Archaeological Preservation Research Laboratory Report 4:

Conservation of Waterlogged Leather Using Polymers

C. Wayne Smith

Conservation Research Laboratory/Archaeological Preservation Research Laboratory

Texas A&M University

The most common methods of preserving waterlogged leather artifacts include some combination of freeze-drying and polyethylene glycol (PEG) impregnation to prevent structurally deteriorated matrix of the leather from collapsing during the preservation process. While these processes are effective conservation strategies, they are time consuming and once completed may produce delicate, friable artifacts. Because PEG used as a bulking agent to treat artifacts remains water miscible, artifacts treated using these technologies often require controlled curation. Changes in humidity and/or temperature can cause the PEG to become unstable. In severe environmental conditions, inter-cellular movement of PEG within and between the cellular structures of an artifact can cause additional structural damage. Intra-cellular migration of PEG can result in surface pooling and eventually, the loss of diagnostic attributes associated with an artifact.

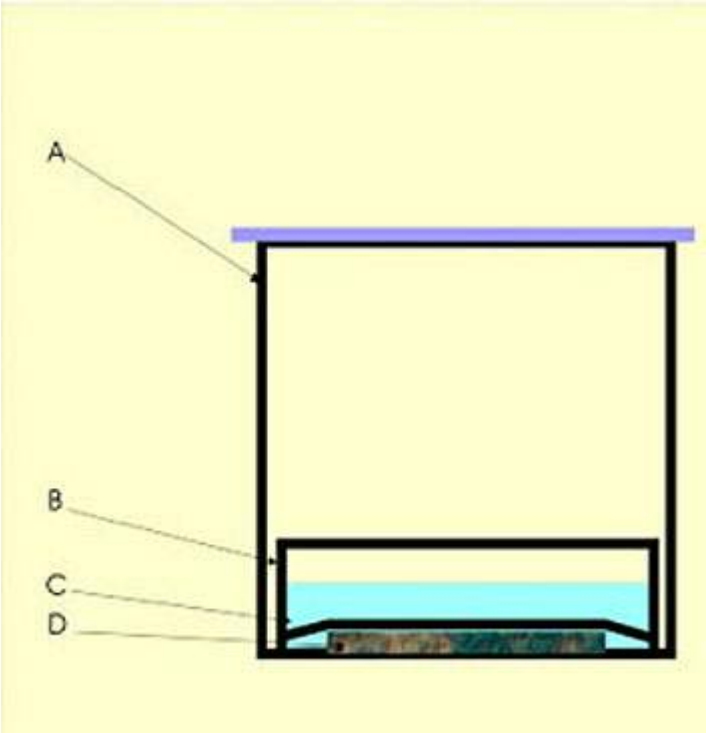
Research at the Conservation Research Laboratory and at APRL has culminated in the development of effective new treatment processes for preserving waterlogged and desiccate leather artifacts. These processes are easily implemented using basic equipment that is commonly found in a modestly equipped conservation facility. Most importantly, these treatment strategies stabilize objects requiring little controlled curation.

Figure 1 A nearly completed waterlogged shoe.

To demonstrate a basic process of silicone oil preservation, a waterlogged shoe dating from the mid 17th-century was preserved. An initial inspection of the shoe indicated that much of the upper structure and heel were missing. The insole, sole and toe portions of the shoe were in excellent but friable condition. Prior to treatment, there was a slight separation between the insole and sole sections. Much of the stitching however, was in good condition and appeared to be holding the sections together quite well.

The shoe had been stored in fresh tap water. Prior to treatment it was placed into a large container and rinsed in running fresh tap water for several days to remove soluble salts and other debris. Titration testing was used to determine the length of the rinsing treatment. The shoe was immersed in fresh acetone. After three days of passive water / acetone exchange at room temperature, the shoe was placed into a new container containing fresh acetone. While in this acetone bath, the shoe was placed into a vacuum chamber with a slight vacuum (40mm) applied to the artifact to ensure maximum removal of free-flowing water. Throughout this last step of water / acetone exchange (WAE), a form fitted piece of aluminum screen was friction fitted over the shoe, pressing against the sides of the container housing the artifact. This screen acted to ensure that the artifact remained fully immersed in acetone throughout the dehydration process.

Presently, APRL researchers are working on new processes that eliminate water / acetone exchanges or other dehydration processes. These alternate processes will be included as updated in the near future.



A. Vacuum Chamber

B. Container with Acetone

C. Aluminum Screen Over Shoe

D. Shoe Immersed in Acetone

Figure 2. Diagram illustrating the dehydration set up.

After the water / acetone exchange (ASE) process was complete, the shoe was placed into another container, and immediately immersed in a Dow Corning silicone oil solution containing a 3% addition of CR-20 Passivation Crosslinker (by weight). As before, a piece of friction fit aluminum screen was placed over the artifact in solution, to ensure that the artifact remained completely immersed in solution throughout the ASE process. While in this solution, the shoe was placed into a bell jar vacuum chamber, and at room temperature, a vacuum of 40mm pressure was applied to the artifact in solution. When small bubbles were noted to be steadily streaming from the artifact, the vacuum pump was turned off and the artifact was left under pressure for three hours.

