

Matousek**TECHNICAL UNIVERSITY BRNO, FACULTY OF CHEMISTRY**

Veslařská 230, 637 00 BRNO, Czech Republic

Institute for Chemistry and Technology
of Environmental Protection

Director

Professor Jiří MATOUŠEK, Dipl.Eng., PhD, DSc

The Chemical Weapons Convention Bulletin Editors:Professor Matthew Messelson
Dept. of Biochemistry and
Molecular Biology
Harvard University
Cambridge, Mass, 02138
USA
Fax 001-617-496-2444Dr Julian Perry Robinson
Science Policy Research
Unit
University of Sussex
Brighton, BN1 9RF
England
Fax 0044-273-685-865

Dear friends,

Please, find enclosed my article proposed for publication in the next issue of the Chemical Weapons Convention Bulletin, tackling a very important problem of implementation of the CWC, starting with the declarations on possession/non possession of CW as well as with future scientific and technological progress within the framework of the CWC scope.

Because of connection with the very basic principles of Pugwash I would like to propose this issue also for reflecting in the agenda of the next CBWCs Implementation Pugwash Study Group Workshop to be held in the Hague 1995.

Looking forward to your answer and to seeing you soon

Friendly Yours

Matoušek
Jiří Matoušek

/: Enclosure 9 pp.

PS. This message sent also by parallel mail

NEW TOXIC AGENTS AND THE CONVENTION

Jiří Matoušek^{*)}

Director, Institute for Chemistry and Technology of Environmental Protection, Faculty of Chemistry, Technical University Brno, Czech Republic

The binding wording of the Chemical Weapons Convention (CWC) already signed by 157 states, while 15 of them have already deposited instruments of ratification, is based on the general-purpose criterion as the leading principle. This means, that any chemical weapons by definition (munitions and devices, toxic chemicals, equipment specifically designed for using CW), no matter whether they are specifically defined or described, already known or still generally unknown, are prohibited (unless in types and quantities used for purposes non prohibited by the Convention).

This interpretation makes no difficulties as for munitions and devices, as well for specifically designed equipment concerned, but already the problem of harassing and incapacitating agents, covered by the conception of riot-control agents shows the difficulties with uniformly and generally accepted interpretation of the very basic principle of the Convention derived from the definition of the chemical weapons in the case of toxic chemicals.

The relevant provisions of the Convention apply for toxic chemical as defined for the purposes of the Convention, i.e. for any chemical possessing such toxicological characteristics (without being limited by quantitative toxicity parameters), giving the agent the quality to be intended for use as chemical weapon, i.e. to cause death or even temporary harm (including only incapacitation) and therefore developed, produced and stockpiled.

The need for listing toxic chemicals in Schedules to be able to verify the implementation by the state parties of relevant provisions, both prohibitions and commitments, is steadily leading some people to the major misunderstanding that prohibited are only compounds listed in Schedules, mainly in Schedule 1. The general opinion among uninformed or semi-informed people on the CWC, I have already very frequently met is, that CWC is something like the list of

^{*)}Professor Jiří Matoušek, Dipl.Eng., PhD, DSc, is former director, Czechoslovak NBC Defence R&D Establishment and member of the Czechoslovak Delegation to the CD in Geneva

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prohibited compounds. Even the negotiators from the CD in Geneva would remember that such idea ("chemical weapons are those listed in schedules") appeared as a negotiating position temporarily at one delegation in 1984, when the schedules were introduced for the first time.

Why the CWC needs Schedules?

Listing of toxic chemicals in the Schedules is vis-a-vis to the above mentioned general-purpose criterion clearly secondary but extremely important, predetermining the fate of concrete toxic chemical within the system of verification régimes and its destruction in the case of the most dangerous chemicals posing the highest risk for the Convention.

It is obvious that at the time being, the Schedules contain only generally accepted lists of compounds situated into individual Schedules according to the risk they pose to the Convention. It is understood that only commonly known compounds, used as chemical warfare agents since the first massive use on April 22, 1915 and then in chemical war and other conflicts and compounds never used but generally known to be intended for eventual use by CW possessing states have been included.

At the time being, Schedules do not list compounds that have not been yet introduced into chemical warfare arsenals but one can assume that countries possessing CW have been carrying out R&D on new compounds till the recent time and maybe that some of them still continue at least in the research, because CWC has not yet entered into force. It is highly probable that the research in this field will be never stopped worldwide because it hardly would be the matter of prohibition. Therefore new toxic compounds, candidate for chemical warfare agents would appear any time in future, moreover even in the framework of the non-CWA-oriented research.

