The Future of Methane Gas Sensors

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Methane gas is an odorless, colorless gas that is highly flammable or combustible at 100% Lower Explosive Limit (LEL) concentrations. For many manufacturers around the world, detecting hazardous levels of methane gas with methane gas sensors is an extremely important daily operation because it provides a safe environment.

Methane is a primary component of natural gas, which is a common fuel source. Natural gas is one of the primary sources of energy used to produce heat and electricity around the world. Methane is also used in chemical reactions that produce other gases, such as hydrogen, carbon monoxide, and carbon black.

However, if methane leaks into the air, as may occur if it passes through faulty pipes or equipment during the production of natural gas, it absorbs the sun's heat and can contribute to the warming of the atmosphere.

Due to this characteristic, methane is classified as a harmful greenhouse gas, similar to carbon dioxide. When it is burned in the presence of oxygen, it produces carbon dioxide and water vapor.

In some ways though, methane can be more damaging to the climate than even carbon dioxide. In the first two decades after it has been released, methane is 84 times more potent than carbon dioxide.

Methane can come from many different manmade and natural sources. However, the biggest contributor to methane in the atmosphere comes from man made emissions related to the production and transmission of oil and gas. Approximately 25% of the

manmade global warming that is currently occurring in the world is attributed to methane emissions.

And even though it doesn't linger in the atmosphere for as long as carbon dioxide, it can be far more damaging to the climate due to its ability to effectively absorb heat. Methane gas sensors are an important tool in addressing and containing leaks that may otherwise continue to emit this dangerous gas into the atmosphere.

The Business Impact of Lost Methane

Methane leaks aren't simply bad for the environment, their presence is a workplace hazard and leaks can make for bad business. It is estimated that in the United States alone, an estimated 13 million metric tons of fugitive emissions are lost from the oil and gas industry – contributing to an estimated $2 billion loss in revenue each year. Globally, the value of leaking gases, including methane, is estimated to be $30 billion annually.

Additionally, major industrial accidents, fires, explosions, and other incidents can occur when methane is released into the workplace atmosphere and ignited. Companies operating in the oil and natural gas sector can minimize the risk of these accidents – as well as any related workers compensation costs and/or payouts from lawsuits for injuries or deaths that may occur. Reducing methane levels isn't just good for the environment; its good for business.

For these reasons, it is important to make available accurate, low-maintenance, and reliable detection devices that can identify methane leaks quickly so that they can be fixed.

The Role of Methane Gas Sensors

Until recently, there was very little data available about where leaks were occurring, how to quickly and accurately identify them, and the best way to fix them. However, a summary of data from studies throughout the US oil and gas supply chain has shown that methane

emissions are much higher than most researchers previously thought.

The detection of methane is essential in providing a safe working environment. With the increased technology provided by methane gas sensors, working conditions for individuals across all of the oil and natural gas production process can be optimized to limit exposure to this toxic and flammable gas.

With the availability of this data, it is clear that major reductions in methane emissions are needed, including methane gas sensing technologies. A methane gas sensor is a device employed as a component in fixed gas detection systems for the purposes of monitoring and detecting levels of methane in the air in % of Lower Explosive Limit (LEL) levels or in a percentage by volume levels.

Policies Changing Methane Emissions

In 2016, the Environmental Protection Agency (EPA) finalized rules that regulate methane emissions from major sources, including those from the oil and gas industry. Those rules are currently being reconsidered, although most industry leaders and environmental groups are opposed to changing the regulations.

The regulations implemented in 2016 imposed the existing rules on new operations extracting natural gas in the United States. It also legally obligated the EPA to apply the same rules on existing operations. Combined, this applies to the majority of oil and gas operations in the country. Industry giants, such as Shell and ExxonMobil have requested that the existing regulation remain intact, as excess methane emissions can present a hazardous working environment, a source of lost revenue, and cause long-term irreversible damage to the environment.

Types Of Methane Gas Sensors

For nearly a hundred years, coal, oil, and gas industries have been using sensors to detect flammable compounds in the atmosphere. Before modern gas leak detection methods were developed, early detection methods had much less precision. The first gas detector in the industrial age was the flame safety lamp that would detect the presence of methane in underground mines. The flame was contained within a glass sleeve and adjusted to a specific height in open air. The flame's height would then vary depending upon the presence of methane or the deficiency of oxygen.

The catalytic combustion sensor was developed in the 1920s, and since that time, methane detection methods have been refined. As time goes on, new technology has increased the sophistication of LEL gas sensors and flammable gas sensors. Currently, two primary

technologies – pellistor and NDIR – for methane gas sensing are available, while NevadaNano's new family of MPS Gas sensors brings new advances to improve safety, reliability, and cost of ownership.

Pellistor Sensors

Pellistor sensors utilize catalytic bead sensing. These sensors burn small amounts of gas that produce heat proportional to the presence of flammable gas. These sensors are very common because they are able to react to most combustible gases, including methane.