Figure 3. Shoe in vacuum chamber, housed in a container with a ventilated cap, to prevent splashing while in treatment.

After three hours of ASE at pressure, valves were opened, returning the shoe-in-solution to ambient pressure. The artifact was left in solution for 24 hours after vacuum assisted ASE.

After the shoe was removed from the silicone oil solution, it was placed on an aluminum screen, and free-flowing silicone oil solution was allowed to drain from the surfaces of the shoe. Note that once the matrix of the leather has been treated with silicone oils, exposure to air is no longer a concern and the conservator can take time to situate or arrange the artifact in an original or desired position before continuing the conservation process.

After allowing silicone oils to drain from the shoe, lint-free cloths were used to lightly pat the surfaces of the leather. This helped to remove additional pooled areas of silicone oils. Lint free cloths with several drops of catalyst were then used to wipe the surfaces of the leather. A very thin, even coating of catalyst was applied to these surfaces and after approximately five minutes, clean cloths were used to wipe any remaining catalyst and silicone oils from the surfaces of the shoe. The shoe was then lightly polished using dry, soft, lint free cloths.

The shoe was then placed into a large Zip-Lock bag, with a wadded piece of cloth, containing several drops of catalyst. After sealing the bag, the artifact was left in close contact with catalyst fumes for an additional 48 hours. Additional catalyst treatment may not have been necessary but vapor catalyst deposition ensures even the thickest sections of leather will receive enough catalyst to ensure complete stabilization.

After treatment, the shoe was removed from the bag and allowed to sit in a well ventilated fume hood, for several hours. Because we were not sure how friable the artifact was during treatment, we did not wipe the surfaces of the leather as thoroughly as we could have. Helen Dewolf used wooden dowels and a very soft brush to do additional post-treatment clean up of the shoe.

Post treatment evaluation of this artifact has revealed no shrinkage. This artifact is safe to handle and as you can see from these photographs, diagnostic features of the shoe are quite visible. Because this artifact was preserved using silicone oil processes, it does not require special curation. Accelerated aging tests have indicated that archaeological leather samples preserved using these technologies are stable and not damaged by fluctuations in temperature, humidity or ultra-violet radiation.

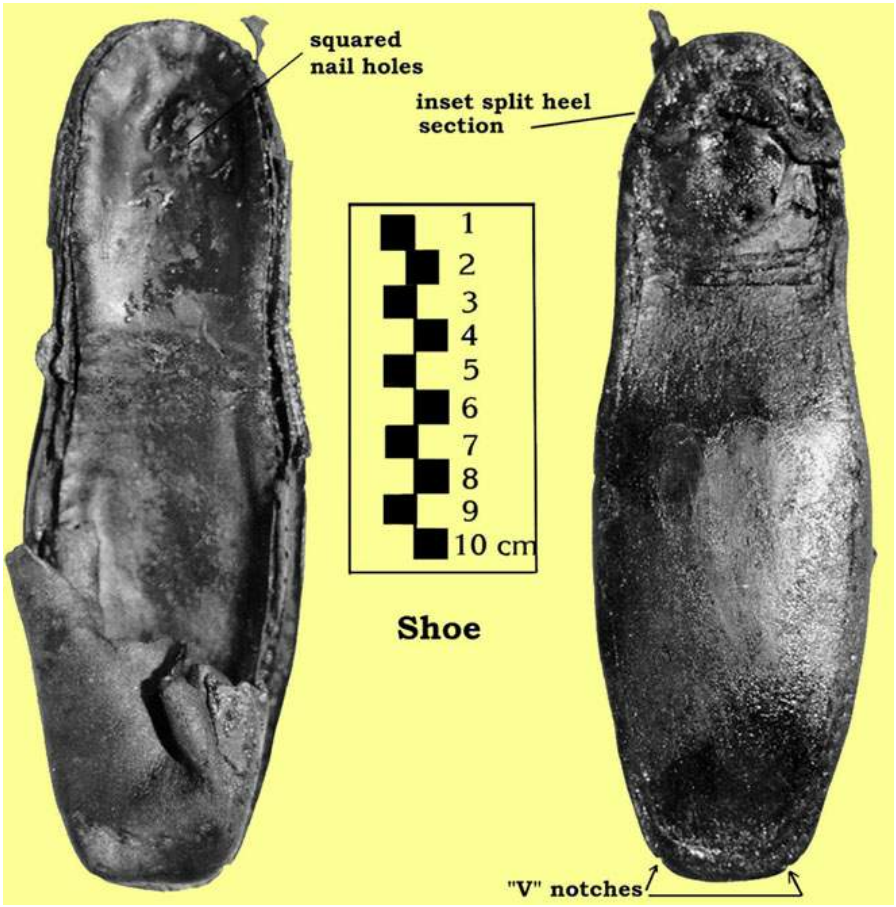


Figure 4. Top and Bottom views of a nearly completed shoe.

Citation Information:

Smith, C. Wayne.

1997 "Conservation of Waterlogged Leather Using Polymers," Archaeological Preservation Research Laboratory (APRL), Report 4, World Wide Web, URL, http://nautarch.tamu.edu/APRL/report04.htm, Nautical Archaeology Program, Texas A&M University, College Station, Texas. November 10, 1997