WHY MOBILE ANALYTICAL TECHNOLOGY IS THE ANSWER FOR EFFECTIVE NATURAL GAS LEAK DETECTION

The issue of methane leaks from natural gas pipelines is a very real one, requiring constant monitoring and control to minimize its impact for both environmental and safety reasons. With ABB's UAV-based mobile gas leak detection system being launched at the end of March 2021, Doug Baer, Global Product Line Manager Laser Analyzers for ABB Measurement & Analytics, explains how the latest generation of mobile gas leak detection measurement technologies can help.

Pipeline networks, especially ones which cross entire countries and run for thousands of miles, will always present an issue when it comes to leakage. The variety of factors at play in operating and maintaining a network, including aging infrastructure, network pressures and the efficiency of any maintenance regimes, mean that leakage in a network can at best only ever be controlled rather than eliminated.

There are many reasons why natural gas leaks from oil and gas networks need to be kept under tight control.

Most pressingly, with the Paris Agreement demanding that industry does more to curb its environmental emissions to keep climate change under control, leaking natural gas pipelines have been identified as a major source of methane emissions that are harming the environment. According to the International Energy Agency (IEA), methane emissions from the oil and gas industry accounted for around 70Mt in 2020 – equating to five percent of world energy-related greenhouse gas emissions[1].

Financially, gas leaking from pipelines also represents the loss of billions of dollars of revenue every year, both in terms of direct product and the effort and costs involved in replacing it.

It can also pose a risk to safety, not just on the industrial sites that produce it but also in the wider community. Incidents such as the San Bruno pipeline explosion in the USA in 2010 and the Buncefield gas storage facility explosion in the UK in 2005 highlight the dangers that can be posed to communities by the escape of explosive gases and vapours.

To help counter these issues, countries around the world are putting in place increasingly strict legislation to try to contain the problem posed by leaking gas pipelines.

Most recently, the US Government last year signed off on the 'Protecting our Infrastructure of Pipelines and Enhancing Safety Act', or PIPES 2020, a major piece of legislation that obliges oil and gas operators to ensure the integrity of their gas distribution networks through regular leak detection and repair programmes. The legislation stipulates that these programmes must be capable of identifying and categorising any leaks that could pose a risk to human safety or the environment, including where they pose a potential risk of explosion or other hazards.

With the spirit of this legislation reflected in other regulations worldwide, operators must increasingly ensure they are using the most effective technologies to help locate, measure, intervene and control natural gas leaks at all points in the distribution network.

Sniffing out leaks

When it comes to detecting gas leaks, various approaches are used, with options including continuous monitoring using in-situ sensors, periodic surveys using handheld devices, and mobile analyzer platforms. Whilst the first two options offer their own set of advantages, the third category – mobile analyzer platforms – is offering exciting opportunities for improved gas leak detection over much wider areas in a greatly reduced timeframe.

An example is the ABB Ability™ Natural Gas Leak Detection System, which combines an analyzer using patented laser-absorption technology with various solutions, ranging from a portable backpack variant through to car-, aircraft- and drone-based versions that allow methane emissions to be accurately tracked back to their source.

At the heart of the system is a patented high sensitivity analyzer capable of measuring both methane and ethane concentrations at rates of up to 5Hz. The analyzer uses a principle called Off-Axis Integrated Cavity Output Spectroscopy (OA-ICOS), which works by using a tunable laser source that produces light at a suitable wavelength for interacting with the gas being analyzed.

The laser enters a highly reflective mirrored cavity, where it is reflected thousands of times before exiting onto a photodetector. This creates an effectively very long optical path amounting to many kilometers, increasing sensitivity and producing strong absorptions as the infrared light interacts with the gas present within the cavity. By changing the wavelength over which the laser operates, the concentration of the gas can be measured with high precision.

