Dr Christina Baxter, of EmergencyResponseTIPS.com and Hazard3.com, offers helpful advice for first responders

Keeping you safe!

This column is intended to provide operational guidance to the hazmat/CBRNE community regarding the selection and performance of equipment and tactics. This time around, we will focus on emergency response to traditional chemical warfare agents (CWAs).

Modern chemical warfare began with the German chlorine attack at Ypres, Belgium on 22 April 1915 and continues to this day. Since then, CWAs have been used in both wartime and during domestic terrorism attacks. Such use remains a serious threat, especially in eastern Europe and northern Africa.

Toxicology

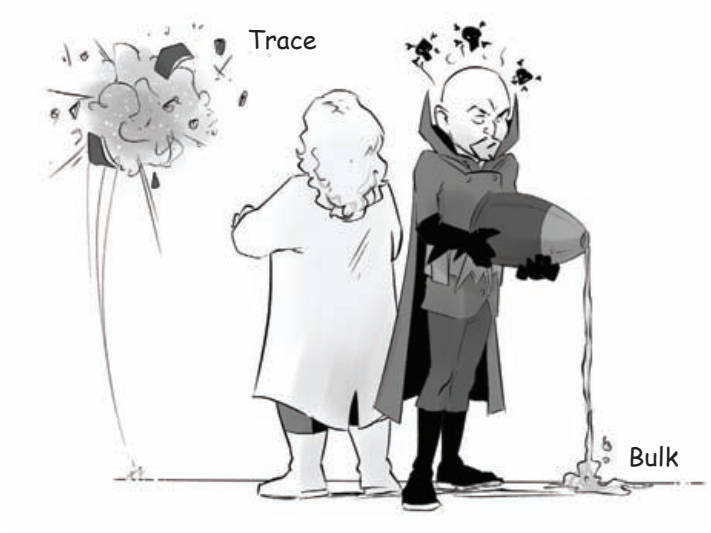
Chemical warfare agents can be divided into two operational constructs - area denial and anti-personnel. Area denial agents, which comprise blister agents and V series nerve agents, tend to be liquids with low vapour pressure and high vapour density. Anti-personnel agents, namely choking agents, blood agents and G series nerve agents, tend to be gases or vapour forming liquids. They typically exhibit higher vapour pressures than area denial agents, and are of variable vapour density. The toxicity of these agents varies significantly. These properties inform both their applications and the effects on responders and adjacent communities.

While inhalation is the predominant route of exposure of concern to emergency responders, ingestion and dermal absorption should not be ignored. These routes of entry must be protected to minimise or prevent exposure.

Detection

Field detection falls into two categories - trace detection for detect-to-warn and detect-to-protect applications and bulk detection for identification and threat confirmation. The detect-to-warn and detect-to-protect technologies should be continuous sampling, fast (in seconds), and simple to use devices, while the detect-to-identify technologies at both trace and bulk levels can utilise batch sampling, slower response (in minutes), and more complicated interfaces.

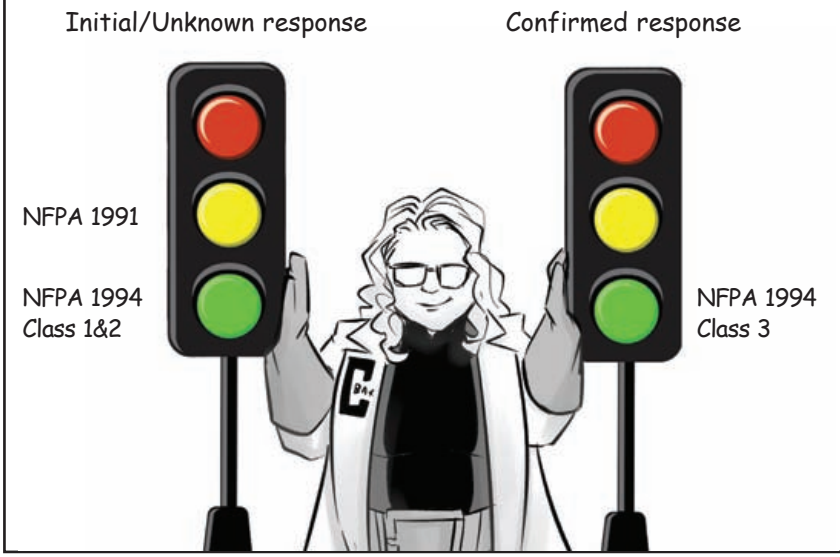
Detect-to-warn or detect-to-protect techniques generally include flame spectrophotometry and photoionisation detectors (PID) as they respond within two to three seconds. Other techniques that can be useful in this space include ion mobility spectroscopy (IMS) and electrochemical cells. Due to the high vapour densities associated with CWAs, care must be taken to ensure that detection attempts are at or below the point of release. CWA vapour pressures, especially at low temperatures, should be considered when selecting detection techniques and the detection approaches adopted.



