Applications for Eco-efficient Industrial processes: to produce and use cleaner, safer, and efficient energy

This Master of Science in Chemical Engineering is also partly focused on the study of industrial processes in relation with solid reactions (particles, powders, granular and porous media): studies ranging from micro to macro scale “From particles to processes”

Course structure

- Process simulation & Advanced thermodynamics (6 ECTS)
  - Focus on fluid thermodynamics
  - Focus on water thermodynamics
- Heat Generation: fission and nuclear reactor, combustion (4 ECTS)
- Applied fluid mechanics for industry (6 ECTS)
- Classical systems for massive energy generation (4 ECTS)
- Systems for mass production of energy based on renewable energies (5 ECTS)
- Energy processes biomass and solar (5 ECTS)
- One of the following modules:
  - Reactivity of heterogeneous systems and modeling for the design of reactors (6 ECTS)
  - Transfers, Reactors and Unit operations (6 ECTS)
- 6-month internship in laboratories at MINES Saint-Étienne or in R&D industrial Centres / 30 ECTS
**Job Opportunities**

Associate Professor, Research Engineer in Industrial R&D Centres, Engineering for Energy processes

Various profiles in the field of chemical processes related to the energy chain:
- Free carbon energy production: nuclear, fossils and bio-sourced
- Efficient plants: materials, energy and water management

**Internship Opportunities**

- Particle design: synthesis, reactivity and transport of dispersed and porous materials
- Modelling of powder chemical transformations in controlled atmospheres with a multiscale approach
- Crystallisation of gas hydrates for flow assurance, CO₂ capture, gas production, CO₂ sequestration and air-conditioning

**PhD Opportunities**

Thermodynamic and kinetic study of gas hydrate crystallisation (joint PhD with a petroleum company)
- Development of a NOx sensor for automotive exhaust applications (joint PhD with an automotive supplier)
- Study of oxalates mixtures decomposition (joint PhD with a nuclear fuel company)

**Requirements for applicants**

- Prior successful completion of a first year of a Master’s Degree in theoretical and/or applied science, or equivalent diploma (at the home university or Ecole des Mines) or 240 ECTS validated
- A good command of English is mandatory
With the collaboration of the Education and Research Centre for Science of Industrial and Natural Processes (SPIN) which gathers:

23 faculty members

28 PhD Students

Laboratories:
- PRESSIC: Processes with solid reactivity and solid-gas interactions
- ProPICE: Powders Processing, Interfaces, Crystallisation and Flow
- GSE: GeoSciences and Environment

Expertise, competences and skills:
- Heterogeneous and granular dynamic systems,
- Multi-physics and multi-scales models, from nm3 to km3
- In line, in-situ and off-line physico-chemical characterisations
- Technology: from sensor to process designing, sizing and prototyping

4 analytical platforms, 1 technology platform, 1 Nuclear room, 1 Nano room
- PC2 : Powder and Physico-Chemical characterisations, / ESMAT : Solids Thermal Micro-Analyses,
- SAC : Spectro and Chemical characterisations, / OSP : 2D and 3D Models in GeoSciences
- HALLE-T2E2: Hall for Energy and Water technologies prototyping

Industrial partners:
Areva, Total, Solvay, Rio Tinto, Arcelor, Lafarge, St-Gobain, Kerneos, Eramet