Postdoctoral Position

Vapor transfers through textiles: NMR and physical approach of fabric hygrothermics

A postdoctoral researcher position is open in the Coussot's group at the University Gustave Eiffel (East Paris) (http://philippecoussot.com)

Evaporation of moisture, usually sweat, is crucial in human thermoregulatory function. Clothing constitutes a protection against external conditions but it also usually stores humidity from sweat or ambient humidity. One of the factors considered as the most crucial in causing wear discomfort during physical activity is the presence of wetness at the skin-clothing interface, but due to fabric sorption clothing can also play a significant role in the moisture transport and heat loss due to sweating, as water vapor adsorption is an exothermic process. An analogous problematic exists with construction biomaterials which appear as excellent hygrothermal regulators. On another side, the drying of textiles requires a huge amount of energy and the search of the most efficient technique is a critical stake.

The current description of these processes relies on empirical models, global laws or statistical approaches, of limited applicability for describing vapor or heat transfers through fabrics. Also, sophisticated models have been developed which take into account at best all the internal processes (vapor transport, sorption, etc), but they generally involve various a priori unknown parameters. The predictions of these models appear to be in qualitative agreement with observations but can hardly be fully validated due to the absence of appropriate measurements of internal physical quantities. One of the major complexity in the process analysis lies in the fact that for hygroscopic fabrics such as wool, viscose, cotton, silk, nylon, some polyesters, etc, some significant amount of water can be absorbed by the solid structure from vapor in the surrounding air. The exchanges of this so-called bound water play a fundamental role in the humidity control and feeling. However, following the transport of bound water in such materials remains challenging.

We recently demonstrated the possibility to measure the local full amount of bound water at any time throughout a model textile sample with the help of Magnetic Resonance Imaging, and analyze the data with a simple diffusion model for vapor transport and sorption. The present post-doctoral research will develop further such experiments and models under various water transfer conditions, with different material types. The candidate will also develop an experimental technique to measure the temperature along the sample axis and/or the heat exchanges during the process, inside the MRI set up. The results will be analyzed with the help of relatively simple models, which will open the way to a full characterization and prediction of material textiles properties under different conditions, and to straightforward formulation of high performance materials by adjusting material constituents.

This work will be carried out in collaboration with NMR experts in Lab. Navier: R Sidi Boulenouar and B. Maillet.

The candidate is expected to have a PhD, a solid background in physics and/or fluid mechanics, and be strongly motivated by research.

Duration: Initial contract for 12 months, possibly extendable depending on achievements.

Gross salary: 2743 euros per month.

Start date: Late 2021 or early 2022. Selection process will start immediately and go on until the position is filled.

To apply or inquire further, please contact Prof. Coussot at philippe.coussot@univ-eiffel.fr

Application should include a current C.V. and a short letter of motivation, along with the names of at least two references.

References: H. Penvern, M. Zhou, B. Maillet, D. Courtier-Murias, M. Scheel, J. Perrin, T. Weitkamp, S. Bardet, S. Caré, P. Coussot, **How bound water regulates wood drying**, *Physical Review Applied*, 14, 054051 (2020)

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