CHEMICAL WEAPONS DUMPED IN THE POLISH SEA AREAS – TECHNICAL POSSIBILITIES OF ITS REMEDIATION AND LEGAL RESTRICTIONS

Jacek Fabisiak

Polish Naval Academy, ul. Śmidowicza 69, 81-127 Gdynia, Poland

Abstract

Conducted in 2005 scientific and research work in the Baltic Sea on dumped chemical weapons were aimed mainly at: confirmation of regions where post-war chemical weapons were dumped, verification of unofficial dumpsites, inventoried quantity of dumped chemical ammunition and toxic warfare agents, development of research technologies for tracking and monitoring the effects of the presence of poisons in the sea and the identification and assessment of risks to sea users and to the living organisms. The results of the above tests clearly indicate that released toxic agents are not neutral to the marine environment and living organisms. During the study, it was undisputed that their presence has a negative effect on marine organisms. Examples include, for example, genetic changes in organisms, especially in fish foraging close to chemical weapons repositories or paralysis (eg burns) of animals that have direct contact with poisons released into the bottom sediments. This causes that more and more often, as the only rescue for the environment, activities aimed at removing chemical weapons lying on the bottom are indicated. The article presents technical aspects related to the removing and neutralization of chemical weapons submerged in the Baltic Sea as well as the legal aspects of such actions, especially in the context of the International Convention on the Prohibition of Chemical Weapons.

Keywords: *chemical weapon, chemical warfare agents, Baltic Sea, remediation*

1. INTRODUCTION

Scientific researches concerning dumped chemical ammunition conducted at the Baltic Sea with great intensity, especially since 2005: MERCW (Modelling of Environmental Risks related to sea-dumped Chemical Weapons) (Missiaen, 2005), CHEMSEA (Chemical Munitions Search and Assessment) (Bełdowski et al., 2014), MODUM (Towards the Monitoring of dumped Munitions Threat) (Bełdowski et al., 2018), and started in 2015 (still ongoing) DAIMOND (Decision Aid for Marine Munitions), were aimed mainly at:

- confirmation of probable areas of chemical ammunition dumpsites and identification of unknown dumpsites;
- inventory of the amount of dumped chemical ammunition and toxic warfare agents (TWA);
- development of research technologies, based on today's best available technique, thanks to which it will be possible to precisely monitor technical condition of sunken dangerous objects;
- development of supporting tools in decision making in case of contact with dangerous objects;
- identification and evaluation of threats generated by the dumped chemical munition for sea users and its environment.

Results of projects mentioned above clearly indicate, that chemical warfare agents penetrating into waters and sediments are not indifferent to the sea environment, and inhabiting organisms. Examples are genetic changes of sea organisms, especially foraging fish near the chemical ammunition dumpsites or paralysis (e.g. burns) of animals having direct contact with released toxins from the sediments Bełdowski at al., 2014). Such a state means that more and more often, as the only rescue for the environment, activities aiming at the extraction of chemical weapons lying on the bottom are indicated.

The article shows technical aspects connected with extraction and neutralization of dumped in the Baltic Sea chemical ammunition, and also legal aspects of such activities, especially in the context of Chemical

Weapons Convention, and working groups reports of HELCOM CHEMU and HELCOM MUNI Helsinki Commission.

2. OUTDATED CHEMICAL WEAPON

After the II World War the reserve of the toxic warfare agents was evaluated as about 500 000 tons. It is estimated that, only in Germany, until the end of war one performed 100 000 tons of TWA (Konopski, 2009). Assuming that TWA contained in ammunition (mainly in artillery shells, aerial bombs and mines) constituted from 10% to 60% of its total mass (Kasperek, 2001), global reserves of chemical munitions after the end of the war could range from 830,000 to 5,000,000 tons. Significant part of this weapon, in particular owned by Germany, had to be destroyed immediately after the end of the war under the Potsdam Treaty. The troops occupying the area of the Third German Reich found in its territory over 300,000 tons of ammunition deployed in the occupation zones. Table 1 summarizes the mass and type of chemical weapons requisitioned by the Allies.

Type of ammunition	**Occupation zone**			
	USSR	**USA**	**Great Britain**	**France**
Chemical ammunition with the metal mass	62,5	94,0	122,5	9,3
TWA in containers	8,0	10,5	4,2	0,2
Together	70,5	104,5	126,7	9,5
Total	311,2			

Table 1. Chemical ammunition and TWA requisitioned by the Allies on the territory of The Third German Reich /in thousands of tons/.

