UNIVERSITY of GREENWICH

Information on Postgraduate Research Scholarship - Ref: Eng-PhD-18-25			
Faculty:	Engineering and Science	**Department:**	School of Engineering
Lead Supervisor:	Associate Prof Michael Okereke		
Project Title:	Self-Healing Composite Pipelines for Sustainable Water Infrastructure		
Project Description: (maximum 500 words)	Across the world, ageing water pipelines lose vast quantities of treated water every day due to cracks, corrosion, and long-term material degradation. These leaks increase operating costs, disrupt communities, and place additional pressure on already stressed water resources. Conventional repair methods are typically reactive, expensive, and environmentally inefficient, often requiring excavation, shutdowns, and repeated maintenance. There is a growing need for smarter materials that reduce leakage and extend infrastructure lifespan. This project investigates self-healing composite pipelines as a sustainable solution. These advanced materials contain microscopic capsules filled with a liquid polymer. When damage occurs, capsules rupture automatically, releasing the polymer into the crack. The polymer then hardens, sealing the damage and restoring part of the mechanical strength without external intervention. Inspired by biological healing, this approach shifts infrastructure from passive components to systems that respond autonomously to damage. Although self-healing behaviour has been demonstrated in laboratory samples, performance under realistic pipeline conditions remains poorly understood. In service, pipes experience internal water pressure, flow fluctuations, soil restraint, traffic loading, and temperature variation. These combined effects influence crack growth, capsule activation, and the durability of healed regions. Understanding these interactions is essential before self-healing pipelines can be adopted safely and at scale. **Aim** The aim of this project is to develop and validate predictive models that describe how self-healing composite pipelines respond to mechanical loading and internal water pressure, and to assess their ability to repair damage under operational conditions. **Objectives** 1. Develop numerical models to simulate crack initiation, capsule rupture, polymer release, and stiffness recovery in composite pipeline materials. 2. Incorporate simplified representations of internal water pressure and flow to capture key fluid–structure interactions affecting damage and healing.		

	3. Perform parametric studies to identify how capsule size, distribution, and material properties influence healing efficiency and structural recovery. 4. Validate numerical predictions through targeted laboratory experiments on composite specimens and pipe sections. The methodology combines advanced computer modelling with focused experimental testing. Three-dimensional numerical models will simulate fracture, healing, and structural recovery within composite pipes, while simplified fluid representations will capture the influence of internal pressure. Sensitivity studies will identify design configurations that maximise self-healing performance. Experimental testing will include mechanical loading of composite specimens and short pipe sections to measure stiffness, strength, and fracture behaviour before and after healing, alongside simple leakage observations to assess crack sealing. The outcomes will deliver a validated framework for evaluating self-healing performance in pipeline materials. This supports the development of more durable, low-maintenance water infrastructure, reducing leakage, repair costs, service disruption, and environmental impact. Scientifically, the project advances understanding of multi-physics behaviour in smart composites. Practically, it provides a foundation for future digital-twin and predictive-maintenance tools that enable proactive infrastructure management. We welcome applications from candidates with a strong background in mechanical or civil engineering, computational or numerical modelling, and excellent experimental skills within these areas or related disciplines. The project offers interdisciplinary training, strong industry relevance, and opportunities to translate fundamental research into practical solutions for resilient, sustainable water systems worldwide and beyond applications. This scholarship is awarded competitively, and all applications are carefully reviewed. While we cannot guarantee an offer, we encourage strong candidates to apply.
Duration:	3 years, Full-Time Study or 6 years, Part-Time Study

Support available (subject to satisfactory performance):

A successful Home candidate will receive:

- A Full tuition fee waiver at the university Home-student rate for the specified duration of the scholarship

A successful International candidate will receive:

- A tuition fee waiver for 50% of the International-student rate for the specified duration of the scholarship.

Tuition fees are subject to annual increases.

This scholarship does not include funding for living expenses.

Person Specification of Essential (E) or Desirable (D) requirements:	
Criteria:	**E or D**
Education and Training:	
• 1st Class or 2nd class, First Division (Upper Second Class) honours degree or a taught master's degree with a minimum average of 60% in all areas of assessment (UK or UK equivalent) in a relevant area to the proposed research project	**E**
• For those whose first language is not English and/or if from a country where English is not the majority spoken language (as recognised by the UKBA), a language proficiency score of at least IELTS 6.5 (in all elements of the test) or an equivalent UK VISA and Immigration secure English Language Test is required, if your programme falls within the faculty of Engineering and Science a language proficiency score of at least IELTS 6.5 overall with a minimum of 6.0 in all elements of the test or an equivalent UK VISA and Immigration secure English Language Test is required. Unless the degree above was taught in English **and** obtained in a majority English speaking country, e.g. UK, USA, Australia, New Zealand, etc, as recognised by the UKBA.	**E**
Experience & Skills:	
• Previous experience of undertaking research (e.g. undergraduate or taught master's dissertation)	**E**
• Hands-on experience in mechanical or materials experimentation, including specimen preparation and mechanical testing.	**E**
• Practical experience using finite element analysis (FEA) software such as ABAQUS and/or ANSYS for structural simulations.	**E**
• Experience working with composite structures or pipeline-related components.	**D**
• Familiarity with fracture or damage modelling approaches, such as cohesive zone models, extended finite element methods (XFEM), or continuum damage mechanics.	**D**
• Experience with fluid–structure interaction (FSI) modelling or pressure-driven loading.	**D**
Personal Attributes:	
• Understands the fundamental differences between a taught degree and a research degree in terms of approach and personal discipline/motivation	**E**
• Able to, under guidance, complete independent work successfully	**E**
Other Requirements:	
• This scholarship may require Academic Technology Approval Scheme approval for the successful candidate if from outside of the EU/EEA	**E**
• The scholarship must commence before 15th July 2026 (offers will be withdrawn if this condition is not met)	**E**
Closing date for applications:	***midnight UTC on 20th February 2026***
For further information contact:	***Dr Michael Okereke (m.i.okereke@gre.ac.uk, +44(0)1634 88 3580, www.linkedin.com/in/miokereke)***
Making an application:	

Please read this information before making an application. Information on the application process is available at: https://www.gre.ac.uk/research/study/apply/application-process. Applications need to be made online via this link. **No other form of application will be considered**.

All applications **must include** the following information. **Applications not containing these documents will not be considered.**

- **Scholarship Reference Number (*insert reference*)**– included in the personal statement section together with your personal statement as to why you are applying
- **a CV including 2 referees** *
- **academic qualification certificates/transcripts and IELTs/English Language certificate if you are an international applicant or if English is not your first language or you are from a country where English is not the majority spoken language as defined by the UK Border Agency** *

**upload to the qualification section of the application form. Attachments must be a PDF format.*

Before submitting your application, you are encouraged to liaise with the Lead Supervisor on the details above.