NILU: F 33/2002

NILU: F 33/2002
REFERENCE: Q-303
DATE: JANUARY 2003

Preventive Conservation Strategies for Organic Objects in Museums, Historic Buildings and Archives

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Presented at: 5th EC Conference report "Cultural Heritage Research: a pan European Challenge" in Krakow. 16-18 May 2002

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Summary
Preventive conservation strategies should be the responsibility of all museums, but it will take a long time before these strategies will be a part of the daily routine. So far the monitoring of light, relative humidity and temperature have been commonplace but there is very little knowledge about the deterioration processes on the objects, and especially on objects made of organic materials. The impact from indoor environment, which organic objects are exposed to, has thus to be assessed. This paper presents the main environmental risk factors and some examples from projects dealing with development of new preventive conservation strategies.

Introduction

All over Europe a broad range of cultural property in museums, historic buildings and archives are being affected either by display or by storage conditions. The key to the survival of these objects is achieving an acceptable indoor environment. Vital to this is a sustainable management of the cultural property including preventive conservation strategies which is defined by ICOM (ICOM, 1991) as follows:

"The provision of suitable environmental protection against the known natural or artificial causes of deterioration of museum specimens and works of art".

Preventive conservation began to be recognised as a distinct discipline of conservation already in 1975 when ICCROM was among the first to offer courses on the topic (PUTT and MENEGAZZI, 1999). The main aims of preventive conservation have also been well described by May Cassar in her book "Environmental Management" where she points out that preventive conservation which should be the responsibility of all museums has two important aspects: *The technical* dealing with the monitoring and controlling the museum environment, and *the organisational* involving all staff working in a museum (CASSAR, 1995).

The aim of this paper is to present the state of the art for preventive conservation strategies for the organic objects in museums, historic buildings and archives and to present some examples of projects dealing with this topic.

State of the art

Recapitulating the EC-funded research it was not until 1991 – and the EC 2nd FP, STEP Programme, that projects started to focus on effects on organic materials indoor, like leather (LARSEN, 1997) and paper (HAVERMANS, 1997). The results from these and other projects were presented in 1994 at the EC Workshop, "Effects of Indoor Environments in

Museums" which was the first large meeting dealing with protection of indoor cultural heritage in Europe.

However, "Preventive Conservation" as a research area was not included in a Key Action for the EC research programmes until 1999 in the 5th FP, Key Action 4.2.2:
"Preventive Conservation Strategies for Indoor Cultural Assets".

Since then there has been a gap between preventive conservation work in museums and the awareness of implementing results from research (e.g. EU research projects) into preventive conservation strategies.

Thus there will be a long way to go before preventive conservation will be a part of the daily routine in museums, historic buildings and archives. Up till now the monitoring of light, relative humidity (RH) and temperature has been commonplace, but there is, however, very little knowledge about the deterioration processes on the objects and especially on objects made of organic materials. Preventive conservation strategies will involve the application of knowledge, skill and judgement to achieve the right balance between the need to protect the heritage and the increasing demand for access or use.

Organic materials such as leather, silk, paper and wood form a large proportion of the total number of heritage assets in museums and historic buildings. They are not only a significant part of Europe's moveable cultural heritage, but they often cover the internal surfaces of historic rooms in the form of wall hangings, wall coverings, curtains and carpets. These objects are prevalent in historic buildings preserved with their original contents that are found throughout Europe. These materials are considered to be among the most vulnerable to deterioration and the following types of impact may be observed (BRIMBLECOMBE, 1990, BLADES et al., 2000):

- Paintings: Discolouring, cracking and soiling
- Textiles: Reduced strength, fading and colour change
- Paper: Embrittlement and discolouration
- Wood: Cracking, rottening and powdering surface
- Leather: Weakening and powdering surface
- Rubber and polymers: Cracking and fading

For this reason, for example leather, silk, paper and wooden objects in museums have traditionally been presented to the public in display cases. In historic house museums on the other hand, organic objects have always been placed on open display because their historic context within a room is considered to be as important as their preservation. In order to protect the latter objects from deterioration it is important to be aware of the risk factors and to develop an appropriate preventive conservation strategy.

What are the risk factors?

The impact from indoor environment in which organic objects are exposed has to be assessed by evaluating the risks provided by the overall environmental conditions on site.

