6th International Congress on

“Science and Technology for the Safeguard of Cultural Heritage in the Mediterranean Basin”

ABSTRACTS

CULTURAL HERITAGE ATHENS 2013

Athens, Greece

22 – 25 October 2013
BIOLOGICAL AND MICROCLIMATIC DIAGNOSIS IN CULTURAL HERITAGE CONSERVATION: INTERDISCIPLINARY RESEARCH AT PALATINA LIBRARY IN PARMA

Cesira Pasquarella\textsuperscript{1}, Giovanna Pasquariello\textsuperscript{2}, Carla Balocco\textsuperscript{2}, Elisa Saccani\textsuperscript{1}, Enrico Marmonti\textsuperscript{3}, Franco Palla\textsuperscript{4}, Manuela Ugolotti\textsuperscript{5}, Oriana Maggi\textsuperscript{6}, Roberto Albertini\textsuperscript{7}

\textsuperscript{1}Department of Biomedical, Biotechnological and Translational Sciences, University of Parma; \textsuperscript{2}National Institute of Graphic Arts, Ministry for Heritage and Culture, Rome; \textsuperscript{3}Department of Industrial Engineering, University of Florence; \textsuperscript{4}Department STEBICEF, Laboratory of Biology and Biotechnology for Cultural Heritage, University of Palermo; \textsuperscript{5}Hygiene Unit, University Hospital of Parma; \textsuperscript{6}Department of Environmental Biology, Sapienza University of Rome; \textsuperscript{7}Department of Clinical and Experimental Medicine, University of Parma

Abstract

In indoor environments such as libraries, museums and archives, the biological component of air (bioaerosol) may be a potential risk for cultural property, operators and visitors. This paper presents a methodological model based on an integrated system for biological (air and surfaces) and microclimatic monitoring to assess and prevent biological risks. Thanks to a grant by the Cariparma Foundation, the system was implemented in the De Rossi room of the Palatina library in Parma during summer and winter, at heights of 1, 2 and 4 metres, in the absence of visitors and operators. Active air microbial monitoring was carried out using DUO-SAS 360 active sampler to measure the concentration of microorganisms in the air (CFU/m\textsuperscript{3}) and Petri dishes exposed for 1 hour, 1 metre above the floor and 1 metre away from any obstacle, to measure the settling rate of microorganisms on surfaces (Index of Microbial Air contamination, IMA). Airborne particles 0.3, 0.5, 1 and 5 \textmu m in diameter were evaluated with a laser particle counter. For surface contamination of ancient manuscripts and shelves, two parameters were measured using nitrocellulose membranes: the Microbial Buildup (MB, the total number of microorganisms that have accumulated on a surface prior to the sampling) and the Hourly Microbial Fallout (HMF, the number of microorganisms that settle on a surface during 1 hour). A VEPS 1000 spore trap sampler was used for direct detection of fungal spores, both viable and nonviable, at the microscope and to measure the temporal distribution of the particulate. Allergens were evaluated by immunoenzymatic assay. Microbiological contaminants were analyzed by means of cultural and molecular biology techniques. Microclimatic parameters were recorded using a data logger for air temperature, relative humidity, air velocity and mean radiant temperature, all combined with infrared measurements of surface temperatures. The Computational Fluid Dynamics (CFD) application for transient simulations, integrated with experimental data and applied to three dimensional models of the studied environment, was used to assess the indoor microclimatic conditions. Air microbial monitoring showed bacterial values ranging from 30 to 660 CFU/m\textsuperscript{3} and from 3 to 18 IMA in the summer, and from 20 to 75 CFU/m\textsuperscript{3} and from 1 to 15 IMA in winter; fungal values ranged from 0 to 60 CFU/m\textsuperscript{3} and from 0 to 3 IMA in the summer, and from 0 to 30 CFU/m\textsuperscript{3} and from 0 to 3 IMA in winter. Cladosporium spp., Alternaria spp. and Aspergillus spp. were the most frequently found microfungi, both in the air and on the surface of manuscripts and shelves. The biomolecular analysis made the identification of non-culturable microorganisms possible. Results from the transient simulation were in good agreement with the experimental data. The use of an integrated system is essential for the diagnosis and prevention of biological risks to the environment-artefact-man complex. CFD is important for indoor air quality control and to provide predictive models. This interdisciplinary research represents a contribution towards the definition of standardized methods for assessing the biological and microclimate quality of indoor heritage environments.