Application Note AP-231

AREARAE INERT FOR INERT GAS CONFINED SPACE ENTRY

One of the most dangerous confined space entries is when an inert atmosphere is present. Inert or "non-reactive" atmospheres are used to displace oxygen or other reactive gases when the presence of that gas presents an explosion risk to either the process being performed or the compounds being stored. Some examples of inert process applications include the transportation of flammable cargo, catalytic processes in the petrochemical refining industry and welding operations. These industrial processes must maintain oxygen levels well below the combustion point for the catalyst or the chemicals being processed and therefore well below the viability point for any workers involved. The most commonly used inert gas is nitrogen though other including "post-combustion" gases are sometimes used with the objective of reducing the atmospheric presence of oxygen from its normal twenty percent to a range of less than four percent to eight percent.

This white paper will address the issues with inert atmosphere confined space entry and the application of wireless gas detection in monitoring the work environment.

Catalysts are substance that initiate or accelerate a chemical reaction without itself being affected. Catalysts are often used within oil refinery reactor pressure vessels to accelerate the crude oil reduction process into the desired output compounds. Refinery hydro-treating reactors typically contain catalysts composed of the following elements: Molybdenum (Mo), Nickel (Ni), Cobalt (Co). When the catalyst beds must be serviced a technique called "gas blanketing" is used to prevent the external atmosphere from reacting with the catalyst and bringing it into the explosive range. Nitrogen is pumped into the vessel until it is purged, then a service technician with special life-support breathing helmet and protective suit enter the pressure vessel. Catalysts are removed from reactors in a highly reactive, sulfided state. The entire catalyst change out process can take as long as a week to complete.

Worker safety is the primary concern during this type of work. Technicians generally work with a safety-locked helmet with redundant air supplies, real-time radio contact with the safety team and personal back-up controls. The person operating both the purge

atmosphere and the worker breathing air works from a trailer on the ground. The purged atmosphere must be continually monitored for real-time oxygen level, explosive gases such as volatile organic compounds as well as carbon monoxide.

THE RISKS OF WORKING IN AN INERT ATMOSPHERE

- The inert atmosphere needs to be monitored for explosive gases. And if people are involved they must have an adequate breathing supply
- Regular calibration and testing of the equipment used to generate inert gas is required to ensure that it works correctly. A sensor to measure the level of the inert gas and/or oxygen is needed to ensure atmosphere is not in flammable range.
- The inert atmosphere needs to be monitored for toxic gases. For example in refinery catalyst maintenance the presence of benzene, VCM, toluene, xylene, EDC, and many other hydrocarbons can exist. (VOC = PID)

WHAT ARE THE SHORTCOMINGS OF SOLUTIONS USED TODAY?

Traditional Wheatstone bridge/catalytic bead based lower explosive limit (LEL) sensors require oxygen to detect flammable gases. Typically a dilution fitting is used to introduce enough oxygen in the air to allow the LEL sensor to read properly. Dilution fittings are cumbersome to use and are often used incorrectly.

LEL sensors only display in one percent increments. Most are not very accurate below 5% LEL. They cannot detect hydrocarbons at toxic levels (only flammable levels).

In order to increase the safety of the workers in the inert atmosphere, remote monitoring by a second person is needed. Without a wireless system, users must hard wire traditional fixed LEL sensors to get remote readings. This is heavy, time consuming, expensive, and very difficult to transport.

ADVANTAGES OF THE AREARAE INERT WIRELESS SYSTEM

A wireless monitoring system allows real-time remote monitoring of the inert atmosphere to ensure worker safety and the data can be shared by both the service provider and the site safety officer.

A wireless system is quick to deploy and does not encumber the service technician with additional hoses or cables.

Sensitive photoionization detectors are used to detect hydrocarbons.

A high range carbon monoxide sensor is used to measure the presence of CO as well as hydrogen. This is in addition to the Oxygen sensor which is used as a second sensor to ensure oxygen levels are low enough to prevent spontaneous explosion.

Flexible firmware allows switching between the NORMAL operation mode and INERT mode.

Measured Results

The AreaRAE Inert is capable of accurate VOC measurements in zero and low oxygen environments.

PID measurements of Hexane in an inert environment were within +/- 10% of the known value.

Using the PID to measure Octane and then converting to % LEL, the AreaRAE has a resolution of 0.02% LEL by volume when compared with existing systems that have a resolution of 3% LEL by volume.