Ph.D. position in Modeling chemical absorption at the gas-liquid interface

CENTRE SPIN/DEPARTMENT PEG/LABORATOIRE LGF

JOB ENVIRONMENT:

Institut Mines-Télécom is the leading public group of engineering and management *Grandes Écoles* in France. Consisting of eight public graduate *Grandes Écoles* and two subsidiary graduate schools, *Institut Mines-Télécom* leads and develops a rich ecosystem of partner schools, economic, academic and institutional partners, key players in education, research and economic development.

Mines Saint-Étienne, a graduate school of the *Institut Mines-Télécom*, is responsible for education, research, innovation, industrial transfer and scientific culture dissemination. With 2,500 students, 500 staff and a budget of €50m, it has 3 campuses dedicated to the industry of the future, health and well-being, and digital sovereignty and microelectronics. It is ranked in the top 15 graduate engineering schools in France and the top 500 universities worldwide.

The 2023-2027 strategy of Mines Saint-Etienne is in line with that of *Institut Mines Telecom*. It aims to:

- Support the ecological, digital and generational transitions and educate the people involved
- Support national and European sovereignty in microelectronics and digital technology

To support this strategy, it is recruiting a doctoral student in Modeling chemical absorption at the gas-liquid interface.

JOB DESCRIPTION:

The centre "Sciences des Processus Industriels et Naturels" (SPIN) is a research, teaching and technology transfer centre renowned for its expertise in Process Engineering applied to divided solids (grains, droplets, bubbles, pores, particles, powders). As part of the Georges Friedel Laboratory (UMR CNRS 5307), it uses its scientific skills and cutting-edge equipment to support innovation by industrial companies faced with the energy transition and the need to invent new high-performance processes and materials. The SPIN centre is structured into three departments and six research themes: powder technology, geometry and physical chemistry of granular media, complex-fluid systems and geo-processes, industrial crystallisation and application of gas hydrates, reactivity and transformation of solids, electrical properties of solids interacting with gases and instrumentation.

One way to capture CO_2 consists in using absorption columns filled with textured sheets, upon which a liquid film flows in interaction with a confined counter-current turbulent gas flow. This allows CO_2 absorption via inter-phase reactive mass transfer from the gas to the liquid. The imposed goals in CO_2 reduction require improvements of the carbon capture process efficiency. Very ambitious optimization strategies based on a detailed knowledge of the hydrodynamics are essential. Indeed, controlling the waves at the gas-liquid interface can have a substantial impact on process efficiency: interfacial waves are beneficial to transfers, and surface textures enhance waves. Meanwhile, more waves (i.e. more interfacial transfer) means more risk of critical events, such as flooding, leading to a significant drop in the process efficiency. Thus, the current project aims at modeling the interplay between hydrodynamics, reactive inter-phase mass transfer and wall structures to uncover optimal configurations for maximizing CO_2 capture while reducing the risk of critical events such as flooding. The outcome of the project will be an efficient hybrid numerical tool, in which the liquid phase is represented via a low-dimensional integral model while the gas phase described with the unsteady Reynolds-Averaged Navier-Stokes (RANS) equations. The small computational cost required by the low-dimensional formulation will allow to investigate several flow conditions over long times, where direct numerical simulations (DNS) based on two-phase Navier-Stokes equations, although complemented with appropriate turbulence models, cannot be employed even with parallelization.

Your main tasks will be:

- Attend at group research meetings
- Attend at national and international conferences
- Write journal publications
- Research stay at a partner University for a short time

Tasks may change depending on the needs of the department and Mines Saint-Etienne.

The position is based on the Saint-Étienne campus.

PROFIL SOUGHT:

You are in one of the following situations:

- 5 years' higher education or equivalent

And ideally:

- Holder of a M.Sc. in Chemical/Mechanical Engineering (or equivalent)

You have the following skills, knowledge and experience:

- Fundamentals of fluid mechanics
- Fundamentals of transport phenomena
- Fundamentals of numerical modeling
- Performed internship on a fluid dynamics topic is a plus

You recognise yourself in the following abilities and skills:

- Motivated, eager to learn
- Motivated to face challenges
- Good spoken and written English
- Communication skills

WHY JOIN US:

Institut Mines-Telecom is characterised by:

https://www.youtube.com/watch?v=m39m6hdNC48

- A scientific environment of excellence
- A group with entities throughout France

Mines Saint-Etienne is distinguished by:

- A privileged working environment with a high student supervision rate and a high environment rate (support and back-up functions)
- First-rate experimental and digital resources
- Significant contract research activity (€11m/year in Research and Innovation contracts), mainly with industrial partners
- 25% international students, Member of the T.I.M.E. network and the EULIST European University
- A centre for scientific, technical and industrial culture - *La Rotonde* - which is unique in France, and which has a major impact on society (> 50,000 visitors per year)
- Pleasant workplace, easily accessible by public transport and close to motorways
- Public transport costs reimbursed up to 75% (subject to conditions)
- Sustainable mobility package

- Staff committee that subsidises sports, leisure, cultural and social events and activities
- The possibility of partial remote working
- 49 days annual leave

ADDITIONAL INFORMATION:

Recruitment conditions:

- Fixed-term contract for a period of 36 months
- Desired start date: 01/10/2025
- Remuneration will be set according to the candidate's profile, based on the rules defined by the *Institut Mines Télécom's* management framework
- Full time
- Position based in Saint-Étienne

The position is open to all, with accommodation available on request for candidates with disabilities.
The job is open to civil servants and/or the general public.
All applications may be subject to an administrative enquiry.

How to apply:

Applications (CV, covering letter, letter of recommendation if applicable) must be submitted on the RECRUITEE platform **no later than 31/05/2025. Note that the position will be closed if a suitable candidate will be found before the deadline.**

https://institutminestelecom.recruitee.com/o/modeling-chemical-absorption-at-the-gas-liquid-interface

As part of its Equality, Diversity and Inclusion policy, École des Mines de Saint Etienne is an employer that is committed to fair treatment of all applicants.

For further information:

For further information about the position, please contact:
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Useful links:

https://www.mines-stetienne.fr/

https://www.imt.fr/

https://www.youtube.com/watch?v=QUeuC5iQiN0

Protecting your data:
https://www.mines-stetienne.fr/wp-content/uploads/2018/12/Informations-des-candidats-sur-les-traitements-de-donn%C3%A9es-personnelles.pdf