



PhD in INGEGNERIA AMBIENTALE E DELLE INFRASTRUTTURE / ENVIRONMENTAL AND INFRASTRUCTURE ENGINEERING - 38th cycle

Research Area n. 3 - Environmental and Hydraulic Engineering and Geomatics

**PNRR_352 Research Field: CHARACTERIZATION OF THE HYDRAULIC PROPERTIES OF
POROUS ASPHALT FOR THE OPTIMIZATION OF WASTE-WATER COLLECTION AND
TREATMENT SYSTEMS***

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

**Motivation and objectives of the research
in this field**

The performance of transportation infrastructures is challenged by heavy rainfall events, whose frequency and intensity are expected to increase in a climate change scenario. The topic of sustainable mobility emerged as an urgent issue also in the context of the Italian National Research Plan (PNR 2021-2027, action A2: Infrastructures for eco-compatible, efficient, safe and resilient mobility). Permeable pavements such as porous asphalt (PA) have proved to be powerful tools to manage stormwater in urban watersheds, offering great advantages in terms of rainwater runoff and traffic safety. Thanks to the high degree of PA connectivity, rainwater can infiltrate through the road surface and be collected in the designed treatment facility. The latter is needed due to the fact that a wide variety of organic pollutants emitted by vehicles and traffic-related activities resulted to be persistent to degradation and tend to bioaccumulate, with a potential environmental impact. The optimization and maintenance of stormwater collection and treatment systems requires an accurate prediction of water fluxes and pollutants concentrations. This highlights the need of characterizing PA in terms of key properties governing the



	<p>dynamics of flow and transport phenomena. Key objectives of the research are: (i) to develop experimental procedures for the determination of flow and transport properties of PA samples and (ii) to evaluate possible mechanisms of interaction between PA and organic pollutants of practical interest.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The project will rely on both numerical and experimental activities, according to the following steps:</p> <ul style="list-style-type: none"> •Definition of a conceptual model based on information and preliminary measurements conducted by the industrial partner (TECNE Autostrade per l'Italia) and specific literature on the subject; •Laboratory activity aimed at assessing flow and transport properties of PA samples made available by TECNE and related to sites of interest for the problem under examination; •Numerical simulation of flow and (reactive) transport processes at the pore scale (analysis to be carried out on digital twins of porous medium samples obtained via X-ray micro-tomography). <p>It is requested to the PhD candidate: i) to have a basic knowledge of Italian language, in order to interact with industrial partner technicians; ii) to be able to write technical report in Italian.</p>
<p>Educational objectives</p>	<p>Educate professionals with solid expertise in:</p> <ul style="list-style-type: none"> •Experimental practices aimed at assessing hydraulic properties of porous samples; •Modeling physical processes in complex systems. The PhD candidate, working jointly with academic and industrial environments, will acquire critical thinking and problem-solving skills to be applied for creating effective solutions to environmental and sustainability issues.



Job opportunities	Roads and railways management; local authorities and industrial companies offering monitoring services of mobility infrastructures environmental impact.
Composition of the research group	1 Full Professors 0 Associated Professors 1 Assistant Professors 1 PhD Students
Name of the research directors	Martina Siena

Contacts	
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	TECNE Autostrade per l'Italia
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	to be defined
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p><u>Universities, Companies, Agencies and/or National or International Institutions that are cooperating in the research:</u></p> <ul style="list-style-type: none"> •Université de Strasbourg/CNRS (France) •University of Lausanne (Switzerland) •TECNE Autostrade per l'Italia <p><u>Educational activities</u> (purchase of study books and material, funding for participation in courses,</p>



summer schools, workshops and conferences): approximately 1902,38 euros per PhD candidate per year, on average.

Teaching assistantship (availability of funding in recognition of support to teaching activities by the PhD candidate): there are various forms of financial aid for activities of support to the teaching practice. The PhD candidate is encouraged to take part in these activities, within the limits allowed by the regulations.

Computer availability: PhDs have their own computer for individual use. They will also have access to CFDHub (www.cfdhub.polimi.it), an Interdepartmental laboratory of PoliMi, with a state-of-the-art infrastructure and scientific computing system.

Desk availability: individual assignment for the entire career.