

RELATED ABSTRACTS

Scientific Investigation, Preservation and Restoration of Works of Art

The Feasibility of Flash Thermography for the Examination and Conservation of Works of Art. This study investigates the feasibility of flash thermography for the examination and conservation of works of art: paintings, works on paper and sculpture. Thermography is a non-destructive technique for the identification of subsurface defects in materials. It is based on the propagation of surface-deposited heat through into the material. Differences in propagation between defect and defect-free areas result in a difference in the surface temperature of the material. The surface temperature is mapped over time by imaging with a mid-infrared digital camera. A xenon arc lamp is used to provide the initial source of radiation, and signal processing is typically applied to the collected data to reduce noise and to enhance key signal characteristics. This technique offers the possibility of investigating the structure of paintings and paper, particularly in cases where other non-destructive examination techniques do not provide sufficient information, for example subsurface delamination and layer structure. The results indicate that thermography is a good technique for detection of paint delamination and the degree of adhesion between layers, particularly in canvas paintings. It also successfully detected wood grain in situations where X-rays did not, although it was not effective for detecting voids or defects in wood.

Blessley, K., Young, C., Nunn, J., Coddington, J., Shepard, S.,
STUDIES IN CONSERVATION, 55, 2, 107-120, 2010

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Modification of Surface Roughness by Various Varnishes and Effect on Light Reflection. The modification of microscopically rough surfaces by commonly used varnishes and resultant changes in light reflection from these surfaces were studied using laser scanning confocal microscopy, stylus profilometry and specular gloss and distinctness-of-image gloss measurements. Natural resins as well as synthetic low molecular weight and polymeric resins were studied. The molecular weights of the resins were determined using size-exclusion chromatography. All the low molecular weight resins, with weight-average molecular weights in the range 800-6500, including the natural resins, essentially produced smooth surfaces and eliminated high-frequency as well as low-frequency roughness, while polymeric resins, with weight-average molecular weights between about 25000 and 210000, produced rougher surfaces, eliminating high-frequency roughness but not all low-frequency roughness. The spatial frequency range of the roughness of the polymeric coatings decreased with increasing molecular weight. As a result, low molecular weight varnishes reduced small-angle scattering about the specular reflection to a greater extent than the polymeric coatings. Polymeric varnishes, therefore, demonstrated lower specular gloss and, in particular, lower distinctness-of-image gloss. Distinctness-of-image gloss values showed good correlation with the weight-average molecular weights of the resins. The power spectral density of the surfaces coated with low molecular weight resins showed a sharper falloff at low spatial frequencies than the polymeric resins.

de la Rie, E.R., Delaney, J.K., Morales, K.M., Maines, C.A., Sung, L.-P.,
STUDIES IN CONSERVATION, 55, 2, 134-143, 2010

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The Validation of Artificial Ageing Methods for Silk Textiles Using Markers for Chemical and Physical Properties of Seventeenth-Century Silk. The Royal Armoury in Stockholm has conducted a project to experimentally evaluate conservation methods used for historic costumes. As the historic value of authentic artefacts precludes their use in experimental work, artificially aged standard silk needs to be used as a substitute. This study aimed to find a suitable artificial ageing method for standard silk resulting in a degradation state that simulated that of silk from seventeenth-century costumes. Four artificial ageing methods were studied: (1) thermal oxidation in dry air, (2) exposure to different relative humidity (RH), (3) immersion in solutions of varied pH, (4) accelerated ultraviolet (UV) exposure at 50 +/- 2 degrees C, 95% RH. Different chemical and physical properties for silk were evaluated using Fourier transform infrared spectroscopy, size exclusion chromatography and tensile tests, which were employed as analytical indicators for comparison between the artificially aged silk and samples from seventeenth-century costumes. Of the ageing methods tested in this study, thermo-oxidation at 125 degrees C in dry air for 28-56 days produced silk with properties most like those of historic silk samples.

Nilsson, J., Vilaplana, F., Karlsson, S., Bjurman, J., Iversen, T.,
STUDIES IN CONSERVATION, 55, 1, 55-65, 2010

Integrated Methodology for the Evaluation of Cleaning Effectiveness in Two Russian Icons (16th-17th Centuries). This article covers a methodology for evaluating the effectiveness of cleaning two Russian icons. The icons belong to a group of five from the same iconographic school, dating from the 16th to 17th centuries. An integrated and complementary approach to varnish and overpaint removal involved microscopic techniques (optical and scanning electron microscopy) and colorimetry (CIE L*a*b* system). The materials and techniques used in these icons have been characterized previously. Cleaning revealed extensive overpainting that had not only dramatically changed the original appearance, but also the meaning and attribution of one of the two icons. The analyses carried out were useful in determining the extent of the overpainting and led to a better assessment of the results and effectiveness of the restoration.

