Water Conference 2015
www.waterconf.org

Cooling effect of water capillary rise through a porous cooked clayey brick

Patrizio Signanini

Department of Engineering and Geology, University of Chieti-Pescara, Italy, signanin@unich.it

Clayey bricks cooked according to the terracotta process [1] show unexpected cooling effect when they are partially immersed in tap water at room temperature. Significant and persistent decreases in temperature have been observed in bricks made up of a new very porous material during the water "capillary" rise. According to the experimental evidences, the brick and the risen water is a far-from-equilibrium system. This thermal decrease is related to two concurrent actions: (i) the highly porous property of the material used; and (ii) a transition-phase-like process of the water. Thus, the water not only cools down the material surface through evaporation at the sample–air interface, but it also expands within the material, causing a further internal decrease in temperature that cannot be explained solely through evaporation. This latter process is persistent enough to maintain the decrease in temperature over time. This unexpected characteristic of water and its persistence when diffusing inside an extremely porous medium are the most original results of this study. These results seem in agreement with the recent model on the fourth phase of water by Pollack [2]. The experimental evidences show the water–brick system works as a thermal engine that exploits the water dissociation phenomenon occurring in hydrophilic materials, that is H2On (the normal state of the water) passes to H2Oez (negatively charged in "exclusion zone") and H2Op (positively charged in "protonated water") water. This water state is not an equilibrium state and it needs a large amount of energy. The generated electric field can be fed by the environmental heat (of the medium) and, consequently, causes the cooling of the sample. For the experimental survey it seems that around 80% of the energy of the water passage from liquid state to vapor state, is spent for the passage from H2On to H2Oez + H2Op and only the remainder 10% is spent for the transition from polarized water to steam.

Finally, further experimental campaigns on both samples and in scale models are still needed to fully appreciate all the thermo-dynamic implications of this fourth state of water generated by the electro-chemical field established at the pore interfaces between the brick matrix and the water.

References

[1] Signanini P., De Santis A., Di Fazio M., Greco P., Merla A., Monosi S., Piazza F, Rainone M.L., Fenzi F., Torrese P. (2014). Unexpected thermal properties of water diffusion in very porous materials, in press on Journal of Water.

[2] Pollack GH. (2013). The Fourth Phase of Water, Ebner & Sons Publishers, Seattle, Washington.