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MUSEUM MICROCLIMATES

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Museum Microclimates

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John Havermans

Summary

Networking of communities of researchers, infrastructure owners and users is one of the important instruments the European Commission is offering in order to establish co-operation and co-ordination between existing facilities, researchers, end-users, industrialists, manufacturers and suppliers.

COST, which stands for European Cooperation in the field of Scientific and Technical Research, is one of the longest-running instruments supporting co-operations among scientist and researchers across Europe. Within the COST domain Chemistry and Molecular Sciences and Technologies, Cost Action D42 is effective since October 2006. Till 2010, representatives from 22 COST countries will discuss the 'Chemical Interactions between the Indoor Environment and Cultural Artefacts' in Cost Action D42 for safeguarding our movable cultural heritage.

Problem to be solved

The conservation of cultural heritage is a duty for all nations, due to ethical reasons. Only very slowly decision makers start to understand that caring about cultural heritage and especially about museum, library and archival collections is also a valuable long-term investment for their economy and in the interest of their citizens. The quality of the indoor environment is decisive for the preservation of a collection. Sensitive materials, displayed in an aggressive environment may suffer from chemical attack of pollutants, leading to irreversible damage within only a few weeks of inappropriate exposure.

Within the EU Research Initiatives (from PF2, 1986 till PF6, 2006) 106 projects have been dedicated to cultural heritage. Among these projects, 20 years of European Research Initiatives are being carried out in the field of Cultural Heritage. The main goal is to reinforce the scientific basis for the establishment of measures and methodologies for the protection and rehabilitation of the European Cultural Heritage. But how we reach the stakeholders? And how can we apply new innovative tools for the preservation of our heritage?

Scientific Objectives

Aim of COST D42 is to explore chemical interactions between cultural artefacts and typical indoor environmental conditions through field studies and laboratory experiments and transfer the results into preventive conservation practice. This COST Action D42 shall establish the links between the Old and New European Research Initiatives and broadens it with new sections and co-operation initiatives.

Benefits

The Action will improve the multi-disciplinary collaboration between key players and will thus improve preventive conservation practices in museums, archives, libraries and the knowledge in the field of the chemical deterioration of historical artefacts by the indoor environment. Furthermore young researchers will benefit, as they will have the possibility to experience international cooperation and participate in student exchange and training schools. Due to this COST Action, activities on pre-normative work in cultural heritage will be enhanced.

Strategy

The Action D42 focuses on the chemical impact of pollutants on materials, thus also considering physical and environmental aspects, materials technology, chemical analytics, emission and standardisation. Within this action three working groups are active.

Working group 1: Preservation (with task group 1 'degradation and stabilization' and task group 2 'Prevention').

Working group 2: Analysis (with task group 1 'materials' and task group 2 'environment').

Working group 3: Guidelines (with task group 1 'methods' and task group 2 'storage and health').

Working group 1 covers the preservation aspects dedicated to the interactions between air pollutants and cultural artefacts. Two task groups have been established: (1.1) on degradation and stabilization;

and (1.2) on prevention aspects. Task group 1.1 will focus on the fundamental scientific aspects of degradation by air pollutants and strategies for stabilization. The objectives will be reached by means of field and lab studies. Task group 1.2 is focusing on the prevention by e.g. chemical air purification and other storage strategies. Also development of innovative methods and strategies belong to their focus.

Working group 2 forms the hearth of the action and is dedicated to analysis for both the materials (task group 2.1) and the environment (task group 2.2). The focus (2.1) is not only on how to analyze the objects non-destructively but also dedicated to the building materials as these materials form the shell of the object. Assessment of VOCs, endogenous and exogenous emissions and particulate matter is the focus of 2.2.

Working group 3 has a direct relation with both the end-users and suppliers via the European Standardization Commission CEN. Dedicated to establish guidelines for the application of methods (3.1) and storage & health (3.2). Task group 3.1 will focus on the assessment ad evaluation of current methods and standards while task group 3.2 will focus on guidelines for healthy storage conditions, materials handling and exhibition.

All working groups have a common focus: to include fundamental research aspects and to disseminate the activities.

Dissemination will be done by means of annual technical committee meetings, bi-annual working group meetings, workshops, symposiums and training schools and Short Term Scientific Missions.

STSM

STSM stands for short term scientific missions. For a period of 1 week till maximum of 2 months, researchers may apply for a grant to work for a period of time at a hosting institute. We welcome especially the applications of young researchers.

Both the originating and hosting institute must be in a COST member country. Dedicated calls are foreseen as all proposals will be evaluated. The proposed STSM should fit in the aims of COST D42. Proposals will be collected by the STSM manager. Latest news on calls and evaluation procedures can be found at our website www.enviart.org or www.COST D42.org.

Action details

The COST Action D42 was approved on June 27, 2006 and entered into force on September 20, 2006. The end of the Action will be on October 1, 2010. On February 2007, the following countries were included in COST action D42:

Austria, Belgium, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Israel, Italy, Netherlands, Poland, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, Ireland, Malta and Romania.

The action is chaired by Dr John Havermans (john.havermans@tno.nl) from the Netherlands and co-chaired by Prof. Dr. Mieke Adriaens (annemie.adriaens@ugent.be) from Belgium. The rapporteur is Prof. Anonio Lagana (Italy) and the scientific officer at COST Office is Dr. Piotr Swiatek (pswiatek@cost.esf.org).

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The historic and ethnographic art museum of Orestiada in Greece - *Ars longa Vita brevis*

Vasilios Lampropoulos and Dorota Nowacka

The Historic and Ethnographic Art Museum of Orestiada, a small town in Northern Greece, was established in 1972 [1]. The Museum houses objects of the culture of Adrianoupoli and Karagats in Turkey, locations from which the majority of Orestiada's population descend.

The foundation of the Museum, the concentration, conservation, and display of a large number of rare and sentimentally valuable objects make a significant contribution to the preservation of the cultural heritage and history of Eastern Thrace [2].

The collections of the Historic and Ethnographic Art Museum of Orestiada include:

- Photographic and archival materials, publications and books
- Material documents of the trade and the traditional profesions
- Agricultural tools
- Furniture and objects of domestic use
- Musical instruments
- Icons
- Ecclesiastical relics from churches of Eastern Thrace
- Traditional costumes
- Weaving tools

The present study has as its main goal to present the specific environmental condition in which the above mentioned collections are stored and displayed, the museum's working weaknesses, the specific architectural and design problems, as well as suggestions for technical improvements that will affect the future operation and viability of the Museum.

The study was based on an in situ research and inventory of the collection, the technical structure and the state of preservation of all artifacts, the methodical control and measurements, the building and inner exhibit and storage spaces, on the conduction of a series of interviews, which included a detailed questionnaire, with the Museum staff and on researching the Museum's archival materials.

A detailed thematic inventory and documentation of the objects, based on the international Object ID system [4] helps trace their history and nature, the materials used in their creation and their existing state of preservation.

The interaction between microclimate and exhibits depends on several parameters. In order to identify the values and variation of these parameters, the present state of the Museum's building facilities and the environmental conditions is analyzed as well as the conditions under which the objects are exhibited and stored [3].

The various organic and inorganic materials used in the creation of the artifacts and the rates of destruction of these objects are examined and combined with the results of the methodical measuerements of the local climate and the indoor climate in the Museum.

The results of the temperature and relative humidity measurements are presented in this poster in the form of the tables, with special emphasis given to the range of the relative humidity, which affects the degradation process of the collection, on a monthly and daily basis.

On occasion of the acquirement of the museum's new building facilities certain suggestions are presented concerning the improvement of the present conditions, the shaping of the building's facade and inner spaces as well as suggestions that are aimined at the improvement of the existing environmental conditions.

Special emphasis is given to the suggestions concerning the creation of new storage facilities and a preventive conservation laboratory that will house, the constantly increasing number of objects, the collection of the Museum and at the same time keep the required specifications of preventive conservation. In this part there are presented solutions, architectural plans of a new storage location, drawings with detailed use of storage space, photographs and general rules of display and storage especially for the sensitive objects of this ethnographic art collection. For the realization of the suggested short and long-term improvements and the future progress of the Museum the financial status of the Museum was taken into consideration.

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References

1 Μαυρίδης, Π., Μπεζιργιαννίδης, Β., Μνήμες από τις αξέχαστες πατρίδες. Δραστηριότητες του Συλλόγου, Μορφωτικός Σύλλογος «Μουσείο Λαογραφίας και Ιστορίας Τέχνης Ορεστιάδας και Περιφέρειας», Νέα Ορεστιάδα, 1996.

2 Bakirtzis, Ch., Triantaphyllos, D., Thrace, Cultural Foundation ETBA Greek National Tourism Organisation EOMMEX, Athens, 1988.

3 Nowacka, D., Μελέτη της συλλογής εικόνων και εκκλησιαστικών κειμηλίων του Ιστορικού και Λαογραφικού Μουσείου Ορεστιάδας. Περιβαλλοντικές συνθήκες και πρόταση δημιουργίας αποθηκευτικού και εκθεσιακού χώρου, unpublished MA dissertation, University of Athens, 2005.

4. Web site: http://www.object-id-com/about.html (3/1/2007).

A presentation of a new experimental test method for humidity buffers – a comparison of two silica gels, Artsorb and Prosorb

Charlotta Bylund Melin

Background

The method presented in this poster was developed as a part of the MSc graduating thesis at the Department of Conservation, Göteborg University [1]. An experimental test method was developed for the purpose of comparing two silica gels, Artsorb [2] and Prosorb [3], but the method may also be used for other humidity buffers.

Silica gel (SiO_2) is a hygroscopic material, which can adsorb and desorb large quantities of water vapour even at small fluctuations in relative humidity (RH) [4]. This capacity makes it suitable as a humidity buffer in small enclosures like museum showcases. It is supposed to be chemically inert and can undergo an indefinite number of moisture cycles. Its efficiency as a humidity buffer is dependent upon the volume and the air exchange rate of the showcase [5].

Artsorb and Prosorb are both developed for museum applications and have been used as humidity buffers in showcases at The National Museum of Fine Arts in Stockholm during the last few years. At the museum, the RH has been monitored [6] in showcases containing Artsorb and Prosorb. Both products have so far shown equally good results in keeping a satisfactory constant relative humidity. Questions on silica gel in general and Artsorb and Prosorb in particular have been, how much silica gel is needed for a specific showcase and for how long will it keep a constant humidity? Is silica gel really eternal or will it at some point loose buffering capacity? A SEM-EDS analysis [7] has confirmed the manufacturers' data on Artsorb containing the highly soluble and corrosive salt lithium chloride (LiCl) [8], whereas Prosorb contains aluminium oxide (Al_2O_3). Will these additives have an influence on the short and long time buffering capacity of the two products? Are Artsorb and Prosorb better humidity buffers than regular density gel or other hygroscopic materials like paper pulp? Is it possible to test the humidity buffering qualities, and if so, how?

From the questions above, the study presented here focused on the development of a simple and reliable test method for evaluating and comparing humidity buffers.

Experiments

The experiments took place in a declimatized room at The National Museum of Fine Arts during a period of six consecutive months. The seasonal fluctuation in this part of the building ranged from 10% RH in winter to 70% RH in summer, so the test results could not be compared. To achieve controlled testing parameters, an airtight showcase was used to simulate a controlled room environment. Within, open glass containers with saturated salt solutions of LiCl and sodium chloride (NaCl) provided a low and high RH respectively. Two additional desiccators were placed inside the showcase and were used as testing chambers for the silica gels. Lids were custom made of 6 mm thick acrylic plastic and perforated with 20 holes, each with a diameter of 8 mm. By using aluminium tape [9] covering a given number holes, a controlled air exchange rate between the test chamber and the surrounding showcase environment was enabled.

