

Lock stock...

THE tenth birthday of the entry into force of the Chemical Weapon Convention (CWC) also covers a 25-year period. There are good reasons for examining this period. In 1987 the former Soviet Union, for the first time in history, displayed its chemical weapons arsenal, clearly demonstrating its intention to get rid of this class of weapons. In addition, the working text of the CWC was nearing completion and everybody involved knew what was at stake. The year 2012 is the date at which, according to the original text of the CWC, all chemical weapons, production facilities, etc in the "possessor states" must have been destroyed.

At the start of the 25-year period there were two opposing blocs – the old Nato and the former Warsaw Pact (SU). Both blocs strongly felt the other was threatening it with, among other devices, chemical weapons. The question now needs to be posed – has anything changed? Has it made a difference?

Many feel that there is still a serious threat of chemical warfare from, for instance, non-member states, and many fear the use of toxic chemical compounds by terrorist. It is often pointed out that a significant part of the former SU stock, now controlled by Russia, will still be around in 2012. In addition, it has still to be seen whether the complete stock in other possessor states will have been destroyed by 2012. It might be better to ask the question – do we believe that the CWC and OPCW have made a contribution to a safer world; was it worth the investment? This paper tries to answer that question from a technical viewpoint.

Quantifying the hazards

If a small quantity of CW is nearly as hazardous as a large quantity then the destruction of 90, or even 99 per cent, of the present stock would mean little in the threat or hazard reduction. In order to evaluate if the CWC makes a difference it is of value to quantify the hazards of chemical weapons. After World War I a discussion took place regarding the effectiveness of some weapon systems and whether or not the weapons were humane. For chemical weapons this resulted in a fierce debate between those in favour of

Ten years after the Chemical Weapons Convention was signed, Dr Jan Medema from the Biological and Chemical Defence Consultancy, asks whether it is genuinely reducing the risks of chemical warfare



New wine in old bottles. Has Iraq proved the worth of the OPCW?

The statistics on CW use, however, did not account for the containers, gas bottles or shells and bombs that had to be used to make the CW attack possible. If that correction is made, it is likely that CW was, per unit weight, about as effective as high explosives.

In the debate some refinements in the statistics were used. So the high explosive

used 250kg of metal and explosive to make one casualty, with one in three dead. Asphyxiating gasses required 100kg to make one casualty, with one in ten dead. Besides the correction for the weight of the containers and the explosives required to throw the CW at the enemy, another important correction also had to be made. The small amount of mustard used in WWI (8,000 tons) produced one third of the casualties – increasing the required amount of asphyxiating gases by another 50 per cent.

For mustard agent (H) the statistics get really complicated. Germany produced 10,000 tons, of which 8,000 were used. The allies produced 2,000 tons by the end of the war, and very little was used. The casualty statistics show that about 400,000 were due to mustard gas. This would seem to lead to a straightforward equation of 20kg of H equals one casualty.

There are, however, two major correction factors. The first one is that the ammunition used by Germany in 1917 and 1918 became of a poor quality; 50 per cent of the ammunition did not explode on impact, leaving today's legacy of an enormous problem in south-west Belgium and northern France. More importantly, a large fraction of H was not used in the anti-personnel mode but in the terrain-denial mode, as a chemical minefield. The Allies quickly learned never to occupy a once-contaminated terrain. With these correction factors, the estimate amount of H to produce one casualty was between three and ten kilograms. The number of deaths was one in 50-to-100 – similar numbers came to light in the use against Iranian troops. The lower death toll of CW agents was used as an argument to show that CW was more humane than high explosive warfare.

The son of Fritz Haber, in his analysis of CW, pointed out that there was a large variation in the effectiveness of individual CW attacks. Some were very effective, while others hardly showed any effect. The statistics discussed above have to be seen as grand total averages, large variations of which might occur. Later computer modelling of CW attacks showed that for unprotected personnel in a defensive scenario the number of effective dosages to produce a casualty was in the order of 1 to 10 million. Or another

...and old toxic barrels

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rule of thumb was the use of one billion effective dosages against a military target, which would produce 30 per cent casualties, sufficient to neutralise the target. For nerve agents this would correspond to about 1kg to produce one casualty or one ton of agent to attack a military target of limited size (infantry).

