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Water transfer properties and shrinkage in lime-based rendering mortars

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Rendering is the practice of covering a wall or a building façade with one or more layers of mortar, with the main aim to protect the masonry structure against weathering. The render applied must show high flexibility, good adhesion and compatibility with the support (i.e. stone, brick) and, overall, it should be characterised by low water absorption and high water vapour permeability.
Water (in the solid, liquid and vapour state) is one of the main factors that drive construction materials to deterioration. Therefore, to evaluate the quality and durability of a rendering mortar, thus ensuring its protective function in the masonry structure, it is fundamental to assess the behaviour of this mortar towards water.
Mortars were elaborated with a calcitic dry hydrated lime, a calcareous aggregate, a pozzolan, a lightweight aggregate, a water-retaining agent and a plasticiser. Four types of lime mortars were prepared, in which the binder-to-aggregate ratios were 1:3, 1:4, 1:6 and 1:9 by weight, whilst the pozzolan was kept at 10% of the lime (by mass) and the total admixtures proportion was less than 2% of the total mass. The influence of the characteristics of mortars pore system on the amount of water absorbed and the kinetics of absorption was investigated by means of: free water absorption and drying; capillary uptake; water permeability; water vapour permeability.
Interesting deductions can be made from the values of water and water vapour permeability found for mortars: the former increases exponentially with the sand volume of the mortar, whilst the latter increases almost exponentially with the initial water content added to the mortar mixes during their elaboration. However, the relationship obtained between porosity of mortars and permeability values is not really clear. This finding suggests that the permeability of a material cannot be estimated on the basis of its porosity as it can be made for the capillary uptake and free water absorption.
Another aspect to be considered in the evaluation of the decay caused by water is the high shrinkage suffered by renders when they are applied on an extended surface (i.e. a wall), especially when they are aerial lime-based mortars. The shrinkage causes the formation of fissures that become an easy way for water to entry and diffuse through the mortar pore system. This factor is rarely taken into consideration during the hydric assays performed in the laboratory, since mortar samples of 4x4x16 or 4x4x4 cm in size do not undergo to such degree of shrinkage. For this reason, we have also studied the shrinkage of these mortars and considered it in the final assessment of mortars hydric properties. The shrinkage was evaluated according to a non-standardized method, by means of a shrinkage-measuring device that measures the mortar dimensional variations over time. This measurement has shown that the highest the lime content the biggest the mortar shrinkage and, consequently, the strongest the decay due to water.