

ORGANO-PHOSPHONATE, ORGANO-HALOGENATED, CYANIDES AND ARSENIC TOXIC IMPACT ON THE HUMAN HEALTH CARE CONDITION

Venelin Terziev¹ and Stoyanka Petkova - Georgieva²

¹Full Member of the Russian Academy of Natural History, Professor, Eng., D.Sc. (National Security), D.Sc. (Economics), D.Sc. (Social Activities), Ph.D., Russian Academy of Natural History, Moscow, Russia, Vasil Levski National Military University, Veliko Tarnovo, Bulgaria University of Rousse, Rousse, Bulgaria, terziev@skmat.com

²Associate Professor, Ph.D., University „Prof. d-r Assen Zlatarov” – Bourgas, Bulgaria, s.p.petkova@gmail.com

Abstract

This research describes the toxic impact on the health condition of living nature because of the inevitable use of toxic chemical compounds (TCC) and toxic industrial chemicals (TICs). To reach this aim, the following objectives were established: to define the large-scale industrial chemicals from the Schedules of the Chemical weapon convention; to investigate the role of each chemical in production process; to determine the current amounts of substances used in the process and find the alternatives for their replacement. The research was conducted on the base of only open-source literature. The general description of the chemicals use was found in electronic and paper encyclopaedias, more deep understanding – received after study of scientific and technological periodics and patents from electronic bases. The content in this review is focused on the toxic impact of the organo – phosphonate, organo – halogenated, cyanides and arsenic toxic chemicals compounds.

Keywords: impact, human health care, toxic chemical compounds, toxic industrial chemicals.

1. INTRODUCTION

This research describes the technologies used in commercially available detection and sensor equipment currently employed for detecting toxic chemical compounds (TCC) and toxic industrial chemicals (TICs). The content in this review is obtained from the open-source literature and information obtained by manufacturers of these detectors.

TCC which are capable of producing large scale destruction and/or of being used to kill or seriously injure a large number of people (2001). They include chemical compounds, which are defined by the Organisation for the Prohibition of Chemical Weapons (OPCW) as “... anything specifically designed or intended for use in direct connection with the release of a chemical agent (CA) to cause death or harm” (2000). This definition can be further divided into three parts to include toxic chemicals and their precursors, munitions or devices, and equipment.

Toxic chemicals are defined as any chemical which can cause death, temporary incapacitation, or

permanent harm to humans or animals, through its chemical action on life processes, whilst precursors are the chemicals involved in the production of toxic chemicals. Hence they are specifically designed to inflict harm or cause death through the release of toxic chemicals. Finally, equipment, as defined by the OPCW, refers to any equipment specifically designed for use "... directly in connection" with the employment of the munitions and devices (2000). Thus, CA is the term used to signify the toxic component of a chemical weapon and can include CWAs and/or TICs. These agents are incorporated in WMD to cause mass casualties by killing, seriously injuring or incapacitating a targeted population through their physiological effects (2005; Pearson, 1990; Evison, Hinsley, Rice, 2002).

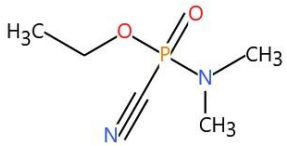
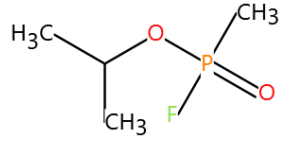
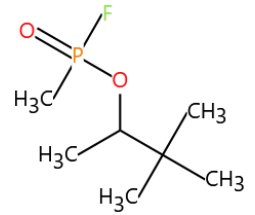
Due to use TCC, which can radically affect the environment, water and air (CAM). Furthermore, many defence operations which are considered the most valuable property of the nation as also effected, which contain complex equipment required for operations. Furthermore, the ability to rapidly detect, identify and monitor TCC in the event of an attack in the environment is also vital for the efficient use of civil defence resources. This capability has the potential to reduce panic and chaos and minimise potential casualties (Bobbitt, 91-94; GID). The above contextual factors illustrate that systems offering detection capabilities need to be reliable, sensitive, accurate and easy to use so as to enhance to protection of environment.

