

Study of indoor air quality and microclimatic conditions in the Sanctuary of the Beata Vergine dei Miracoli in Saronno

Andrea Bergomi ^(a), Valeria Comite ^(a), Vittoria Guglielmi ^(a), Roberto Bonomi ^(b), Carola Ciprandi ^(b), Carlo Mariani ^(c), Antonio Faggiano ^(d), Maria Ricciardi ^(d), Antonio Proto ^(d), Mattia Borelli ^(a) & Paola Fermo ^(a)

^(a) Department of Chemistry, University of Milan, Via Golgi 19, 20133, Milan (MI), Italy

^(b) Scuola di Restauro ENAIP Botticino, Botticino (BS), Italy

^(c) Architect, Via Giuseppe Giusti n. 21/B, Seregno (MB), Italy

^(d) Department of Chemistry and Biology "A. Zambelli", University of Salerno, Via Giovanni Paolo II 132, 84084, Fisciano (SA), Italy

andrea.bergomi@unimi.it

Keywords: cultural heritage, sanctuary, microclimate, air pollutants, monitoring campaign.

The Sanctuary of the Beata Vergine dei Miracoli was built between the XV and XVII centuries and is located in Saronno, a small town in the Lombardy region of Northern Italy. Once the architecture of the sanctuary was completed at the start of the XVI century, some of the most renowned and influential artists of the time were summoned to work on the interior decorations [1]. Thanks to the work of these artists, the sanctuary is still today the home of several masterpieces, including frescoes, wooden sculptures and carvings. Poor indoor air quality and microclimatic conditions are two factors which contribute significantly to the degradation of works of art such as the ones previously mentioned. For this reason, museums have imposed concentration limits on the major air pollutants, along with temperature and relative humidity ranges that need to be respected [2]. However, the same regulations do not apply directly to sanctuaries and other indoor sites which attract large numbers of people acting as vehicles for the penetration of pollutants from outdoor. Hence, a proper and thorough air quality characterization is of the utmost importance for the safeguard of the works of art in such places.

In the present work, microclimatic conditions have been monitored using temperature and relative humidity data loggers (USB Mini TH, XS Instruments). Instead, an optical particle counter (P-Dust Monit, conTec Engineering Srl) was used to carry out the particle count and to determine the concentration of particulate matter (PM). The particles were classified into fifteen different dimensional classes and PM concentrations were expressed as PM₁₀, PM_{2.5} and PM₁. Furthermore, diffusive passive samplers (Radiello®, Fondazione Salvatore Maugeri-IRCCS) were used to determine the concentration of BTEX (benzene, toluene, ethylbenzene and xylene). In order to identify possible spatial variations, the studies were conducted in different sites and at different heights in the Sanctuary. Moreover, air quality was monitored before, during and after religious ceremonies in order to evaluate the impact of the presence of people on the concentration of specific pollutants. Particular focus was given to the Easter Mass and the Easter week during which liturgical services which attracts a large number of people were carried out. Also, a comparison with outdoor values were performed, in order to highlight accumulation phenomena and other variations in the concentration of the species. Preliminary analyses on the conditions of some wooden sculptures present in the two main chapels of the Sanctuary were carried out using X-Ray Fluorescence (XRF) directly on the works of art and Scanning Electron Microscopy coupled with Energy-Dispersive X-ray spectroscopy (SEM-EDX) on the dust deposited on the sculptures, which was collected with an appropriate brush. This enabled to establish the presence of degradation phenomena originating from poor indoor air quality and microclimatic conditions.

References

- [1] Gatti Perer M.L., *Il Santuario della Beata Vergine dei Miracoli di Saronno*, ISAL (Istituto per la Storia dell'Arte Lombarda), (1996).
- [2] Decreto Ministeriale 10 Maggio 2001, n. 112/98, Atto di indirizzo sui criteri tecnico-scientifici e sugli standard di funzionamento e sviluppo dei musei.