Archaeological Preservation Research Laboratory Report 8:

# Conservation of Waterlogged Corn Cobs Using Silicone Oils

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A large corn cob specimen dating to 1870 from Yorktown was selected for an experiment involving the use of silicone oil impregnation and polymerization to bulk and stabilize this organic artifact. Prior to conservation, the cob (AS264), was stored in a glass jar in a mixture of alcohol and water. The core area of the cob was completely hollow and although there was a great deal of debris and exfoliation in the alcohol/water solution, the cob was soft to the touch and did not crumble when handled.

Prior to treatment, AS264 was rinsed for one hour in a free-running gentle bath of fresh water as a means of removing sediments and debris from the surfaces of the cob. The sample was then placed on paper towels and allowed to drain of excess surface moisture for two minutes before it was weighed and measured. In addition to weighing the cob using two different scales, measurements were recorded including maximum length and mid section diameter. Before treatment, the wet weight of AS264 was 16.8 grams and it measured 5.6 centimeters in length with a diameter of 2.63 centimeters.

## Dehydration of the Sample

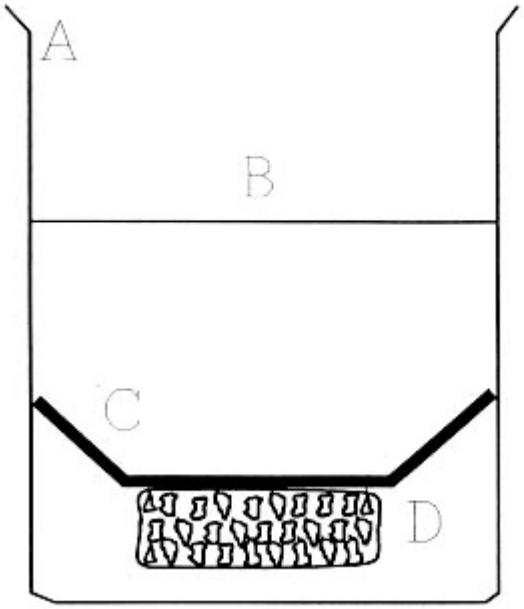
Before bulking with silicone, AS264 was placed in an initial bath of acetone at the same temperature which the cob was stored to prevent stress on the sample. The beaker containing the acetone and the corn cob was then placed into a freezer mounted vacuum chamber and for six hours, a vacuum of 26.5 PSI was applied for six hours. When rapid bubbling had ceased, the sample was assumed to have been fully dehydrated and the used acetone from the dehydration process was replaced with fresh acetone of an equal temperature. The cob was allowed to sit in this solution in the freezer for twelve hours prior to bulking with PS343 silicone.

## Bulking With PS343 Silicone

After allowing free-running acetone to drain from the sample for less than one minute, the sample was placed in a clean, dry beaker and freezer cold PS343 silicone was added. Because of the viscosity of the liquid and the slightly buoyant nature of the cob, a section of thin mesh screen was molded over top of the cob to ensure that the specimen remained completely submerged throughout the bulking process (Figure 1). With the screen in place, the beaker was placed back into the freezer mounted vacuum chamber and a vacuum of 26.5 Torr was applied for eight hours. With silicone immersion under pressure complete, AS264 was allowed to remain in the freezer for an additional twelve hours.

Figure 1. Beaker set-up.

A. Beaker
B. Level of PS343
C. Mesh Screen Preventing Floating
D. Corn Cob




After bulking, the PS343 silicone was carefully decanted from the beaker and the cob was removed and allowed to drain of excess, free-flowing silicone for a few of minutes. The cob was then placed in a clean beaker and ethyltrimethoxysilane, a cross linking agent, was added. The beaker was then returned to the freezer mounted vacuum chamber and as before, a vacuum of 26.5 Torr was applied. Very few bubbles were noted while bulking the cob during this stage of treatment and after eight hours, the application of a vacuum was discontinued and sample AS264 was allowed to remain solution in the freezer for an additional twelve hours.