The time for the experiment was limited, hence the two silica gels were tested during rather extreme conditions. The objective was to compare their humidity buffer properties, not to find their optimal capacity. During a series of pre-tests [1], where the amount of silica gel, salt solution, and number of open holes where varied, these conditions could be obtained. During the actual tests, the amount of silica gel used was doubled, as compared to the manufacturers' recommendations [2, 3], and ten holes were open, giving an air exchange rate of 4,6 times/day, tested as described by Calver et al. [10]. RH and temperature were monitored [6] during the tests in the two desiccators as well as in the showcase

For the different test series, the two silica gels were reconditioned to keep an RH in the desiccators at 30, 50 and 70% respectively. The saturated solution containing LiCl provided a dry environment inside the showcase of approximately 15% RH, whereas the solution of NaCl created a higher humidity of approximately 75% RH. Four test series were performed:

Test 1) Silica gel reconditioned to 70% RH in a showcase climate of 15% RH.

Test 2) Silica gel reconditioned to 50% RH in a showcase climate of 15% RH.

Test 3) Silica gel reconditioned to 50% RH in a showcase climate of 75% RH.

Test 4) Silica gel reconditioned to 30% RH in a showcase climate of 75% RH.

The silica gels where reconditioned in a climate chamber [11] for two weeks, after which the humidity level of the silica gels where confirmed by measuring [6].

Each test ran for three separate weeks. The pre-tests showed difficulties to reach the reconditioned RH due to the high air exchange rate. The lids of the desiccators were therefore carefully covered by two layers of plastic foil [12] during the first 24 h.

Result and discussion

Within the timeframe of the research project, the test series were only carried out once, which is why the results are not conclusive or verified. However, preliminary results indicate the following:

None of the two silica gels have shown clearly better results than the other.

When reconditioned to 50% RH (tests 2 and 3), Artsorb presents better results in a humid climate and Prosorb in a dry climate. Possibly Artsorb's performance is due to the content of LiCl, as this salt has a pronounced desiccative property.

When reconditioned to 30% and 70% RH (tests 1 and 4), the results did not follow this tendency but the two silica gels had greater difficulties in keeping a constant humidity. This stresses the necessity of using larger quantities of silica gel under more harsh conditions than recommended by the manufacturers or using more airtight showcases. This is also demonstrated by the fact that the plastic foil worked successfully when the silica gel was reconditioned to 50% RH but did not work satisfactory when reconditioned to 30% and 70% RH. Using plastic foil must be looked upon as an emergency expedient.

The result in test 1 showed a sudden drop (both silica gels, from approximately 60% RH to below 30% RH) when the plastic foil was removed. The drop could be explained by stack pressure [13]. Although, why the RH remained low for more then a week and then suddenly rose again to 65% RH could not be explained within this study.

The showcase climate shows that it is more difficult to keep a stable humidity at low RH (15% or below) than compared to a high RH (75%) using the same amount of saturated salt solutions.

Although the method needs to be further tested and evaluated, it shows potential to be a useful tool in comparing different humidity buffers and their ability to keep a constant relative humidity in museum showcases. The method is inexpensive and easily enables reproducibility within most museum environments.

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References

1 Bylund Melin, C. (2005) ART-SORB® & PROSORB. En jämförande studie av två fuktbuffrande kiselgeler och utvärdering av en ny försöksmetod. (In Swedish).Göteborgs universitet.
2 Fuji Silysia Chemical Ltd., Japan. (http://www.fuji-silysia.co.jp/english)
3 Long Life for Art, Germany. (http://www.cwaller.de)
4 Weintraub, S. (2002) Demystifying silica gel. Object Speciality Group Postprints. Vol. 9, 2002. American Institute for Conservation, Washington, D.C. 24 pp.
5 Yu, D., Klein, S. A., and Reindl, D. T. (2001) An evaluation of silica gel for humidity control in display cases. In: WAAC Newsletter. May 2001. Volume 23. No. 2.
6 TinyView Plus, humidity and temperature logger. Producer: Intab. (http://www.intab.se)

7 LEO-1455VP equipped with a LINK/EDS-unit, Inca 400, for micro X-ray analysis.
8 Dupas, M., Salies, A., and De Witte, E. (1987) The presence of soluble salts in silica gel. In: ICOM Committee for Conservation. Preprints, vol. III. 8th Triennial Meeting. Sydney, Australia 6-11 Sept. 1987, pp. 867-869
9 Scotch Aluminium Foil Gas Barrier Sealing Tape. Distributor: Conservation by Design Ltd. (http://www.conservation-by-design.co.uk)
10 Calver, A., Holbrook, A., Thickett, D., Weintraub, S. (2005) Simple methods to measure air exchange rates and detect leaks in display and storage enclosures. In: ICOM Committee for Conservation: 14th Triennial Meeting, The Hague, 12-16 Sept. 2005. Preprints. Vol. II, p. 597-609.
11 KBF 115. Producer: WTC Binder Labortechnik GmbH.
12 Glad® Cling Wrap.
13 Stack pressure is the movement of air into and out of the desiccator due to a difference in indoor-to-outdoor air density resulting from moisture differences.

AZOTON™, A NITROGEN CLIMATIC CABINET FOR THE TRANS-PORT AND SAFE STORAGE OF ORGANIC ARCHAEOLOGICAL FINDS

MORAITOU GEORGIANNA, LOUKOPOULOU POLYTIMI AND STAMOU PANAGIOTIS

INTRODUCTION

It has been said that excavation is destruction. This is especially true when fragile organic archaeological finds come to light without any preventive measures taken. Organic artefacts excavated from wet or damp sites contain excess water which supports a weakened cellular structure. Exposing the artefact to a new environment incurs accelerated rates of deterioration or even immediate collapse [1,2,3,4]. Storage at High Relative humidity levels, in the presence of oxygen, introduces the danger of microbial growth, while it accelerates the corrosion of metals. Moreover temperature acts as an accelerator.

Freshly excavated wet or damp organic and composite materials recovered from excavations in Greece have been either consolidated immediately in situ as a first aid measure [5,6] or have been preventively stored in common household refrigerators [5]. In some cases, a high RH was maintained in the presence of a biological growth inhibitor, with or without refrigeration [5,6,7]. Unfortunately very limited data is published while no systematic assessment of past and current practices is available.

Based on the fact that many chemical, electroc-hemical, photochemical and biological degradation mechanisms are oxygen dependent and that climatic conditions (Temperature and Relative Humidity) largely affect the dimensional stability and integrity of many categories of Cultural Heritage, the Getty Conservation Institute has developed hermetically sealed low oxygen display and storage cases for many important pieces of the international cultural heritage [9]. Inert gases have also been used for the elimination and control of insect infestation and micro organism growth on museum objects [10,11].

AIM

In the present project, a combined dynamic/ passive, nitrogen / climatic control cabinet was specifically designed and constructed for the transport and storage of freshly excavated wet or damp (not waterlogged) organic and composite (metal/organic) material. A relatively low cost preservation cabinet was constructed in order to transport objects from the excavation site to the conservation and diagnostic laboratory while awaiting interventive conservation treatment. The effective dimensions of the cabinet were based on a statistical approach of the size of wet organic artefacts recovered from land sites in Greece.

PERFORMANCE EVALUATION OVER A PERIOD OF 1 YEAR

The cabinet was evaluated in its stationary performance in Corinth Archaeological Museum. The air was removed from the cabinet using the vacuum pump. Two Artsorb cassettes (330x 110x 40mm) preconditioned at 72% RH were placed in the interior together with the oxygen scavenger and oxygen indicator tablet. Nitrogen was introduced after percolation in two water bottles after which it acquired a RH of 64%. The cabinet maintained a constant climate with daily discrepancy of RH in the order of ± 2.5%. The lowest T° of 7°C was recorded in January 2006, while the upper limit in the summer was set to 20° C. Initiation of refrigeration did not create any vibration. The draw backs of its performance were the following:

- It took long before the RH reached the selected value of 72% (without the use of the refrigeration fan).
- When refrigeration circulation was initiated, RH reading was disturbed due to the vicinity of the very sensitive RH sensor to the draft fans.
- The silicone seal of the door was too thick
- The bellow attachment configuration (tube fitting and connector) was not stable.
- The O_2 monitoring proved inefficient. Given that the air-tightness (leak rate) of the cabinet is not known it is impossible to detect eventual introduction of air. The conscious use of oxygen eye tablets has already been reported [12].

RECOMMENDED IMPROVEMENTS

- Replacement of the forced draft (very gentle though) circulation cooling by inductive cooling ''cold plate'' on the rear side.

- The silicone seal of the door should be industrially standardized.
- The bellow attachment configuration should be more stable
- An efficient oxygen detection system should be installed

Further improvements

The cabinet can be improved and standardized, but with a considerable increase in cost. Further improvement in order to permit sampling, conservation interventions, monitoring and setting up of experiments includes:

- installation of gloves so that any conservation treatment is performed within the set climatic environment (glove box)
- Long distance monitoring and graphic history display
- Battery power pack or generator facility
- Rotating platform for the support of the object
- Septum port for removing gas samples for analysis [9]
- Small opening for the removal of samples.
- Weighing facility incorporated for use in experiments

Conclusions

AZOTON™ is a versatile piece of equipment for every archaeological conservation laboratory in Greece. The cabinet evaluated is a low budget prototype. It is intended to be used for wet organic archaeological finds for transport and safe provisional storage. It can also be used with or without nitrogen for the preventive conservation of all kinds of humidity sensitive material and for experimental purposes.

Acknowledgments

The cabinet was specified and commissioned by the Directorate for Conservation of Ancient and Modern Monuments, the central conservation service of the Hellenic Ministry of Culture and constructed by LOGICARE CO. in early 2005 for the needs of the 37th Ephorate of Prehistoric and Classical Antiquities in Corinth. The project was funded by the railway construction company ERGOSE. We thank the 37th Ephorate and especially Dr A. Mandis, director and Mrs P. Lekka, conservator for their support and collaboration.

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Bibliography

1Cronyn, J.M, The elements of Archaeological Conservation. London 1990, Routledge.
2 Watkinson D. and Neal V., First Aid for finds, London 2001, Rescue –UKIC Archaeology Section 3rd edition 1st reproduction.
3 Preventive conservation recommendations for organic materials. Conserve O Gram, July 1993. Number 1/3. http://www.cr.nps.gov/museum/publications/conserveogram/01-03.pdf
4 First aid for wet-site objects Conserve O Gram, July 1993, Number 6/1 http://www.cr.nps.gov/museum/publications/conserveogram/06-01.pdf
5 Hellenic Ministry of Culture, unpublished reports
6 Adrimi- Sismani, V., Timvos Ferron, Athens Annals of Archaeology, XVI 1983, v 1-2, Archeologika Chronika, 23- 41
7 Mertzani, M., Analysis and conservation proposal of an archaeological sponge, Proceedings of the 8th ICOM group on Wet Organic Archaeological Materials Conference, Stochholm 2001, P. Hoffmann et al. (eds.), 501-525.
8 Moraitou, A., Examination of an archaic textile from Vergina, Archaeometry Issues in Greek Prehistory and Antiquity, Hellenic Society of Archaeometry, Y. Bassiakos et al.(eds), Athens 2001
9 Oxygen- Free Museum Cases, Shin Maekawa (ed), The Getty Conservation Institute, Research in Conservation, 1998
10 Valentin, N., et al., Microbial control by low oxygen and low relative humidity environment, Studies in Conservation, 35, 1990, 222-230.
11 Gilberg M., The effects of low oxygen atmospheres on museum pests, Studies in Conservation, 36, 1991, 93-98.
12 Carrio V., Stevenson S., Assessment of materials used for anoxic microenvironments. Townsend J. Eremin K., and Adriaens A. (eds.) Conservation Science 2002, Papers from the Conference held in Edinburgh, Scotland 22-24 May 2002, Archetype Publications, London, 32-38.

