Gas-free specialty gas applications

Where has all the gas gone?

By Stephen B. Harrison

Many diversified industrial gas companies expect their specialty gases business to be one of their growth engines. Double-digit revenue and profit growth has been the norm for decades. One driver of market growth for specialty gases has been international trade, which requires harmonisation of measurement that relies on accurate calibration gas standards.

Toughening environmental legislation around the world has also pulled for more specialty gases. The 2020 sulfur cap in the MARPOL Annex VI marine emissions; the EU Industrial Emissions Directive, the ongoing modernisation of the EURO 5, 6, and 7 automotive emissions legislation; and China's blue-sky initiative all count as examples. Specialty gases are also used in pharmaceutical drug discovery. Clinical labs also rely on them for diagnostic applications. These markets are growing as nations invest in public health and seek to meet the needs of growing or ageing populations.

On the other hand, specialty gas products are not immune to the concept of 'gas intensity' – progressive productivity improvements which mean end-users can do more with less gas. Furthermore, some established specialty gases applications are moving to gas-free technologies and there is a fascinating range of drivers behind this transformation.

Gas chromatography goes gas-free

Measuring trace levels of volatile organic compounds (VOCs) in ambient air quality (AAQ) monitoring for environmental protection, or indoor air quality determination for health, has relied on gas chromatography (GC) for decades.

The flame ionisation detector (FID) is a universal technique which is both well-known and easy to operate. The combination is known as GC-FID. Chromatography requires a carrier gas, such as helium. The FID requires a fuel gas, such as hydrogen and an oxidiser such as high purity air (zero air). Calibration gas mixtures containing precise amounts of VOCs are also required to validate the measurements.

Operating a GC-FID without specialty gases is not possible. But the use of an alternative gas analysis technique can eliminate the need for these cylinder gases. There is an emerging trend to use laser-based analytical techniques for the measurement of trace levels of VOCs.

Dave Worton, Science Area Leader, Gas and Particle Metrology Group at NPL explains, "Proton transfer reaction mass spectrometry (PTR-MS) is now finding more widespread application in AAQ monitoring. It belongs to the family of chemical ionisation MS (CIMS) techniques. Whereas the GC-FID needs an array of gases for its operation, the PTR-MS just needs electrical power and deionised water."

> "On the oceans, gas analysers inevitably get the roughest possible treatment…"

Gas chromatography also requires some patience. The results are known only a few minutes after the sample has been injected to the gas analyser. It is not a continuous, or on-line gas analysis technique. On the other hand, PTR-MS is. This means that it can be used for real-time analysis which is important in applications where the sample concentration changes rapidly in a highly dynamic way.

Offshore oil and gas exploration – without instrumentation gas cylinders

The GC-FID technique is also common for mud sample analysis in oil and gas exploration. These gas analysers are mission-critical on exploration drilling rigs. Without the analysis, the drilling operation is just guesswork. And without a chromatography carrier gas and the fuel and oxidant gases for the flame, there is no analysis.

On land, cylinder specialty gases are a good option but transportation of replacement cylinders to the rigs is expensive. Gerard Catchpole, Global Sales and Marketing Manager for the Gas Generator Division of VICI AG International, says that, "We recently introduced a new rack-mounted high-purity zero air laboratory gas generator designed with the offshore sector in mind." The big step forward here is that the air compressor is built-in.

These lab gas generators are used offshore to feed a GC-FID flame. That's a sensitive instrument which helps the drilling team to analyse mud samples in real time and guide the exploration towards the richest oil and gas finds. The compressed air on the rigs is often wet or oily. This is exactly what the GC-FID does not want for the flame, so integrating an air compressor to make clean dry air in the zero air generator means optimum analytical results day after day.

Back-up gas cylinder supplies are also not required because most operators run two generators side by side, each one at 50% capacity. If one needs servicing the other can ramp up to 100% until both units are available. "The rigs run VICI DBS hydrogen, nitrogen and air generators miles away from any service depot and getting spare parts to them is not so easy," says Catchpole.

