Professor Lev A Fedorov, President of Russia's Union for Chemical Safety, discusses the problems posed by Russia's old chemical munitions

The Soviet legacy

The Chemical Weapons Convention (CWC) must solve three difficult and large-scale tasks: the destruction of all current stocks of chemical weapon (CW), the liquidation of all chemical weapon production facilities (CWPF), and finding and destroying all old and abandoned CW.

The problem of old chemical weapons (OCW – CW produced either before 1925 or between 1925 and 1946 and determined as "unusable") is faced by many countries, including Russia. The problem of OCW is an especial concern to Russia; between 1990-1992, before signing of the CWC, the Soviet/Russian Army presented for inspection and destruction only 40,000 metric tons of the current (post-WWII) stocks of toxic chemicals (TCs). In that time the Soviet/Russian Army declared only seven depots where these TCs had been concentrated and stored in previous years, and the Soviet chemical industry declared only a few CWPF. There was no information about the fate of Soviet stocks of CW produced during 1924-1945, but not declared.

Since the entry into force of the CWC, the Russian authority did not inform the Russian people or the Secretariat of the Organisation for the Prohibition of Chemical Weapons (OPCW) about Soviet OCW buried on former production facilities, military proving grounds, ammunition depots and camps, etc, or dumped in lakes, swamps, rivers and seas. Actually Russian OCW must be declared and, after verification of their status by the Technical Secretariat OPCW, must be destroyed as toxic waste. The undeclared Russian OCW represent a burden and potential hazard for the environment.

There is now a need to differentiate between stockpiled and non-stockpiled CW. Stockpiled CW are identified and characterised and stored in controlled environments, such as ammunition depots. The United States and Russia have officially acknowledged their stockpiles of CW.

Non-stockpiled CWs include numerous chemical warfare materials, especially old munitions discovered during excavation, or those abandoned and lost. The United States is working on a campaign to dispose of non-stockpile materials – those not included in the unitary chemical stockpile, including former CW production facilities, miscellaneous CW and buried and recovered CW. The Russian authorities did not prepare a complete non-stockpile CW programme, and is only discussing a programme involving CWPF, which will not include the search for and verification and destruction of OCW. As the result, Russia has no national programme relating to the cleaning and soil decontamination of related testing ranges, proving grounds, storage facilities, military camps, etc.

Each state party to the CWC has agreed to a definite set of fundamental obligations under that Convention. The CWC places a duty on Russia as a member state to both declare and destroy any CWs, including OCW. The destruction must be undertaken in accordance with special timelines in an approved manner and verified. The Russian National Authority's obligations to the OPCW include an initial and annual declaration, accrediting OPCW inspectors, overseeing closure and destruction activities relating to CW and CWPF, co-ordinating the provision of national assistance and reviewing national regulations in international trade in chemicals. In addition, the Russian Authority must be involved in international activities on representation to the Conference of State Parties, the resolution of abandoned CW, etc.

Once the CWC comes into force, the OPCW will apply the verification regime at the CW-related facilities in a series of programmes, including one for the verification and destruction of OCW. Within 30 days, every State Party with OCW on its territory must provide data on these weapons to the Technical Secretariat. This information includes all possible information on the location, type, quantity and current condition of the CW and will be verified later by the Technical Secretariat through initial inspection. The purpose of this inspection is to verify the information submitted and determine whether the CW meet the definition of OCW.

After the initial inspection, the "usability" of the old CW must be determined in accordance with the definition of OCW. If the CW meets the definition (CW produced between 1925 and 1946 which have deteriorated to such extent that they can no longer be used as CW), destruction is required. For Russia, the correct meaning of Article III, paragraph 2 and Article IV, paragraph 17 of the CWC is very important. Those paragraphs mention CW buried before January 1977 and CW dumped at sea before 1985, which do not need to be declared. It is important to note that these paragraphs mention only "proper" CW (usable CW), but do not mention OCW (unusable CW).

The problem of OCW in modern Russia is the result of Soviet military-chemical activity in 1918-1945 which were characterised by the creation of a large-scale Soviet military-chemical infrastructure in preparation for offensive chemical war. Before the First World War, industry in the Soviet Union produced, among others, such well-known TCs as non-distilled sulphur mustard gas (H), thickened mustard gas (HT) lewisite (L), hydrogen cyanide (prussic acid) (AC), and chloroacetophenone (CN). The documents already examined reveal that approximately 10,000-20,000 metric tons of TC were produced between the First and Second World Wars.

During the First World War, Soviet chemical industry were produced TC including sulphur mustard gas, thickened mustard gas, lewisite, a mixture of sulphur mustard gas and lewisite, adamsite, phosgene and hydrogen cyanide. No less than 120,000 metric tons of TC were produced in the

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Soviet Union during the Second World War, including 76,700 tons of sulphur mustard gas, 20,200 tons of lewisite, 6,100 tons of adamsite, 8,300 tons of phosgene and 11,100 tons of hydrogen cyanide. These TC were partially charged to chemical munitions; for instance 4,573,600 rounds containing sulphur mustard gas and lewisite.

