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

PNRR 630 Research Field: IMPROVEMENT OF BIOLOGICAL HYDROGENOTROPHIC METHANE PRODUCTION FROM CO AND CO2 UNDER DIFFERENT REACTOR CONFIGURATIONS. MODELLING AND EXPERIMENTAL ACTIVITIES

Monthly net income of PhDscholarship (max 36 months)
€ 1500.0 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	Climate change demands urgent and substantial interventions in our energy systems. Power-to-CH_4 technology emerges as a pivotal solution, enabling the storage of surplus renewable energy while capturing carbon, thus playing a dual role in combating climate change. Hydrogenotrophic Methanogenic (HM) Archaea are to biologically catalyze CO_2 and CO with green H_2. So far, research on biological methanation of CO_2 has reached quite high TRLs (> 5), while methanation from CO is at a much lower TRL stage. In both application, a crucial aspect is to develop and optimize reactor configurations able to foster as much as possible the H_2 transfer rate. The research aims are: to identify best operating conditions and reactors configurations to achieve a high conversion efficiency to methane of CO and CO_2 blends and to study technical solutions to increase the transfer of hydrogen by reducing the energy consumption of this phase. The research is fully coherent with the Green Deal objectives.
Methods and techniques that will be developed and used to carry out the	The research methodology combines experimental and

research	modelling techniques. Experimental batch tests will serve to understand the factors affecting CO methanation rate and efficiency. Then two small pilot scare reactor configurations will be tested under continuous and dynamic feeding: a biofilm gas transfer membrane and a trickling bed reactor (@RSE SPA). Studies and modelling of the fundamental processes governing the process (i.e.: microorganism growth of fixed support, gas transfer, chemical equilibria in the liquid phase) will complete the research paving the way for the simulation of reactor performances.
Educational objectives	To develop substantive knowledge, to master the analytical and methodological skills required to evaluate and conduct research, to design original research in this area, to demonstrate the ability to communicate the results of his/her research in a clear and effective manner, aware of the importance of adequate and accurate science communication to different stakeholders.
Job opportunities	Typical opportunities into the job market are: R&D Industrial Divisions, Universities and Research Centers, local and national Authorities and Environmental Agencies, environmental consulting companies.
Composition of the research group	1 Full Professors 0 Associated Professors 1 Assistant Professors 0 PhD Students
Name of the research directors	Francesca Malpei

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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	750.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	RSE Spa - https://www.rse-web.it/
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	Université de Montréal (Canada, prof. Guiot group) and/or DTU (prof. Angelidaki group) and/or Washington State University (prof. Ahring group)
By number of months abroad	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.