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# Postdoctoral Position

## Fluid Transfers during Drying of Bio-based Construction Materials

Bio-based construction materials, formed by the dispersion of vegetal elements (wood, hemp, cellulose wadding, straw, etc) in a cementitious matrix, have the advantage of being light and made of partially recycled and recyclable materials. In addition they exhibit excellent acoustic and hygrothermal properties. Various thermo-hydro-mechanical models have been developed taking into account their heterogeneous structure, but large discrepancy between their predictions and real properties are still observed in some cases, which might originate from the original and partly unknown hygrothermal mechanisms of the vegetal phase [1]. The objective of this project is to clarify the physical origin of these properties.

In that aim we will focus on a few model materials, either made of a pure cellulosic phase or of vegetal elements dispersed in a model (clay or silica) paste. Water transport characteristics during imbibition, drying or pure vapor transfer will be studied with standard approaches (deformations, weight, flow rate, etc). However, the specificity of such materials, which is at the origin of their remarkable hygrothermal characteristics, is that they are able to absorb (bound) water which can then migrate through the solid structure by diffusion or desorb later. In order to follow these transfers, and in particular distinguish bound and free water transport or exchanges, we will use an original technique developed in Laboratoire Navier [1-3], which relies on NMR relaxometry. This non-invasive and non-destructive technique consists to analyze qualitatively and quantitatively the evolution of the shape of the distribution of NMR relaxation times for the liquid water in different states (bound or free water, in different pore sizes) in the system. Besides, MRI can also be used to study large composite systems (paste + vegetals). Depending on time and candidate skills, the candidate might be involved in molecular simulations of the transfer mechanisms at the scale of the adsorbed phase. These simulations will address the diffusion of bound water in fiber, the vapor absorption, and the bound water transfer between two fibers in contact. The objective is then to estimate the order of magnitude of the transport properties and deformations at a local scale, which are not directly accessible by experiments, and see how they can explain the macroscopic properties. This approach will rely on our experience [4-5] in the poro-mechanical modeling with adsorption in clays, rocks or cellulose.

**Involved groups :** *Rheophysics and Porous Media*: P. Coussot (http://philippecoussot.com), O. Pitois; *Multi-Scales*: L. Brochard; *NMR and MRI team*: B. Maillet

**Expected skills**: Background in chemical engineering, mechanics or physics. Previous experience in porous media is an advantage.

**Gross salary**: 2500 euros per month - **Initial duration**: 1 year - **Work start**: within the end of 2020

**Deadline**: The selection will start in July 2020 and continue until a suitable candidate is appointed

**Contact**: send a CV (résumé) including a list of publications to philippe.coussot@univ-eiffel.fr

**References**

[1] Zhou et al, *Physical Review Research*, 1, 033190 (2019)
[2] Lerouge et al, *Physical Review Applied*, 13, 044061 (2020)
[3] Fourmentin et al, *Construction and Building Materials,* 124, 405-413 (2016)
[4] Honorio et al, *Langmuir*, 33, 12766-12776 (2017)
[5] Brochard et al, *Langmuir*, 28, 2659-2670 (2012)