Source: Kasperek T., Broń chemiczna zatopiona w Morzu Bałtyckim, Adam Marszałek, Toruń, 2000, p. 21.

Since the 1945 the most used method of destroying the chemical ammunition was dumping. It was thought that placing toxic warfare agents located in rockets, bombs and other devices on the bottom of the seas and oceans will be the best alternative for used so far, yet not always safe, methods of destroying of the toxins on land. Land methods of destroying of the toxic warfare agents mostly consisted in burning or simply burial in places far from areas inhabited by people and inaccessible to them, e.g. in old, inactive mines. Reasons for dumping dangerous substances was the belief that the vastness of the seas and oceans would alleviate the negative effects of poisons on the environment. Toxic warfare agents were expected to lose their toxicity due to natural chemical decomposition processes, and in the event of their unexpected release, for example due to the corrosion of ammunition, barrels or other packaging, in such a large mass of water will be quickly diluted, resulting in water concentrations of poisons will no longer be a significant threat to the environment.

The lack of use of chemical weapons during the Second World War did not mean that the world ceased to be interested in it. The victorious powers (USA, United Kingdom, Russia), as well as other countries (e.g. Japan), continued the pre-war research programs and continued to produce chemical weapons, very often even more dangerous, based on new, more toxic poisonous compounds (e.g. XV). Over time, the stock of weapons stored in the warehouse, due to various processes, became obsolete and unusable. The situation forced the chemical weapon owners to destroy it. Just as it was done right after the end of the war, it was decided on a proven way of destroying it - drowning. This method was used until the beginning of the 1970s, that is until the date of signing agreements prohibiting the destruction of dangerous substances, including chemical weapons, by means of drowning. Until that time, chemical weapon holders deposited over one million tons of chemical munitions produced during World War I and II, as well as in the post-war period, at the bottom of the seas and oceans. The USA alone, from

1918 to 1970, dumped about 350,000 unnecessary chemical munitions in the seas and oceans (Smart, 1997), which today is a significant problem for both the living organisms and the users of the seas. Chemical ammunition was often dumped with conventional weapon, what made the dumping areas even more dangerous.

As of today, 127 regions of chemical munitions are documented in detail, in which only the USA has made 74 discharges (James Martin Center, 2018). This list is not closed. It is assumed that there are more than 300 places of dumping chemical ammunition. Chemical weapons were dumped in the Atlantic, Pacific and Indian Ocean, off the coast of North and East Canada and the United States, in the Gulf of Mexico, off the coast of Australia, New Zealand, India, Philippines, Japan, Great Britain and Iceland, in the Caribbean, Black, Red, Mediterranean, North and Baltic Sea.

3. CHEMICAL AMMUNITION DUMPED IN THE BALTIC SEA

Some of the confiscated German chemical weapons were dumped in the Baltic Sea. In 1945 to 1948, the Soviet Military Forces (SMAD - Soviet Military Administration in Germany) sank in the regions of the eastern part of the Bornholm Deep and in the south-eastern part of the Gotland Deep (areas designated for sinking German chemical weapons in the light of the provisions of the Potsdam conference from 1945) over 34,000 tons of chemical ammunition containing about 12,000 tons of toxic warfare agents (Kasperek, 2000). The type and amount of ammunition dumped in the biggest dumpsite of chemical ammunition in the Baltic Sea - Bornholm Deep are presented in Table 2, the type of chemical ammunition and mass of toxic warfare agents dumped in total in the Baltic sea by Russians is presented in Table 3.

No.	Ammunition type	Amount [pcs]
1.	Containers with mustard gas (1,000 kg containers, 100 l. and 150 l. barrels)	1 533
2.	Containers with Clark I (100 l. and 250 l. barrels)	922
3.	Containers with adamsite (125 kg barrels)	7 518
4.	Containers with prussic acid (cyclone B) (cans)	7 860
5.	Artillery shells filled with sulfur mustard (caliber: 75mm, 105mm, 150mm)	408 565
6.	Chemical bombs KC-50, KC-250, and KC-500 filled with sulfur mustard, Clark I, chloroacetophenone, adamsite, and arsenic oil	93 704
7.	Chemical explosives of 20kg	34 162
8.	Chemical missiles of 85 kg	6 777
9.	Chemical smoke bombs up to 50 kg	430
10.	Chemical smoke missiles of 100mm and 14 kg	10 420
11.	Chemical smoke missiles of 3 kg	35 040
12.	Chemical missiles in boxes	518

Table 2. Characteristics of chemical ammunition dumped in the Bornholm Deep.

