Conservation Meets Sustainability: Recycling Wooden Exhibition Cases

The Role of Exhibition Cases

Museums attempt to give visitors reasonable access to their collections, while preserving objects for the enjoyment and use of future generations. Exhibition cases are designed to provide visual access to museum objects, while protecting them from accidental damage, theft, vandalism, dust, ultraviolet light, environmental pollutants, extreme relative humidity, and temperature fluctuations.

A well-designed, functional exhibition case is thus an integral part of a successful exhibit, making it the object of intense focus and often heated debate among an exhibit's numerous stakeholders: art handlers, building managers, curators, conservators, designers, engineers, fabricators, scientists, and security officers, among others. The processes described in this paper are a result of an exemplary collaboration between conservators and fabricators to address the persistent problem of VOCs emitted by wood by applying principles of sustainability to high-tech solutions.

The Drawback of Wooden Display Cases

Wood long ago became the material of choice for museum display cases because of its availability and relatively low cost. Further, wooden cases can be built simply using in-house craftsmen and facilities. Which largely explains why wooden exhibition cases are still being used in museums, despite numerous reports since the 1970s on the volatile organic compounds (VOCs) emitted by wood (specifically, acetic and formic acids) that can corrode objects displayed within a sealed case. The damage to objects in a sealed display case caused by the VOCs released from wood is irreversible.

Wood is corrosive by nature, and all wood, whether aged or newly harvested, can emit VOCs such as acetic and formic acids at room temperature. VOCs trapped within a sealed case, where there is no natural ventilation, can corrode metal, paper, and textiles, accelerate degradation, and cause irreversible color changes and fading.

The earliest report of damage to objects enclosed within a wooden display case was published in the 19th century (Eastlake et al. 1850). Since then, systematic studies in conservation have recorded and illustrated the corrosion caused by VOCs emitted from wood (Oddy 1975, 235-237; Oddy 1973, 27-28; Padfield et al. 1982, 24-27; Hatchfield 2002; Sage 1994, 113-124).

VOC Tests and Material Evaluation

Museums routinely use the Oddy test (Oddy 1975, 235-237) to detect corrosive gases within display cases. The test, devised by British Museum conservation scientist Andrew Oddy in 1973 (Oddy 1973, 27-28), places coupons of silver, copper, and lead inside airtight glass jars and exposes them to the VOCs commonly emitted by wood, as well as high temperature and 100% relative humidity.

Lead is extremely susceptible to corrosion by the acids emitted from wood. Lead exposed to VOCs forms a characteristic white crystalline growth on its surface, composed of lead salts. Silver coupons become tarnished by sulfur and carbonyl sulfides off-gassed from wood, and copper coupons are susceptible to chloride, oxide, and sulfur compounds.

Objects made from materials that fail the Oddy test cannot be displayed in wooden cases without considerable risk of permanent damage.

Misconceptions about VOCs

There are many misconceptions concerning VOCs. These commonly held but potentially dangerous beliefs need to be recognized in order to ensure the safety of objects in museum displays:

- VOCs in wood can be contained with paint and other coatings.
- Aged wood does not release VOCs.
- The process of engineering wood does not release VOCs.
- Colors and dyes do not release VOCs.
- "Green" materials are conservation-friendly.
- Plastics do not release VOCs.
- Adhesives do not release VOCs.
- Gaskets do not release VOCs.

The Zero-VOC Conservation-Grade Microchamber

The Smithsonian Institution is committed to addressing present problems with sustainable solutions that do not compromise the needs and resources of future generations. This approach to preventive conservation is not only environmentally sound, but also economically viable.

For the last 10 years, a museum conservator and exhibition fabricators at the Smithsonian have engaged in a collaborative effort to design and produce a practical and sustainable solution to the problem of VOC corrosion. The team's objectives were to minimize the corrosive damage caused by VOCs emitted from wood, without having to discard countless wooden exhibition cases that remain a valuable commodity to the museum.

