CASE STUDY

BIOREMEDIATION OF A FORMER MANUFACTURING FACILITY, MOSTON, GREATER MANCHESTER

Project description

In April 2001, RSK was commissioned by Jones Homes Limited to investigate and subsequently remediate a former manufacturing facility, ahead of the construction of a residential housing development. The site was used for numerous manufacturing purposes from the 1930s until it ceased operating in the 1980s.

The surrounding area consisted primarily of residential houses and was bounded to the south-east by a railway line located at the base of a steep slope.

Site investigation

RSK carried out several site investigations over a three-year period – including one when the site was operational – to assess the extent of the contamination. As a result, a number of areas of potential concern (APC) requiring remediation were identified.

In particular, the following contaminants were noted:

- maximum toluene concentration of 11 mg/kg
- maximum total petroleum hydrocarbon concentrations of greater than 23,000 mg/kg.

Development of remediation strategy

Following a detailed review of practical remedial options, it was concluded that the impacted materials could be treated with ex situ bioremediation. Having decided on what course of action to take, RSK authored a method statement that detailed site-specific clean-up target levels, the remediation method and the validation measures required, which was approved by the local authority environmental health department and the National House-Building Council. Significantly, RSK was able to gain approval for reuse of remediated materials on site before this became a widely accepted approach.

Implementation of remediation strategy

APC removal

All APCs were excavated under the supervision of an RSK environmental supervisor (ES), who was responsible for inspection, record keeping and validation. Classification of 'contaminated' material was based on visual and olfactory evidence, supported by on-site and laboratory testing. Any excavated material that was considered inert was stockpiled separately. Contaminated material was stockpiled for subsequent screening and bioremediation. As some hydrocarbons (and soil types) respond better to bioremediation than others, the material was segregated accordingly.

Once the ES concluded that all contaminated materials had been removed from the excavations, validation samples were recovered from the side walls and the base of the excavations, a selection of which were submitted for laboratory analyses. The stockpiled material assessed as uncontaminated was either returned to the excavation as clean fill material following validation or retained for reuse elsewhere on the site.

Bench-scale testing

A bench-scale microcosm test was undertaken to determine the following parameters:

- optimised aerobic biodegradation rates
- achievable bioremediation goals for specific contaminants
- nutrient addition requirements.

The completion of successful microcosm testing gave all parties confidence in the remedial technique and helped define treatment schedules.

Bioremediation

In August 2003, RSK designed and implemented the bioremediation strategy, with supervision undertaken by our Geosciences team. The following tasks were undertaken.

- Soil receiving – soil was delivered to the screening area at a rate of 65 m^3/hr.
- Screening – all soils were homogenised by a segregating bucket mounted on a 21-tonne crawler excavator. Screening was at the 40-mm-size fraction. All oversized material was stockpiled separately and assessed for contamination.
- Preparation of windrow mat – a flattened rectangular treatment area covering less than one hectare was prepared on site. This area was covered by a 300-mm thickness of clay to act as an impermeable membrane to catch any run-off from the contaminated windrows that were to be placed on the area. This 'bio-mat' sloped downwards towards its centre and also towards the north-west, where a sump was constructed. The sump was excavated to collect any surface water run-off from the bio-mat.
- Windrow formation and handling – these were set out initially by usual surveying techniques on the 'bio-mat'. The sub-40-mm soil was loaded directly into wheeled dump trucks for formation of soil windrows. The rate of windrow formation was designed to match the screening and homogenising output of 65 m^3 per hour. The windrows were profiled by a crawler excavator and, once formed, covered with composting fleeces to allow the air to circulate while preventing the ingress of rainwater.

- Aeration of windrow – the windrows were turned periodically using a bespoke windrow turning machine to aerate the soils and promote aerobic bacterial activity. This operation first required a machine to remove the fleece covering each windrow. The turner then passed over the windrow completely turning the exposed soils and re-forming the triangular cross section of the windrow. The fleece cover was then replaced and the subsequent windrow similarly treated.
- Monitoring – as the works progressed, RSK carried out regular (at least weekly) monitoring of the soil vapour (air trapped between the soil particles) in the centre of the windrow for carbon dioxide and oxygen. Temperature in this central portion was also monitored. This was done to ensure conditions were suitable for the promotion of aerobic bacterial activity and was used as a guide to turning frequency.

Final validation

In the final stages of the remediation process, RSK recovered composite soil samples from each of the windrows and submitted them for speciated hydrocarbon analyses. The results indicated that the established target values for the individual carbon ranges had not been exceeded and, following approval from the local authority environmental health officer, the windrows were deemed to be suitable for on-site use.

Added value

- 4800 m^3 of hydrocarbon-impacted material was successfully treated on site.
- Site-specific target levels were achieved.
- RSK's strategy of reusing material on site was significantly cheaper than landfill disposal.
- Reuse of materials on site resulted in lower carbon footprint and less disturbance to local residents, as lorry movements were kept to a minimum.
- RSK's strategy of preparing the treatment area in a distant part of the site caused minimum disturbance to local residents.
- Reusing the material on site resulted in cost savings from not needing to import material.

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