The writing of this article follows on the heels of a meeting between the author and the Chief Deputy Attorney General of the Commonwealth of Pennsylvania. The purpose of that meeting was to investigate and discuss the circumstances of a fatal Pennsylvania mining accident.

The Attorney General’s office was desperately trying to determine an answer to the question of why the portable gas monitor, that was carried by the victim and designed to detect the methane gas that was inadvertently ignited into the fatal explosion that took his life, was turned off at the time of the accident.

Industrial Scientific Corporation has designed and manufactured portable gas monitoring instruments for more than twenty years. There are countless testimonials from how these instruments have saved lives and improved the level of safety in the workplace. Yet accidents like the one described above still occur and workers are still injured and killed in gas related accidents. This has led to one very clear realization. Manufacturers can design and produce the most reliable and best performing gas monitors possible. They could be maintained and cared for with the highest level of integrity. But if they are not used properly or not used at all, they cannot perform the function for which they were intended – saving lives.

It becomes clear how tracking behavior patterns surrounding the use of gas monitoring instruments and analyzing exposure data collected from these instruments can be used as leading indicators of potential workplace safety problems.

Behavior and Safety

The term behavior can be defined as an “observable action or activity.”1 Carrying this definition through with regard to safety it can be said that behavior is an observable action or series of actions or activities that result in patterns that affect the safety of an individual or a group of workers.

Individual behaviors are repeatable. If you have done it once, you will likely do it again. Whether it has been done consciously or subconsciously, we have all trained ourselves to perform in certain ways. When unsafe behaviors start to occur with increasing frequency, the likelihood of accidents and injuries occurring becomes greater.

Safety behaviors can be viewed similarly to the illustrious safety fire triangle. When fuel and oxygen are present in the correct proportions along with a source of ignition, explosion occurs. When unsafe behaviors (sources of ignition) occur in the presence of significant hazards (fuel and oxygen), accidents and injuries do occur.

Now, back to the definition; behaviors are observable and are seen by others. As such, they are recordable. Since they are recordable, behaviors are leading indicators that can be analyzed and subsequently corrected to prevent accidents and injuries.

Gas Monitors and Datalogging

Datalogging is a feature that has been available in portable gas monitoring instruments since the early nineties. However, it is a feature that historically has been used very infrequently. Through the first decade of availability, less than 10 percent of the portable gas monitors that were sold were equipped with datalogging functionality. Datalogging was considered a premium function and provided as an option at a premium price. The data recording capability was generally limited to storing average or peak gas readings and did not encompass storing values for other information. Figure 1 is provided as an example of a typical datalog file from a portable gas monitoring instrument.

Today’s portable gas monitors generally have datalogging functionality as standard equipment. Dataloggers are capable of utilizing flexible recording intervals and having periods of data storage up to one year or more. Beyond storing gas levels, instruments also store a number of other parameters such as calibration dates, temperature readings, on/off times, minutes of operation and user identification and location information. Figure 2 is provided as an example of an alarm event data file recorded on a typical gas monitoring instrument.

Figure 1. A datalog file recorded on a typical gas monitoring instrument.

Figure 2. An alarm event data file example recorded on a typical gas monitoring instrument.

Today’s portable gas monitors generally have datalogging functionality as standard equipment. Dataloggers are capable of utilizing flexible recording intervals and having periods of data storage up to one year or more. Beyond storing gas levels, instruments also store a number of other parameters such as calibration dates, temperature readings, on/off times, minutes of operation and user identification and location information. Figure 1 is provided as an example of a typical datalog file from a portable gas monitor. Although many of the instruments available today have these features activated all of the time and record the information continuously, the data is rarely used for anything beyond after-the-fact investigations following a safety related incident. What is largely missed is that all of these parameters are useful for not only establishing what has occurred in the past (leading indicators), but provide indicators for what potentially may occur in the future (leading indicators).

