COMMITTEE ON DISARMAMENT

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Working Paper

Verification of a Chemical Weapons Convention

Sampling and Analysis of Chemical Warfare Agents under Winter Conditions

Introduction

In connection with Norway's participation in the Ad Hoc Working Group on Chemical Weapons and as a Norwegian contribution to the work of the Committee on Disarmament, the Norwegian Ministry of Foreign Affairs initiated in 1981 a research programme on the sampling and identification of chemical warfare agents under winter conditions.

A primary objective of the research programme was to focus on the verification problems which would have to be dealt with within the framework of a Chemical Weapons Convention. More specifically, the aim was to establish the possibility of using snow samples for verification of alleged use of chemical warfare agents under winter conditions. In particular, the possibility of positive verification some weeks after alleged use, with the purpose of finding a realistic timeframe for undertaking on-site inspection under winter conditions, have been investigated.

The first part of the research programme was carried out in 1981/1982. The results were presented in a report, which in August 1982 was submitted to the Ad Hoc Working Group on Chemical Weapons. A summary of the report was contained in a Norwegian Working Paper on Verification of a Chemical Weapons Convention (CD/311). The English version of the report was annexed to CD/311.

The second part of this research programme was carried out during the winter 1982/1983. The present Working Paper summarizes the results of the second part and the recommendations in regard to verification of alleged use of chemical weapons, which can be drawn on the basis of the results of the research programme.

Description and Results of the Norwegian research programme

The investigations, carried out during the winter 1981/1982 and the winter 1982/1983 were based on a scenario in which the chemical agents have been used at a low concentration ($0.25 g/m^2$) against unprotected troops or civilians.

Particular attention has been paid to carry out the experiments under field conditions, thus leaving the samples out-door to deteriorate by exposure to the prevailing weather condition such as wind, changing temperature and snowfall.

The first part of the Norwegian research programme covered an investigation of representatives of nerve agents and mustard gas.

In the second part of the Norwegian research programme a similar investigation was carried out, including incapacitating agents and precursors. The analytical methods and details of the results of the second part are explained in the research report which is annexed to the English version of this Working Paper.

To make the approach as realistic as possible the second part of the research programme included an investigation of the possibility of detecting CS in the snow samples after the release of a grenade containing the riot control agent CS. Even though CS is a riot control agent it may serve as an example of a thermally released solid chemical agent.

To ensure the maximum reliability of the results and to exclude the possibility of false positive results from other compounds either of natural or man made origin, control samples not containing agents, were taken in different environments including forest and urban areas. To simulate a battlefield, a large amount of TNT was exploded, and snow samples containing large amounts of decomposition products from the explosive were taken nearby.

The experiments carried out during the Norwegian research programme have shown that under winter conditions the stability of different chemical agents vary. This will markedly influence the possibility of verification of use of chemical agents by means of chemical analysis of snow samples taken some time after the alleged attacks. Of the agents investigated the following are relatively stable:

- The agents 2-chlorobenzalmalononitrile (CS), α-chloroacetophenon (CN), 10-chloro-5, 10-dihydrophenarsazine (DM or adamsite)
- The immediate decomposition product of a precursor mixture (mixture (1:1) of methylphosphonyl dichloride and methylphosphonyl difluoride)
- The nerve agent ethyl S-2-diisopropylaminoethyl methylphosphonothiolate (VX)

For these compounds except for VX, it is expected that at least 25 per cent of the original agents are still available for analysis in samples taken as long as one month after the attack. VX is slightly less stable, the values are here between 1 and 10 per cent. Very selective and sensitive analytical methods are available for all compounds and there would be no difficulties in verifying the presence of these agents several weeks after a chemical attack during winter conditions.

The nerve agents tabun, sarin and soman as well as the blister agent mustard gas were found to be markedly more unstable. After two weeks, generally less than 0.1 per cent of the original agents were still present in the samples. The analytical methods used are, however, very selective and sensitive, and verification of use by chemical analysis of snow samples would be highly possible. After one month, it was still possible to analyse these nerve agents but the content of mustand gas was below the sensitivity limit of the method. The amount of nerve agents still left in the samples were in the order of 1/100000 of the original amount. The verification of use of sarin and to an even larger extent mustand gas is uncertain and highly dependent upon the weather condition. This was demonstrated by the experiments in the first part of the research programme, where sarin was not detected after four weeks.

High temperature and strong wind is unfavourable to positive verification. As expected, a snowfall covering the samples reduce evaporation, and increase the possibility for verification. This was confirmed by the experiments and was specially important for the agents sarin, soman and mustard gas. Under this condition it was also possible to detect and analyse mustard gas after four weeks.

Concluding remarks

For the purpose of verification of alleged use of chemical weapons, the utmost reliability of the results is always of paramount importance.

Most chemical agents are not found in the natural environment, and verification of these agents in samples taken in a battlefield would be a clear indication of a violation of the Convention. Most chemicals in the natural environment evaporate and undergo decomposition, which is also true for the chemical warfare agents. A certain time after use, the amount still present will be less than the sensitivity limit of the presently available analytical methods. After this time the only alternative is to verify the presence of a decomposition product. As evidence this is not as compelling as verification of the agent itself; neither is the verification of impurities known to be present in chemical agents.

The research programme demonstrates the importance of the time factor. The samples should therefore be taken as soon as possible after a report on alleged use has been received. Further decomposition of the chemical agents in the samples on the way to the analysing laboratory should be avoided by rapid transport and proper handling. To ensure the integrity of the samples, personnel

having the necessary knowledge should do the sampling and transportation and be selected by the Consultative Committee or a suborgan under the Consultative Committee (Fact-finding Panel/Executive Council). It is necessary that the personnel is selected and trained in advance, and may be called upon on the shortest notice possible.

The laboratory or laboratories where the analyses will be carried out, should be selected and supervised by the same suborgan. To ensure the utmost sensitivity and selectivity of the chemical analyses, sophisticated analytical methods will have to be applied, requiring highly trained scientific personnel and modern equipment, such as a combined gas chromatograph/mass spectrometer (GC/MS) and a high performance liquid chromatograph (HPLC). Such equipment is commercially available. It is used by a large number of civil chemical laboratories, and so are in principle the analytical procedures needed. However, there exist numerous possible chemical warfare agents, which represent various types of chemical compounds. Several different techniques will therefore be needed, all requiring skilled operators. In addition, to obtain the maximum reliability of the results, it may also be necessary to apply more than one independent analytical method for each chemical agent. The analytical results will also be reflected by the quality of the samples. This stresses the importance of a proper collection of samples.

To improve the analytical techniques it is highly recommended that the selected laboratories have small amounts of the potential chemical warfare agents for use in analytical training and for use as reference compounds.

In several countries, laboratories have already relevant experience in this field, and co-operation among these laboratories should be encouraged. This will promote flexible procedures and incorporation of any new scientific achievements in this field.

The regular updating of the procedures for sample taking and analytical methods should be the responsibility of the Consultative Committee.