11th. World Congress on Computational Mechanics (WCCM2014)
5th. European Conference on Computational Mechanics (ECCM V)
6th. European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

MODELLING TRACHEID CELL-WALL SORPTION

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Key words: Wood, Multi-physics, Moisture transport, Heat and Shrinkage/Swelling

ABSTRACT

Moisture sorption of wood cell-wall tissue is the governing phenomenon of wood's hygroscopicity. This means that in contrary to other porous materials for which hygroscopicity is a surface and capillary action phenomenon, the moisture balance between wood material and vapor in its surroundings is established by the chemical reactions of making and breaking hydrogen bonds. Since sorption concerns hydrogen bonds of the same character as found for liquid water, sorption can be considered a phase change of water, from (or to) vapor to (or from) moisture bound in the cell-wall tissue. As for all phase changes an energy exchange takes place during sorption. The heat of sorption is, therefore, one consequence of sorption. Another consequence is shrinkage/swelling of the cell-wall tissue as water molecules enters or leaves the cell-wall. Neither the influence of heat conduction in nor volume change of cell-wall have, to the authors knowledge, hitherto been included in sorption and/or moisture transfer models for wood material. An additional fact is that the cell-wall tissue is solid, i.e. if there exist pores they are not observable by AF-microscopy and therefore water molecules can only be exchanged at the cell-wall surface. Inside the cell-wall moisture is transferred by diffusion either inward from, or toward the cell-wall surface.

Present analysis considers modelling moisture sorption in cell-wall tissue as a diffusion process including the influence of heat of sorption with accompanying conduction as well as volume change of the actual cell-wall. The results are compared to sorption experiments on wood from Norway spruce [Picea Abies].