The message from WWI is that relatively small amounts of CW can be effective in producing casualties amongst unprotected personnel. The second important lesson from WWI is that, once troops have a rudimentary form of protection, the amount required to make a casualty increased and this was proportionate with the protection factor. In 1916, all British troops were equipped with masks of some form, and the Wehrmacht no longer attacked them seriously with CW, until 1917 when the first H attacks were aimed at the troops with respiratory protection. The results were devastating – in three weeks the British faced more CW casualties than in the whole of 1916. The conclusion is: CW works when the protection is circumvented, but becomes nearly totally ineffective when there is some form of protection. In terms of WWI statistics, if the respiratory protection factor of the troops was ten the amount of asphyxiating gasses required to make one casualty would be above 1,000kg, disregarding the explosives and containers required to transport the agents.

The short-term goal of the CWC is to reduce the amount of agent present in the world. Every ton of agent can still produce 100 to 1,000 casualties among military in defensive position. So, with a few hundred tons available in rogue states, it still would be possible to make around a million victims. Even if we reduced to 10,000 tons during 1987 to 2012, we still need the full chemical defence system. The picture, however, becomes very different when protection is involved. When the skin and the respiratory system are continuously included, the protection factor moves to about 1,000 (present day masks and clothing are aiming at these or higher numbers); the few hundred tons in a rogue state would just be sufficient to attack one target with minimal effect.

Incomplete destruction by 2012

It is unlikely that the possessor states will have destroyed all the stock by 2012, and significant quantities might still be around.

Improvements in detection and protection have eroded the efficacy of CW against military targets

More than just the agent is required to start a chemical war, however. At the beginning of WWII, the US estimated that for the first two months of a 'chemical war' 25,000 tons of (mainly) mustard agent was required. This is still true; a large stock is required to start a 'chemical war'.

If the agent is available, the next step is a filling station to fill the shells and the bombs. Then weapon systems must be available to deliver the weapons and trained personnel to carry out the missions. For instance, artillery-firing tables are required to calculate ammunition expenditure for various climatic conditions. The military doctrine to use chemical weapons, the trained troops, the standard operating procedures and the artillery firing tables have all disappeared from the military scene during the last 20 years. But above all the political will – the intention to carry out a chemical war – has been abandoned by the member states. The conclusion is that even when the destruction is not complete by 2012 the previous 100,000 tons do not present a real hazard. If there is a hazard it comes from the few hundred tons possibly available in rogue states.

The consequences of a few hundred tons

The few hundred tons estimate comes from US open source published on the Internet. Recently, a larger number (3,000-5,000) was mentioned in a South Korean intelligence estimate. The record of the intelligence community regarding estimates, however, is not very good. In 1987 the same Internet sources came to estimate quantities in the USSR of 400,000 tons – ten times the present day value. The last estimate of the Iraqi capability comprising 700 tons appeared to be false, as did the estimate for Libya. For the time being it seems that the term a few hundred tons per rogue state is the best

available estimate.

In order to neutralise the few hundred tons outside the control of the OPCW, chemical defence is mandatory. Without this defensive posture the effects of the agent might be devastating. The available amount of agent in a conflict will be reduced by pre-emptive strikes. In addition, superior air power will not allow a full attack to develop. The total amount of agent in a conflict will have been reduced by a least a factor of hundred, if not a thousand, in comparison with 25 years ago. This means that a chemical attack will become a rare incident and has very little consequences provided the troops are protected. The paradox is that if the troops are lacking chemical defence, the consequences of a CW attack might be very serious. Chemical defence is usually seen in several steps. The first question is – what are the agents of interest and how much of this agent will the soldier encounter in the battlefield? Combined with this is the effective dosage of an agent or how much protection is required in order to prevent casualties when attacked? Actually this is the ratio between the challenge dosage and the 'just no-effect' dosage.

