SMARTMUS-E, managing energy in museums under climate change

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The need of knowledge on materials degradation related to building hygrothermal behaviour

Introduction

The monitoring and control of thermo-hygrometric indoor conditions in museums aims to assure the preservation of cultural heritage collections. Nevertheless, the current paradigm ruling the control of environment in museums is still very restringing regarding set points for Temperature (T) and Relative Humidity (RH) conditions (ASHRAE, 2019; British Standards Institute, 2012; Technical Comitte CEN TC 346, 2011; UNI10699, 2002).

This is explained by current normative requirements and by a cautious approach of conservation professionals. In order to adopt wider, yet safe set points for T and RH a methodology correlating actual chemical and/or physical degradation in artworks to environmental conditions is needed.

SMARTMUSE-E aims to propose a sound methodology for analysis of T and RH fluctuations in museum environments based on chemical and physical indicators for degradation that guarantees the preservation of collections and allows a smart use of energetic resources.

Research Objectives

To meet this goal, this action has four research objectives:

1) To give to the methodology published in 2020 (Lucero-Gómez et al., 2020), for the monitoring of fluctuations of temperature and relative humidity in museum environment, a chemical and physical background considering materials degradation

2) To gain knowledge into material's degradation produced by hygrometrical changes in real museum environment in the following case studies: Gallery of Academia of Venice (GAV), Český Krumlov Castle (CKC), Viking Museum (VM) and Historical Museum of Oslo (HMO), and National Heritage Institute of Czech Republic (NHI)

3) To monitor and characterize museum environment in historical buildings to understand their behaviour and to evaluate their capacity dumping outdoor climate variations.

4) To use the knowledge gained on museum environment in historical buildings behaviour to set accelerated aging conditions that mimic as much as possible real environment.

5) To extend the exploitation of the methodology, by creating a base of end users (museum professionals) trained in the application of the methodology beyond the initial partner institutions: GAV, VMO, HMO, CKC and NHI to help them to manage their energy consumption.

Strategy

The adopted strategy for this project (Figure 1) contemplates the following main steps

(Figure 1)

1) Documentation of historical environment, architecture of the buildings and history, collection's characteristic and history.
2) Mock-up creation and physico-chemical characterization. The techniques that may be involved are: Desorption electrospray ionization mass spectrometry (DESI-MS), Matrix-assisted laser desorption/ionization mass spectrometry (MALDI-MS), Ion mobility-Mass spectrometry (IMS-MS) and supercritical fluid chromatography and classical techniques involved: Pyrolysis/ Gas chromatography-Mass spectrometry (Py/GC-MS), Gas chromatography-Mass spectrometry (GC-MS), Fourier transformed Infrared spectrometry (FTIR) and Raman spectrometry
3) Aging (natural and accelerated).
4) Physico-Chemical characterization after ageing of mock-ups, characterization of historical environment.
5) Integration and analysis of results, definition of damage and of safe limits for T and RH fluctuations.
6) Training of end users (museum professionals) by opening workshops online and in person. Information available on the website of the project, creation of a professional forum

Expected Impacts

By using new techniques in the characterization of artistic materials, we hope to determine which of these techniques or which combination of them is more suitable for a complete, reliable and fast characterization of changes related to aging. It is also possible that SMARTMUS-E establishes specific molecular markers for different situations.

Our research team expects that by generating new knowledge on materials degradation and their resistance to T and RH fluctuations, SMARTMUS-E will contribute to the evolution of the currently prevalent mind-set about what is judged as a "safe" environment for artistic collections and to impact national and international bodies, so they allow a more flexible approach to the control of T and RH in Museums. By allowing greater fluctuations, or allowing set points for T and RH more closely related to actual outdoor conditions authors expect that the project will contribute to the smart use of energetic and economic resources in Museum context.

Authors hope that by creating projections of the extreme periods, that climate change could induce, SMARTMUS-E will raise the awareness on the society on how the conservation of precious historical objects could be endangered, and how their conservation will become more and more difficult and expensive, as climate change becomes present.

References

ASHRAE, 2019. Chapter 24: Museums, Galleries, Archives, and Libraries. In: ASHRAE Handbook HVAC Applications, SI EditionAmerican Society of Heating, Refrigerating, and Air- Conditioning Engineers Inc.

British Standards Institute, 2012. Specification for Managing Environmental Conditions for Cultural Collections British Standards Institute. London.

Lucero-Gómez, P., Balliana, E., Izzo, F.C., Zendri, E., 2020. A new methodology to characterize indoor variations of temperature and relative humidity in historical museum buildings for conservation purposes. Building and Environment 185, 107147. https://doi.org/10.1016/j.buildenv.2020.107147

UNI10699, 2002. Beni culturali. Principi generali per la scelta e il controllo del microclima per la conservazione dei beni culturali in ambienti interni.Italy.

Figures

Please enter the caption of each Figure and the desired width in the table below.

No.	Caption	Width (8 or 17 cm)
Fig. 1	Consecutive steps on the strategy for SMARTMUS-E project	17cm

Acknowledgments

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