PLEA2006 - The 23rd International Conference on Passive and Low Energy Architecture, Geneva, Switzerland, 6-8 September 2006 - Paper 603

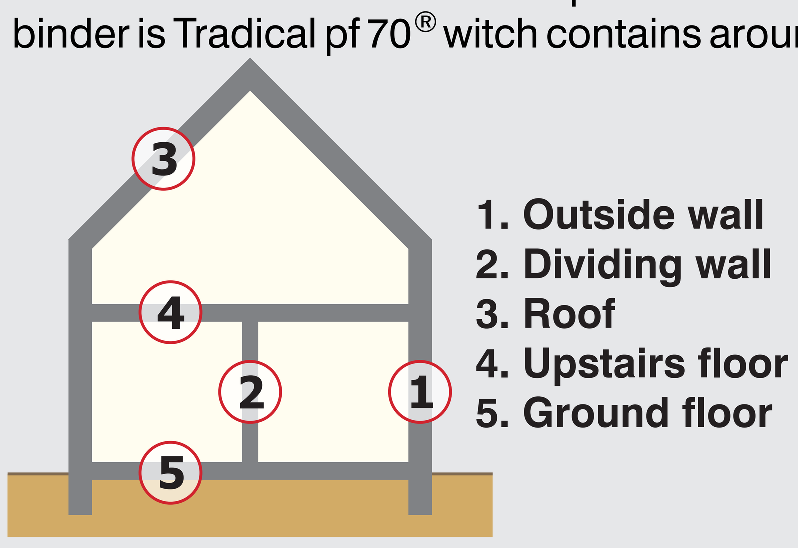
SORPTION BEHAVIOUR OF LIME-HEMP CONCRETE AND ITS RELATION TO INDOOR COMFORT AND ENERGY DEMAND

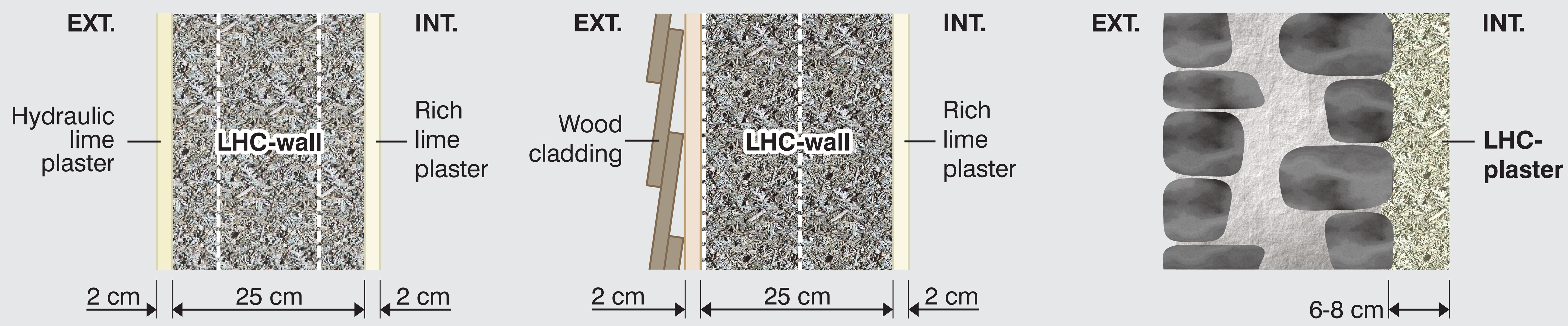
Arnaud Evrard
Architecture et climat, Université catholique de Louvain, Louvain-la-Neuve, Belgique - arnaud.evrard@uclouvain.be

Keywords: **sustainable building materials, transient transfer, moisture buffering, retarded sorption, moist thermal conductivity**

