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Synthesis and Analytical Characterisation of Polymer-Silica Nanoparticles Composite for the Protection and Preservation of Stone Monuments

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Abstract : Historical stone surfaces and architectural heritage may undergo unwanted changes due to the exposure to many physical and chemical deterioration factors, the innovative properties of the nano - materials can have advantageous application in the restoration and conservation of the cultural heritage with relation to the tailoring of new products for protection and consolidation of stone. The current work evaluates the effectiveness of inorganic compatible treatments; based on nanosized particles of silica (SiO2) dispersed in silicon based product, commonly used as a water-repellent/ consolidation for the construction materials affected by different kinds of decay. The nanocomposites obtained by dispersing the silica nanoparticles in polymeric matrices SILRES® BS OH 100 (solventless mixtures of ethyl silicates), in order to obtain a new nanocomposite, with hydrophobic and consolidation properties, to improve the physical and mechanical properties of the stone material. The nanocomposites obtained and pure SILRES® BS OH 100 were applied by brush Experimental stone blocks. The efficacy of the treatments has been evaluated after consolidation and artificial Thermal aging, through capillary water absorption measurements, Ultraviolet-light exposure to evaluate photo-induced and the hydrophobic effects of the treated surface, Scanning electron microscopy (SEM) examination is performed to evaluate penetration depth, re-aggregating effects of the deposited phase and the surface morphology before and after artificialaging. Sterio microscopy investigation is performed to evaluate the resistant to the effects of the erosion, acids and salts. Improving of stone mechanical properties were evaluated by compressive strength tests, colorimetric measurements were used to evaluate the optical appearance. All the results get together with the apparent effect that, silica/polymer nanocomposite is efficient material for the consolidation of artistic and architectural sandstone monuments, completely compatible, enhanced the durability of sandstone toward thermal and UV aging. In addition, the obtained nanocomposite improved the stone mechanical properties and the resistant to the effects of the erosion, acids and salts compared to the samples treated with pure SILRES® BS OH 100 without silica nanoparticles.

Keywords : colorimetric measurements, compressive strength, nanocomposites, porous stone consolidation, silica nanoparticles, sandstone
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