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# DESICCANT TUBES FOR STORAGE OF UNSTABLE MATERIALS, OR CONFESSIONS OF A MICROCLIMATE DENIER

DENNIS PIECHOTA

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This tip describes the construction and use of Tyvek tubes filled with activated regular density silica gel desiccant to maintain low relative humidity conditions within storage cases. Measuring 2 x 24 in., they are used to help achieve an in-case relative humidity of 15% or less for collections of unstable archaeological iron artifacts. The tubes are constructed of sheets of needle-punched Tyvek (Type 1622E) formed into tubes sealed with Tyvek tape. Custom-cut bag clasps allow resealable access through one end of the tube for refilling with reconditioned silica gel. Tyvek straps are attached to each end of the tubes to secure them to the sidewalls of the case in areas that will not interfere with access to the stored collections.

KEYWORDS: Silica gel, Desiccant, Museum storage, Unstable metal, Archaeological iron, Microclimate

## 1. OVERVIEW

At the Fiske Center for Archaeological Research of the University of Massachusetts–Boston (UMB), we actively excavate artifacts from historic sites around the United States and the world. This means that five archaeologists and graduate students from UMB and other universities recover large numbers of unstable ferrous artifacts during each excavation season. With only one conservator to treat these artifacts, we needed a place to store them at least temporarily under desiccating conditions.

The university-wide heating and cooling system exacerbates the well-known instability of archaeological iron. In the study/storage rooms, the relative humidity (RH) is often very high in the summer months when water is injected into the air-handling system to provide basic comfort cooling. In the north temperate climate of Boston we expect low relative humidity levels in heated rooms during the winter. But monitoring has shown that the relative humidity can spike up to 70% RH as moisture is sometimes injected during unexpectedly warm winter days (fig. 1).

## 2. DESICCANT TUBE DESIGN

My goal was to create a microenvironment where I could maintain relative humidity at or below 15% RH. To that end I dedicated a single museum storage cabinet: a Delta Designs DDLX-G cabinet with exterior dimensions of 147 cm wide x 200 cm high x 80 cm deep. The cabinet is fitted with four pull-out shelves and one fixed shelf, and has an internal air volume of approximately two cubic meters (fig. 2).

Typically we need all available shelf and drawer space for the collections, but just inside each sidewall there is a 2 in. (5 cm) wide space that is not used. So I designed 2 in. diameter Tyvek tubes to contain desiccant silica gel. I first tested attaching the tubes to the walls with adhesive-backed Velcro, but this method proved unreliable. The Velcro adhesive tended to separate from the cabinet sidewall or from the Tyvek tube. Instead, the four continuous stanchions built into the case to support the shelves and drawers were used to hang desiccant silica gel containers.

An effort was made to design custom desiccant packages that would be inexpensive and easy to construct, have secure closures, be archival, facilitate easy silica gel maintenance, and fit the available space. After a period of testing, the following tube construction materials (fig. 3) were selected: “soft” Tyvek (Type 1622E) sheeting, Lineco brand Tyvek tape with acrylic pressure-sensitive adhesive, desiccating silica gel (regular density, grade 3 on 8 mesh), and Clip-n-Seal brand bag closures.

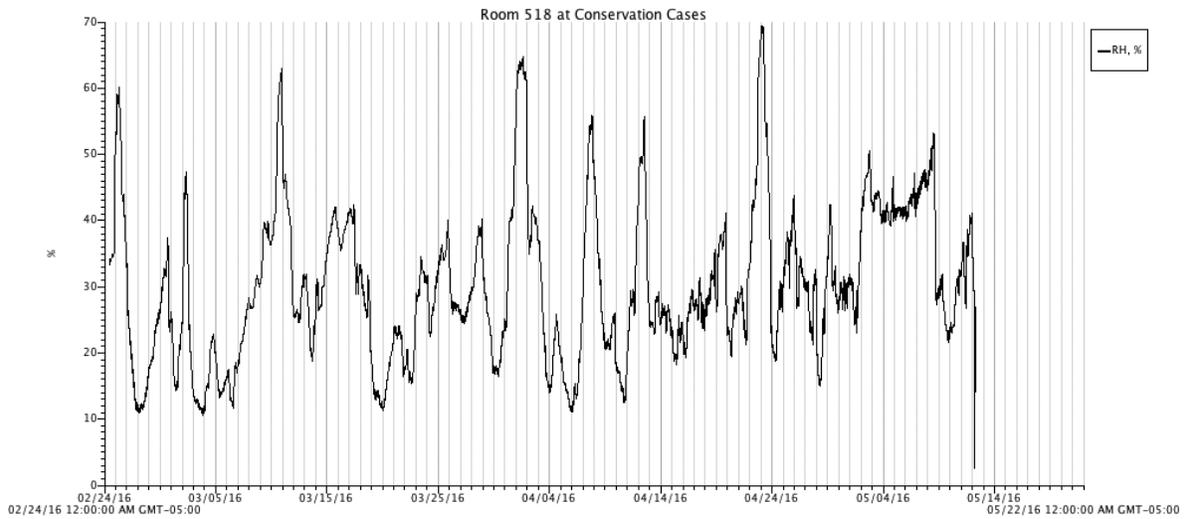


Fig. 1. Damaging relative humidity conditions during three months in the winter and spring due to comfort heating and cooling where moisture is injected into the air-handling system to cool during unexpectedly warm days (Courtesy of the author)



