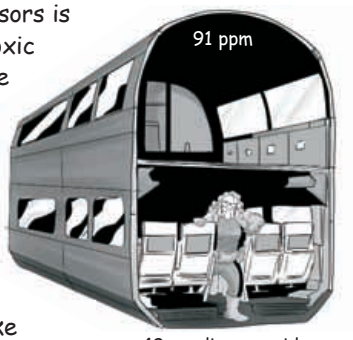
Dr Christina Baxter, of EmergencyResponseTIPS.com and Hazard3.com, offers helpful advice for first responders

Keeping you safe!

Binary devices, or gas-forming devices, are a threat device employed over the years by foreign and domestic terrorists. These devices incorporate a toxic solid or liquid that is reacted with an acid or water to rapidly generate a toxic gas and often in large volumes. The reaction ceases when either of the precursors is spent. The toxic precursor is typically a skin contact hazard, and the gas formed is toxic by inhalation. These may include cyanide, phosphide, azide, sulfide, amide, hypochlorite and arsenide salts. As an example: 49 grams of sodium cyanide can form around 24.5 litres of hydrogen cyanide gas at room temperature.



49g sodium cyanide = 24.5L HCN & 181 ppm

The two precursors are kept segregated until the point of release making these devices safe to prepare, move and position before use. Due to the simplicity of design and the relative ease of access to precursor materials, the threat of binary devices remains elevated. Relatively small amounts of toxic precursor can be used to generate large volumes of the toxic gas, which is a major threat in enclosed spaces like mass transit or buildings where large numbers of persons congregate.

Background

These devices have been exploited by terrorists for decades due to their ease of manufacture and use. To illustrate this the Aum Shrinkyo cult placed hydrogen cyanide binary devices in several locations within the Tokyo (Japan) subway system in 1995. A few years later convicted anarchist, James Dalton Bell, was also found with a variety of toxic chemicals including acid, cyanide, and sarin derivative in his basement after he contaminated an Internal Revenue Service office with a foul-smelling chemical in Vancouver, Washington (USA).

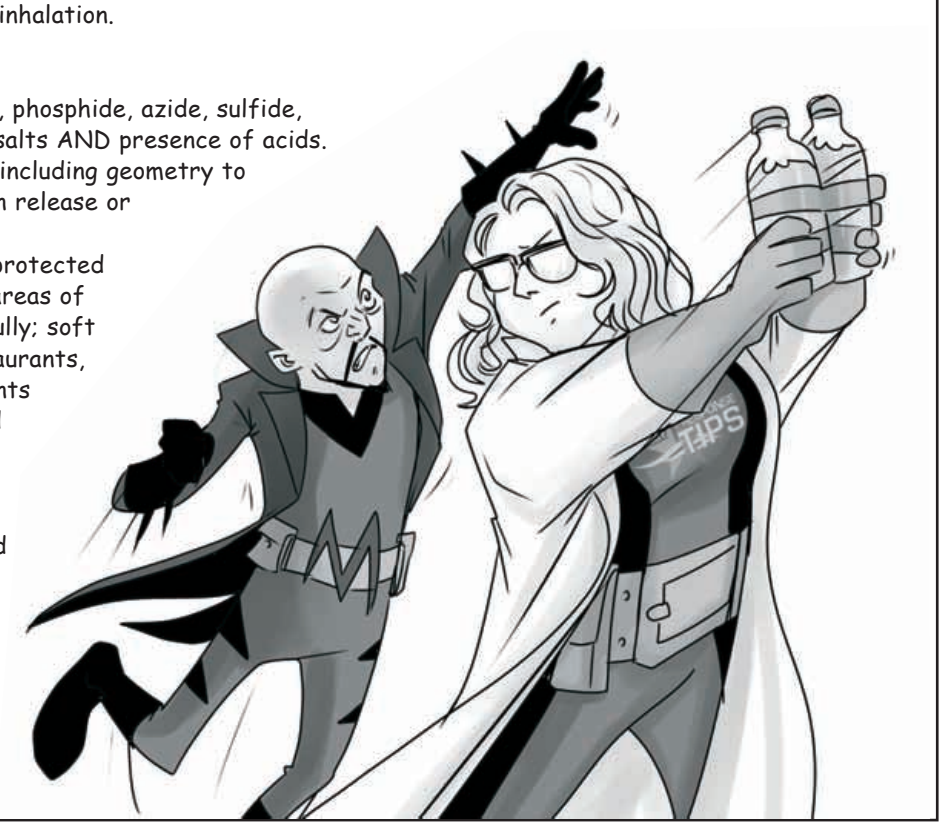
In 2003, an Al-Qaeda plan to utilize similar devices in the New York City subway system was foiled. It was during this plan that the Mubtakkar (loosely translated to "invention") device geometry was first discussed. The Mubtakkar design stored the precursor components of sodium, or potassium, cyanide separately from the acid solution to minimize danger during assembly, storage, and transport. Once the material was emplaced, a small explosive charge was used to break the containers and force the mixing of the precursor materials, forming hydrogen cyanide. Methods for production of hydrogen cyanide and its precursors are available in books like Abdel-Aziz's Mujahideen Poisons Handbook, Ledgard's Preparatory Manual of Chemical Warfare Agents, and Harber's Assorted Nasties as well as on Jihadist's forums.

