CHEMICAL MUNITIONS DUMPED IN THE BALTIC SEA

A GUIDEBOOK FOR FISHING BOAT CREWS

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INTRODUCTION

One of the key elements of each citizen's safety is high awareness regarding the hazards they might encounter each day. Thanks to having the knowledge about the hazards we are able to appropriately prepare and, if need be, react. To supplement this assumption, the participants of the CHEMSEA international research project (co-financed by the European Union), whose purpose is the search for and evaluation of post-war munitions dumped in the Baltic Sea, prepared a guidebook about the hazards caused by the post-war chemical munitions dumped in the Baltic Sea. This publication is mainly aimed at fishermen, those people under everyday threat of direct contact with chemical munitions and weapons as well as products of their decomposition. In this guidebook, alongside basic information about chemical weapons, their types and locations of dumping, you will find photos depicting such chemical munitions and code of conduct in case of fishing them out. This guidebook also contains a list of institutions, and their telephone numbers, responsible for reacting when a vessel becomes contaminated.

A SHORT DESCRIPTION OF CHEMICAL WEAPONS

Chemical weapons are classified as **weapons of mass destruction.** Their main purpose is the elimination of soldiers from battle and hindering the exploitation of terrain and technical measures. Chemical weapons are toxic chemical agents as well as the means of transporting and dispersing them in the area of fighting. They have the ability to create contamination in a large area, often far away from the original point of dispersion. Also, they can vary in the degree of contamination from temporarily disabling a human being to causing their death. Chemical agents used as weaponised chemical agents are characterised by their ease of human body penetration (airways, skin, eyes).

Chemical weapons were first used on a massive scale during World War I. It happened on 22nd April 1915 nearby the city of Ypres (now in Belgium). Then the German army released 1600 large and 4130 small bottles of chlorine. As a result, approximately 15,000 soldiers were poisoned, out of whom 5,000 died. The weapon was used despite signing the 1899 Hague Declarations forbidding the use of munitions filled with choking or poisonous gases.

Fig.1. Gas attack using chlorine conducted during World War I. Source: wikipedia

Up to now chemical weapons have been used:

- in Morocco, Ethiopia and China – between the wars period;
- to exterminate people in German concentration camps (Cyclone B) – World War II,
- In Vietnam, Iraq, Japan, Syria – after World War II.

Perfecting the arsenal of chemical weapons was conducted until the 1980s, when world military powers decided to withdraw from the idea of utilizing chemical weapons, deeming it ineffective (during that period chemical weapons were used in Vietnam and Iraq). The consequence of the change in the stance on chemical weapons was the problem of tens of thousand tons of chemical weaponry. The collapse of the Soviet Union as well as discovering huge amounts of chemical weaponry in Iraq led to the signing of the Paris Treaty in 1993 – The Chemical Weapons

Convention (CWC), effective 1997 after being ratified by a number of countries.

Classification of toxic chemical agents

The most dangerous quality of chemical agents is their toxicity which is defined as harmful influence on the human body. In view of this harmful influence on different organisms, toxic chemical agents can be divided as follows:

- nerve agents – the most dangerous and at the same time the most efficient toxic agents which attack the human nervous system, leading to death. This group includes sarin, soman, tabun, V-gases;
- blistering agents – causing outer and inner blisters. These include: sulphur and nitrogen mustard, lewisite;
- toxic agents – derivatives of hydrogen cyanide and cyanogen chloride
- chocking agents – phosgene and its derivatives (diphosgene and triphosgene);
- irritants – two subgroups are recognized:
  - lachrymators (tear gas) – chloroacetophenone, chloropicrin;
  - sternutators (affecting the airways) – adamsite, diphenylchlorarsine (DA), diphenylcyanoarsine (DC);
- incapacitating agents (sedatives and

hallucinogens, e.g. LSD) and phytotoxic agents (toxic effect on plant growth).

Means of transportation and dispersal of toxic chemical agents in the area of fighting

In terms of the method of transporting the agent onto the target destination, they can be divided as follows:

- artillery;
- mortar;
- rocket propelled (guided and unguided missile);
- aerial bomb;
- chemical weapon cartridge;
- chemical fougasses.

OFFICIAL AND NON-OFFICIAL REGIONS OF MUNITION DUMPING IN THE BALTIC SEA

After World War II, in line with the Potsdam Conference (signed in August of 1945), the allied forces began destroying the leftover war equipment (weapons, munition, etc.). Dumping toxic agents in seas (including the Baltic Sea) was considered to be the best and cheapest of methods. As a result, tens of thousand tons of weapons, including chemical ones, were left in the Baltic Sea. Dumping chemical munitions was

chosen for a number of reasons: firstly, it was a very fast method; secondly, it did not require much financial means; thirdly, no special installations needed to be produced; and lastly, the allies and Russians did not know how to properly destroy the munitions. The official dumping grounds for chemical weapons in the Baltic Sea are: the Gotland Deep, the Bornholm Deep and the Little Belt Strait.

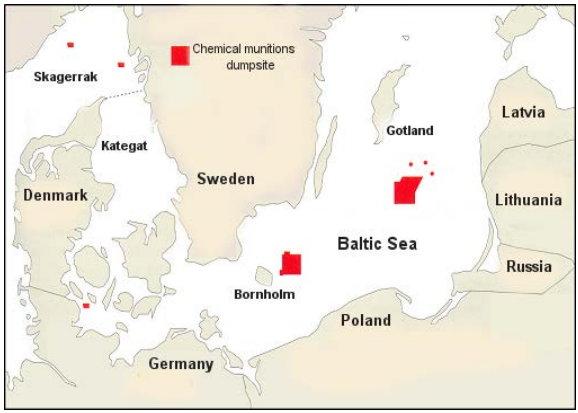

Fig. 2. The official dumping regions of chemical munitions in the Baltic Sea, source: www.chemsea.eu

The collected documentation and witness statements show that the munitions were also dumped to the east (approx. 8,000 tons) and south-west (approx. 15,000 tons) of Bornholm. That data is still unofficial as both the type and amount of toxic chemical agents in those areas remain unverified.

