

Brownfield Remediation in Hamburg – Three Examples

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In Hamburg the Division for Remediation of the State Ministry of Urban Development and Environment is responsible for the clean up of those contaminated sites which are owned by the City of Hamburg. Since 1986 more than 100 sites have been remediated. During the last years for this purpose a budget of around 15 million EUR per year has been allocated from the city parliament. The staff of the Division for Remediation has more than 30 persons, they are civil- and process engineers, geoscientists or chemists and administrative officers. They are experienced in the remediation of contaminated sites like hazardous waste disposal sites and residential areas. 27 process engineering plants all over Hamburg are used to clean contaminated groundwater or soil air. During the last 15 years more than 30 brownfield projects have been finished.

Decontamination and Containment

There are two basic remediation strategies to eliminate hazards: The decontamination and the containment. When the “decontamination” approach is realized, the hazardous waste or the contaminated soil is being excavated and treated, e.g. by incineration or microbiological treatment. Afterwards the ground is clean and the hazardous compounds are destroyed. In addition it might be necessary to clean the groundwater.

The “containment” approach means the encapsulation of the hazardous waste. By that the pathways out of the contamination are interrupted, they don't threaten the subjects of protection anymore, like groundwater, soil including plants and the air. So the environmental risks are minimized. The surface of the contaminated site is sealed or covered to keep the materials inside and to prevent the intrusion of rain water and the solution or washing out of pollutants. Usually materials like plastic liner sheets or mineral liners are used to set up the cap. Contaminations in the deeper subsoil are enclosed by a wall (often a sheet pile wall or a slurry trench wall) to interrupt the horizontal pathway out of the contamination into the groundwater. If the groundwater is already contaminated, it has to be treated by a water purification cleaning facility.

Containment is used for large contaminated sites, for example old landfills with million tons of dumped waste. Often it is too expensive to decontaminate these areas or there are no technical methods or capacities to treat those large volumes. It has to be taken into account that a containment is a building and aftercare is necessary, since the cap and/or the wall must be observed and reconstructed sometimes. This is associated with additional costs. Therefore a containment is often a “never ending story”.

Case 1: Decontamination of a Gasworks

In the past in Hamburg many districts had their own gasworks. Often they were built in the second part of the 19th century and they were run up to 1960 or 1970. Usually they worked according to the same plan:

- Coal was heated at a temperature of more than 1000 °C to produce coke for the steel industry. This was called carbonisation.
- The heating process yielded a raw gas, which was a by-product.
- During the cooling of the gas tar was intercepted.
- This tar yielded thousands of organic chemical compounds.
- After cooling the gas was purified. This generated by-products like ammonium sulfate as a mineral fertilizer, sulfuric acid and benzene which were sold. Often this part of the plant is called the “Chemistry Area”, because here the highest contamination in the soil is expected.
- The refined gas was used as so called “town gas” for the illumination of the streets.

All these chemicals contaminated the site. After closing the gasworks were demolished, but only above the surface. Below surface constructions like caverns, pits or pipelines filled with hazardous waste are still there. Therefore it is important to know, how the specific site of a gasworks area was used. So, before starting a campaign to investigate the subterranean conditions, a historical research is necessary to get information about the location of e.g. the coal depots, the ovens and the caverns filled with tar oil. In particular we get these information from old approval documents.

For the gasworks in Hamburg-Bahrenfeld near Altona, which covers an area of 9 hectares and where some buildings are still existing, the historical research and the subsequent investigation resulted two sub-areas which had to be cleaned up. One of them was a – so called – “hot spot”, in this case a local benzene contamination down to a depth of 12 m which was excavated. For the protection of the pit a bored pile wall was built.

Moreover subterranean caverns filled with tar oils were found. To treat this material, the oils were mixed with shavings from saw mills as an oil adsorbing material and incinerated at a high temperature incineration plant. 45,000 tons of contaminated soil (and rubble) were thermally treated, more than 12,000 m³ were dumped and 1640 m³ of tar oils were incinerated. The remediation costs were around 5 million EUR. On the cleaned area new apartment buildings were built while the old buildings of the gasworks were cleaned and conserved. The former coal depot has now become a hotel, its name is “guestworks”.



Case 2: Decontamination of a Shipyard

The Stülken shipyard was built in 1845, destroyed in 1943 during the war and then rebuilt. After the demolition of the buildings in 1988 the area of 12 hectares was investigated. Only in a part of 1.2 hectares high concentrations of hydrocarbons from mineral oil were found (16,000 mg/kg) down to a depth of 5 m.

Approximately 60,000 m³ contaminated soil were excavated and decontaminated or dumped: Around 18,000 m³ were treated by soil washing, the recycled sand was refilled. The contaminated sludge from the soil washing was incinerated. A volume of 9000 m³ was cleaned by microbiological treatment. 3000 m³ contaminated water out of the excavation pit was treated in a water purification facility.

The neighbourhood of the river Elbe with its tide required special precautions concerning excavation activities. The excavation could be done only at low tide periods and during summer season (from May to October 1990) in order to minimize the risk of flood damages or a hydraulic base failure. The remediation costs amounted to 9.1 million EUR. Today a musical theatre is located on the area vis-à-vis to the Landungsbrücken landing stage.



Case 3: Containment of an old Waste Disposal Site

At the Neuhöfer Straße near to the harbour an old waste disposal site was filled with municipal and hazardous waste especially from the petroleum industry between 1930 and 1964. Heavy metals, hydrocarbons and chlorinated hydrocarbons were being detected. The size of the area is 7.4 hectares. The dumped materials have a volume of 450,000 m³ down to a depth of 7 m below surface. At the bottom of the waste a natural soft layer stratum of clay is existing. Its thickness is between 2.5 m and 8 m. Therefore it forms an effective barrier against contaminant transport.

Because of its dimension it would have been too expensive to excavate the whole dumping site and to decontaminate the hazardous waste. Therefore it was remediated by containment: At first the area was enclosed by a sheet pile wall which was rammed into the soil to interrupt the horizontal contaminant flow into the groundwater

or into the harbour surface water nearby. Then the surface was sealed to prevent the intrusion of rain and water from snow melt. Methane emerging from the municipal waste is discharged by gas wells.

The surface sealing has been constructed as a trafficable asphalt layer system in order to use the site as a container storage area. The site is also crossed by rails. The construction of a trafficable asphalt sealing system is more expensive than that of a "green" cover system. But this solution was chosen, because Hamburg needed a container storage area. Shortly after completion of the site encapsulation, the area has been rented out to a container company, and so the City of Hamburg gets back at least a portion of the remediation costs (6.8 million EUR).



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