MOULDS ON BOOKS STORED ON "COMPACTUS SHELVES": A CASE STUDY

MARIASANTA MONTANARI, FLAVIA PINZARI AND MILENA RICCI

INTRODUCTION

"Compactus shelving" is one of the systems of choice utilised for the conservation of materials in libraries, archives and museums. Compactus shelves allow for a more efficient use of space, adequate protection against dust deposition, and a stable climate with reduced exchange of humidity on outer surfaces (Gallo et Regni, 1998). These characteristics represent an undoubted advantage from the point of view of preservation and conservation of materials, but they can also represent a risk when used in storage environments that cannot guarantee constant climatic parameters. Compactus shelves could be considered ideal equipment for preventive conservation when the overall climatic situation is ideal. The resilience in heat and humidity exchange between the micro-environment inside the compactus shelves and the outer environment could represent a severe peril to stored objects, especially when these are composed of hygroscopic materials. Recommended standards for preserving documents of all kinds are now well known (18-20°C and 50/60% RH for books and periodicals, and 5°C and 35% RH for colour print photographs). The reality is that in most cases, it is difficult to maintain a stable level of temperature or relative humidity, even with the benefit of air conditioning. Specific climatic and economic conditions play an important role, which must not be underestimated. In many real situations, compactus shelving was the cause of degradation phenomena that could not be explained by the environmental parameters at a macro-level, but (mainly) by micro-environmental situations that were determined by several accidental factors. During the course of several investigations in libraries and archives, different causes led to the same results, namely the development, inside compactus shelves, of moulds on volumes' bindings, especially when made of leather, parchment and cotton fibres. The fungal mycelia, in all the observed materials, were always characterised by their scattered appearance, in that the colonies developed in the form of light coloured spots measuring 0,5-1 cm in diameter. Among the situations examined the causes of mould development varied:

- small libraries with no funds or poor information used compactus shelves simply to save space and did not have an air conditioning system installed;
- libraries with an apparently perfect air conditioning system positioned the air venting modules inappropriately in relation to the compactus shelves, thus creating incorrect air circulation and the occurrence of non-uniform climatic parameters along and among the shelves;
- libraries with efficient conditioning units but affected by structural problems such as rising damp from the floors and along the walls.

Due to the frequency of occurrence of moulds on library and archival materials stored in compacti, and the similarity in the appearance of infections, a study was undertaken that was aimed at the evaluation of the common factors, aside from the presence of compactus shelves that caused the development of such degradation phenomena.

In this report the case of a depository located at the Estense Historical Library in Modena, containing compactus shelves, and the solutions placed into effect to overcome deterioration phenomena are described.

The Estense dukes' library, moved from Ferrara to the Ducal Palace in Modena, was opened to the public in 1764 (it was one of the first to be opened) and has been located in the present-day building, the Museum's Palace, since 1833. It originates from the ancient Este dukes' library, which was created in XIV century, and was later enriched with precious volumes under Niccolò III, Borso and Ercole I. Among the most valuable volumes in the collection is the famous Borso d'Este Bible, a masterpiece of Ferrarese miniature painting.

MATERIALS AND METHODS

Prior to the investigation a thorough analysis of documents relevant to the organisation of the historical library and its depository, and of previous reports on the state of conservation of materials, was performed. The study consisted in both an environmental and biological evaluation of the hygienic state of conservation structures and materials. The instruments employed for the collection of climatic data were digital hygro-thermometers (Hygrolog-D Rotronic AY – Swiss).

During the investigation, sampling of fungal structures from damaged library materials was carried out.

Swab sampling - Sterile cotton swabs were used to obtain samples suitable for further fungal and bacterial culturing and identification. The swabs were wiped along the entire area showing visible damage.

Adhesive tape sampling - Removable adhesive tape was used to collect samples of fungal mycelia and sporulating structures from the parts of the bindings presenting fungal structures. The colonies were brought into contact with the adhesive side of the tape by applying very light pressure, after which the tape was transferred on to a glass slide using a drop of mounting fluid, so as to be examined under a microscope (Samson et al. 2002).

Agar/broth cultures - Fungal structures sampled with cotton swabs were inoculated directly on to agar plates and swabs were then immersed in sterile Czapek broth (Samson et al, 2002).

Optical microscope observations - Illuminated microscopic examination of mounted slides carrying adhesive tape samples and fungal structures was performed using an Olympus AX60 microscope fitted with phase contrast and a digital camera.

Aerobiological investigations - Sampling of atmospheric aerosol was carried out using the gravitational deposition method: collection, by gravity, of particles on Petri dishes containing a suitable culture medium. Culture plates with a diameter of 9 cm containing Malt Extract Agar medium (MEA 2%) were used. The plates were placed on the shelves inside and outside the compactus, in the same places where the digital hygro-thermometers were positioned. The sampling interval was 1 hour. Following exposure to air, the plates were placed in a thermostat at 27°C for 7 days and checked daily, with Colony Forming Units (CFU) counts being carried out.

Results and discussion

The depository examined at the Estense is located on the first floor and is part of a two-floors library tower that was known as the “metal stacks” up until the end of the 20th century, and is characterised by metal shelves. Previous reports documented the fact that the depository suffered from severe climatic problems with high values of relative humidity in the summer months during the 1970s. Due to conspicuous development of moulds on materials the books stored in the “metal stacks” were subjected to heavy treatment with Ethylene Oxide during the 1990s (Gallo et Valenti, 1996). But the library’s climatic problems were not sporadic, and a comprehensive restoration of the whole structure, which is built on a water-bearing geological stratum, was needed. Reclamation of the building’s foundation and of the floors and walls was, in fact, performed in 1996-98. “Compactus shelves” were substituted for most of the metallic shelves forming the “metal stacks” in 1999. The first symptoms of adverse climatic conditions in the form of whitish efflorescence were observed in the compactus shelves in 2004. Moulds had grown especially on the spines of a few books stored in compactus shelving. The University of Modena and Reggio Emilia made an aerobiological survey of the depository in spring 2004 and detected the presence, in the air and dust, of several Dematiaceous fungal spores and propagules (specifically, belonging to the genera *Alternaria, Cladosporium, Stemphylium*) and of numerous conidia of *Penicillium* sp. A further investigation was performed during the autumn of 2004 by the “Biology” and “Environment” laboratories of the Istituto Centrale per la Patologia del Libro that led to the conclusion that biodeterioration was confined to the depository on the first floor, specifically to some of the volumes conserved inside the compactus shelving in the inner area. The volumes stored on the open metallic shelves in the same environment proved to be free from mould growth.

Significantly, damage was very localised and limited, as anticipated in the introduction, to only some parts of the bindings. Moreover, only books with bindings made of leather, parchment or canvas presented the efflorescence, while bound volumes and bindings made of cardboard or paper-bound volumes were free of moulds.

The analysis of air quality performed by gravity collection of CFU showed the presence inside the compactus shelves of a significant charge of vital aero-diffused microflora composed of fungal spores and propagules (mainly genera *Aspergillus, Penicillium, Alternaria, Geotrichum, Eurotium, Gliocladium*), several yeasts and bacterial cells. Sampling of fungal material performed directly on library materials by means of swabs and adhesive tape showed that the efflorescence was actually composed of fungal mycelia and that some of the growing strains belonged to species known to be dangerous for library materials. The light microscope observation of adhesive tape samples revealed fruiting structures with spores attributable to species of *Chaetomium* or *Botrytis,* genera that are known to be cellulolytic and proteolytic.

The analysis performed by researchers from the "Environment" laboratory revealed that, despite the above-mentioned reclamation intervention, the library suffered from rising damp in walls due to capillary action. This phenomenon was affecting both the inner and outer walls to a height of at least 20 cm from the floor. The highest concentration of mould was detected in correspondence to the wettest wall, namely the one closest to the courtyard.

Moreover, conservators and librarians who reported typical symptoms of so-called "sick building syndrome" were alerted to the presence of fungal and bacterial spores, along with volatile organic compounds produced by actively growing micro-organisms.

Climatic measurements were repeated continuously in 2005 (October-January) by using three hygro-thermometer probes positioned vertically along the inside of a compactus shelf (from 15 cm from the floor to the highest shelf). Contemporaneously climatic measurements of the whole depository were recorded.

The results of the environmental monitoring indicated that besides the generally good maintenance of standard climatic conditions (the average of relative humidity values ranged between 50 and 60%, and the temperature from 20 to 22°C), a gradient of humidity was present inside compactus shelves (it was higher near the floor). Moreover, the relative humidity inside the compactus was slightly but constantly higher than outside.

The hypothesis formulated to explain the occurrence of damage in library stored materials was a sum of microclimatic events including: i) a lack of ventilation inside compactus, ii) a resilience in climatic changes inside the compactus with respect to the macroclimate in the depository, iii) the hygroscopic behaviour of binding materials used in the volumes, iv) a higher susceptibility to humidity of the exposed parts of the books (spine, upper edge and fore edge); v) the fact that the Heating, Ventilation and Air-Conditioning systems (HVAC) due to obsolete safety rules had to be switched off during the night and on weekends, thereby causing fluctuations in climatic parameters and eventually causing condensation phenomena on inner shelves and materials; vi) seasonal changes.

In order to avoid mass disinfection of materials with toxic gases, the problem of mould efflorescence in the depository of the Estense Library was tackled by using a combination of low-impact/toxicity treatments aimed at stopping damage to materials, in addition to leaving the premises safe for staff.

The operations carried out were the following: i) the HVAC was checked for efficacy, and the ventilation openings were cleaned and checked for correct functioning; ii) HVAC filters were changed more frequently; iii) side panels of the compactus shelves were removed to facilitate ventilation; iv) books were mechanically freed of dust within a safety cabinet, v) fungal efflorescence was removed manually by specialised personnel using soft brushes and a vacuum cleaner within a safety cabinet fitted with HEPA filters and the correct personal safety devices.

Following reclamation of the volumes and the adoption of most of the suggested modifications, a further investigation at the depository was conducted after a period of 20 months. A visual inspection and photographic comparison of the state of conservation of the books and the development of mould were performed. Although some of the operations suggested had not yet been completed (i.e. the reclamation and disinfection of the entire ducting system of HVAC) the biodeterioration phenomena appeared almost everywhere to be substantially reduced, and all the volumes that were previously affected by mouldy efflorescence appeared to be in the same condition as they were following cleaning.

To conclude, the experience of the Estense Library suggests that a frequent visual inspection of materials stored inside compactus shelves is highly recommended, notwithstanding the presence of a well-functioning HVAC and the maintenance of optimal standard climatic values.

Micro-environmental anomalies and localised deterioration phenomena, if promptly pinpointed can be easily contained and resolved, while invasive reclamation of materials should, as far as possible, be avoided and adopted only as a last resort.

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References

1 Gallo F., Regni M. (1998) Conditions microclimatiques da les bibliothèques italiennes. La climatologie dans les archives et les bibliothèques. Actes des Troisièmes Journées sur la Conservation Préventive. Arles, 2-3 décembre 1998, Centre de Conservation du Livre, pp. 69-83.
2 Gallo F., Valenti P. (1996) Mass interventions in two Italian libraries. In: Federici, C., Munafò, P., (Eds), International Conference on Conservation and Restoration of Archival and Library Materials. Erice, 22nd-29th April 1996. G.P. Palumbo, Palermo, pp.153-166.
3 Samson, R.A., Hoekstra, E.S., Frisvad, J.C., Filtenborg, O., (Eds.) (2002) Introduction to food-and airborne fungi. Sixth Edition. Centraalbureau Voor Schimmelculture. Utrecht. The Netherlands.

Early warning dosimeters for monitoring indoor museum climate: environmental impact sensors and LightCheck™

Peter Mottner

Artworks of cultural value are suffering severe stresses by environmental impacts. Especially indoors, humidity, condensation, temperature changes or gaseous pollutants (e. g. SO_2, NOx, O_3), chlorides, and the attack of micro-organisms are endangering the precious objects of art by physical and chemical attack. Indoors - and hereby especially in show cases or magazines - humidity in combination with chemicals like formic or acetic acid leads to degradation risks. The impact of the indoor micro climate may cause corrosion and deterioration of the material, or finally lead to a complete loss of the original object.

A better understanding of the objects stress situation can be achieved by microclimatic measurements (temperature, air humidity, condensation frequency etc.). However, microclimatic measurements do not provide complete information, as they neglect the important influences of pollutants and synergetic effects of different parameters, and are difficult to perform and in any case very expensive.

