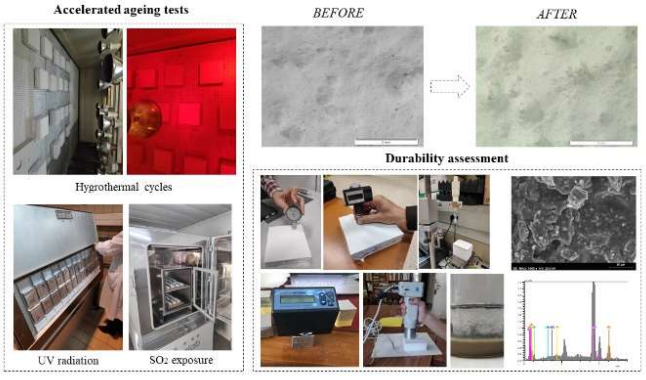
Durability for sustainability of multilayer rendering systems: ETICS and thermal mortars

Summary

The trend and the market of multilayer rendering systems, such as ETICS and thermal mortars, is spreading throughout Europe showing the great potential of these systems for either new constructions or thermal retrofitting of façades. They present several advantages when compared with other thermal insulation solutions, such as the correction of thermal bridges, protection of the masonry and structural elements, and increase of thermal efficiency, with relatively low installation costs and ease of application. Nevertheless, a number of questions have been raised on their long-term durability, particularly related to biodeterioration. This PhD study will contribute towards the development of ETICS and thermal mortars multilayer systems (TMMS) with improved durability in the urban environment through the analysis of the main degradation mechanisms and the definition and validation of an optimized durability assessment methodology, including the risk of biocolonization. An extensive literature review will be performed at the beginning of the study and for each component task keeping the present state of the art updated, particularly on the main causes of degradation of multilayer thermal rendering systems as well as the analysis of existing durability assessment methodologies. According to the present knowledge, 12 different sound systems will be selected and characterized following the adequate National or International Standards. Water performance (i.e. capillary absorption, drying, water vapor permeability, water absorption under low pressure), surface properties (roughness, color, gloss), thermal conductivity, porosity and microstructure will be assessed. Furthermore, the susceptibility of ETICS and TMMS to biological colonization (mould growth) will be assessed. This task will allow the development of a combined performance criteria of multilayer rendering systems considering the material/system properties, water resistance and bio-susceptibility as well as the definition of a simple and efficient method for assessing the systems bio-susceptibility. In Task 3, a set of simulations (e.g. WUFI Pro) will be performed to assess the hygrothermal impact on multilayer rendered façades. Mould growth will be assessed using three well-known and most established models: the VTT, the MRD, and the IBP biohygrothermal model. The results obtained will allow not only the definition of the system properties that most affect mould growth, but also the assessment of mould growth risk. The analysis of the specific degradation mechanisms (including biocolonization) and damages in these systems will help on the definition of an optimized durability assessment methodology. The durability of the systems will be assessed through accelerated aging tests (i.e., hygrothermal cycles, UV radiation cycles, exposure to pollutants) and natural exposure tests. Two stations will be used to ensure different environmental conditions (urban and maritime) and consequent degradation mechanisms. During natural exposure, monolithic IC devices will be used to monitor surface temperature (ST) and surface relative humidity (SRH) for each system. Theoretical models already available in literature will be applied using ST and SRH results to give an indication on mould growth. The systems will be also characterized throughout natural aging by means of non-destructive testing. Finally, the experimental and numerical results will be used in combination for the definition of an optimized durability assessment methodology.

Keywords

Thermal rendering systems, durability, accelerated aging, degradation mechanisms, hygrothermal simulation, biocolonization.



Methodology for the durability assessment of multilayer rendering systems.

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