Appendix B

Conservation of Materials Recovered from the USS Eastport and the Ed. F. Dix

by

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Introduction

Whenever cultural materials are recovered from archaeological sites, care must be taken to ensure that these long-buried materials, upon being exposed again, do not deteriorate. This is particularly true of materials recovered from submerged sites. If proper steps are not taken, wooden artifacts will warp and crack as they dry out, and the corrosion of metal artifacts will continue, and may accelerate, upon exposure to the air. In a relatively short time, what had appeared to be a substantial wooden plank can become a piece of twisted, rotting wood, the seemingly intact iron tool can become a mass of amorphous iron oxides, both at that point useless to the archaeologist as a means of interpreting the past.

In preparing for the partial excavations of the wrecks of the USS *Eastport* and *Ed. F. Dix*, the U.S. Army Corps of Engineers, Vicksburg District, recognized the potential for such problems and entered into a Cooperative Agreement with Northwestern State University (NSU) in Natchitoches, Louisiana. Pursuant to this agreement, an archaeological conservation laboratory was established at NSU for the purpose of conserving cultural materials recovered during the course of the excavation. As agreed upon by both parties, conservation of the materials would utilize standard conservation procedures.

A basic description of conservation treatments for each of the types of artifacts collected from the two wrecks is given below. All solutions were prepared with distilled water, unless otherwise noted. More detailed descriptions of these and other archaeological conservation procedures can be found in Hamilton (1996), Pearson (1987), Singley (1988), and Cronyn (1990).

Iron Artifact Conservation

The iron artifacts recovered during the course of the excavation were assessed to be, overall, in very good condition. Corrosion, from superficial to moderate, was noted on these objects, but the vast majority was determined to be structurally sound and capable of withstanding electrolytic reduction treatment.

Prior to treatment, iron artifacts were stored in either a 5 percent sodium sesquicarbonate solution (pH 9.7) or a 5 percent sodium carbonate solution (pH 11.5). These alkaline solutions serve to neutralize the acids that contribute to iron corrosion, thus preventing further deterioration of the artifacts. Of the two, sodium carbonate was used in our laboratory most frequently, as it proved to be less expensive and more readily available.

One problem facing conservators of iron artifacts is the presence of chlorides. If present and not removed from the artifact, chlorides can react with moisture in the air to form hydrochloric acid, which will cause the artifact to continue to corrode. Solutions containing the *Eastport*/*Dix* iron artifacts were tested for chlorides using the silver nitrate test, which is capable of detecting the presence of chlorides in extremely small quantities (Plenderleith and Werner 1971:201, as cited in Hamilton 1996), and by utilizing Quantab® chloride titration strips. Both tests proved negative for chlorides, and simplified our conservation strategy for treating the iron artifacts by electrolytic reduction.

During the process of electrolytic reduction, also called electrolysis, a low-amperage electrical current is passed through the artifact while it is immersed in a suitable electrolyte. A number of variations for setting up this procedure are possible (Figure B-1). As the electrical current is applied, negatively charged particles will travel through the electrolyte to the positive terminal, or anode, of the electrolytic setup,

