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Evaluation of the Efficiency of Nanomaterials in the Consolidation of Limestone

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Abstract : Nanomaterials are widely used nowadays for the consolidation of degraded archaeological limestone. It's one of the most predominant stones in monumental buildings and statuary works. It is exposed to different weathering processes that cause degradation and the presence of deterioration pattern as cracks, fissures, and granular disintegration. Nanomaterials have been applied to limestone consolidation. Among these nanomaterials are nanolimes, i.e., dispersions of lime nanoparticles in alcohols, and nano-silica, i.e., dispersions of silica nanoparticles in water, promising consolidating products for limestone. It was investigated and applied to overcome the disadvantages of traditional consolidation materials such as lime water, water glass, and paraliod. So, researchers investigated and tested the effectiveness of nanomaterials as consolidation materials for limestone. The present study includes an evaluation of some nanomaterials in consolidation limestone stone in comparison with traditional consolidants. These consolidation materials are nano calcium hydroxide nanolime, and nanosilica. The latter is known commercially as Nano Estel and the former Known as Nanorestore compared to traditional consolidants Wacker OH (ethyl silicate) and Paraloid B72 (a copolymer of ethyl methacrylate and methyl acrylate). The study evaluated the consolidation effectiveness of nanomaterials and traditional consolidants by using followed methods, characterization of physical properties of stone, scanning electron microscopy (SEM), X-ray diffractometry, Fourier transforms infrared spectroscopy, and mechanical properties. The study confirmed that nanomaterials were better in the distribution and encapsulation of calcite grains in limestone, and traditional materials were better in improving the physical properties of limestone. It demonstrated that good results could be achieved through mixtures of nanomaterials and traditional consolidants.

Keywords : nanomaterials, limestone, consolidation, evaluation, weathering, nanolime, nanosilica, scanning electron microscope
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