Chemical Warfare Agent (CWA) Identification using Rigaku Handheld Raman Spectroscopy

Terrorist attacks using chemical weapons has over a 100-year history,[1] with WWI being the first war with over a million casualties directly related to the use of chemical weapons. Despite multiple conventions outlawing the development, production, and possession of chemical warfare agents (CWAs); threats of chemical weapons use remain a concern world-wide. Methodologies for easier generation of traditional CWAs, in addition to newer generations of chemical agents developed during the Cold War era allow for weapons to be more readily accessible and more easily escape notice in transport. In certain areas of the world, "disposed" CWAs can present a threat to innocent parties too when improper disposal, or forgotten stores of materials are unearthed.

In the last decade, the assassination of Kim Jong Nam with VX in Malaysia[2] and the murder and attempted poisoning of residents in Amesbury and Salisbury, UK[3] are two prominent cases of CWA-centered attacks. These exposures occurred in public locations, not only afflicting their intended victims, but necessitating extensive decontamination over the course of months and even years. The Salisbury incident highlighted the need for newer CWAs to be available on portable detection equipment given that the Novichok agent was only identified after samples were sent to Porton Down.[4] Proper and rapid identification of CWA precursors, degradation products and even non-lethal rioting agents are critical in helping to reduce casualties and inform emergency personnel how to treat those exposed to these materials.

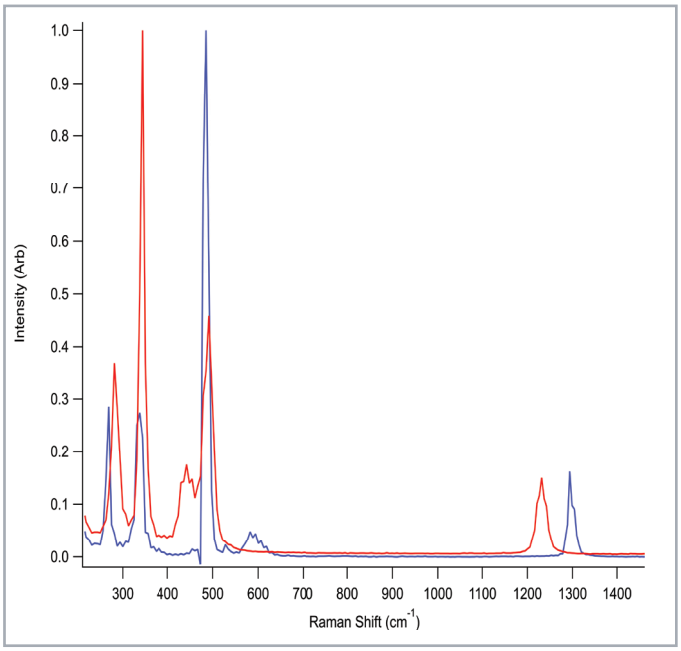

Figure 1. CWC Scheduled precursors phosphorus oxychloride (red) and thionyl chloride (blue) are readily detected and differentiated using Rigaku's CQL Max-ID.

Rigaku CQL Max-ID Handheld Raman Provides Analysis of Chemical Warfare Agents

Rigaku's CQL Max-ID instrument presents some advantages of detection of CWAs in the field compared to other competitive equipment. Raman spectroscopy, the technology leveraged by Rigaku's CQL portfolio of handheld analyzers, is a highly selective bulk analytical technique, which collects a spectral fingerprint from solids, liquids and gels. Figure 1 shows the spectra for two similar G-series precursor compounds that are highly reactive and produce toxic decomposition products when exposed to water. These materials can safely be scanned and identified through glass or transparent containers without opening them, thereby reducing the risk of exposure to remediation or hazmat teams. The CQL Max-ID™ has a library containing 4th generation agents, such as Novichok agents and many others. Correctly identifying threat materials helps guide first responders in their course of action.

