Chemical Munitions in the Baltic Sea – the Lithuanian experience

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A side event at the OPCW 22nd session of the Conference of the States “Sea Dumped Chemical Weapons”
2017-11-29
After World War II

~40 vessels (170,000 t of chemical warfare) at the depth 200-700 m

35,000 t at the depth of 70-105 m

10,000 t at depth of 70-120 m

2 vessels with 69,000 tabun grenades at the depth 30 m (retrieved)

(gross tones, CW with shells)
National project 2002-2004

- October, 2002 (scanning of the dumpsite bottom)
- June, 2003 (CW dumpsite)
- August, 2004 (national monitoring stations)

Scientific research vessel “Vėjas”

Totally 39 objects: 13 bombs, 2 barrels
National project 2002-2004

Sampling stations in the Lithuanian economic zone (prefix ChG mark stations from the mission in June, 2003)
As concentrations in the surface sediments in the Southeastern Baltic

As range from 1.1 to 19.0 mg/kg
- 9.7 mg/kg at dumpsite
- 2.1 mg/kg in other samples
Conclusions (2002-2004)

- Water depth, north direction bottom water currents, bottom currents velocities and bottom relief prevent chemical munitions from reaching the Lithuanian coast.

- Studied parameters did not show any changes of the environment at the chemical munitions dumpsite.

- Higher As concentrations were found at the chemical munitions dumpsite, compared to other sites. However, As concentrations were low relative to other investigations.

- Chemical munitions - subject for future investigations.
Resolution adopted by the General Assembly

[on the report of the Second Committee (A/65/430 and Corr. 1)]

65/149. Cooperative measures to assess and increase awareness of environmental effects related to waste originating from chemical munitions dumped at sea

The General Assembly,

Recalling the recommendations of the United Nations Conference on the Human Environment, held in Stockholm in June 1972,¹


Recalling relevant international and regional instruments such as the United Nations Convention on the Law of the Sea,⁴ the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter,⁵ the Convention for the Protection of the Marine Environment of the North-East Atlantic,⁶ the Convention on the Protection of the Marine Environment of the Baltic Sea Area,⁷ the Convention for the Protection and Development of the Marine Environment of the
An independent **Scientific Advisory Board** on the chemical munitions dumped at seas has started its work in 2010 under the initiation of Lithuania.

Representatives and scientists from different environmental organizations from Australia, Belgium, Japan, USA, Canada, Poland, Lithuania, France, Russia and Sweden became members of the Scientific Advisory Board.
Sampling stations in 2013 and R/V “Vėjūnas” (EPA)
CHEMSEA project 2011-2014

1st class targets

2nd class targets

3rd class targets

5th class targets

Probable munition

Other strong echoes

Unrecognizable, in sediments or flat objects

Other echoes
Sediment sampling and detection of CWA with ChemPro100i detector in 2013
Macrozoobenthos organisms were found in all the studied stations except CHEMSEA5. During the research period 1981-1993, 10 macrozoobenthos species were found in 78-110 m depth. In 2013 only *Halicryptus spinulosus*, *Bilgydes sarsi* and Ostracoda were found in 18 samples.

Large heaps of damaged valves of *Macoma balthica* were found in 85 m (CHEMSEA3) depth, but no one was alive.
CHEMSEA project 2011-2014

Correlation between Fe and As in the Baltic Sea sediment

Legend
Arsenic concentrations, mg/kg
- <1.9
- 2.0 - 5.0
- 5.1 - 10.0
- 10.1 - 15.0
- 15.1 - 20.0

Gotland munitions dumpsite

ICP MS Agilent 7500, Nature Research Center

Residual arsenic normalized to iron

Arsenic concentrations (mg/kg dry weight) in the surface sediments of the Lithuanian economic zone
## Results

<table>
<thead>
<tr>
<th>Station</th>
<th>Hydrogen sulphide in near-bottom water, mg/l</th>
<th>Macrozoobenthos</th>
<th>Chem Pro100i detector</th>
<th>Arsenic, mg/kg</th>
<th>Residuals As/Fe</th>
<th>Clark I/II-related, µg/kg</th>
<th>TPA-related, µg/kg</th>
<th>PDCA-related, µg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>ChG1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>ChG2-1</td>
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<td></td>
<td>15.9</td>
<td>-1.0</td>
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<td></td>
<td></td>
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<tr>
<td>ChG2-2</td>
<td></td>
<td><strong>Blister</strong>*</td>
<td></td>
<td>14.2</td>
<td>1.7</td>
<td></td>
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<tr>
<td>ChG5</td>
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<td>not detected</td>
<td></td>
<td>7.2</td>
<td>-1.2</td>
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<td>66</td>
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<td></td>
<td>2.2</td>
<td>-</td>
<td></td>
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<tr>
<td>65</td>
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<td></td>
<td>3.5</td>
<td>-1.4</td>
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<td>CHEMSEA2</td>
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<td>not detected</td>
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<td>6.9</td>
<td>1.1</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>CHEMSEA1</td>
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<td>not detected</td>
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<td>4.2</td>
<td>-0.4</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>CHEMSEA4</td>
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<td>not detected</td>
<td></td>
<td>4.0</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEMSEA3</td>
<td><strong>0.01</strong> Large heaps of dead Macoma valves</td>
<td><strong>Chemical hazard</strong></td>
<td></td>
<td>9.8</td>
<td>0.6</td>
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<tr>
<td>CHEMSEA5</td>
<td><strong>No organisms found</strong></td>
<td>not detected</td>
<td></td>
<td>8.3</td>
<td>1.0</td>
<td>17</td>
<td>14</td>
<td>42</td>
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<td>CHEMSEA6</td>
<td></td>
<td>not detected</td>
<td></td>
<td>&lt;1.9</td>
<td>-0.1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Blister - sulphur mustard (HD), lewisite (L), nitrogen mustard (HN₃)

