# PhD Research Position
# (Nancy, France)

## « Impact of climatic conditions on long term performances of treated soils »

A fully funded PhD scholarship for 3 years at the Université de Lorraine (F) is available to start in October 2020. This work will be accomplished in cooperation with the company Ginger-CEPBTP.

Waste-geomaterials generated by construction and mining activities represent more than 50% of the total waste generated in Europe, corresponding to 1.5 billion tons of excavated geomaterials that are landfilled while at the same time virgin soil and rock resources are extracted and used by the same infrastructure projects. The fundamental goal of this thesis is to contribute to the development of strategies and tools for the valorisation of waste-geomaterials, and thus to turn a waste into a valued durable construction material. Although frequently used, this technique is limited to certain materials and applications due to a lack of knowledge on the coupling between the physical and chemical actions of the binder and the geotechnical behaviour of the treated material. The challenge is to determine how the site materials can be reused in a variety of contexts (backfill, dykes, canals, retaining walls, dams, etc.).

In this context, a key issue is the permanence of the effect of lime and/or cement treatment, especially when the treated soil is exposed to environmental stresses such as water cycles and permanent water circulation. A few studies based on in situ sampling have attempted to evaluate the performance of treated materials several years after construction of the infrastructure (Cuisinier et al., 2020, 2012; Cuisinier and Deneele, 2008; Gutschick, 1978; Kelley, 1988). At the same time, some experiments conducted on reconstituted samples in the laboratory have shown that the succession of humidification/drying (Alavez-Ramirez et al., 2012; Chittoori et al., 2018; Consoli et al., 2018, 2017; Dempsey and Thompson, 1968; Guney et al., 2007; Khattab et al., 2007) or permanent contact with water (Kenai et al., 2006; Mehenni et al., 2015) could lead to a significant decrease in the hydromechanical characteristics of the treated soil. Other processes, such as leaching (Le Runigo et al., 2011; McCallister and Petry, 1991; Moghal et al., 2015), can also induce a negative change in performance over time.

However, it is essential to take into account this evolution of the material subjected to environmental stresses in order to achieve an appropriate and sustainable dimensioning of earth structures made from treated soils. This is all the more important in the context of climate change, which will lead to ever-increasing environmental stresses on structures made of treated soil. In this context, the main objective of the thesis is to understand the evolution of the hydromechanical characteristics of soils treated with lime and/or cement as a function of environmental stress (hydric cycle and prolonged exposure to water). For this purpose, the research work will focus on reference soils and on treated materials taken in situ, just after the treatment or on old structures, several years after the commissioning of the structure.

The thesis work will combine an experimental approach and a modelling approach using the resources of the project partners. The thesis should lead to the development of an approach to take into account the alteration of the mechanical characteristics of a treated soil in the dimensioning of a geotechnical structure.

Candidates should own Master Degree in civil or geotechnical engineering at the beginning of the research project (October 2020), and have a strong interest in mechanics of geomaterials.

Knowledge of the French language is not mandatory, and the thesis could be written in English.

This work is part of an EU funded project (GeoRES). The candidate will interact with the other partners of the project (http://emps.exeter.ac.uk/engineering/research/computational-geomechanics/geores/)

**Conditions**

*Starting date* : October 2020 for a duration of three years

*Gross Salary* ≈ 24 000 € per year ("convention CIFRE")

*Partner n°1 :* LEMTA https://lemta.univ-lorraine.fr/

*Partner n°2* : Ginger-CEBTP : https://www.ginger-cebtp.com/

**How to apply ?**

Send before the 5 July 2020 a CV (2 pages max), transcripts, if available a copy of the Master thesis (pdf file, internet link, etc.) and the name of one referee to both supervisors:


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## References


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