

PhD position in Fluid Mechanics and Numerics for Thermochemical Heat Storage - 36 months

Centre SPIN/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 PhD student in fluid dynamics and numerics.

JOB DESCRIPTION:

Centre SPIN (« Sciences des Processus Industriels et Naturels ») of Mines Saint-Etienne is a research, teaching and technology transfer center recognized for its expertise in Process Engineering applied to granular media, at the service of innovation for industrial companies facing the digital and environmental transition. Most of the research activities in centre SPIN are carried out in the Georges Friedel Laboratory (LGF), a Joint Research Unit of the CNRS (UMR 5307), affiliated with the Institute of Engineering and Systems Sciences (INSIS). These researches address complex challenges related to the sustainability and energy efficiency of industrial components and installations, while exploring various stages from grain to factory. The study of powder technologies to contribute to both the industry decarbonation and the fight against global warming has become one of the main activities of centre SPIN/LGF.

The successful candidate will contribute to the MULTITHERMO project, a cutting-edge initiative focused on advancing Concentrated Solar Power (CSP) technologies, financed by the French National Research Agency (ANR). Thermochemical heat storage, a pivotal aspect of this project, involves storing thermal energy through endothermic and exothermic solid-gas reactions. Rotary kilns involving powders emerge as key players in this endeavour due to their potential for efficient energy storage. Thermochemical heat storage consists of storing thermal energy through an endothermic reaction that can then be reused at another time through the reverse exothermic reaction. Gas-solid reactions, particularly those in rotary kilns involving the chemical transformation of powders, are particularly interesting due to their much greater energy storage density, limitless storage duration as chemical bonds without heat losses, and simple product separation. Despite their potential, a satisfactory physical-chemical modelling that comprehensively incorporates the intricate interactions between fluid physics, granular flow, heat transfers and, chemical kinetics within rotary kilns has never been successfully carried out until now. The successful candidate will contribute to bridging this critical gap, paving the way for advancements in sustainable energy solutions.

Job duties and activities: your job will involve:

1. Modelling and Simulation of Rotary Drum:

- Develop and implement a comprehensive CFD-DEM model for granular flow in a rotary drum involving thermochemically interesting powders at low temperatures in the absence of chemical reaction.
 - Validate simulations using experimental results conducted by others at SPIN.
2. Modelling and Simulation of Electrical Rotary Kiln (ERK):
- Extend the validated model to simulate granular flow in an ERK with thermochemical storage reactions going on by adding a chemical kinetic module.
 - Compare simulations with experiments conducted at SPIN.
3. Extension to Solar Rotary Kiln (SRK):

Extend findings from ERK simulations to model granular flow in a Solar Rotary Kiln developed at PROMES, a research partner of LGF in the MULTITHERMO project. 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:

Master's degree in a relevant field (fluid mechanics, numerical modelling, chemical engineering...)

You have the following skills, knowledge and experience:

- Strong background in fluid mechanics and numerics
- Knowledge of chemical kinetics would be an asset

You recognise yourself in the following abilities and skills:

- Autonomy and proactivity
- Demonstrated research aptitude
- Excellent communication skills
- Strong ability to work in a team

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 october 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 30/06/2025**.

<https://institutminestelecom.recruitee.com/o/phd-position-in-fluid-mechanics-and-numerics-for-thermochemical-heat-storage-36-months>

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:

Loïc Favergeon, researcher at centre SPIN, supervisor of the PhD student

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For all administrative information, please contact:

Milica PETKOVIC– HR Administrator

Email: milica.petkovic@emse.fr

Tel: + 33 (0)4 77 42 02 08

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>