Source: Kasperek T., *Broń chemiczna zatopiona w Morzu Bałtyckim*, Adam Marszałek, Toruń, 2000, p.25.

Chemical weapons in the Baltic Sea were also dumped just before the end of the war (April / May 1945) by the Weimar and Nazi Germany, which in the area of Little Belt sank about 5,000 tons of chemical munitions (mainly KC-250 air bombs and 10.5 and 15cm grenades) filled with tabun and sulfur mustard. Moreover, at the turn of September and October 1945, the British occupying forces in this region sank two barges filled with 1,250 tons of chemical munitions, including tabun (Knobloch et a., 2013). These barges in 1959 and 1960 were raised and re-sunk at much deeper depths in the Norwegian Sea.

According to witnesses, in 1946 four ships with 15,000 tons, and in 1956 four more ships loaded with about 50 tons of chemical munitions were sunk in the area to the southwest of Röhne (Bornholm), and another 8,000 tons in the area east of Bornholm (Kasperek, 2001). Moreover, it has been documented that in the years 1959 and July 1965, the German Democratic Republic dumped in this region around 60 tons of toxic warfare agents (sulfur mustard, phosgene, adamsite, Clark) (Knobloch, 2013). The chemical ammunition mass and toxic warfare agents dumped in the Baltic Sea including the Danish and Skagerrak straits are presented in the Table 4.

Type of ammunition	Type and amount of TWA /in tons/					
	Mustard gas	Arsenic compounds	Adamsite	Chloroacetophenone	Others	Total
Aerial bombs	6 432	984	642	520	-	8578
Artillery shell	729	-	66	39	-	834
Exploding aerial bombs	341	-	-	-	-	341
Mines	46	-	-	-	-	46
Containers, barrels	87	1 225	773	-	80	2 165
Total	7 635	2 209	1 552	559	80	12 035

Table 3. Type of the chemical ammunition and mass of the toxic warfare agents dumped in the Baltic Sea by Russians.

Source: Kasperek T., *Broń chem. zatopiona w Morzu Bałtyckim*, Adam Marszałek, Toruń 2000, p. 27.

Dumpsite	Ammunition mass [t]	TWA mass [t]	Types of TWA
Bornholm Deep	approx. 32 000	approx. 11 000	Sulfur mustard, Clark, adamsite, chloroacetophenone
A water reservoir east of Bornholm	approx. 8 000 not verified		No information
A water reservoir south west of Bornholm	approx. 15 000 not verified		No information
Gotland Deep	approx. 2 000	approx. 1 000	Sulfur mustard, adamsite, chloroacetophenone
Little Belt	approx. 5 000	750	Tabun, phosgene
Mäseskär	approx. 20 000 not verified		Sulfur mustard

Table 4. Mass of chemical ammunition, mass and type of toxic warfare agents dumped in the Baltic Sea.

Source: Kasperek T., *Broń chem. zatopiona w Morzu Bałtyckim*, Adam Marszałek, Toruń 2000, p. 28

4. CHEMICAL AMMUNITION DUMPED IN THE POLISH SEA AREAS

Polish Exclusive Economic Zone (EEZ) extends between 53º44' - 55º54' N and 14º15' - 19º40'E. In the zone, as an effect of Polish marine actions, fishing, and also described findings, one selected six regions of the total area of 439 km^2, in which there is a risk of human injury or ship contamination with chemical weapons. These are: areas of Bornholm i.e. borderland with the Danish Exclusive Economic Zone of approx. 220 km^2, Dziwnów (88 km^2), Kołobrzeg (8 km^2), Darłowo (8 km^2) and Hel. Although, the biggest, taking into account the amount of dumped chemical ammunition, "Polish" region of chemical ammunition dumpsite is Gdańsk Deep (two regions of the area of 8 km^2 each). In this area

about 60 tons of ammunition containing mainly mustard gas was dumped (Knobloch, 2013). The areas of Polish EEZ, on which there is a risk of contact with toxic warfare agents and type of chemical ammunition fished there are shown in the Table 5.