In reality, the whole of southern Baltic Sea can be considered as the area of chemical munition dumping, due to the fact that the navigational equipment was not precise enough. Munitions were dumped during transport, and those packed into wooden crates could have stayed adrift travelling substantial distances.

Fig. 3. The official and unofficial areas of chemical munition dumping in the Baltic Sea, source: www.chemsea.eu

Artillery munitions, grenades, aerial bombs, mines, barrels with toxic chemical agents and other warfare material were dumped in the Baltic Sea. Assuming that toxic chemical agents represent on average 15% of the whole weapons cache, it is estimated that the munitions dumped range from 6,000 to even 13,000 tons. On the basis of the

gathered information, it has been concluded that in the Baltic area the following are the dominant agents: chloroacetophenone (2-Chloro-1-phenylethanone), diphenylchlorarsine (DA), diphenylcyanoarsine (DC), adamsite (10-chloro-9,10-dihydrophenarsazinine), phosgene (carbon oxychloride), mustard (2,2'- dichloro-diethyl thioether), lewisite (2-chlorovinyldichloroarsine), tabun (ethyl ester of dimethylphosphoro-amidocyanidic acid) and cyclone B (hydrogen cyanide)

Fig. 4. On the left: A barge with bombs, On the right: dumping munitions en route to areas of dumping, source: www. Marine Technology Society Journal, vol. 43, issue 4, Fall 2009, p. 25

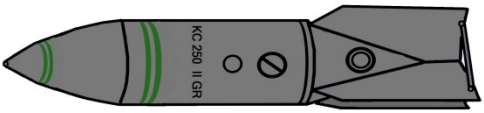

Fig. 5. Schematics of KC250 bomb filled with 100 kg of phosgene; source: chemsea project

Fig. 6. KC250 bomb, source: http://levis.sggw.waw.pl

Fig. 7. Artillery munition (various calibre), source: www.chemsea.ue

Fig. 8. Anti-personnel mine type 37 filled with diphosgene; source: chemsea project

Characteristics of official areas dumped

South of Little Belt and transport routes from Flensburg

Area according to current sea charts

- Depth: 25-31 m;
- Ground: partly thick layer of mud (0-8 m);
- Size: 4,180 ha.

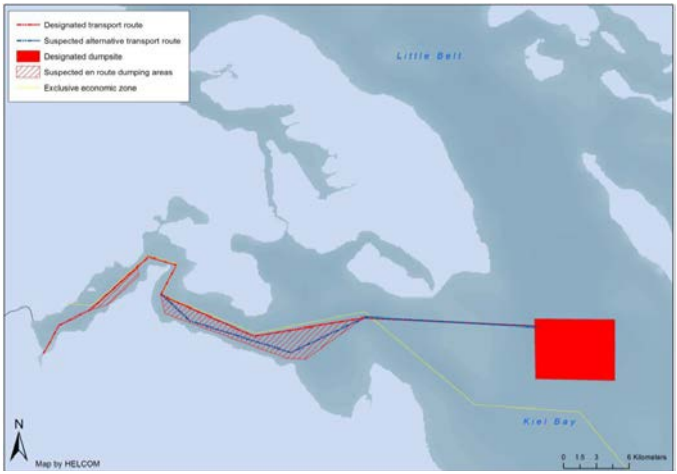

Figure 9: Map of the dumpsite south of Little Belt designated in sea charts; the suspected former transport route; and areas suspected to be contaminated by chemical warfare materials dumped en route.

Dumping activities

- April/May 1945, on behalf of the German Navy
- September/October 1945, emergency dumping of leaking materials, under control of the British Military Administration in Germany (uncertain).

Originating harbour:

- Flensburg

Amounts dumped (approx.):

- 5,000 tonnes item-by-item (2,000 tonnes payload, est. at 40%);
- 1,250 tonnes on two barges (cargo from barges recovered in 1959/60, payload 143 tonnes Tabun-mixture (DE Ministry for Interior 1960).

Chemical warfare agent types:

- Tabun (found by investigations in 1955 & 1959/60 (barges) and 1971/72 (scattered items);
- Sulfur mustard (historical evidence).

Container-types:

- Bombs (e.g. KC250), partly in wooden crates;
- Grenades (10.5 and 15 cm), fuzed (at least partly).

On-site-dumping:

- Item-by-item; not all ships anchored, partly drifting items reported;
- Scuttling of two barges.

En-route-dumping:

- Possibly 1,200 tonnes of munitions dumped en route along the southern part of the Flensburg Fjord.

Mixing with other warfare materials:

- Yes (based on findings and historical evidence).

Warning in sea charts:

- Foul (explosives);

- Anchoring and Fishing dangerous.

Catches & accidents:

- No official reports.

Gotland Basin and transport routes from Wolgast

Area according to current sea charts:

- Depth: 93-137 m;
- Ground: mostly thick layer of clayey mud (0-6 m);
- Size: 141,610 ha.

Fig. 10. Map of *the* dumpsite Gotland Basin designated in sea charts source: developed by J. Michalak

Dumping activities:

- May – September 1947, on behalf of the Soviet Military Administration in Germany.

Originating harbour:

- Wolgast.

Amounts dumped (approx.):

- 2,000 tonnes item-by-item (1,000 tonnes payload).

Chemical warfare agent types:

- Sulfur mustard;
- Clark-types / arsine oil;
- Adamsite;
- α-chloroacetophenone;
- Tabun (suspected, found in Wolgast harbour).

Container-types:

- Bombs, partly in wooden crates;
- Grenades;
- Bulk containers;

On-site-dumping:

- Item-by-item; ships not anchored, partly drifting items reported.

En-route-dumping:

- Possible.

Mixing with other warfare materials:

- Co-dumping of conventional munitions and occurrence of sea mines;
- Chemical waste (hydrogen cyanide).

Warning in sea charts:

- Explosives Dumping Ground;
- Anchoring and Fishing dangerous.

Catches & accidents:

- Yes.

