CBRN INSIGHTS: CHEMICAL THREATS

Unprotected exposure to toxic chemicals, whether accidentally during industrial use or intentionally as a result of warfare or terrorism, can result in severe consequences including serious injury and death. This paper will explore the history, properties and effects of three notable chemical threats and the importance of appropriate respiratory protection in mitigating their effects.

INTRODUCTION

Modern chemical warfare dates to the First World War, in which over 100,000 deaths occurred as a result of chemical weapon use. Since then, chemical weapons have been responsible for more than one million casualties globally.

Although 98% of the global population live under the protection of the Chemical Weapons Convention (a treaty brought into force in 1997 to prohibit the production, stockpiling and use of chemical weapons and their precursors), chemical substances and weapons still pose a tangible threat. This is highlighted by recent incidents such as the use of a Novichok nerve agent in the UK city of Salisbury in March 2018.

CHLORINE (CL2)

Chlorine is a natural chemical element that is widely used in industry and found in many chemical compounds. In its natural gas form, Chlorine is a highly toxic greenish-yellow gas. Even when not used as a weapon of war, it regularly accounts for fatalities and hundreds of injuries on an annual basis around the world.

Chlorine is widely used in the production of everyday items such as plastics, pharmaceuticals, cleaning products and textiles as well as for the purification and treatment of drinking water. It is also used in the manufacture of refrigerants, solar panels and body armor.

The development of Chlorine as a weapon was overseen by Fritz Haber, a German chemist considered by many to be 'The Father of Chemical Warfare'. Chlorine gas was used extensively during the First World War and was deployed to devastating effect by German forces in the Battle of Ypres on 22nd April 1915. It was first used by British forces later in the same year at Loos.

More recently, international observers have estimated that Chlorine has been used in around 90% of all confirmed chemical attacks carried out by the Syrian military regime since the beginning of the ongoing Civil War in 2011.

At low concentrations (1 to 10 parts per million), exposure to Chlorine can cause irritation of the eyes, nose and throat while higher concentrations (over 15 ppm) can result in blisters on exposed skin, breathing difficulties, nausea, vomiting and asphyxiation. Chlorine is typically classified as a 'Choking Agent'.

HYDROGEN CYANIDE (HCN)

Hydrogen Cyanide, a highly volatile, fast-acting and lethal substance, takes the form of a colorless liquid at temperatures below 25.6°C. As a gas, it has been reported to smell of bitter almonds.

Millions of tons of Hydrogen Cyanide are produced every year for industrial purposes. It is commonly used in processes including electro-plating, fumigation and in the production of synthetic fibers and plastics. Hydrogen Cyanide is also one of hundreds of harmful chemicals found in cigarettes. Perhaps most infamously, it was a key component of the notorious 'Zyclon B', used by the Nazis to murder over a million people in concentration camps.

Symptoms of exposure to Hydrogen Cyanide can present within just 15 seconds and, at low concentrations, can include dizziness, nausea, headaches and vomiting. Symptoms resulting from higher concentrations are more severe and can include convulsions, irregular heartbeat, cessation of breathing and coma. Death can occur less than eight minutes from exposure.

Hydrogen Cyanide is a cellular asphyxiant, meaning that it inhibits the body's ability to use oxygen and victims of exposure suffocate to death. As a result, Hydrogen Cyanide is commonly categorised as a 'Blood Agent'.

SARIN (GB)

At room temperature, Sarin is a clear and odorless liquid and is classified as a lethal, non-persistent chemical agent, meaning that it can evaporate quickly to form a vapor. As it is heavier that air, Sarin vapor will typically sink, staying close to the ground and collecting in low-lying areas.

Sarin was originally developed in Germany in 1938 by chemist Gerhard Schrader as an organophosphate pesticide. Throughout the Iran-Iraq war of the 1980s it was used extensively as a chemical weapon by Iraqi forces, notably against Kurds in the Northern Iraqi town of Hallabja. During the five-hour attack, it is estimated that around 5000 people (most of them civilians) were killed and over 10,000 were injured. Sarin was used in 1994 and 1995 by the doomsday cult Aum Shinrikyo to carry out two terrorist attacks in Japan in which a total of 21 people died.

Like Chlorine, it is believed that Syrian Government forces have repeatedly used Sarin against opposition military and civilian targets during the Syrian Civil War. The UN estimates that Sarin-filled surface-to-surface rockets killed 1,500 people in Eastern and Western Ghouta on 21 August 2013.

Early symptoms of Sarin exposure include dimness of vision, excess salivation, headaches and sweating. Medium-term symptoms can include difficulty breathing, runny nose, pinpointed pupils and tightness in the chest. Late-term symptoms include nausea and vomiting, muscle twitching, loss of bladder and bowel control, seizures and paralysis of the heart and diaphragm. Classified as a 'Nerve Agent', Sarin disrupts the victim's central nervous system and causes nerve endings to go into 'overdrive'. Liquid or vapor exposure can ultimately cause death within minutes.

PROTECTION AGAINST CHEMICAL THREATS

Many of the negative effects of exposure to these and similar chemical substances can be mitigated by appropriate respiratory protection. Respirators, such as those produced by Avon Protection, are a primary protective measure against the effects of chemical weapons and other chemical threats.

Filter-based systems, including Air Purifying Respirators (APRs), Escape Hoods and Powered Air Purifying Respirators (PAPRs) utilize a bed of activated carbon (along with other additives) contained within the filter which absorbs harmful molecules as the contaminated air passes through it.

Alternatively, Self-Contained Breathing Apparatus (SCBA) systems do not use filters to protect against chemical substances but instead provide a clean, uncontaminated air supply to the wearer via a compressed air cylinder. SCBA systems have the additional benefit of being suitable for use in oxygen-deficient environments.

Further information relating to filter and respirator technology can be found in other Avon Protection white papers: **How Do Mask Filters Work?** and **Respirator Technology: APR 101**. Available now to view and download at **www.avon-protection.com/whitepapers.htm**