Fig. 2. The Delta Designs DDLX-G cabinet in which the desiccant tubes are installed (Courtesy of the author)



Fig. 3. Desiccant tube construction materials (Courtesy of the author)

Tubes were constructed using the following method:

1. Cut the Tyvek sheeting into an 8 ½ x 26 in. (22 x 66 cm) section.
2. Fold it lengthwise and make two consecutive ½ in. wide folds in the mating edges.
3. Seal the fold with a continuous length of Lineco Tyvek tape.
4. To form the straps, cut two 2 x 9 in. (5 x 23 cm) strips of Tyvek sheeting.
5. Triple-fold each strap lengthwise and staple each one near the ends of the tube.
6. Over the seam of the Tyvek tube, staple each strap in two points. This reinforces the tube seam and secures the straps in the form of a loop.
7. Seal one end of the tube by making two consecutive ½ in. wide folds and finish the tube by sealing with a length of Lineco Tyvek tape.
8. For the recloseable end of the tube, cut a Clip-n-Seal bag clip to 3½ in. (8.9 cm) and 4 in. (10.2 cm) lengths with the rod portion ½ in. (1.3 cm) longer than clamp portion to facilitate opening.
9. Apply labeling to identify the contents of the tubes.
10. At the fume hood, complete the tube by filling with approximately 900 g activated silica gel and close with the bag clip (fig. 4).

It is a good practice to periodically rescreen the silica gel with a #14 testing sieve or similar to remove the fine silica dust that can develop over time due to decrepitation.



Fig. 4. Completed desiccant tube filled with approximately 900 g activated silica gel (Courtesy of the author)

Within the cabinet, attach 10 in. (25.4 cm) miniature bungee cords to the cabinet stanchions. Their hooked ends conveniently grab the Tyvek tube handles and facilitate installation and removal (figs. 5a, 5b).

### 3. PERFORMANCE

The rate at which one will need to refill the desiccant tubes with fresh silica gel to maintain a relative humidity of 15% or less will vary greatly with each installation. The air volume of the case, the number and size of the tubes installed, the airtightness of the case, the access rate or use of the stored collections, and the room RH conditions will determine the annual silica gel replacement rate. Over the last two years at the UMB archaeology lab, I have needed to replace the desiccant twice annually. By



Fig. 5a. An overview of the opened cabinet showing five desiccant tubes installed along the sidewall; 5b. Detail of one desiccant tube installed using mini bungee cords attaching the straps to the cabinet stanchions (Courtesy of the author)

swapping out 10–12 tubes containing approximately 900 g each of silica gel, we have successfully maintained the target humidity in a Delta Designs DDLX-G case containing approximately two cubic meters of air volume. A datalogger with an LCD display (HOBO UX100-003) and visible through the glass door of the cabinet is used to monitor the case temperature and humidity. To speed the replacement process. A sufficient store of previously desiccated silica gel is kept on hand in a sealed metal container. The “spent” desiccant is then regenerated by heating to 180°C independent of the replacement process. While the maintenance of an artificially dry microenvironment in a temperate climate will always require vigilance and dedication, this method has gone a long way towards bringing routine to what was a dreaded chore.

## SOURCES OF MATERIALS

Clip-n-Seal bag clips, Mini 10 in. bungee cords

Amazon.com

PO Box 81226

Seattle, WA 98108-1226

888-280-3321

<https://www.amazon.com/>

DuPont Tyvek Type 1622E

Material Concepts

11620 Caroline Rd.

Philadelphia, PA 19154-2116

800-372-3366

<http://www.materialconcepts.com/>

HOBO UX100-003 datalogger

Onset Corp.

470 MacArthur Blvd.

Bourne, MA 02532

508-759-9500

<http://www.onsetcomp.com/>

Lineco Tyvek Tape, 1 in. x 150 ft.

University Products

PO Box 101, 517 Main St.

Holyoke, MA 01041-0101

800-628-1912

<https://www.universityproducts.com/>

Silica gel, RD, Grade 03

Fisher Scientific

300 Industry Dr.

Pittsburgh, PA 15275

800-766-7000

<https://www.fishersci.com/>

Testing Sieve No. 14

Forestry Suppliers  
205 W. Rankin St.  
Jackson, MS 39201  
800-647-5368

<http://www.forestry-suppliers.com/>

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