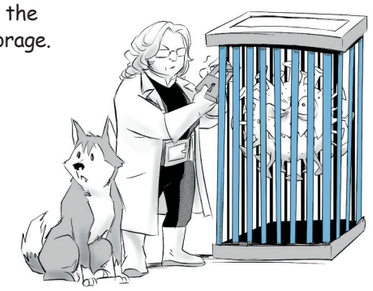
Dr. Christina Baxter, of EmergencyResponseTIPS.com & Hazard3.com, offers helpful advice for first responders. This issue is about the Covid-19 vaccine.

CBRNeWORLD

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. In this edition we will focus on the upcoming delivery of Covid-19 vaccines requiring ultra-low temperature storage.



The human body naturally makes messenger RNA (ribonucleic acid), or mRNA, to build, maintain and repair the body. Scientists at several companies have developed mRNA vaccines to help the body produce proteins that mimic those found in the SARS-CoV-2 virus, which is responsible for the disease known as Covid-19. These proteins trigger immune cells in the body to produce antibodies against the SARS-CoV-2 virus.

In addition to requiring two shots three weeks apart, these vaccines must be stored at ultra-cold temperatures to remain viable. The vaccines will therefore be shipped and stored on dry ice (solid carbon dioxide, CO_2), which is available in flakes, pellets or block form. It sublimes (vaporises directly to the gaseous state) at a temperature of -78.5°C (-109.3°F) or higher with one lb (0.45kg) of dry ice producing 250L (55gallons) of gas. This creates a logistical and safety challenge for the emergency response community worldwide.

Storage

Dry ice must be stored in well ventilated locations, having first been placed in insulated and ventilated storage containers designed for this purpose. Due to its thermal expansion, dry ice should never be stored in a tightly sealed container such as an ultra-low freezer or glass container. Styrofoam is an appropriate storage material as it is both a good insulator and not airtight. Where possible, continuous monitoring of gaseous CO_2 should be implemented to ensure that levels remain below 5,000ppm. It is important to note that CO_2 is heavier than air and will accumulate in low lying areas.

Handling

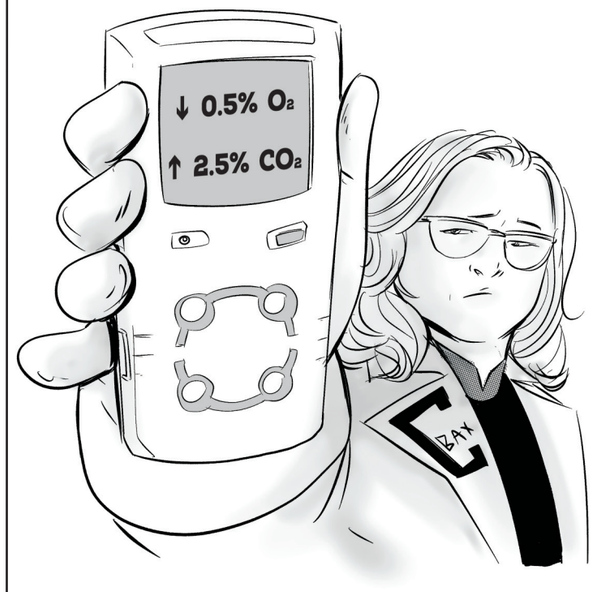
For any event involving the sublimation or release of gaseous CO_2, self-contained breathing apparatus (SCBA) should be used due to the potential for low oxygen environments, caused by displacement by CO_2. Structural firefighting ensembles, including both fire gloves and extrication gloves, provide limited protection in extreme cold temperatures, however, they can be utilised for rescue operations. Specialised loose fitting gloves are required when handling the dry ice itself or leaking containers. If an area is well ventilated and it is determined that SCBA is not required, eye protection should be worn. Where possible, fans should be used to increase the natural ventilation. Adding water to dry ice will increase the speed of the sublimation process and results in a corresponding higher risk of asphyxiation.

Hazard – burns/frostbite

At -78.5°C (-109.3°F), skin contact with dry ice can lead to severe frostbite. In case of contact, do NOT apply hot water, dry heat, or radiant heat. Remove any clothing that is not frozen to the skin. Move the exposed person to a warm area before thawing the affected part by carefully washing the area concerned with lukewarm (less than 35°C) for 10 to 15 minutes, immersing if possible. Do not rub the exposed areas as tissue damage may result. If there is contact with the eyes, flush them while holding the eyelids open.

Hazard – asphyxiation

Carbon dioxide is a simple asphyxiant therefore continuous monitoring of CO_2 and oxygen should take place whenever working around dry ice. Remember that a 0.5% drop in the oxygen level is equivalent to a 25,000 ppm (2.5%) increase in CO_2 levels in the environment. While exposure to this level of CO_2 increases the depth and rates of respiration, the corresponding decrease in oxygen concentration results in decreases in coordination, intellectual performance, and ability to perform strenuous work. In extreme cases where the oxygen concentration drops to 10% (from 19%), death can occur.



Hazard – explosions

Due to its thermal expansion, dry ice should never be stored in a tightly sealed container or any container with a screw-top lid. Dry ice will sublime about five to 10lbs every 24 hours in a typical storage container. This alone could cause an explosion in a tightly sealed container.

Disposal

The best disposal method is to just place the unused portion of dry ice in a well-ventilated area and allow it to sublimate naturally. Dry ice should never be disposed of in the trash nor should it be placed in a sink, toilet or other drain.

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