Ventilation of Hydrogen in a Geological Disposal Facility

Fully-funded PhD Studentship

Organisation: University of Bristol – Department of Mechanical Engineering.

Supervisor: Dr Andrew Lawrie.

Funding: an enhanced stipend (up to £18,000 per year) is available. The project funding is for 4 years.

Partner: Radioactive Waste Management Ltd.

Start date: from 1st October 2021.

Eligibility: The funding will cover tuition fees for UK-based students. Overseas students are also welcome to apply.

Closing date for applications: 25th June 2021.

Project Description

The aim of this project is to predict the behaviour of slowly-released buoyant gasses in a Geological Disposal Facility (GDF) and inform the design of ventilation for such facilities. Geological disposal involves isolating radioactive waste in a vault deep inside suitable bedrock to ensure that no harmful quantities of radioactivity ever reach the surface environment. A GDF will be a highly engineered structure consisting of multiple barriers designed to provide protection over hundreds of thousands of years.

Hydrogen gas – which is potentially flammable – can arise from the corrosion and degradation of certain types of radioactive waste. Ventilation of hydrogen is a significant engineering challenge for a GDF; new research is required to inform the design of the vaults themselves and size the mechanical ventilation for them. Passive safety in the event of a loss of power is a further consideration.

The release of dense and buoyant gases has been extensively studied, including several recently by the project supervisor (Dr Andrew Lawrie) on determining scaling laws for particular geometries. Here our focus will be to migrate existing understanding of special cases into the more general GDF context to predict the likely evolution of hydrogen concentrations. The key scientific challenge lies in estimating the rate of molecular mixing in a vault environment that will have thermal sources and may become density-stratified.

Laboratory experiments measuring vault circulation and release concentrations directly (primarily using non-invasive optical methods) will provide validation for Computational Fluid Dynamics models that will inform the design of GDF vaults and ventilation structures. A sensitivity analysis of the flow will guide suitable locations for a network of hydrogen leak sensors designed to solve the inverse problem of leak source-finding amongst the many individual radioactive waste packages that will be stored in the vault.

University of BRISTOL

Candidate Requirements

Applicants must hold/achieve a minimum of a Masters degree (or international equivalent) in one of the following: Aerospace Engineering, Physical Sciences, Mechanical Engineering, Chemical/Process Engineering. Applicants without a Masters qualification may be considered on an exceptional basis, provided they hold a first-class undergraduate degree.

Some experience in programming in a compiled language relevant to the design of numerically intensive simulation is essential.

Enquiries and Further Information

For informal enquiries, please email Dr Andrew Lawrie Andrew.Lawrie@bristol.ac.uk

For general enquiries, please email came-pgr-admissions@bristol.ac.uk

For information about the department, please see

http://www.bristol.ac.uk/engineering/departments/mecheng/

Application Details

To apply for this studentship submit a PhD application using our online application system http://www.bristol.ac.uk/study/postgraduate/apply/

Please ensure that in the Funding section you tick "I would like to be considered for a funding award from the Mechanical Engineering Department" and specify the title of the scholarship in the "other" box below with the name of the supervisor. Closing date for applications: 25th June 2021.