ACOUSTIC EMISSION MONITORING TO STUDY ENVIRONMENTAL FATIGUE IN WOODEN OBJECTS

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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. When wood is restrained in its movement, a noteworthy effect of the dimensional change are high stresses within the material, which can cause significant damage.

Monitoring the dimensional changes of the objects cannot however provide any direct information about the development of mechanical damage resulting from the stresses. The damage can be detected only indirectly by monitoring deformation of the object's surface but highly sensitive interferometric technique must be used, inconvenient *in-situ*. In contrast, an acoustic emission method can detect braking of fibres, cracking or detachment of cell walls in wood. The method, widely used in the engineering applications, records the acoustic waves generated during even very small releases of energy usually associated with mechanical damage. Therefore it can provide valuable information about micro fracture of wood, pre-cursors of macro damage as well as macro damage. Additionally, a failure occurring inside the material can be detected. Much higher frequency of elastic waves in the material than the frequency of the background noise enables acoustic emission method to be used in *in-situ* applications.

In the present work, systematic measurements of acoustic emission in specimens of linden, a tree species frequently used in cultural heritage objects, have been undertaken to determine signal frequency range, dumping coefficients and to optimise signal to noise ratio. Then, the specimens were subjected to various relative humidity changes and the number of acoustic emission events was recorded. Correlations between the accumulation of the events and damage were attempted. The results obtained have been used to validate results of modelling damage in wood under environmental stress aiming at establishing allowable thresholds in the slope, magnitude and repetition rate of the relative humidity fluctuation which wooden objects may ultimately endure without irreversible deformation or damage.