Picture credit: US Dept Defense

CHEMISTRY LESSON

Tony Kingham *examines the evolving threat from chemical weapons and reveals how we are fighting back*

Chemical weapons are nothing new. The earliest recorded use of gas warfare in Europe dates back to the fifth century BC, during the Peloponnesian War. Spartan forces besieging an Athenian city placed a lighted mixture of wood, pitch and sulphur under the walls hoping the noxious smoke would incapacitate the Athenians, so they would be unable to resist the assault that followed.

Sparta was not alone in its use of unconventional tactics in ancient Greece; Solon of Athens is said to have used hellebore roots to poison the water in an aqueduct leading from the River Pleistos around 590 BC during the siege of Kirrha.

Since then, military leaders down the centuries have used a full range of different chemicals to give them an advantage, especially in siege warfare, where they have time to prepare their deadly chemical concoctions and the intended victims cannot leave and so are sitting targets.

But it was not until the 20th century and the dawn of the industrial era that chemical weapons really came of age, and that again was in another form of siege warfare, the trenches of the World War I.

The Hague Declaration of 1899 and the Hague Convention of 1907 prohibited the firing of any projectiles: "the sole object of which is the diffusion of asphyxiating or deleterious gases". However, Germany exploited this loophole by opening canisters filled with poison gas and letting the wind carry it towards the enemy lines, instead of launching it in artillery rounds. Things then quickly escalated with the first full-scale deployment of deadly chemical warfare agents during the Second Battle of Ypres.

By the end of the war both sides were firing chemical artillery shells and it is estimated that a total 50,965 tons of pulmonary, lachrymatory and vesicant agents were used, causing an estimated 1.3 million casualties directly and of these, between 100,000–260,000 were civilians.

While civilians were not directly targeted, it is the nature of these weapons that once a shell explodes and the chemical agents are released into the air, they are out of control and completely indiscriminate. A change of wind direction can mean that agents drift back to affect your own troops or drift into nearby villages and towns, killing and injuring civilians – even your own.

It was the appalling physical injuries and indiscriminate effect that made these weapons seem somehow abhorrent, even within the carnage of a world war. However, they continued to be used occasionally between the wars and contrary to widespread belief, were used during WWII by the Japanese against other Asian opponents, though not against the industrial nations for fear of reprisals. Then, of course, there is Nazi Germany's extermination of millions of Jews, gassed with carbon monoxide and hydrogen cyanide.

Since World War II, chemical weapons have been used by rogue nations such as Iraq and Syria against their enemies, both internal and external, military and civilian. And despite the international community banning the use of chemical weapons in 1997 via the Chemical Weapons Convention, state actors are still the most likely users of chemical weapons. According to a report by the Center for Strategic and International Studies in 2018: "In 2012, a 20-year moratorium on state employment of chemical weapons use was broken. Since then, there have been more than 200 uses, against civilians, military targets and political enemies."

Another disturbing and evolving threat is the 'alleged' use of CW by state actors as weapons of political assassination in public places. North Korean agents used the nerve agent VX to assassinate the half-brother of the North Korean leader Kim Jong-nam in Kuala Lumpur International Airport in 2017 and Russian agents used Novichok nerve agent to assassinate former spy Sergei Skripal in Salisbury in the United Kingdom.

For terrorists, chemical weapons have a particular attraction. They are easy to make and the ingredients are easy to obtain and transport. They can also be used in aerosol form, released into water supplies or used to contaminate food. The threshold of skill required for the manufacture of these weapons has dropped, once upon a time you would usually need the skills of a trained chemist to manufacture these agents, but as a result of modern communications, a committed terrorist can be coached via the dark web. Anyone can make them.

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Chemical weapons also have a special physiological impact. They are unseen silent killers, which once released, are impossible to stop. This was first demonstrated in June 1995 in the Matsumoto sarin attack perpetrated by Aum Shinrikyo, a Japanese doomsday cult. They used a converted refrigerator truck to release a cloud of sarin, which cult members had manufactured themselves. The trucks cargo space held "a heating contraption that had been specifically designed to turn" 12 litres of liquid sarin into an aerosol, while fans diffused the aerosol into the neighbourhood. Eight people died and over 500 suffered harmful effects. A year later Aum Shinrikyo perpetrated the more famous sarin attack on the Tokyo underground killing 12 and injuring over 5,000.