Various uses of Lime Hemp Concrete in buildings

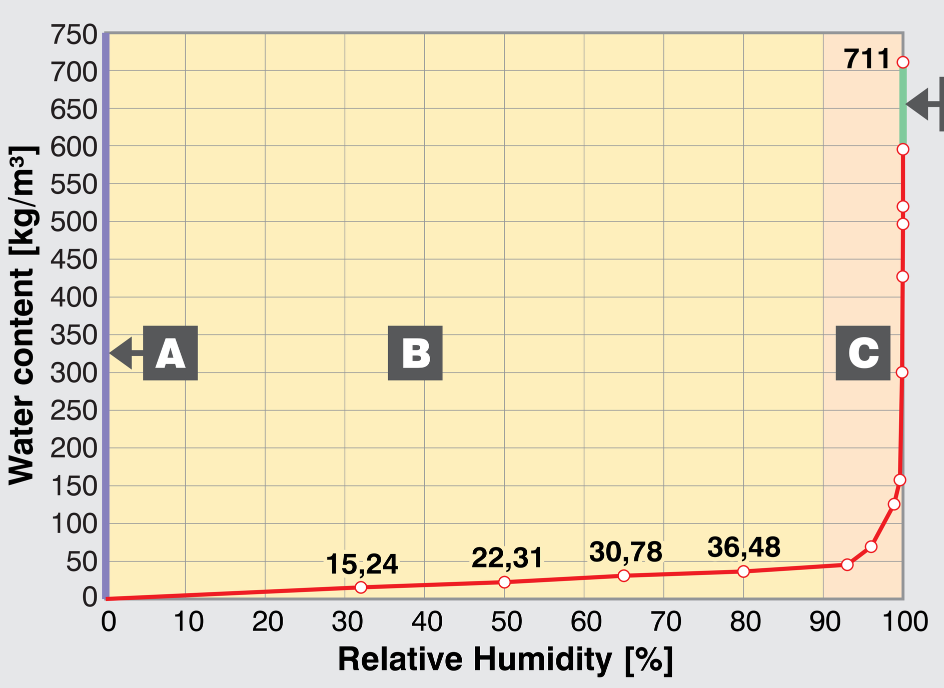
Hemp chips were first introduced in buildings in France in the beginning of the nineties to lighten concrete mixture. Through these experiments, practitioners noticed that better results were obtained with an appropriate lime-based binder. Lime-Hemp Concrete (LHC) is nowadays mainly used to cover masonry walls or to fill timber frame structures, in old or new buildings. It is also possible to use it for roof insulation and to realise light floor layers. For each different use, a specific mixture was defined: LHC-wall, LHC-roof, LHC-floor and LHC-plaster (depending on the quantity and the type of binder). This innovative insulation material have already been analysed in previous researches and many thermal, hydric, acoustical and environmental qualities were pointed out. The results presented here after are referring to a specific LHC-wall mixture made with the hemp chips Chanvribat® and the binder is Tradical pf 70® witch contains around 75 % of rich lime, $Ca(OH)_2$.



