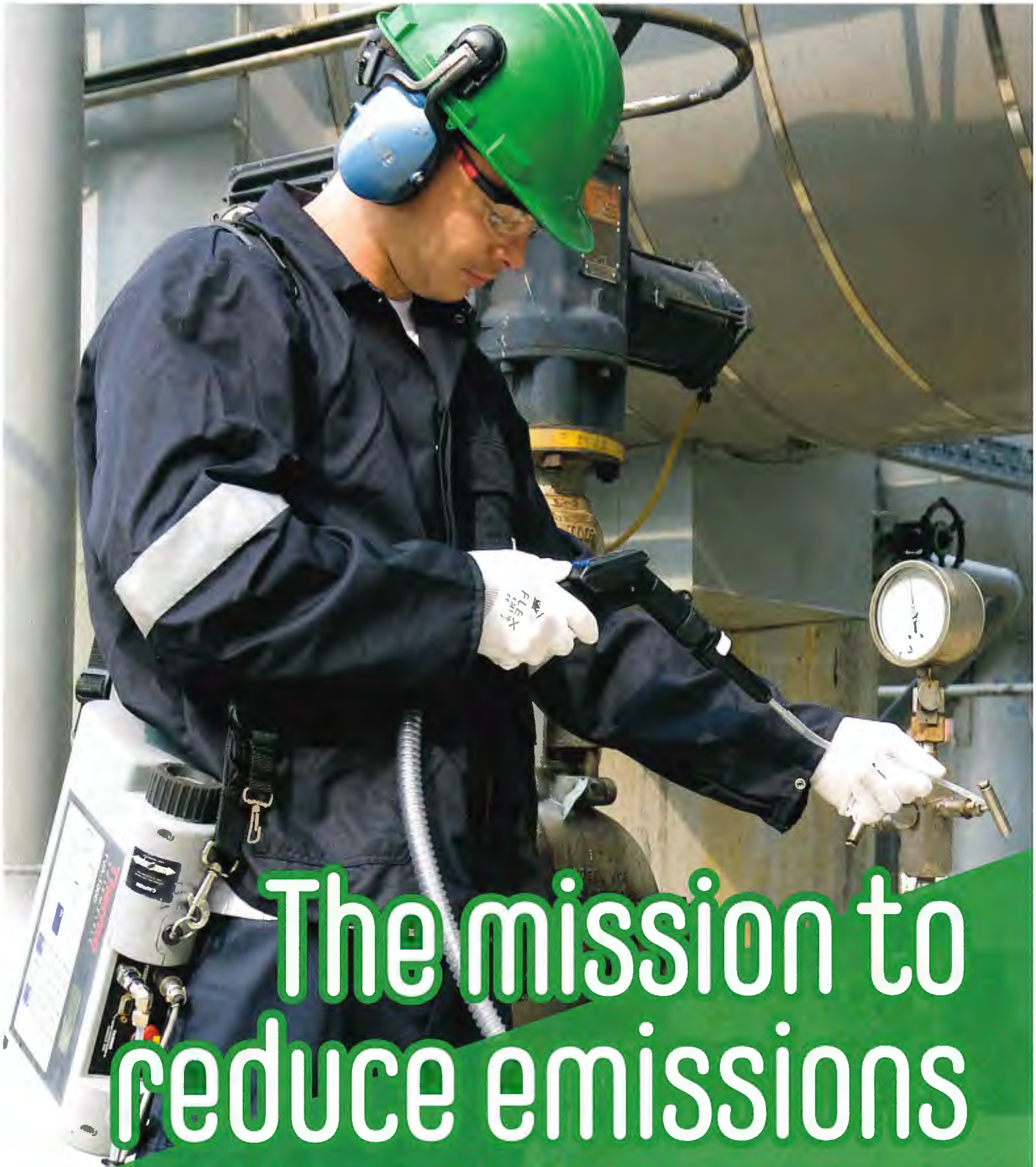

The mission to reduce emissions

Bart Wauterickx, The Sniffers, Belgium, outlines the techniques available to reduce emissions from compressor and valve stations on pipeline networks.

Methane transport through pipelines is a major tactic in current energy supply. With gas as the transition energy source towards a fossil fuel free environment, gas demand is expected to grow. Since the transport of energy or mega joules, in the form of methane through underground pipelines, is 10 - 20× more economic than the transport of the same energy through an electricity network, underground pipelines will be important for a foreseeable time.

