



Ph.D. Thesis Position (October 2021- September 2024)

Doctoral discipline: Process Engineering

Subject:

Valorization of sewage sludge ashes in cementitious materials

Host institution:

The work will mainly take place at Ecole Nationale Supérieure des Mines de Saint-Etienne (ENSM-SE)

158 cours Fauriel, CS 62362, 42023 Saint-Etienne Cedex 2, FRANCE

SPIN Research and Academic Center

Regular visits to industrial partners (FMI-Process and Vicat) are planned.

General context:

For thermal valorization, about one third of the sludge produced in Europe by urban wastewater treatment is incinerated. The mineral residue obtained at the end of this process (ash) is an ultimate residue that is currently disposed of in landfills. The annual quantity of ash produced in Europe is estimated to be between 3 and 4 million tons and is expected to increase in the coming years due to changes in European regulations on the use of sludge for land application and composting.

The desire to ash valorization is fully in line with a circular economy approach, on the one hand, by completing the thermal sludge recovery process designed by FMI-Process through a material valorization of the final residues produced, and on the other hand, by reducing the environmental impact and the carbon footprint of cementitious materials by reducing their quantity in construction materials.

Within the framework of a preliminary study on the pozzolanicity and the hydraulicity of ashes, the interest of a partial substitution of cement by ashes could be demonstrated. It appears then necessary to deepen this study in order to better characterize the reactions involved and to optimize the formulation in order to produce a valuable material. This work will be the subject of a contractualized collaboration between FMI Process (ash producer), Vicat (cement manufacturer) and the Ecole des Mines de Saint-Etienne.

Objectives:

The objective of this Ph.D. thesis is to understand the phenomena involved in the development of materials formulated by substituting part of the cement by ash of different origins, in order to optimize these formulations to obtain valuable materials. For that, many physico-chemical analysis techniques will be used in order to characterize in depth the ashes and the reactions implied during the hydration of the formulations as well as the nature and the quantity of the species produced. The properties of the obtained material will also be characterized in the fresh state (rheological properties, setting time...) and in the hardened state (mechanical and diffusion properties).

Contact:

Ph.D. supervisor: Philippe Grosseau, grosseau@emse.fr

Ph.D. co-supervisor: Alexandre Govin, govin@emse.fr

Candidate profile:

Motivated and ambitious student with a Master in Engineering or Master of Sciences (MSc) degree with a specialization in chemistry / physical chemistry / materials / civil engineering. Significant experience in the field of cementitious materials would be appreciated.

An aptitude for experimentation and teamwork is required.

Grant:

~1600€ net / month (research grant + teaching assistantship)

Application procedure:

The applicant should submit the following:

- Cover letter
- Resume
- Letter(s) of reference

to Philippe Grosseau (grosseau@emse.fr) and Alexandre Govin (govin@emse.fr).