The assessment of such complicated situations by easy-to-handle and low-cost techniques can be achieved by using standardised, highly sensitive test glasses as dosimeter materials. The performance of this sensor method is possible for every kind of artwork material, monitoring the integral atmospherical impact around the object, and thus allowing a final risk evaluation. This method, developed at the Fraunhofer-Institut fuer Silicatforschung (ISC), Germany, for environmental stress monitoring on artworks, has been widely used in many European countries in the last 15 years, especially for monitoring climate effects in museum display rooms, show cases and magazines, but also as an early warning system for potential environmental risks, caused by industrial exhaust gases on immovable heritage (e.g. stained glass windows). The method is licenced in Germany as German Technical Guideline VDI 3955/2. Used as »stress dosimeters«, the sensors allow the evaluation of long term risks in short term experiments, integrating all environmental influences as well as synergetic interactions. Exposure times of 1-3 months are recommended. A distinct value, representing the environmental risk potential, can finally be stated after instrumental analysis. A special analytical tool, applied on the sensor surface, allows the determination of damage origin.

In case of lighting damage potential (e.g. coatings, composite materials, textiles), light dosimeters for museum application are available, developed at Fraunhofer ISC within a European Research project (2001-2004), and awarded with the Pan-European Grand Prix d'Innovation in 2003 ('Cultural Heritage Preservation'). The product is available on the market since then as LightCheck™.

Background, measurements on site, references and future application potential of both early warning dosimeters, especially for indoor collections, will be shown.

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Preservation conditions of roman glass vessels of 1st century AD from Rhodes Island - Greece

Lampropoulos V., Kontonikoli M., Papadimitriou M. and Karampotsos A.

Introduction

The deterioration and preservation of materials depends on two things: the nature of the material and the environment surrounding the material, whether in the ground or in the museum.

This study aims to present the environmental influences in the excavation and temporary storage areas combined with the material's structure and chemical composition on rates and forms of degradation. Additionally, these forms of corrosion were confirmed macroscopically and microscopically. Finally, the compilation of this information led to:

- Identifying the factors in the environment which may be affecting the deterioration/preservation of the artifacts.
- Understanding and minimizing or eliminating conditions that can cause damage.
- The appropriate conservation and restoration methods in order to deal with the archaeological vessels.
- Proposing preventive measures in order to provide a stable exhibition and storage environment and consequently avoid those situations in which problems may arise.

On the curators' initiative of the XII Ephorate a project was begun to establish an overall, sustainable conservation concept for five glass vessels of 1st century AD from Rhodes Island, involving a team of conservators, archaeologists and scientists. The results of the investigations undertaken are presented in this poster and briefly discussed.

Experimental Techniques

Five glass vessels were examined in this study (Y931, Y932, Y933, Y934 and Y941).

Elemental analysis, using scanning electron microscopy (S.E.M.), has been carried out on 7 samples (Y931, Y932, Y933, Y934A, Y934B, Y941big, Y941 small) in order to evaluate the morphological and chemical changes.

It was also essential to study the environmental conditions (data regarding winds, temperature and relative humidity) of the excavation area, as well as the topographical data (ground - water level) because the mechanism of glass corrosion is related with these two parameters. The above information was collected from the department of statistics of National Meteorological Service, for the period from 1955 up to 2004, and the National Institute of Geology and Mining Research respectively.

To further investigate the effect of environmental conditions, pH, electric conductivity and concentration of sulfate (SO_4^{2-}) and chloride (Cl^-) ions measurements were performed on six soil samples.

Finally, all types of deterioration were identified macroscopically and were confirmed by the S.E.M. analysis in order to give a broad outline of the restoration campaign.

Results - conclusions

Analyses of structural material

1. Si and Na are generally low and very low in all the cases. Additionally, Al, on samples 4 and 7 in the case of section 2 (≈2%, <1% respectively), and Ca, on samples 5 and 6, are also very low (<2%, <5% respectively). This is because the materials have been leached out by the intense humidity present.
2. K on samples 1, 2, 3, 5, 6, 7, is too low (≈0%), this is because the material has been leached out by the intense humidity present and also because of a possible lack in raw material.
3. Ca, on samples 1, 2, 3 is generally very low (<5%, <3%, <5% respectively), perhaps a little higher in the exterior surface because of calcium salt crust formation. There is a normal level of Ca on samples 5 and 6 and it is especially high in the exterior surface, perhaps because of the crust of calcium salt.

Environmental study

By observing the average RH per month, high values (67 - 69%) have been noticed. According to the data of atmospheric humidity (condensation), the rainfall and the ground-water level (capillary rising), the result is likely to be a high percentage of relative humidity (RH%) in the ground.

The temperature in the deep layers is theoretically lower than that of the surface ground. This multiplies the problems, when the excavated objects are revealed and transported from a cooler to a warmer ground environment. Finally, in the region of excavation of the glass unguentaria, conditions of frost nor particularly high temperatures have not been observed.

Topographical data (ground - water level)

We are led to the conclusion that the sea influences the height of the ground-water level. Also the ground-water level is too small in order to allow contact of the rising humidity, according to the phenomenon of capillary rising, with the level of excavation.

Finally, petrographically the ground is constituted by alluvium of certain dilouviac depositions (sand, gravel, mica) and also few neogenic rocks (clay, metamorphic).

Acidity - alkalinity - salinity of excavation ground

The pH results show the followings:

1. Sample No Y931: alkaline ground that indicates a presence of calcium carbonate ($CaCO_3$).
2. Sample No Y932: light limestone ground (area of low alkalinity).
3. Samples No Y933 and Y934: acidic ground that identifies a presence of aluminosilicates (quartz, clays etc.).
4. Samples No Y941 small and Y941 big: light acidic to neutral, which means ground of aluminosilicates composition.

Low conductivity has been observed that involves low concentration of chlorides and salts in general. This shows that the presence of chloride (Cl^-) and sulfate ions (SO_4^{2-}) is due to the high bed level affected by the height of rainfall and the sea level.

Forms of deterioration

In all the cases the same forms of deterioration have been observed: dulling, crizzling (as a result of pressure application), lamination, iridescences, pitting and crusting (depositions of clay and insoluble salts hard crusts) with biological deposits. The forms of corrosion were caused by:

- the presence of humidity (ground - water level is near the depth that the artifacts were found, rain and atmosphere/water condensation),
- the temperature variations,
- the crystallization of soluble salts (subsoil waters contain ions of sodium (Na^+), potassium (K^+), calcium (Ca^{2+}), sulfates (SO_4^{2-}), chlorides (Cl^-) and silicates (SiO_3^{2-}) from the soil, the soluble components of the aluminosilicates and the sea). [1]
- the low pH of the soil samples (pH<9): SiO_2 is leached out slowly and continuously at a pH of less than 9 whereas the increased extraction of Na and CaO below pH 9 is responsible for the intense decay of the artifacts. [2]
- the biological action.
- the storage conditions.

Conservation processes

On-site conservation took place prior to laboratory treatment. Systematically remedial treatment of the altered glass vessels was carried out in the laboratory. This involves the following steps:

1 Investigation and documentation (systematically recording, photographs, drawings)
2 Non destructive analysis of the material's structure and examination of the deposits
3 Pre-consolidation of iridescent layers
4 Cleaning (removal of soil and encrustations with chemical and mechanical methods)
5 Consolidation of the corroded surfaces
6 Joining of the broken pieces

Preventive measures for display and storage

A range of preventive measures has been proposed in order to ensure the appropriate conditions for storage and exhibition of these glass vessels and their long-term preservation.

Museum environment

Damage can occur by failing to control and monitor the environment of materials at risk. Moreover, conservation treatments have been introduced new materials into the artifacts which themselves are subject to decay.

The primary concern is humidity and temperature: moderate temperature (T= 18 - 21°C) and a constant range of 45 - 50% relative humidity, along with good ventilation, should keep the glasses in good condition. More restricted environment (RH closer to 40%) should be kept for crizzling and sensitive glasses [3]. Extremes or rapid fluctuations in humidity and temperature should also be avoided.

A well-controlled and regularly monitored display or storage environment is fundamental in order to achieve the above appropriate environmental conditions.

Although glass is not considered a light - sensitive object, the control of light is an issue in the case of ancient glasses. Generally, low levels of illumination should be maintained for unstable glasses in order to prevent heat built-up and sharp changes in temperature and relative humidity [4]. Light sources should be placed outside cases and not very close to a glass object. Strong sunlight and lighting devices, emitted UV radiation and heat, are also a potential source of damage.

Materials for display and storage should not emitted volatile organic compounds. All glass must be protected from dirt and dust.

Storage facilities

Using open shelving or closed cabinets with sturdy and well-balanced structure is recommended. Cushion surfaces and place each object so that it is well-spaced from others and resting firmly without protruding beyond the edge of the shelf. As a final precaution, minimize traffic in storage areas.

Display

The display cases must be stable and sturdily built in order to avoid breakage and vibrations. Shelves should be horizontal and carefully fixed. Adequate supports are required in the case of non well stand glass vessels. Metal generally is not recommended for holding glass as it can scratch or stain it [4].

Handling

All glass must be handled very carefully. In the case of iridescent glass, handling must be kept to a minimum.

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References

1 Lampropoulos V.N., Environment of Monuments, Museums and Archaeological Sites, Athens, 2003.
2 Kontou E.K., Kotzamani D.D., Lampropoulos V.N., Glass, Technology, Corrosion and Conservation, Athens, 1995.
3 Koob P. S., Conservation and Care of Glass Objects, Archetype Publications, London, 2006.
4 Rottenberg B.L., Care and Display of Glass Collections, American Association for State and Local History (AASLH), Technical Leaflet 127, 1980.

LONG TERM PREDICTION OF MARBLE EROSION AND RISK ANALYSIS FOR THE CONSERVATION OF THE STATUE OF DAVID OF MICHELANGELO

LIVIO DE SANTOLI GIANFRANCO CARUSO AND MATTEO MARIOTTI

INTRODUCTION

The installation of a new HVAC system in a museum needs an appropriate inquiry in order to predict every possible environmental modification which could be detrimental for the sensible materials of the works of art.

The importance of the statue of David of Michelangelo in Florence (Italy), which in the last decades was submitted to a huge numbers of visitors per year (1,000,000), focused researchers' attention on the implementation of a kind of air ventilation solution for the preservation of the statue from the action of indoor pollutants. The proposal carried out is related to an air curtain protection system of the statue designed by CITERA of the Faculty of Architecture Vallegiulia in Rome, simulated by the implementation of a CFD model, to evaluate as homogeneous as possible a field in terms of air velocity and of concentration of pollutants. The simulation result states that the injection from the bottom of the statue of air with low velocity (1 m/s), with controlled relative humidity, and cleaned by a high efficiency filtering section, couldn't carry out any kind of decay for the marble of the statue. Nevertheless, under the suggestion of the management of the museum a study about long term decay phenomena on the marble was developed, in order to evaluate any new possible risk due to the presence of pollutants in the air flux surrounding the surface of the statue.

The aim of this paper is the evaluation of the long term effect of the impingement of particles on a marble surfaces, with a CFD simulation implemented with the Tulsa model of the erosion effect.

RESULTS AND DISCUSSION

The surface decay of the cylindrical specimen is evaluated through the erosion rate (kg/m^{2}s) in order to measure the material loss caused by the inpingement of particles. Different diameter of particles are provided to consider their different behaviour during the evolution of transport process. Knowing the maximum erosion rate and fixing an evaluation lapse time, the thickness of material loss on the marble surface can be estimated.

The maximum eroded thickness on the impinged contour in a lapse time of 100 years is negligible even according to the high value of safety adopted in term of concentration of particles, inlet velocity, lapse time and material properties.

CONCLUSION

The simulation of the long term erosion effect due to the impingment of particle on a marble surface show the negligibility of this decay effect on marble surfaces. The hypothesis of absence of filtering section for a lapse time more than tree times long if compared with the life cycle of the design system, supports this statement with an even geater level of certainty. LOAEL (Lowest Adverse Effect Level) as a function of different particles concentrations and particles diameters has been presented.