Before and during the Second World War, the capacity for large-scale production and filling of TC existed in Russia in a minimum of 17 sites, and between 1924-1945 munitions were filled with numerous TC. It is necessary to take into account that, in the period between the First and Second World Wars, the TC were included in the Soviet chemical munitions together with explosive components to guarantee battle readiness.

The ecological legacy

It is difficult to evaluate the possible ecological damage without specific historical information. The system of arsenals was changed in 1986-1989 when the CW were concentrated at a limited number of sites before the signing of the CWC. Two storage facilities with persistent TC are in Gorniy (Saratov oblast; sulfur mustard gas and lewisite) and in Kambarka (Udmurt Republic; lewisite). Two arsenals with artillery munitions are in Shchuchie (Kurgan oblast) and Kizner (Udmurt Republic). The other three CWs arsenals with air munitions are in Leonidovka (the Penza oblast), Maradykovskiy (Kirov oblast) and Pochep (Bryansk oblast).

The CWC defines the destruction of CW as "*a process by which chemicals are converted in an essentially irreversible way to form unsuitable for production of chemical weapons, and which, in an irreversible manner, renders munitions and other devices unusable as such*". The methods for CW destruction have been evolved over the 20th Century. The CWC allows each country to determine their own methods of CW destruction, but now they must ensure public and environmental protection. As a result, the CWC now prohibits some destruction options which were previously popular, such as land burial, open pit burning and sea or inland water dumping.

By analysing the information available in the archives of the Soviet Army we concluded that in most cases CW utilisation was not irreversible, but the Russian Army is concealing the locations of CW burial and dumping sites. There are several examples relating to the theoretical aspects of chemical munitions "utilisation" during the period between World Wars. The first example is related to the treatment of chemical artillery shells. The recommendations given in "Directions for chemical artillery shells usage" in 1924 were simple: "*Defective shells are to be eliminated either by gun shots or by burying them in soil to the depth of not less than 1.5 arshines (1 arshine = 0.711metres.). No shells could be thrown into the water to avoid poisonings.*" The second example concerns the transportation of air chemical bombs. The simple recommendation given in "Instructions for air chemical bombs equipped with military chemical compounds transportation and storage" (1934) was as follows. During any transportation including cartage, "*in case of a TC leak, the leaking bomb should be separated and destroyed by burying it in soil on the depth of not less than 1.5 meters.*" *In case of transportation by railways, "the leaking bomb is separated and buried in soil in a place pointed by the railroad administration…*"

The third example relates to tests carried out – only 60 per cent of air chemical munitions prepared for tests in the autumn of 1940 were spent on new aviation proving grounds in Kazakhstan. The extra 40 per cent did not return to their storage places, however, and were buried on those proving grounds right after the War has started. The further destiny of those chemical munitions remains unknown.

The Red Army leaders had no idea about the damage from CW burying, of course, although in one of his orders in 1938, Soviet military minister K E Voroshilov reproached his subordinates for burying TC in the Kuzminki (Moscow) proving grounds instead of eliminating them. TC were buried in different containers, such as barrels, bottles, missiles, mines, balloons, grenades and air bombs, and as a result the polygon territory had become polluted and very dangerous for people.

At that time, in 1938, the minister introduced a "Temporary Instruction for TC elimination" in which burying was substituted with incineration and which specified that locations for incineration should be no closer than three kilometres from human accommodation. This Instruction was never fulfilled, however, and TCs and chemical munition burying and incineration continued in the subsequent decades. K E Voroshilov's order restricting CW burial was cancelled in 1957 by by defense minister Marshal G K Zhukov. By this time the Soviet Army had started preparing to clear the CW storage of first-generation munitions in expectation of the second generation. It was impossible to burn tens of thousands of tons of TC, so they buried and dumped them.

The real Russian situation

Today, most of the old and abandoned CW remain underground on the numerous former Soviet testing sites, proving grounds, storage facilities, military camps, filling stations, production sites, etc [a full Annex is provided online at www.cbrneworld.com]. A large amount of OCW was dumped in lakes, swamps, rivers (including Volga) and seas (Kara Sea, White Sea, Barents Sea, Okhotsk Sea, Japan Sea, etc).

A wide variety of old Soviet chemical ammunition, produced in 1924-1945, may still be found in Russia at approximately 370 sites. These munitions include air chemical bombs, air fragmentary-chemical bombs, toxic smoke bombs, aerial spray devices, artillery shells, mortar chemical shells, land mines, toxic smoke candles, etc. As a result of our work in the military archival depository, we have documentary proof of numerous instances of chemical munition burying on many proving grounds during the period between World Wars.

Unfortunately, there almost were no excavations during this period. The only example we can show of CW excavation was carried out on the Kuzminki testing site and proving grounds in Moscow in October-December 1937. According to the status on 15 November 1937, 6855 mortar chemical shells, 751 artillery chemical shells, 75 air chemical bombs, 732 toxic smoke candles, 904 barrels with non-distilled sulphur mustard, 277 gas-cylinders with phosgene, hydrogen

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cyanide and chlorine, 30 metric tons of adamsite and 156 metric tons of arsenic TC production waste were dug up. In addition, 24 barrels of non-distilled sulphur mustard gas, 22 gas-cylinders, 103 artillery chemical shells and 119 mortar chemical shells were lifted from the bottom of the polygon lake. Those excavations were postponed because of wintertime, and were never recommenced. Normal (unhydrolysed) mustard gas was found in the soil on the territory of this proving ground in 1998.

