

**THE UNIVERSITY OF SHEFFIELD**  
**EPSRC CASE studentship with industry support**

**Electrokinetic-enhanced engineered bioremediation of contaminated soil and groundwater**

Applications are invited from UK students for an EPSRC CASE PhD studentship, in collaboration with Shell Global Solutions (UK), to start in October 2011. The studentship covers fees and maintenance costs, and provides a tax-free stipend of £13,590 per year. It is enhanced by an additional tax-free award of £1,000 per annum. Applicants should have at least a 2:1 honours degree in Microbiology, Molecular Microbiology, Biochemistry, Chemistry, Hydrogeology, Earth Science, Environmental Engineering, Chemical Engineering, Physics or equivalent research-quality relevant experience.

**Background**

Bioremediation is used to manage soil and groundwater pollution, but is often controlled by mass transfer limitations, which affect the efficiency of the biodegradation processes involved, particularly in heterogeneous media. Electrokinetics (EK) is an emerging technology that can be used for the *in situ* bioremediation of many contaminants in porous media. EK uses a low voltage electric field applied between electrodes to move charged or neutral species in solution from one electrode or the other. It can reduce mass transfer limitations in both soils and groundwater and increase microbial activity, by increasing the supply and re-distribution of reactants (e.g. oxidants and nutrients) and microorganisms which support contaminant biodegradation. Most applications have focused on soil-based problems and contaminants in low-permeability zones (e.g. clays). However there has been relatively little research on EK applications for *in situ* groundwater remediation. This studentship aims to provide scientific information to address these issues. It will examine the fundamental processes and relevant controls for EK in the engineered bioremediation of organic contaminants in soil and groundwater. The organic compounds will include representative petroleum hydrocarbon chemicals present in fuels.

**Project**

The studentship will be within the Groundwater Protection and Restoration Group (GPRG) at Sheffield. Laboratory experiments will explore the bioremediation of contaminants using EK methods, in bench-scale model soils and aquifers. The effect of system design (electrode arrays, treatment cycling), physical setting (homogenous vs. heterogeneous porous media) and environmental conditions (contaminant mixtures, oxidants and nutrients supply) on treatment performance will be examined. The response of *in situ* microorganisms to changes in pH and geochemical conditions during EK treatment will be deduced, using state-of-the-art molecular microbiological techniques. This will identify the relationships between EK processes, microbial dynamics, system set-up and treatment efficiency. Some development of methods for GC-MS analysis of organic compounds and molecular microbiological analysis will be undertaken. The research will provide new scientific understanding on EK processes for the enhanced *in situ* removal of organic contaminants in soil and groundwater, and guidelines for the engineering design of bioremediation systems at field-scale using this technology.

**Support**

The GPRG is an international centre of excellence for applied groundwater research and offers an excellent environment in which to start a research career. The University's Graduate School ensures that students obtain good research training, and the department provides excellent support facilities. The student can attend professional development short-courses, provided within the MSc in Contaminant Hydrogeology at Sheffield, as well as access to other university courses. Students are expected to attend international conferences and encouraged to make poster and oral presentations during their PhD. The project will be supervised by Steve Thornton and Wei Huang in the GPRG and Jonathan Smith (Shell Global Solutions UK, SGS). Work placements will be undertaken in SGS research laboratories to gain experience and training in experimental methods, analytical techniques, *in situ* remediation concepts and other areas related to different management and business functions.

**Applications**

Informal enquires and applications should be directed to Dr Steve Thornton (tel: 0114 222 5744; [s.f.thornton@sheffield.ac.uk](mailto:s.f.thornton@sheffield.ac.uk)). Applicants should provide details of two academic referees and submit a covering letter outlining their background and explaining their suitability, interests and motivation for applying. The project is multidisciplinary and applied in nature, combining microbiology, geochemistry, analytical chemistry, physics and aspects of hydrogeology. It involves the design and operation of laboratory experiments, and microbiological and chemical analysis of aqueous and solid environmental samples. Experience in microbiological analysis and experimental laboratory work would be advantageous, although full training will be provided. **Closing date for applications is Monday 1<sup>st</sup> August, with interviews in late August.**