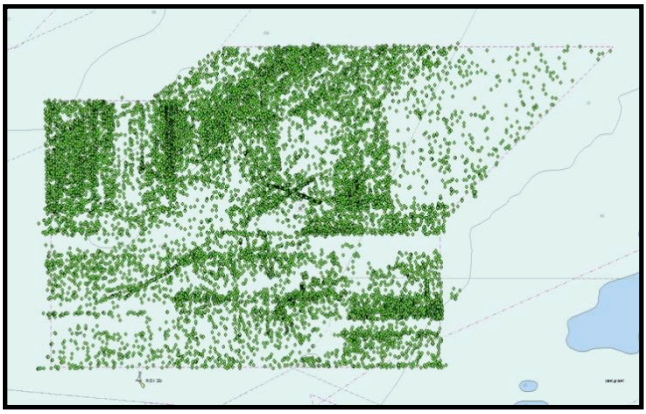

Figure 11. The results of hydroacoustic surveys in the region of Gotland Deep, source: chemsea.eu

Bornholm Basin and transport routes from Wolgast

Area according to current sea charts:

- Depth: 93-137 m;
- Ground: mostly thick layer of clayey mud
- (0-6 m);
- Size: 67,260 ha.

Dumping activities:

- August 1945 - December 1946, on behalf of the British Military Administration in Germany (based on single source);
- August 1947 – January 1948, on behalf of the Soviet Military Administration in Germany (major activities);
- 1959 – July 1965, on behalf of GDR authorities.

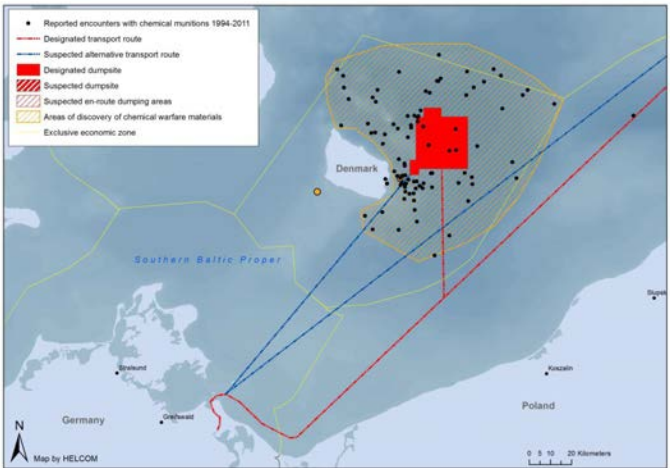

Fig. 12. Map of the 'extended dumpsite' east of Bornholm designated on sea charts and (suspected) former transport routes from the loading port of Wolgast. Reported encounters with chemical warfare materials and emergency relocation areas are also indicated.

Originating harbours:

- British activities: Hamburg, Kiel, Lübeck;
- Soviet activities: Wolgast;
- GDR activities: Wolgast, Peenemünde, Karlshagen.

Amounts dumped (approx.):

- 32,000 tonnes item-by-item (Soviet activities, 11,000 tonnes payload);
- 30 tonnes item-by-item (GDR activities);
- 30 tonnes on scuttled hulk (GDR, 1962).

Chemical warfare agent types:

- Sulfur mustard (no evidence for nitrogen mustard);
- Clark-types / arsine oil;
- Adamsite;
- α-chloroacetophenone;
- Phosgene (only GDR transports);
- Lewisite (found in on-site investigations);
- Tabun (suspected, found in Wolgast harbour).

Container-types:

- Bombs, partly in wooden crates;
- Grenades;
- Bulk containers;
- Spray cans;
- Wooden crates.

On-site-dumping:

- Item-by-item; ships not anchored, partly drifting items reported (Soviet activities);

- Scuttling of vessels (GDR, British activities).

En-route-dumping:

- Yes (Soviet activities).

Mixing with other warfare materials:

- Co-dumping of conventional munitions;
- Chemical waste (hydrogen cyanide).

Warning in sea charts:

- Explosives Dumping Ground (sometimes referred to as ‘extended dumpsite’);
- Anchoring and Fishing dangerous;
- Gas munitions (for circular area of formerly designated dumping in the north-eastern part of the Explosives Dumping Ground; sometimes referred to as ‘primary dumpsite’).

Catches & accidents:

- Yes.

Characteristics of unofficial areas dumped

The areas of the Rønne Bank and the Adlergrund, roughly half-way between Bornholm and Rügen

Area according to current sea charts:
- No special area designated in sea charts;
- Depth: 5-40 m;
- Ground: mostly stones and gravel (Adlergrund).

Dumping activities:
- 1956 – 1959, on behalf of GDR authorities (based on single sources).

Originating harbours:
- GDR activities: Wolgast, Peenemünde, Karlshagen.

Amounts dumped (approx.):
- 60 tonnes scuttled on 5-6 ships (GDR activities, based on single sources).

Chemical warfare agent types:
– Mixed munitions.

Warning in sea charts:
- No warnings pertaining to munitions

Catches & accidents:
- No official reports.

This area is in the interest of HELCOM MUNI on the basis of documented official correspondence conducted between the end of 1952 and beginning of 1953 in the GDR authorities discussed whether chemical munitions was sunk

by the Soviet administration in Germany to the north-east of the island of Bornholm or in the Adlergrund.

Gdansk Deep

Area according to current sea charts:

- Depth: 80-110 m (in the wider area);
- Ground: muddy sediments;
- Size: 100 ha (explosives dumping ground currently designated in sea charts).

Amounts dumped (approx.):

- 60 tonnes.

Chemical warfare agent types:

- Sulfur mustard (two incidents in 1954).

Container-types:

- Bombs (two incidents in 1954).