An important question in this respect is, how to reflect these facts nowadays and in the future, because it is really impossible to rely that the general-purpose criterion would act automatically without being supported by the necessary role of Schedules as an undivisible part of the verification mechanism.

On the one hand, absence in the Schedules of any toxic chemical, actually possessed by the state party as a part of his chemical arsenal will be no excuse for this state party not to reveal it in its declaration on possession/non possession of chemical weapons. This means that the legislation of any signatory state and then of the party to

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the Convention must accept the obligation not to develop, stockpile, produce and use any toxic chemical, even if it is not scheduled, if it meets the signs as defined by the Convention.

On the other hand, the international verification system, carried out by the organs of the OPCW and its Technical Secretariat need to have in the hands necessary data, starting with formulae, physicochemical and toxic properties, necessary characteristics for instrumental verification, like IR, NMR and MS spectra of such not generally known toxic chemicals, their precursors, by-products and degradation products, not to speak about enough qualified knowledge on the protection, decontamination, first aid, treatment and like.

Everyone would agree that the Schedules are open-ended; they have to count with the scientific and technological progress which can be neither stopped nor braked either by any decree or even action of good will. That is, why everyone informed should undertake relevant measures to contribute to corresponding amendment of the Schedules, be it governments, NGOs or concerned scientists even if individuals.

It can be expected that the first major amending of the Schedules, mainly of Schedule 1 would proceed as a result of the information contained in the declarations on possession/non possession submitted by the state parties - owners of chemical weapons.

Is there any risk for the CWC till that time, i.e. as generally expected, during less than one year? I suppose not, but only in the case that the interpretation of the CWC provisions is uniform in all signatory states, that is, if all signatories honour the general-purpose criterion actually as the leading principle and reveal their complex chemical arsenals (if they are possessors) quite completely.

But there is still reason for a concern bearing in mind various approaches to the interpretation of the CWC. Therefore, I do sincerely believe that without underestimating any country and even without any concrete suspicion on the lack of enough good will in any country, it is time to think on amending the Schedules, mainly Schedule 1 just now to cover the very start of the implementation of the CWC from the beginning, i.e. since closing facilities and submitting declarations.

One have reason to be convinced that the CW-possessor states have been continuing their CW development far beyond what is represented by the listed compounds mainly in Schedule 1 and that some compounds may exist, not yet incorporated into this Schedule, posing high concrete risk

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to the Convention, both *per se* as in the form of key precursors, intended for binary systems generating above mentioned compounds as a result of use of munitions and devices.

New supertoxic lethal chemicals, their binary components and Schedule 1

Annex on Chemicals and its part (A) Guidelines for Schedules of Chemicals clearly indicate the criteria to be taken into account in considering whether a toxic chemical or precursor should be included in Schedule 1.

For present consideration, even if the criterion (a) connected with actual development, production, stockpiling or use cannot be proven at a moment, the criterion (b) is the reason for starting the procedure of amending Schedule 1. The criterion (b) contains mention on posing high risk to the object and purpose of the CWC by virtue of the compound's high potential for use in activities prohibited under CWC because one or more of the conditions defined in paras (i), (ii) and (iii), referring on the closely related structure to other listed chemicals, on possessing such lethal or incapacitating toxicity as well as other properties qualifying the compound for use and on the possibility of use as a key precursor, while having (c) little or no use for non-prohibited purposes.

To show that this problem is quite serious, I would like to reveal one concrete case that can serve as an example for fulfilling the Guidelines for amending Schedule 1.

A case example for amending Schedule 1

In the second half of the 1970s, some reports appeared that the US planned to introduce a new supertoxic lethal agent with intermediary volatility (IVA - Intermediate Volatility Agent) to amend and in future to substitute for both then operational agents, i.e. GB and VX.

According to some data, this agent (IVA) was planned to be introduced as binary IVA-2 to substitute even for both GB-2 and VX-2 in the future munitions and devices, simplifying thus substantially the perspective US chemical arsenals in the 1990s as then presumed.

