



Treatment of Organic Contaminants in Soils



Reclamation and re-use of contaminated land is becoming increasingly important due to the shortage of land suitable for development in urban areas. Government policy is to encourage the reclamation of previously used land for further use. In 1986 almost half of all development in the UK took place on previously used land, and the proportion is likely to increase as pressures on land availability grow. Some 32,000 hectares of derelict land are considered suitable for reclamation.

The hazards posed by soil contamination on previously used sites can be difficult and expensive to overcome. At present only a limited range of treatment methods are available, and these are relatively ineffective for dealing with the presence of persistent organic substances such as dioxins, PCBs and polynuclear aromatic hydrocarbons (components of oily and tarry wastes). The water in close association with polluted soil may also be contaminated.

Methods which require the excavation and removal of contaminated soil for disposal elsewhere transfer the problem to another site where it remains to be dealt with at a later date. Permanent solutions are needed which detoxify the harmful contaminants preferably without requiring the large scale transport of material for treatment. There may be, for example, further scope for using microbiological degradation processes and for improving techniques for introducing the biologically active media into the contaminated soils.

ETIS aims to fund basic industrial research, up to proof of concept stage, into any innovative methods of treating persistent organic contaminants in soils and associated groundwater, in-situ or otherwise on site.





2 February 1993

COMMERCIAL-IN-CONFIDENCE

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Your ref:

Our ref: EPT/5/3/43

Dear Sir

**ENVIRONMENTAL TECHNOLOGY INNOVATION SCHEME: ETIS 162G
IN SITU TREATMENT OF SOILS CONTAMINATED WITH STABLE ORGANICS**

1. I am pleased to inform you that, subject to the terms and conditions of this letter, the Secretary of State for the Environment ("the Secretary of State") is prepared to pay Envirotreast Ltd ("the Company") a grant not exceeding £39,250 to undertake research into the in situ treatment of soils contaminated with stable organics ("the project"). This is in accordance with the detailed proposal submitted under the Environmental Technology Innovation Scheme (ETIS) on 23 September 1992 ("the application"). The offer is made on the condition that the project will be carried out by the Company, and Warren Spring Laboratory (together, "the Collaborators"). A similar letter is being sent to the other Collaborator.

2. This offer is conditional on the Department receiving within two months of the date of this letter a grant offer acceptance duly signed by the Company. If this condition is not met, the grant offer will lapse automatically. The grant offer may be renewed or extended at the discretion of the Secretary of State. Details of how to claim grant will be sent to you after acceptance.

Financial

3. The grant will be 50% of the net eligible costs not exceeding £78,500 (see Schedule 1 to this letter) of the work carried out by the Company on the project incurred on or after the date on which the Collaborators signify acceptance of the terms and conditions of this offer or, if there is more than one such date, the later such date. Grants will be payable in instalments on submission by the Company of a statement of monies expended by the Company on the project. Unless the

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NEWS RELEASE

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29 July 1993

GOVERNMENT GRANTS TO TACKLE VOC RELEASES AND CONTAMINATED SOILS

Environment Minister Lord Strathclyde today announced two further grants under the Environmental Technology Innovation Scheme (ETIS). The grant offers total £420,000 and go to consortia consisting of Carrs Paints Ltd and Micromask Ltd; and Envirotreat Ltd and Warren Spring Laboratory.

The first grant will help to fund a research project to develop a VOC-free microfine electroscopic powder printing and coating process to replace wet systems. The second grant will help research into a novel in-situ treatment process for contaminated soils. The grant offers represent 50% of the eligible project costs.

Welcoming the projects, Lord Strathclyde said:

"I am very pleased that my Department has been able to make these grant offers to support research work in two important areas of environmental technology. We must constantly strive to find ways of reducing industrial releases of VOCs and of cost-effectively restoring our large areas of contaminated land in the UK. These projects are helping in these aims and I wish the companies every success."

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Details of ETIS projects announced today;

<u>Participants</u>	<u>Project description</u>	<u>Location of participants</u>
Carrs Paints Ltd, Micromask Ltd	Development of m i c r o f i n e electroscopic powder printing and coating process to replace conventional wet systems. Grant:£350,808	Birmingham (Carrs Paints); Radlett, Hertfordshire (Micromask).
Envirotreast Ltd, Warren Spring Laboratory	Development of an in-situ treatment for soils contami- nated with stable organics and heavy metals. Grant:£69,900	Kingswinford (Envirotreast); Stevenage (Warren Spring).

Notes to Editors

The Environmental Technology Innovation Scheme (ETIS) is a grant scheme launched in October 1990 with the aim of helping companies to undertake research into new environmental technology. It is run jointly by the Departments of Environment and Trade and Industry.

The planned period for submission of applications under ETIS ends in autumn 1993, but the scheme has already attracted a large number of good applications. These will use up the remaining budget for the scheme. New applicants are being informed of the position.

Solvents are responsible for the production of gaseous volatile organic compounds (VOCs). VOCs combine with nitrogen oxides in the atmosphere to produce low altitude ozone under the action of sunlight. Ozone is a damaging pollutant which adversely affects human health, interferes with plant growth and damages building materials.

There are an estimated 75,000 - 100,000 contaminated land sites in the UK. Many of these sites are contaminated with persistent organic compounds and heavy metals. At present, many sites lie derelict and, because of the associated hazards, cannot be used for construction or agriculture without first being remediated. Conventional treatment often consists of excavation and removal to landfill, which can be expensive and simply transfers the contaminants elsewhere.