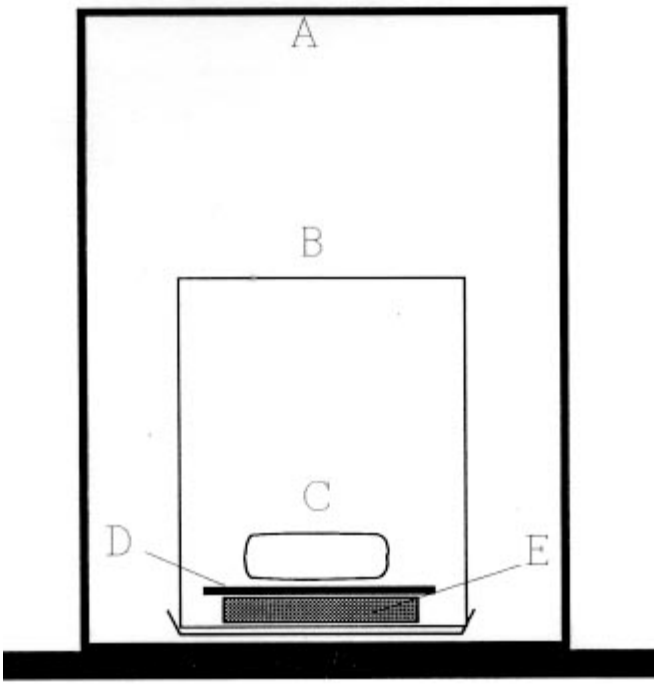
The Process of Polymerization

While the sample was stored in solution in the freezer, a warming oven with a containment chamber was prepared and preheated to 130 degrees Fahrenheit. To contain the fumes of the heated catalyst a chamber consisting of an inverted polypropylene bucket with a tight fitting lid was placed in the warming oven. The lid acted as the base

of the chamber as well as the surface on which the artifact and chemicals would be placed during the polymerization process. In the center of the lid, a shallow bowl containing two ounces of CT-30 was positioned. A mesh screen was then placed on top of the bowl acting as a platform on which the corn cob would be placed so that it rested in a position within the fumes of the warmed catalyst. With the body of the inverted pail placed in position, forming a tight fit with the lid, a relatively air tight containment chamber was created to keep the artifact in contact with catalyst fumes (Figure 2).

Figure 2.
The Oven
Set-Up

A. Warming Oven
B. Containment Chamber
C. Corn Cob
D. Mesh Support Screen
E. Dish with Catalyst




After verifying that the oven had reached a temperature of 130 degrees Fahrenheit, artifact AS264 was positioned on the mesh screen in the containment chamber and the oven was closed, allowing treatment of the artifact to continue for eight hours. At this time, the oven was opened for an inspection of the artifact and the catalyst. The sample's surface felt slightly wet to the touch and it was noted that there was a thick crusty layer on the catalyst's surface. This layer formed due to the dripping of excess silicone from the cob. To ensure a strong concentration of catalyst fumes was being produced, the catalyst was replaced with two ounces of fresh catalyst. The chamber cover was repositioned and the artifact was exposed to catalyst fumes for an additional twenty-four hours.
After three days of containment chamber treatment, the corn cob was removed from the oven and exposed to additional catalyst because its surfaces still felt slightly damp. Instead of placing AS264 back into the warming oven containment chamber, another method was chosen to ensure that the surfaces of the hollow cob interior were exposed to catalyst. To do this, three strands of pipe cleaner were twisted together forming one long

probe. Following immersion in CT-30 the cob was lightly tamped to remove free-running catalyst and the pipe cleaner gently positioned inside the length of the core. To treat the outside of the cob, an additional amount of CT-30 was sparingly sprinkled onto a lint-free rag which measured twelve inches square. The cob, with its pipe cleaners in place, was then loosely wrapped in this cloth so that its surfaces and ends were completely covered. The wrapped sample was then placed into a plastic bag and allowed to remain at room temperature for two days (Figure 3). At this time, measurements and other observations concerning the post-treatment state of the cob were recorded.

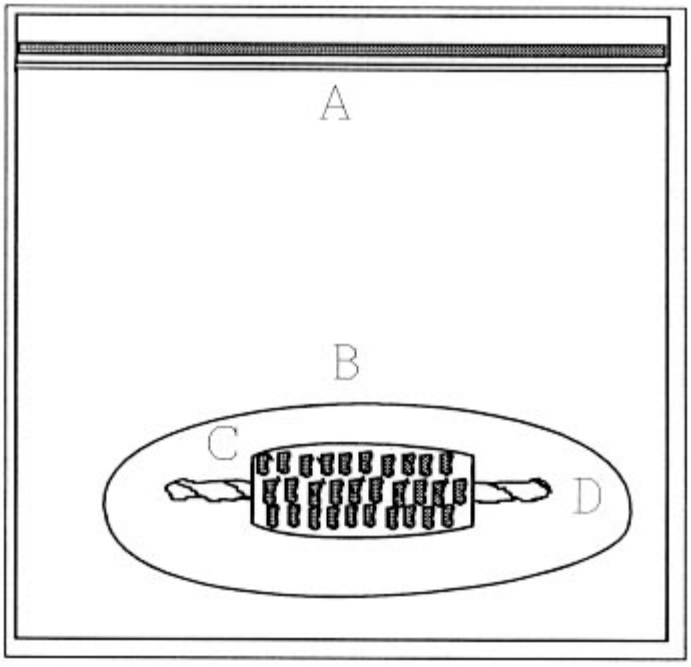



Figure 3. Curing the cob.