The reason for introducing such an agent was obvious: GB is too volatile especially in summer or/and in hot

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climate while VX possessing extremely high percutaneous toxicity (about 15 mg/man) has a very low tension of saturated vapours and very low volatility. This is why any clothing barrier hinders to penetrate it to the skin surface in vapours which is the condition for achieving small effective doses over even field clothing. Therefore, VX being highly toxic over unprotected skin possesses relatively low effectiveness over any clothing barrier. This phenomenon disqualifies considerably this agent.

The new agent was considered to combine the advantages of both GB and VX, i.e. higher volatility of GB enabling the creation of high vapour concentrations over the target area necessary for quick and high effect through inhalation, together with high percutaneous toxicity of VX and to remove already mentioned disadvantages of both GB and VX.

Till now, no data have been published concerning this intermediate volatility agent, its structure, physicochemical and toxic properties and other information relevant from the point of view of the chemical defence, neither became clear, whether R&D continues or whether and at which stage it has been stopped in the US or whether there were similar attempts in any other chemical weapons possessor country.

It is however without any doubt that such a new agent, like any new potential agent to be introduced or actual agent already introduced into the chemical arsenals in any country could have considerable impact on the tactics of chemical defences and effectiveness of operational methods and means of physical and medical protection and as such would pose high risk for the CWC.

Therefore, even non-CW-possessing countries, feeling themselves endangered devoted great deal of attention to such an agent, of course solely for the reasons of protection. One of such countries was Czechoslovakia, thank to its exposed strategical position in its modern history, coinciding with the history of chemical warfare.

Myself, being as colonel in charge of the director for research in the Czechoslovak NBC Defence R&D Establishment (then Research Institute 070 in Brno) in the 1980s, after careful analysis of open and other sources started the research on the new group of compounds, presumably potential IVA in May 1983. Under my personal leadership, a group of Czech defence chemists (J. Matoušek, J. Moravec, J. Chalupa, I. Mašek, M. Konečný and R. Slejška) carried out the primary research with the aim to synthesise and characterise (from physicochemical and toxicological point of view) relevant compounds and to assure the small-scale production to enable the secondary research. Main aim of the secondary research was to establish the impact of relevant compound(s) on the

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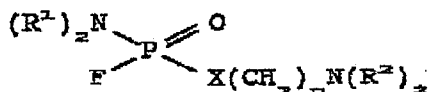
already operational methods and means of the Czechoslovak Army and Civil Defence for physical and medical protection, i.e. on the set of protective and rescue means and systems, such as respirators, protective clothing of all kinds, methods for field detection, monitoring and field analysis, means and methods of decontamination of all kinds, means and methods for the first aid and medical treatment. The secondary research proceeded at the end of the 1980s and in early 1990s in all relevant departments of Research Institute 070 in Brno, corresponding medical part at the Military Medical Academy in Hradec Králové under leadership of V. Hrdina.

The research was considered as top secret in the very primary phases. Therefore we have marked the group of compounds under research arbitrarily and only for internal communication by the cryptonym GV (due to the similarity with both G and V agents). We decided never to use both names, i.e. the cryptonym and chemical name or chemical formula together. The reason was obvious. First of all, using parts of the US army code could have brought future problems in international communication because our designation was considered not to correspond to the potential (or actual) US Army code. This expectation has been proven as correct, actual code used in the US for our compound(s) is GP. Secondary, it was necessary to avoid any suspicion that Czechoslovakia was carrying R&D of offensive chemical weapons assets. This was very serious in the time of the last rise of East-West confrontation (synchronic with the beginning of the Star Wars era, of deployment of IMF nuclear forces in Europe and preparation for starting the binary weapons production programme in the US). Especially the latter issue and its justification was connected with compilation by CIA of various lists of possessors of chemical weapons, containing, contrary to the truth, even Czechoslovakia. As well known, even prestigious authors (our friends and colleagues), like J.P. Robinson and H.G. Brauch in their review reports held Czechoslovakia for owner of chemical weapons till the end of the 1980s and even later, obviously using the CIA database. (I also have protested several times at various international fora against the accusation that Czechoslovakia was stockpiling chemical weapons and that USSR deployed or stored chemical weapons on our territory). It was also decided not to publish the results prematurely.

But I think that nowadays, in the time of the last preparations for ratifications and entering the CWC into force, the correct momentum has come to reveal the principal results of our research to show to the community of defence chemists that the real danger of introducing such new supertoxic lethal organophosphorus compounds actually exists.