Figure 1. LDAR measurements with FID VOC measurement device.

In an environment of sustainable development, asset owners are confronted with challenging objectives to reduce methane emission to the atmosphere. During the COP 21 Paris climate conference in 2016, the impact of methane having a GWP 23× higher than CO_2 has been made very clear. The industry is requested to do more to reduce emissions and actively contribute to a more sustainable future for our planet.

Figure 2. VOC screening with optical gas imaging camera.

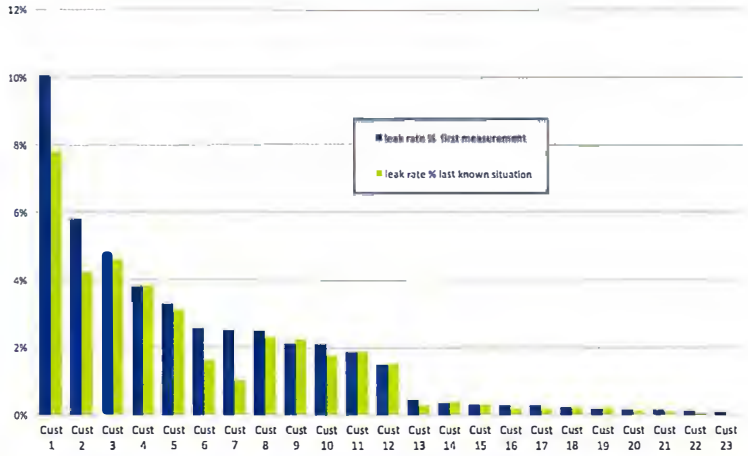

Figure 3. Leak rate percentage for 23 gas compressor stations.

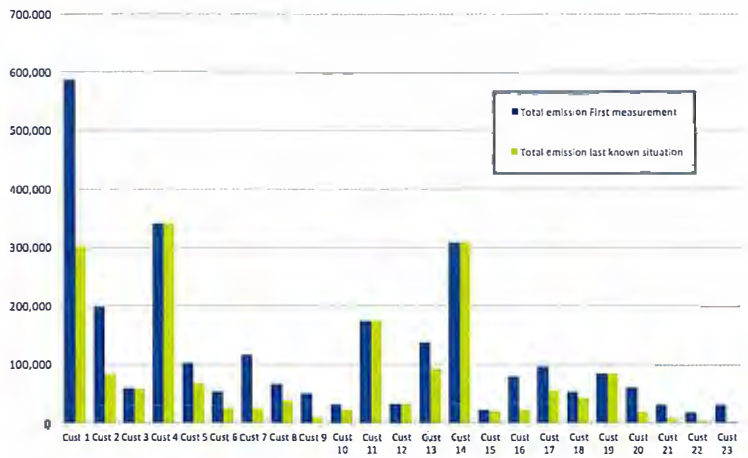

Figure 4. Total emissions in kg/y for 23 gas compressor stations.

This article describes the best available techniques to reduce fugitive emissions from compressor, measurement or valve stations that are built along a pipeline network.

Headquartered in Belgium, The Sniffers was founded in 1991. The company has its core business in oil and gas plants and in the chemical and petrochemical industry. Customers go to The Sniffers to measure emissions released into the atmosphere, to detect and quantify energy leaks, and to help them maintain the integrity of pipeline networks. The Sniffers' advice helps clients to reduce emissions, save energy, and prolong the lifetime of their assets. The company offers a set of innovative services that apply to transportation, production, monitoring and maintenance – LDAR, optical gas imaging, high flow sampling, ultrasonic, drone OGI and satellite information. The Sniffers relies on its vast knowledge of country legislations, the stability of a certified/accredited programme, proprietary software and long-term relationships with global customers.

A compressor, measurement or valve station for an underground pipeline network is confronted with canalised emissions (e.g. compressor seal leaks to a vent) and fugitive emissions. Canalised emissions are monitored with the appropriate flow metering; fugitive emissions are not always known and not always managed. Measuring methods like bagging or high flow sampling are very accurate but also time consuming and costly. A good balance between accuracy and cost has been reached over the years and delivered an adequate working practice with LDAR, based on EPA Method 21 Determination of Volatile Organic Compound Leaks and EPA 453 Protocol for Equipment Leak Emission Estimates.

