

Nanomineralogy of mortars and ceramics from the Forum of Caesar and Nerva (Rome, Italy): The protagonist of black crusts produced on historic buildings

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Abstract

The recent focus of the impacts of atmospheric pollution on effective conservation methods for historic structures of great cultural heritage has been shown to be of critical importance for preservation. This work focuses on medieval Roman mortars and ceramics from the historic Forum of Caesar and Nerva, in Rome, Italy, and analyzes the urgency of repair of defects in rendered façades based on the inspection of surfaces where defects were detected, defining a methodology to predict the repair urgency of defects and building elements. X-ray spectroscopy (EDS), field emission scanning electron microscopy (FE-SEM), high-resolution transmission electron microscopy (HR-TEM), and X-ray powder diffraction (XRD) analyses are well equipped to study mineralogy, ultra-fine particles, and nanoparticles (NPs, minerals and amorphous phases) that are present in medieval Roman ruins. Applied analysis of ruin-derived mortar and ceramics detected the presence of materials, primarily constituted of quartz, alumino-silicates, Fe-hydr/oxides, portions of amorphous phases, calcareous minerals, pyroxene, and carbonaceous materials. The Forum of Caesar and Nerva are two of the greatest remaining symbols of historic Roman construction. Many compounds recognized by XRD can be revealed by advanced microscopies and vice versa. The incidence of NPs containing potentially toxic elements (PTEs), and numerous carbonaceous complexes linked with building material alterations due to moisture and atmospheric contamination were also discovered. This study assesses the philosophies of preservation and culture, while considering the exhaust emitted by vehicular traffic in order to propose a justifiable and effective method to best conserve historic Roman structures located in high traffic areas.

Keywords

Air contamination; Forum of Caesar and Nerva; Building impacts; Historical structure degradation