Behavior and Gas Monitoring Instruments

There is a typical hypothesis held by users equipped with gas monitoring instruments. The first involves patterns of how the instruments are maintained and the conditions in which they are used. It relates to patterns of behavior surrounding how the instruments are actually used. The Industrial Scientific iNet database provides insight into both types of gas monitoring behaviors.

The iNet is a patented system in which Industrial Scientific Corporation collects data from customers using portable gas monitoring instruments in a variety of industries. The data is retrieved from the instruments via a system of instrument Docking Stations™ and is uploaded to the iNet database via the internet. The data includes information on patterns of bump testing, calibration and diagnostic testing as well as gas exposure data. Although the primary purpose for collecting the data is to provide proactive instrument maintenance services, the data can also be used to provide insight into the behaviors surrounding the instruments. Past customers can be provided reports indicating the behaviors surrounding the calibration and maintenance of their instruments as well as reports that summarize instrument and employee exposure to gas hazards and instrument alarming conditions.

Portable gas monitoring instruments should be tested and calibrated on a routine basis. Manufacturers and industry best practices recommend that portable gas monitors are bump tested daily or prior to each use. The bump test is a critical act, providing direct feedback to the user regarding the operational integrity of the instrument and is the only method of ensuring that the instrument is functioning properly and safely.

Data collected from 95 customers using 2300 portable gas monitors reveals that the instruments are bump tested on frequency intervals from 2 to 651 days. The data shows that the instruments are tested on average every 51 days while they are being used on average every 3 days. Clearly this data reveals a pattern of unsafe behavior that is likely to lead to a negative outcome. Examining the data more closely will uncover what individuals or groups, or what specific functional areas neglect the recommendations or requirements to perform the regular instrument bump testing leaving them vulnerable to future accidents.

Gas exposure data recovered from approximately 10,000 instruments used by approximately 120 customers revealed more than 45,000 toxic and combustible gas alarm conditions where exposures exceeded recommended safety guidelines over the two-month period of September and October, 2007. Add conditions on low oxygen exposures and an additional 2,400 dangerous conditions were encountered. Without individual analysis of each of these encounters it is difficult to determine whether or not these exposures resulted in any significant accident or injury. However, it can certainly be deduced that these instances could indicate behaviors that bring the hazardous conditions and individual workers much too close together.
Many of the alarm conditions revealed in the data clearly show behaviors of repeated exposures to dangerous conditions. In the example shown in Figure 2, a worker was repeatedly exposed to elevated conditions of hydrogen sulfide that were as much as eight times higher than the recommended safety limits. The worker claimed contrary to the medical evidence that no exposure occurred. However, post incident review of the available data revealed that the worker initially retreated from the dangerous condition, only to repeatedly return for several minutes before retreating again from concentrations that were continually increasing each time the area was entered.

In another example revealed from recorded data, a multi-gas instrument was being used for atmospheric testing in confined space entry applications. The company procedures required that atmospheric testing be performed continuously during the period of entry. Data collected from this instrument uncovered that the instrument was being used for three to five minutes intervals for pre-entry testing and was then turned off until it was used again for the next entry.

Summary Actions

In each of the examples cited, individual behaviors led to or could have led to serious exposures to dangerous conditions. Without the use of datalogging and subsequent analysis of the data, employers and safety professionals would typically be unaware that the conditions or behaviors existed. In the limited data set studied, 47,000 alarm conditions would likely have gone unrevealed in just a two month period.

These recorded observations are all leading indicators to potentially catastrophic situations. With early and routine analysis of the data, the catastrophic consequences of the behaviors can be avoided. Data can reveal the need and opportunities for training. Repeated exposures will occur when workers are not properly trained to recognize the presence of gas hazards and how to respond to them. Workers must have an understanding of the situations that they may encounter in order to respond to them in a comfortable, confident and positive manner. These situations can and will be revealed through a careful analysis of past data.