A PID/FID measuring device is used to measure all concentrations of gas around every individual potential leaking source. The device is calibrated 3× a day and is set with the correct response factor relative to 100% methane.

Leaking sources are categorised in:

- Lower than 9 ppm.
- Leaks between 9 - 1000 ppm (1000 ppm defined as the repair threshold).[1]
- Leaks between 1000 - 100 000 ppm.
- Leaks above 100 000 ppm.
- N/A sources: not accessible sources that cannot be reached without removing isolation, or icing or outside reach.

These ppm values are converted into kg/y based on the correlation calculation principles as described in the EPA guidelines.

A less accurate measuring practice is the use of an infrared optical gas camera. This IR camera can visualise leaking gases from equipment; it cannot, however, quantify the leak. A correlation methodology called 'leak/no leak' has been developed to provide an estimate of the mass leaks.

Although the screening with an IR camera (also called SMART LDAR) is faster, the detection level is much higher compared to PID/FID detection. The quality of the IR screening is also very sensitive to the weather conditions and experience of the operator. The probability of finding all leaks above 100 000 ppm is high and the chances for missing leaking sources above 5000 ppm is also high.

A benchmark study has been executed for gas compressor stations involving 23 plants from Europe, South America and Asia. These plants were having potential leaking sources varying from 3500 - 50 000 in number.

Using the PID/FID measuring techniques or the optical gas camera, every potential source was surveyed, resulting in an average of 2.0% detected initially leaking sources (as shown in Figure 3), however with a variety ranging from 0.1 - 10.0% leaking sources. After a first repair attempt, the percent of leaking sources dropped to 1.65% with a range from 0.1 - 7.8%. This first repair attempt is, in most cases, a tightening effort.

Replacing gaskets and seals or executing a revision of a component, or even installing upgraded equipment, is mostly postponed to the next shutdown. In several countries, the legislation requires the plant to undertake a repair attempt within several weeks after detection of the leak. It is this mandatory repair activity that helps to reduce these emissions.

Based on the correlation calculation protocols as described at EPA – the identified leaks and the default zeros – mass leak can be derived for the total plant as shown in Figure 4. Expressed in kg/y, the initial emission of gas to the atmosphere per gas compressor station was 118 000 kg/y (range 17 000 - 590 000 kg/y). After the first repair effort, the average drops to 80 000 kg/y, or a reduction of 32%, with one maintenance intervention.

Figure 5 provides the mass leak per source. On average, an individual source in one of the 23 gas compressor stations is emitting 8.2 kg/y, calculated over the total of present sources (range 1.23 - 37.0 kg/y). A repair exercise based on tightening reduces the average emission per source to 5.5 kg/y (range 0.01 - 31.0 kg/y).

If a leak is detected, one can expect an emission of 828 kg/y (range 89 - 8500 kg/y).

The Sniffers' proprietary business application called SFEMP – Sniffers Fugitive Emission Management Program – enables customised enquiries in this emission data. An analysis on source type level indicates that most leaks are identified with connections and flanges, but most emissions in kg/y are present with dynamic seals such as compressor seals and stem valves. Benchmarking these results between peers reveals practices that drive better results than others.

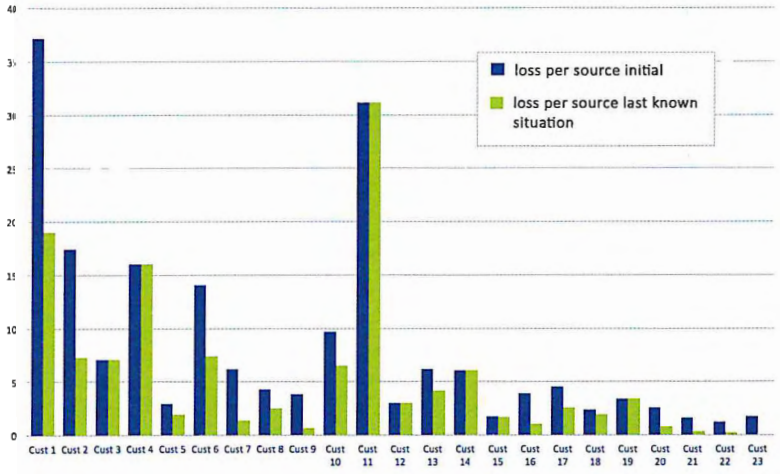

Figure 5. Average emission per source in kg/y for 23 gas compressor stations.

