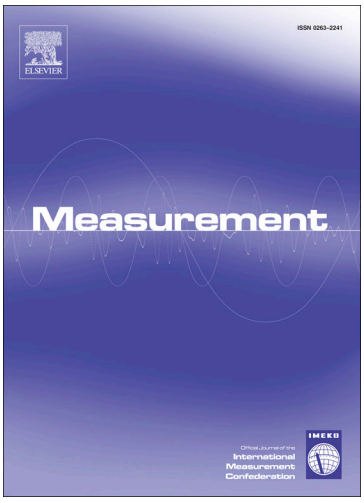

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Evaluation and monitoring of water diffusion into stone porous materials by means of innovative IR thermography techniques

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Abstract
This paper shows the application of two innovative infrared thermography (IRT) methods for the evaluation of water transport phenomena through the outer layers of porous stone materials. An infrared camera measured: a) the moisture stain due to the water absorption after having spilled a drop on the stone surface and b) the ”moisture ring” around the damp surface, after the contact between a soaked round sponge and the stone surface. The time of spreading and the geometric shape of the damped area depend on the porosity of the stone material and are useful to characterize the physical stone features. In addition, monitoring the evolution of the moisture ring by IRT allows implementing and optimize the data coming from protocols of water repellent products with data coming from the “contact sponge measures”. Moreover, moisture ring test links IRT and laboratory tests characterizing the transport phenomena of liquid and water vapour in porous building materials. Thirty specimens of marble, calcarenite and sandstone were tested with steady methods (dry index and water absorption by capillarity), that validated the data provided by the two innovative IRT techniques.

Keywords: evaporation, porosity, IR thermography, contact sponge, moisture ring, spilling drop

1. Introduction

The cycle of water-vapour exchange between air and masonry materials is mostly influenced by their chemical and mineralogical composition, hygroscopicity of mineral components, pores amount, their size, distribution and shape and by the surface hydrophilicity, as well known by the scientific literature [1, 2, 3, 4]. Water enters into a porous material as either vapour or liquid; as vapour is retained as a function of hygroscopicity, and it could cause the local phenomena of condensation; as a liquid, it could be transported through capillary network. In its path, liquid water dissolves soluble salts, which precipitates on the outer surfaces or in the layer underneath in functions of their solubility, giving raise to the efflorescence or sub-efflorescence phenomena