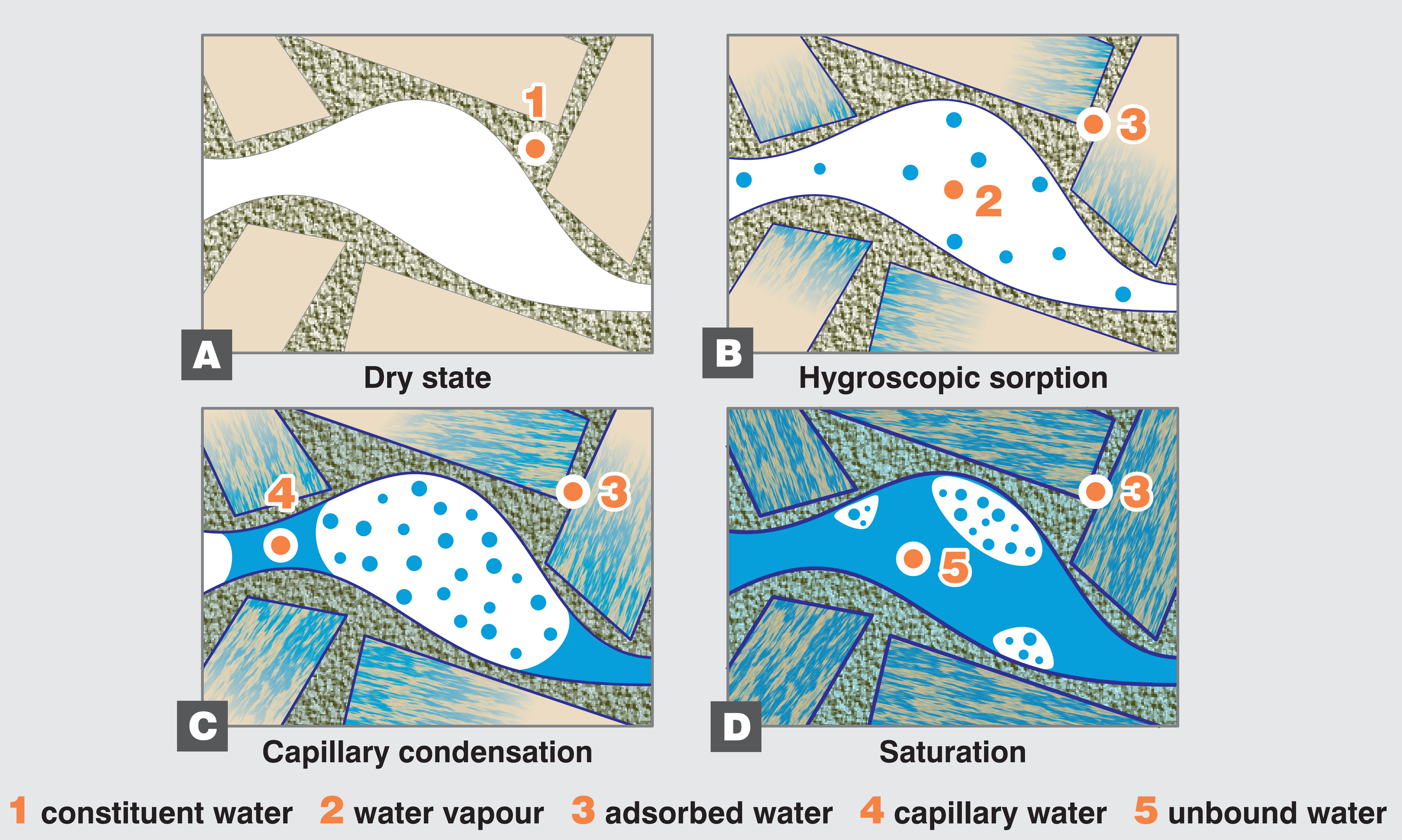


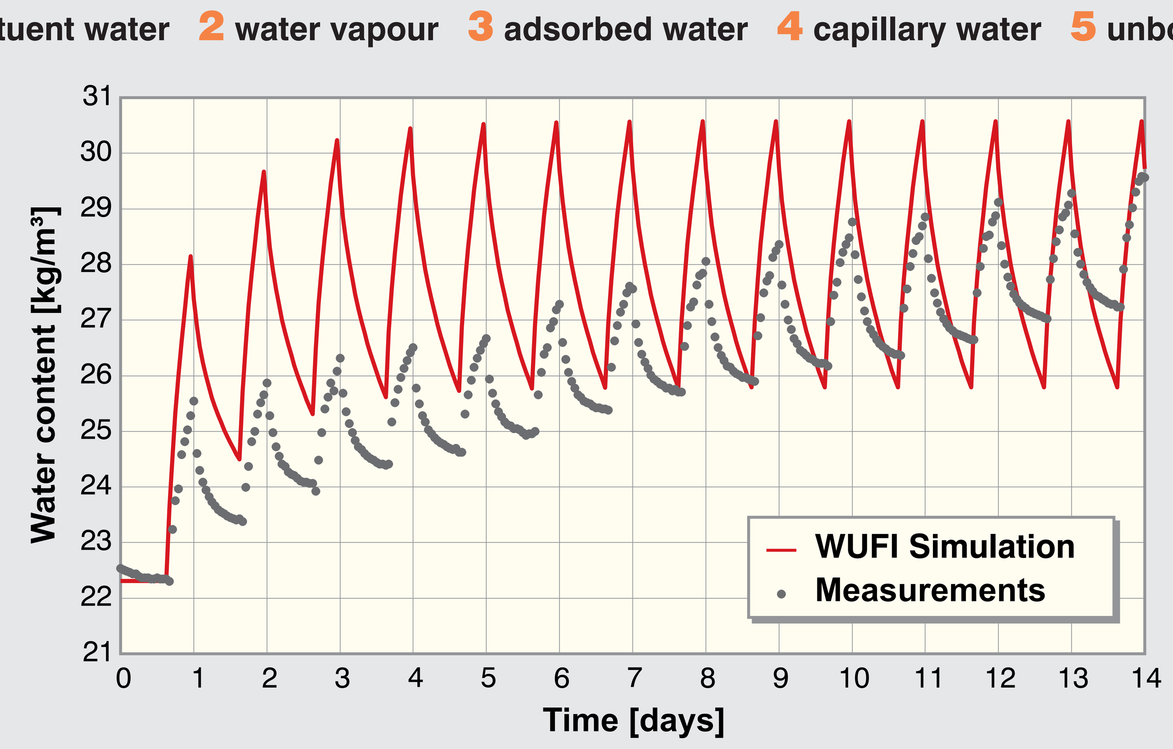
Sorption behaviour, equilibrium and transient state