A long look into leading indicators in recorded data may also reveal the need for changes in processes that will enhance worker safety. Repeated data patterns in particular applications may indicate that a process change is necessary or potentially has the ability to mitigate exposure to hazardous conditions. Repeated exposures in particular applications or in particular locations may also indicate that maintenance or other corrective action is necessary to eliminate potential hazardous exposure.

Finally, safety can only be ensured if the tools used to provide safety to workers are in good functional condition. Continuously reviewing data related to the maintenance of safety equipment such as portable gas monitoring instruments will aid in ensuring that best practices are being followed and that workers are not needlessly being exposed to hazardous conditions because the tools designed to protect them are not being kept in proper working order.

The gas monitor carried by the victim of explosion described in the introduction to this paper had no datalogging capability. There was no opportunity to analyze data and or see a pattern of behavior that may have been a leading indicator that could have predicted the potential for, and subsequently prevented that tragic explosion. Nevertheless, it is unlikely that the day of the explosion was the first time that the victim had carried the monitor in the aff position.

Do not waste the opportunity to use recorded information that reveal patterns of behavior and offer opportunities to prevent catastrophic incidents before they occur.

References


---

Worklite Sales Gather Momentum

Since its summer launch, the new ATEX Certified Worklite from Wolf Safety (Germany) has received some excellent evaluations and has already achieved a notable level of sales from a variety of quarters. To date, 100 units have been sold to a leading UK offshore tank cleaner and maintenance contractor who has completely re-equipped his portable lighting needs with the ATEX Worklite. Other significant sales have come from utility companies, where the product is being used to light tunnels, sewers and drains.

This portable lamp which has no trailing cables and a 1000 lumens light output, incorporates a cluster of “fitted for life” LEDs to produce a 30 degree floodlight for up to 30m, facilitating a host of difficult inspection and maintenance tasks in confined hazardous areas. The 12 hour duration on full beam ensures that the Worklite will last a full maintenance shift.

Regular Worklite sales enquiries continue to come from the petrochemical industry for its use in maintenance shutdowns, the automotive industry for lighting internal paint booths, the railway industry for tunnel inspections and the arm forces for illuminating repairs to fuel and munitions storage.

Gas Detection Test/Calibration/Data-Logging Docking System Launched

Honeywell (UK) have announced the launch of the Honeywell MicroDock II—a fast/calibration docking system compatible with the company’s expanded X series, which includes two new portable gas detectors, the XS (five-gas detector) and the XD (single-gas detector). The MicroDock II offers protection for an entire crew, with user-friendly features including easy expansion (up to ten MicroDock modules can be interlinked), “one touch” calibration/bump testing/data transfer, simplified record keeping and battery charging of up to six X5 detectors (X5 model only).

“The MicroDock II packs advanced technology into a compact, lightweight design that’s remarkably user friendly, flexible and expandable to serve crew in a wide range of industrial settings where toxic and combustible gases pose a risk,” said Elizabeth Wassele, Strategic Marketing Manager Portables (EMEA). “With its low maintenance, one touch operation and simple record keeping, the MicroDock II minimises the cost of ownership for those seeking an all-in-one calibration, testing and data management system for portable gas detection equipment.”

The MicroDock II is entirely self contained and lightweight, and can operate without a computer. The included Fleet Manager software for PCs consolidates MicroDock II data information into a central database, taking the work out of data analysis and management. This software tool enables users to create reports automatically and manage detector configurations. Instrument records are stored for easy retrieval in the MicroDock II as well as each individual gas detector. The MicroDock II connects to a PC using a standard USB connection. The unit operates via an 11 wall adapter or set of four C-cell batteries. An additional wall adapter is needed for charging detectors. Standard features include robust, built-in pump with up to 5-gas inlet, multi-language support, and black, impact resistant polycarbonate housing. The Honeywell Analytics X series also includes the Impulse XP (single-gas) and Impulse X4 (4-gas) portable gas detectors. All X series units include a standard two-year factory warranty.