XRS FOR PREVENTIVE CONSERVATION OF CULTURAL HERITAGE

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Preventive conservation implies, i.a., the characterization of the atmospheric environment around monuments or cultural heritage (CH) items, with the intention to improve the conditions and to contribute to the preservation of CH items. While earlier, much interest was on e.g. sulphur dioxide and its effect on buildings, the focus has now shifted to the indoor environment and to atmospheric particles in, e.g., museums.

Analytical chemistry does play a key role in the chemical characterisation of the environment and it appears that X-ray spectrometry (XRS), in its many forms, is one of the most relevant analysis techniques, as it is in CH research in general (concerning the methodology used by the artists, provenancing and the discovering of forgeries, and the preparation for restorations), as appears from recent conferences on CH. XRS has indeed been the method of choice for the characterisation of the inorganic composition of atmospheric aerosols, since very long.

We have, over the last decade, intensively used various forms of XRS, namely energy-dispersive X-ray fluorescence e.g. with polarized high-energy beam excitation, and automated electron probe X-ray microanalysis, together with ion chromatography, micro Raman analysis, on-line soot determinations, gravimetry, etc., to identify particle types and their sources in indoor environments, including museums, while also gaseous indoor pollutants were assessed using passive diffusion samplers. In each case, both bulk aerosols and individual aerosol particles were studied. For microanalysis of single particles, we have investigated a dozen techniques, but for wide, real-life applications, automated electron probe X-ray microanalysis was most rewarding.

We have first studied atmospheric aerosols in and around e.g. the Correr Museum in Venice, many other museums in Austria, Japan and England, and in the caves with prehistoric rock paintings in Altamira, Spain. Very recently, measurements were done in the Metropolitan Museum of Art in New York and the Wawel Castle in Cracow, in Italian and Polish mountain churches, in a number of museums in Belgium and the Netherlands, and in cathedrals with medieval stained glass windows. E.g. in the Correr museum, it appeared that the particles that were most threatening for the Bellini paintings were released by the deteriorating plaster renderings, and could be avoided by simply plastifying the museum walls, while in the Wawel Castle, outdoor pollution particles, like fine soot from diesel traffic, entering via leaks around the windows and doors, and also street deicing salts and coal burning pollution particles, brought in by visitors, mostly in winter, were found to be most worrisome. In the Metropolitan Museum, the reaction products of sea spray with nitrogen oxides from traffic appeared to penetrate unexpectedly in some of the galleries and some of the show cases.

Urgent questions that are far from having been solved at this moment pertain to the deposition processes from the atmosphere to the CH items, the critical surface interactions that take place on the CH items, and the establishment of suitable particle concentration standards.

The predominant role of XRS in these fields is well established.