CASE STUDY

AIR SPARGING TO REMEDIATE DISSOLVED PHASE BENZENE AT A FORMER GASWORKS AND NAPHTHA CRUDE OIL GASIFICATION SITE

Introduction

In 1999, RSK's remediation contracting arm RemedX was commissioned by SecondSite Properties (now part of National Grid) to clean up a five-hectare site in Croydon that previously contained gasworks and naphtha crude oil gasification plants. The project is notable for the fact that RemedX designed and installed arguably the UK's largest ever air-sparging system, which was combined with soil vapour extraction (SVE).

Site description

The site's geological sequence was made ground over terrace gravels, which were situated above Thanet Sands underlain by the Upper Chalk. The fill material generally comprised sand, gravel and clay intermixed with varying quantities of waste items, most commonly concrete, brick rubble, clinker and ash. The Terrace Gravels were variable, with clay, silt, sand and gravel strata found to be highly permeable and in irregular succession. The Thanet Sands were of moderate to low permeability. The Upper Chalk is a major aquifer and was in hydraulic connectivity with the overlying Thanet Sands.

Site investigation results confirmed two principal areas of significant benzene, toluene, ethylbenzene and xylene (BTEX) contamination, with impact to both the shallow ground/soil and groundwater. Concentrations of BTEX were up to 70,000 µg/l within the shallow groundwater present in the Terrace Gravels. There was also evidence of some polycyclic aromatic hydrocarbon contamination, and light non-aqueous phase liquid (LNAPL) was identified in one isolated area.

Early remedial works

The first stage of the remedial works entailed excavating and removing the underground structures of the naphtha gasification plant, which included underground storage tanks and areas of gross contamination within shallow soils at depths of up to 4 m. The next step was to break out and remove all underground obstructions, mainly concrete mass. All material during this stage was sent to landfill.

Pilot trials

Based on extensive pilot tests, RemedX concluded that air sparging combined with SVE would be the most efficient means to remediate the site. The bespoke system, optimised for the site's ground conditions, included the following features:

- 171 sparge wells installed to a maximum depth of 10 m below ground level (bgl) with a spacing of 11m
- 84 SVE 50-mm wells installed to a maximum depth of 3 m bgl
- 20 SVE 100-mm wells installed to a maximum depth of 10 m bgl.

These wells were installed within the centre of the treatment areas and used to abstract the initial high concentrations of methane within the more contaminated zones. The wells were constructed in such a way that a vacuum could still be produced in the vadose zone. Furthermore, as the wells were also screened below the water table, they could also be utilised for pumping fluids if required. The area where LNAPL was identified was isolated from the sparging system until it was removed by other methods.

Concerns with fugitive soil vapour emissions

During pilot trials, a large body of dissolved methane was discovered in the groundwater. This presented a risk of explosions during the initial operational phase of the remediation system. As the explosiveness of methane was only an issue when the wells were brought on line, the switch-on took place in a phased manner, with each well individually purged before moving on to the next. In addition, real-time methane detectors that would shut down the system if levels became too high were installed within the pipework.

Stakeholder consultation

To ensure the remediation programme conformed to stringent regulatory requirements, RemedX engaged the Environment Agency (EA) from the outset until project closure. Unusually within the remediation industry at the time, monthly meetings were held, often with the EA in attendance, to give a comprehensive overview of progress against defined targets and to encourage discussion on issues of concern.

Additional site input

RemedX conducted full-scale pumping tests to assess regional aquifer properties and confirmed that there were no further contamination issues at the site. Towards the end of the project, the team managed the abandonment of two 100-m-deep extraction wells to Environment Agency standards.

Conclusion/outcome

The remediation system operated for a period of eight months in which the objective of 80% reduction in groundwater of dissolved phase concentrations of benzene and petroleum hydrocarbons was achieved to the agreed timescale, together with an asymptotic cumulative total contaminant mass removal/destruction estimate.

For further information, please contact:

RSK: The Old School · Stillhouse Lane · Bedminster · Bristol · BS3 4EB · UK
Tel: +44 (0)117 947 1007 · Contact: Simon Jackman · Email: sjackman@rsk.co.uk