A multi-analytical approach to assess the impact of air pollution on cultural heritage: degradation of stones, mortars and bricks

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Air pollution is one of the most important causes of surface decay in urban environment. Among the degradation processes due to airborne pollutants, the formation of black crusts is one of the most dangerous one. Currently, emissions from mobile combustion sources are the main agents responsible for pollution, although a significant decrease is expected in Europe within the next decade. The surfaces of architectural heritage in urban environment are exposed to degradation due to the interaction with atmospheric pollutants both in gaseous and in particulate phase. Monuments located in the historic centres of large cities are subjected to typical anthropogenic emissions. The precise identification of the main substances responsible for the surface degradation phenomena, in particular leading to blackening, erosion of carbonatic matrices and disintegration, is essential for the definition of conservative intervention and maintenance strategies, as well as for the development of emission reduction policies on a larger scale.

Black crusts and substrate (stones, mortars or bricks) specimens have been sampled in Mlian and Monza from monuments of historical interests and analyzed by a multi-analytical approach including FT-TIR spectroscopy, ion chromatography (IC) and electron microscopy coupled with energy dispersive X-ray spectroscopy (SEM-EDX). The characterization of the carbon fraction (organic carbon, OC, and elemental carbon, EC) was performed using a new approach based on a thermal protocol and on the use of CHN analysis and thermogravimetric analysis (TGA). This integrated approach has been already applied in some case studies [1-4].

Data acquired on the specimens have been compared with those collected by the regional environmental protection agency (ARPA Lombardia) in order to assess, also through the use of dose-response functions, the degradation phenomenon that occur.

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