Application Brief AB-058

THE ROLE OF GASID™ IN AIR MONITORING

Introduction

Air monitoring is a critical part of any HazMat event, and numerous technologies exist for detecting flammable and toxic gases and vapors at low levels. These include combustible gas indicators (CGI) which detect flammables, four gas meters which detect flammables, oxygen, carbon monoxide and hydrogen sulfide, and photoionization (PID) detectors and colorimetric tubes which detect low level toxics. Unfortunately, not one of these technologies is capable of identifying unknown gases and vapors, which is critical to knowing what product is being detected in the first place.

The GasID fills this gap in air monitoring. Gases and vapors are identified rapidly and easily with the GasID through a process called **molecular fingerprinting**, in which the infrared (IR) spectrum of a product is compared to 1000's of reference spectra of known compound fingerprints. Contaminated air samples are acquired with a specialized device that uses **thermal desorption** to concentrate the product into the GasID analyzer. Alternatively, highly concentrated samples can be acquired and analyzed with standard Tedlar™ bags. Armed with the identity of the sample, responders can interpret other meter readings more accurately during continuous monitoring and employ appropriate site remediation strategies. This Application Note discusses how the GasID is used to enhance the air monitoring process during different chemical event scenarios.

GasID Identifies Gases and Vapors for:

- ✓ Accurate LEL Readings of Flammables
- ✓ Accurate PID Readings of Low Level Toxics
- ✓ Selecting colorimetric tubes for quantification
- ✓ High Ionization Potential Products
- ✓ Non-Flammables

Knowing the Identity Makes Monitoring Better

More information about the product at a chemical event is always better. This is absolutely true for air monitoring, as the detectors that are commonly used require some knowledge of the gas or vapor identity to be used most accurately. Colorimetric tubes can indicate if a low level toxic gas or vapor is present, but only if the correct tube is used. CGI and PID meters provide precise concentrations of vapors and gases (in %LEL and ppm, respectively), but only if the right correction factors are applied to the calibrated readings.

As an example, consider a vapor release at an industrial plant that causes employees to complain of eye and throat irritation and dizziness. A HazMat team is called in and conducts air monitoring with a four gas and a PID meter. The team determines that the atmosphere is flammable, but the product is only present at 3.5% of the LEL of methane and 300 ppm isobutylene units. A sample is acquired with the GasID and subsequently identified as isopropanol, as shown in Figure 1. This information is then fed back to the PID technician who, after correcting the PID readings by the isopropanol factor of 6.0, realizes that the actual concentration is 1800 ppm, which is very near the IDLH value of 2000 ppm (10% of LEL) for this flammable product. This allows the team to accurately know when the atmosphere is no longer a flammability hazard as the product is vented outdoors.

