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SORPTION MODEL FOR THE RISK ASSESSMENT OF MOISTURE DERIVED DETERIORATION OF WOOD

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ABSTRACT: The talk deals with investigating the exposition of wood artefacts to relatively fast changes of the ambient air humidity and the response of hygroscopic material in its moisture content. At the microscopic level the moisture sorption in wood is composed at least of two distinct processes, namely of the adsorption of water vapour in the lumens and of fixing the bound water in the cell walls, in the so called fiber saturation area. In spite of this complex nature it has been proved that in terms of macroscopic evaluation the moisture sorption in wood can be commonly described as diffusion by means of the Fick's law [1]. A specific dynamic model has been developed describing the moisture transfer between wood and the ambient air substantially changing its relative humidity. The model is particularly aimed at describing the moisture exchange in the surface layer of the specimen with the possibility to estimate the gradients of moisture sorption in the material layers. The dynamic properties of the moisture transfer are expressed by means of transfer functions. The interface conditions on the specimen surface are based on a specific notion of representative equilibrium moisture content (EMC) using the Zuritz model as the most suitable for this purpose [2]. Utilizing the relation between the moisture changes and the induced changes of the stress and strain in the material layers [3], safe limits of relative humidity variations are determined using frequency response analysis. For the model parameterization, a set of laboratory experiments are performed, to investigate the dynamical response of the moisture content and the associated deformations of the wooden samples to step-wise variations of relative humidity. The approach considers the RH climatic variability as a factor of constant impact on building hosting artworks which transfer the impact indoors affecting slowly but steadily the deformation resistance of the hosted artworks. In order to assess the resistance a threshold value assigned to each building is used and regularly monitored. Remote sensing by automated surface monitoring developed for this aim is used based on the principles of non-contact and non-invasive coherent interferometric metrology. Laboratory simulations on classified risk-index samples allow following up the changes in the deformation values and narrowing up a classification of deterioration risk to materials susceptibility to RH change.

References

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