

## Master training in the frame of research project BIO UP

### Hosting Laboratories:

- Univ. Clermont-Auvergne – Institut Pascal (UMR 6602)
- INSA Lyon – GEOMAS (EA 7495) / MATEIS (UMR 5510)

**Estimated duration:** February to July 2022

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## Mechanical and Thermal characterization of mineral-vegetal composites

### Context

Biobased materials, produced from biomass, are being increasingly used on a massive scale in the construction sector. From an environmental point of view, they allow the storage of CO<sub>2</sub> during their entire lifetime thanks to the mechanism of photosynthesis. In addition, their high porosity and chemical composition give them high hygrothermal and acoustic insulation properties. Therefore, these materials are key alternatives to traditional construction materials for the energy-efficiency renovation of existing buildings.

Hemp concretes are the most widely used biobased concretes in France. Although construction rules exist for these materials, their growth is still limited by the lack of knowledge and high variability of the performances of biobased concretes, especially for their mechanical properties.

### Objectives

The training is dedicated to the observation and characterization of mineral-vegetal interphases (ITZ). The first objective will be to study the properties of the interphase of several vegetal-binder couples selected in previous tasks. The second objective concerns the experimental characterization of the hygrothermal and mechanical performances of vegetal concretes at a composite scale.

### Methods

In a first step, the methodology to observe ITZ around vegetal particles will be developed. The novelty consists on the monitoring of the formation by imaging with a high-definition camera to measure the kinetics of the formation of the ITZ surface.

The second step will be dedicated to local characterisations for the different configurations: micro-indentation and pull-out tests of particles will be investigated to provide information on the gradient of elastic modulus from the matrix, ITZ, to the aggregate, and behaviour. As a result, it will be possible to assess material the level of compatibility of an aggregate from a batch with a given binder by comparison with the reference.

During the third step several sets of mechanical tests in compression and shear will be performed. Digital Image Correlation technique will be used to determine the stress paths and the stress transfer at the ITZ. The transfer of these stresses to the plant aggregate will be evaluated and will allow us to define the optimum mechanical strength for the investigated composites. Therefore, the global mechanical properties will be issued.

Secondly, the impact of the improvement of the ITZ will be assessed on the most important hygrothermal properties such as conductivity, diffusivity, effusivity, moisture buffer value (MBV), and water vapour transfer of the composites.

**Application and contacts**

The training will be supervised by Sofiane Amziane, Evelyne Toussaint, Salah Oulboukhite (Université Clermont-Auvergne), Fabien Delhomme (GEOMAS/INSA Lyon) and Elodie Prud'Homme (MATEIS/INSA Lyon).

All interested applicants should send their CV with a letter of motivation and a transcript of their M1 and M2 grades to [Sofiane Amziane](#) and [Fabien Delhomme](#).

**Gratuities: about 600 € per month**