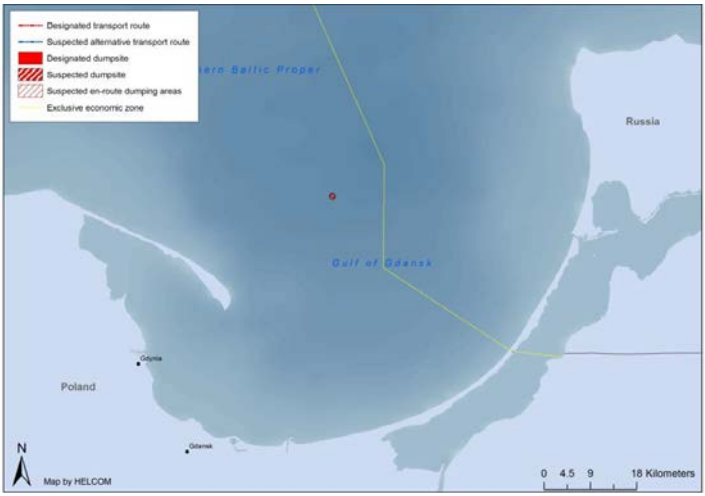

Fig. 13. Map of the Gulf of Gdansk, indicating where the former Explosives Dumping Ground is designated on sea charts. The position and extent of the possible chemical munitions dumpsite is unknown, but it is currently being investigated by the CHEMSEA project.

Mixing with other warfare materials:

- Suspected area marked as formerly used explosives dumping ground

Warning in sea charts:

- Explosives Dumping Ground;
- Anchoring and Fishing dangerous.

Catches & accidents:

- Yes (two incidents in 1954).

THE HAZARDS OF EXPOSURE TO CHEMICAL MUNITIONS DUMPED IN THE BALTIC SEA

The toxic chemical agents dumped in the Baltic Sea exhibit the following toxic properties:

TABUN- the most toxic of all the chemical agents dumped in the Baltic Sea. It is absorbed via all channels (skin, eyes, respiratory tract). The first discernible symptom of tabun exposure is miosis (pupil constriction – tabun's action results in impaired vision, changes in visual acuity, decreased eye accommodation, photophobia, eye pain and sore eyeballs). Miosis keeps up for a few days and wears off without leaving any permanent side effects. It appears on a dose approximately 100 times smaller than the fatal dose which is 400 $mg*min*m^3$ for respiratory tract (death occurs after 15-20 minutes). In the case of skin contamination, the fatal dose equals 1 gram per person.

Mode of action in marine waters (if the agent is released from a container) – it quickly undergoes hydrolysis and the compounds yielded are not toxic. The yielded hydrogen cyanide easily degrades in marine environment.

To prevent tabun contamination, one is advised to wear protective rubber clothing and a gas mask.

In case of contamination – first aid includes: rinsing eyes with running water and a 2%

solution of acidic sodium bicarbonate ($NaHCO_3$ –baking soda). The skin should be rinsed with running water with soap. In case of internal contamination, one should drink an activated charcoal suspension to vomit. In case of severe contamination, administer intramuscular injections of atropine. Artificial respiration can be performed in the case of breathing problems.

SULPHUR MUSTARD - dumped sulphur mustard can preserve its toxicity for many years. It can be identified by its characteristic mustard-like odour. It is toxic in the form of vapour, liquid and solution. It is absorbed through the eyes, respiratory and alimentary tract and it causes eye injuries. The first symptoms of skin contamination include redness and appear after a period of latent action of 4 up to 24 hours, depending on the dose. After 24 hours one can notice small vesicles which coalesce into one large blister filled with serous fluid.

After a few days the blister bursts, revealing a deep slow-healing wound. These wounds are susceptible to bacterial infection, hence the treatment is very long (up to several months) and requires particular sterility of environment.

Fig. 14. Clinical symptoms of sulphur mustard exposure, source: chemsea.eu

The healed wounds leave scars and brown spots on the skin.

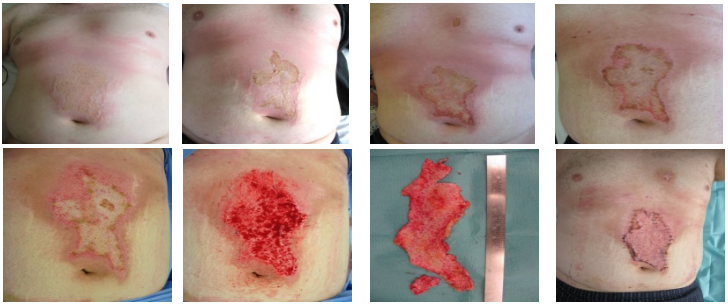

Fig. 15. Stages of burn by sulphur mustard in the first 20 days, source: chemsea.eu

Symptoms of sulphur mustard contamination through the respiratory tract appear after 4 to 6 hours. Typical among them are: painful hacking cough, vocal atrophy or even pneumonia. If

sulphur mustard vapours affect the eyes, it could lead to conjunctivitis and subsequent corneal damage, resulting in ulceration and irreversible complications, leaving the eyesight permanently damaged. Sulphur mustard exposure frequently brings about permanent impairment, known as *cachexia.* Treatment invariably requires medical care. Studies have shown that sulphur mustard may have teratogenic effects (affecting the embryo or foetus) as well as carcinogenic (cancer-causing).

Mode of action in marine waters (if the agent is released from a container) – hydrolysis of sulphur mustard, which has not been dissolved in water, progresses very slowly. Concentrated sulphur mustard exhibits aluminium-like consistency**.** It easily congeals, taking solid form which is hard to break up.

To prevent sulphur mustard contamination*,* one is advised to wear protective rubber clothing and a gas mask*.*

In case of contamination*,* first aid involves immediate removal of sulphur mustard from the skin surface or alimentary tract, using cotton wool (or lint) tampons and a 5-10% solution of sodium bicarbonate, ammoniacal water or 1-2% solution of potassium permanganate. The surface of the wound and mucous membrane

should be rinsed with a 5% solution of sodium bicarbonate, the eyes – with a 0,2% solution of sodium bicarbonate. Sterile dressing should be applied on the contaminated areas. In the case of removal from the alimentary tract, one should purge or have the stomach pumped.

Fig. 16. Lump of sulphur mustard
http://www.environet.eu/pub/pubwis/rura/zatopiona_bron.pdf

NITROGEN MUSTARDS - Nitrogen mustards exhibit toxic properties akin to those of sulphur mustards. Symptoms of poisoning are also similar. The differences lie in the latent period of action – for nitrogen mustards the time is much shorter, even a few minutes. Nitrogen mustards can be recognized by their characteristic flower-like scent.

Mode of action in marine waters (if the agent is released from a container) – hydrolysis progresses very slowly. Nitrogen mustards' activity in marine waters has not been

thoroughly explored. It is believed that the products of hydrolysis are also toxic, though less than pure nitrogen mustard.

