Ozone measurements inside the National Gallery of Marche (Urbino, Italy) and source assessment.

De Nuntiis P*., Geniali A., Lattanzi C.*, Maione M.**, Mangani F.**, Mandrioli P.*****

*Faculty of Environmental Sciences. University of Urbino.61029 Urbino (Italy). **Inst. of Chemical Sciences. University of Urbino. 61029 Urbino (Italy). *** Institute of Atmospheric Sciences and Climate, National Research Council (CNR-ISAC). 40129 Bologna (Italy).

Problems related to the occurrence of specific pollutants inside museums, art galleries, and libraries are due to the role they play in the decay of the objects of art displayed in these buildings. Among the atmospheric pollutants that can be found in a Museum environment, ozone was recognized as one of the most aggressive, due to its capability to induce fading in organic artists' pigments and dyes, and to spoil textile fibers, textile colours, and cellulose. Even if ozone is generally transferred into buildings from outside, for this contaminant different indoor sources can be hypothesized, especially from electrical devices. Recommended limits on ozone concentrations in the indoor air of museums, art galleries, and libraries is much lower that those assessed for health-based air quality standard, due to the long-term exposure of objects of art to this contaminant, and being the fading process scaled according the product of ozone concentration by the duration of exposure. Therefore, meanwhile ozone limits for health protection have been fixed at 55 ppbv (or 110 ?g m^{-3}), suggested ozone concentration limits for the above cited environments are no higher than 1 to 13 ppbv, with the most frequent recommendation being 1 ppbv.

The case study here presented is the National Gallery of Marche sited in the Renaissance Ducal Palace of Urbino, built by Francesco Laurana during the second half of the fifteenth century. Therefore the container itself is an outstanding work of art. The gallery is not provided with a air conditioning system, and ventilation inside the museums is simply assured by opening doors and windows that, especially during the warm season, when higher ozone levels are generally found, are always open. The ozone monitoring campaign has been carried out since August 2001, using passive samplers then analyzed by UV-Vis Molecular Absorption Spectrophotometry. Passive sampler were placed in different rooms and also in some outdoor locations. The average exposure time was one week. The above cited ozone concentration limits were shown to be frequently exceeded, with significant variations of the indoor/outdoor concentration ratios in the different rooms monitored.

Ozone measurements were associated with other kinds of investigations, such as thermo-hygrometric and aerobiological studies.

Specifically, bioaerosol was used as outdoor air masses tracer. Different aerobiological monitoring campaigns were carried out using a cascade 6-stage impactor. The biological samples underwent culture techniques analyses and optical microscope observations. Results obtained confirmed the efficacy of the proposed approach.