

CIVIL AND ENVIRONMENTAL ENGINEERING

DIATI/DeltaNova - Innovative approaches for in-situ remediation of contaminated aquifers

Funded By	DeltaNova S.r.l. [Piva/CF:12302620013] Dipartimento DIATI
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Context of the research activity	<p>Contaminated sites are a widespread environmental concern in Italy and across Europe, often resulting from long-standing industrial activities. This PhD project focuses on innovative in-situ remediation approaches for aquifers affected by chemical, physical, and biological contaminants, including emerging pollutants such as pharmaceuticals and PFAS. The research will address pollutant fate and transformation, improve the sustainability of remediation processes, and develop novel engineering solutions for managing complex contamination scenarios.</p>
	<p>Contaminated sites, especially those affecting groundwater resources, are a major environmental issue in Italy and Europe, often linked to past and ongoing industrial activities. In particular, groundwater contamination by emerging pollutants—such as per- and polyfluoroalkyl substances (PFAS)—represents a growing environmental and public health concern due to the widespread diffusion, not totally known health effects and lack of effective remediation technologies. These substances are in fact widely used in industrial and consumer products, highly persistent, mobile, and resistant to conventional remediation treatments.</p> <p>This PhD project aims to develop and validate innovative in-situ remediation strategies for aquifers impacted by PFAS and other emerging pollutants. The research will focus on the development, testing, and application of reactive and/or adsorptive materials, including nanomaterials and micromaterials, to be injected into the subsurface for the creation of reactive zones near contaminant sources. This nanoremediation approach offers several advantages over conventional methods: increased reactivity, reduced remediation time, lower costs, and improved sustainability.</p> <p>The PhD project will be carried out in collaboration between the Groundwater Engineering Research Group of Politecnico di Torino and DeltaNova srl, spinoff company of Politecnico di Torino specialized in the development of innovative solution for remediation of contaminated aquifer systems.</p>

Objectives

The PhD activity will address the following areas:

- Design and optimization of reactive mixtures, based on engineered nanomaterials for adsorption and/or degradation of PFAS and other emerging contaminants.
- Laboratory-scale batch experiments to assess removal efficiency, equilibrium and kinetic parameters, and stability of the materials in relevant hydrochemical conditions;
- Experimental studies on mobility and distribution of the reactive nanomaterials in saturated porous media simulating aquifer conditions.
- Development of innovative injection and dosing strategies to ensure effective subsurface delivery while avoiding clogging or material loss.
- Numerical modeling of transport and reactive processes to support design and scale-up of remediation processes.
- Design and implementation of pilot and full-scale tests in real contaminated sites.
- Environmental sustainability and risk assessment, using modeling tools (e.g., LCA, risk analysis) to evaluate the overall impact and guide technology validation.

This integrated approach—from laboratory to field—will support the implementation of effective and sustainable remediation technologies by targeting emerging contaminants of high concern. The collaboration with DeltaNova will foster the transition from research to application, with direct industrial relevance.

The project ultimately aims to improve current remediation practices and contribute to the safe and rapid restoration of contaminated aquifers, aligning with EU goals for environmental protection and circular use of natural resources.

Skills and competencies for the development of the activity

The ideal candidate holds a Master's degree in Environmental and Land Engineering or related fields, with solid knowledge of groundwater engineering and flow modeling (familiarity with groundwater modeling software is desirable). Experience with emerging groundwater contaminants (e.g. PFAS), their analytical characterization (e.g. HPLC-MS, GC/MS), and removal strategies (adsorption with GAC, degradation) is highly valued. Excellent knowledge of English language, strong teamwork ability, curiosity, and a genuine motivation to explore innovative and sustainable remediation solutions are essential.