**Numerical simulation of moisture transport in thermally modified wood**

**exposed to rain**

Stefania Fortino1,\*, Petr Hradil1, Tuuli Uimonen2

1 VTT Technical Research Centre of Finland Ltd, P.O. Box 1000 FI-02044 VTT, Finland, [stefania.fortino@vtt.fi](mailto:stefania.fortino@vtt.fi), [petr.hradil@vtt.fi](mailto:petr.hradil@vtt.fi)

2 Jartek Invest Oy, Svinhufvudinkatu 19, 15110 Lahti, Finland, [tuuli.uimonen@jartek.fi](mailto:tuuli.uimonen@jartek.fi)

\*Corresponding author

**Keywords:** thermally modified wood, moisture transport, rain effect

Renewable wooden products exposed to continuously variable outdoor climates are strongly affected by the moisture levels in the material. High moisture contents accumulated in wood during long periods, in combination with favorable temperatures, represent a risk for the durability of thermally modified wood products because of the decay development. In this context, numerical simulations can quickly predict the high levels of moisture as well as the related risk of decay in decking products for buildings. This information can help to optimize the product maintenance for example suggesting the use of appropriate coatings. Earlier studies by the first author have shown that the single-phase finite element modelling of moisture diffusion in untreated wood is an efficient tool to simulate the moisture transport in wooden components of buildings sheltered from rain (Fragiacomo et al. 2011). An extension of this approach, that takes into account the effect of rain in thermally modified products, is proposed in the present paper. The sorption isotherms used in the model are measured at different temperatures above zero degrees Celsius within this research. In addition, the diffusion coefficient includes the contribution of free water in wood above the fiber saturation point. A case-study of thermally modified wood is numerically analyzed and the results in terms of moisture contents are compared with data taken from a previous research (Metsä-Korteläinen et al. 2011). In future work, the proposed moisture transport model will be combined with well-assessed models for wood decay (Brischke and Meyer-Veltrup 2016).

**Acknowledgements:** The authors would like to thank project DigiMoist1 (A Digital end-user toolset for Moisture assessment in Wooden buildings – 1st part: Hygro-thermal database), funded by the Finnish Ministry of the Environment within the “Wood Building Action Plan”, and project Click Design (Delivering fingertip knowledge to enable service life performance specification of wood), funded within the ForestValue Research Programme.

REFERENCES

Fragiacomo M., Fortino S., Tononi D., Usardi I., Toratti T. (2011) Moisture-induced stresses perpendicular to grain in timber sections exposed to European climates. *Engineering Structures* 33 (11): 3071–3078.

Metsä-Kortelainen S., Paajanen L., Viitanen H. (2011) Durability of thermally modified Norway spruce and Scots pine in above-ground conditions. Wood Material Science and Engineering, 6: 163–169

Brischke C. and Meyer-Veltrup L. (2016) Modelling timber decay caused by brown rot fungi. *Materials and Structures* 49:3281–3291.