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Prevention and Remediation Issues in Industrial Sectors

Remediation of Military Sites in Germany

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Major Training Areas In Germany

FRG total area: 137 800 sqm
37 683 qkm
83 Million people
Area FMoD: 1 350 sqm
3 497 qkm

31 Major Training Areas

610 000 acres /247 050 ha

German Forces 469 000 acres/
189 945 ha
Allied Forces 141 000 acres /
57 105 ha
Allied Forces 141,000 acres

Th. Strassburger, 2002

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German Ministry of Defense Site Remediation Program

Phase I Identification and initial assessment

Phase II Investigation and risk assessment
- -identification of contaminants
- -evaluation of distribution, concentration and mobility of contaminants

Phase III Remediation (decontamination or conservation)
- -remediation planning
- -remediation measures
- -remediation proof

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German Ministry of Defense Site Remediation Program

Status of Program 01.01.2005

Phase I:	387	sites to be assumed to be contaminated
Phase II:	1367	sites under investigation
Phase III:	111	remediation running

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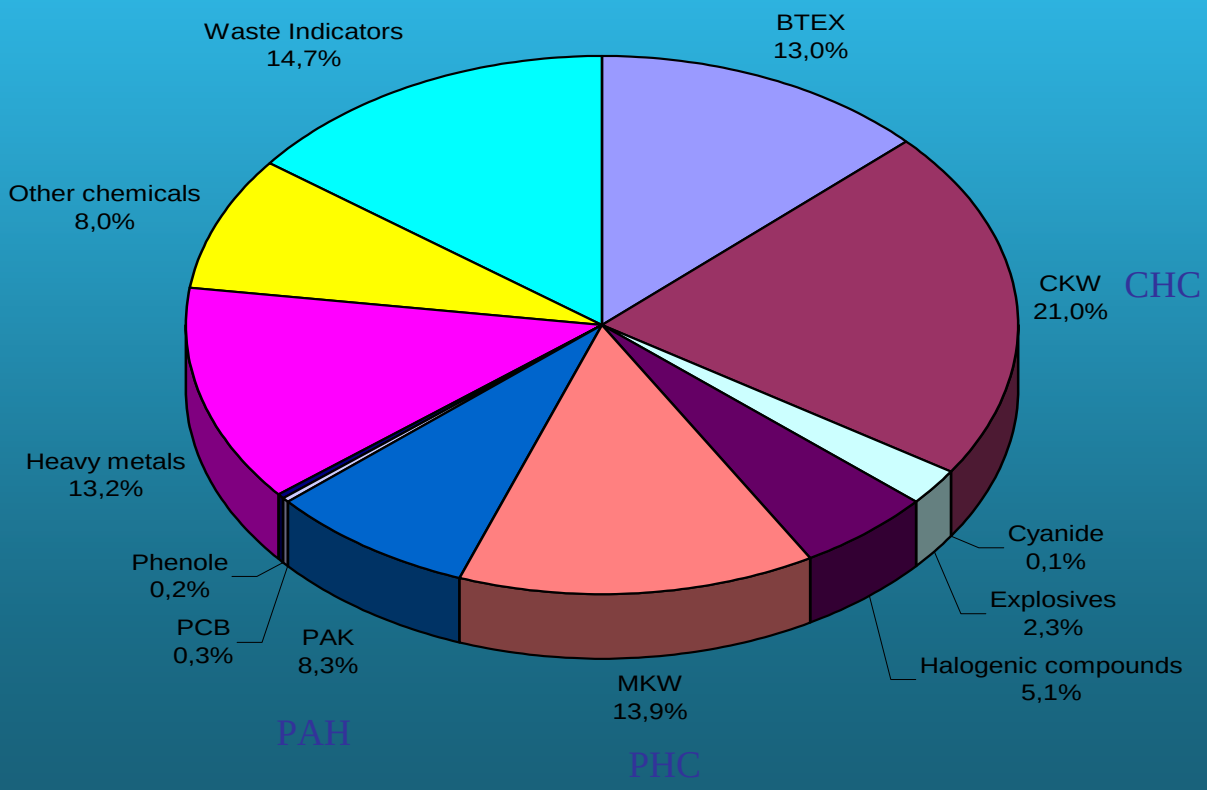
German Ministry of Defense Site Remediation Program

Altlastenprogramm Phase IIa

Relative Frequency of Contaminants



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Main Types of Contaminated Sites on Military Ground

Normal contaminations due to former workshops, tankstations etc.