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REFERENCES

1 Livio De Santoli, Francesco Mancini, Matteo Mariotti, Air curtains as a protection for indoor cultural heritage: a proposal for Michelangelo's David in Florence, Proceedings of the 10th international conference on indoor air quality and climate, 4-9 september, Beijing, indoor Air 2005, Beijing;

2 J. K. Edwards, K. Jeremy, B. S. McLaury, S. Brenton, S. A. Shirazi, and A. Siamack. Supplementing a CFD Code with Erosion Prediction Capabilities. In Proceedings of ASME FEDSM'98: ASME 1998 Fluids Engineering Division Summer *Meeting*, Washington D.C., June 1998.

The monitor ship project regarding the micro-climate in the national museum of art of Romania

Carmen Tănăsoiu

After the events of December 1989, the building of the National Museum of Art of Romania, the formal Royal Palace, was rehabilitated and the permanent exhibition was reorganized.

During the spring of 2002, the Romanian Medieval Art Gallery has been reopened. The project of monitoring and evaluating the microclimate in the 10 rooms of the exhibition was then initiated.

At the beginning the project lasted a year and determined by the variety and fragility of the exhibit objects (icons, liturgical golden embroideries, manuscripts and silver items, all dating from the 14th-18th century) which required some special and different conditions of conservation.

During this project were bought termohygrographs for all exhibit rooms. The relative humidity (RH) and temperature (T) parameters were constantly registered, daily and weekly, in the showcases and in the different corners of exhibition rooms, making comparisons between those parameters and the outside ones. The first part of the project consisted in the registration of the variations of the temperature and relative humidity from the exhibition rooms (between April - September) without any working climatisation system.

During the autumn and winter seasons, the project was developed using the climate control system (ventilation, central heating, and humidification of the ventilated air).

We were interested to compare and analyze if there were any kind of differences between:

a. the relative humidity and temperature evolution/ statistics in the exhibitions rooms
b. the same parameters for those items exhibit in showcases or without ones
c. the final analyses between each exhibition room and the others.

Without working of any climate control system (April – September) the diagrams show a perfect correspondence between the exterior and interior microclimate.

In the second part of the project, even though the climatisation system works, it could be noticed an influence of outside parameters visible on our diagrams.

Because of the results obtain in this project we decide to extend it to the whole museums exhibition rooms and make it permanent.

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Using microclimates within a large building in an arid climate

Patricia A. Morris

Instead of trying to adhere to the NISO published standard*s* for temperature and humidity throughout an entire building, libraries would find it better and cheaper to adapt those standards to a microclimate approach. This recommendation arises from the experience of the University of Colorado at Boulder, where attempts to adhere to the published standards in the main library building proved difficult, even counter-productive. In the stacks, for example, when temperature was stabilized at 70 degrees Fahrenheit, relative humidity rocketed up and down, yet caused no damage to the books. Similarly, in the archives, when relative humidity rose above well above the standard, it caused neither physical damage nor mold bloom. Yet in cataloging, when relative humidity rose while staying within the limits of the standard, the books showed marked physical damage (warped boards and cockled text blocks). [1]

Given that these results called the NISO standard [2] into question, the preservation staff studied the building conditions for more than a year, using first eight and then sixteen data loggers. The building, comprising more than one hundred thousand square feet and conditioned by nineteen different air handling units, turned out to be a panoply of microclimates, for which the NISO guidelines proved to have been drawn too narrowly, especially in semi-arid Colorado where the HVAC system was based primarily on evaporative cooling. The Libraries thus reinterpreted the guidelines in order to establish an environment appropriate to each microclimate and to the types of material held therein. Other libraries, too, should be able to preserve their collections without replacing buildings or making vast expenditures by using the microclimate approach.

Overall environmental standards for the Norlin Library building were established in accordance with our understanding of the microclimates within the structure, the nature of our climate and HVAC system, and the locations and nature of our various collections within the building's climate zones. We want to avoid relative humidity above 40%--somewhat easier to do in the semi-arid climate of Colorado. Neither fluctuations nor relative humidity below 20% are considered cause for concern, given the nature most of our collections. The system has always managed to maintain steady temperatures from 70-72º Fahrenheit.

As a result, any modifications to the HVAC system were adopted with an eye to the microclimate approach. Sensors in the archives will be relocated, and the air handlers will be modified to respond to dew point controls to enable the system to respond more quickly to rising humidity, in an area where collections are less chemically stable (photographic media and older, very acidic paper). The Special Collections are already enclosed by interior security walls that greatly diminish environmental fluctuations. While temperatures are slightly higher in the Special Collections Annex, the very low relative humidity is stable, and the materials in the Annex are all volumes bound in paper, leather or cloth; unbound materials there are tightly boxed. Major changes in the HVAC system are required only for the north end of the cataloging area, where there is a cul-de-sac in the air circulation system that causes considerable damage to new materials when relative humidity rises and remains moderately high for a period of five to ten days. That air handling unit's sensor has to be relocated, and the air handler will have to be equipped with a heating coil (equipment left out during the last renovation because the area is heated with radiators).

Using our building's structure and its HVAC system we can address preservation of the collections, provided we have a clear understanding of the makeup of our collections and the true vulnerability of each type of media.

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NOTES

1 For a fuller description of methodology and literature review, consult Patricia Morris, “Interpreting Published Environmental Guidelines for Preservation in Libraries”, portal (7:1), 111-122.
2 William K. Wilson, *NISO TR01-1995: Environmental Guidelines for the Storage of Paper Records* (Bethesda, MD: NISO Press, 1995).

Life expectancy prediction based on chemiluminescence experiments and model-free simulation

Fabian Käser

Various organic materials react with environmental oxygen. They oxidise and therefore change their optical, mechanical and chemical properties. For the adequate conservation of solid materials used in art and cultural artifacts, substantial knowledge about the stability and the sensitivity to oxygen of organic materials is of particular importance.

Previous research has shown that established analytical methods such as oven-ageing tests and oxygen uptake techniques are very laborious. Furthermore, short-time experiments such as measuring the oxidation induction time OIT or -temperature OIT' using DSC or other conventional thermo-analytical methods are unsuitable for long-ferm prediction of oxidative behavior because of the use of highly elevated temperatures in the experimental conditions. Various studies indicate that measurement of oxidation-induced chemiluminescence can be a useful aternative to determine the stability of organic materials against oxidation.

The principle of chemiluminescence in the oxidative reactions studied is not yet entirely understood. It is believed to be a termination of two peroxy radicals in a Russel mechanism. The chemiluminescence emission results from the relaxation of excited triplet carbonyl functions ('R=O') to its ground state.

To measure chemiluminescence, a novel apparatus was developed at the Berne University of the Arfs (Switzerland). Preliminary data acquired with this prototype strongly supports the use of the chemiluminescence method to characterise oxidation reactions and to determine the effects of conservation procedures on objects. Combining the insights gained under realistic conditions with an isoconversional analysis (after Friedman and Ozawa-Flynn-Wall of experimental kinetics) promises to be a powerful tool for prediction of life expectancy under given realistic conditions.

Using this advanced method, the effects of environmental influences (temperature, time, relative humidity, UV-Vis-radiation, partial pressure of oxygen) against ihe rates of oxidation can be demonstrated in a very realistic manner.

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Dust - developing a method for sampling and analyzing dust in museums.

Maria-Louise Jacobsen

Damage caused by dust has been observed on several different objects and materials and there seems to be a need for general guidelines to reduce the dust exposure. To do so it is necessary to identify the dust in museums by sampling and analyzing. Different methods have been developed for monitoring dust deposition but these are still too expensive and resource consuming to be used routinely. Furthermore, no national or international standard for sampling or analyzing dust exists.

This poster describes a method for sampling, measuring and analyzing dust. The method is cheap and easy to reproduce and without visual interference in an exhibition.

Sampling was performed using dust lifters [1]. Glass slides were placed to accumulate dust by natural deposition. After a period of exposure, the dust lifter, which is a sticky gelatin film, was placed over the area of interest, applied with a slight pressure, and then removed with the dust particles adhering to the gel.

From digital images of the dust samples (by microscope camera), image analysis was done using Image J, a public domain Java image-processing program [2]. The dust deposition level can be defined as the number of particles per area unit, and the area fraction covered by particles. By processing images of the dust samples with Image J, it was possible to calculate particle count, area fraction and size distribution of particles. In this investigation we placed a lower boundary in the program so only coarse particles larger than 2 µm were recorded.

Optical microscopy was used for examining the composition of dust, thus identifying sources. The gel foils can be examined readily by transmitted light in the polarizing microscope [3].

The method was put to use for collecting, measuring and analyzing dust from various locations including four exhibition rooms and four storage areas. The period of exposure was 1-12 months.

This poster shows the results from the measuring and analyzing of the sampled dust.

Result 1: It is observed that the dust accumulation is dependent on a variety of factors and is lower in enclosures. This is seen in both exhibition and storage. The results suggest a tendency for an accumulation of the number of particles for the first six months of exposure; subsequently a slower accumulation or stagnation is observed. The area covered with dust is observed to be either reasonably constant or increase approximately linearly with the duration of exposure.

Result 2: The size distribution for all samples shows that the smaller particles are in the majority (approx. 2/3 of the particles are < 20 µm2), however, the larger particles such as textile fibres and large skin flakes account for the main area coverage fraction.

Result 3: The observations follow a normal distribution [4], which permits the use of statistical analysis and forecasting. By implementing a linear regression model, it is determined that the average size and number of particles have a statistically significant effect on the area covered by dust.

Result 4: In exhibitions, outside display cases, on horizontal surfaces the values for the area covered has been up to 6 % after 183 days of exposure. By using a linear regression model it is predicted that the area covered with dust is due to reach a proportion of 22.5 % after a period of 36 months. This is a statistical projection, where changes in climate and visitors are not included. Carbon on a coloured surface can be seen at 2.4 % area covered [5]. Assuming the dust is made up of dark fine particles this point will be met after a period of 3-4 months of dust exposure. The study can form the basis for new initiatives to minimize the dust exposure.

Result 5: Many types of particles are readily identified, and the particles origin from humans e.g. textile fibres, human hair and skin flakes, from the building e.g. mineral fibres, paint flakes and from outside e.g. plant parts, insect parts, sand grains and pollen. It is observed that the dust exposure depends on the origin of sampling e.g. dust amount increases, when the distance to the main entrance decreases. This can be due to decreasing tracking in from the visitors with distance from the entrance [6].

In addition it is noted that close to open doors, the dust compounds have a higher content of organic non-human compounds, which are not seasonally distinct, like pollen, fungal spores, plant fibres and insects.

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References

1 BVDA Environmental Gel Lifters, from:
P-B Miljø
Enebaervej 7
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2 http://rsb.info.nih.gov/ij/
3 Ryhl-Svendsen, M. & Jacobsen, M.-L. (in press): Sampling of Coarse dust. Presented to NKF Congress, Stockholm, 1. December 2006.
4 Jacobsen, M.-L. (2006): Støv. Udvikling af en metode til opsamling, måling og analyse af støv. Unpublished master-thesis from the School of Conservation, Copenhagen.
5 Bellan, L. M.; Salmon, L. G. & Cass, G. R. (2000): A Study on the Human Ability to Detect Soot Deposition onto Works of Art. Environmental Science & Technology, Vol. 34 (10), pp. 1946-1952.
6 Stainton, S. (1980): The care of floors and floor coverings, Conservation within Historic Buldings, IIC, London, pp. 44-46.

Open air museum buildings. Microclimate, mould attack, research and conservation.

Jon Brænne.

Abstract

Due to the changes in the climatic condition in the past five to six years, we have in Norway in open air museum- and listed buildings noticed a new type of damage to the vulnerable, painted distemper decorations.

In a short time, well preserved 18th. and 19th. Century decorations have been severely attacked, and sometimes damaged by mould growth.

The problem however is not only the mould. Many of these distemper decorations are in need of conservation.

The traditional way of carrying out the conservation of distemper decorative painting on wood is to use animal glue dissolved in water. Most frequently used are Sturgeon or gelatine glues in very low concentrations dissolved in deionised water.

By carrying out necessary conservation on the mould infested distemper decorations, we realized that we could add new "food" to the mould, and in this way increase the mould growth on the painted surface.

In collaboration with Mycoteam, an independent Norwegian consultant company in bio deterioration, we have carried out research on the subject.