Region	Depth [m]	Type of ammunition
Bornholm	70 - 105	Bombs, artillery shells, mines, containers, containers with mustard gas, arsenic compounds
Dziwnów	10 - 12	Artillery shells with mustard gas and arsenic compounds
Kołobrzeg	65	Bombs, artillery shells, mines, containers, containers with mustard gas, arsenic compounds
Darłowo	90	Bombs with mustard gas
Hel	up to 117	Bombs, artillery shells, mines, containers, containers with mustard gas, arsenic compounds
Gdansk Deep	80 - 110	Bombs with mustard gas. Conventional ammunition was also dumped in the area

Table 5. Regions of Polish sea areas, in which there is risk of fishing out the toxic warfare agents.

Source: Elaboration based on: Styczyński A., based on the materials of Command OPChem Naval Command Headquarters of The Republic of Poland , 2004; Knobloch T. et al., *Chemical Munitions Dumped in the Baltic sea*, HELCOM, Helsinki, 2013; Beldowski J. et al., *CHEMSEA FINDINGS – results from the chemsea project – chemical munitions search and assessment*, Institute of Oceanology Polish Academy of Sciences, Sopot, 2014.

5. THE CURRENT STATE OF DUMPED AMMUNITION

Chemical ammunition dumped in the Baltic Sea occurs mostly in the forms of bombs and artillery shells. Moreover, toxic warfare agents, which it was not time to fill up the ammunition, were dumped in containers, mostly barrels. Mostly used were artillery shells with a caliber of 105 and 150 mm, which bodies length was up to 30 mm. Bombs had diameters from 20 to 48 cm, length from 109 to 181 cm, and their bodies thickness was merely from 1,5 to 3 mm. The smallest contained from 13 to 15 kg of chemical warfare agent – the biggest up to 200 kg. Taking into account the fact that fuses were unscrewed from chemical munitions before flooding, there is no threat resulting from a sudden explosion of ammunition. Even if not all fuses were removed, the explosive of the fuse has oxidized to the present day, so the risk of explosion is also low in this situation. Currently, chemical ammunition poses a threat only when the chemical warfare agents contained inside it exits outside, for example due to the unsealing of ammunition or TWA containers due to corrosion.

The state of ammunition depends on:

- the initial thickness of shells of bullets, bombs and other types of ammunition;
- the material from which the bullet body was made;
- way of ammunition packing;
- the method of ammunition submerging (in the ship's hull, in concrete blocks, boxes);
- type of bottom in the area of dumping; is it lying on the hard bottom (the ammunition is then exposed to water), or is it in the mud (ammunition is cut off from the oxygen supply and from the mechanical impact of sea currents).

The rate of corrosion is conditioned by the type of material of ammunition bodies, containers walls and sea water environment, in which they are. Thin-walled shells of bombs and other ammunitions, if they were on the hard bottom and were exposed to water, are rusted and they may no longer contain warfare agents. Numerous actions of mine sweeping, during which the ammunition, conventional, was extracted, conducted especially in coastal dumpsites, as well as bombs and shells fished by the fishermen using bottom nets, determined that the state of ammunition presents itself as follows:

- Artillery ammunition with a thick shell (more than 10 mm depending on the caliber), lying on sand or gravel rusted only by a few millimeters. The igniters from aluminum or its alloys have been oxidized completely;
- Small caliber ammunition (20 mm) fuses that were exposed to direct water or whose packaging has already been destroyed are almost completely rusted. Their explosive charges and the main contents are devoid of protection;
- The shells in the containers are still intact, just like those that were buried in the mule, they are still in good condition and in many cases are suitable for use.

General corrosion of metal ammunition bodies and container walls in the marine environment proceeds at a rate of about 0.005 - 0.5 mm per year. Contact corrosion, local can be much faster. It is estimated that currently the thickness of ammunition bodies and container walls has decreased by 2 - 3 mm compared to the original one. It is estimated that in most cases, submerged ammunition is corroded in 70-80% (Surikov, 1996). However, due to the large number of parameters, theoretical considerations or any other calculations do not apply to determining the state of ammunition located in individual dumpsites. Research has shown that both completely intact chemical ammunition and completely corroded missiles are found, in which there are no longer chemical warfare agents.

