

TDP 1 - Remediation Trial Using Low Temperature Thermal Desorption to Treat Hydrocarbon Contaminated Soil

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Purpose & Objectives

This project report describes the successful pilot trial of low temperature thermal desorption (LTTD) technology as part of a process to assess the feasibility of full scale LTTD cleanup of contaminated soil at a chemical works.

Approximately 38 tonnes of soil contaminated with petroleum hydrocarbons was treated by the "Thermal Soil Remediation Unit" (SRU), owned and operated by BAE Systems Property and Environmental Services (BAE).

The purpose of this report is to describe the site conditions, provide an objective assessment of the performance of the SRU technology under pilot trial conditions, and extrapolate costs to full cleanup of the site. Specific objectives are to:

- Describe the site characteristics including ground conditions and the nature and distribution of contaminants
- Describe the design and operation of the BAE SRU trial
- Assess the technical and economic performance of the SRU

Background

The chemical works is located on 130 hectares of reclaimed sand dunes and has been in operation since the early 1960s.

The area of site that is the subject of this report is the Tank Farm Area (tank farm). This area, which has stored a variety of hydrocarbons during its service life was decommissioned in 1999 and is awaiting demolition and removal.

During the extended period of operation, product spillage and tank leakage occurred, leading to severe contamination of the subsurface soil and groundwater.



BAE Systems facility in Chorley, Lancashire.

During the period 1993 to 1999, the site owner commissioned several environmental investigations of the whole chemical works site as part of its corporate due diligence programme. Phased ground investigations were carried out to investigate the extent of contamination and to obtain supporting geological and hydrogeological data on the area. Subsequent borehole sampling provided information on the nature and extent of contamination by hydrocarbons.

Following closure of the production plant in 1999 a more detailed investigation was undertaken to characterise contamination in the tank farm and to assess remedial options. This process led to the selection and evaluation of LTTD.

A pilot to assess LTTD was carried out at BAE Systems facility in Chorley, Lancashire with the full cooperation of the regulator, the Environment Agency, which was provided with data and appraised of decisions at each stage of the process.

Conclusions

1. Cost-benefit analysis on a range of remedial options carried out at the site showed that based on site investigation work, LTTD technology was worth assessing on a pilot trial basis.

Snapshot

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Close up of the thermal soil remediation unit.

2. LTTD technology successfully treated more than 85 tonnes of contaminated sand during a field trial at the BAE site. The results showed that sand containing an optimum contamination level of 2% can be satisfactorily treated to below Site Trigger Levels at a feedrate of 16 tonne/hour with stack emissions being maintained at below authorisation limits.

3. Desorption temperatures of 300°C to 350°C should be maintained with the SRU to ensure that residual aromatic levels in treated sand are kept within the specification limits.

4. The site comprised sandy soil with an inherent relatively low water content, which did little to reduce the efficiency of the thermal process. Based on experience from other sites, it is expected that moisture levels in excess of 12% would reduce the material throughput rate by approximately one tonne per hour for each additional 1% of moisture content.

5. The safety of personnel carrying out the remediation is a major consideration, and occupational hygiene considerations for the full scale remedial operation are not trivial. During the trial, atmospheric and personal exposure levels were kept within acceptable limits. Airborne aromatic concentrations were found to diminish significantly at a distance of ten metres from the contamination source. During excavation work, atmospheric aromatic

concentrations at the site limits were significantly lower than the Annual Air Quality Standards. The minimum personal protective equipment required when working within close proximity of the contaminated material is a 3M 4251 organic vapour mask with an A2P3 filter.

6. The ground contamination was shallow. Contamination observed in the area of the excavation used to obtain contaminated sand for the trial extended from immediately beneath the surface to the water table, a depth of 1.5 m to 2 m.

7. Free phase aromatics remaining in the ground beyond the excavation will drain into the excavation. This process is expected to be slow. Additional pits covering extensive areas will be required to recover the aromatics in the summer time window appropriate for this operation (i.e. low water table).

8. The air operated pumping system and tank used to store and separate the aqueous phase hydrocarbons recovered from the pit proved to be satisfactory.

9. The 96,000 tonnes estimated for remediation is a best estimate using current information, there is a contingency allowance for contamination extending beyond the defined boundaries. The remediation programme will require 83 weeks continuous operation to treat the estimated volume of material in the defined area.

10. The remediation of the area in a one stage process allowing reuse of the soil will carry significant cost benefits.

Lessons Learned

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1. Technology field trials provide greater clarity for associated issues such as material handling and throughput, technology limitations, licensing, planning needs, health and safety, and full scale costs.
2. Early involvement of the regulator is beneficial to identify and address issues at an early stage. Reaching agreement on ground cleanup specifications and the methodology to be employed is crucial. A team to manage and progress the remediation project should communicate information to the regulator at every stage. Unnecessary delays due to poor communication can be expensive.
3. Significant contaminant losses can occur even before treatment through volatilisation during material handling activities such as excavation, sorting, stockpiling and moving. This should be taken into account during planning the trial or full scale cleanup, and every attempt should be made to minimise the handling and disturbance of contaminated material.
4. Occupational hygiene considerations for the full scale remedial operation are not trivial and should be considered carefully. The working conditions involving hand digging at the site should be avoided if at all possible and should only be allowed if alternative means cannot be used.
5. Analytical techniques for determining the concentration of aromatic compounds through (i) rapid field techniques and (ii) precise laboratory determination would be beneficial both for site characterisation and assessing remedial options.