High spec, clean tech

The role of specialty gases in environmental protection

By Stephen B. Harrison

Bob Brown, the Australian politician once said, "The future will either be green or not at all." As we seek to maintain our industrialised way of life in a sustainable way, employing clean technologies and high specification industrial gases has become critical and will become more so.

With this as the backdrop, it is no surprise that BOC Australia has recently announced the investment of AUD$20m to upgrade its Wetherill Park specialty gases manufacturing facility. Chris Dolman, Business Manager Specialised Markets at BOC Australia in Sydney, commented, "We live in a beautiful country with natural wonders like the Great Barrier Reef and the Gondwana rainforest which can only survive if we protect the cleanliness of our air, soil and water. But we also suffer from significant problems, for example reduction of the ozone layer which is caused by pollution created all over the globe, so environmental protection has become a real priority for Australia and at BOC we are proud to be making world-class specialty gases that are part of the solution to this problem."

Specialty gases, related gas control equipment and analytical instrumentation all play essential roles in environmental protection. From the use of synthetic air in the analysis of TOC levels in waste water to the use of high purity argon in ICP instrumentation for drinking water purity assay, specialty gases are in use daily. Measurement of heavy metal and organic chemical contamination in soil is also an area where specialty gases are consumed. Furthermore, high precision specialty gas mixtures play a critical role in analytical techniques that are required to protect the quality of the air we breathe.

At the heart of The Linde Group's specialty gases strategy is a commitment to innovation and clean technology. Dr. Roberto Parola, Global Product Manager for Specialty Gases and Equipment at Linde in Munich, added, "We stand ready to support end-users who need to keep pace with multiple environmental air emissions legislation changes globally. Our gases and equipment product range is in continuous development with a focus on what is required for the Marpol Annex 6 legislation for international shipping, the EU NRMM Stage 5 legislation for non-road diesel emissions, the Euro 6 transport emissions legislation and the EU IED and upcoming MCP legislation for stack emissions."

"Furthermore, we generate market insights into what might be required by future legislation such as Euro 7 and structure our R&D pipeline to anticipate market requirements accordingly."

Another related area where Linde is tracking market requirements closely is in ambient air quality. In the recent EU Air Quality Policy package a number of significant policy changes will be implemented, including the National Emission Ceilings (NEC) directive with an eye on 2020 to 2030 emission caps for NH_3, NOx, SO_2, non-methane VOC's and PM2.5 particulate matter across member states. Parola added, "The inclusion of VOC's in the NEC directive is of particular interest, as these are generally amongst the most high-tech, high-spec gas mixtures that Linde regularly produces for the environmental market."

High spec

For stack emissions monitoring, Air Products in Europe has optimised its ISO 17025 accreditation scope to serve its users and is one of the few gas companies to offer gas mixtures containing NO, SO_2, CO and CO_2 in the same cylinder.

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These multi-component gas mixtures are ideal for CEMS applications and avoid the need for users to order and handle multiple cylinders, thereby saving time and money. Coupled with high purity nitrogen delivered with a BIP® (Built In Purifier), this system makes a great combination for FTIR calibration and purge gases.

David Bryant, Air Products European Segment Programme Manager, Speciality and Medical Gases, added, "These calibration gas mixtures are provided with stability assurance, which our customers demand, even when the most reactive components are used. This is achieved by choosing the most suitable cylinder passivation treatment and filling techniques, according to the components used in each mixture."

Stack emissions monitoring is the final stage in the environmental management process but only reflects what has gone on before. The real work of 'clean technology' takes place in unit operations that reduce the emissions of pollutant gases and each of these operations requires process control measurement. For example, in many glass factories natural gas is combusted in air to melt the glass and the production of NOx is inevitable. To reduce the NOx emissions to levels required by local environmental legislation, the flue gases can be treated with a selective catalytic reduction (SCR) system. Urea is dosed prior to the SCR system where it decomposes at high temperature to form ammonia, which produces the right conditions to reduce the NOx back to nitrogen over the SCR catalyst.

To dose the appropriate level of urea, it is necessary to measure the NOx levels and adjust the urea addition in proportion. But, having solved the NOx emissions problem, it is unacceptable to create an ammonia emissions problem – so fine tuning of the process can be achieved with ammonia slip measurement in the flue gas to avoid urea overdosing.

The gas mixtures used to calibrate process control analysers are not generally required to be accredited according to ISO17025, nor must they be traceable to national standards. It is normally only the calibration gas mixtures used for calibration in the final stage of regulated emissions monitoring that must fulfil these additional high spec requirements. This opens up the market for process control gas mixtures to a wider range of certification levels which can be produced by a broad range of suppliers who operate good, but not world-class, specialty gas mixtures production facilities. So, in many emerging markets such as India or Thailand, it would be common to use locally manufactured calibration gas mixtures for process control applications and to import US EPA protocol gas mixtures or ISO17025 accredited gas mixtures to support the final stages of regulated emissions monitoring.

Clean tech

The NOx reduction process referred to above is the equivalent of the addition of AdBlue® to cars and trucks powered →

→ by diesel engines fitted with SCR units. To avoid the problem of ammonia emissions here, the EU recently introduced the requirement for ammonia slip measurement with a cap at 10 ppm (parts-per-million).

This change was both an opportunity and a challenge for specialty gases producers. On the one hand, more gases would be required by automotive emissions testing laboratories but, since the ammonia mixture is highly reactive and is required at ±3% accuracy, it requires excellent process control and high-tech gas mixture preparation and analytical techniques to ensure that the mixture is produced reliably.

Monitoring of ammonia in the US automotive emissions legislation is not yet required. However, the challenges for specialty gases producers to help end-users meet the requirements of US legislation are also very challenging and involve a range of highly reactive chemical species. For example, the US greenhouse gases emissions legislation calls for N_2O measurement. Producing accurate N_2O calibration gas mixtures requires the complete absence of oxygen and therefore requires perfect cylinder purging and filling discipline. However, the peak of sophistication in transport emissions measurement today is formaldehyde.

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With the increasing use of CNG and LNG as transport fuels, emissions of formaldehyde are on the increase because it is a combustion by-product of methane. As any specialty gases lab technician will testify, handling formaldehyde is something that requires both extreme caution and competence. Some components in gas mixtures have a lower level to which they can be filled or analysed, formaldehyde on the other hand, has an upper level at around 30 ppm…at higher concentrations it can spontaneously polymerise to paraformaldehyde!

To address the technical challenges of filling specialty gases mixtures which contain reactive components, Rotarex has over many years perfected the technical design and manufacture of its products such as the D405 stainless steel non-return cylinder valve and the associated SL/I 70 or SL/I 75 pressure regulator, which is employed in small portable specialty gases cylinders.

Mathieu Chatelet, Sales Manager and Key Account Manager at Rotarex Group in Luxembourg, added, “The technology inside our valves and regulators relies on very basic physics and mechanics, but the cleanliness and precision to which they are manufactured is unparalleled.”

“This combination of tried-and-tested and cutting-edge is what makes them highly suited to the high-spec, clean-tech environmental applications for specialty gases calibration mixtures involving ppm and ppb (parts-per-billion) levels of ammonia, oxides of nitrogen, formaldehyde and many others.” gw

About the Author

Stephen Harrison is an industrial gases consultant at sbh4 GmbH in Munich. He was previously global head of Specialty Gases & Equipment at Linde Gases and has 27 years of experience in the industrial gases sector.
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