On the basis of laboratory tests and theoretical considerations, the time is determined after which poisonous substances can escape from submerged ammunition and containers for 8 to 390 years. It follows that the process of seepage of toxic agents into seawater has been going on for quite a while and will last for a long time. The course of this process depends primarily on the type of ammunition or containers in which poisonous substances are placed. The time when poisonous substances can escape from thin-walled containers (canisters, barrels) was rated at 8 - 30 years, and with artillery shells 150 mm at 100 - 390 years (Witkiewicz, 1998).

6. LEGAL ASPECTS OF CHEMICAL WEAPONS EXTRACTION

For 50 years after the end of the war, especially during the Cold War period, the case of chemical munitions sunk in the seas and oceans had a purely political dimension, and all information on this subject were covered by the embargo. It turned out to be a very effective brake on all actions aimed at counteracting the threats posed by the liquidation of chemical weapons by the method of dumping them. In 1972, an international agreement was signed - *Convention on the Prevention of Marine Pollution by Sinking Waste and Other Substances*, called the London Convention, but the primary purpose of this act was to stop the pollution of the marine environment by sinking waste and other hazardous substances, including chemical weapons and not the indication of actions aimed at preventing threats posed to the environment by poisons already on the bottom.

However, with the passage of time, the problem of dumped chemical munitions began to emerge on the daylight. First of all, more and more fishermen began to catch, together with the fishing, ammunition filled with poisons, which often caused extensive burns. Often, chemical ammunition or barrels filled with toxic warfare agents on beaches were also found, as a result of which tourists were seriously burned. To this day, over 680 cases of contact with dumped chemical munitions have been reported (HELCOM, 2018). A lot of them caused serious contamination of people, especially fishermen. Over such a long time, it can be argued that there were not many cases of contamination, because only a few hundred. You can also claim that there were a few hundred of them too many. Secondly, the more intense exploitation of the seabed and the need for undersea investments (laying of power cables, construction of gas pipelines, wind farms) forced investors to conduct detailed research of the bottom in terms of the safety of future underwater constructions. Very often areas for investment were determined, or were running close to, or even by, areas of chemical weapons dumping. An example is the Nord Stream gas pipeline.

About what was known, although one can assume that not all cases of catching up were reported and recorded. The future is more interesting than the past. Some believe that in a dozen or so dozens of

years, massive release of poisonous substances into the water may occur, causing its contamination and thus adverse effects on plant organisms and animals. At the same time, the thesis is formulated that an ecological catastrophe is possible. Not everyone, however, shares this opinion and believe that mass contamination of the Baltic Sea will not occur even in the case of corrosive destruction of ammunition bodies and container walls. In any case, the possibility of occurrence or increase of water contamination should be expected as the process of corrosion of chemical munitions proceeds. However, it is currently difficult to predict how this process will go over time and how big this contamination will be.

Different views on the expected effects of the presence of chemical munitions in the sea result in different views on how to handle dumped ammunition. According to most experts, it is not advisable to extract ammunition from the sea and bring it ashore for destruction. However, the current events and the need to use the seabed necessitate a wider problem of dumped chemical munitions, informing the public about this extremely serious threat and what seems to be the most important decision - what should be done with chemical weapons dumped in the Baltic Sea?

The problem of dumped chemical ammunition in the Baltic Sea is a subject of research of the Baltic Marine Environment Protection Commission (HELCOM), which coordinates works described in the Convention of protection of the marine environment of the Baltic Sea area from 1992. To solve the problem of dumped chemical ammunition in 1993 the Helsinki Commission appointed special working group – HELCOM CHEMU. One of many tasks of the group was to make a decision about further fate of dumped chemical ammunition. The final report of the Group contained the statement that the warfare agents do not cause a serious risk for the environment, therefore, we should not undertake any work related to their extraction and destruction on land. It should be noted here that, taking into account the huge amount of work that the group put into creating the final report, the conclusions contained therein were based mainly on archival data, theoretical considerations of poison behavior in the marine environment and based on research, mining and utilization technologies applied in the eighties.

In 2010, at a ministerial meeting of the States parties to the HELCOM convention in Moscow, it was decided to set up another, under the model of HELCOM CHEMU, an expert group on dumped chemical weapons, this time under the name HELCOM MUNI. The main goal of the group was to evaluate the validity of the conclusions and recommendations contained in the HELCOM CHEMU report. The group final report: *Chemical Munitions Dumped in the Baltic Sea Report of the ad hoc Expert Group to Update and Review the Existing Information on Dumped Chemical Munitions in the Baltic Sea* (HELCOM MUNI) was accepted on the 3rd of November 2013 at the ministerial meeting of state members of the Helsinki Convention in Copenhagen. The analysis of new facts and the results of scientific research has made the current view that chemical munitions should be left at the bottom is no longer unambiguous, although the report does not address the issue of extraction and destruction of dumped chemical weapons.

