ALLOWABLE THRESHOLDS IN DYNAMIC CHANGES OF MICROCLIMATE FOR WOODEN CULTURAL OBJECTS

Slawomir Jakiela, Roman Kozlowski and Lukasz Bratasz

Institute of Catalysis and Surface Chemistry, Polish Academy of Sciences, Cracow, Poland

Fluctuations in ambient relative humidity are considered to be one of the main factors which contribute to the deterioration of wooden cultural objects. Dimensional change is the most important consequence of moisture sorption by wood. A noteworthy effect of the dimensional change of wood is the resulting high stresses within the material, which can cause significant damage.

This paper reports on the *in situ* monitoring of the wooden polychrome and gilded main altar in the church of Rocca Pietore in Italy, carried out within the European Commission Friendly Heating project. The altar has been exposed to considerable climatic fluctuations in its microenvironment mainly due to hot air heating operating in the church. The main conclusion from the monitoring was that no shrinkage due to fall in RH could be detected in massive wooden elements due to their large size. The external dry zone of wood, generated during each heating episode, tended to shrink, but the shrinkage was restricted by the still wet and swollen interior. This created tension on this outer layer and high stresses were developed, as evidenced by the number of cracks running deeply into the wood's structure in the radial direction.

A systematic numerical modelling of the phenomenon has been undertaken. Moisture adsorption/desorption isotherms and water vapour diffusion coefficients were systematically determined for a full range of relative humidities and several temperatures. The results were used to model the moisture transport in wood subjected to climatic fluctuations and the resulting gradient in the moisture content in the cross section of a wooden element. The change of moisture content is concentrated in the outer part of the cross-section, as anticipated. Then, mechanical properties of wood as well as swelling/shrinkage in response to changes in temperature and relative humidity were determined. The results were used to calculate internal stresses due to non-uniform moisture distribution on drying or wetting. The