POLITECNICO DI MILANO

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

THEMATIC Research Field: MULTI-PHASE FLUID DYNAMICS OF BUBBLE COLUMNS: EXPERIMENTAL AND NUMERICAL INSIGHTS AND ADVANCES

Monthly net income of PhDscholarship (max 36 months)
1700.0 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	**Bando a valere sul fondo FIS2 (Decreto Direttoriale n. 1236 del 1-8-2023), progetto AURIGA, Codice progetto FIS-2023-00204, CUP D53C25000730001** The increase in atmospheric greenhouse gases, particularly CO2, is a major driver of climate change, with the energy sector contributing a significant proportion of global emissions. Gas-liquid reactors are one of the key technologies for carbon capture, allowing CO2 to be absorbed in solvents. In particular, bubble columns have been widely used in this context due to their ease of operation, minimal maintenance requirements and excellent heat and mass transfer capabilities. Unlike traditional organic solvents, ionic liquids are low temperature melting salts classified as 'green solvents', characterised by low volatility, high thermal stability, non-flammability and customizable physic-chemical properties. However, there is a significant gap in the understanding of the fluid dynamics (at different scales) of bubble columns operating with ionic liquids, highlighting the need for in-depth research, on both the experimental and the modeling perspectives. This research aims to bridge this gap. Objectives of the research are:

	1. Carry out systematic multi-scale experimental investigations of two-phase bubble columns (at different scales) operating with ionic liquids, considering mixtures of ionic liquids and water at different concentrations. 2. Derive, validate and apply predictive numerical tools (e.g. CFD and lumped parameter models) that accurately describe the fluid dynamic behaviour of the multi-phase system. 3. Explore innovative design configuration of the gas injector that could lead to controlling the fluid dynamics properties in the bubble column. 4. Disseminate the findings widely within the industrial and academic communities, thereby fostering the adoption of best practices and shaping the direction of future research.
Methods and techniques that will be developed and used to carry out the research	The expected tools to be used during the research are: **Theoretical tools**: Statistical analysis, Machine Learning, … **Computational tools**: Matlab, Python, ANSYS Fluent, DNS ad-hoc codes…
Educational objectives	In general, this activity aims to promote interdisciplinary collaboration, develop critical thinking, and advance research skills. In particular, the PhD candidate will acquire high-level skills and expertise in the field of fluid dynamics research. The presence of international collaborations will allow the student to interact with leading European and non-European institutions in this research area.
Job opportunities	Job opportunities for a successful PhD candidate include both industrial and academical research or specific job positions as Thermal-Fluid Engineer
Composition of the research group	2 Full Professors

	4 Associated Professors 3 Assistant Professors 10 PhD Students
Name of the research directors	Giorgio Besagni

Contacts
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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	850.0 €
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, instrumentations 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.