Sandu, I.C.A., Bracci, S., Lobefaro, M., Sandu, I.,
MICROSCOPY RESEARCH AND TECHNIQUE, 73, 8, 752-760, AUG 2010

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AMS radiocarbon dating and scientific examination of high historical value manuscripts: Application to two Chinese manuscripts from Dunhuang. In order to develop their restoration, a material study was undertaken on two Chinese manuscripts, shaped like binded codex (Chinese Pelliot 2547 and 2490), supposed to be dated from 8th and 10th centuries, and belonging to the Pelliot collection of the National Library of France in Paris. It allowed a better knowledge of the making technique of their bindings together with some of their components. We undertook the identification of the inks, and pigments used for calligraphy, and the dating of the wood and of the binding of the documents. Microsamples of inks were characterised by scanning electron microscopy (SEM) and the results of the x-ray microanalysis of particular interest are the presence of hematite and ochre in red samples, and carbon black and traces of bone black in the black inks. The taxon of wood has been identified on thin strips by the classical techniques used in xylology: the two scrolls were identified as *Tamarix* sp. (Tamaricaceae). The AMS radiocarbon dating of the manuscripts was also carried out on the wooden sticks which hold the paper sheets. Comparison of the potential calendar age distributions indicates probability distributions in the region between 662-781 cal AD and 862-994 cal AD for CP2547 and CP2490 respectively, which corresponds to the expected values. These results allowed to bring wider knowledge on the inks and the paintings and, in particular, have led to propose a date for the making of the binding of the CP2547, which confirms ideas proposed by book historians.

Richardin, P., Cuisance, F., Buisson, N., Asensi-Amoros, V., Lavier, C.,
JOURNAL OF CULTURAL HERITAGE, 11, 4, 398-403, OCT-DEC 2010

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A methodological approach in the evaluation of the efficacy of treatments for the dimensional stabilisation of waterlogged archaeological wood. The aim of the work is to set up a methodological approach to verify the effectiveness of the treatments of decayed waterlogged archaeological wood and to point out the proper thermo-hygrometric conditions for its preservation after treatment. The treatments were performed on wood samples of maritime pine (*Pinus pinaster* Aiton), oak (*Quercus* sp. *caducifolia*), elm (*Ulmus* cf. *minor*) and strawberry tree (*Arbutus unedo* L.), obtained from stems pertaining to the original vegetation found in the excavation site of the Ancient Ships in Pisa (Italy), and dated from seventh century BC to second century AD. The utilised products were: Polyethylene Glycols (PEG) of various molecular weights, a Polypropylene Glycol (PPG 425), Trehalose (alpha-D-glucopyranosyl-alpha-D-glucopyranoside), and their mixtures, and also a Hydroxypropylcellulose (Klucel). The main objective to be pursued by the treatments was considered the stabilisation of the original size and shape of samples. The various steps of this approach were: the execution of a preliminary diagnostic survey on untreated samples; the characterisation of treatment solutions 'as such' to establish the property to be monitored during the treatment; the evaluation of the main physical characteristics of wood after the treatment were determined. Among the latter, the coefficient of dimensional stability during the exposure to a series of selected thermo-hygrometric conditions and the retention of consolidants after the treatment. These two measurements allowed the definition of the 'efficacy of a treatment', with a new parameter firstly utilised in this work. It measures the stabilisation capability of the percent unit of retained product, and its value permits to put in evidence the consolidants that stabilise wood with the lowest amount of product. Conversely, it was not possible to measure the Anti-Shrink Efficiency (ASE), one of the most utilised parameters for the evaluation of treatments, because of the serious distortions and fractures observed in all the heavily degraded untreated samples.

Giachi, G., Capretti, C., Macchioni, N., Pizzo, B., Donato, I.D.,
JOURNAL OF CULTURAL HERITAGE, 11, 1, 91-101, JAN-MAR 2010

Study on some sorption properties of treated bentonites for their potential use as a moisture regulating system for the preservation of historical wooden elements. We report the first results of a research study aimed at developing a new strategy for the conservation of wooden structural elements present in historical buildings, based on moisture regulating systems. As has been happening for artefact preservation in museums, the idea is to develop systems based on the ability of some highly hygroscopic materials to moderate variations in relative humidity. These materials could adsorb and release moisture to reduce the extreme values of humidity in the micro-climate, for example between wooden beams and masonry. In order to experimentally verify this possibility using current, low cost and easy handling building materials, 5 bentonite samples were laboratory processed to improve their adsorbing properties by means of treatment with sodium carbonate at 3 concentrations: 2, 3 and 4% by weight. The effectiveness of ion exchange between sodium carbonate and bentonite was controlled by measuring the swelling volume of the bentonites. All the samples (n = 15) were tested for their hygroscopic properties. Adsorption isotherms were measured at 25 degrees C, using desiccators with silica gel, saturated salt solutions and bi-distilled water. A comparison between isotherms of one of the lower hygroscopic treated sample of bentonite and of a sample of wood and of a sample of brick and some numerical analyses with the Delphin code were made in order to evaluate the potential use of this bentonite as a moisture regulating system for the preservation of historical wooden elements. Results show that it seems to be possible to use bentonites as a moisture buffering material in order to reduce moisture content in wooden beams at least during their adsorption phase. It remains to investigate their desorption phase and their behaviour if they be in a saturation condition. Further studies are currently under way.