The team designed a lightweight, non-wood chamber that can be retrofitted to existing wooden display cases of assorted sizes and dimensions. This isolation chamber, made of non-VOC-emitting material, eliminates direct air exchange between the chamber and the wooden case on which it fits, and prevents contact between display objects and the wooden case (Fig. 1).

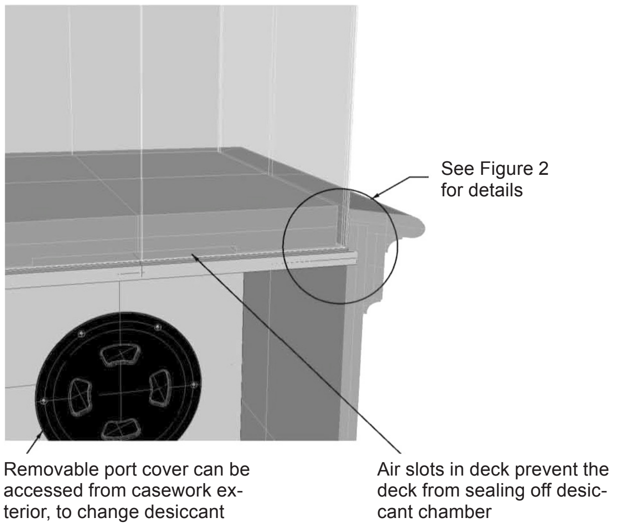

Figure 1. Retrofitted wooden case showing acrylic vitrine cover, upper deck with slots for air exchange with subdeck, and subdeck. Side port with removable cover provides easy access to desiccants and acid scavengers without disturbing the deck assemblage.

A subspace houses materials that further safeguard display objects, such as silica gel to absorb moisture, a VOC absorber, and an acid scavenger. With the object on display securely housed in the isolation chamber, the wooden case can retain its aesthetic appeal while serving as a base of support for the chamber (Fig. 2).

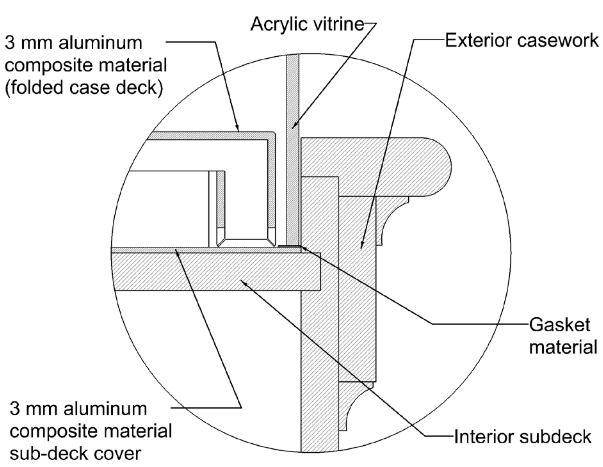

Figure 2. Detailed cross-section of retrofitted exhibit case showing typical construction, including aluminum composite subdeck cover, case deck, gasket, and acrylic vitrine exterior housing.

A recyclable* aluminum and polyethylene composite called DIBOND® is used to make a box that fits inside an existing wooden case (Fig. 1). Computerized drawing and cutting methods provide the precision and speed necessary to produce precisely sized boxes to accommodate wooden cases of various sizes, styles, construction, and dimensions.

To avoid using adhesive, which is a source of solvent-based VOCs, DIBOND® sheets are scored and miter-folded, a process similar to origami folding, with only a few metal rivets to reinforce the corners (Fig. 3).