-Restricted to small areas

Contaminations due to specifically military training activities

-Special training sites such as ordnance detonation areas, impact areas, firing ranges

-Heavy metals, explosives (and UXOs)

Contaminations due to areas of production of military device, ammunition, warefare agents, mainly of the time of World War I and II

-Severe contamination of greater areas

-Big amounts of toxic chemical compounds, partly in combination with ammunition and UXOs

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Contaminated Site of Roman Times at Mechernich

About 30 km west of Bonn the Romans mined lead out of galina leading sands.
The high concentration of lead in the soil prevented vegetative covers, so that creeks polluted the nearby pastures and other agricultural land.
Although mining was continued after World War II, the original pollution is of Roman time.
In the meanwhile remediation measures were performed, mainly by landcover and soil protecting vegetation.
Even military property is concerned.

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Example 1 of Major Contaminations on Military Ground

Brückberg Barracks

Former Prussian Firework Laboratories
From 1892 till 1918 production of fulminate of mercury (Hg(NOC)2)
Production of ignitors as well chemical compounds as metal device.
Mercury contamination in topsoil by fulminate production.
PAH contamination in soil and groundwater by th use of tar oils:
Tar oils were used for lubrication of steam engines and drilling processes. The oil was produced by destillation of coal tar and contained PAH. Dirty oil with drillings and swarf of metal treatment was poured into ponds, where the metal debris was sedimentated while the oil rised to the surface and could be recycled and be used again.
Conventional remediation (decontamination) would exceed the value of the property. Only securing measures have been performed.

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Example 2 of Major Contaminations on Military Ground

Training Area Stadtallendorf and Herrendorf Barracks

situated about 20 miles west of MTA Schwarzenborn, 517 ha = 1276 acres

influenced by

former explosives production factories

- WASAG (Westfalian Anhaltinian explosives joint-stock company)
- DAG (Dynamite Nobel joint-stock company)

1940 – 1945: production of navy explosives (WASAG) and TNT (DAG)

max. production rate of WASAG: 2500 tons/month

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Example 2 of Major Contaminations on Military Ground

Training Area Stadtallendorf

From 1938 till 1945 the training area was used as military airfield

March 24, 1945 bombing attack by US Air Force with 2396 bombs with a total weight of 131 tons, 25% as duds

1946: blowing-up of ammunition bunkers including ammunition

1945 –1958 sweeping (picking up ordnance) of the area and blowing up the assembled duds and UXOs in bomb craters, in all an amount of about 30 000 tons.
Furthermore deposition of TNT and RDX-sludges and attempts to burn them.

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Example 2 of Major Contaminations on Military Ground

Training Area Stadtallendorf

Contaminations and remediation measures

Military, municipial and private ground is affected by these former activities. Explosives can still be assembled on the ground, and there are severe regional groundwater contaminations.

Interception and cleaning of contaminated groundwater in the vicinty of water-extracting wells for the supply of the town of Stadtallendorf,
Ammuniton clearance and ongoing investigations

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Example 3 of Major Contaminations on Military Ground:

Major Training Area Munster North

Total area 10200 ha =25200 acres

History (1)

1893	Emperor William II decreed the establishment of the Munster Training Area
1914 f	Test and production installations for warfare agents type of ammunition used: organo-arsenic agents like Clark I, mustard gas etc.
1918 f	From the western front all chemical ammunition was sent to Munster Training Area. In October 1919 a train with 1 million chemical grenades and mines aboard exploded there and initiated further explosions of the depot.