ETIS 162G: ENVIROTREAT LTD, MAY GURNEY (TECHNICAL SERVICES)
LTD AND THE UNIVERSITY OF BIRMINGHAM

(This is a second revision of the original version accompanying the Department's offer letter to Envirotreat Ltd, dated 2 February 1993)

PROJECT TITLE

Treatment of Soils Contaminated with Stable Organics.

AIMS OF PROJECT

To develop to proof of concept an in-situ organophilic clay treatment technology, which will enable the positive and permanent chemical bonding of organic compounds, such as polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs) and chlorinated hydrocarbons, present in contaminated land. The project aims prevent the leaching of these organics into groundwater and aims to set target leachability standards, equating to a maximum of 50 times the current UK drinking water standards.

PROJECT DELIVERABLES

Development of a modified organophilic clay to enable positive and permanent chemical bonding of organic compounds.

Design/modification of a continuous flight auger to enable low pressure injection and homogeneous mixing.

A Final Report to include specific and detailed information on the design and modifications made to the auger, the general composition of the optimum modified organophilic clay, results from the test-rig/evaluation stage and the optimum design/operational parameters enabling in-situ treatment of organic compounds in contaminated land.

Dissemination through scientific publications/conference papers of, in general terms, the modifications made to the auger and organophilic clay, the results obtained and recommendations for optimum performance.

MAIN TASKS

1. Process development work to develop and prepare formulations of modified organophilic clays for treatability studies. Envirotreat. (accomplished April 1993-April 1994)

Remaining Tasks (Months Duration in Brackets)

- 2. a) Further development of the organophilic clays to include X-ray diffraction and absorption tests. Laboratory treatability studies to develop optimum process mixes, to evaluate the technology using laboratory analytical techniques, to develop and refine the technology as necessary and to produce an optimum mix for the site trial. University of Birmingham. (9)

- 2. b) Limited laboratory work will be carried out on four organic contamination groups which are not expected to be represented in the site trial, ie
 - a) PCBs and chlorinated hydrocarbons;
 - b) polyorganics eg phenols;
 - c) benzene groups; and
 - d) heterocyclics.
 Organophilic clays will be developed and mixes prepared and tested.
 Envirotreat/University of Birmingham. (11)

- 3. Auger development to modify a continuous flight auger design, incorporating special features for low pressure injection and homogeneous mixing. Construction of test-rig powered by existing plant and equipment. Envirotreat/May Gurney. (9)

- 4. Test-rig stage where both the technology and in-situ method of application will be tested. The test-rig stage will take place on a MOD site (West Drayton, Middlesex). Envirotreat/University of Birmingham/May Gurney. (0.3)

- 5. Test-rig stage evaluation of samples taken from the treated soil section at predetermined intervals. Analysis will be by several methods. University of Birmingham (6)

PROJECT TIMETABLE

(task numbers as under Main Tasks above)

Task	Months	
2a	9	-----
2b	11	-----
3	9	-----
4	0.3	-
5	6	-----
Elapsed time		0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

In addition, to arrange progress review meetings between the nominated officer and members of the project consortium as and when necessary but probably at three monthly intervals; to cooperate with monitoring by the Department of steps taken to

exploit the results of the project commercially during the period referred to in paragraph 14 of the Offer Letter and to arrange, in consultation with the Department, or to co-operate with the Department in arranging, appropriate reporting of project results, having due regard to the need to avoid prejudice to the Collaborators' commercial interests.

This Schedule is primarily based on the detailed description of the work to be carried out as contained in the project proposal submitted to the Department on 23 September 1992, and on reports on the work carried out in the period April 1993 - April 1994.

Support is not available to carry process development further than the point at which the concept has been proven.

September 1994



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Your Ref

Our Ref EPT 5/3/43

Date 26 March 1996

Dear Mr McLeod

ENVIRONMENTAL TECHNOLOGY INNOVATION SCHEME (ETIS) PROJECT 162G: IN SITU TREATMENT OF SOILS CONTAMINATED WITH STABLE ORGANICS

Thank you for your letter of 6 March 1996.

A general aim of the ETIS scheme (now closed to applications) was that the results of grant-aided research should point the way towards improved environmental standards. The project aim for project 162G, as set out in the grant offer letter, was to prove the concept of a technique for preventing the leaching of organic compounds such as PCBs, PAHs and polynuclear aromatic hydrocarbons into groundwater. The offer letter set out a target for the project that contaminants in leachate from treated samples would be at or below levels of 50 times the current UK drinking water standards. The ETIS Office agreed that the treated samples of soil should be treated using the US Toxicity Characteristic Leaching Procedure (TCLP).

The ETIS Office is satisfied that the project has been carried out in accordance with the terms of the grant offer letter, although we are not in a position to verify the technical results achieved, for third parties.

Yours sincerely

John Thompson

LONG-TERM VALIDATION

An Engineering and Physical Sciences Research Council (EPSRC) funded project has assessed long term performance of cored samples from the West Drayton trial site (Al-Tabbaa and Evans, 2003).

Core samples were extruded after 4.5 years and subjected to a range of physical and leachate testing procedures.

The results of the testing show excellent long term performance. Unconfined compressive strength values ranged between 1400 and 7550 kPa and permeability values ranged between 0.01×10^{-9} and 2.5×10^{-9} metres per second. Satisfactory durability testing was also observed. Leachate testing demonstrated that both the pH and leachability of values for heavy metals and organics were acceptable. pH values using the NRA leaching test ranged from 8.3 to 11.3 and from 6.3 to 7.4 using the acidic leaching TCLP test. Leachable concentrations of heavy metals and organics were around drinking water standards.

Reference

Abir Al-Tabbaa and Chris Evans (2003). Deep soil mixing in the UK: geoenvironmental research and recent applications. *Land Contamination and Reclamation* 11 (1), 2003.