D'Orazio, M., Quagliarini, E., **JOURNAL OF CULTURAL HERITAGE**, 11, 2, 185-195, APR-JUN 2010

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Integrated reflectography and thermography for wooden paintings diagnostics. The need of inspecting a masterpiece of fine art without affecting it led to develop non destructive methods of investigation. In the field of art conservation, several diagnostic techniques are being widely used to inspect works of art, giving different but complementary results. The present work deals with two of these methods, reflectography and thermography, both techniques examining objects in the infrared spectrum but in different wavelength bands. Their integrated data potentially provide a powerful tool for mapping hidden features and alterations of artworks. This was confirmed during the inspections of a 13th century panel painting under restoration at the Opificio delle Pietre Dure laboratories (Florence, Italy). A graphical user interface was also designed to aid operators in the field of conservation dealing with the results of the two IR methods. Many options such as image adjustment, comparison, overlaying and transparency variation, in addition to thermographic elaborations, have been made available to users. Imaging data integration provides a multi-layered and multi-spectral representation of the painting that yields a comprehensive diagnosis confirms the anomalies individuation and reduces the ambiguities of information coming from a single diagnostic method.

Ambrosini, D., Daffara, C., Di Biase, R., Paoletti, D., Pezzati, L., Bellucci, R., Bettini, F., **JOURNAL OF CULTURAL HERITAGE**, 11, 2, 196-204, APR-JUN 2010

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A study of mechanical properties of papers exposed to various methods of accelerated ageing. Part I: The effect of heat and humidity on original wood-pulp papers. The damage to historical documents and books caused by the acidic character of paper is often manifested as a complete loss of their mechanical properties. Deacidification and restoration of archived paper objects require knowledge of the long-term behaviour of paper before and after repair actions. Our study was focused on the investigation of mechanical properties (tensile strength, stretch, tensile index, zero-span tensile strength, folding endurance) of original papers (one alkaline and three different acidic samples) exposed to five methods of dry-heat and moist-heat accelerated ageing. The degree of paper deterioration upon ageing was significantly influenced by the temperature and relative humidity, along with the intrinsic chemistry of the individual paper samples. The correlation matrix evaluated at a 95% confidence level for tensile strength, stretch, tensile index and zero-span showed linear correlations between these mechanical properties for all the paper samples. However, a linear dependence of folding endurance on zero-span tensile strength was found only for alkaline paper, which revealed the highest resistance to the accelerated ageing tests. In addition, the concentration of paramagnetic semiquinone species in the acidic lignin-containing paper samples was monitored by Electron paramagnetic resonance spectroscopy.

Havlinova, B., Katuscak, S., Petrovicova, M., Makova, A. Brezova, V.,
JOURNAL OF CULTURAL HERITAGE, 10, 2, 222-231, APR-JUN 2009

Discrimination of painting binders subjected to photo-ageing by using microspectrofluorometry coupled with deconvolution analysis. Organic binding media found in paintings exhibit characteristic fluorescence properties that strictly correlate with their chemical composition and may vary as a function of the ageing time. The aim of this work was to investigate the capability of microspectrofluorometry to distinguish between different binders. Linseed oil and protein-based media, deposited as thin films on microscope glass slides both in the presence and in the absence of inorganic pigments, were examined before and after artificial photo-ageing. Cross-sections of some paint layers were also examined. The article points out that microspectrofluorometry coupled with deconvolution analysis can be a useful tool for distinguishing between oil- and protein-based media. The curve-fitting analysis furnished a fine characterization of each binder/pigment combination, and highlighted the small spectral differences between their fluorescence signals.

Matteini, P., Camaiti, M., Agati, G., Baldo, M.-A., Muto, S., Matteini, M.,
JOURNAL OF CULTURAL HERITAGE, 10, 2, 198-205, APR-JUN 2009

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A note on glass and silica in oil paintings from the 15th to the 17th century. This article reports new discoveries relating to ground glass and silica in European easel paintings from the 15th to the 17th centuries that were created by various German, Italian and Netherlandish artists. The earliest known additions of these extenders date to the early 1430s. Glass powder of varying fineness, prepared from vessel or window cullet, is often found in red lake glazes as well as in other colours or preparatory layers of paintings. SEM/EDX analyses of the glass particles reveal a variety of chemical compositions (soda ash, wood ash, wood ash-lime, wood ash-lead, mixed alkali), which are discussed with respect to the provenance of the paintings. Historical sources on painting techniques mention glass additions most frequently to accelerate drying of oil paints, but also occasionally to facilitate grinding of pigments. Another possible function of powdered glass and silica, especially in oil-bound red lake glazes, is that of a transparent filler, as will be here discussed based on paint trials.

Lutzenberger, K., Stege, H., Tilenschi, C.,
JOURNAL OF CULTURAL HERITAGE, 11, 4, 365-372, OCT-DEC 2010