The next steps are the technical chemical defence steps: detection, physical protection, medical countermeasures, decontamination and training. With a fair chemical defence system, comprised mainly of detection, protection and training, the effects of the few hundred tons will be largely neutralised, to the degree that they are militarily non-significant. Present-day detectors are capable of detecting most classical agents of interest – the scheduled compounds. Problem areas sometimes mentioned are toxic industrial chemicals (TICs) and non-scheduled highly toxic compounds (Novichoks – next generation nerve agents/compounds) or synthesised toxins. Regarding detection, TICs are not a real problem because one can



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usually smell their presence. Non-scheduled nerve agents will still act as cholinesterase enzyme inhibitors, and enzymatic detectors will work. Methods are under development to rapidly detect pathogenic aerosols and toxin aerosols.

Two parameters, one for efficiency and one for capacity, can characterise the physical protection provided to the troops. The total amount of agent, concentrations and dosages in a future individual attack are lower than in the previous century. The potential opponents will not have the capability to carry out major attacks. The casualty acceptance is also reduced. As a consequence the efficiency, defined as the ratio in challenge dosage and permissible exposure dosage, stays the same.

The required capacity is reduced a great deal – multiple attacks on the same unit are no longer of interest. Secondly, the “fight dirty” concept has been abandoned and troops will withdraw to a contamination-free area shortly after contamination. The required protection times, and thus the capacity, can therefore be reduced. Consequently the ALL number of spare canisters can be reduced from 3 to 1.2 per man. Similarly, the number of protective suits, gloves and boots can be reduced from 2-3 to 1.2 per man. Decontamination of suits for chemical agents becomes superfluous.

TICS are not a real problem in regard to skin effects, yet they might form a problem for respiratory protection – large storage sites of TICS in the area of operation, however, must be known and one should prevent any operations in the vicinity of those sites. The present day canisters can cope with small amounts of TICS, so the concentrations encountered at some distance from a storage site should be fine. Special canisters are required if one wants to operate close to the storage sites.

In view of the fact that chemical warfare will be reduced to rare incidents, with very limited number of casualties, it is not realistic to pay much attention to medical countermeasures. In addition, large sums have been spent for 90 years in finding a therapy, for instance, for mustard gas poisoning without success and breakthroughs are not expected in the near future. The extensive research towards therapy and prophylaxis for CW

agents can better be spent in the area of biological and toxin weapons.

Decontamination regarding CW agents will seldom, if at all, be used in future conflicts. Nuclear and biological decontamination might be of interest, but just water will do the trick in most cases. Chemically contaminated equipment will be abandoned, and clean up might become of interest after the conflict. No military wants to move equipment around that has been contaminated because a guarantee that equipment is absolutely toxin free cannot be given. In view of the changed conditions, it is mandatory to set up new doctrines regarding chemical defence and new forms of training. Without training, the chemical defence system will not work adequately and the few hundred tons might become very hazardous again.

Conclusion

Technically, the main success of the CWC is the significant reduction of the amount of CW agents intended for use in conflicts. Chemical warfare will be restricted to rare incidents, but this has consequences for the defensive posture of the forces. There will be less interest in the area of medical countermeasures and decontamination. Detection will still be of much interest, but in the area of physical protection there could be far less emphasis on the capacity of the protection. This will reduce the investments for canisters and for protective clothing, and this will also reduce the physiological burden of the mask and clothing. Decontamination and medical countermeasures are the main areas where a return on investment in the CWC can be found, and training of the adjusted chemical defence posture is essential. It is important to note that this paper refers to the use of chemicals in conventional war, not to the use by terrorist against a civilian target. Medical countermeasures and decontamination might have a role there, but they are not directly the concern of a MoD. The Chemical Weapon Convention and chemical defence work together towards the same goal, making chemical warfare an issue of the past.