We identified the mould. Then laboratory test were carried out to analyse how the specific, identified mould would grow on different types of distemper paint, and traditional and contemporary conservation media in the question for the actual conservation works to be executed.

Summary and conclusion.

The results from the research and the conservation work brought forward new knowledge, concerning the subject. The conservation work was carried out in a wooden interior, painted with distemper in 1784, infected with mould growth.

The poster will present the measures and analyses of the climatic condition in the building and the actual decorated room through one year. The analyses of the mould and the artificial mould growth on distemper and conservation materials, and the final conservation work will be presented.

By using the new knowledge generated through this project, it may be possible to take preventive precautions, concerning similar damages and conservation problems in distemper and linseed oil painted and decorated museum buildings.

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Improved protection of paintings during exhibition, storage and transit – PROPAINT (EU project FP6, 044254)

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To preserve the paintings as close as possible to the artists' original expression is a central focus for museum administrators and conservators. An important part of this work is to protect the paintings against degrading influences of various indoor environments. The main aim of this EU-funded project PROPAINT, is to develop innovative protection treatments used as a preventive conservation measure for paintings during exhibition, storage and transit. The project will investigate the protective effect of microclimate frames for paintings and undertake research on the protective effect of varnishes applied to paintings generally and inside microclimate frames specifically. Measurements of the state of microenvironments in microclimate frames and the potential deteriorating effects on paintings will be made both in the laboratory and at selected sites in art galleries, storage depots and in transit by using, for the first time simultaneously, several dosimeters developed in previous EC projects. The appropriateness and synergies of their integrated use will be evaluated. The results of the project will allow improved design of microclimate frames to offer the best possible microclimates for conservation of paintings. The project will contribute with improved comparative knowledge about microclimate effects on varnishes applied to paintings as remediation surface treatments. The project results will also contribute to preventive conservation measures and standards for microclimate control of paintings.

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Incised ceramics (1650-1250 B.C.) - degradations caused by the microclimate in the storage area

Simona Violeta Gheorghe

Along the Middle and Inferior Danube, several cultural groups were defined having in common the technique of ceramics decoration, precisely the method of intarsia with white paste. This archeological phenomenon was described differently by the researchers in the neighbouring countries. In Romania this type of ceramics was called Garla Mare - Carna culture. [1]

The poster presents a study made on a lot of 50 pieces of ceramics belonging to this category and dated 1650 - 1250 B.C. The objects were brought to the laboratory to be re-restored, because first intervention happened in the 80's but their preservation status was so deteriorated that they could not be exhibited.

We noticed that the pieces had the same types of deterioration: some fragments were detached, others (though not detached) were not stable, many joints had no alignment, the plaster used for fillings was cracked and there were salt deposits on the surface of some ceramic fragments.

By studying the excessive ageing, the degradation of the old adhesive (polyvinyl acetate emulsion), the plaster fillings and the soluble salts on the surface of the ceramic paste, we draw the conclusion that these degradations had been caused by a wrong microclimate because ceramics are vulnerable to changes in temperature and humidity.

There is a need for a stable microclimate with a regular value of temperature and humidity because this is the most important aspect for the restored ceramic pieces. Generally, an RH within the range 40-65% is considered acceptable for sound ceramic objects.

Extremes of temperature can harm ceramics by causing thermal shock or by weakening existing faults. Restored ceramics are especially vulnerable: this includes restored pieces that should not be subjected to high temperatures. [2]

Polyvinyl acetate emulsion is a vinyl polymer. After decades of wrong use and storage the polymers degrade, leading to the deterioration of restored pieces. [3]

Certain types of adhesive (including polyvinyl acetate emulsions) soften when heated and age more rapidly.

Old plaster fillings used to replace missing areas can also cause problems in high humidity. Salts from the plaster, particularly sulphates, may be absorbed into porous ceramic (chemically the plaster is calcium sulphate hydrate [4]).

The efflorescence of soluble salts on the surface of some ceramic fragments is also caused by acid cleaning, a treatment that was used in the 80's not too cautiously.

Fluctuations in RH can move the deliquescent salts in and out of solution, which draws the salts up through the pores of the artifact. At a high RH they will dissolve. When the RH drops they will crystallize. [6]

The storage cabinet where these pieces came from had been monitored for some time, then on the basis of some measurements (which proved the existence of a unstable microclimate, unsuitable for storing the restored ceramic pieces) and observations we drew up a report and after that the storage for the archeologic ceramics was reorganized. It was equipped with air conditioning system and silica gel was used to have a safe control of the microclimate stability.

The poster presents diagrams from the monitoring of the storage cabinet as well as digital and stereomicroscopic images of the studied degradations, together with explanations.

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REFERENCES:

1 M. Nica, "The Thracian world at the crossroads of civilizations. Proceedings of the Seventh International Congress of Thracology, Constanta-Mangalia-Tulcea, 20-26 May 1996, Bucuresti, 1998

2 Oakley Victoria & Jain Kamal, "Essentials in the Care and Conservation of Historical Ceramic Objects", Archetype Publications, 2002

3 C. J. Williamson, "Polymers in Conservation", N. S. Allen, M. Edge, C. V. Horie Eds., Cambridge, 1992

4 Mathieu Etienne, "Chimie pour le restaurateur d`ouvres d`art", Ed. Consevart S.A., Belgium, 1993

5 Idem [2]

6 Jonson Jessica S. "Soluble salts and Deterioration of Archeological Materials", Conserve O Gram 6/5, Washington, D.C.: National Park Service, 1999

Magasinmanualen (the Danish museum storage manual) www.magasinmanualen.dk (www.collectionmanagement.dk)

Lone Petersen

In 2007 a webbased manual for good storage of museum objects is under construction in Denmark. The manual will comprise knowledge and experience concerning storage of museum objects and preservation of the physical cultural heritage. Furthermore, it will seek to gather all known Danish development projects on this topic, and it will be a portal to sites of similar topics abroad. The Danish Museum Storage Manual will give advice and guidance to everyone establishing or running museum stores.

The backbone of The Danish Museum Storage Manual will be the presentation of six prominent Danish museum stores. To start with the sites of four museum stores for cultural historic objects are built, then the sites of stores for objects of natural history and art objects. The museum stores in the manual are all noted for being good models in each their way and for making their knowledge and experience available to others. The presentations are based on five principal subjects: Organisation, design, construction, internal lay out and operation. The objective of The Danish Museum Storage Manual is a website of about 300 pages plus attached articles and documentation.

From late summer 2007 it will be possible to tour the individual museum stores on www.magasinmanualen.dk or to seek information on specific subjects. For example: Roof construction, operating budgets, pest control, user's manuals, cleaning procedures or floor paint. From September 2008 an English version of all relevant pages will be unrolled, on www.collectionmanagement.dk. The Danish Museum Storage Manual is financed by the Danish Agency of Cultural Heritage. The Danish National Museum and The Association of Danish Museums also participate in the project.

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The conservation and exposition project of the medieval plasters in San Fruttoso Abbey

Donatella.Fiorino and Elisabetta Giani

The present work refers to the project for conservation and exhibition of two large and precious medieval slabs of plasters (2,00 x 1,10 m) part of the structure San Fruttuoso Abbey, Liguria, Portofino mountain, from XI century

During the archaeological excavations in 1989, plasters were found in fragments in the high filling (2,20 m) of the crypt.

In 2004, the exposition space for the plasters was decided to be the crypt, where they were found, but the microclimate conditions for the conservation of the items were not suitable.

The project for the definitive exposure of the plaster is herewith presented.

A microclimatic monitoring of the crypt, of the upper church and of the cloister was carried out.

In order to create a suitable microclimate for the exhibition of the plasters, a filtered area in front of the crypt will be set up. By a system of two sliding doors this area will be isolated from the outside. Here the microclimate will be controlled by an active air conditioning system in order to stabilize the microclimatic conditions for the conservation of some wall plasters still now *in opera* in the wall of the crypt. Due to the underground location the air temperature of the crypt is quite stable.

The microclimate project is planned in two steps:

- first cutting the high air RH% fluctuations to stabilize this parameter
- then using an air tight show case to expose the two fragmentary plasters.

The show case will be a self-standing horizontal structure, semi suspended from the ceiling by two cables.

Furthermore an architectonic intervention will be done to create a visual connection between the crypt and the lodge in the dome of the upper church: a glass window in the crypt ceiling, built in 1989 will be carried out.

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The action of the debasing factors on the woolen fabrics, fixed dye with mordants based on metals

Alina Maria Garau

The poster presents a study on a group of 45 ethnographical pieces, woven of wool, stored for a long period of time in an inadequate space, containing enough factors of risk to determine the debasing process.

Wool is the most often used material at the ethnographical fabrics manufacture, either they have as purpose to decorate the interior of the habitat or they belong to the popular costume.

Their chromatics is made of several basic colors and a multitude of shades obtained from dye plants.

The natural dyeing, Romanian's people occupation of centuries, based on a precise knowledge of the local flora features, was achieved in the 19th century using extracts of bark, decoctions from stems and flowers, and other different caustics. [1] During the dyeing process, in order to obtain dark colors, the majority of the recipes which came from old times, contained mordants based on iron, copper, potassium, aluminum, etc.

The samples studied showed that the degradation process has gradually caused effects that changed their properties: discolouration, structural brittleness, loss of elasticity and flexibility, loss of strength. [2]

The deteriorations of this kind were present on the entire surface of the pieces, and important sections woven and decorated with threads of black, green and blue color changed the thickness of the threads, to their entire loss of their physical integrity (powdery).

The capacity of energy and light absorption of the rugged dark surfaces determined the massive degradation of the wool threads of black, blue and green color.

This degradation did not come from mechanical usage or biological attack. Because of the lack of special storing conditions, the impossibility of keeping a steady level of the micro-climatic parameters recommended in museum storage, wool, a sensitive fabric through its organic nature, suffered irreversible degradations. [3]

Comparing with the recommended values for: RH between 40%-50%, temperature between 15-18 C, light 50 lx; the measurements made in the museum storehouse showed major accidental fluctuations determined by the irregular working of the heating system and the lack of the air condition equipment, an inappropriate ventilation (the entry in the building is directly from outside and the airing is done by opening the windows and the outside door), the lack of curtains at the large windows.

In these conditions, the light (especially the UV) and the temperature, are strong energy sources in determining the process of degradation. [4]

The chemical reactions which appear in the wool fiber under the influence of the micro-climatic factors, released the breaking of the protein chain that begin to break up, free radicals appear under the form of carboxyl and amines. The free radicals under the influence of the oxygen contribution determined by the deficient ventilation produce reactions of oxide decrease at the level of mordants based on metals. [5]

The stronger the light is, the faster the oxidation is produced. The photochemical process once started continued in the fabric and after the source light is off, and the iron, taking into account that is the most reactive metal, as time passes, becomes unstable and endangers the dye, the caustic and the support fiber.

The poster presents digital and stereomicroscopic images of the studied degradations, together with the different explanations.

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REFERENCES

1 De la fibra la covor, Editura Fundatiei Culturale Romane, Bucuresti, 1998

2 Aurel Moldoveanu, Conservarea preventiva a bunurilor culturale, Bucuresti, 1999

3 NPS Museum Handbook, Part I, 2002

4 Bishop Museum, Art Conservation Handout, 1996

5 Feller, Robert, The deteriorating effect of light on museum objects, in Museum News, Technical Suppliment, June 1964

Collection storage environments in the national museum of Denmark – the use of MyClimateData web-based information system.

Lars Aasbjerg Jensen & Jesper Stub Johnsen

This poster will report on the joint research project between the National Museum of Denmark (NMD) and the Image Permanence Institute (IPI). The primary purpose of this research and implementation project is to utilize IPI technology, analytical methods, and experience in the evaluation of collection storage and display space environments at the NMD. The information gathered will be used in the planning and execution of storage improvements and in identifying circumstances where objects of great cultural or monetary value are at accelerated risk from the effects of the storage environment. It will also allow the NMD to quantitatively document the progress made toward improvement in both collection care and mechanical system operating efficiency.