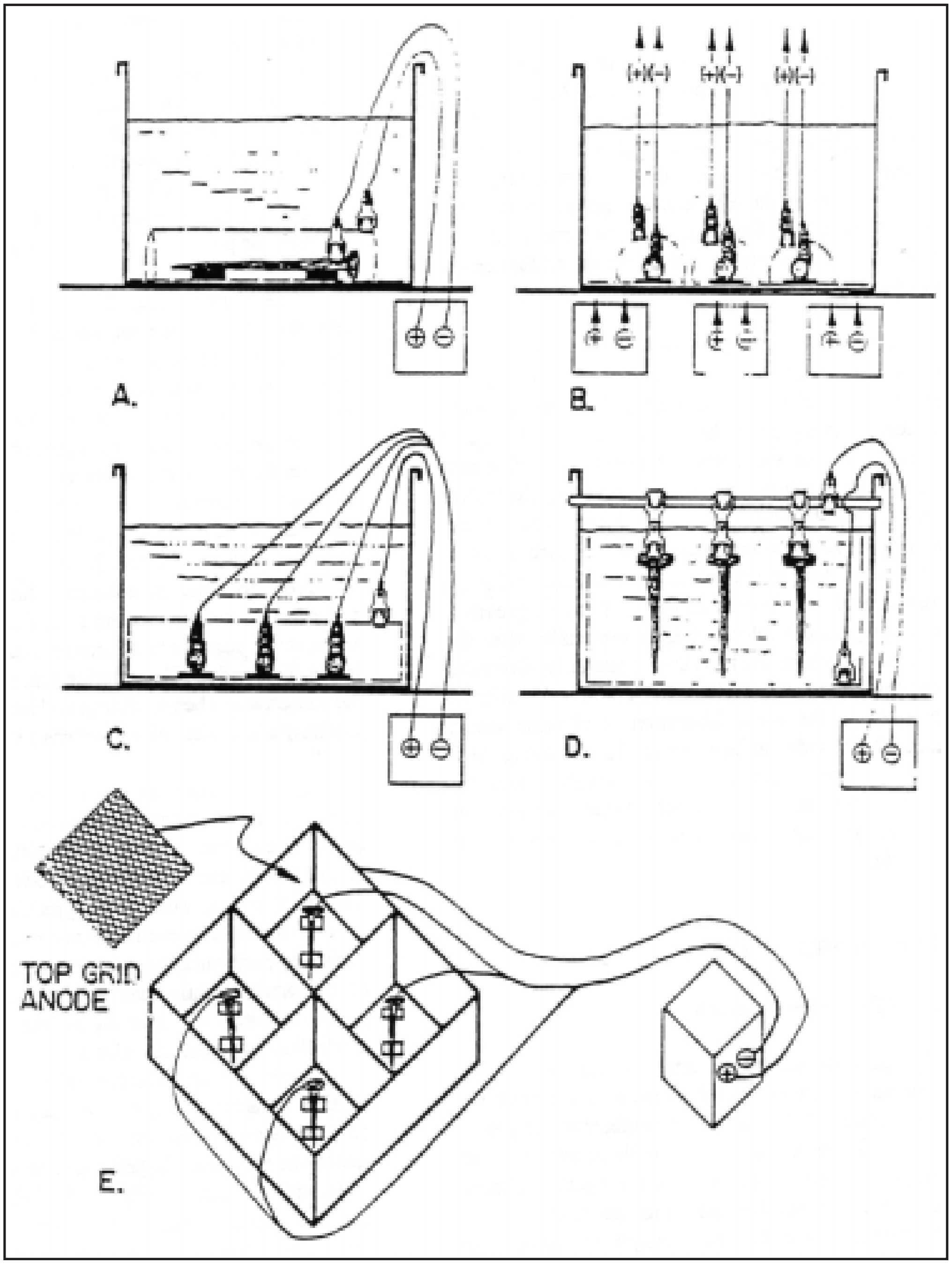

Figure B-1. Electrolytic reduction setups (Hamilton 1996:65, Figure 5).

and positively charged particles will travel to the negative terminal, or cathode. This process results in the evolution of oxygen, or oxidation, at the anode, and the evolution of hydrogen, or reduction, at the cathode. In this way, at low current densities, some of the corrosion products at the cathode can be reduced to metallic iron. Medium current densities work best for chloride removal, while high current densities, which result in the vigorous evolution of hydrogen at the cathode, are best for cleaning artifacts of any remaining corrosion products or other encrusting material (Hamilton 1996:64, 69). For the purposes of the *Eastport*/*Dix* materials, two electrolytes were tested for ease of use and efficiency in treating the artifacts — a 5 percent sodium carbonate solution and a 2 percent sodium hydroxide solution. Of the two, the sodium hydroxide solution was found to produce equivalent results in a shorter period of time, so the majority of the iron electrolysis was and is being carried out with this electrolyte. During the course of electrolysis, artifacts are immersed in this solution inside stainless steel vats.

For the treatment of each artifact, the negative terminal from a direct current (DC) power supply is connected to a copper rod from which the artifact is suspended in the electrolyte, while the positive terminal is connected to the stainless steel vat. The artifact thus acts as the cathode, and the vat as the anode, for the procedure. In order to ensure reduction of the iron corrosion products, low current densities are employed for the initial electrolytic treatment of the artifacts, followed by a treatment of high current densities for final cleaning. The progress of each artifact is followed closely, with each being removed from treatment for examination and mechanical cleaning as the procedure progresses.

After electrolysis is complete, the artifacts are rinsed in alternate cold water and boiling water baths to remove any remaining residue left over from the electrolyte. The artifacts are then coated three times with a 20 percent tannic acid solution (in ethanol) before being immersed in Witco 180M microcrystalline wax. The tannic acid treatment serves two purposes – it forms a protective tannate film on the surface of the artifact, and it also turns the artifact a black color, which many find aesthetically appealing for iron artifacts. The wax treatment, in which the wax is heated to approximately 250°F, removes any water which may still be present in the artifact and provides an impermeable coating which prevents any further corrosion by sealing the artifact's surface, thus inhibiting interaction with moisture in the air.