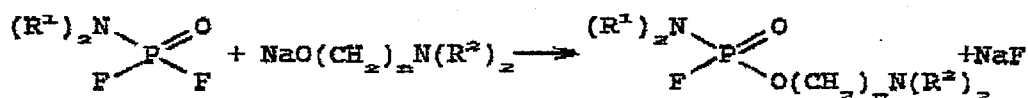
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From all possible models onto consideration a group of organophosphorus compounds corresponding to the general formula



was chosen for research.

Corresponding compounds, N,N-dialkylaminoalkyl (dialkylamido)fluorophosphates, were prepared by various methods, potentially suitable for presumed binary system. For preparatory purposes, to obtain compounds with the highest yields and purity, the reaction of dialkylamidophosphoryldifluoride with corresponding alcoholate was used:



The reaction was carried out in n-hexane solution and subsequent purification by distillation was necessary. The compounds have limited stability which does not hinder their possible use in binary systems, potential precursors being enough stable.

Basic data on prepared compounds show¹ that they corresponds to the types of agents with intermediary volatility. All compounds of this group possess extremely high toxicity and enzymic activity, comparable with the most toxic G and V agents. The highest percutaneous toxicity exerts the most simple agent. i.e. 2-dimethylaminoethyl (dimethylamido)fluorophosphate (DMAEDMAFP), while lower than VX.

For the group of compounds, basic physical, chemical and toxic properties were determined. Individual compounds were characterised beside of elemental analysis by ¹H-NMR (nuclear magnetic resonance), IR and mass spectroscopy. For further works, methods of detection and determination were elaborated as well.

The results, published for the first time have shown¹ that a new group of supertoxic lethal organophosphorus compounds exists as candidate for new chemical warfare agents, possessing extremely high inhalation toxicity and very high percutaneous toxicity.

Toxicity parameters are given in Table 1 as compared with operational chemical warfare agents.

**Toxicity of 2-dimethylaminoethyl (dimethylamido)V
fluorophosphate (DMAEDMAPF)
as compared with other relevant organophosphorus chemical
warfare agents**

Table 1

Compound	mean values of LD ₅₀ mg/kg for rats	
	intramuscular (i.m.)	percutaneous (p.c.)
GB	0,096	84,00
GD	0,069	11,25
GF	0,080	3,94
VX	0,015	0,077
DMAEDMAPF	0,017	1,37

Beside of high toxicity, the simple method of synthesis is to be stressed, utilising the key precursor, e.g. $(CH_3)_2NP(O)F_2$ that is very easily accessible. This poses great danger for the CWC and thus speaks for the inclusion of both dialkylaminoalkyl (dialkylamido)fluorophosphates, as well as of their key precursors dialkylamidophosphoryldifluorides into Schedule 1, because they pose much higher risk, than e.g. GB, GD, GF and their key precursor, methylphosphonyldifluoride, $CH_3P(O)F_2$.

Conclusions

This work shows that a new group of supertoxic lethal organophosphorus compounds exist as candidate for new chemical warfare agents with possible use in binary systems, more dangerous than most of the operational toxic agents.

This means that it is necessary to count with such or similar compounds in the framework of chemical defence where the known list of chemical warfare agents should not be considered as definitely closed.

Whether such or similar compounds were actually developed and tested as candidate chemical warfare agents and whether they have been already introduced into chemical

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arsenals is up to the responsibility of the countries possessing chemical weapons. It can be hoped that this will be reflected within the ratification process on the CWC in those states and mainly in their declarations on the possession of chemical weapons.

Anyway, for the community of the states having already signed the CWC, it is extremely important the correct interpretation of the Convention, mainly of its leading principle of general purpose criterion and only of complementary role of schedules as a tool for verification exercises. Nevertheless, vis-a-vis to the existence of such compounds and hopefully to the contribution of open and frank declarations on possession of chemical weapons, it is just now the time to think how to amend the schedules, representing the major threat to the CWC.

I consider this fact as an important challenge for preparing for effective and verifiable general and comprehensive ban of chemical weapons.

I would like also to propose starting the process of amending Schedule 1 with N,N-dialkylaminoalkyl dialkylamidofluorophosphates and with corresponding key precursors, i.e. dialkylamidophosphoryldifluorides.

Notes and references

- 1 Matoušek, J., Mašek. I.: On the new potential supertoxic tetrahedral organophosphorus chemical warfare agents with intermediary volatility. The ASA Newsletter, vol. 44, 1994
- 2 Technical details on syntheses and properties of the compounds will be published elsewhere.