INERT GAS MONITORING

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Definitions

Inerting

- Inerting is the process in which a substance is converted from a reactive or flammable condition to a non-flammable, non-reactive or a safe state. It can be done by adding inert gas that replaces the atmospheric air containing moisture or oxygen. Inerting is capable of reducing the risk of explosion and also prevent dust explosions and unwanted reactions.

Combustible Gas Detection

- In detecting combustible gases in oil and gas, petrochemical and other applications, choosing between the two most common gas sensing technologies used for this purpose will be critical in ensuring a safe, reliable and cost effective solution. These technologies are **catalytic combustion** and **infrared**. Both have advantages and disadvantages depending on an applications specific needs.

Definitions

Dilution tube

- A dilution fitting is a sample draw adapter that allows use of a standard hot bead sensor to obtain direct readings from oxygen deficient atmospheres.
- The adapter includes a dilution orifice designed to mix the gas sample with an equal volume of fresh air. Since fresh air contains 20.9 percent oxygen, even in the worst case, the sample will contain at least 10 % oxygen. This is an adequate concentration for the sensor to detect gas accurately.

Catalytic Detector

Catalytic Detectors

- Catalytic detectors are based upon the principle that when gas oxidizes it produces heat, and the sensor converts the temperature change via a standard Wheatstone Bridge-type circuit to a sensor signal that is proportional to the gas concentration. The sensor components consist of a pair of heating coils (reference and active). The active element is embedded in a catalyst. The reaction takes place on the surface of the catalyst, with combustible gases reacting exothermically with oxygen in the air to raise its temperature. This results in a change of resistance.
- There is also a reference element providing an inert reference signal by remaining non-responsive to gas, thereby acting as a stable baseline signal to compensate for environmental changes which would otherwise affect the sensors temperature.

Catalytic Detector continued

Advantages

The major advantages of catalytic detectors:

- Robust.
- Simple to operate.
- Easy to install, calibrate and use.
- Long life with a low replacement cost.
- Proven technology with exceptional reliability and predictability.
- Easily calibrated individually to gases such as hydrogen which cannot be detected using infrared absorption.
- Can perform more reliably in dusty & dirty atmospheres as they are not as sensitive as optics to the build-up of industrial contaminants.
- Can perform more reliably in high temperature applications.
- Are less sensitive to humidity and condensation.
- Not as significantly affected by changes in pressure.
- Can detect most combustible hydrocarbons.

Catalytic Detector continued

Disadvantages

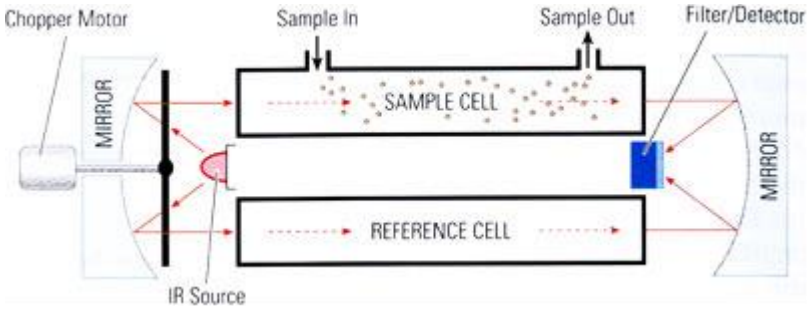
The limiting factors in catalytic detector technology:

- Catalysts can become poisoned or inactive due to contamination (chlorinated & silicone compounds, prolonged exposure to H2S and other sulphur &/or corrosive compounds).
- The only means of identifying detector sensitivity loss is by checking with the appropriate gas on a routine basis and recalibrating as required.
- **Requires oxygen for detection**.
- Prolonged exposure to high concentrations of combustible gas may degrade sensor performance.
- If flooded with a very high gas concentration, may show erroneously low or no response, and sensor may be damaged or rendered inoperable.

