppm (parts per million), can prove to be unstable over time and can result in incorrect measurements, lost productivity, and — with emissions monitoring — potential legislative fines.

To keep pace with technological advances and increasingly stringent legislative requirements, Linde's SPECTRA-SEAL® calibration gas mixtures use state-of-the-art packaging technology with proprietary cylinder treatment processes that exceed the increasingly demanding requirements for consistency and stability in a wide variety of calibration standards, down to part-per-billion levels. SPECTRA-SEAL® offers long-term stability for binary calibration gas mixtures requiring low-level carbon monoxide, carbonyl sulphide, methyl mercaptan, hydrogen sulphide, nitric oxide, nitrogen dioxide, sulphur dioxide, or moisture.

SPECTRA-SEAL® calibration gas mixtures provide at-line stability and extended shelf life.

With any gas used for calibration purposes, the most important requirement is that it can accurately and repeatedly report values of the relevant instrument being measured. Linde's HiQ® 60 specialty gas products were developed to provide accurate, stable gas products with a full 60 months performance guarantee.

In the US, the EPA has defined shelf lives for Protocol gases as between six to 36 months — depending on the gas and concentration — and similar shelf life standards exist in the ISO framework for reference materials. Not withstanding these international protocols, the development of what is an extended 60-month — or five-year — shelf life is a significant leap forward in the supply of calibration gases. Previously, gas suppliers across the market offered product expiration guarantees generally limited to 36 months, with many products available with only 12 or 24 months of shelf life. Gas products with these more limited shelf lives can impact measurement accuracy, as gas stability in terms of consistency and quality can change over time. Where consistency or purity of the gas has been compromised, this can result in expensive system re-calibration procedures, additional cylinder changeovers, and wasted human resource time.

A further development in emissions monitoring and detection has been the miniaturization of emissions monitoring devices, which are often dispersed across remote locations throughout a plant. These instruments demand smaller, highly portable gas calibration solutions. Linde's ECOCYL® gas calibration solutions include compact, light-weight gas cylinders, which not only meet the challenge of calibrating distributed devices, but are significantly more environmentally-friendly and cost-effective than more traditional, disposable, heavier-weight cylinders. Refillable, they help mitigate environmental waste or costly regulatory cylinder return and waste handling issues often related with typical disposable cylinder packaging. The cylinders also have a pressure of 150 bar, containing at least 50 percent more gas than most disposable cylinders.

"All our solutions reflect global trends towards improved accuracy and reliability of emission monitoring, as well as sustainability in the long term," affirms Harrison. "They're also addressing the requirements for reduced consumables usage, lower re-purchase cost, and lower cost of ownership."

For more information on Linde's specialty gases calibration solutions visit http://hiq.linde-gas.com or contact Linde at press@linde-gas.com. ■