Munitions formulations, degradation/weapons aging, precursor contamination and chemical structure often contribute to a fluorescent signal when CWAs are analyzed using 532 nm or 785 nm Raman excitation. The 1064 nm excitation, used in CQL Max-ID allows for a reduction in fluorescence commonly encountered with CWAs, especially with nitrogen mustards. Figure 2 shows some of the CWAs that CQL Max-ID is capable of detecting, including VX used in the Malaysia and Novichok used in the UK. Reduction in fluorescence generation allows users to make accurate chemical determinations.

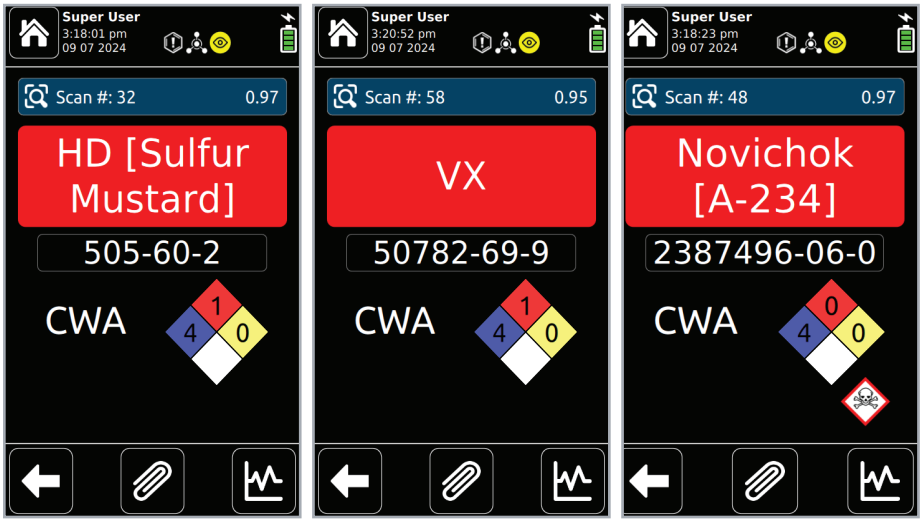

Figure 2: Result screens from the Rigaku CQL Max-ID for several CWAs using ThreatAlert scan mode

The Rigaku CQL Max-ID instrument is also capable of scanning colored-materials, as several CWAs are often found mixed with oils or other non-clear solvents which permit easy aerosolization and dispersion of the materials during an attack. With ThreatAlert™, CWA detection amongst many possible interferences is prioritized for easy recognition by users. Configured in Chemguard scan mode, users are provided tailored, prioritized information when threats are identified. Rigaku's CQL Max-ID permits faster, easier and more accurate portable CWA detection by users, keeping the public safer and minimizing possible exposure.

Conclusion

The persistent threat of chemical warfare agents (CWAs) necessitates advanced detection technologies to ensure public safety and effective response. Rigaku's CQL Max-ID instrument, with its use of Raman spectroscopy and 1064 nm excitation, stands out as a crucial tool for the rapid and accurate identification of CWAs in the field. By enabling the safe detection of hazardous substances through glass or transparent containers and minimizing interference from fluorescence, CQL Max-ID significantly enhances the capabilities of first responders and remediation teams. The instrument's ability to prioritize and clearly present threat information ensures that users can make informed decisions quickly, reducing the risk of exposure and improving the outcomes in CWA-related incidents. As the nature of chemical threats evolves, tools like the CQL Max-ID are vital in safeguarding communities from the dangers posed by chemical weapons.

References

[1]https://www.sciencehistory.org/stories/magazine/a-brief-history-of-chemical-war/ Retrieved 20 Mar 2024

[2]https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9905702/#B75 Retrieved 20 Mar 2024

[3]https://www.counterterrorism.police.uk/salisbury/ Retrieved 20 Mar 2024

[4]https://www.independent.co.uk/news/uk/crime/salisbury-poisoning-sergei-skripal-russia-b2223018.html Retrieved 20 Mar 2024

Rigaku Analytical Devices

Rigaku Analytical Devices, Inc.
Toll Free: +1 855.785.1064
Direct: +1 781.328.1024
Email: handhelds@rigaku.com
www.rigakuanalytical.com