Introduction

In 2010 The Walters Art Museum received a Conservation Project Support grant from the Institute of Museum and Library Services (IMLS) to support the retro-fit of cases housing the museum’s permanent collections of ancient, Medieval, Islamic and early Renaissance art. Over a period of less than 6 years, this casework constructed of Medex (a formaldehyde-free wood panel product used successfully in the past at The Walters) had caused the notable deterioration of a variety of material due to the emission of volatile organic compounds (VOCs). Salts efflorescing from ceramics and fills on stone, voluminous white corrosion on metals and tarnishing of silver were all noted. Plush fabrics including velvets and ultrasuedes were used, for these particular cases and during the course of this project, it was determined that they too played a role in the rapid deterioration of the collection.

Contributing factors to the problem:

The Walters had approved the use of Medex based upon Oddy tests performed in the past. Since that time there may have been a change in the formulation of the Medex that contributed to the increase of acid emissions.

The design of the cases in this installation included better sealed vitrines, which inadvertently contributed to the problems.

Acid Detection Strips, A-D strips were used to confirm the presence of acidic vapors. A-D strips are paper-based indicators which use bromocresol green. A-D strips were developed to detect acetic acid but can detect other acids as well. Green indicates a pH of 5.4 and below and yellow of pH 3.8. Within an hour of placing this strip in the case with Roman bronzes, it turned yellow/green indicating an acidic environment. (Nicholson C. & O’Laughlin, E. 1996. The use of A-D strips for Screening Conservation and Exhibit Materials”, The Book and Paper Annual, Volume 15).

Case Fabrics and their contribution to VOC’s:

Velvets and ultrasuedes approved through the use of the Oddy test initially did not cause the A-D strips to react. Several months after the fabric swatches were placed in polyethylene bags with an A-D strip and stored in the dark, the A-D strips changed dramatically, indicating a problem with the fabrics as well. We do not know that the acid content was not solely from the fabric, as cases using pH neutral fabric were also affected.

Velvet and ultrasuede fabrics incorporate formaldehyde in the dying process. Synthetic resins such as ethylene urea melamine formaldehyde is added to velvets to make them more resistant to crushing. The formaldehyde from the resin off-gasses slowly overtime when exposed to light (Dadd, Home Safe Home, New York: Jeremy R. Tarcher/Penguin 2004).

Analysis of Corrosion Products:

Acetates were present on the salts from this vessel, WAM 48.2098, see detail below. They were detected using FTIR Spectroscopy by Dr. Jennifer Giaccai, then Conservation Scientist at the Walters Art Museum.

Throughout the duration of the project it was noted that porous materials that had come to equilibrium in a case environment saturated with organic acids, once removed from that dynamic, were releasing acids themselves. This was observed when ceramics, ivories and even some corroded metals were placed in polyethylene bags with A-D strips overnight. On many occasions there was a notable change in acidity in the two vessels at left where you can see the green color of the A-D strip. In most cases we found it effective to bag the ceramics with repeated changes of Micro-chamber Paper until the A-D strips no longer registered acid levels as seen on the near left image. This effectively removed any of the physically bound acids. In cases where the object retained a substantial acid level, soaking to remove the chemically bound acetic acid was required.

Finding the right solutions:

Identification and introduction of new case materials:

The first step in the retro-fit was to cover all exposed Medex surface with heat-sealed Marvelseal 360, tested and shown to significantly reduce the VOC emissions from the Medex.

Case design included painted surfaces that could not be Marvelseal and so new products were evaluated as a replacement for Medex building material.

Komatex (synonymous with Sintra) an unplasticized polyvinyl chloride was among the materials tested. It performed well with both Oddy tests and testing with A-D strips. Composites have been given cautious use about the use of PVC in the past, but this has often been connected to the inclusion of plasticizers absent in the Komatex. PVC is durable and inert when not exposed to extreme heat or light.

Dibond, a rigid aluminum polyethylene sandwich, and 9 lb Ethafoam were also introduced as interior case construction materials.

New specifications for Permanent Case Installations:

Interiors of all cases are covered with fabrics and blocks constructed of Dibond (360).

Case decks, backboards and blocks wherever possible are constructed of Dibond, a polyethylene sandwiched with aluminum skin. In some cases Ethafoam has been bonded to the surface to create a plank like thickness for building purposes.

Cross section of Dibond sheet showing polyethylene core with aluminum skin.

Underside of block constructed of Medex and bonded with Marvelseal 360.

Underside of test block constructed of Dibond. Recent tests have included 9 lb. Ethafoam placed secured to Dibond facing. Adhesives are still being sealed for use in permanent display.

1. Silica gel compartment doors are lined with Pacific Silvercloth to act as a scavenger for sulphurous gases entering from outside the case.

2. Carbon Web #375 carbon filters are placed first above the deck days prior to the reinstallation of art objects. Once objects have been installed, they are placed below the deck to continue to act as a sorbent for any residual VOC’s being emitted from objects.

3. Microchamber paper is also distributed within the case as an adsorbent prior to reinstallation of objects.

Passive indicators to monitor case conditions include: A-D strip, RIH and temperature strips and copper, silver and lead coupons.

Walters staff repainting each object using templates, photos and existing mounts. Art handlers Mike Mckee and Gill Frony reinstallation objects after retro-fit of cases. Where ultraseude and velvets were once used, new Benjamin Moore low VOC paints are made to the previous fabric color. Mylar separators are used whenever necessary between painted surfaces and metals or porous surfaces.

The Walters would like to acknowledge the generous support from the Institute for Museum and Library Services (IMLS) who has funded the retro-fit of Phase I and Phase II of problematic cases at the Walters Art Museum. Thanks also to Dr. Odile Madden from the Museum Conservation Institute, MCI, for performing Raman Spectroscopy and Jennifer Giaccai for her work on the FTIR and XRF. Thanks also to current Walters staff Terry Drayman-Weisser, Meg Craft, Mike Mckee, Gill Frony, Joan Elies, Rod A. Osbourne, Michael Byzacios, Wayne Johnson, Ashley Boyser, Susan Wallace, Marden Nichols, Martina Bagnoli and former interns Lauren McNally, Jessica Arista and Rachel Penniman for their participation on the project.

X-ray fluorescence analysis was performed at the Walters Art Museum with the assistance of Lauren McNally and Conservation Scientist Jennifer Giaccai. Analysis identified calcium and chlorine in the efflorescence. This may support the identification of thecitrith chloride (Ca(CH3)2COO)(ClNO3)(H2O), a salt known to form on museum objects containing calcium and that have been contaminated with chloride salts and nitrate salts and then exposed to acidic acid vapors. (Gibson, L.T. Cooksey, D. Littlejohn, K. Linnow, M. Steiger, and H. Tennet. 2005. The Mode of Formation of Thecotrichite, a Widespread Calcium Acetate Chloride Efflorescence. Studies in Conservation 50:284-194.)