POLITECNICO DI MILANO

PhD in INGEGNERIA AMBIENTALE E DELLE INFRASTRUTTURE / ENVIRONMENTAL AND INFRASTRUCTURE ENGINEERING - 40th cycle

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

THEMATIC Research Field: REMOVAL OF PFAS AND (MICRO-)POLLUTANTS FROM WATER FLOWS DERIVED FROM INERT MATERIAL WASHING

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 presence of per- and polyfluoroalkyl substances (PFAS) and other micropollutants in water has raised significant environmental and public health concerns, particularly due to their persistence and resistance to conventional treatment methods. Several industrial activities, such as inert material washing, rely on modular small to medium-sized or mobile plants, which produce water streams likely contaminated with these substances. Effectively treating such streams is complex, as these plants cannot rely on all the treatment units available in large-scale wastewater treatment plants. Therefore, efficient treatments must be carried out in a few relatively simple steps, both in terms of plant engineering, process control and management. Recent revisions of European water and wastewater regulations, coupled with the increasing focus on sustainable industrial processes, water saving and reuse, pose new challenges for the wastewater treatment sector particularly concerning micropollutants. These developments underline the need for innovative treatment solutions. This research aims to explore, develop and optimize advanced water treatment processes for the efficient removal of potential pollutants from water flows resulting

	removal of potential pollutants from water flows resulting from inert material washing, addressing both environmental impact and operational challenges, while ensuring safer water management practices. The study will focus on understanding the characteristics of these water streams under various inert washing operating scenarios and on identifying suitable treatment solutions to minimize environmental impact and support water reuse.
Methods and techniques that will be developed and used to carry out the research	The research will begin with a comprehensive literature review to identify water volumes and potential pollutants present in water streams from inert material washing, along with their typical concentrations. A mass balance of the washing processes will be conducted to determine suitable treatment trains for different scenarios, considering varying features of the inert materials, washing equipment, and operational conditions. A Design of Experiments (DOE) approach will be used to design and conduct laboratory-scale experiments to evaluate, for instance, the adsorption capabilities of different commercially available activated carbons. For instance, the effect of carbon and water steams characteristics and operating parameters on the removal of various PFAS and micropollutants will be assessed. In parallel, the performance of alternative materials, particularly waste-derived materials, will be explored as potential substitutes for activated carbons, with a focus on their environmental sustainability and pollutant removal efficiency. To complement the chemical analyses, toxicity tests (such as Daphnia assays and germination tests) will be conducted to assess the overall effectiveness of the treatments, providing insights into the safety of treated water and its potential for non-closed-cycle applications and reuse. The project will also involve developing a comprehensive mass balance to evaluate the feasibility of water recovery for washing or other applications, contributing to a circular economy approach. The outcomes of this PhD research are expected to contribute to several Sustainable Development Goals

	(SDGs), including SDG6 (Clean Water and Sanitation) by developing treatment techniques that improve water quality and support water reuse; SDG3 (Good Health and Well-being) through the removal of harmful pollutants, reducing health risks; SDG9 (Industry, Innovation, and Infrastructure) by fostering the development of advanced technologies in industrial water treatment; SDG11 (Sustainable Cities and Communities) and SDG12 (Responsible Consumption and Production) through the reduction of water pollution, the promotion of sustainable industrial processes, and enhanced resource efficiency. It is requested to the PhD student to be autonomous in transferring to the sites selected for the research by car (no public transportation available to the plants managed by Tecnoidea Impianti).
Educational objectives	The main objective of this PhD project is to train professionals who can: • conduct autonomous research and become experts in topics related to environmental contamination and water treatment; • design and plan effective interventions for the removal of pollutants from water streams; • assess the environmental and human health implications of these interventions. The PhD student will benefit from internal knowledge transfer and continuous exchange with experienced senior researchers at the university. Additionally, through collaboration with Tecnoidea Impianti, industrial partner specializing in water and sludge treatment technologies, the researcher will have the opportunity to gain real-world experience, combining academic research with practical industrial applications. This synergy will provide the student with valuable insights into the technical challenges faced in industry, enabling them to apply research-driven solutions to address these challenges effectively.
Job opportunities	Industrial sector (water and wastewater treatment and management, consulting), senior consultants for engineering companies, public bodies and authorities

	involved in environmental policies, research agencies and institutions.
Composition of the research group	0 Full Professors 1 Associated Professors 2 Assistant Professors 5 PhD Students
Name of the research directors	Manuela Antonelli

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

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Educational activities (purchase of study books and material, funding for participation to courses, summer schools, workshops and conferences): the Ph.D. programme supports the educational activities of its Ph.D. students with an additional funding equal to 10% of the scholarship, starting from the first year.

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

Computer availability and desk availability: 1st year +2nd year +3rd year: individual use.