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Structural Energy Storage in Clay-Based Soils

Applications are invited for a fully funded PhD studentship at Imperial College London on an interdisciplinary project spanning civil engineering, chemistry, and materials science.

Project description:

Structural energy storage is an emerging field with the potential to transform sustainable infrastructure in which materials are designed to simultaneously perform mechanical and energy storage functions. While early research has focused on composites and cementitious systems, this PhD project will investigate a largely unexplored alternative: natural clay soils enhanced with conductive and electrochemically active phases.

Clay minerals possess charged nanoscale surfaces, rich pore-fluid chemistry, and unique physico-chemical interactions. These characteristics make them a promising yet under-studied platform for electrochemical energy storage. The aim of this PhD is to establish a fundamental, experimentally grounded understanding of how electrochemical functionality can be introduced into clay-rich geomaterials without compromising their mechanical performance in geotechnical applications.

Keywords: Sustainable infrastructure; Energy storage; Geomaterials; Electrochemistry; Geotechnical engineering

Supervisory team: Dr. Angela Casarella (Department of Civil and Environmental Engineering), Prof. Milo Shaffer (Professor, Department of Chemistry) and Dr. Samuel Cooper (Associate professor, Dyson School of Design Engineering).

Student activities

The PhD will combine laboratory experimentation, materials characterisation, and data analysis. The work will involve investigating the electrochemical behaviour of natural and engineered clays, performing electrochemical measurements alongside geotechnical and physical characterisation of the materials, and examining the interactions between mechanical behaviour and electrochemical processes. The project will focus on developing mechanistic understanding and transferable insights that can inform future large-scale or in-situ applications of clay-based energy storage.

Student benefits

The studentship will provide (i) interdisciplinary training across engineering, chemistry, and materials science, (ii) hands-on experience with advanced geotechnical, electrochemical and material characterisation techniques and (iii) opportunities to collaborate across departments and research groups at Imperial College London.

Applicant requirements:

Academic background (essential)

- Applicants should hold, or be on track to achieve, a First Class or Upper Second Class (2:1) degree (or international equivalent) in Civil Engineering, Material Science, Chemistry or a closely related discipline.

Technical background (desirable)

- Prior laboratory or experimental experience in geotechnical engineering, material science or chemistry.

Skills and attributes (essential)

- Strong analytical and data processing ability and a clear interest in experimental research.
- Excellent written and verbal communication skills in English.

Scholarship:

The studentship will provide funding for up to 3.5 years, including:

- London weighted UKRI stipend (£23,195 per annum for 26/27);
- ***Tuition fees for Home and international students:***
- Research expenses associated with the project (£4,000 over the 3.5 years) for consumables, conference attendance, and travel associated with the research etc.

How to apply:

Applicants wishing to be considered for this opportunity should send the following application documents to Dr Angela Casarella (a.casarella@imperial.ac.uk):

1. Cover letter, explaining their motivation and suitability by addressing the requirements
2. Current CV including degree result and, if possible, class ranking.
3. Undergraduate and/or postgraduate academic transcripts illustrating grades for each module undertaken

Deadline

The deadline for student applications is **Friday, 27 February 2026.**

Application via the Imperial College Registry is not necessary at this stage, and will follow after discussions with the supervisory team.