"In the past, we sent our service teams out to the rigs. But with so many safety considerations now, offshore training certification takes about a week and is quite costly. Fortunately, with the digitalisation of our equipment and modern communications possibilities, we can advise the offshore crew remotely and guide them through the steps required to conduct maintenance or change out the rack-mounted unit."

CEMS calibration – without cylinder gas mixtures

As of 1st of January 2020, the low sulfur emission levels in the IMO regulations became effective worldwide. The measurement of nitric oxide emissions is also required. This brings maritime air pollution control closely in line with shore-based power plants, cement works and oil refineries where continuous emissions monitoring systems (CEMS) have been used for decades.

The selection of instrumentation for ocean-based emission monitoring can draw from lessons learned in land-based CEMS applications. ABB has decades of experience in emissions monitoring on land and at sea. Its marine CEMS Product Manager, Carolin Seubert, says that, "Simplicity is the key for CEMS at sea. On the oceans, gas analysers inevitably get the roughest possible treatment. Cruise ships on the Caribbean confront 10m waves during the hurricane season – that's just the way it is out there."

"Knowing that, we incorporated a robust non-dispersive ultra-violet (UV)

Limas analyser into our GAA610-M marine emission monitoring system. It uses light in the UV wavelength to analyse NOx concentrations. For the sulfur dioxide and carbon dioxide measurements, we rely on another low maintenance technology using light in the infrared (IR) wavelength. This is based on our renowned Uras26 non-dispersive IR gas analyser." Both techniques require minimal operator intervention.

Calibration of the CEMS instrumentation is a fundamental requirement for emission monitoring compliance. An analyser that is not correctly calibrated cannot be relied upon to report the required precise environmental emissions data.

The CEMS analysers are designed with busy maritime engineers in mind. The UV and IR gas analysers in the ABB GAA610-M are fitted with cells which are filled with gas mixtures of a known concentration that enable automated calibration of the gas analyser. "It's ideal for shipping operators because they do not need to take gas mixture cylinders on board to calibrate their CEMS gas analysers," says Seubert.

It might be good news for the ship's engineer, but it limits the growth opportunity for specialty gases in this emerging marine CEMS application.

The idea is no 'flash in the pan'. The equipment CEMS gas analysers are certified to DNV GL, Lloyds Register, ABS, Bureau Veritas, NK and CCS. Neither is the impact on specialty gases a 'drop in the ocean'; hundreds of ships are already using the GAA610-M system today and ABB has confirmed that hundreds more will be installing their gas analysers this year.

Pack up and go home, or go deeper?

Does this spell the end of growth in specialty gases? Most certainly not. The product group still makes a major contribution to integrated business models and is core to players that are focused in this space.

Yes, there are reasons for caution and good business planning, but there is no reason for alarm. Providing excellent products and tip-top service will also help to insulate specialty gases from the threat of competing alternative technologies.

As some specialty gases applications diminish, other opportunities emerge. The ongoing churn in specialty gases products and applications is nothing new and the constant innovation in the sector is one of its major attractions for the people who thrive in it. For companies with enough bandwidth, the incorporation of competing supply modes such as laboratory gas generators in a 'solution focused' product offer has been the answer. Integration across the value chain is also a potential solution.

The combination of gas supplies and gas analysers in a bundled offer is another potential route to insulate the specialty gases business revenue stream from the market dynamics that exist. Business partnerships may be a route to achieve these integrated solutions, or it might be a case of getting the cheque book out for some visionary M&A activities. gw

ABOUT THE AUTHOR

Stephen B. Harrison is celebrating 30 years involvement in the industrial gases sector this year. He was previously global head of Specialty Gases & Equipment at Linde Gas in Munich and spent more than 15 years with BOC Gases in the UK. He is now a consultant at sbh4 GmbH.