Also, the very important international agreement 'Convention on the Prohibition of Research, Production, Storage and Use of Chemical Weapons and the Destruction of its Chemicals' (CWC), which entered into force on 29 April 1997, did not regulate the status of chemical munitions sunk in the seas and oceans before the 1st of January 1985. This convention is a purely disarmament treatise and its primary purpose is the verifiable destruction of all types of chemical weapons and, as a result, its elimination as a weapon of mass destruction. It also strives to transform or destroy plants and facilities for the production of chemical weapons, liquidate warehouses used for its storage, and above all, the destruction of stored chemical weapons, war supplies of poisonous agents and their immediate precursors. Thus, the entry into force of the convention, which is so important to the world's safety, did not solve the problem of chemical weapons resting on the bottom of the seas and oceans.

In connection with the above, the status of chemical ammunition retrieved or discarded from the sea remains unresolved in the context of the provisions of the Chemical Weapons Convention. The dilemma is: Do the extraction of, for example, the KC-250 air bomb, filled with 100 kg sulfur mustard, makes the state an owner of chemical weapons? What destruction procedures should be taken in the context of the provisions of the Convention? Where, who and how is supposed to destroy poison? Who is to finance such activities? There are still no answers to these and many other questions, just because as long as the out-of-date chemical weapons are lying on the bottom, the current regulations regarding the liquidation

of chemical weapons do not apply to it. Since the CWC Convention does not include outdated chemical weapons dumped before 1985, perhaps it should be treated as hazardous materials and proceed with it, as the procedures for the disposal of dumped dangerous objects, e.g. conventional ammunition.

7. TECHNICAL ASPECTS OF CHEMICAL AMMUNITION EXTRACTION

Currently many skeptics states that extraction of dumped chemical ammunition creates bigger threat for the environment rather than living it on the bottom. Perhaps this view was justified 30 years ago, but the development of science and technology has meant that currently used technologies for the production and destruction of chemical weapons are safe for the environment and people. Many countries struggling with the problem of dumped chemical weapons decided to clean their waters from it a dozen or so years ago. Such actions were taken, among others, by the United States, Italy, Australia and Japan.

The fact that from year to year the basin is more and more intensively used economically speaks for the commencement of works aiming at the purification of the Baltic Sea from dumped chemical weapons. The scope of mining works is increasing, new gas pipelines and power lines are being constructed, new wind farms are planned to be built. All this is an interference with the seabed and poses a risk of violating chemical munitions and, consequently, the possibility of violent release of poisons and, as a result, serious pollution of the environment. In addition, underwater work, during which chemical munitions will be encountered, in accordance with the guidelines, must be stopped until the threat is removed. Inevitable, sooner or later, will be the necessity to create a system that will enable the extraction and destruction of dumped chemical weapons in such situations.

In the 1990s, several companies offered mining of dumped chemical munitions, however, such operations involved very high costs (about 8 billion dollars) and the need to destroy poisons on land. There are also proponents of the view who think that this ammunition should be isolated from the surrounding water. The possibility of covering the landfills with a layer of concrete or polymer is being considered. In the case of shipwrecks filled with ammunition, it is proposed to change the water in them to a solution of the substance, which, after polymerization, would cause the hull with filling to become a monolith. This would prevent the destructive action of water on the metal parts of the ammunition and prevent the escape of poisonous substances into the water. However, similarly to the case of ammunition extraction, this solution would not be technically easy and also very costly, while not providing absolute certainty of its effectiveness. After taking into account the arguments given, one can understand why the view prevails that dumped chemical munitions should be left in the sea without interference.

