
REMEDIATION OF THE CONTAMINATED SITE "OLI", BÜRSTADT, GERMANY

HIRSCHBERGER, Frank

HYDRODATA GmbH España
e-mail: hydrodata@arrakis.es
alc@iimac.es Web: www.HYDRODATA.de

PROJECT HIGHLIGHTS: Groundwater Treatment; Wet oxidation technology; UV-radiation; Hydrogen peroxide; Infiltration; Striping; Remote control system; Soil vapor extraction; Microbiological soil treatment

At a former metal-processing factory in Germany, significant concentrations of mineral oil hydrocarbons were found in the soil and volatile chlorinated hydrocarbons (CHC) were found in the soil vapor and in the groundwater. The primary CHC compounds were cis-1,2- Dichloroethene and vinyl chloride.

The site is located within a residential area. The generally sandy aquifer is confined with a thickness of approximately 70m. The affected soil consists of silty layers, which appear to have prevented the migration of mineral oil into the groundwater; however, it did not stop the chlorinated hydrocarbons from migrating into the aquifer.

Due to the significance of the environmental impact the site had to be remediated. After a detailed investigation and demolition of all buildings, various remediation techniques were applied to remediate the site for a future use. The remediation technologies applied during the project included: (1) soil vapor extraction, (2) excavation and microbiological on site treatment of contaminated soil, (3) groundwater extraction, (4) groundwater treatment with wet oxidation technology (UV-radiation and hydrogen peroxide), and (5) groundwater stripping.

The groundwater remediation plant is designed for a flow volume of 60 m³/h and is controlled and regulated via a remote control system. To date, more than 510 kg of contaminants have been removed from the groundwater. Concentrations of contaminants have been decreased from several thousand µg/l to approximately 250 µg/l.

1. HISTORICAL BACKGROUND

At a former metal-processing factory in Buerstadt, Germany having an area of 5,500 m², mineral oil hydrocarbons (DEC H18) were found in the soil (with concentrations of up to 23,000 mg/kg), and volatile chlorinated hydrocarbons (CHC) were found in the soil vapor (up to 1,400 mg/m³) and in the groundwater (up to 15,000 µg/l). The primary CHC compounds were cis-1,2- Dichloroethene and vinyl chloride.

Starting in 1952, cooking pots made of aluminum were produced at the site; initial production was stopped at the end of 1981. In 1982 the site was leased to two other companies, which continued the production of cooking pots. Both companies stopped production in the beginning of 1987 and in mid 1989, respectively. The owner of the site is undergoing the process of insolvency.

As part of the production process cutting fluid and hydraulic oil (mineral oil hydrocarbons), as well as solvents (chlorinated hydrocarbons), were introduced into the ground. During the period of production the neighboring residents made several complaints about noise, odor, and dust nuisance.

2. INITIAL INVESTIGATION

Since 1988, at the initiation of the authorities, several investigations of soil, soil vapor and groundwater have been conducted on the factory site and the surrounding area. Groundwater wells with depth up to 42 m, as well as several sondier borings for the soil and soil vapor sampling, were installed.

Regarding the CHC-contamination, two entry points could be located. The CHC had already reached the groundwater in high concentrations and had contaminated the approximately 70 m thick, highly permeable aquifer with concentrations up to 15.000 µg/l. In the ground, parts of the contaminants were transformed into the highly toxic vinyl chloride. A contamination plume of CHC developed in the aquifer, according to the groundwater flow direction. The mineral oil hydrocarbons (up to 23 g/kg) were introduced in the ground at different locations of the former factory site. They were nearly completely absorbed in a silt-clay-layer, which is located directly under the factory site. Therefore a marked entry of hydrocarbons in the groundwater did not take place.

3. REMEDIATION CONCEPT

The remediation is being carried out under the responsibility of the "Altlastensanierungsgesellschaft" as part of the "Hessische Industriemüll GmbH". This organization generally oversees the investigation and remediation of sites that cause a significant environmental risk and do not have an owner, or belong to owners that are not able to pay the necessary project costs due to bankruptcy.