To prevent nitrogen mustard contamination, one is advised to wear protective rubber clothing and a gas mask.

In case of contamination, first aid involves the same steps as in the case of sulphur mustard.

LEWISITE - absorbed through the skin and respiratory tract, can be recognized by its geranium-like scent. It is a toxic blister agent. Upon skin contact, the symptoms appear immediately in the form of light stinging of the contaminated areas. Larger doses give rise to cherry-red blisters which burst after 2-3 hours, giving way to huge, open wounds. An average fatal dose of lewisite absorbed by the skin equals 20 mg per kilogram of body mass. If absorbed by the airways, it gives symptoms of coughing, dyspnea (shortness of breath), vocal atrophy and often pneumonia.

Mode of action in marine waters (if the agent is released from a container) – it is barely soluble in water. Hydrolysis yields a non-volatile dichloro(2-chlorovinyl) arsine oxide of blistering and toxic properties. Further breakdown may occur in alkaline environment, and the yielded arsenic acid preserves its toxicity due to the presence of arsenic.

To prevent lewisite contamination, one is advised to wear protective rubber clothing and a gas mask.

In case of contamination, first aid involves the same steps as in the case of sulphur mustard. Additionally, one might apply an ointment (external treatment) or administer intramuscular injections (internal treatment) – the so-called BAL (*British Anti-Lewisite);* trademark name - **dimerkaprol, dimercaprol.**

PHOSGENE - is classified as a toxic, choking agent, penetrating the organism through the respiratory tract. Contamination symptoms appear at varied periods of latency, depending on the dose, time of exposure and the nature of works performed. The latent period may last from 1 to 12 hours (in the case of high concentrations, the latent symptoms do not occur). Delayed effects include: dyspnea (shortness of breath), coughing and foamy blood-tinged sputum. Later on, the frequency of cough increases and the victim experiences growing dyspnea (breathing becomes harder and harder). Facial and neck skin turns blue (the so-called peripheral cyanosis). Within the next hours the alveoli fill with plasma. The face turns grey and pulse reaches 120 beats per minute (the so-called central cyanosis). Heavy pulmonary oedema is very difficult to cure.

Death occurs within the first 24 hours as a result of hypoxia (oxygen deficiency) and acute circulatory failure.

Mode of action in marine waters (if the agent is released from *a container)* – it quickly undergoes hydrolysis and the yielded compounds are non-toxic.

To prevent phosgene contamination, one is advised to wear a gas mask.

In case of contamination*,* first aid involves removing the victim form the area of contamination and allowing them to breathe oxygen-enriched fresh air. The victim should remain calm, avoiding physical or mental strain. In critical cases, they ought to take a half-sitting position and inhale ethanol (inhalation should take 30-40 minutes at 10-15-minute intervals).

PHENACYL CHLORIDE - is classified as a toxic, tear gas (riot control agent) belonging to the group of the so-called lachrymators. It affects the mucous membranes of the eyes, causing a heavy flow of tears. At high concentrations the facial skin may be irritated. Symptoms wear off after the victim abandons the area of contamination, not leaving any after-effects.

Mode of action in marine waters (if the agent is released from a container) – it undergoes very slow hydrolysis. It is not biodegradable, but the yielded products of hydrolysis may be biodegradable and dissolve completely in water.

To prevent phenacyl chloride contamination, one is advised to wear a gas mask.

In case of contamination, first aid involves removing the victim from the area of contamination and immediate change of clothes. The eyes should be rinsed with a 2% solution of acidic sodium bicarbonate ($NaHCO_3$ – baking soda) or a huge amount of clean water. To ease the pain, instil a 2% solution of Novocaine into the affected eye(s). In case of persistent eye watering, instil a 1% atropine solution. The contaminated skin should be profusely rinsed with water and then with acetone.

HYDROGEN CYANIDE - better known as **prussic acid or cyclone B,** is classified as a toxic agent. It is absorbed into the organism through the airways**,** crippling tissue respiration. Symptoms of contamination depend on the concentration of hydrogen cyanide vapours. At lower concentrations, there are 4 stages of poisoning:

1. stage of initial symptoms: dizziness, rapid breathing, apprehension and a metallic aftertaste in the mouth;

2. stage of dyspnea: chest pains, shortness of breath, problems with maintaining balance and painful rapid breathing;
3. stage of convulsions: muscle tremors, loss of balance and consciousness
   and gradual loss of response to external stimuli;
4. stage of paralysis: gradual loss of respiratory and circulatory function, death occurs after several dozen minutes from the first stage.

At higher hydrogen cyanide concentrations the contamination progresses rapidly, without distinct stages.

If contamination occurs through the alimentary tract, the fatal dose is 1 milligram per kilogram of body mass.

Mode of action in marine waters (if the agent is released from a container) – it undergoes hydrolysis very quickly, yielding non-toxic compounds.

To prevent hydrogen cyanide contamination, one is advised to wear a gas mask with a proper absorbent filter.

In case of contamination, first aid involves removing the victim from the area of contamination:

- subsequently the victim should inhale amyl nitrite;

- administer 25 cm^3 of 50% sodium thiosulfate intravenously;
- in case of contamination by mouth, pump the stomach with a 25% solution of sodium thiosulfate or with a fresh mixture of 6% sodium carbonate, 15,8% of iron sulphate in a 3% solution of citric acid;
- administer 50 cm^3 of methylene blue solution in 2 - 40% glucose intravenously;
- conduct uninterrupted oxygen therapy

NOTE! Do not perform artificial respiration.

CYANOGEN CHLORIDE - is a toxic chemical agent. It is absorbed through the respiratory tract/airways. Symptoms of contamination are similar to those of hydrogen cyanide, though cyanogen chloride is 3 times less toxic. In addition, cyanogen chloride can irritate the mucous membrane of the eyes.

Mode of action in marine waters (if the agent is released from a container) – it undergoes hydrolysis, yielding hydrochloric acid and cyanic acids. The compounds are volatile.