With a sensitivity over 1,000 times higher than conventional leak detection technologies, the OA-ICOS method permits the analyzer to detect single parts per billion (ppb) levels of methane and ethane every second, enabling variations in atmospheric concentrations to be quickly measured over long distances where other technologies would be ineffective.
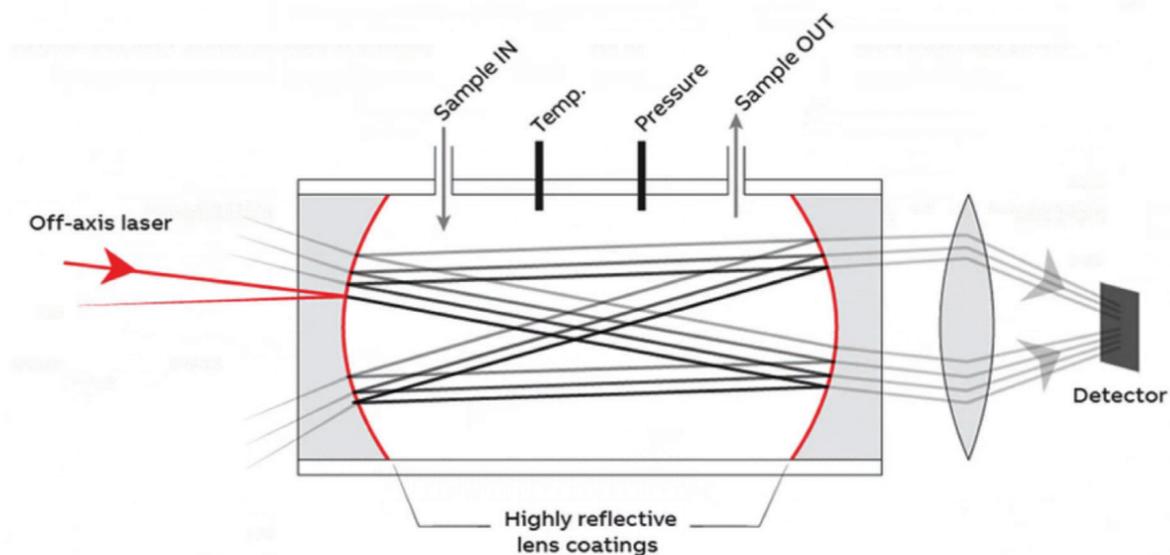
Taking gas leak detection mobile

While in-situ gas leak detection sensors and equipment can detect the presence of a leak, actually locating it can often require additional effort, including the deployment of maintenance resources using handheld survey equipment. As well as incurring time and cost, this approach can pose a potential risk to safety as people are exposed to potentially high levels of explosive gases.

A mobile gas leak detection solution combining a high sensitivity analyzer such as the one described with a vehicle or airborne platform can help to overcome this challenge, enabling leaks to be quickly traced to the source with relatively little effort.

When methane is leaking from a pipeline, it is carried by the wind, mixing with the air and decreasing in concentration as it travels further from the point of origin. By passing the analyzer through the diffused air, either by driving or flying through it with an aeroplane or drone, the methane can be detected, and its concentration levels calculated. If both methane and ethane are measured, the origin of the gas can be distinguished from normal background levels that may come from other sources such as landfill or farming. With data able to be gathered even over long distances from the point of leakage, there is the potential for considerable time and cost savings compared to conventional leak detection techniques.

Further benefits can be derived by combining the measured data with other technologies, including digital GPS and mapping software and commercially available applications such as Google Earth, which together can be used to build a detailed report of methane sources and emissions rates over a given surveyed area.

In ABB's system, for example, data from the analyzer is combined with GPS coordinates from mapping software and wind speed and direction from an anemometer and fed into a laptop which performs the leak analysis and provides a real-time picture of the area surveyed overlaid with details on methane concentrations and potential leak points. This information can be used to produce detailed digital reports allowing the operator to take necessary measures to find and fix the leaks.

MOBILEGUARD™

Vehicle -based

HOVERGUARD™

MICROGUARD™

UAV-based

Handheld

Stationary

EVERGUARD™

Keeping an eye on emissions

With industries across all sectors under growing pressure to reduce the environmental and societal impact of their operations, the use of the latest emissions measurement technologies is becoming increasingly important.

The UAV-based analyzer (HoverGuard™) is just one of a number of options available to help industrial operators measure gas concentrations more accurately, with developments in measurement and digital technologies increasingly combining to offer highly accurate measurement solutions that are at the same time easy to use and integrate.

As a global leader in continuous emission monitoring with over 60,000 systems installed in more than 50 countries worldwide, ABB can help you to ensure your operation meets the relevant regulatory and environmental standards.

Its Continuous Emissions Monitoring Systems (CEMS) offer complete solutions for continuous recording and evaluation of emission data in all industries. The systems provide important information for the environmental and economic operation of production facilities across multiple industries, from oil and gas through to paper, food and beverages, and cement for the construction industry.

For more information about how ABB can help to make emissions measurement easy, visit www.abb.com.measurement.

References:

1. International Energy Agency, January 2021 - Driving Down Methane Leaks from the Oil and Gas Industry - A Regulatory Roadmap and Toolkit - https://www.iea.org/reports/driving-down-methane-leaks-from-the-oil-and-gas-industry

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