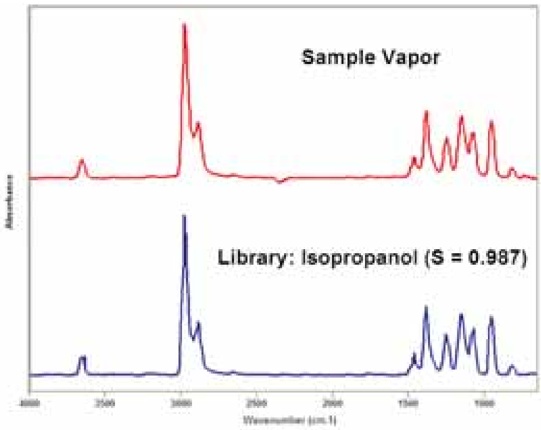
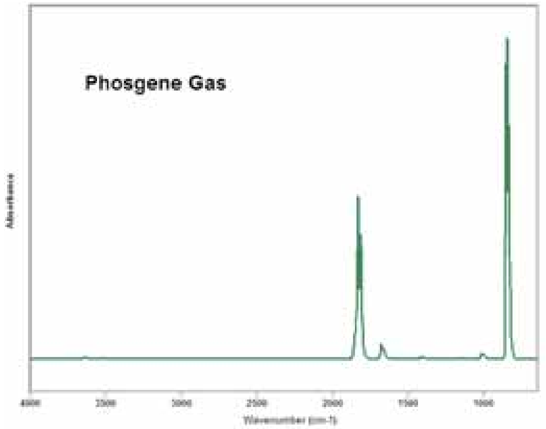
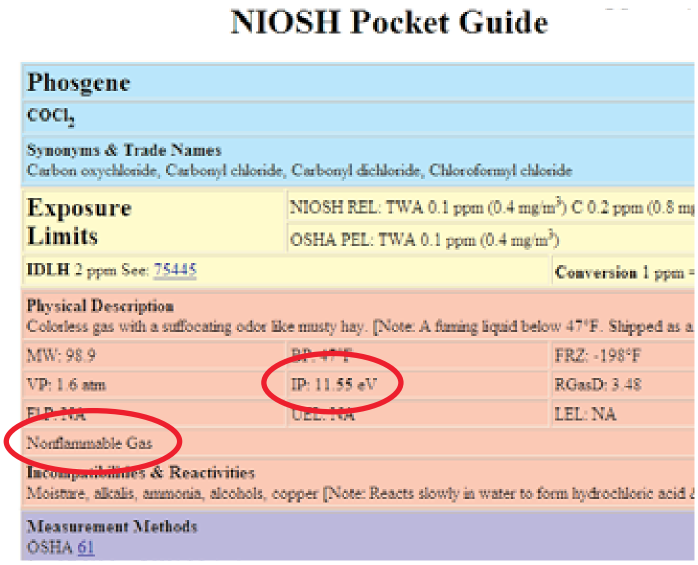


Figure 1. Once a vapor sample is acquired and identified with the GasID libraries, the appropriate correction factor can be applied to subsequent PID readings to make them more accurate.

Another area where product identification is important is monitoring oxygen levels in confined spaces. A typical four gas meter will give %O_2 levels as one of its readings, and OSHA has set guidelines for what concentrations constitute normal, rich and deficient oxygen levels. Interestingly, the O_2 concentration in a space can drop from 21% to 20.5% and still be considered "normal," but the four gas meter won't necessarily indicate what is displacing the oxygen. Nevertheless, 2.5% (or 25,000 ppm) of the air in the space is being replaced by "something" - and knowing the identity of that something is critical. If the product is not carbon monoxide, hydrogen sulfide, or a flammable it won't be picked up by the four gas meter, but it is likely well above its IDLH level. This is where the GasID comes in.

Consider the highly toxic but non-flammable gas phosgene, which is normally stored as a liquefied compressed gas. Suppose a container of phosgene were illicitly obtained by a group of domestic terrorists who transfer the product to incompatible secondary containers and hide them in a closed-up basement. If the secondary containers leak or rupture, the basement could become a deadly environment that has a nominally "normal" O_2 level. When law enforcement officials raid the house, a musty, suffocating odor alarms them to a potentially hazardous environment. A survey of the basement area by the local HazMat team indicates no flammables but slightly suppressed oxygen levels. A sample of the atmosphere with the GasID clearly shows that phosgene is present, as shown in Figure 2, which explains the four gas meter readings. A direct link to the NIOSH database in the GasID software allows the PID technician to see that the IP of this product is 11.55 eV, so the higher energy bulb is put into place to allow the phosgene levels to be accurately monitored while the atmosphere is remediated.