The moisture retention curve of LHC-wall was established. It gives an overview of hydric behaviour in static conditions, but hydric equilibrium was sometimes very long to obtain. Samples were then submitted to humidity cycles during a dynamic sorption test inspired by the Nordtest project: 16 hours in 50 % of RH, followed by 8 hours in 80 %. The last graphic shows that computer simulations can lead to unrealistic results with this material if retarded sorption effects are neglected. Significant latent heat effects can also be vorestall.



Moisture retention curve

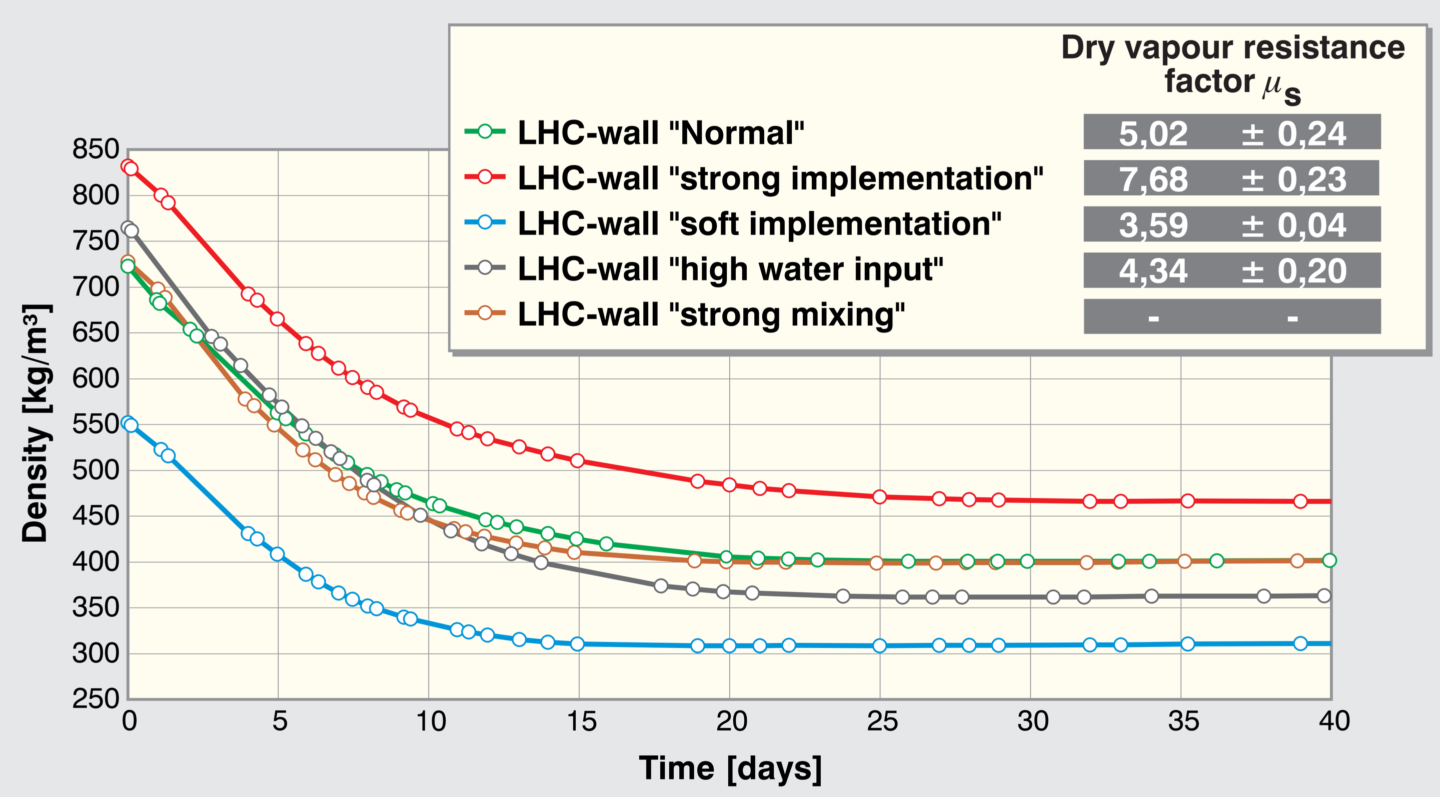




Moisture buffering

Drying, density and vapour resistance factor

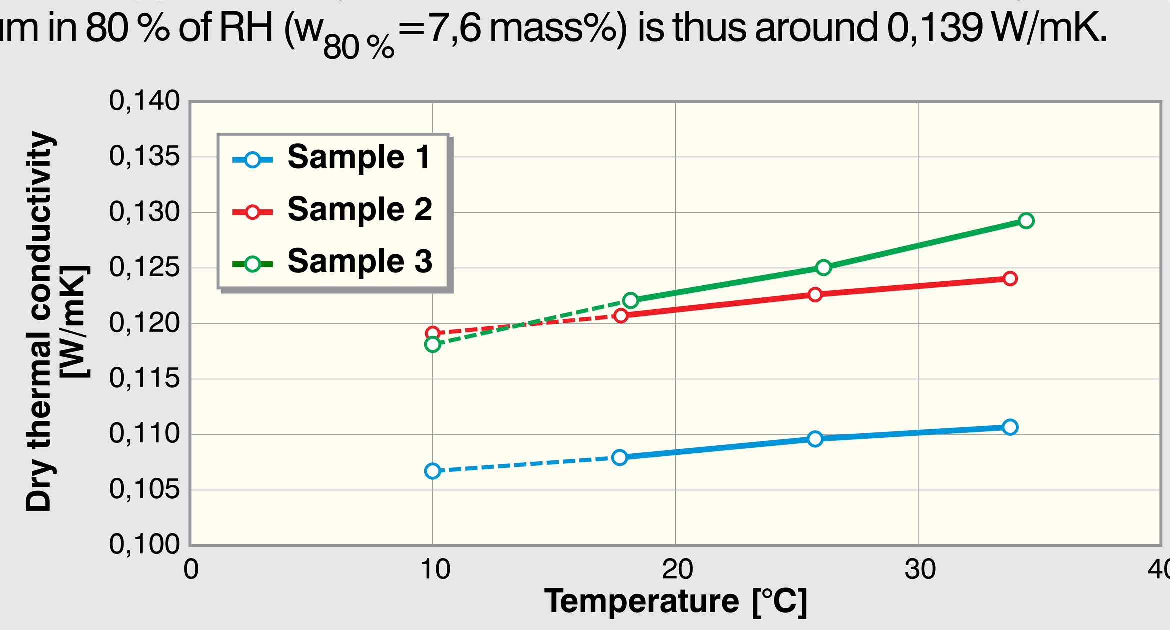
Recent experiments focused on drying process, density and dry vapour resistance factor of different groups of LHC-wall samples (diameter: 190 mm, thickness: 35 mm). These results show the influence of significant parameters on material's final properties



Drying of each group of LHC-wall samples

Thermal conductivity

Dry and moist thermal conductivity of LHC-wall was determined following DIN 52616. Mean dry value at 10°C is 0,115 W/mK with a standard deviation of 0,56 %. A linear relationship between thermal conductivity and water content was observed with a moisture-induced supplement of approximately 2,73 % / mass%. Thermal conductivity of samples at hydric equilibrium in 80 % of RH ($w_{80\,\%}$=7,6 mass%) is thus around 0,139 W/mK.



Dry thermal conductivity

Conclusion

The intermediate results here presented are part of a research with two main objectives: to gather a complete set of hygrothermal parameters for LHC, allowing computer simulations, and to define a precise building process to develop this technique in the Walloon Region. High thermal and hydric capacity, together with both low heat transfer parameters (in dry or wet state) and high moisture transfer ability can be pointed out to explain the low energy demand (insulation and thermal load) with natural humidity regulation observed with this kind of envelops. For all these reasons, we are convinced that LHC material can help to define a sustainable architectural environment for next generations.

Architecture et climat
Lhoist
Fraunhofer Institut Bauphysik
IBP
REGION WALLONNE