Soil Mix Remediation Technology (SMiRT)

Introductory Factsheet

Environmental

Knowledge Transfer Network

CL:AIRE

Prepared as part of the Dissemination package for the Technology Strategy Board's Collaborative R&D Programme on Contaminated Land Remediation Technologies

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The Problem: Sustainable Contaminated Land Remediation

The UK has a substantial legacy of chemical contaminants in soil. Sometimes the contaminants may be present naturally, but often they result from human industrial and domestic pollution. In most cases, levels of contaminants are sufficiently low that there is no appreciable risk. Sometimes however, there can be significant risks to people or the environment. When such risks exist, that land is considered to be 'contaminated land'[1].

Traditionally, the management of contaminated soils has centred on their disposal to landfill in what is termed a 'dig and dump' approach. Concerns regarding the environmental sustainability of this approach, coupled with the rising price of landfilling hazardous material such as contaminated soils has however meant that dig and dump is not as attractive as it once was. Innovative and more sustainable options for contaminated land remediation have therefore been the subject of much ongoing research and development.

The 'In-Situ' Option

Amongst the options available to increase the sustainability of contaminated land remediation is In-Situ Land Remediation (ISLR).

ISLR can be defined as the treatment of soil or groundwater in place without being brought to the surface. This form of land remediation can also include techniques which selectively remove the contamination from the soil or groundwater in order to allow capture or destruction at the surface (e.g. soil vapour extraction)[2].

By treating soils 'in-situ', significant cost and carbon savings can be made by reducing the volume of contaminated soils disposed to landfill. Some of the less aggressive ISLR techniques such as in-situ bioremediation and stabilisation/solidification can also reduce the overall energy input required to remediate contaminated land and hence improve the sustainability of the remedial option.

The Scale of the Problem

The Environment Agency has estimated that 300,000 hectares of land at over 325,000 sites in England and Wales are contaminated with a variety of pollutants.

Soil Treatment for Grape Storage Facility, France

On average 250 new sites have been classified as contaminated each year since 2000[3].

Various estimates of the contaminated land market size[4,5] indicate that remediation of these contaminated sites costs in the region of £506-578M per annum. This figure has the potential to increase significantly (between 5-7% p.a.[5]) with the onset of the various legislative drivers highlighted in Box 1, as well as the growing land-use pressures that have placed a focus on 'brownfield' redevelopment.

Box 1: Key Legislative Drivers of the UK Contaminated Land Market

- **UK Planning Law and Part 2A of the Environmental Protection Act (EPA) 1990**

The UK Town and Country Planning system ensures that when land is developed or redeveloped, any potential risks associated with contamination are properly identified and remediated. Part 2A of the EPA similarly provides a framework for the identification of contaminated land, but is principally employed in circumstances where there has not been any identifiable breach of a pollution prevention regime. However, whilst Part 2A focuses on risks relating to site's current use, the planning regime is more wide-ranging and requires consideration of risks associated with the potential end-use of the site[2,6].

- **European Directives for Environmental Protection**

A number of European Directives set up to protect the wider natural environment, such as the Water Framework Directive, the Landfill Directive and the Soil Framework Directive also have implications for the land remediation market. Various requirements of the Landfill Directive for example have raised the cost of disposing contaminated land to landfill increasing the incentive to apply more sustainable remedial options[2].

The Project: Soil Mix Remediation Technology (SMiRT)

Project SMiRT is the largest of the ten projects that received funding from the Technology Strategy Board (then the Department for Trade and Industry) under its Autumn 2005 Contaminated Land Remediation Technologies Collaborative Research and Development funding competition.

Project Overview

The £1.24M project aims to develop, advance, validate and increase the uptake of soil mixing technology (SMT) in the remediation of contaminated land in the UK. SMT involves the use of a range of different mixing tools and additives to construct various ISLR options, such as permeable reactive in-ground barriers, low-permeability containment walls, and stabilisation/solidification of "hot-spot" contaminated soils. SMT can also be used for non-remediation applications such as to improve the engineering strength of soft soils.