**Chemical hazard - generic alarm for chemicals in hazardous concentrations or chemical mixtures
Conclusions (2011-2014)

- Arsenic concentrations in sediments of the chemical munitions dumpsite (<1.9 to 15.9 mg/kg) are in line with the concentrations found during previous study of the dumpsite in 2003 (2.1 to 19.0 mg/kg).
- Number of the macrozoobenthos species has decreased notably (from 10 in 1981-1993 to 3 in 2013).
- Chemical warfare agents (Clark I/II-related; Triphenylarsine and PDCA-related) were found in sediments of station CHEMSEA5.
- Chemical munitions - subject for future investigations.
Towards the monitoring of dumped munitions threat - MODUM

The main aim of the project – establishment of the monitoring network observing CW dumpsites in the Baltic Sea, using Autonomous Underwater Vehicles (AUV’s) and Remotely Operated Underwater Vehicles (ROV’s).
Hull-mounted side scan sonar: Klein L-3 UUV - 3500

<table>
<thead>
<tr>
<th>Klein Features</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side Scan Sonar Dual frequency</td>
<td>455 kHz / 900 kHz</td>
</tr>
<tr>
<td>Optional Swath Bathymetry</td>
<td>455 kHz</td>
</tr>
<tr>
<td>Pulse Technology</td>
<td>Wideband FM Chirp (1,2,4, 8 msec)</td>
</tr>
<tr>
<td>Swath Range</td>
<td>350m @ 455 kHz / 150m @ 900 kHz</td>
</tr>
<tr>
<td>Side Scan Data Output</td>
<td>SDF or XTF</td>
</tr>
</tbody>
</table>

IVER-2 Autonomous Underwater Vehicle (AUV)

Performance:
- Maximum operation depth – up to 150 m
- 2-3 missions per day
- Average mission time – 2.5 h

Sensors:
- CTD/STD
- Sound speed
- pH
- Turbidity
- Chlorophyll
- Oxygen saturation
- REDOX
MODUM project 2013-2015

Chemical munition dumpsite survey
2014.09.01-03
Activities:
• SideScanSonar survey
• Sediment sampling

Chemical munition dumpsite survey
2015.09.03-05
Activities:
• AUV
• SideScanSonar
• Sediment sampling
MODUM project 2013-2015

Gotland Deep Baltic Sea in 2015 Autumn
Student's Post, on NATO Science for Peace and Security (SPS) Summer School on Sea Dumped Chemical Weapons, Canada

Published on September 14, 2016
Decision Aid for Marine Munitions
DAIMON: Methods

- Munition Status Examination
- Modelling of possible release
- Pollution of sediments and water
- Impact on biota assessment
- Risk categorization procedure
DAIMON project 2015-2019

Decision Support System / DSS

- Risk levels
- Binary or scale

- Explanation
- Knowledge based

- Weight – for overall risk
- Geographical extent

DSS beta version ready to test at the beginning of 2018 during workshops in LT, PL, FI and DE.
DAIMON (Decision Aid for Marine Munitions) is an international project consisting of partners from Poland, Germany, Sweden, Finland, Norway, Lithuania and Russia, and cooperating experts worldwide, united by the goal to solve the problem of underwater munitions. This project is part-financed by the EU INTERREG Baltic Sea Region Programme 2014-2020.

DAIMON newsletter:

1. May 2017
2. October 2017

Enter your Email •

Baltic Sea contains a dark legacy of ca. 30,000 tons of dumped chemical warfare agents (CWA) and more than 200,000 tons conventional munitions originating from the I and II WWs. In addition, ca. 45,000 tons of CWAs were dumped in Skagerak. There is a constant release of contaminants, either due to corrosion of the shells or due to anthropogenic disturbance.

The question which DAIMON takes up is how to proceed with the identified and mapped warfare objects. Remediation or no action are subject to heated disputes among the decision-making bodies. Since there cannot be a general answer to this question, DAIMON will develop tools to support the Baltic Sea Region governments and companies in case-to-case decision-making.

Newsletter #2

Are there chemical warfare agents in our fish?

As you could read in the previous DAIMON newsletter, our team discovered clark I and clark II earlier this year in fish from the Mødeakse area. Implying that residues of chemical weapons now are present in the Baltic ecosystem and possibly in our food.

This summer, VERIFIN laboratory analysis of 20 cod muscle samples collected from the Bornholm dumpsite during the R/V Walter Winchell III cruise in December 2016. Target chemicals were oxidation products of clark compounds, adamantane and triphenylamine. After extraction, purification and concentration steps samples were analysed by liquid chromatography-mass spectrometer method. Of the 20 samples two have contained oxidation product of triphenylamine and one contained oxidation form of clark I and/or II.

VERIFIN also received 20 hagfish samples collected from Skagerrak Wreck no.13 during the R/V IMOS cruise in June 2017 (read more below). By now half of the samples have been analysed using the same method and for some target chemicals as cod samples. All the analyzed hagfish samples have contained oxidation product of triphenylamine and four samples have contained oxidation form of clark I and/or II.

Concentration of those chemicals in all positive cod (from Bornholm Sea) and hagfish (from Skagerrak) samples ranged at no per gram level, which is just above measurable levels. These are indeed low levels, but these substances do not exist naturally and should not be present in fish and shellfish.
THANK YOU FOR YOUR ATTENTION!