WHITE PAPER

HOW TO MEASURE OXYGEN LEVELS FOR SAFETY IN ENCLOSED SPACES USING THE TDLS MEASUREMENT PRINCIPLE

Preventing explosions and implementing fire safety practices with inert gas blanketing in storage tanks, flow lines, and flare lines

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Introduction

The limiting of oxygen concentrations in enclosed spaces has many applications, including safety, process control, and product quality. This is often done through the process of inert gas blanketing, which simply adds an inert gas, such as Nitrogen, into an enclosed space (e.g., sealed compartment, storage tank, flow line, flare line, etc.) in order to counter the effects of oxygen on the product. The process of inert gas blanketing protects volatile, combustible, or perishable products from reactions like oxidation or explosions.

Why Measure Oxygen Levels?

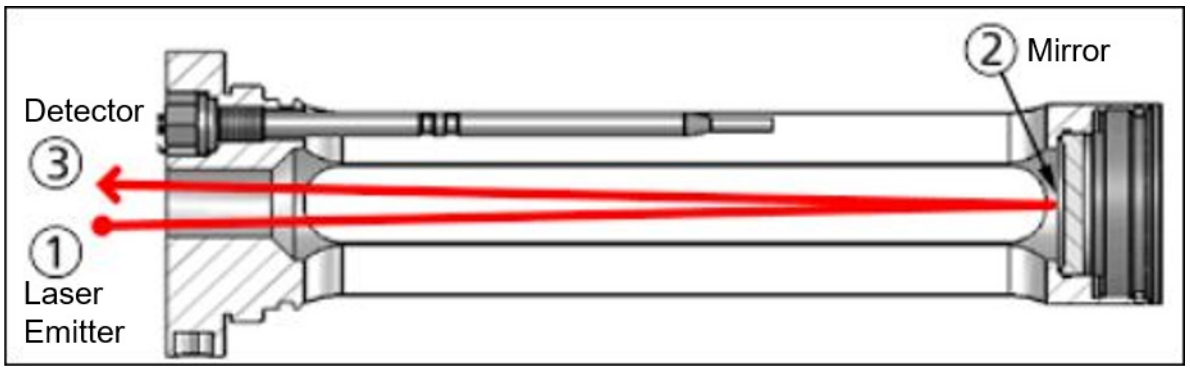
The main reason to measure oxygen levels is to prevent explosions. Three elements are required for the creation of an explosion: fuel, ignition source, and oxygen. Explosion prevention aims to remove at least of these three elements. With inert gas blanketing, there is greater control over the level of oxygen in the enclosed space. With inerting, oxygen is displaced and concentration is decreased to a safe level.

If oxygen is present in an enclosed space, it has a very high chance of exploding. For example, if oxygen is present above the presence of hydrocarbon fuel in a storage tank, a simple spark or strike of lightening can cause a massive explosion.

Some may be less apparent as well. For example, in a flow or flare line, oxygen on a line leading to a flare tip can cause major damage to the process line, resulting in huge setbacks in the operations and also a major safety hazard for workers in the plant.

- Refinery and chemical plant vapor recovery systems (ship and railcar loading, chemical sewers, others) are typically fed to a compressor for reprocessing. The O2 of the recovered gasses needs to be below the explosive limit before entering the compressor.
- Feed gas and lines to thermal oxidizers are typically monitored for O2 to prevent explosive conditions in the oxidizer.
- Storage silos for plastic pellets, polysilicon or any finely powered products are blanked to prevent hydrocarbon or dust explosions and may be monitored for O2 concentration as well.

In addition to preventing explosions, many products are sensitive to the introduction of oxygen or contaminants. The presence of oxygen can impact product quality for a variety of industries. It can change the polymerization process, changing the polymerization of amides to super-polyamide. This is often seen in the production of Kevlar vests, where a single change in the process can severely affect the quality of the final product. It can also be seen in the food and pharmaceutical industries. The introduction of oxygen under protective packaging can impact the shelf life and overall quality of products.



How Do We Measure Oxygen Levels?

SICK uses an industrial laser beam with a wavelength range of around 762nm. The term for this measurement principle is called Tunable Diode Laser Spectroscopy (TDLS). This uses a laser emitter, detector, and a mirror in an open measurement cell to make extremely fast, selective, and accurate measurements of oxygen levels in an enclosed space. It is all done with no moving parts.