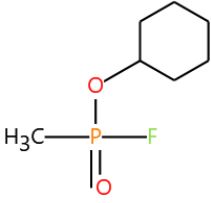
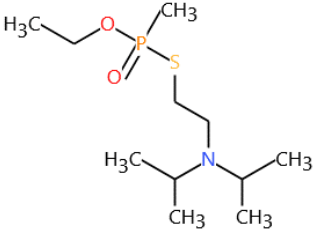
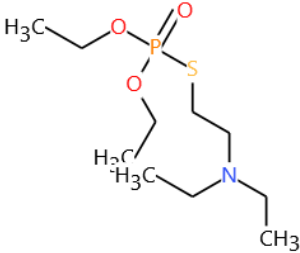
2. THE TOXIC ORGANO-PHOSPHONATE, OGRANO - HALOGENATED, CYANIDES AND ARSENIC COMPOUNDS IMPACT ON THE ENVIRONMENT AND THE HEALTH STATUS OF HUMAN

- Toxic chemical compounds (TCC)

Nerve agents are a group of particularly toxic CWAs and also included in schedule (2001) of chemical weapon convention that belong to the chemical group of organophosphorus compounds. They are generally stable, easily dispersed and highly toxic (2005; Stebbins). Nerve agents fall into two categories, the 'G' and the 'V' agents. The 'G' nerve agents are so named as they were first synthesised by German chemists in the late 1930s. They include Tabun (GA), Sarin (GB), Soman (GD) and Cyclosarin (GF), which are fluorine (GB, GD, GF) or cyanide (GA) containing organophosphorus compounds (2000). The 'V' agents, which are sulfurcontaining organophosphorus compounds, were developed in the 1950s by British chemists and are more toxic and persistent than the 'G' agents. The most common of these VX agents is VX. In general, the persistency of nerve agents ranges from low for GB through to very high for VX.

Table 1. Toxic organo-phosphonate compounds.

	Abbreviation	Structural formula
G-Type		
Tabun (C ₅ H ₁₁ N ₂ O ₂ P) (RS)-Ethyl N,N-Dimethylphosphoramidocyanidate	GA	
Sarin (C ₄ H ₁₀ FO ₂ P) 2-(Fluoro-methylphosphoryl)oxypropane; Phosphonofluoridic acid, P- methyl-, 1-methylethyl ester	GB	
Soman (C ₇ H ₁₆ FO ₂ P) 3,3-Dimethylbutan-2-yl methylphosphonofluoridate	GD	

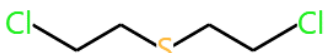
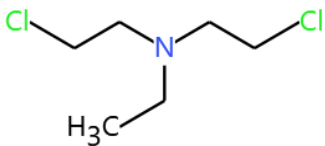
Cyclosarin (C ₇ H ₁₄ FO ₂ P) Cyclohexylmethylphosphonofluoridate	GF	
V-Type		
O-ethyl- S-diisopropyl amino methyl methylphosphonothiolate (C ₁₁ H ₂₆ NO ₂ PS)	VX	
Amiton or Tetram (C ₁₀ H ₂₄ NO ₃ PS) O,O-Diethyl S-[2-(diethylamino)ethyl] phosphorothioate	VG	

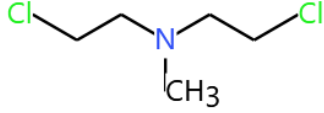
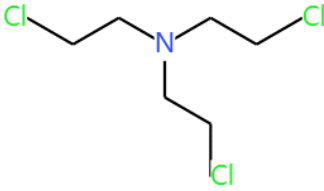
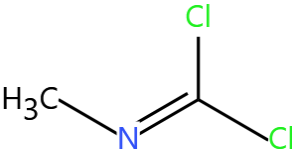
- Toxic organo-halogenated compounds

Toxic organo-halogenated compounds, are primarily intended to injure rather than kill people, however, exposure in some cases can be fatal. These compounds are producing blisters on the skin and when inhaled in the body through respiration. It destroys the respiratory system. Intersectional system and destroys DNA and RNA. These compounds are also included in schedule 1 chemical weapon convention. They are known as mustards, arsenicals and urticants. They are relatively persistent and may be used in the form of colourless vapours and liquids.