To prevent cyanogen chloride contamination, one is advised to wear a gas mask with a proper absorbent filter.
In case of contamination, first aid involves removing the victim from the area of contamination:

- subsequently the victim should inhale amyl nitrite;
- in case of contamination by mouth pump the stomach with a 25% solution of sodium thiosulfate;
- administer 50 cm3 of methylene blue solution in 2 - 40% glucose intravenously;
- conduct uninterrupted oxygen therapy.

CLARK I – DIPHENYLCHLORARSINE (DA*)* is classified as a toxic chemical irritant (sternutators). It is absorbed through the eyes and airways. Symptoms of poisoning include: lachrymation (tearing), coughing, sneezing, chest pain and difficulty in breathing which (at low concentrations) wear off after a dozen or so hours. At very high concentrations (2mg per dm^3), it may lead to death due to permanent respiratory paralysis.

Mode of action in marine waters (if the agent is released from a container) – it quickly undergoes hydrolysis, yielding non-toxic compounds with the exception of arsenic which can languish at the bottom for a long time and accumulate in living organisms.

To prevent diphenylchlorarsine contamination, one is advised to wear a gas mask.

In case of contamination*,* first aid involves removing the victim from the area of contamination. Subsequently, the eyes and

nasopharynx should be rinsed with a 2% solution of sodium bicarbonate ($NaHCO_3$ – baking soda) or a huge amount of water. If possible, the victim's clothes should be changed. If need be, painkillers, sedatives and cough medicine ought to be administered. In the case of pulmonary oedema, undertake the same steps as in phosgene poisoning.

CLARK II – ***DIPHENYLCYANOARSINE (DC)*** Its toxic effect on the human organism is analogous to that of DIPHENYLCHLORARSINE. Symptoms of poisoning are also similar, though the first symptoms of irritation occur at a concentration (of aerosol in the air) 10 times lower than in the case of DIPHENYLCHLORARSINE.

Mode of action in marine waters (if the agent is released from a container) – it breaks down into initially toxic componds diphenylchlorarsine and hydrogen cyanide, which easily breaks down in water, yielding non-toxic compounds. Hydrolysis of DIPHENYLCHLORARSINE is referred to above.

To prevent diphenylcyanoarsine contamination*, one is advised to wear a gas mask.*

In case of contamination*,* first aid involves removing the victim from the area of contamination. Subsequently, the eyes and nasopharynx should be rinsed with a 2%

solution of sodium bicarbonate ($NaHCO_3$ – baking soda) or a huge amount of water. If possible, the victim's clothes should be changed. If need be, painkillers, sedatives and cough medicine ought to be administered. In the case of pulmonary oedema, undertake the same steps as in phosgene poisoning.

ADAMSITE - another toxic chemical irritant. Adamsite aerosol causes severe airway and mucosal irritation. Symptoms of irritation include: immediate, increased salivation, after a short while chest pain and difficulty in breathing. After a few hours the symptoms disappear without leaving any permanent after-effects.

Mode of action in marine waters (if the agent is released from a container) – it barely undergoes hydrolysis and the yielded compound is subject to processes similar as in the case of Diphenylchlorarsine and Diphenylcyanoarsine. The compound displays low reactivity.

To prevent adamsite contamination, *one is advised to wear a gas mask.*

In case of contamination*,* first aid involves removing the victim from the area of contamination. Subsequently, the eyes and nasopharynx should be rinsed with a 2% solution of sodium bicarbonate ($NaHCO_3$ – baking soda) or a huge amount of water. If possible, the victim's clothes should be

changed. If need be, painkillers, sedatives and cough medicine ought to be administered. In the case of pulmonary oedema, undertake the same steps as in phosgene poisoning.

The chemical ammunition dumped in the Baltic Sea poses a contamination hazard not only for people, but also for other living organisms, fish being the most significant ones for the human food chain. Presented below are several photographs depicting the effects of fish's exposure to chemical ammunition (or to put it more precisely – the chemical toxic agent inside the ammunition).

THE CURRENT STATE OF DUMPED CHEMICAL MUNITIONS

The assessment of the current state of the chemical munitions is based on the examination of the properties of the metals sunk in the sea, done using the underwater remotely operated vehicle (ROV). Discussing the behaviour of metals in the sea environment, it was observed that the speed of corrosion is dependent not only on the chemical reactivity of the toxic agents found within the bombs, munitions, fougasses and containers (barrels), but also on many other environmental factors. These include: temperature, salinity, pH of water, depth, type of sea bottom, etc. Research has shown that the corrosion speed is diverse and can range from the hundredths to decimals of milimeter per year. It means that approximately 60 years after the dumping, the corrosion could have created a 3mm (and more) destruction of the original thickness of the walls (if the munition was dumped with triggers made from aluminium, we must suppose that those have become fully corroded). Considering the above, it has to be said that aerial bombs with thin walls (3mm), lying on hard bottoms are corroded to a large extent and can be free of toxic agents. Artillery munitions with thicker coating are watertight. Barrels (containers) made from thin-walled sheet metal are corroded to a large extent and, similarly to aerial bombs, if

positioned on hard bottom might not contain toxic agents.

The best preserved munition is the one positioned in silt. In such a case the slower process of corrosion has destroyed the coating only slightly. However, a heightened gas pressure within the bombs was observed due to breakdown of some toxic agents (mainly sulphur mustard, whose self-active breakdown creates gases – hydrogen chloride, hydrogen and ethylene). Generalizing the results of the conducted research, it should be assumed that the chemical munitions dumped in the Baltic Sea are corroded in 70-80%.

Below is the photographic documentation of research conducted using the ROV within the CHEMSEA project and the activities pertaining to the state of chemical munitions dumped in the Baltic Sea.

