Orthogonal Detection for More Complete Protection from Toxic Gases and Vapors in Overhaul Operations

While long considered to be less toxic than firefighting suppression activities, overhaul and fire investigation activities do potentially represent both acute and chronic toxic atmospheric events. Carbon Monoxide (CO) and Hydrogen Cyanide (HCN) detectors, while appropriate for detection of CO and HCN respectively, are not good indicators of total toxicity in the post fire environment. New multisensory "orthogonal" technologies like the Environics' ChemPro100i provide the opportunity to detect a much more representative array of the toxic gases and vapors present in the overhaul environment and alert operators that a toxic event is happening that requires them to "mask up" or exit the overhaul environment.

What Is Overhaul?

Overhaul is the stage of firefighting where fire suppression is complete and firefighters search for and extinguish possible sources of re-ignition and fire investigators may begin the search for the source of the fire. It is during this stage of firefighting, where there is no fire and little to no smoke in the environment, that a firefighter is likely to remove Self Contained Breathing Apparatus (SCBA) and work "barefaced." Because SCBAs can be heavy and bulky, it is common practice with many firefighters not to wear SCBAs during overhaul.

Overhaul Poses a Real Toxicity Threat

Building materials, furnishings, paints, plastics and the electronics found in today's buildings all have the potential to burn and decompose into acutely acting and chronically acting toxic gases and vapors. A number of studies have demonstrated that these toxic gases and vapors are not just present during suppression activities but also during the overhaul and investigation stages. This means that many potentially toxic and carcinogenic gas and vapors can be present during the overhaul process such as: Carbon Monoxide (CO), Hydrogen Cyanide (HCN), oxides of Nitrogen (NO and NO2), Sulfur Dioxide (SO2), Polycyclic Aromatic Hydrocarbons (PAHs), Aldehydes (like Formaldehyde), acids (like HCl), aromatics (like benzene) and Phosgene (from the thermal decomposition of refrigerants). Even a small kitchen fire can off-gas many toxic vapors including PFIB (perfluoroisobutane, a chemical warfare agent) and HF (hydrofluoric acid) when Teflon thermally decomposes. Some of these chemicals found in overhaul have good warning properties but many do not.

CO and HCN Don't Work as "Canaries"

Traditionally CO detectors have been used to indicate the presence of toxic gases but there is no significant correlation between CO levels and levels of other chemicals that may be present during overhaul. Electrochemical cells used to measure CO are also prone to give inaccurate readings in the presence of interferents or high humidity.

Cost of Ownership for CO & HCN

The electrochemical (EC) sensors used in CO and HCN detectors have a finite life and require periodic calibration. CO sensors last 2 years and HCN sensors last just one year. Calibration gas for CO sensors is stable and inexpensive but calibration gas for HCN sensors is expensive and short-lived. Using the cost structure from a popular name brand company, the cost per year of owning a CO sensor is about $160/year factoring in sensor replacement and calibration gas costs. For an HCN sensor the comparable cost is $675/year. So, the on-going yearly cost of using a CO and HCN detector for overhaul detection is $805/year.

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sales@environics.fi · www.environics.fi
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An "Orthogonal" Solution

In gas detection the word "orthogonal" has come to be used to characterize detectors that use multiple, non-redundant sensors to solve a detection problem. The Environics ChemPro100i is such an orthogonal detector. While at its heart there is an aspirated Ion Mobility Spectroscopy (IMS) sensor, it uses this sensor with additional sensors and "fuzzy logic" to classify chemicals. The ChemPro100i has the ability to demonstrate warning for more threatening chemicals in the overhaul environment than any handheld detection technology. While the ChemPro100i has a higher purchase cost, it doesn't have the calibration and sensor replacement costs that EC sensors bring with them. With the Guaranteed Cost of Ownership (GCO) program that comes with the ChemPro100i maintenance costs are completely covered for the first 5 years of ownership. In the absence of wearing an SCBA the ChemPro100i represents a more systematic approach to monitoring the overhaul process for toxic gases and vapors. If a toxic gas or vapor is present it directs the operator to "mask up."

The ChemPro100i Ion Mobility Spectrometry is a "PID on Steroids". With its 60 000 eV ionization energy it allow s sniffing hundreds of dangerous chemicals and sort the ions instead of just counting them like a PID. Therefore, the ChemPro 100i is ideally suitable for Overhaul situations to warn in the presence of poisonous gases. The technology is based on orthogonal sensors with 16 channel IMS, 3 MOS, FET and atmospheric sensors.

Overhaul library

The built-in Overhaul library at the ChemPro 100i is measuring 19 most common Overhaul chemicals such as Acrolein, Benzene, CO, Formaldehyde, HCN etc. at TWA levels. In addition, the library contains a generic "Chemical Detected" alarm in case the detector is seeing a potentially dangerous chemical that is not in the current library. The "Chemical Detected" covers hundreds of toxic chemicals thus providing an additional level of safety for the user.

What the ChemPro100i Tells You			What the ChemPro100i is Detecting	
Text/Icon	Audio	Visible	Chemicals	Alarm Limit ppm
Mask Up 	▪▪▪▪▪▪▪▪	Red LEDs	Acetaldehyde (CH_3CHO) Acrolein (C_3H_4O) Acrylonitrile (C_3H_3N) Ammonia (NH_3) Benzene (C_6H_6) Carbon monoxide (CO) Formaldehyde (CH_2O) Formic acid (CH_2O_2) Glutaraldehyde ($CH_2(CH_2CHO)_2$) Hydrogen bromide (HBr) Hydrogen chloride (HCl) Hydrogen cyanide (HCN) Hydrogen fluoride (HF) Isocyanates (TDI, MDI) Naphthalene ($C_{10}H_8$) Nitrogen oxides (NO, NO_2) Sulphur dioxide (SO_2) Toluene ($C_6H_5CH_3$) Vinyl chloride (H_2C:CHCl)	Detectable mostly at TWA Levels
Chemical Detected 	▪▪▪▪▪▪▪▪	Red LEDs	Generic alarm for chemicals in hazardous concentrations or chemical mixtures	

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The Overhaul library is designed to provide a prompt for operators to put on their self-contained breathing apparatus (SCBA) and is not meant for chemical classification. Advanced users can glean additional information about the atmosphere by using the “TIC-Classifier” or “TIC Confirm” libraries.

The “Trend” screen provides a rolling line graph and audible “Geiger Counter” style beep so users can “see” and “hear” areas of higher Concentrations. When significant levels of chemicals are found and classified the classified name is shown on the “Trend” display . No other CWA detector has the ability to simultaneously sniff and classify.

RAD Module

The RAD module brings additional capability to the ChemPro 100i – it allows measuring also hazardous gamma radiation with the same instrument than Chemicals. The ChemPro100i contains also a handy ”Sampling Cap” that allows using the Chempro for collecting an air sample. The Sample Cap fits a regular Tedlar bag into the Chempro air inlet.

About Us & ChemPro100i

ChemPro 100i is a product of Environics, fielded in more than 50 countries and widely used among Hazmat teams in the US and Canada. Environics has been present in the US since 1988, represented by Gases101 LLC, Round Rock Texas since 2015. Please contact us for further information

Master Distributor in the US

Gases 101 LLC
sales@gases101.com
1107 Wonder Dr, Round Rock
TX 78681
+1 512 436 8923

Environics Oy

Timo Jaakkola
timo.jaakkola@environicsusa.com
Sammonkatu 12
50100 Mikkeli – Finland
US Cell +1 443 703 8008

tel +358 201 430 430 · **fax** +358 201 430 440
sales@environics.fi · www.environics.fi

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