OVERVIEW
In October 2007, Cambridge University launched the largest Technology Strategy Board funded project on Contaminated Land Remediation Technologies. Project SMiRT (Soil Mix Remediation Technology) is a £1.24M project led by the contractor Bachy Soletanche. Cambridge is the only academic institution involved and is a major partner in this project. The project also includes three engineering consultancies (Arcadis Geraghty & Miller, Arup, Merebrook Science & Environment), three trade associations (British Urban Regeneration Association, British Cement Association, UK Quality Ash Association) and four materials Suppliers (Amcol Minerals Europe, Richard Baker Harrison, Kentish Minerals and Civil & Marine Holdings).

Project SMiRT aims to achieve significant technical advancement and cost-savings by developing an innovative single soil mix technology (SMT) system for integrated remediation and ground improvement, with simultaneous delivery of wet and dry additives, and with advanced quality assurance system.

Soil Mix Technology (SMT) involves the use of a range of different mixing tools and additives to construct permeable reactive in-ground barriers, low-permeability containment walls, “hot-spot” soil treatment by stabilisation/solidification and for the improvement of soft soils. A range of the soil mix technology equipment developed by Bachy Soletanche and the resulting treated ground are shown in the figures.

The project involves 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 equipment will be designed and manufactured. Extensive field trials will then follow, scheduled for the first half of 2009. Extensive in-situ testing, sampling and groundwater monitoring will then be carried out together with extensive laboratory testing of the site samples and assessment of the field measurements.

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 and a major dissemination programme through CL:AIRE.
METHODOLOGY

Tasks A and B: Development, construction and validation of SMT equipment
Current SMT equipment allows either dry or wet binder delivery and are two very different systems. For one set of equipment to be able to deliver both, significant changes need to be made to existing equipment or a completely new system will need to be designed. A quality assurance system, which will measure and monitor variables such as dry binder delivery pressure, injection quantity and rate, auger rotational speed, column depth, penetration and withdrawal rates and torque, will also be designed and implemented in the new SMT equipment.

Task C: Laboratory treatability studies
Extensive laboratory treatability studies will be carried out to optimise the selection and application of the additives for the field trials using both performance and cost. A range of conventional and novel materials and binders will be used, some in dry and some slurry form, as appropriate for the required application including: organoclays, zeolites, zeolite-clay mixes, PC and blended PC, PC-zeolite and PC-organoclays and reactive magnesia cements. A range of tests will be conducted as appropriate for the required application including density, strength, leachability (batch and tank), flow-through column sorption and desorption, stress-strain, compressibility, wet-dry and freeze-thaw durability and resistance to chemical attack. Site soils as well as generic soil and contaminant types will be tested.

Task D: Field trials
Extensive field trials will be carried out on at the selected site which will contain varied ground conditions and a cocktail of contaminants. The field trials will take a total of ~6 weeks in which a large number of soil mixed sections including reactive wall sections, hot-spot treatments and ground improvement
sections, with different treatment arrangements including installation techniques in each type of treatment, will be installed. The developed quality assurance system will be used to record and monitor important operational parameters for every column installation.

**Task E: Field sampling, monitoring and testing**
Boreholes for groundwater monitoring will be installed in the vicinity of the treated areas. Coring of the hot-spot treatment and ground improvement columns including all the different variable considered will be carried out. A number of columns will also be fully extruded for inspection. In-situ testing will be performed as appropriate.

**Task F: Laboratory testing of field samples**
The site trial samples will be laboratory tested for the range of tests used in the treatability study work. Trends between different binder mixes including wet and dry binders, different installation techniques, variations with depth and between single and overlapping sections, where appropriate, and variations between the laboratory treatability study results and the field trial results 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.

**Task G: Stakeholder meetings**
A number of brainstorming and information exchange workshops and meetings will be held at which issues of stakeholder concerns will be addressed and will be fed back into the project activities.

**Task H: Dissemination of the results**
Dissemination of the various research and development findings of the project to the wider community in the contaminated land, waste management and construction sectors, will be carried out using a number of routes throughout the project with significant contribution from CL:AIRE and IPM-Net.