The poster should be considered as a supplement to the paper presentation from Image Permanence Institute, which will focus on the research and development of the collection storage information system titled *MyClimateData*. The poster will present relevant cases from the use of *MyClimateData* in order to evaluate, compare and suggest solutions to storage dilemmas from the National Museum of Denmark and the project partners.

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Problems of conservation of Francesco da Milano panel painting in the church of Lago di Revine Lago, affected by thermo-hygrometric changes due to the heating system

Vasco Fassina and Marta Mazza

The Virgin with the Child and Saints George, Catherine, Mary Magdalene and Blaise in the church of S. George at Lago di Revine Lago in the province of Treviso is a wood panel oil painting by Francesco da Milano around 1515. The painter was born in the province of Milano at the end of XV century and was then active between the provinces of Treviso and Pordenone and this explain how he was identified by his provenance rather than with his proper surname *Pagani*. His masterpieces are conserved in churches and main museums of these territories and one of the most important works are the frescoes of the Sala dei Battuti in the Conegliano Dome, in which the systematic use of the most advanced Dürer's engraving heritage is observed.

At first when the bad state of conservation prevented a good legibility of the Lago's painting it was dubiously attributed to him as an artwork from his late period, a mature and tired work strongly conditioned by a misunderstanding imitation of the art of Titian. The discovery of the payment document related to the Lago's painting anticipated his execution to the biennium 1515-1517, which represented the apex of the artistical activity in which some elements of Lombardesque matrix still late-15th century but realized with a good consistency and rare technical ability were present. The successful results obtained with an accurate restoration work confirmed the initial attribution and returning one of the most significant pictorial texts of this excellent Masters of the Renaissance. The returned legibility has allowed to make some stylistic comparison thus permitting a re-examination of Francesco da Milano's early activity period.

The bad state of conservation of the painting has driven the people in charge of the conservation to plan a restoration of the painting. The painting was formed by six horizontal panels and the wooden painting support presented an intense attack of insects as well as an invasion of micro organisms which caused the formation of numerous cavities. The pictorial surface was almost completely covered by dirt deposits and a thick brown overprinting on the San Blaise dress was present. The pictorial film and the preparation layer below presented a widespread lack of adhesion and cohesion often localized in correspondence to the woodworm cavities. The widespread presence of numerous cavities on the six panels affected strongly the dimensional stability of the wood above all in the presence of temperature and relative humidity changes.

During laboratory operations large wood warping were observed, probably due to the increase of moisture caused by the water-based solution used for the consolidation of the support. This strong sensitivity to moisture content was a very critical point especially in view of the returning back of the painting in the church, which was characterized at that time by harmful changes of temperature and relative humidity. During the restoration work, an environmental survey regarding temperature and relative humidity measurements was carried out in the church to evaluate its suitability to conserve in the proper way the painting when the restoration would be finished. In fact, it was necessary to evaluate if the heating system actually existing could cause some troubles according to the intermittent working during Sunday services.

The microclimate measurements have been carried out very close to the previous painting location and sufficient data were collected to describe the microclimate in different seasons like winter, spring and summer. The examination of data shows that in the quarter February-April 2003, in correspondence with intermittent heating system working during Sunday or holidays services, about thirty events of sudden changes of temperature and relative humidity were observed. Extrapolating the obtained data to the whole winter period from October to April, about sixty events characterized by a temperature increase of 15°C and a relative humidity decrease of 15% can be estimated. Furthermore twenty minor events with temperature change of 10°C and relative humidity of 10% in correspondence with the beginning and the end of winter in which the heating system is moderate due to the mild external temperatures were observed.

In the quarter in which the heating system is switched off, the temperature and relative humidity are very stable and in particular the RH is fluctuating around 60% for a long time with some slow fluctuations to decreasing RH up to 55% or increasing RH up to 65-70%. The switch on of the heating system causes systematically a decreasing of RH up to 45%. We can conclude that when the heating system is switched off, the environmental parameters are very stable in particular the RH is fluctuating in the range 55-65%, while when the heating is switched on the RH decrease at 45% and rarely at 40%. As it is not possible to prevent the strong fluctuations of the intermittent heating system, which is very dangerous for the proper conservation of the fragile wooden support, it was necessary to stabilize the environment close to the panel painting by using an airtight showcase with the following requirements:

-the whole structure should be in an inert materials like metal thus preventing any attack from insects and micro organisms typical in the case of showcases in wooden materials.

-metal varnishes should be free from VOC to prevent any pollution of the indoor display case atmosphere.

-glasses should be auto load bearing able to resist tvandalism and without optical and chromatic aberration for a better vision of the artwork.

-easily and friendly opening showcase system to inspect closely the painting surface in order to detect small exfoliation, scaling or blistering of the surface due to unstable microclimate conditions.

-easy sustaining and fixing systems of the artwork to guarantee the static stability during the showcase opening as well as the preventing of any structural stresses due to the natural movements of the six panels of the painting.

-cold lighting system with UV and IR filtration with a luminance less than 150 lx.

-passive stabilization of the indoor environment by using Art-Sorb to maintain constant RH.

-the airtight system is obtained with a neoprene-based perimeter gasket having a high compressive property. All the contact points are sealed with neutral silicone to guarantee the absence of gaseous pollutant emissions for the indoor environment. There are also some entering and exit openings which could be used for future connections with an active climatization system.

The stabilization of the indoor microclimate is obtained by placing some aluminium trays fixed on the bottom of the showcase in proximity of the painting and vertically distributed to allow a uniform control of RH by the Art-Sorb pre-conditioned at 60% RH. This high RH was chosen to maintain the painting as close as possible to the natural environmental conditions of its previous five century history. The control of the maintenance of stable conditions was obtained by using some electronic probes measuring temperature and RH.

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A preliminary survey of the environmental conditions of conservation of Giorgione's panel painting of Castelfranco Veneto, affected by microclimate changes induced by the church heating system

Vasco Fassina and Stefano Filippi

In the period between 1995 and 2000 Giorgione's panel painting of Castelfranco Veneto showed serious problems of conservation. For this reason people in charge of the conservation started a survey to evaluate the causes of decay. The painting is located inside the altar of the Costanzo Chapel of the Dome hanging on the wall which is adjacent to the central heating system room of the church.

The deterioration of the panel painting is depending on the intrinsic factors such as the constituent and the restoration materials, as well as on the external factors such as the microclimate parameters of the environment in which the panel painting is located.

As the painting presented diffuse lifting of paint along the grain of the wood as well as swelling and shrinkage of the painted surface it was decided to carry out an environmental survey. To characterize the environmental conditions of the Chapel a continuous monitoring system measuring the temperature and the relative humidity of the air and the surface temperature of the panel painting was installed.

From the results obtained it can be observed that during the period considered the relative humidity values are in the range between 35 and 60 %, with a 5% of fluctuations during the switch off of the heating system, while when the heating system was working relative humidity fluctuations were much higher. In particular during Christmas time relative humidity gradients increased up to 30% in a very short period of time, about two hours. During the same period temperature gradient was between 3 and 5 to 6 °C.

When the ambient relative humidity falls, the equilibrium moisture content of wood drops and the wood shrinks with important resulting deformations. Vice-versa the wood will swell with increasing relative humidity. For practical purposes, the relationship between deformation and equilibrium moisture content may be assumed to vary linearly. It is of critical importance to recognize that free-swelling dimensional changes are stress-free strains. It is only when under restraint that hygroscopic materials subjected to relative humidity changes develop stress-associated strains.

Two types of wood are present in Giorgione's panel painting: wooden panels are poplar-based while reinforcements of the reverse panel are mahogany-based. The temperature and relative humidity fluctuations in a panel painting under restraint cause differential mechanical strains according to the different wood materials as well as the painted layer materials.

During the year the slow changes of temperature and relative humidity have a negligible influence on the inside environment and consequently very modest strains and deformations on the panel painting occurred. On the contrary, in winter, the strong and sudden changes of relative humidity and temperature due to the switch on of the heating system during the week-end caused differential strains on the two different woods, poplar and mahogany, as well as on the painted layer of the Giorgione's panel painting.

All these troubles were ascribed to the air heating system and the remedies to adopt were fundamentally traceable to the substitution of the air heating system with another one able to produce only limited thermo-hygrometric changes and the contemporaneous creation of a microclimate stable environment in the Costanzo Chapel where the paintings was located before its removal for restoration purposes. This last proposal related to the climatization of the Costanzo Chapel as it would have a destructive impact on the wall masonry due to the inserting of the piping of the air treatment. It was not considered appropriate and it was discarded.

Regarding the first point, the old air heating system, very dangerous for the conservation of the precious painting, was recently substituted with an infrared heating from high temperature emitters heated directly by gas combustion. Notwithstanding this change there remained the problem to create an appropriate environment to maintain constant the environmental conditions. At this stage the only option was to consider a display case. Among the numerous requirements of the display case in addition to the environmental stability it was of primary necessity the possibility to have a close inspection of the artwork and in the case it would be necessary to have a friendly system for handling the artwork in order to realize simple operations of surface maintenance of the painting.

It was at first evaluated the hypothesis to insert in the altar niche of the original location of the painting an airtight display case with an opening system towards the Costanzo Chapel environment. As Costanzo Chapel is subjected to temperature and relative humidity fluctuations ascribed to the visitors and to the heating system of the church it was necessary to isolate the painting from the unstable Costanzo Chapel environmental conditions. The difficulty to realize a display case inserted in the niche and having contemporaneously the possibility to open the front door of the display case has driven us to make an airtight showcase from the Costanzo Chapel. The display case is opened on the opposite side of the chapel and is in thermo-hygrometric equilibrium with the room lying behind, which in turn is characterised by an isolation with other neighbouring environment and maintained at 55% of RH, which is the average historical condition in which the panel painting was conserved in the previous five centuries.

Behind and close to the panel painting some trays vertically distributed along the whole panel containing Art-Sorb and pre-conditioned at 55% of RH were buffering the environment. This passive system is working in a proper way only for small changes of RH, but if the changes are very large there is the risk that the buffering system is not able to counterbalance the fluctuations. For further safety an active system formed by a humidifier and a de-humidifier apparatus was installed with the aim to produce or remove water vapour until to counterbalance strong and persistent changes of RH.

The thermo-hygrometric environmental parameters in the Costanzo Chapel and in the isolated room were continuously measured to check at any time the stability of the environmental conditions of the room lying behind the panel painting.

In addition to environmental conditions checking the isolated room was also conceived to allow the close inspection of the surface painting as well as the easy handling of the panel painting in case of urgent intervention of ordinary maintenance of the painted surface if critical occurrence would take place.

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Real time corrosion monitoring with automated corrosion loggers – end-user testing in the new collections centre of the Swiss National Museums

V. Hubert, T. Prosek and K. Doubravova

The Collections Centre of the Swiss National Museums, constructed in 2007 in the township of Affoltern-am-Albis, is a state-of-the-art facility which contains both the newly designed conservation treatment laboratories, the laboratory for conservation research as well as the museum's storage facility. Housed are the nearly one million objects that comprise the museum's entire collections. Having formerly been dispersed amongst various storage locations throughout the city of Zurich, these objects are now to be found under a single roof. The outfitting of the new storage space was determined by a number of considerations and challenges, important among them were that the objects themselves are of a wide variety of materials (wood, textiles, leather, metals, glass, stone, ceramics and plastics among them), and as well as the large size of the three-storeyed building (3 x 2970 m2) designated for the storage space.

Priority is given to maintaining the condition – and thus integrity – of the objects by long-term, specific environmental controls within the storage space. Strict use of archival quality packing materials and the engagement of equipment with state-of-the-art facilities are engaged. Temperature and RH are controlled at a constant rate and environmental data are monitored and logged by computer. Fresh, incoming air is filtered and the air in the storage space is exchanged with a fixed rate.

As most of the pollutants within the storage area derive, in fact, from the objects themselves (due to prior conservation treatments, fumigants, etc.) there has been required another type of monitoring which alerts the need for conservation treatment or at least a suppression of off-gassing.