NIOSH Pocket Guide

Phosgene		
$COCl_2$		
Synonyms & Trade Names Carbon oxychloride, Carbonyl chloride, Carbonyl dichloride, Chloroformyl chloride		
Exposure Limits	NIOSH REL: TWA 0.1 ppm (0.4 mg/m³) C 0.2 ppm (0.8 m	
	OSHA PEL: TWA 0.1 ppm (0.4 mg/m³)	
IDLH 2 ppm See: 75445		**Conversion** 1 ppm =
Physical Description Colorless gas with a suffocating odor like musty hay. [Note: A fuming liquid below 47°F. Shipped as a		
MW: 98.9	BP: 47°F	FRZ: -198°F
VP: 1.6 atm	IP: 11.55 eV	RGasD: 3.48
FLP: NA	UEL: NA	LEL: NA
Nonflammable Gas		
Incompatibilities & Reactivities Moisture, alkalis, ammonia, alcohols, copper [Note: Reacts slowly in water to form hydrochloric acid		
Measurement Methods OSHA 61		

Figure 2. Gases like phosgene are highly toxic but non-flammable, yet they can displace O2 at high concentrations without being detected by a %LEL or standard 10.6 eV PID meter. A direct link to the NIOSH pocket guide in the GasID software makes this information readily available.

Problem Vapors for Other Meters

Certain vapors can be problematic for PID measurements because of the relatively high correction factors (CF) needed to produce accurate concentration readings. For instance, acetic acid has a CF of 22 for a particular manufacturer's PID when calibrated to isobutylene and a 10.6 eV bulb is used. To put this into perspective, consider that if 100 mL (about one-third of a can of soda) of acetic acid liquid is spilled in a 20' × 20' × 8' clandestine drug lab, the molar concentration of acetic acid vapor upon evaporation would be 432 ppm, which is well above the IDLH value of 50 ppm, but well below the 10% of LEL value of 4,000 ppm, for this product. However, a PID meter calibrated to isobutylene would only read 19.6 ppm (432 ppm ÷ 22), which could lead to a misinterpretation about the potential hazards at the scene. As shown in Figure 3, acetic acid vapor is readily identified with the GasID, which would allow a HazMat team monitoring the clandestine garage with a PID to get the right information.

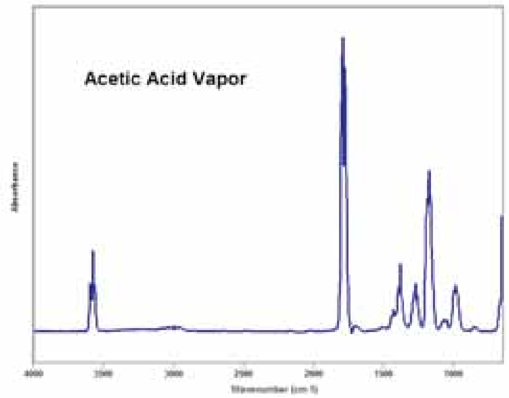


Figure 3. Acetic acid vapor is an example of a product that has a high PID correction factor, so knowing it is present is crucial for obtaining accurate concentration readings.

Some vapors are not even detected with the standard 10.6 eV bulb of a PID, and are not flammable so they are not picked up by %LEL meters. For example, chloroform and carbon tetrachloride are common industrial solvents that are non-flammable but have IDLH values of approximately 500 and 200 ppm, respectively. Unfortunately, they also have IP values over 11 eV, so they cannot be monitored with a PID unless an 11.7 eV bulb (which is not typically used by most responders) is employed. However, these solvents produce easily distinguishable IR spectra, as shown in Figure 4, making them easily identifiable with the GasID.

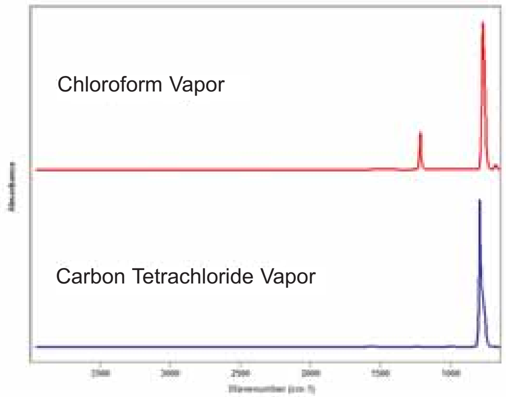


Figure 4. Some toxic compounds, such as chloroform and carbon tetrachloride, are not detected by a standard 10.6 eV PID bulb or by a flammability meter, but are easily identified with the GasID using the spectra shown here.

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