This chemical compounds are readily absorbed by all parts of the body, including the eyes, mucous membranes, lungs, skin and blood-forming organs. They cause inflammation, blisters and general destruction of tissue. Furthermore, the severity of blister burns is directly related to the concentration of the agent and the duration of contact with the skin. However the actions of some vesicants can be delayed anywhere between two and 24 hours before any pain or symptoms are produced by which time cell damage has already occurred (2005). Furthermore, in order to contaminate environment, or equipment with a persistent hazard.

Table 2. Toxic organo-halogenated compounds.

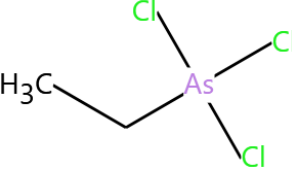
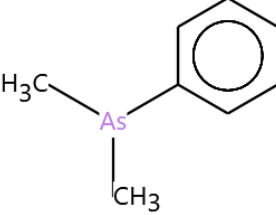
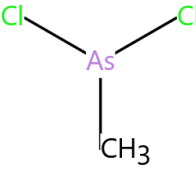
Agent name	Abbreviation	Structural formula
Sulphur Mustard C ₄ H ₈ Cl ₂ S 1'-thiobis [2-chloroethane]	H, HD	
Nitrogen Mustard	HN-1 (bis(2-chloroethyl) ethylamine)	

	HN-2 (bis(2-chloroethyl) methylamine, mustard)	
	HN-3 (tris(2-chloroethyl) amine)	
Phosgene Oxime (CHCl ₂ NO) dichloroformaldoxime	CX	

- **Arsenicals**

Arsenicals, including lewisite (L), mustard-lewisite (HL) and phenyldichloroarsine (PD), have arsenic as a central atom in their chemical structure, and are more dangerous as liquids than vapours due to their lower volatility (2001; 2005). Although not as common or stable as mustards, arsenicals produce much the same injuries to the skin and mucous membranes but also have the added effect of being systemic poisons (2001).

Table 3. Toxic cyanides compounds.


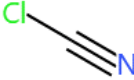
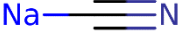
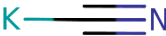
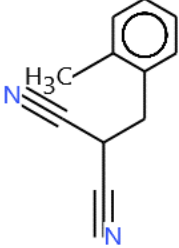
Agent name	Abbreviation	Structural formula
Ethyl Dichloro Arsine (C ₂ H ₅ AsCl ₂)	ED	
Phenyl Dichloro Arsine (C ₆ H ₅ AsCl ₂)	PD	
Methyl Dichloro Arsine (CH ₃ AsCl ₂)	MD	

- Toxic cyanide compounds

Toxic cyanide compounds, including hydrogen cyanide (AC), cyanogen chloride (CK), are included schedule 3 of chemical weapon convention and some inorganic cyanide compounds like sodium cyanide and potassium cyanide which are very toxic not including in chemical weapon convention exist in solid form, where (AC) and (CK) are highly volatile and thus able to enter the body through the respiratory tract. They interfere with oxygen metabolism in cells by preventing the normal utilisation of oxygen leading to respiratory failure. AC, for example, acts by inhibiting the cytochrome oxidase enzyme reaction, which is responsible for directing oxygen utilisation in the bloodstream. As a result of exposure, breathing rate is increased which leads to the inhalation of a larger dose (Sun, Ong, 2005). Symptoms of cyanide compounds

exposure are related to dose. Low-dose exposure causes headache and higher-dose exposure causes chills, nausea, and vomiting and severe exposure damages blood cells, leading to anaemia, eventual death and quickly contaminate the environment (Terziev, Petkova - Georgieva, 2019-a).

Table 4. Toxic cyanides compounds.