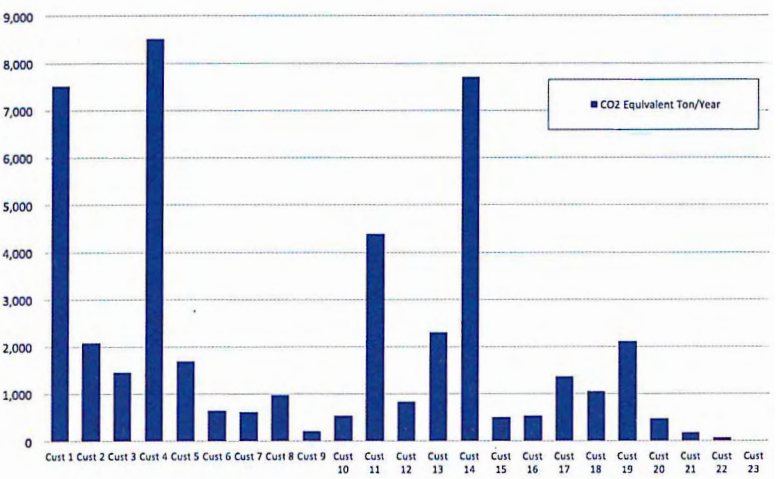

Figure 6. CO_2 equivalent emitted by 23 gas compressor stations (in tpy).

A recent publication by Carbon Limits from Norway analysed the effectiveness of repair activities for the gas industry in Europe.[2] Depending on the source type, in only 50% (range 45 - 70%) of the maintenance activities, the repair was effective in reducing the emission by more than 90%. In 30% of the cases (range 20 - 50%) the emission reduction was partially effective with only a 50% emission reduction realised. This result reflects the immediate effect without analysing the effect of the repair after several months or years.

The low immediate effectivity of repair attempts, mainly through tightening, invites plant engineers to reflect on its current practices. Why does a source leak?

- Can the technical specifications of the seals or gaskets improve?
- Are the assembly instructions still valid?
- Is the component supplier knowledgeable and ambitious enough?
- Can the design of the installation simplify?
- Is it possible to avoid connections?
- Are there negative environmental influencing factors like vibrations that can be reduced?

The benchmarking data between different players in the same business segment reveal the better practices. What you measure improves. By understanding how each site performs amongst their peers, real opportunities for improvement are revealed. Learning from each other and from the best available techniques drives any improvement plan. By intelligently using emission data and turning it into knowledge, the gas industry can position itself at a sustainable level for all stakeholders.

Not only the exploration of gas offshore and onshore, or only the gas processing plants, but also the transportation and distribution of gas can contribute to lower emissions to the atmosphere. In The Sniffers' study of 23 gas compressor stations, an average of 828 t of CO_2 equivalent was released every year. A quality LDAR programme with a local engaged maintenance team can reduce more than 70% of the initial emissions, in three or four years. Key success factors in this endeavour are:

- A detailed and updated inventory of all potential leak sources – this allows efficient organisation of measurement campaigns, source traceability and accurate emission calculation.
- Credible and reliable measurements: as costs are driven by the maintenance activities, clients like to have access to accurate and trustworthy data, which helps when prioritising maintenance work and business decisions. An ISO 17025 laboratory accredited measuring company provides that comfort.
- Just tightening is perhaps a short-term solution, but not the only activity to make a difference; proper LDAR software such as SFEMP enables the customised inquiry of detailed information, including historical reflections and source type information.
- Introduce the best available techniques (BATs) as a result of a benchmarking comparison to realise step improvements.
- A complete alignment between environmental and maintenance objectives at the plant is essential. Reaching lower emissions to the atmosphere is a common goal of both departments. Top management has to be outspoken of the ambition of the company to introduce sustainable solutions and make the world greener.

The Sniffers has more than 25 years of global experience in leak detection and emission reduction through LDAR programmes. Time and again these source-based measurements have proven to be the most effective method for emission monitoring and reduction. By providing clear and actionable data, The Sniffers enables pipeline asset owners to reach emission reduction targets and maintain process safety at the same time. WP

References and notes

1. Some legislations define a variety of repair definition concentrations depending on the source type.
2. Carbon Limits AS, 'Statistical Analysis of Leak Detection and Repair Programs in Europe'. 30/11/2017.