

Monitoring of Indoor Air Quality in Museums

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Abstract : The cultural heritage of each country represents a unique and irreplaceable witness of the past. Nevertheless, on many occasions, such heritage is extremely vulnerable to natural disasters and reckless behaviors. Even if such exhibits are now located in Museums, they still receive insufficient protection due to improper environmental conditions. These external changes can negatively affect the conditions of the exhibits and contribute to inefficient maintenance in time. Hence, it is imperative to develop an innovative, low-cost system, to monitor indoor air quality systematically, since conventional methods are quite expensive and time-consuming. The present study gives an insight into the indoor air quality of the National Byzantine Museum of Cyprus. In particular, systematic measurements of particulate matter, bio-aerosols, the concentration of targeted chemical pollutants (including Volatile organic compounds (VOCs), temperature, relative humidity, and lighting conditions as well as microbial counts have been performed using conventional techniques. Measurements showed that most of the monitored physiochemical parameters did not vary significantly within the various sampling locations. Seasonal fluctuations of ammonia were observed, showing higher concentrations in the summer and lower in winter. It was found that the outdoor environment does not significantly affect indoor air quality in terms of VOC and Nitrogen oxides (NOX). A cutting-edge portable Gas Chromatography-Mass Spectrometry (GC-MS) system (TORION T-9) was used to identify and measure the concentrations of specific Volatile and Semi-volatile Organic Compounds. A large number of different VOCs and SVOCs found such as Benzene, Toluene, Xylene, Ethanol, Hexadecane, and Acetic acid, as well as some more complex compounds such as 3-ethyl-2,4-dimethyl-Isopropyl alcohol, 4,4'-biphenylene-bis-(3-aminobenzoate) and trifluoro-2,2-dimethylpropyl ester. Apart from the permanent indoor/outdoor sources (i.e., wooden frames, painted exhibits, carpets, ventilation system and outdoor air) of the above organic compounds, the concentration of some of them within the areas of the museum were found to increase when large groups of visitors were simultaneously present at a specific place within the museum. The high presence of Particulate Matter (PM), fungi and bacteria were found in the museum's areas where carpets were present but low colonial counts were found in rooms where artworks are exhibited. Measurements mentioned above were used to validate an innovative low-cost air-quality monitoring system that has been developed within the present work. The developed system is able to monitor the average concentrations (on a bidaily basis) of several pollutants and presents several innovative features, including the prompt alerting in case of increased average concentrations of monitored pollutants, i.e., exceeding the limit values defined by the user.

Keywords : exhibitions, indoor air quality ,VOCs, pollution

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