HYDRODATA GmbH was contracted to develop a remediation concept for the OLI-site.

Site conditions were found to be difficult with regard to implementing a remediation strategy. The site is located within a residential area, the thickness of the aquifer is 70 m, and directly under the site, the aquifer is confined under a silt lens. The silt lens prevented the migration of mineral oil into the groundwater; however, it did not stop the chlorinated hydrocarbons from migrating into the aquifer.

During the initial investigation work, severe contamination of the soil vapor and the ground water with vinyl chloride was identified. The remediation concept was subdivided in several steps to allow an immediate start of the process.



Groundwater Remediation Plant

In accordance with the responsible authorities (local government, water board, etc.) it was agreed to immediately initiate the remediation through the installation of a soil vapor extraction system and demolishing the existing buildings. Starting in 1992, the buildings were demolished and the debris has been recycled or disposed of. At the same time, soil vapor was extracted and cleaned.

The final concept regarding the remediation of the affected soil was presented to the authorities in 1992. The several remediation alternatives that were presented included:

- microbiological treatment
- disposal
- washing

In conclusion, a microbiological on-site-remediation was to be carried out. Because of the soil matrix, the soil washing was not possible due to technical reasons (high share of clay/silt), and the disposal option was rejected because of the landfill area limitation, according to the regulations of the state Hessen.

4. REMEDIATION GOALS

The remediation goals were set to:

Soil	500 mg/kg (mineral oil hydrocarbons (DEC H18))
Groundwater	0,025 mg/l (CHC total), 0,003 mg/l (Vinyl chloride)

Related to the soil remediation, it was agreed, that in exceptional cases a value of 1.000 mg/kg could be accepted if it could be proved that the microbiologically non-degradable hydrocarbons will not cause any environmental risk.

With a notice dated April 1999, the remediation goal for groundwater was lowered to 0,010 mg/l (CHC total).



Maintenance of an UV-radiation lamp

5. REMEDIATION

Soil vapor extraction started in October 1991; the buildings were demolished between January and April 1992. The resulting debris has been recycled or disposed of.

Subsequently, the contaminated soil was removed. A large portion of this activity was performed using a special drilling technique where the content of the drilling core is replaced by clean soil. The use of this technique prevented the confined groundwater from entering the excavation pit. In total between October 1992 and May 1993, 4,752 m³ of contaminated soil was removed and 831 drillings for soil replacement were performed. The contaminated material was moved into the remediation tents and microbiologically treated on site.



Groundwater Remediation Unit (in wintertime)

At the suggestion of the authorities, analysis were performed to determine, if other cost efficient alternatives for the on-site-remediation exist, because since the permission of the remediation the official guide values were changed, and with this alternative ways of the recycling of the contaminated soil were possible. The soil was therefore reused and the construction site could be cleared in July 1995 (except the units for the groundwater remediation).

The contaminated water continues to be pumped and treated in a remediation plant (combination of deferrization, wet oxidation, and stripping) that was put into permanent operation in 1995. Using UV-radiation and hydrogen peroxide, the CHCs are degraded to the greatest extend possible and vinyl chloride is eliminated completely. In the subsequent stripping tower, the remaining contaminants are removed. The selected process combination resulted in substantially reduced operational costs. The plant is designed for a flow volume of 60 m³/h. The cleaned water is re-infiltrated into the ground. All essential process data are transferred to the HYDRODATA office (Oberursel, closed to Frankfurt/Main) via a remote system that allows control of the entire unit.

The operation of the groundwater remediation plant for several years shows steady cleaning results with significantly decreasing contaminant concentrations in the groundwater. The monitoring program was significantly reduced since 1996.

At the end of 1999, additional optimization tests for the reduction of the operational costs of the plant were carried out. As a result of these tests, the pump capacity and the number

of the used UV-tubes could be reduced, which resulted in a reduction of the energy consumption. Since April 2000, groundwater is only taken from one conveying well with a pump capacity of approximately 12 m³/h.

To date, more than 510 kg of contaminants have been removed from the groundwater and concentrations of contaminants have decreased from several thousand µg/l to approximately 250 µg/l.