A. Sealable Plastic Bag
B. Cloth Wrap Around Cob
C. Corn Cob
D. Twisted Pipe Cleaners With Catalyst

Observations

The heavy accumulation of sediment and small pieces of disintegrated corn cob that were observed in the original storage solution of alcohol and water may have resulted from damage due to the movement of specimens during transport to the lab. AS264 had not suffered physical damage and was chosen for experimentation because it had retained many of its original attributes making it easily recognizable as a corn cob. The fact that the artifact had been stored in alcohol was advantageous because it helps to firm and stiffen many organic artifacts, making them more rigid and less prone to damage due to cellular collapse (Hamilton). One concern of this experiment was to determine what aspects of the diagnostic sample attributes were preserved using silicone bulking

techniques. Experimentation with air-drying waterlogged samples of corn cob from the same provenance, indicated that extensive shrinkage and distortion destroyed the cobs which were allowed to air-dry and post-treatment samples were very brittle and prone to extensive crumbling and flaking. Such was not the case with AS264. No flaking has been observed in the sample and apart from a slightly wet appearance, the cob is dry and firm to the touch. The only objectionable aspect of this treatment method to date is that for a short period of time after exposure to the catalyst, samples tend to take on the odor of catalyst for a short period. After usually two or three days, this odor dissipates.

Because of its hollow core and open fibrous nature, rapid dehydration of the corn cob sample was possible. To prevent applying additional stress to the cob throughout the experiment, it might have been better to place it in a cloth bag to absorbing and preventing the movement and jostling of the cob due to bubbling during the application of a vacuum. Very little particulate was noted in either the PS343 silicone or the ethyltrimethoxysilane solutions as they were decanted after bulking the specimen which indicates that any vigorous bubbling that occurred during the processes of bulking the cell structures of the corn cob had little if any detrimental effect on artifact integrity.

The process of polymerizing the silicone impregnated cob appeared to take longer than what had been experienced while conserving glass, leather and cork. This is probably due to the larger cavities within the cob and the greater quantity of silicone required to bulk these cavities.

Post-treatment measurements and weighing of this sample indicates that the process was very successful in preserving the diagnostic attributes of the original waterlogged artifact. Following treatment, the cob weighed 16.6 grams with a maximum length of 5.6 centimeters and a diameter of 2.5 centimeters. This specimen changed in weight by -1.2048% and diminished by only -5.2% in diameter. The post-treatment length of the sample remained equal to the its wet length (Figure 4).

Data for AS264

| | **Weight (g)** | **Length (cm)** | **Width (cm)** |
|---|---|---|---|
| **Wet** | **16.80** | **5.60** | **2.63** |
| **Post Treatment** | **16.60** | **5.60** | **2.50** |
| **% Change** | **-1.20%** | **0.0%** | **-5.20%** |

To determine the effectiveness of various bulking processes, it was necessary to determine the absolute weight of equal volumes of water and the PS343 silicone. There were some problems projecting the conserved weight of the artifact because the amount of free water in the wet sample upon which the projected weight must be calculated cannot be determined without its destruction. Determining a projected weight for the conserved corn cob might be beneficial because a comparison of the projected weight and the actual weight would indicate the degree of bulking that did occur. It was determined that PS343 silicone was 5.905511% lighter than its equal volume of water. Using this

figure, the projected weight of our conserved corn cob should have been 15.34487 grams. The conserved weight of the cob is 16.60 grams due to either slightly over bulking or a small amount of free water included in the wet weight of the artifact that was lost during the dehydration process. The small amount of shrinkage in the diameter of the conserved cob was most likely also due to this inclusion of excessive free water in the wet sample.

## Conclusions

Silicone bulking using PS343 silicone appears to have been highly successful in preserving the diagnostic attributes of this archaeological sample. While the cob is darker in coloration than most associated with corn cobs, no attempts were made at removal of stains and discoloration which may have been caused by long-time close association of the artifact to sediments and decomposing materials. The value of this treatment appears to be the ease with which it can be used to bulk the cellular structure of the corn cob. The time required for completion of this artifact was undoubtedly lengthened by the amount of time taken during the introduction of the cross-linking agent. Presently, the amount of bulking and exposure to cross linking agents is experimental and it was felt that error on the side of caution was in the best interest of an artifact. Continuing experimentation is required to determine optimum treatment schedules for bulking and cross-linking.

PS343 was chosen as the bulking agent for this artifact because it was believed that with its greater viscosity, this silicone would act to more fully bulk the large open cavities of this structurally compromised corn cob. Experimentation and comparison of the application of different molecular weight silicone oils is necessary to see what effects viscosity and molecular weight have on preserving the diagnostic attributes of waterlogged corn cobs from historic period archaeological sites.

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Citation Information:

C. Wayne Smith
1998, "Conservation of Waterlogged Corn Cobs Using Silicone Oils", Archaeological Preservation Research Laboratory (APRL), Report 8 , World Wide Web, URL, http://nautarch.tamu.edu/APRL/report08.htm, Nautical Archaeology Program, Texas A&M University, College Station, Texas.