A TDLS Oxygen Transmitter uses the entire spectrum to make a measurement. The changes in the pattern of the entire spectrum are utilized to determine the chemistry of the sample. Equipment has become more sensitive and has improved, a very narrow wavelength of light can be used to look at the pattern or individual peaks in a narrow band pass. With this measurement, a single peak can be focused on and the oxygen concentration can be determined in the sample. With this narrow bandwidth, it is extremely selective, fast, and accurate.

The TRANSIC Oxygen Transmitter

SICK's gas analyzer is the TRANSIC Oxygen Transmitter. Gas analyzers can be installed either extractive or in-situ. Both provide adequate measurement results in inerting applications, but exhibit different advantages.

In-Situ Mounting

An in-situ version mounts directly at the measuring point, requiring no sample system. It has an extremely fast response time and is simple to install. It provides accurate and representative measurement, measuring exactly where it is most important. There are some cost savings on equipment and maintenance through operation by not requiring any gas sampling. It also has a small footprint as it can be installed most anywhere.

For the TRANSIC Oxygen Transmitter from SICK, a flange mounting adapter can be used for a redundant unit. The adapter flange includes the process flange attached directly to the pipe and an instrument flange that includes the probe installed directly into the process line. That's accomplished by putting in an instrument flange adapter that has an appropriate to seal the sample in and the atmosphere out.

Sometimes when making in-situ measurement, there can be undesirable materials in the flow. Accessories like PTFE filters and steel mesh filters adapt the TRANSIC to harsh process environments. This can save on expensive sample conditioning systems treatment equipment. Customers can maintain their own spares and can easily perform field service for the product.

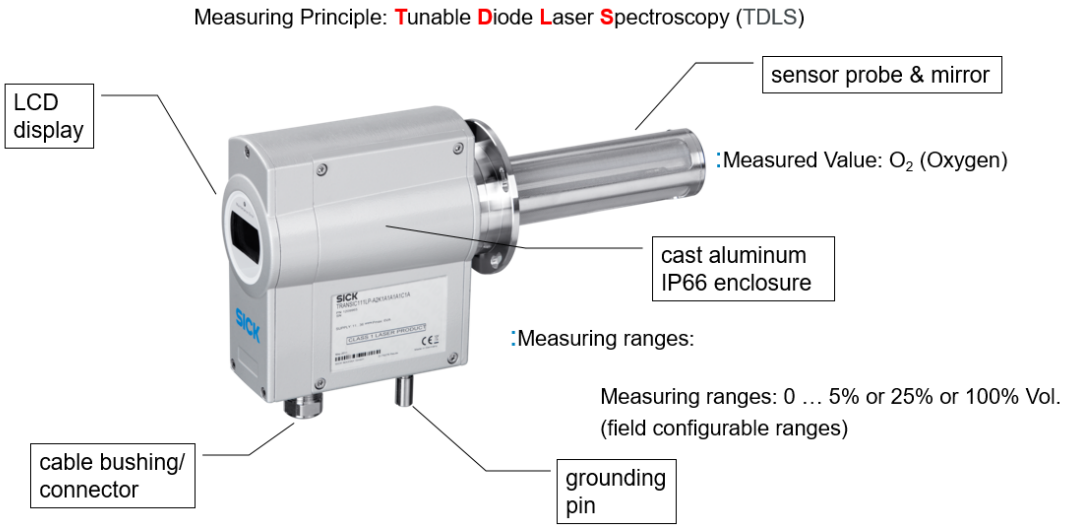
Extractive Mounting

An extractive sample cell version can compensate for pressurized or high temperature applications. It utilizes a simple sample condition system to provide control for the pressure and temperature. It is ideal for replacing problematic paramagnetic principle analyzers and electro-chemical cells (fuel cell). It has convenient positioning of the analyzer.

The entire oxygen transmitter with the appropriate cell is mounted on the sample panel. Depending on the application itself, the pressure, temperature, and flow can be controlled by bringing sample to the panel. It can even indicate whether there is positive flow or not. We have an eductor, if it's low pressure, we can allow a stream of nitrogen to pull the stream through the eductor and back to the process.

Conclusion

A real-time solution that is suited to the process possessing a wide dynamic range and a linear response, will give you the peace of mind you need to focus on operations. The TRANSIC is an approved electrical equipment for hazardous environments. It meets Class 1, Division 2 on the electronics closure, Groups A-D. Inside the process itself, it is Class 1, Division 1 and 2, Groups A-D. The Transic Oxygen transmitter from SICK meets these requirements in a small, robust package that meets NEC Class 1 Division 2 area classification and can easily be integrated into your plant.



Contact Us

For more information about the TRANSIC oxygen transmitter, contact a SICK representative at info@sick.com or visit our website at www.sick.com.