The application of this treatment regimen for the iron artifacts from the *Eastport*/*Dix* excavation has proven very successful. The artifacts are checked periodically by visual inspection, but no indications of further corrosion have been noted to date.

Wood

A number of wooden artifacts were recovered during the excavation, including planks and timbers from the vessels and the remains of barrels and boxes that contained a portion of the cargo of the *Dix*. Though waterlogged, the majority of these materials were in a good state of preservation.

As wooden artifacts deteriorate, one result is the weakening of the cell walls due to the loss of cellulose through microbial attack. If the cell walls are not strengthened prior to the removal of water, the artifact can be destroyed as the weakened cell walls collapse upon drying, causing checking, cracking, and warping (Grattan 1987). Typically in the conservation of waterlogged wood, a "bulking agent" is added to the wood to support the cell walls prior to controlled removal of the water the item contains. A number of bulking agents have been utilized by conservators, including sucrose, colophony, and polyethylene glycol (PEG), to name a few. Of these, PEG in one of its various molecular weights is the most commonly used, due to its relatively low cost and high success rate (Grattan and Clarke 1987; Hamilton 1996:27-32). For these reasons, the decision was made to conserve most of these wooden items from the *Eastport* and *Dix* with PEG.

When utilizing the PEG conservation method, the artifact is typically immersed in a vat containing a heated 1 to 5 percent solution of PEG. As the PEG enters the wood to strengthen the cell walls, additional increments of PEG are added to the solution slowly over time until the solution reaches 70-100 percent PEG (Hamilton 1996:27). Of the various approaches to using PEG, experience has indicated that a treatment of PEG 400, followed by freeze-drying, results in an artifact with minimal shrinkage without the "waxy" feel PEG can impart to an artifact (see Singley 1988:65, 67 for a similar treatment).

One disadvantage to using PEG is that it tends to render the wood a very dark color. This may be of little consequence to structural timbers and planking, but it can present a problem for other types of artifacts. The tops of some of the barrels and sides of some of the boxes recovered from the *Ed. F. Dix* exhibit stenciling. Most of this stenciling is clearly visible in the untreated wood, but, as has been proven in other cases, PEG can darken wood to the point of making stenciling invisible. Infrared photography can render the lettering visible again (Coble 1996), but clearly the best approach is to employ a conservation method that will preserve the light coloring of the wood. Personal experience has demonstrated that the best approach for this situation is the acetone-rosin technique. In this technique, colophony (pine rosin) is dissolved in heated acetone until a saturated solution is achieved. Saturation is indicated by a thick, undissolved layer of colophony in the bottom of the heated vat. After dehydration in successive acetone baths, the artifact is suspended in the acetone-rosin solution above the undissolved colophony. Over time the colophony penetrates the wood, supporting the cell walls. When the artifact is removed from the solution, the excess colophony is wiped away and the acetone allowed to evaporate. This process results in a lighter, more natural-looking wood than PEG, but is only used for limited applications due to the high costs of the constituents and the flammability of the solvent (Hamilton 1996:29-30).

Leather

A small number of leather shoe fragments were recovered. Experimentation with various leather conservation techniques suggests that leather is best preserved with a polyethylene glycol (PEG) treatment followed by freeze-drying. As the NSU Conservation Laboratory freeze-drier is currently not operable, the conservation of the leather items has been postponed until repairs can be effected.

Lead

Some lead fragments were found, but even after lead begins to corrode, it tends to stabilize after a thin layer of lead oxide forms on the surface of the artifact. These items seemed to be stabilized in this manner. For this reason, and because they appear to have been subjected to heat of sufficient intensity to melt them to the point of being unrecognizable as identifiable artifacts, the lead items were considered to be of low priority for conservation. When conserved, electrolytic reduction will be used to preserve the lead artifacts.

Coal

A number of pieces of coal, which would have served as fuel for the steam engines of the vessels, were recovered. After experimentation, it was determined that conservation procedures were unnecessary for this material, and it was allowed to air-dry, with no apparent adverse effects.

Conclusion

The Cooperative Agreement between the U.S. Army Corps of Engineers, Vicksburg District, and Northwestern State University expired in 1999. Even though Northwestern State University agreed to provide stabilization and curation of the materials recovered from the partial excavations of the USS *Eastport* and *Ed. F. Dix* for the duration of the agreement, archaeological conservation of these artifacts continues. These conservation efforts have proven to be a successful training ground for graduate and undergraduate anthropology students in the application of suitable techniques for the preservation of archaeological materials, as evidenced by the fact that all conservation efforts of these materials have proven successful to date, and a number of students who formerly worked in this laboratory have now moved on to positions where the knowledge gained in the NSU Archaeological Conservation Laboratory has proven to be invaluable.

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