More recently, hydrogen cyanide-based devices have been of interest to white supremacy-based domestic terror groups in addition to the renewed interest to jihadists. As mentioned earlier many threat materials that can be made using binary devices – hydrogen cyanide-based devices have historically been the most common. We only need to go back to 2017 in Sydney, Australia to see a foiled plot to use a hydrogen sulfide generating device; this improvised chemical dispersion device was part of the "most sophisticated" terror plots attempted on Australian Soil.

Current Threat Landscape
Based upon past events and current threat intelligence, binary devices are most likely to be used to generate hydrogen cyanide, phosphine, and hydrogen sulfide; however, azides, amides, hypochlorite, and arsenide salts cannot be discounted. Devices may not be as intricate as those included with a traditional Mubtakkar design; they may be as simple as two glass containers duct taped together for throwing.

Due to this renewed interest, it is imperative that emergency response entities recognize the indicators of a binary device, the locations where it is likely to be utilized, and the gases that may be produced which may cause injury or death rapidly by inhalation.

Key Indicators
• Chemicals: Presence of cyanide, phosphide, azide, sulfide, amide, hypochlorite or arsenide salts AND presence of acids.
• Device: Device characteristics including geometry to force comingling of material upon release or deployment.
• Target: Indoor venues or well protected outdoor venues are most likely; areas of egress must be monitored carefully; soft targets like shopping malls, restaurants, movie theaters, and outdoor events where security is not heightened remain most likely.
• Signs and Symptoms: Respiratory distress and rapid onset of the effects on affected persons.
Symptoms presented by affected persons can inform responders about the gas formed from a binary device until detection can be applied to confirm the agent.

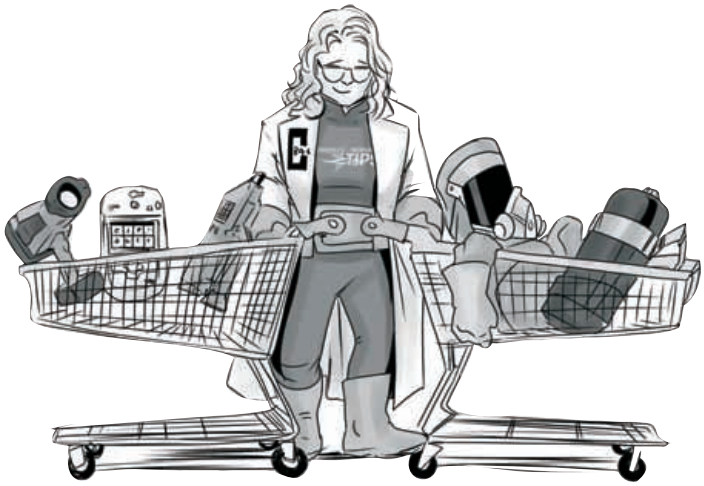


Initial Emergency Response Considerations
If a binary device is suspected, emergency responders need to isolate the affected area (out to 60 meters (200 feet) and not enter the space without first considering the hazards and risks. Once the area is isolated, establish command and seek expert advice. Although a device may appear harmless and finished, it should not be disturbed as any remaining materials can react forming more gas. If possible, place a closed container (like a trash can) over the materials to minimize the spread of gases while evacuating the area and manage ventilation systems. This may include turning ventilation systems off to minimize agent dispersal to areas where evacuations may be occurring. When ventilating a space also consider where the gas will be exhausted to and ensure downwind exposures are considered before commencing.

Keeping you safe!

Hazardous materials response considerations

Identification of the gaseous agent is essential to assure the safety of responders and the public. Since many of the gases formed are both toxic and flammable the environment should be continuously monitored for toxicity and flammability using portable gas detection equipment over a range from below the permissible exposure limit (PEL) up to the lower flammability limit (LFL) and including the immediately dangerous to life and health (IDLH) level and lethal concentration (LClo). Detectors may include the AP4C, electrochemical sensors, PIDs, and newer technologies like gas phase FTIR. As part of your pre-planning, consider what detectors can be applied to identify and monitor these agents.



Responders must use a Self-Contained Breathing Apparatus (SCBA) for respiratory protection until the agent is identified and its concentration is determined. This information can be used to determine whether other forms of respiratory protection can be safely adopted. Remember that there may be very high concentrations in enclosed spaces and these will increase as you approach the binary device. Hydrogen sulfide, hydrogen cyanide, and phosphine are not skin hazards at the concentrations up to and including lethal concentrations, therefore firefighter protective gear is suitable for skin protection during the evacuation of casualties. Consideration should be given to wearing chemical protective clothing when dealing with the device itself.

While binary devices are rapidly spent, mitigation of the device and the remaining contents may be necessary. First, ensure that there are no explosive components within the system design. Next, if possible, segregate the chemical components from one another and from the outer container. Remember this is a crime scene; while it is imperative that the reaction be mitigated, it is also important to preserve the evidence. Finally, properly transfer the materials to safe containment for evidence and then neutralize residual materials.

Fresh Air Decontamination can be performed through natural ventilation or forced ventilation. If the toxic or corrosive liquids/solids directly contact a person's skin or localized redness is evident, wet decontamination approaches are warranted.

For further guidance on binary devices, the products and amounts produced, ventilation requirements, and recommendations for protection, detection, and decontamination, consider employing the Emergency Response Decision Support System (ERDSS, also known as the Chemical Companion).

Remember - Preplan in conjunction with your response partners to identify suitable detectors, respiratory and skin protection approaches, and mitigation strategies that will protect the crime scene, as well as your decontamination and medical strategies. Most importantly practice together!

Until next time,

CBax away!

Images are courtesy of Phil Buckenham
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