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Example 3 of Major Contaminations on Military Ground

MTA Munster North - History (2)

1935-45 Mustard gas (S-Lost) loading depot ("smoke loading depot)
Research and test center for chemical and smoke agents
Pilot plant for the production of nerve agent (Sarin)
Test material, defective ammunition, and exploded ordnance was simply buried in the area

1945-48 After the war the British Forces blew up the buildings and bunkers together with the ammunition

1950-53 The state police of Hannover picked up all visible ordnance from the surface and buried it in the MTA Ehra-Lessien

1954 f "Detoxication Actions", that means further identification and decomposition of chemical ordnance, growing up of the WIS-office (Bundeswehr Research Institute for Protective Technologies and NBC-Protection)

MTA Munster N

Contaminations and remediation measures

- wide ranged organo-arsenics and arsenic in soil and groundwater
- tetrachlorethene in the groundwater of the southern part of the MTA
- still duds and UXOs in the area
- still restricted areas (entrance prohibited)

MTA Munster N

Contaminations and **Remediation Measures**

- Continuing groundwater-treatment
- Continuing surveying and clearancwe of UXOs and disposing
- Continuing local site remediation
- Looking for innovative remediation techniques in order to clean topsoil and reduce the hazard agent input into the groundwater

Remarks and Conclusions

At the time 38 contaminated sites are identified and will be further investigated and treated.

Although former attempts of phytoremediation with the plant species polygonum sachalinense failed, it should be tested whether other plants such as ferns could lead to more appropriate results.

In all MTA Munster has charcteristics of a megasite and will need a long time and much money to be once remediated.

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Example 3 of Major Contaminations on Military Ground

MTA Ehra-Lessien - Warfare Agent Pits

The state police of Hannover buried chemical grenades and other ordnance, which they picked up in Munster area and other places, into sand pits within the later impact area of the MTA Ehra Lessien. Later the pits were protected by concrete covers.
Although the groundwater was contaminated with As and the As plume extended far outside the training area, the only measure perfomed was monitoring.
In 1998 MOD ordered to excavate the contaminated soil and the chemical ordnance and to transport them back to the nowadays GEKA in Munster for decontamination of soils collected and decomposition of ordnance/agents in appropriate incinerators.
The work had to be done by own personal and equipment.
It was finished mid of 1999. During the remediation measures all training activities were stopped.

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Example 3 of Major Contaminations on Military Ground

MTA Ehra-Lessien - Warfare Agent Pits

Pit 1 was said to contain 1250 chemical grenades
It contained about 2000 grenades of 150 mm in diameter

Pit 2 contained a mixture of differnt grenades, chemical mines etc., in all 2840 objects, most of them without former documentation

Pit 3 contained a mixture of different ordnance and other military device, among those 6652 handgrenades and about 5000 different grenades

The following pictures will illustrate the work done

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MTA Ehra-Lessien

Building an access road to warfare agent pits

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MTA Ehra-Lessien

View to the concrete cover of the pits filled with chemical ordnance

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MTA Ehra-Lessien
Removing the concrete covers

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MTA Ehra-Lessien
Excavating works

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MTA Ehra-Lessien prepartion of the workstation for the fireworkers

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MTA Ehra-Lessien: 150mm Lost-grenades, pit 1

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MTA Ehra-Lessien: Extracting, cleaning and packing of warfare agent grenades

The grenade transporter, shown without escorting vehicles

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Prevention Measures against New Contaminations on Military Ground especially Training Areas

- education and training
- military equipment sustainable to the environment
- military installations sustainable to the environment
- facility and terrain management

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Prevention Measures against New Contaminations on Military Ground especially Training Areas

- Drawing up of basic geological and geographic information of terrain
- Assessment how the intended use of military equipment will affect the environment
- Assessment how the intended use of he terrain will affect the environment, especially soil , water and groundwater
- Planning and performing training activities on the basis of terrain of terrain information
- Planning and performing facility and terrain management measures respecting the above listed items

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Current Problems and Supposed Solutions

2 groups of hazardous substances are supposed to be polluted into the area by military activities:

- Heavy metals on firing ranges, impact areas etc.
- Explosives on ordnance detonation sites, impact areas

Recommended measures:

- Monitoring
- Immobilisation of heavy metals by increasing pH-value (liming) or by heavy metal accumulating plants
- Avoidance of infiltration of contaminated run-off water but assembling it for decomposition of explosives in constructed wetlands