Infrared Detector

Infrared Detectors

- The Infrared (IR) detection method is based upon the absorption of infrared radiation at specific wavelengths as it passes through a volume of gas. Typically two infrared light sources and an infrared light detector measures the intensity of two different wavelengths, one at the absorption wavelength and one outside the absorption wavelength. If a gas intervenes between the source and the detector, the level of radiation falling on the detector is reduced. Gas concentration is determined by comparing the relative values between the two wavelengths. This is a dual beam infrared detector.



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Infrared Detector continued

- Infrared gas detection is based upon the ability of some gases to absorb IR radiation. Many hydrocarbons absorb IR at approximately 3.4 micrometres and in this region H2O and CO2 are relatively transparent. As mentioned earlier, there are some hydrocarbons and other flammable gases that have poor or no response on a general purpose IR sensor. In addition to aromatics and acetylene, hydrogen, ammonia and carbon monoxide also cannot be detected using IR technology with general purpose sensors of 3.4 micron specifications.

Infrared Detector continued

Advantages

The major advantages of IR gas detectors:

- Immunity to contamination and poisoning.
- Consumables (source and detector) tend to outlast catalytic sensors.
- Can be calibrated less often than a catalytic detector.
- **Ability to operate in the absence of oxygen or in enriched oxygen.**
- Ability to operate in continuous presence of gas.
- Can perform more reliably in varying flow conditions.
- Even when flooded with gas, will continue to show high reading and sensor will not be damaged.
- Able to detect at levels above 100 % LEL.

Infrared Detector continued

Disadvantages

The limiting factors in IR technology:

- The initial higher cost per point. IR detectors typically are more expensive than catalytic detectors at initial purchase.
- Higher spare parts cost.
- Gases that do not absorb IR energy (such as hydrogen) are not detectable.
- High humidity, dusty and/or corrosive field environments can increase IR detector maintenance costs.
- Temperature range for detector use is limited compared to catalytic detectors.
- May not perform well where multiple gases are present.

Dilution tube

Operation

- Combustible sensors detect gas by catalytically burning it on the active bead. The process requires oxygen. The sensor requires at least **10 percent oxygen** by volume to detect accurately.
- A combustible sensor in a 100 percent gas or vapor environment will produce a reading of zero percent LEL.
- Dilution adapters may only be used together with instruments that are equipped with continuous motorized pumps. Dilution adapters MAY NOT be used with squeeze-bulb or hand-aspirated sample draw kits.
- Improper use of dilution orifices can lead to inaccurate readings. These have the potential for being the basis of flawed decisions, a major cause of accidents. Users should clearly understandthe limitations before making use of this accessory.

Dilution tube continued

Operational concerns

- An important consequence of diluting the sample with fresh air is that the amount of flammable/combustible gas/vapor in the sample also is diluted.
- Since the adapter provides a 50:50 dilution, the combustible and toxic gas readings must be doubled to obtain the true concentrations.
- The adapter should be removed as soon as dilution sampling is completed. Leaving the dilution adapter in place during normal operation can lead to potentially dangerous misinterpretation of test results.
- Make sure to locate the instrument in fresh air at all times while the dilution orifice is being used. Only fresh air containing 20.9 % oxygen should be used to dilute the sample. If the dilution adapter is located in an oxygen deficient or otherwise contaminated atmosphere, proper sample dilution will not occur, and accurate readings will not be obtained.

Dilution tube continued

Operational concerns continued

- The amount of air drawn into the dilution orifice is affected by the length and inner diameter of the sample draw hose. It is also affected by altitude and the flow rate of the mechanical pump contained in the instrument.
- Each adapter should be individually calibrated while attached to the monitor and sample probe assembly that will be used during sampling.
- Make sure that the sample tubing does not kink or become blocked during operation.
- Any change in the flow characteristics of the sample drawing tubing can change the dilution ratio of the adapter.

Conclusion

WHEN…

monitoring the atmosphere in a confined space, there are several important issues that need to be considered, reviewed, and managed. One of the major issues centers on air quality and what you are breathing, both prior to entry and during occupation of a confined space. You need to know what the oxygen content of the atmosphere is and whether there are explosive or toxic gases that could threaten the safety of the environment or, perhaps more importantly, **your life**….

When properly used and maintained, gas detection monitors will protect both.