Combined biological in-situ-remediation of CHC- and BTEX-contaminations at different areas of a contaminated site with one operation unit

IBL Umwelt- und Biotechnik GmbH

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Outlines

• Process of assignment
• Preliminary tests
• Remediation guarantee
• Remediation concept
• First results
**Process for assignment**

Department for Defense Charges (AVL) developed a proceeding for technical and financial realization of remediations at former military sites. AVL-proceeding. After return of the sites local authority of the county can apply for an AVL-proceeding. The authority is responsible for technical and financial realization. 90% of money is payed by german government, which passes to account for money assigned to NATO-troop-statutes, 10% of the costs are payed by the county.

- Call for bids
- Results of studies
- Order for remediation
- Order for preliminary studies
- Remediation guarantee for given remediation targets
- Control of success
Aerial view of the site

Former NATO-Airport in Baden-Württemberg, Germany
Site map

- Maintenance garages B102
- Gas station B90
- Dugout from world war I
- Kerosene discharging station
Contaminations at the site

CHC: main contamination at maintenance garage B102 & gas-station B90
BTEX: main contamination at kerosene discharging station
TPH: co-contaminant at kerosene discharging station
PAH: co-contaminant at kerosene discharging station
Remediation tasks

Excavation at 3 areas with sheet pile walls to 4,5 m depth
Total volume: 46,500 m³
Disposal at landfill site: 27,000 m³

Biological in-situ remediation to 15 m depth
Total area: 14,500 m²
Total volume: 203,000 m³
Remediation guarantee & target values

Remediation is accomplished if calculated target values in downstream monitoring wells are achieved.

Downstream target values:
20 µg/l BTEX, 10 µg/l CHC, 200 µg/l TPH, 0,2 µg/l PAH

Central immission target values (average concentration):
115 µg/l BTEX, 10 µg/l CHC, 1155 µg/l TPH, 1,45 µg/l PAH

IBL gave guarantee to meet the target values within 42 months.
General soil profile

Upper Rhenish low-lands

0,0 - 0,4 m: top soil

0,4 - 3,5 m: silt, fine-sandy

(3,5 - 4,5 m: fine-sand, silty)

4,5 - 25,0 m: gravel, sandy
Groundwater flow direction: NNW

$k_f$-value: $2,3 \times 10^{-3}$ m/s

Porosity: 15 – 20 %

Hydraulic gradient: 0.09%

Semi-confined aquifer
3D diagram at the surface of the gravel layer
Results of geological and hydrogeological studies

1. Higher depth of fine-sand/silt layer leads to deviation of ground-water flow in the north east corner of kerosene discharging station, no effect at gas station B90.

2. Groundwater sampling in different depths gave no indication for depth displacement of contaminants.

3. Very homogenous soil structure, high permeability and porosity with low groundwater gradient are given.

4. Conceptual site model and groundwater model with was developed.

5. Enlargement of contamination area was determined.
Combined degradation test for BTEX & CHC

Samples in test vessel & reserve vessel are incubated at constant temperature.

Aliquots are taken from the water phase at defined times removed volume is substituted by buffer-solution.

Red colour in waterphase is caused by resazurin to check oxygen concentration.
Combined degradation test

Degradation of contaminants during test

Addition of BTEX at \( t = 5 \) d
Results of biological studies

1. Kerosene discharging station:
BTEX degradation, BTEX-degraders at the border of the contamination, high toxicity in center & low number of degraders leads to inhibition of degradation

2. Gas station B 90:
transformation of CHC parent contaminants.

3. Maintenance garages B 102:
Degradation of added BTEX

4. Combined degradation of BTEX and CHC metabolites
Optimized remediation infrastructure

- Infiltration area
- Discharge water
- Infiltration- / Extraction wells
- Remediation plant
- Infiltration tube
- Hydraulic Safeguarding wells
Groundwater simulation

extraction 54 m³/h:
SB1, SB4, SB5 & SB7

Infiltration:
SB10, SB12, SB15 & southern infiltration tube

circulation each 4 m³/h:
SB10/SB20, B12/SB19, SB8/SB7, SB2/SB3

discharge 22 m³/h
Process flowsheet
## Total costs of remediation

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<tr>
<th>activity</th>
<th>price</th>
<th>difference</th>
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<td>Main offer</td>
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<td>Alternative offer (one operation unit)</td>
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<td>Alternative offer (all inclusive disposal)</td>
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<td>Additional waste volume</td>
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<tr>
<td>Total contract sum</td>
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</table>
Excavation 1

B90

B102

kds

Google Earth
Excavation 2
Construction works 1

Lösungen für die Zukunft
Construction works 2

Lösungen für die Zukunft
Remediation plant
Actual situation

1. Excavation accomplished (6 months longer, approx. 35% more contaminated soil for disposal)

2. Pilot phase successfully performed

3. CHC-contamination at kerosene discharging station from upstream contamination, no hydraulic barrier

4. Maximum concentrations in the center were reduced to approximately 10%-25% of total amount after excavation, in downstream wells concentrations have not changed
Project partners

- SHBA Freiburg: Technical authority
- AJAG (E): Money source
- Arcadis Consult: Coordination office

Client & Regulatory authority: Landratsamt Ortenaukreis

External control laboratory: Labor Vogt

Control office: Zink Ingenieure

Execution: IBL Umwelt und Biotechnik