XRS IN PREVENTIVE CONSERVATION

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In the framework of several projects on cultural heritage (CH) preservation, we have recently carried out studies in various museums and churches throughout Europe and the USA, to examine the effects of indoor and outdoor air pollution, mostly based on x-ray spectrometry (XRS). In each case, bulk aerosols and individual aerosol particles (and also gases) were studied. For microanalysis of single particles, we have investigated a dozen techniques in the past two decades, but for wide, real-life applications, automated electron probe x-ray microanalysis has been the most rewarding. Different options for handling the large amounts of data generated by this technique, and for automated classification of particle types, have been examined. Recent methodological work includes the elemental speciation and low-Z element analysis using Monte Carlo quantification for thin-window Si(Li) detectors, analyses at liquid-nitrogen temperatures, and surface layer analyses for microscopic particles. Also gaseous pollutants were analyzed by using passive gas diffusion monitors, bulk aerosols ion chromatography and organic compounds by GC-MS.

Atmospheric aerosols were studied in and around e.g. the Correr Museum in Venice, the Art History Museum in Vienna, the Royal Museum of Fine Arts in Antwerp, the Sainsbury Center for Visual Arts in Norwich, the Metropolitan Museum of Art in New York and the Wawel Castle in Cracow. E.g. in the first case, it appeared that the particles that were most threatening for the Bellini paintings in the museum were released by the deteriorating plaster renderings, and could be avoided by plastifying the museum walls, while in the latter case, outdoor pollution particles, and especially soot particles, were found to easily enter the museum.

Another study concerned the possible accumulation of air pollutants in the interspace between the original medieval stained glass windows and the recently installed protective glazings, in majestic cathedrals and churches in Cologne, Paris and Troyes. Because of the strong drafts in the interspace, no worrisome increase in the particle concentrations in the interspace air or in particle deposition on glass collectors positioned in the interspace was noted. However, NO from candle burning proved to be a problem within the churches.

Also, the above-mentioned methodologies were applied to study the effects of different heating systems in a small church in the Italian Dolomites and in a wooden church in the Southeastern region of Poland; both contain valuable CH items. In the former case, it was found e.g. that the combustion heating system introduced high NO levels and generated a strong air current, circulating and resuspending outdoor, candle soot and incense particles; together with the generated strong physical expansion and dehydration phenomena, this was dramatically harmful for the 14^{th} century wooden altar in the church. Installing a novel and especially designed electrical heating system in the pews proved to be beneficial for the CH items in this church.