Extensive laboratory treatability studies in which a wide range of conventional and novel binders and additives will be tested together with a range of soils and contaminants. In parallel, the novel SMT equipment will be designed and manufactured. Field trials will then follow at a number of sites of varied ground condition and contaminant mix. These trials will take place in 2009, and will incorporate trials of the various SMT applications highlighted previously.

A programme of field sampling, monitoring and testing will also be undertaken as part of the field trials. This will incorporate the installation of boreholes for groundwater monitoring and coring of the hot-spot treatment and ground improvement trenches. A number of sections will also be fully excavated for inspection and in-situ testing will be carried out as appropriate.

Installation of a Containment Barrier for Pump & Treat, UK

Key Facts...

- Development, construction and validation of Soil Mix Technology (SMT) equipment;
- Laboratory treatability studies to optimise selection of soil mix additives;
- Field trials of SMT application (e.g. reactive wall construction, hot-spot treatment and ground improvement) in selected sites of varied ground conditions and contaminant mixes;
- Field sampling, monitoring and testing;
- Laboratory testing of field samples;
- Stakeholder meetings; and
- Dissemination of results.

The site trial samples will also be laboratory tested for the range of tests used in the treatability study. Trends between different binder mixes, different installation techniques, variations with depth and between single and overlapping sections, where appropriate, and variations between the treatability study and field trial will be investigated.

As one of the main concerns is the long-term effectiveness of SMT treatments, a dedicated testing programme will be performed including desorption tests to assess the permanence and robustness of sorptive behaviour under varied environmental conditions, long-term monitoring of the groundwater around the treated areas on the site and the application of accelerated ageing experimental techniques and associated numerical modelling.

Project Objectives

The objectives of the project are to:

(i) develop single advanced SMT equipment for integrated remediation and ground improvement, through simultaneous delivery of wet and dry binders, and with advanced quality assurance and performance procedures systems;

(ii) increase technology validation and stakeholder confidence by performing extensive field trials and laboratory testing; and

(iii) to expand the boundaries of the new technology by testing novel additives.

Keeping you up to date

Stakeholder Consultation and Output Dissemination

As a major step towards increased understanding and uptake of SMT in the UK, the project will also involve consultation meetings with a wide range of stakeholders. A number of brainstorming meetings and information exchange workshops will be held at which issues of stakeholder concerns will be addressed and fed back into the project activities. For further details of these meetings, contact Dr Abir Al-Tabbaa at the details below.

Outputs and findings of the project will also be disseminated to the contaminated land and waste management communities with the support of the Environmental KTN and CL:AIRE.

Project Partners

The project is led by the contractor Bachy Soletanche and involves Cambridge University, three engineering consultancies (Arcadis Geraghty & Miller, Arup and Merebrook Consulting), three trade associations (British Urban Regeneration Association, British Cement Association and the UK Quality Ash Association) and four materials suppliers (Amcol Minerals Europe, Richard Baker Harrison, Kentish Minerals and Civil & Marine).

Various Perspectives of SMT in Progress Using 'Trenchmix'

References

[1]www.defra.gov.uk/environment/land/contaminated/index.htm

[2]Environmental KTN (2008) *Priority Area 9: In-Situ Land Remediation Business Case*

[3]Environment Agency (2005) *Indicators for Land Contamination, Science Report SC030039/SR*

[4]UK CEED (2006) *Emerging Markets in the Environmental Sector*

[5]MBD (2008) *UK Contaminated Land Treatment Market Development Report*

[6]www.environment-agency.gov.uk/subjects/landquality/113813/781510/781563/?lang=_e

Further references which may be of additional interest:

Environment Agency Contaminated Land Homepage
www.environment-agency.gov.uk/contaminatedland

European Commission Environment Homepage
http://ec.europa.eu/environment/index_en.htm

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For details of other Technology Strategy Board Contaminated Land Remediation Collaborative R&D Projects:

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