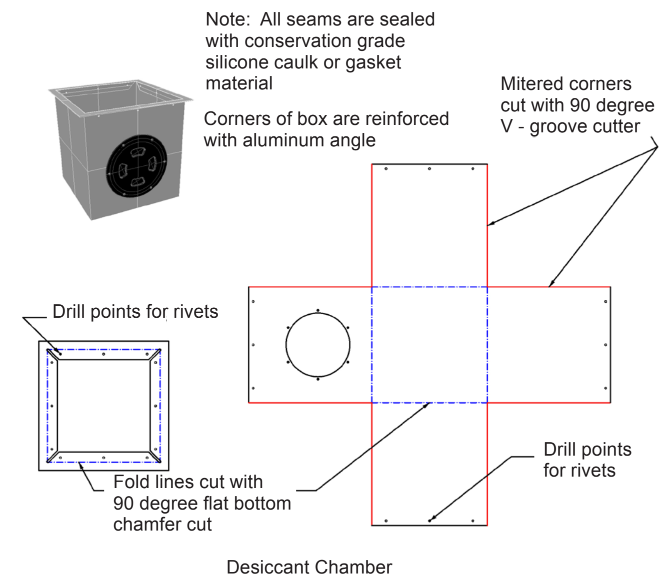

Figure 3. Illustration of CNC (Computer Numerical Control) routed DIBOND® (aluminum composite material) in flat form. After post machine cutting the components are folded to form the chamber box, riveted and sealed along the seams with silicone caulk.

This box serves as the chamber's subspace and houses buffered silica gel, VOC absorber, and acid scavenger. An access port on one side of the box allows for easy access to the subspace from the exterior of the case.

A shallow, channeled deck is then constructed from DIBOND®, using the same techniques of scoring and folding. This deck fits atop the DIBOND® box (Figs. 1 and 2). Slots in the deck provide for air exchange with the desiccants in the subspace. An acrylic vitrine cover fits into a recessed area between the deck and the wooden case, completing the retrofitted display case.

Application

Our newly designed micro-chambers were first employed in the Smithsonian exhibition "Cyprus: Crossroads of Civilizations" at the National Museum of Natural History (September 29, 2010 through May 2, 2011). Marking the 50th anniversary of the independence of the Republic of Cyprus, the exhibition featured more than 200 artifacts, including gold jewelry, vases, bowls, bronze and copper items, and nearly 100 coins from the Hellenistic period to the Venetian period (Figs. 4 and 5). The micro-chambers were central to our efforts to preserve these invaluable items on loan to the Smithsonian.

Figure 4. This microchamber with deck was retrofitted to an existing wooden case. A set of metal coupons (upper right corner) inside the case showed no corrosion after nine months. Photo: Don Hurlbert, NMNH.

Figure 5. Wooden display cases retrofitted with conservation-grade microchambers for the exhibition "Cyprus: Crossroads of Civilizations" at the Smithsonian's National Museum of Natural History, September 29, 2010 through May 2, 2011. Photo: Don Hurlbert, NMNH.

For the Cyprus exhibit, wooden display cases gathered from various Smithsonian museums and units were retrofitted with our conservation-grade micro-chambers. Colored fabrics and plastic laminates were chosen for their non-corrosive properties, ease of handling, and suitability for the exhibited items. Didactic panels were, for the most part, posted inside the display cases. In addition, sets of copper, lead, and silver coupons were placed on each deck to monitor for the presence of VOCs for the duration of the exhibition (Fig. 4).

After nine months inside the micro-chambers, these coupons were retrieved. Close examination showed no corrosion or tarnish on any of the metal coupons, proving that the micro-chambers performed as expected, providing a VOC-free environment for exhibited museum pieces.

Summary

The sustainable, conservation-grade micro-chamber described here has gained increasing acceptance within the Smithsonian since 2011. Indeed, the Office of Exhibits Central, which supports Smithsonian museums and units in all aspects of exhibition design and production, has been routinely retrofitting existing wooden cases for Smithsonian museums and units.

Museum curators and designers are constantly on the lookout for colors, materials, and textures to enhance the visual impact of their displays. To meet this demand, plans are under way to improve the design of the micro-chamber and to test a variety of sustainable, recyclable materials for the deck and isolation chamber that have aesthetic appeal, yet meet increasingly stringent safety standards.
*DIBOND® is a fully recyclable material. However, at present, the specialized machines required to recycle DIBOND® are manufactured and used only in China.

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