In 2017 Australian Counter Terror police arrested two brothers for plotting to blow up a passenger aircraft. But during the investigation it also became known that they had tried to build a chemical weapon to disperse lethal gas against members of the public.

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How interested groups like Islamic State and al-Qaeda are in perpetrating WMD chemical attacks is not known. But we do know is that al-Qaeda is desperate to regain its leadership position within the Islamic Jihadist movement and one of the ways it will feel it can achieve that is through another 'spectacular,' and a WMD strike of some kind against the West would certainly fit that bill.

And it does have form in this area. CNN reported that during the Iraq War, al-Qaeda in Iraq launched a bombing campaign using chlorine gas from 21 October 2006 to June 2007, fortunately US and Iraqi forces successfully destroyed much of al-Qaeda in Iraq's chemical weapons organisation.

Whether it is a known terrorist group, a doomsday cult or a radicalised lone wolf, chemical attacks are hard to detect, hard to defend against and difficult to predict and respond to.

The first obvious strategy is to control the CW components. But that is getting increasingly difficult. As more nations industrialise and develop chemical industries of their own, the more difficult it is to manage and monitor the chemicals available.

As with most terrorist threats, disrupting an attack before it happens through good intelligence is the only tangible way of defeating it. And, in the information age that will come down to harvesting vast amounts of data across digital communications and picking up those signals, patterns and connecting the dots. But we should not underestimate good human intelligence, whether that is informants or members of the public being on the lookout for anyone purchasing suspicious quantities of certain chemicals.

But, if a terrorist plot goes undetected, once an attack is in progress, the outcome is already set. It is then a case of mitigation and disaster management.

Fortunately, or unfortunately, whichever way you look at it, Europe and the US have extensive experience in managing chemical attacks dating back to Cold War days, when nuclear and chemical attacks were expected.

Industrial disasters like the Bhopal gas leak in India in 1984 – which killed over 2,200 people – and the Fukushima Daiichi nuclear disaster in 2011, gave governments the impetus to roll out decontamination equipment to civilian authorities.

Agencies like the US Department of Homeland Security (DHS) Science and Technology Directorate (S&T), the Defense Threat Reduction Agency (DTRA) and other partners and industry continue to do research and collaborate on the inhalation hazards of industrial chemicals like ammonia and chlorine, using initiatives like Project Jack Rabbit. As part of this programme, DHS S&T led the Jack Rabbit II project, involved multiple large-scale chlorine release experiments at the US Army Dugway Proving Ground in 2015 and 2016. Nine chlorine release trials were successful. The purpose of these experiments was to establish, in the event of an incident, whether it is it safer for people to remain where they are or if it is better to evacuate. If you are a first responder called to the scene – what protective gear do you need and how can you secure the surrounding area and more.

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Cold War experience means that we are we are pretty well prepared in terms of equipment. Companies like DuPont and Blucher have been manufacturing HAZMAT suits for decades. Airboss and Hughes Safety manufacture decontamination showers and Avon Protection and Environics make respirators, to name but a few.

Another essential piece of equipment for first responders are sensors that can detect and identify trace-level chemicals. Again, these have been around for some time, but they have tended to be quite bulky. Swedish technology company Serstech produces the 100 Indicator, a hand-held, small, and light Raman spectrometer that can identify more than 14,000 substances.

Vince Deery Sales and Marketing Director 3DX-Ray, which has been appointed global distributor for the Serstech range, notes: "The Serstech 100 Indicator is small and light and comfortably fits in your hand or uniform pocket. Its robustness, high quality and high performance provides near lab-quality analysis in the field even under toughest conditions. The same instrument can be customised to identify any combination of explosives, narcotics, toxic industrial chemicals (TICs), pharmaceuticals and chemical warfare agents."

Whether it is a CW attack or an industrial accident, there will inevitably be chemical incidents in the future, and it will only be through close co-operation between relevant government agencies, first responders and industry that we will develop the technologies, procedures and protocols needed to mitigate the worst effects and save many lives ●

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Picture credit: US Dept Defense