Bulk technologies such as Raman, FTIR, and colorimetric can be used for confirmation and identification of larger sample volumes (high micrograms to milligrams). Trace technologies such as gas chromatography mass spectrometry can be used to identify at trace levels but at the cost of speed of analysis (many minutes).

Personal Protection Equipment (PPE)

Many factors should be taken into consideration when choosing PPE, including the agent and its likely concentration, tasks to be performed, location, and duration of the potential exposure. In considering the PPE itself, the key elements are respiratory protection and skin protection. Respiratory protection can range from air purifying respirators incorporating a suitable cartridge to self-contained breathing apparatus. There are many standards for skin protection across the world. In the US, NFPA 1994 garments class one or two ensembles are recommended for initial response to CWA events. If these are not available, fully encapsulating NFPA 1991 ensembles can be used, however, physical restrictions to movement, hand function, hearing and loss of comfort can be associated with them. Once the threat identity has been confirmed via detection and identification devices, NFPA 1994 class three ensembles may also be utilised. Charcoal based suits, although currently not certified against NFPA standards, can be employed if data is available to support their use in the temperature, humidity, and chemical concentration environment.



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Decontamination

The first step towards decontamination is the evaluation of exposed versus contaminated people and materials. It is important to differentiate between exposure, which means having a substance around you, and contamination, ie having a substance on or in you. For people potentially exposed, but not contaminated, removal from the source of the exposure and treating any symptoms is sufficient. Apply the emergency response decision support system (ERDSS) decontamination module to help with this assessment.

For those determined to be contaminated, a hybrid approach to decon is recommended. First remove any affected clothing. Then, if there is evidence of skin deposition of liquid, aerosol, or solid, blot the affected area with an absorbent material, being careful not to apply pressure. If available, reactive skin decontamination lotion (RSDL) can be used to degrade any residual threat material. Finally, wash the affected area of the skin with soap and water.

Exposed Contaminated

When decontaminating protective clothing or equipment, first blot any residual material you see, then apply an appropriate decontaminant (eg bleach solution, peroxide solution, peracetic acid solution), followed by rinsing or removing the decontaminant. With highly toxic threats like CWAs, it is imperative that continuous detection and identification is used to ensure complete degradation of the threat material, and successful decontamination of the individual.

To enhance your readiness to manage incidents involving CWA threats it is essential to engage with your security, public health and police agencies to identify the likely threats. This ensures your agency and allied responder approaches and training are contemporary and appropriate for the operational context.

A safe and effective response to events involving CWAs includes:

1. Detecting, and if possible, identifying the agent used.
2. Minimising opportunities to generate aerosols.
3. Minimising opportunities for unexpected exposure.
4. Wearing the appropriate respiratory and dermal protection.
5. Ensuring appropriate field expedient decontamination is available, minimise exposure via hybrid decontamination approach.

See past issues for details on other emerging chemical and biological threats. These include fourth generation agents (April 2020), toxins (October 2021), binary devices (February 2022), pharmaceutical based agents (April 2022), and riot control agents (June 2022).

Images are courtesy of Phil Buckenham
https://philbuckenhamart.wixsite.com/philbuckenham