The main environmental risk factors on the indoor environment in museums, historic buildings and archives are:

- *Climate;* inappropriate humidity, temperature and light
- *Gaseous and particulate pollution,* outdoor – indoor sources
- *Microbiology*

Climate

Relative humidity, specific humidity, temperature and light are all important factors that usually are monitored in most museums, historic buildings and archives today. Limiting relative humidity fluctuations is important in the preservation of organic materials. Organic materials should be stored at appropriate relative humidity (RH) ranges between 40–70 % (ERHARDT and MECKLENBERG, 1994). Light and ultraviolet radiation are monitored for light-sensitive objects (THOMSON, 1986). Studies of the microclimate and air velocity have been made in several museums and historic buildings (CAMUFFO, 1983, 1998, BRIMBLECOMBE, 1999). Results from several studies have shown that the impact on indoor climate is due to: wall thickness (insulation), air leakage, ventilation systems, heating, solar radiation and amount of visitors.

Gaseous and particle pollution

In defining indoor air quality in museums there is a focus on the following components; SO_2, NO_X, O_3, H_2S, soot, acid and alkaline particles, HCHO, and volatile acids. For organic materials SO_2, NO_X and O_3 are the most hazardous gases (BAER and BANKS, 1985, BRIMBLECOMBE, 1990). Results from monitoring in museums show that indoor concentrations of outdoor pollutants depend on building type and use. For example, results from monitoring outside and inside of the Historic Museum in Oslo, Norway show that NO_X values were found at equal amounts indoor/outdoor while the SO_2 concentration indoor was reduced compared to the outdoor values (DAHLIN et al., 1997). From monitoring of ozone in museums in Cracow it was found that museums rapidly ventilated, through many open doors and windows, obtained indoor ozone concentrations of about 42-44 % of the outdoor values (SALMON et al., 2000).

Microbiology

Fungal attack on objects on display in exhibitions or stored in depots with high humidity has long been a problem in many countries. Some researchers and conservators have found that bacteria may also present risks (BRIMBLECOMBE, 1999).

Museum collections are also at risk from handling and use of the objects and from different activities within the museum. The impact of visitors may cause environmental implications to the objects and the building, for example may the presence of human beings alter the conditions of temperature and humidity in the air (CASSAR, 1995).

However, the total effects of the complex synergistic interaction of pollutants, relative humidity, temperature, light and UV-radiation and its effects are not elucidated by the measurement of individual parameters. The primary interest of conservators rests in the total impact of the conditions on the organic objects.

Projects aiming at better preventive conservation strategies

The IMPACT - project

The EU-project "Innovative Modelling of Museum pollution and Conservation Thresholds" (IMPACT- EC-EVK4-2000-00695) illustrates how an ongoing project is dealing with development of tools in order to contribute to a better preventive conservation strategy. The aim of the project is to:

- Develop a web-based software tool to help museums deal with pollution problems
- Develop innovative materials for use as passive pollution absorbers inside buildings.

In order to develop innovative materials for use as passive pollution absorbers it has been necessary to study dry deposition velocities of gases deposited from the indoor air onto material surfaces. As a participant in the "IMPACT" – project, the Norwegian Institute for Air Research (NILU) has measured deposition velocities of three gases, O_3, SO_2 and NO_2, onto selected materials which have been used in museum buildings. The measurements of the different material samples were performed in a climatic test – chamber at NILU under near laminar airflow conditions. Deposition velocities to materials were measured at varying air humidity and at varying temperature between 20 - 30^{o}C (GRØNTOFT, 2002). Fig. 1 shows measured deposition velocities for the three gases to a number of materials at RH = 90 %. The general trend seen in the figure was a low deposition velocity (0-0,03 cms^{-1}) for the slightly water-soluble NO_2 gas. The deposition velocity was considerably higher (0,05-0,10 cms^{-1}) for the somewhat more water soluble and more reactive O_3 gas while a twice as high deposition velocity (0,1-0,2 cms^{-1}) was measured on alkaline surfaces for the easy soluble and reactive SO_2 gas (GRØNTOFT, 2001).

