PhD Thesis offer: Local moisture measurement in heterogeneous porous materials by electrical impedance spectroscopy

Context

Evaluating the energy consumption of thermal processes (like baking or drying) and the quality of the final product or predicting the performance and the durability of biobased building materials used in building envelops are challenges to overcome for the food-processing industry and the building sector. To help them, the lab develops coupled heat and moisture transfer models to have a better knowledge on the involved physical phenomenon and to be a ground for digital twins. Nevertheless, these models need to be validated against experimental data collected at product scale, but also at local scale, particularly for moisture content.

Nowadays, numerous indirect measurement methods were developed and tested to measure local moisture content in large homogeneous porous media (like soils or building materials) that are subjected to small hygrothermal loads. However, measuring moisture content in small (few centimeter) heterogeneous material subjected to structural change (creation of porosity) due high (> 200 °C) and fast (few minutes) thermal loads is challenging.

Description of the work

Objective

In this PhD-thesis, we aim to test the potential of electrical impedance spectroscopy. This method allows measuring rapidly with low disturbance the material electrical properties as function the frequency and evaluating the material physical properties, like moisture content.

Milestones

- State of the art on electrical impedance spectroscopy and on its application to porous media
- Getting familiar with the measurement method first on reference materials (homogeneous and isotropic) and then on materials with porosity heterogeneities, both conditioned at given moisture states. Comparison with other measurement techniques available in the lab.
- Measurement on materials subjected to thermal and/or moisture load with higher and higher dynamic and levels (moisture monitoring in building envelope, during material drying and last during baking). Comparison with numerical results.

Workplace and resources

The student will be helped by the technical staff of the laboratory to prepare the set-up and perform the measurements. Three associate professors will supervise the work and help the student in the results analysis:

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The PhD thesis takes place for 3 years (start in automn 2023) at IRDL in Lorient (France).

Skills required

Master 2 or 3rd year of « école d'ingénieur » with good knowledge in thermal sciences, materials sciences, metrology, physics, electronics and/or signal processing.

Application procedure

The interested candidate is invited to contact as soon as possible the supervisors of this project and send Curriculum vitae, cover letter and, if possible, a letter of recommendation.