Fig. 18. Aerial bomb situated at the bottom of the Gotland Deep (photo taken in April 2013); source: chemsea.eu

Fig. 19. Corroded barrel situated on the bottom of the Gotland Deep (photo taken in April 2013); source: chemsea.eu

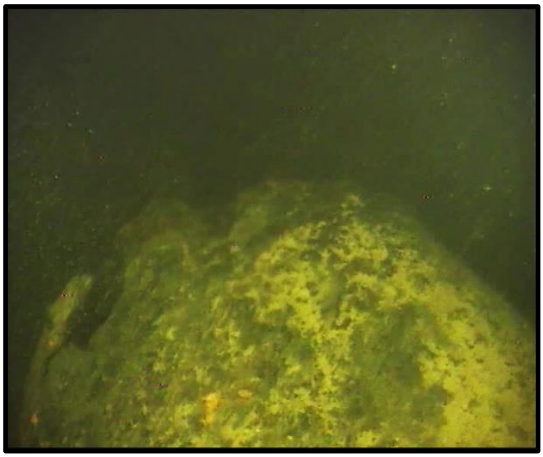

Fig. 20. Corroded coating of an aerial bomb (photo taken in April 2013 in the area of the Gotland Deep); source: chemsea.eu

Fig. 21. The body of an aerial bomb with visible dross (photo taken in April 2013 in the area of the Gotland Deep); source: chemsea.eu

Fig. 22. A lump of solidified mustard; source: Maritime Surveillance Centre South on Bornholm

Fig. 23. A lump of mustard weighing 45 kg fished out during trawling, source: Maritime Surveillance Centre South on Bornholm

CODE OF PRACTICE IN CASE OF FISHING OUT CHEMICAL MUNITIONS

1 Aim of the code of practice

The aim of this code of practice is to define the course of action in case of fishing out or extracting from the sea dangerous military materials supposedly holding toxic chemical agents.

2 Range of use specifying the limitations

The code of practice is implemented with the purpose of saving the life and health of crew members in case of fishing out or extracting from the sea dangerous military materials supposedly holding toxic chemical agents.
The code of practice is applicable to sea vessels excluding vessels of the Navy, Coastguard and Police.

3 Persons responsible for implementing the code of practice

Vessel captains (masters) are responsible for implementing the code of practice.

4 Content of the code of practice:

A. General provisions

1 Toxic chemical agents are chemical compounds which influence the human organism,

weakening it or causing death. On the bottom of the Baltic Sea the following occur most often: **mustard, lewisite, adamsite and chloroacetophenone.** Agents occur in bombs, artillery munition and other various containers. They can also be fished out as lumps coloured bright yellow, yellow or brown, often with sticky clay-like texture. Symptoms of contamination: t**earing, redness of the mucus, hoarseness, cough, eye pain, feeling of stuffiness, redness of the skin, painful blisters and ulceration**.

2 In the sea areas marked on maps as places of munition or other dangerous materials dumping as well as en route to this areas there is a **risk of extracting or fishing out dangerous military materials**.

3 It is reminded that the **ban on fishing with bottom equipment in the areas designated on maps** as places of munition and other dangerous materials dumping is to be respected.

4 Due to the heightened risk of extracting dangerous military materials during fishing, if the crew of the vessel recognises one of the following while pulling out the fishing equipment:
- suspicious objects similar to bombs, missiles or containers can be found in the nets,
- the net and fish have an unnatural scent,

- stinging of the eyes or unnatural redness and stinging of the skin can be observed,

it should be assumed that contamination with toxic chemical agents occurred.

B. Detailed provisions:

1. If while pulling out the fishing equipment there will be a suspicion that there might be dangerous materials within it (e.g. toxic chemical agents), the captain is obliged to undertake all necessary steps to rid the vessel of such materials:
   - the equipment should be cut off as quickly as possible,
   - specifying the position of dumping the equipment,
   - the place of dumping should be marked with a yellow buoy, and the position of the event must be written down and reported to the nearest emergency point.
2. If toxic chemical agents are pulled on-board, one should:

- reposition the vessel in such a way that the contaminated places are on lee side,
- close all openings on the bridge and other rooms,
- contact the nearest emergency point, giving the description of the fished out object's outer appearance or substance and all affected crew members,

- direct the vessel to the nearest port,
- not enter the port without specific permission,
- under no circumstances touch the contaminated areas on the vessel, fishing equipment and the fished out, unknown objects and substances,
- in case the clothing is contaminated, take it off immediately, put in plastic bags and secure airtight,
- stay on the radio listening for further instructions,
- stay alert until a representative of the port authority and an expert military squad arrives. Adhere to all directions given by the above parties,
- before entering the port, notify the authorities about the number of contaminated persons, the excavated chemical compound and discuss the place of mooring. The place of mooring should be as far as possible from other vessels,
- after arriving at the port, draft a written dispatch about the fished out toxic chemical agents under the instructions given by the appropriate authorities,
- not load or unload cargo, equipment or personal belongings on or off the vessel before the arrival of expert military squad.

C. First Aid in case of Contamination With Toxic Chemical Agents

With the kit: (it should be located in the first aid kit on all vessels with bottom fishing equipment operating in areas of chemical weapons dumping):

Fig. 24. Personal anti-contamination kit IPLS/ATLAS

In case of eye irritation:

- do not rub, even if stinging,
- wash out with a large amount of water, starting at the nose and moving outwards,
- after washing the eyes, close them and wash the skin around the eyes with soap and water,
- do not use eye cream or bandage the eyes.

In case of clothes contamination:

1. Tear the packaging of the powdered anti-contaminant, take out the glove and put it on either hand.

Fig. 25. Powdered anti-contaminant from the IPLS/ATLAS kit

2. Put the anti-contaminant on the contaminated area by shaking the glove, next brush off the powder and cover with another layer.

In case of contamination of rubber work-clothes or equipment:

1. The contaminated element of work clothes should be covered with organic anti-contaminant. Take out the container with anti-contaminant, release the aerosol valve and by repeatedly pressing the trigger, cover the contaminated area.
2. If a second contamination occurred, i.e. by

touching the equipment with the contaminated glove etc., cover the areas with organic anti-contaminant.

Fig. 26. Organic anti-contaminant from the IPLS/ATLAS kit

3. Protective elements (clothing, gloves) made of rubber or rubber-like materials should be rinsed with water after 30 minutes.
4. Gloves and clothing should be treated as disposable.
5. Contaminated fishing equipment should be secured in such a way, that it remains inaccessible to people. The equipment should be handed over to the military chemical squad, e.g. the Navy's.

