



PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 41st cycle

THEMATIC Research Field: ADSORPTION PROCESSES FOR CO₂ CAPTURE

Monthly net income of PhDscholarship (max 36 months)

1600.0

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

Adsorption is one of the most promising emerging technologies for capturing CO₂ from point source emissions and from the air via direct air capture (DAC) processes. Adsorption processes have unexplored potential in hard-to-abate sectors with intermittent gas properties (e.g. steel production) and in synergy with the recovery of waste industrial heat and cooling energy (e.g. from LNG regasification). The overall objective of this PhD project is to perform techno-economic analyses of different applications of adsorption-based CO₂ capture processes. The project will be developed through the following work packages (WPs):

- WP1: Literature review on sorbent materials and adsorption processes for CO₂ separation from different sources (flue gases from different emitters and air). Identification of sorbent materials and process flowsheets to be considered in the following WPs.
- WP2: Development of models for the calculation of the mass and energy balances of CO₂ separation via PSA, VPSA, TSA, VTSA processes, with different sorbent materials.
- WP3: Development of models for the optimization of adsorption-based CO₂ separation processes integrated with CO₂ purification units and designed for different industrial processes.



Methods and techniques that will be developed and used to carry out the research	The research program requires the use of the following computational tools: • Aspen Plus and Aspen Adsorption softwares, for the calculation of mass and energy balances of the CO₂ adsorption processes. • MILP optimization software (using programming language - such as Matlab, Python, or GAMS) for the optimization of the integrated adsorption processes.
Educational objectives	The PhD candidate will: • Become expert in critically analysing the performance of energy conversion processes from energy, environmental, and economic points of view. • Acquire specific process modelling and process optimization skills, becoming a proficient user of software for process simulations (Aspen Plus) and for optimization. • Acquire skills in scientific writing and in the dissemination of scientific results at conferences. • Acquire skills in teaching and supervision of younger students. • Acquire project management skills. • Possibly, acquire skills in the preparation of research project proposals for competitive calls.
Job opportunities	Apart from academia and research institutes, the main expected job opportunities after the PhD will be in consultancy and in industry (both technology providers and end users), which, in the next decade, will implement low-emission processes and technologies.
Composition of the research group	5 Full Professors 9 Associated Professors 5 Assistant Professors 25 PhD Students
Name of the research directors	Manuele Gatti, Matteo Carmelo Romano



Contacts

manuele.gatti@polimi.it matteo.romano@polimi.it

Additional support - Financial aid per PhD student per year (gross amount)	
--	--

Housing - Foreign Students	--
----------------------------	----

Housing - Out-of-town residents	--
---------------------------------	----

Scholarship Increase for a period abroad	
--	--

Amount monthly	800.0 €
----------------	---------

By number of months	6
---------------------	---

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 10% of the annual gross amount 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.

Awards: Awards up to a cumulative amount of euro 16'000 gross for the entire PhD duration (split in different contributions among the different years) may be granted upon achievement of satisfactory results in terms of scientific performance and contribution to side activities. More details will be provided by the supervisors/tutor and PhD school.