At this point, one should consider whether to extract all of the chemical weapons sunk in the Baltic Sea, or whether an effective system should be created to destroy it in the area where it is a threat to fishing, beaches, new bottom investments or other economically important operations. The Naval Academy in Gdynia proposed on the basis of a vessel withdrawn from the operations, to create a mobile sea vessel with the installation for the safe destruction of chemical ammunition. At the same time, the unit would act as an analytical laboratory, monitoring and rescue unit, and most importantly, it would have a system for the safe destruction of chemical weapons at sea. It would be equipped with the best currently available technique, among which the necessary equipment would be:

- A group of submersible vehicles (AUV and ROV equipped with appropriate grabbers and manipulators), which will enable precise location of dangerous objects, their identification and assessment of technical condition as well as equipment for hydrocaustic research;
- Installation for destruction of the chemical ammunition directly at the sea. One of the systems commonly used around the world is DAVINCH. Installation consists of a chamber resistant to high pressure, in which the vacuum detonation of the extracted missiles takes place. There are also German technologies specialized in safe destruction of dumped chemical ammunition. Also in Poland, technologies for destroying chemical ammunition were developed, based on cold-plunged destruction of toxic warfare agents. The proposed techniques allow safe destruction of poisons. Decomposition products are not toxic to the environment. One problem is arsenic, a component of

several toxic agents (Adamsite, Clark, Lewisite). However, it can be isolated in metallic form from the degradation products and then passed on to further industrial use, e.g. for the production of glass;

- Barge towed (no drive) - necessary to install on it an installation for ammunition destruction and TWA;
- Laboratory and measuring devices for identification of chemical ammunition;
- The satellite positioning system of the ship (EGNOS-WAAS) and submersible vehicles (USBL);
- Special containers for the ammunition lifting.

It does not seem feasible to clean up the Baltic Sea from all of the chemical munitions that lie on its bottom. However, the extraction and destruction of several thousand copies of ammunition (as much destruction process as the chamber will allow) should give measurable, qualitative effects.

CONCLUSIONS

- As of today, the basic documents regulating the issues of dumped post-war chemical munitions in the Baltic Sea are: report of HELCOM CHEMU working group from 1994 Report on chemical munitions dumped in the Baltic Sea – report to the 16th Meeting of Helsinki Commission, 8 – 11 March 1994, from the Ad Hoc Working Group on Dumped Chemical Munition (HELCOM CHEMU) – Danish Environmental Protection Agency (1994), guidelines on rules of conduct from 1995 Final Report of the ad hoc Working Group on Dumped Chemical Munition (HELCOM CHEMU) to the 16th Meeting of the Helsinki Commission – HELCOM (1995) and report of the HELCOM MUNI working group Chemical Munitions Dumped in the Baltic Sea Report of the ad hoc Expert group to Update and review the Existing Information on Dumped Chemical Munitions in the Baltic Sea from the 2013;
- The Convention on the Prohibition of Research, Production, Storage and Use of Chemical Weapons and on the Destruction of its Inventory of 13 January 1993 does not regulate cases of chemical ammunition dumped before 1 January 1985 (Article 3, paragraph 2). However, if a chemical ammunition or war-related poisonous means are found or landed ashore, the State in whose territory the incident has occurred is obliged to proceed (already as a TWA holder, assuming that these are the quantities to be reported) in accordance with the provisions of this Convention;
- The resolution Cooperative measures to assess and increase awareness on the issue of environmental effects related to waste originating from sea-dumped chemical munitions (A/RES/65/149) of the unsettled cases of dumped chemical munitions and TWA was to be presented at the 65th session of the UN General Assembly, and it was sent for further work. Unfortunately, the work was abandoned.
- In Poland, the basic document regulating the actions taken in the case of threats, including chemical ones, is the National Crisis Management Plan developed by the Government Security Center, constituting the basis for the development of departmental action and response plans. In the part concerning chemical contamination at sea, the minister competent for maritime economy, through maritime offices, is responsible for cooperation with the Navy and the Border Guard in the field of identification and elimination of hazards of dumped chemical ammunition and TWA. In accordance with the provisions of the above document, the Navy was obliged to recognize and liquidate the threats related to these funds. In the case of incidents with chemical munitions or TWA, the Minister of National Defense should provide support to public and local administration authorities through separate sub-units and branches of the Polish Armed Forces.
- In accordance with the recommendations of the HELCOM CHEMU (1995) report, in Poland an Instruction for handling of munitions and chemical weapons was developed and issued for Polish sea areas, which were implemented;

- Currently, there is a technology that can be used to effectively locate, secure transport, recovery and disposal of dumped ammunition, without adversely affecting the environment. Therefore, it is possible to remove the post-war chemical munitions at the bottom and this possibility should be considered;
- Cleaning the bottom requires a detailed assessment of such operation and high financial expenditures.

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