



PhD in INGEGNERIA AMBIENTALE E DELLE INFRASTRUTTURE / ENVIRONMENTAL AND INFRASTRUCTURE ENGINEERING - 39th cycle

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

PNRR 117 Research Field: RESOURCE RECOVERY FROM RESIDUES DERIVED FROM
DRINKING WATER TREATMENT *

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

Nowadays, the human pressure on natural resources has been growing due to the urban growth, leading governments to consider innovative management strategies. In particular, we are assisting to a shift of paradigm, from linear resources flows, in which resources are exploited for goods production which then become a waste, to a circular resources flows, in which recovery and reuse are the key steps towards an effective reduction of the environmental impacts.

In this perspective, the circular economy principles have been largely applied to the wastewater treatment field, promoting virtuous practices for: i) wastewater reclamation to be used for irrigation in the agricultural field, ii) nutrients recovery, especially phosphorus, iii) bioenergy production to reduce fossil fuel exploitation. Completely extraneous to the concept of the circular economy is remained the drinking water treatment field so far. In fact, drinking water production is always associated to consumers' safety, neglecting its multiple impacts on the environment, in terms of required resources and energy.

However, the circular economy concept could be applied also to the drinking water treatment field, acting at two levels: i) optimisation of the treatment trains in terms of



	<p>levels: i) optimisation of the treatment trains in terms of chemicals and energy, to reduce their fingerprint on the environment, also contributing to limit the greenhouse gases emissions; ii) recovering resources from the residues of the treatments, e.g. the sludges derived from the various liquid/solid separation operating units which are conventionally used in this field.</p> <p>The main aim of this project is to develop an integrated framework for the implementation of the circular economy concept in the drinking water treatment field. In detail, the different operating units will be linked to the resources contained in the residues, defining the protocols for an effective recovery. The feasibility of the recovery will be also assessed, based on the size of the drinking water treatment plants and the match with the eco-design principles for the recovery procedures, to approach a sound sustainability.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>Research will be carried out through both experimental and modelling approaches, after an extensive literature review.</p> <p>Experimental work will be focused on: i) residues characterization; ii) development of protocols for resources recovery (char, bioflocclulants, metals, etc.); iii) recovered resources characterization and performance as a function of their potential application; iv) functionalisation of recovered resources to improve their performance and characteristics.</p> <p>Pilot-scale experiments will be planned and performed based on the results obtained at laboratory scale. Case studies will be selected according to their relevance with respect to the general aim of the research, among the ones proposed by Hera S.p.A., managing the integrated water system in Emilia Romagna.</p> <p>Advanced statistical analyses, such as the DoE (Design of Experiments) techniques, and modelling will support experimental plan design, data elaborations and optimization of the set-up strategies.</p> <p>Modelling work will be also focused on evaluating environmental and human health risk associated to the developed protocols.</p> <p>Interpreting models, including cost models, will be</p>



	<p>developed to provide design and operation guidelines for the integrated framework.</p> <p>It is requested to the PhD student: i) to be autonomous in transferring to the sites selected for the research by car (no public transportation available), considering that the work will be carried out in Milan and in various sites in the Emilia Romagna region; ii) to have a basic knowledge of Italian in order to interact with plant and lab technicians.</p>
Educational objectives	<p>The main objective is the formation of professionals that can develop autonomous research and become experts in environment-related topics who not only can plan and design interventions but can also assess their implications on the environment and human health.</p> <p>The young researcher will take advantage from internal know-how transfer and from the continuous exchange with the experienced senior members in the research group and from the collaborating research groups.</p> <p>Moreover, the researcher will have the opportunity to combine expertise collaborating with experts of Hera S.p.A., managing the integrated water system from which case studies are selected.</p>
Job opportunities	Research agencies, Research Institutions, industrial sector, public Bodies and Authorities involved in environmental policies and senior consultants for engineering companies.
Composition of the research group	0 Full Professors 1 Associated Professors 1 Assistant Professors 2 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

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	HERA S.p.A., Bologna, Viale Carlo Berti Pichat 2/4 - https://www.gruppohera.it/
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

Universities, Companies, Agencies and/or National or International Institutions that are cooperating in the research:

1. Politecnico di Milano, Department of Chemistry, Materials, and Chemical Engineering "Giulio Natta" (DCMIC)
2. University of Milan, Department of Chemistry

Educational activities (purchase of study books and material, funding for participation to courses, summer schools, workshops and conferences): the Ph.D. course 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 assistantship (availability of funding in recognition of support to teaching activities by the PhD student): Ph.D. students are encouraged to apply, upon prior authorization, to the calls to support teaching activities at the undergraduate and Master levels at Politecnico, being paid for that. The teaching assistantship will be limited up to about 80 hours, maximum half of them devoted to teaching and classroom activities and the rest to support classworks and exams.

Computer availability and desk availability: each Ph.D. student has his/her own computer for individual use. Each Ph.D. student has his/her own desk, cabinet and locker.