Pellistors are solid-state devices that are used to detect combustible gases or those which have a substantial difference in thermal conductivity to that of surrounding air. These sensors work through the presence of small pellets of catalyst-loaded material whose resistance changes when in the presence of methane gas. When the combustible is present, the resistance of the pellet increases in relation to the resistance of an inert reference pellet, which allows for the measurement of the gas present.

Pellistor beads run at high temperatures, meaning they can be an ignition source in explosive or combustible atmospheres. However, they are safely enclosed within the sensor so that they cannot act as an ignition source for the surrounding gas.

Unfortunately, catalytic bead sensors aren't without their drawbacks.

Only Accurate For One Gas At A Time

Pellistor sensors are only accurate for the gas the sensor is calibrated or adjusted to with a k-factor.

In situations where it's not known whether the gas present will be methane or another combustible gas, the sensor will provide unreliable readings if the combustible gas is other than methane. With linear output corresponding to the gas concentration, correction factors are accounted for to calculate the approximate response of pellistors in relation to the other flammable gases. This makes pellistors a good option when flammable vapors are present.

Susceptible To Poisoning

One of the major disadvantages of pellistor sensors is their susceptibility to "poisoning." Over time, the catalytic elements in pellistor sensors can be poisoned by compounds such as silicon, lead, phosphates, and sulfur, which reduces their lifespan and accuracy. These compounds cause the sensor to suffer from an irreversible loss of sensitivity when poisoned. Under other conditions, inhibition can be seen, which is a reversible loss of sensitivity, but still presents an extreme hazard for individuals working in the vicinity. The more highly concentrated the compound or gas, the quicker the sensor burns out.

When exposed to high gas concentrations, pellistor sensors can be damaged and the 'fail safe' may not work. In these instances no notification is provided to the operator when an instrument fault is detected. These faults can only be identified by testing prior to each use, ensuring that the performance of the sensor is still intact.

Must Be Calibrated

Lastly, catalytic elements lose effectiveness with exposure to common atmospheric chemicals and require frequent characterization to ensure accurate, safe measurement of methane concentrations. They can also struggle in environments with low oxygen levels, since the combustion process through which they work requires adequate oxygen.

Non-Dispersive Infrared (NDIR) Sensor

Non-Dispersive Infrared Sensors are the second type of methane gas sensor in widespread use. NDIR sensors use infrared lamps to measure the concentration of methane and some other potentially combustible gases.

Infrared light of a particular wavelength will be absorbed by the targeted gas – in this instance, methane. There are generally two beams emitted – one with the wavelength that is absorbed by methane, and another reference beam. Each beam has equal intensity deflected by a mirror and onto a photo receiver inside the sensor. The difference in intensity between reference and measurement beam indicates the concentration of the gas present.

Unlike pellistor sensors, NDIR sensors aren't prone to poisoning, enabling longer calibration intervals. In addition, NDIR sensors have high selectivity and can accurately measure methane concentrations in a mixed gas background. NDIR sensors can also be used in low oxygen and inert environments. These sensors provide fail safe testing and the operator would be notified in the event that the sensor were faulty.

While NDIR sensors offer some advantages over pellistor sensors, they do have some downfalls of their own.

Can't Detect Hydrogen And Other Hydrocarbons

NDIR sensors measure gas through the absorbance of infrared light at unique wavelengths.

But some gases, like hydrogen, do not absorb infrared light and thus can't be measured. In addition, NDIR sensors accurately detect only methane. In an environment where multiple hydrocarbons may be released, NDIR sensors are likely to provide false readings.

Trouble Detecting Mixed Compounds

Mixed compounds are also a challenge for NDIR sensors, making NDIR sensors not suitable for environments with multiple gases. In many instances the response of NDIR sensors when multiple gasses and flammable gasses are present will be a non-linear, or false, reading.

NevadaNano's MPS Flammable/LEL Gas Sensor brings new advances to hazardous and combustible gas safety due to its features. The MPS Flammable Gas Sensor combines the best features of both catalytic bead sensors and NDIR sensors. This hybrid design combines the best features of both pellistor and NDIR sensors to provide the best possible solution for detecting methane gas that is currently commercially available.

These sensors are precise in their measurement of methane gases and can be used across a variety of atmospheric conditions – including when mixed gases are present, or when oxygen levels are low.

With temperature and pressure compensation features, NevadaNano's MPS Flammable/LEL and Methane Gas Sensors provide a reliable and durable sensor that will work in a wider variety of conditions than other sensors are able to currently. These sensors are helping to keep more methane out of the atmosphere, ensuring work places in the oil and natural gas industry stay safe, and safeguarding companies from lost profits that can stem from escaped gases and accidents or injuries that could potentially occur related to methane concentrated in the working environment.

- Accurate measurement of Hydrogen, Methane, and 10 other flammable gases and mixtures with a single calibration.
- Classification of single gases and mixtures to help identify the type and source of a leak.
- No Calibration Required 5-year life
- Integrated measurements of temperature, pressure, humidity, and automated compensation for the environmental conditions
- Immune to Poisoning
- Ready for extreme environments with accurate measurements over -40C to +75C and broad humidity range.