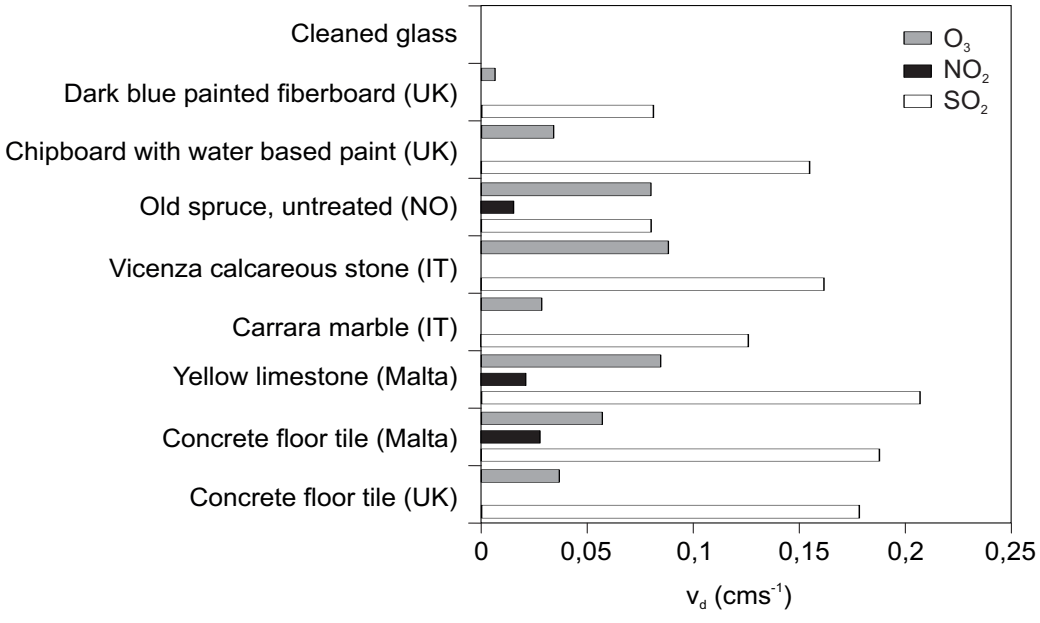

Figure 1: Deposition velocities of SO_2, NO_2 and O_3 on materials at RH = 90 %. All gases were tested on all samples and if no reaction on the material was detected, no bar is indicated in the figure (GRØNTOFT, 2001).

From deposition velocity measurements and modelling of reaction mechanisms NILU has developed a model that gives mean deposition velocities in rooms indoor. This model will be

included in the wider IMPACT project model, which will calculate indoor concentrations of gases in museum buildings from measured outdoor concentrations. The IMPACT model will be of great help for the museum staff evaluating indoor environment and for the preventive conservation work.

The MASTER - project
A new EC- project: "Preventive Conservation Strategies for Organic Objects in Museums, Historic Buildings and Archives" – The MASTER - project (EVK-2001-00243), are at the moment under contract negotiations with EC, however the main ideas behind the project will be presented here.

The main aim of this project will be: *To provide conservator staff of museums, historic buildings and archives with a new preventive conservation strategy for the protection of cultural property, based on an early warning system assessing the environmental impact on organic objects.*

The aim will be carried out by the following objectives:

- Revise and refine existing preventive conservation strategies for protection of organic objects, based on the end-users identified needs
- Develop a classification system for risk assessment of organic objects in museums, historic buildings and archives
- Evaluate decay on organic objects in different test environments
- Develop an early warning system based on an effect sensor for organic materials (EWO-sensor), assessing deterioration on organic materials indoor, based on the end-users identified needs.

The early warning system including the EWO-sensor that will be developed within the MASTER-project will provide a relatively cheap and easy way for museums and other cultural heritage organisations as a first step to evaluate the quality of the environment they provide for organic objects. This represents a considerable step forward, when previously museums had to rely on analysing a wide range of diagnostic parameters, such as light, RH, temperature and pollution to answer this question. These factors are still very important, but the EWO-sensor strategy will provide a means of surveying rapidly and simply many different environments, both storage and display. This is particularly important for organic objects that are often present in large numbers in collections, such as those of historic buildings with original textile furnishings and decorations; or in libraries and archives, which hold large numbers of paper documents (MILLS and WHITE, 1994).

Conclusions

At the moment there are several EU-funded research projects going on in Europe, dealing with problems concerning preventive conservation, but there are still research gaps which have to be filled.
A working paper for the European Parliament (the STOA-project) stated in October 2001 that there is still a need for research within the following topics (CASSAR et a., 2001):

- *Response of materials to microclimatic changes*

- *Measurements of indoor emissions from materials and humans in cultural heritage environments*
- *Secondary reactions among gases and secondary products of indoor chemistry*
- *Dry deposition of particles and the ways that particles age or react with surfaces*
- *New and multi-functional sensors for air pollutants in museums and archives*
- *Development of integrated management strategies.*

A main challenge must be to ensure that research projects will have a relevance to the museum staff, so that they can be implemented into their preventive conservation strategies.

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