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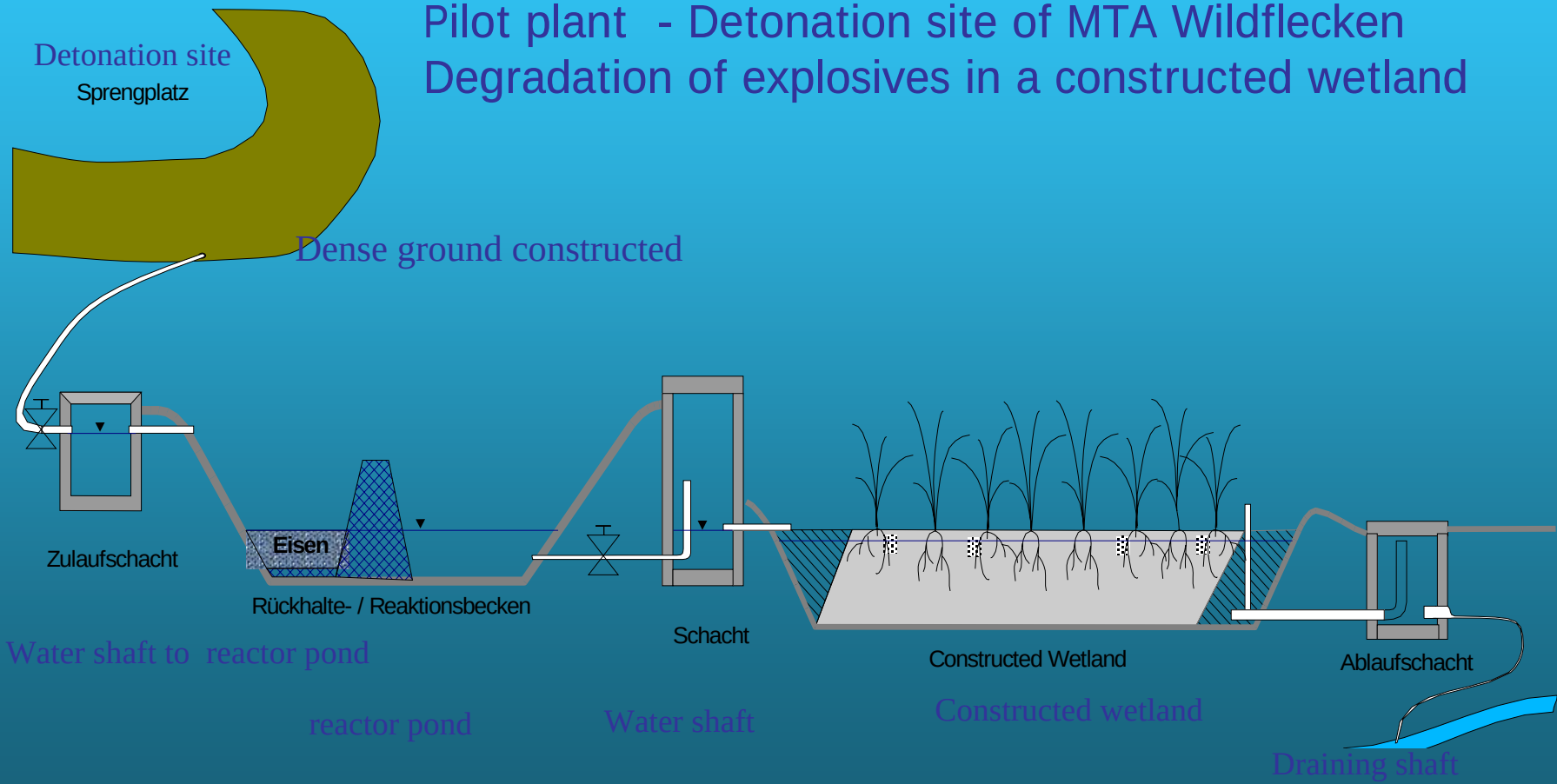
Current Problems and Supposed **Ways of Solutions**

Pilot plant - Detonation site of MTA Wildflecken
Degradation of explosives in a constructed wetland



Personal Remarks

Remediation processes on military used ground may take a long time but should be cheap and good. This cannot be achieved by conventional techniques, rather innovative techniques have to be found and applicated. First and foremost phytotechniques seem to promise best results in long term perspectives as well in remediation as in prevention of a wide range of various contaminations. Especially for the remediation of megasites it could be an real chance.
In that direction I will aim my future efforts.

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Thank you for listening!

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