

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

While long considered to be not as toxic as firefighting suppression activities, overhaul and investigation activities do represent both acute and chronic toxic events. Current gas detection technologies are unable to see the complete picture and provide full protection for all the gas and vapor toxic threats present in the overhaul and investigation environments. New multisensory “orthogonal” technologies like the Environics’ ChemPro100 provide the opportunity to detect all 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 reignition 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 his/her 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 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 NO<sub>2</sub>), Sulfur Dioxide (SO<sub>2</sub>), Polycyclic Aromatic Hydrocarbons (PAHs), Aldehydes (like Formaldehyde), acids (like HCl), aromatics (like benzene) and even

Phosgene (from the thermal decomposition of refrigerants). Some of these chemicals have good warning properties but many do not.

The conclusion of ATF **Health Hazard Evaluation Report 96-0171** by Gregory Kinnes and Gregg Hine demonstrates the potential for toxic atmospheres to be present during overhaul and fire investigations: “Although the environmental sampling conducted during this investigation indicated that most contaminant concentrations did not exceed the relevant evaluation criteria, it still indicated that the potential for exposure exists. In addition, the sampling indicated that the potential for exposure to carcinogens existed to some extent.”

#### CO and HCN Don’t Work as “Canaries

Carbon Monoxide (CO) and now Hydrogen Cyanide (HCN) sensors have been sold as “overhaul” sensors to provide firefighters with some sense of security that they are unmasking in a “clean” atmosphere. However, in “**Characterization of Firefighter Exposures During Fire Overhaul**” Bolstad-Johnson et al found that “...CO concentrations did not predict concentrations of other products of combustion.” This study was published in 2000, before the wide acceptance of HCN monitors for overhaul work. However, this study does provide an additional clue that HCN, like CO, does not predict concentrations of other products of combustion. “...Only 4 samples (out of 26 fires sampled-ed.) resulted in concentrations above the LOD (Limit Of Detection-ed.). None of these four samples had concentrations of HCN above 10 mg, hence, the concentrations could not be quantified, but were all well below 1 mg/m<sup>3</sup>.” For reference the OSHA PEL for HCN is 11mg/m<sup>3</sup> so the HCN levels monitored were well below potentially toxic levels. This isn’t to say that CO and HCN may not be present during overhaul activities in significant and even toxic concentrations. But CO and HCN

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concentrations do not correlate with total toxicity. Put another way, CO and HCN sensors are not appropriate “canaries” for judging total toxicity in an overhaul environment.

### An “Orthogonal” Solution

One of the meanings for orthogonal is the characteristic of being independent (relative to something else). In gas detection orthogonal has come to be used to characterize detectors that use multiple, non-redundant sensors to solve a detection problem. The Environics ChemPro100 is just 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 ChemPro100 has the ability to demonstrate warning for more threatening chemicals in the overhaul environment than any handheld detection technology. In the absence of wearing an SCBA the ChemPro100 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.”

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