There are several historical examples of work done on chemical plants, arsenals and proving grounds. For example, in 1950, approximately 2,000 metric tons of non-distilled mustard gas were destroyed at Kambarka (Udmurt Republic) using an open-air burning technique. This territory is polluted with polychlorinated dioxines generated from the burning. Other chemicals were destroyed at Kambarka as well.

Similarly, CW produced by the plants at Chapaevsk, Dzerzhinsk and other towns were stored in a depot near Chapaevsk City (the Pokrovka settlement) following the Second World War. In the early 1960s, at least 1,200 metric tons of mustard gas were disposed of by incineration and burial. Non-distilled mustard gas was produced in the chemical plant in Chapaevsk until 1943, after which production was halted when it became impossible to prevent injuries. Lewisite production continued throughout the war. Wastewater treatment facilities did not function as a rule, despite ongoing production of TC, and waste was dumped directly into the Chapaevka River and from there reached the Volga. Spoiled TC and munitions went to a dump, now deserted, on the plant site. After the war a considerable amount of CW that had been rejected by the army was destroyed at the plant. The plant's own storage facility was also destroyed in the late 1950s. An environmental study carried out in winter 1993-1994 showed the concentration of arsenic in the soil on the territory of the plant exceeded official standard for maximum permissible concentration by a factor of 8,500 times. In areas of the town surrounding the plant the concentration of arsenic exceed standards by a factor of two-to-ten. Fifty years after the end of lewisite production, a byproduct – beta-chlorvinylarsinoxid, a substance even more toxic than lewisite – was found in the soil on the territory of the plant and in nearby residential areas downwind. Now this territory is polluted with arsenic and polychlorinated dioxines generated at that time. Normal (unhydrolysed) mustard gas was found in the soil on the territory of plant at the end of 1990.

In yet another example, production of non-distilled mustard gas and aircraft bombs charged with mustard gas was carried out systematically at the Stalingrad (Volgograd) chemical plant during the war until autumn 1942. The majority of the plant's discharge was dumped directly into Volga River. In February 1965, the dam separating the so-called "white sea" from the Volga River was broken and the contents were discharged into the river. Such examples demonstrate why Russia has so many environmental problems caused by OCW.

Modern Russian OCW tasks

Although OCW may no longer be usable in military terms, they still pose a risk for people and the environment, therefore. Taking into account the toxicity grade, etc, it is evident that OCW should be destroyed first. Cleaning the highly contaminated soil at former test range target areas is an unresolved problem to date. The biggest problem posed by the destruction of these OCW is their content of arsenic. Another important problem is the unknown storage conditions, because many OCW have been buried for years.

Certain activities related to the disposal of the OCW are integral to the various national programmes relating to both the cleaning of testing ranges and soil reclamation. A number of European countries, including Germany, Belgium, France (programme SECOIA), Italy and the United Kingdom, are faced with an on-going process of recovering old chemical munitions from old test or storage sites. The US Army estimates there are suspected burial sites at approximately 63 locations. Technological solutions were therefore developed.

In Russia there is no official data about the further fate of TC and chemical munitions produced in 1924-1945. We had expected that Russian government would declare all its knowledge about OCW and take the necessary measures to destroy the OCW in accordance with the provisions of the CWC. We had also expected the Russian government would reasonably take appropriate actions to identify OCW as such indications arises. In fact, the Russian authorities did not realise their obligations for OCW.

The future programme of Russian OCW disposal should contain a detailed description of successive operations. Some OCW procedural steps for disposal are clearly evident. Initially, they call for a comprehensive search of the archives (military and industrial) to prepare a list of related sites. The second step is to create an inventory of possible sites with OCW, followed by reconnaissance and locating. The next important stage is biological monitoring of the numerous contaminated sites. It is important to know the suitableness of related sites for people living there. Chemical monitoring is required for finding arsenic, sulphur mustard gas and other hazardous chemicals in the contaminated soil. It is then necessary to implement reconnaissance of related sites with metal detectors to prepare an accurate map.

The next step is unearthing munitions and identifying chemical and fragmentary-chemical munitions. The most important and dangerous stages are the removal, transportation, storage and demilitarisation of old chemical and fragmentary-chemical munitions (taking into account the prohibited destruction options such as land burial, open pit burning and sea or inland water dumping). The final step is decontamination of soils on the related sites.

In the ecological part of the OCW disposal programme, attention should be given to the weakening of the dangerous influence of the process on the population of surrounding area and on the environment. Such measures can be divided into two main groups. The first group of measures is defined by the requirement for safety during the recovery, transportation, storage and utilisation of chemical ammunition. The second group includes the need to prevent TC leakage from soil and chemical ammunition and for continuous monitoring.

End Note – A full version of this article, including annexes will be available online