



PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 39th cycle

THEMATIC Research Field: NUMERICAL AND EXPERIMENTAL CHARACTERIZATION OF TWO-PHASE EXPANSIONS OF ORGANIC FLUIDS

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

CUP: D53D23018390001.

The research will be carried out in the framework of the project POWHER (Partial evaporation ORC systems for industrial waste heat recovery) funded by the Italian Ministry of University and Research (MUR) through the financing scheme PRIN 2022 PNRR.

The research is motivated by the opportunity of implementing large-scale partial evaporation organic Rankine cycles (PE-ORCs) as power production systems with enhanced efficiency with respect to more traditional ORC plants. ORC are power production systems effectively applicable to exploit renewable and heat recovery energy sources, thus capable of providing a relevant contribution to decarbonization. The distinctive feature of PE-ORCs is the two-phase (vapor-liquid) process occurring within the expander (typically a turbine for MW-scale plants). The two-phase expansion needs to be properly modelled within computational fluid dynamics (CFD) tools employed for expander design/analysis. To date, the lack of two-phase process models tailored to organic fluids, including possible thermo-chemical non-equilibrium, which are experimentally validated, is one of the main factors that prevented the industrial development of PE-ORCs. The proposed research aims to fill this gap



	through the development of accurate computational models of two-phase expansions of organic fluids and by their experimental validation via two-phase nozzle expansion tests on organic fluids at the TROVA facility of Politecnico di Milano.
Methods and techniques that will be developed and used to carry out the research	To carry out the research numerical tools to model two-phase expansions of organic fluids need to be developed (on the basis of existing ones, applied to different fluids). Also, suitable experimental methods and measurement techniques need to be developed and implemented. This includes the design of experiments and of the TROVA nozzle test section, as well as the implementation of the control and measuring systems required to run two-phase tests.
Educational objectives	Main educational objectives are: - understanding the physics of two-phase flow processes, especially in the case of organic fluids; - design, implement, and apply experimental methods suitable to provide insights on two-phase expansions of organic fluids; - developing two-phase models to be implemented in CFD design/analysis tools for turbomachines; - running facilities/prototypes operating with non-conventional fluids at high temperature and pressure.
Job opportunities	Job opportunities, especially in R&D divisions, are mainly in: - organic Rankine cycle and heat pump manufacturers; - energy/chemical process companies involved in plant construction and management (e.g. power production units, refineries, etc); - process and energy components manufacturers, e.g. fluid machines, heat exchangers, boilers; - oil and gas industry;- research centres and academia.
Composition of the research group	3 Full Professors 1 Associated Professors 1 Assistant Professors 3 PhD Students
Name of the research directors	Andrea Spinelli (Supervisor), Alessandro Romei



Contacts

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Additional support - Financial aid per PhD student per year (gross amount)	
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Housing - Foreign Students	--
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Housing - Out-of-town residents (more than 80Km out of Milano)	--
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Scholarship Increase for a period abroad	
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Amount monthly	700.0 €
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By number of months	6
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Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Educational activities: Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentation and computer, etc. This amount is equal to 5.707,13 for 3 years.

Teaching assistantship: Availability of funding in recognition of supporting 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: individual use.

Desk availability: individual use.