This makes the Collections Centre an ideal end-user for testing a new type of automated corrosion loggers. A logger of this sort was developed during a research project entitled, 'Automated Corrosion Sensors as On-Line Real Time Process Control Tools' CORRLOG, and was under the support of the European Commission within the Sixth Framework Program [1]. The goal of the project was to develop a logger enabling a continuous measurement of the corrosion rate of selected metals in air [2]. The logger is manufactured by nke, rue Gutenberg, ZI Kerandré, F 56700 Hennebont, France.

In the Collections Centre storage facility, one data logger has been installed in the vicinity of the archaeological artefacts due to the fact that a wide variety of materials can be found in this one area. Wood, textile or bone, most having been dried from a waterlogged state, and metals (mainly copper, iron and bronze) with stone as well as ceramics are available for monitoring. The data logger has been equipped with a copper sensor, while an iron sensor has been independently placed nearby without a logger. The data of the copper sensor are recorded permanently and read out every two weeks. For the iron sensor single data is simply read every two weeks. The test phase has been for a three-month period with the measurement results and possible consequences of storage conditions presented in the poster.

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References:

1 www.corrlog.com
2 http://iaq.dk/iap/iaq2006/Prosek_IAQ2006.pdf

The implementation of preventive conservation measurements in German museums and collections

Alexandra Jeberien

Introduction

The poster will present the results of a project that looked at the implementation of preventive conservation principles in German cultural institutions, e.g. of historic collections, and at art, history or archaeology museums.

The project was developed and instituted by the conservation and restoration class of the University of Applied Sciences Berlin (FHTW Berlin) and was financed through the European Social Fund and the Berlin Senat for Economy. It ran from May 2006 to October 2007.

Objectives

The main objective of the project was to document and assess the implementation process of preventive conservation at museums and historic collections in Germany. Besides parameters concerning climate control, lighting, pests and air pollutants, information regarding the use of fairly recent preventive instruments, like risk assessment, risk management and disaster planning was noted.

The second aim of the study was to present and explain the positive features of preventive measures to those working in the field, including administrative, scientific and technical staff. At the same time, difficulties in establishing the principle of preventive conservation in operational practice were recorded.

Methods

A representative sample of the various German collections and museums, especially those in some stage of re-organisation or construction, were asked to participate in the study.

Information on the implementation of preventive measures was collected via questionnaires that were developed specifically for this project. Interviews were carried out directly at the institutions and on site. All staff levels of the museums and collections were included: administration, scientific and custodial staff, collection managers, conservators and conservation technicians. This way, difficulties and strong objections to implementing preventive measures were immediately noted.

Results

By the end of the project, museums from Germany and also one institution from Switzerland had contributed to the study. Other institutions have expressed interest but did not return the questionnaire in time.

After evaluating the collected data we are able to state the following:

I The awareness of the necessity of preventive measures is very dependent on the level of the employee. Administrators and conservators have a very good understanding of the need for preventive conservation, however, this is not true within the academic circles.

II Secondly, preventive conservation knowledge differs widely among the institution's staff: while a comprehensive level of knowledge has been established with the conservation body, other staff members seem to have a much lower level of preventive conservation knowledge. Again, the academic / scientific staff members are among those with the lowest knowledge level of the principles of preventive conservation.

III Those questions specifically regarding issues of implementation demonstrated that conservators have the highest impact, while the administrative staff shows very little commitment and the academic and scientific body show almost no commitment.

IV The study also demonstrated that although conservators have the highest institutional prevention knowledge level, they are hardly involved with decisions regarding preventive measures, e.g. construction, re-organisation, transportation and presentation issues.

V We also discovered that most staff members are unfamiliar with proven economic aspects of preventive conservation measurements.

VI A very POSITIVE finding was related to disaster preparedness and risk prevention: We were very surprised to learn that all responding institutions either are working on or already practise existing disaster prevention plans.

Discussion

The study gives an impression of the current status of preventive conservation at cultural institutions in Germany and German speaking countries; specifically with respect to the situations in which conservators work. Since preventive conservation is meant to be a team concept, not only conservators, but all members of the institution, need to understand the pros and cons of preventive conservation.

Awareness of and knowledge about preventive measurements needs the most improvement at the administrative and academic level. Once the whole staff understands the advantages of preventive conservation principles it will be possible to draw an overall strategy for preventive measures, which will contribute to the minimization of dangers and risks, especially related to storage, transport and presentation of cultural heritage.

Conclusion

The information gleaned from this study will prove valuable for correcting current problems in educational programs as well as assist in the development of new conservation, specifically preventive conservation, educational tools.

Results of this study have already been applied to the development and design of a web-based manual (eLearning tool) on preventive conservation. This tool will aid students, conservation graduates and also experienced conservators keep up to date on current conservation issues, especially new concepts in the field of preventive conservation. The tool will complete conservation training as well as contribute to establishing and/or broadening the level of preventive conservation knowledge of administrators, curators and academics in German museums and collections.

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Preventive conservation for exhibition - display and storage conditions of classical string instruments: the case of violins

Lampropoulos V., Kotsifakos I., Kontonikoli M. and Brass N..

Introduction

The protection, preservation and conservation of musical instruments, depend on their structural materials (wood, metal, adhesives, varnishes etc.), the construction techniques (hand made or industrial), the quality of raw materials and their processing. But they also depend on the environment that instruments have been subject to for a long period of time, their use and the damages that may have occurred.

VIOLINS: Materials and construction techniques.

The violin has arguably earned the title of the king of musical instruments. Its sound, so clear and expressive, can produce a great scale of timbre. A lot of musicians have dedicated their life to it, and manufacturers combine art, science and mysticism for its construction.

The wood that manufacturers use for violins is: maple flame for the back-plate, the scroll, the ribs, the neck and the peg-box, spruce for the soundpost and the belly and also for the bass bar and the interior coat. Ebony is used for the tuning pegs, the tailpiece, the tail pin, the chin rest and the fingerboard. On some violins there are decorative patterns of ivory, bones or even small diamonds, but also decorations painted with tempera or gold and silver leaves.

Various materials are used for the bow of a violin: Pernambuco, but also snake wood or synthetic materials like fiberglass and filaments of carbon; the bristles of the bow are obtained from the mane or tail of a white horse; the bottom section ("frog") is made from ebony, ivory or turtle's carapace; and the small screw from silver or gold. Also, the interior slipknot that holds back the bow's bristles is bronze and the wire around the bow (where the violinist holds it) is silver. Finally, the resin, which is used to make the bow stick to the string, is colophony (rosin).

The interior of the strings is composed of steel, animal bowel, silk or nylon and the outer wire, is silver or aluminum or sometimes even gold.

To join the violin pieces together, manufacturers use fish glue. After assembling, manufacturers cover the violins with varnish. This could either be an oil varnish based on linseed oil or walnut oil, with turpentine added, or an alcohol-based varnish with shellac and resins like gum mastic, sandarac, balm etc. Sometimes colorings such as amber, benzoin, copal, dragon's blood, elemi (gum elemi) etc. are added to the varnish.

Factors of corrosion on the structural materials of violins.

The factors of corrosion pertaining to the structural materials of violins are:

- Structural faults in the wood (such as knots, crevices, twisting of the fibers, irregular order of the augmentatives rings, interruption of the wooden tissue's continuity, irregular structure, irregularity of colour etc.) and attack from microorganisms prior to felling.
- Variations in temperature and relative humidity (RH%).
- Air pollution and noise.
- Light (visible, infrared and ultraviolet radiation).
- Biodegradation
- Human factors

Preventive measures for display and storage

Basic preventive measures to protect and preserve violins, relating to their keeping, display, transportation and handling have been proposed in order to ensure the appropriate conditions for storage and exhibition.

MUSEUM ENVIROMENT DISPLAY - EXPOSITION

Relative Humidity - Temperature.

The recommended temperature and humidity levels: the RH should be between 50 - 60%, and the daily variations around ± 2% or higher but no more than 5% and the temperature T= 18 - 21 °C with daily variation ± 1.5 °C.

The display area should be air-conditioned and showcases provided with adjustable microclimatic conditions. This can be accomplished in a passive way (the building's protection from humidity, direct sunlight, high temperatures etc.) or in actively (mechanical heating - cooling systems).

Light.

Even though wood is not one of the most light-sensitive materials, protection from the UV and IR radiation is needed. The recommended exposure level of illumination is 100 - 150 lux and the maximum luminous exposure in a year is 600,000 lux/hours. The UV radiation level should not be higher than 75 Mw/lm, and this can be arranged easily by using the proper filters on the lighting source.

There are 4 kinds of filters to control the UV radiation:

a. Acrylic solids or polycarbonate sheets.
b. Thin films of acetate salts on the glass of the windows or the showcases.
c. Varnishes.
d. Special thin glass sheets with covering for the absorption of UV radiation.

Control of the IR radiation is achieved with filters, special lamps and light reflection – white pigments on the walls can be used for this purpose.

Air Pollution.

The international levels of the air pollutants in a museum that have been defined are:

a. Concentration of SO_2 = 5 μg/m3 that is 1.9 ppb
b. Concentration of NO_2 = 5 μg/m3 that is 2.63 ppb
c. Concentration of O_3 = 5 μg/m3 that is 2.5 ppb

These levels are also recommended for the preservation of classical string instruments.

Display cases.

The display cases must be stable and airtight to the highest degree possible, with sealed joins in order to remain uninfluenced by the museum's microclimate.

In general, the display cases should meet the following standards:

- To be manufactured from materials that cannot react with the objects.
- To provide a stable microclimate to the objects.
- To protect the objects from air pollutants, dust and biological depositions.
- To protect the objects from vandalism, from touching, from stealing or from any other damage.
- To be functional and to provide easy access to the museum inspectors.
- To have the right proportions and height to enable the visitors to observe the objects.
- To isolate the objects from vibrations of the building.
- To be the "scenery" for each object and
- To allow visitors to come as close as possible to sensitive and precious objects.

Storage facilities.

The recommended relative humidity and temperature levels that should prevail in the storage areas are 45 - 55% and T = 21 °C (with a daily variation of ± 1.5 °C) respectively and lighting level 150 - 200 lux. Three successive filters (active carbon) in the airing system are recommended for the absorption of air pollutants.

The storage units should protect violins from mechanical damage, vibrations, dust, water and fire. They should be stable, sturdy and to ensure safe handling and moving. Shelves should be metal, and the objects should rest on their largest surface on a layer of foam or bubble-plastic. Violin bows are commonly stored in drawers. Metal drawers lined with polyethylene foam with grooves to place the bows are recommended. Humidity controllers like silica gel, can be used in order to preserve the relative humidity at the appropriate levels.

Using / playing historic instruments.

The problem of the use of historic musical instruments that are in a museum or refraining from their use is still unsolved. From the perspective of preventive conservation, playing must be kept to a minimum, and after any use instruments should be well cleaned and checked by conservators for possible damages. If any damage occurs during playing, the person responsible for the collection is obliged to stop the performance and not allow further use of the musical instrument until after its restoration. To reduce the possibility of musician-induced damage it is recommended that performances be given only in special arranged rooms inside the museum.

Transportation

The transportation of the objects is inevitable and is usually needed for photographing, registration, studying and displaying. Transportation should not happen hastily within the public areas of the museum while it is open. Transportation is sometimes needed for lending, restoration or relocation and takes place by truck, airplane, train or boat. Regardless what means of transportation are chosen, the environmental conditions should be similar to those of the museum. This can be achieved by using proper materials for their packing.

The transportation case should be constructed of inert materials and be well sealed. Furthermore, the inside of the cases should be lined with materials such as polyethylene foam in layers or sheets in order to prevent damage to the objects from vibrations and blows.

· The transportation of classical string musical instruments can also be done inside their special cases that should be constructed from materials resistant to mechanical impact, and extreme environmental conditions

Conclusion

Preventive conservation is necessary for the preservation of musical instruments. Appropriate measures should be taken for storage, exhibition and transportation.

The above-mentioned preventive measures depend on the specific needs and capabilities of the foundation that keeps collections of classical string musical instruments.

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The Nydam boat, a 4th century AD warship, was on temporary display at the National Museum of Denmark in the spring and summer of 2003. Its length prevented it entering the normal exhibition area. An inflated, climate controlled, tent-like structure was built for the boat in the courtyard of the museum.

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