In case of contaminating open skin:

1. The contaminated area, as possible, wash with warm soapy water.
2. Cover the contaminated areas with anti-contamination/preventive cream.

Fig. 27. Anti-contamination/preventive cream from the IPLS/ATLAS kit

Without the kit:

1. Remove by available means the contaminated substance from the skin – do not rub in! The contaminated areas should be washed with a large amount of warm water with a cleaning substance (soap, dish-washing fluid). This method yields positive results if done within 5 minutes of the contamination.
2. In case of eye irritation:
   - wash with a large amount of fresh water,
   - do not rub the eyes,
   - do not use any medical substances or bandage,
   - contact a doctor immediately.
3. In case of blisters, do not prick, but put on a dressing. Contact a doctor immediately.
4. The victims must be placed as far away as

possible from the contaminated areas and equipment in such a way as they are not in the way of vaporizing toxic agents being blown onto them.

D. What to wear

The basic element providing more security when in contact with chemical munitions is proper clothing. It should contain measures to protect the skin: rubber boots, trousers, jacket and gloves as well as means of protecting the airways and eyes: gas mask at best (a half-mask can be used but it is not protection enough from toxic agents)

Fig. 28. Examples of protective clothing and measures

1 part of calcium hypochlorite + 8 parts water	1-2 l/m^2	

E. What can be used to decontaminate the deck

For deck decontamination it is best to use calcium hypochlorite (granular preferred)

Presented barrel contains 45 kg of calcium hypochlorite. This amount is sufficient to decontaminate from 90 - 180 m2 deck.

F. Points of emergency contact:

Marine board information office in Gdynia GUM-RADIO	VHF FM channel 16 and 71
Port Authority Gdańsk	VHF FM channel 14
Port Authority Gdynia	VHF FM channel 16 and 12
Port Authority Władysławowo	VHF FM channel 16, 10 and 71
Port Authority Hel	VHF FM channel 16, 10 and 71
Marine administration control and dispository centre in Słupsk RADIO	VHF FM channel 16 and 12 2182 kHz AM
Port Authority Łeba, Ustka, Darłowo, Kołobrzeg	VHF FM channel 16 and 12
Port Authority Świnoujście	VHF FM channel 16, 12 and 71
Port Authority Dziwnów	VHF FM channel 16 and 10

G. Report about fishing out a substance suspected to be a toxic chemical agent

After arriving at home port or the nearest port, a written report should be drafted, with the following information:

- position and time of trawling start, during which the suspected dangerous substance was fished out (i.e. munitions or chemical substance – liquid, jelly, solid),
- change of trawling course and duration of trawling on a given course,
- position and time of the start of pulling out the fishing equipment or other equipment which was used to fish out the findings,
- names of those crew members who were on deck while the chemical find was fished out,
- detailed description of the fished out munition of warfare gas,
- actions undertaken after realising that toxic chemical agents were fished out,
- in case of dumping the pulled out dangerous materials, specify the position of dumping and the type of position marking.

The report must be delivered to a marine board competent for the home port of the vessel and the port of arrival.

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- L. Konopski, *Historia broni chemicznej*, Wyd. Bellona, 2009
- J. Fabisiak, *Instrukcja bezpieczeństwa pracy przy posługiwaniu się bojowymi środkami trującymi*, wydawnictwo niepublikowane.
- *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), 2013
- Research results of the CHEMSEA project

Cover photo: *Cutter returning from fishing* (fot. M. Kowalski) http://www.birdwatching.pl/wyprawy/art/797

Pictures of protective measures and calcium hypochlorite come from:

http://www.legar.pl
www.demar.com.pl
http://sanexhurtowniabhp.pl
http://www.all.biz

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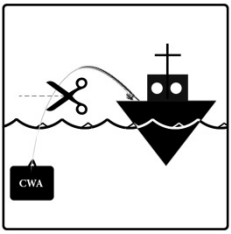
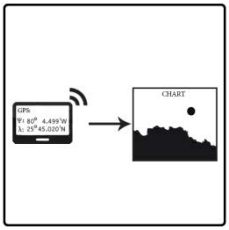
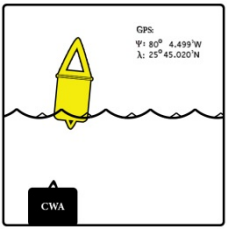
PROCEDURES IN CASE OF CHEMICAL AMMUNITION FISH



the equipment should be cut off as quickly as possible

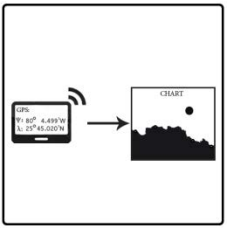


specify the position of dumping the equipment and write it down

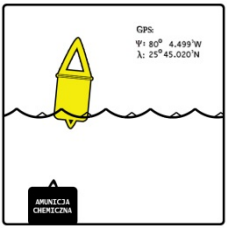


the place of dumping should be marked with a yellow buoy and reported

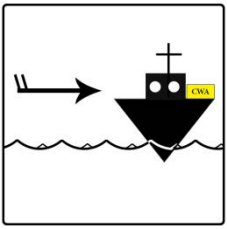
PROCEDURES IN CASE OF PICKING UP CHEMICAL AMMUNITION



specify the position of extraction and write it down



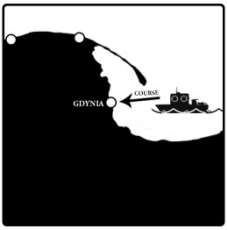
the place of extraction should be marked with a yellow buoy



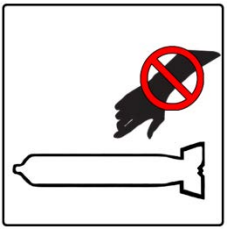
steer the vessel in such a way that contaminated places remain lee side

close all the openings and hatches

contact the nearest emergency point, giving the description of extracted objects



direct the vessel to the nearest port



do not touch the contaminated parts of the vessel nor the fishing equipment

take contaminated clothing off immediately and put it into plastic bags and secure it airtight

stay on the radio watch for further instructions

CHEMSEA CHEMICAL MUNITIONS SEARCH & ASSESSMENT

Baltic Sea Region Programme 2007-2013