Agent name	Abbreviation	Structural formula
Hydrogen Cyanide (HCN) Hydridonitridocarbon	AC	
Cyanogen Chloride (CNCl) Chlorcyan	CK	
Sodium cyanide	NaCN	
Potassium cyanide	KCN	
Orthochlorobenzal melonitraile	CS	

3. CONCLUSION

All of the TCCs currently considered to be a threat have been known for decades, with the simplest and most prolific TCC being the vesicant, sulfur mustard which was first synthesised in 1823 (2001; Eiceman, Karpas, 1994). They are considered the most hazardous chemicals, both for the environment and the health status of any life being. They are very persistent. This character is referring to their low biodegradability and high level of bioaccumulation (Todorov, 2018a, Todorov, 2015). Due to low biodegradability, the secondary product formed posses an increased toxicity as compared to parent molecules. As with other species, TCCs tend to accumulate in fatty tissues in humans because of their nonpolar, lipophilic physical properties and their resistance to biochemical degradation. TCCs have entered the environment through legal and illegal use and disposal. As a result, the patterns of defence have also been fairly conservative, with detector technology being somewhat reactive rather than proactive (Petkova - Georgieva, 2018; Eiceman, Karpas, 1994). Most detectors are designed to respond only when a threat is directly imminent and therefore tend to 'detect to respond' or 'detect to react' rather than "detect to warn" (Kosal, 2003).

REFERENCE LIST

- Chemical and Biological Defense Primer. (2001). USA, October, 2001; pp 1-20.
- OPCW, (2000). Fact Sheet 4: What is a Chemical Weapon? 2000.
- Guide for the Selection of Chemical Agent and Toxic Industrial Material Detection Equipment for Emergency First Responders. (2005). Guide 100-04, Volume I and II: Summary; SAVER July, 2005; pp 1-5.
- Pearson, G. S. (1990). Chemical and Biological Warfare. Journal of Naval Engineering 1990, 32, (2), 190-

207.

Evison, D., Hinsley, D., Rice, P. (2002). Chemical Weapons. *BMJ* 2002, 324, 332-334.

CAM - Chemical Agent Monitor. In *Smiths Detection Technical Information*, Smiths Detection.

Bobbitt, R., Chemical and Biological reconnaissance technology in the US Army. *Defence Systems International*, 91-94.

GID -2A - Chemical Warfare Agent Detection System. In *Smiths Detection*.

Making the UK safer: detecting and decontaminating chemical and biological agents, (2004). The Royal Society: April, 2004; pp 1-50.

Sun, Y., Ong, K. Y. (2005). *Detection technologies for Chemical Warfare Agents and Toxic Vapors*. 1st ed.; CRC Press: Boca Raton, Florida, 2005; p 272.

Stebbins, M., Types of Chemical Weapons. In *Federation of American Scientists*.

Kosal, M., E. (2003). *The Basics of Chemical and Biological Weapons Detectors*; Center for Nonproliferation Studies: USA, November 24, 2003.

Eiceman, G. A., Karpas, Z. (1994). *Ion Mobility Spectrometry*. CRC Press: Boca Raton, Florida, 1994.

Petkova - Georgieva, St., (2018). Basic Problems to Solve in Strategic Controlling Implementation, annual of "Prof. Dr. Assen Zlatarov", pp. 71 - 77, v. XLVII, book 2, Burgas, Bulgaria, 2018, ISSN 2603-3976.

Todorov, M. (2018a). Recent advances in computational chemistry for identification of ligands for biological receptors: interdisciplinary aspects, *Medical Science Pulse* 2018 (12) 1, pp. 12-15, DOI: 10.5604/01.3001.0011.6670, ISSN: 2544-1620.

Todorov, M. (2015) Computational tools for prediction of nuclear receptor mediated effects. *East. Acad. J.*, 2015, 1, pp. 46-56, ISSN: 2367-7384.

Terziev, V., Petkova - Georgieva, S. (2019). The performance measurement system key indicators and the determinants impact on the level of decentralization using as an example a subdivisional unit from the Bulgarian social health and care experience. // *Proceedings of SOCIOINT 2019- 6th International Conference on Education, Social Sciences and Humanities 24-26 June 2019- Istanbul, Turkey*, International Organization Center of Academic Research, Istanbul, Turkey, 2019, pp. 515-524, ISBN: 978-605-82433-6-1

Terziev, V., Petkova - Georgieva, (2019a). S. A research study of nonlinearity experiencing in the rate of current account deficit to the Bulgarian health and care national product. // *Proceedings of SOCIOINT 2019- 6th International Conference on Education, Social Sciences and Humanities 24-26 June 2019- Istanbul, Turkey*, International Organization Center of Academic Research, Istanbul, Turkey, 2019, pp. 525-533, ISBN: 978-605-82433-6-1.