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Long-Term Effects Of Acid-Cleaning Archeological Ceramics

Acid-cleaning is one method used by archeological conservators and archeologists to quickly remove mineral salts that have collected on the surface of archeological ceramics. It has been used for many decades with many variations in the procedure. Mineral salts are removed because they obscure the surface of ceramics, making them hard to analyze and to reconstruct. These mineral salts have a variety of informal names including caliche, lime, marl, insoluble salt and calcareous crust. They often have a gray to tan color and are commonly carbonate or sulfate salts. Carbonates are easily acid-soluble; sulfates are not. The term insoluble salt is most common in the conservation literature and will be used throughout this *Conserve O Gram*.

A wide array of ceramics have been cleaned with acid including both ceramics in archeological research collections and complete pots purchased as antiquities and found in historic collections. This *Conserve O Gram* will not tell you how to do acid-cleaning of ceramics. Instead it:

- provides information on ways to identify objects that may have been acid-cleaned.
- describes typical deterioration problems that may occur as a result of acid cleaning.
- discusses ways later analytical work may be affected by the treatment.

There are different procedures for cleaning ceramics with acid, the most aggressive is done by immersing ceramic sherds in a bucket of dilute acid (usually 5-25%). Hydrochloric, nitric, formic, and acetic acid have all been recommended. Other acids have probably been used. The technique has been used in many ways, and with careful control can be a fairly effective and quick way to reveal the surface of a ceramic. However, irreversible damage can occur when treatment is carried out without careful planning and consideration. Damage can readily occur if high concentrations of acid are used and if the treatment is not carefully monitored. In addition, further damage can occur after treatment while the object is in storage.

Identifying Damage from Acid-cleaning

Acid-cleaning is an aggressive and indiscriminate treatment. It removes acid-soluble deposits from the surface of the ceramics and will also dissolve acid-soluble components of the ceramic; both the temper (material added to the clay during processing) and the clay body. In addition to the chemical dissolution, bubbles formed by the reaction of acid with the acid-soluble components cause physical damage on a microscale. Notably, the bubbling can cause visible damage through loss of small fragments of the surface, paint, and surrounding clay. When they react with temper or insoluble salts that have been deposited in pores, the bubbles can destroy the surrounding clay (Hodges, 1987). If this chemical and physical damage is extensive, it can be seen with the naked eye.

Ceramics treated with acid may have an eroded, pitted or porous look. The surface may be cracked, friable or powdery. Paint may be flaking. Using a microscope you will be able to see all of this damage more easily. Be aware, however, that there are other ways this sort of damage can occur to ceramics during burial or later in storage, so a fragile surface or eroded

structure is not a sure sign that acid-cleaning has been done.

Another chemical change that occurs is sometimes known as "acid burn." It is commonly known from black-on-white ceramics excavated in the Southwest. Acid burn is caused when iron in the clay or paint reacts with components in hydrochloric acid, creating yellow-colored substances. These substances (iron chloride, iron oxide) redeposit in the ceramic causing yellow staining.

Ceramics with acid burn often have a light- to golden-yellow color. The color change probably occurs when hydrochloric acid is used on any ceramic, but the natural orange or brown color of many ceramics masks the color change. Other acids besides hydrochloric acid probably cause a similar chemical reaction, but the reactants do not have a yellow color (Johnson et al. 1995). More research is needed to completely understand this process and its long-term effects.

Deterioration in Storage

Acid-cleaning removes the insoluble salts by chemically changing them into a more soluble form that is dissolved in the wash water. Some of these salts can redeposit in the pores of the ceramic and if not removed have the potential to cause further damage. Salt deposition is minimized if the ceramic is soaked in water before acid immersion to fill the pores. If these salts are not removed, they may cause later damage in storage. With changes in relative humidity in storage these salts crystallize and expand at or below the surface and can damage the surface, slip, or paint. This type of damage is described in detail in *Conserve O Gram* 6/5, Soluble Salts and Deterioration of Archeological Materials. Soluble salts are also introduced during burial and their presence is not a true indicator that acid-cleaning was used.

In summary, acid-cleaned ceramics may have fragile surfaces. Paint may be loosely attached. The slip or polished surface may be cracked and separated from the body of the clay. You should carefully examine ceramics that you suspect have been acid-cleaned before touching the surface. This fragility means that objects should be handled with great care. You may have to create a specialized mount to support the object in storage or to carry it (see *Conserve O Gram* 4/12). Careful storage and handling can prevent further loss to the surface.

If damage and deterioration are severe, you should contact a conservator for advice on treatment and storage needs.

Effects of Treatment on Later Analysis

The most obvious effect on analysis occurs when the acid-cleaning or later soluble salt deterioration removes surface decoration. If paint decoration is destroyed, a good part of the information contained in the ceramic is lost. Evidence of the contents left on the surface or soaked into the fabric of the object (e.g., food or drink) may also be destroyed - removing a wealth of information on how the ceramics were used. In order to remove the soluble salts, the ceramic may be soaked in changes of deionized or distilled water. This removes the salts, but it may also be removing heavy metals (e.g., iron, titanium) as well. There has been little examination of the analytical effects of the treatment, so in general, ceramics known to have received acid-cleaning should not be used for instrumental analysis.

Archeological repositories and museum collections should request documentation on acid-treatment (or any other treatment) that was done during field and laboratory processing of ceramics. Guidelines for preparation of collections during and after excavation should include information on the effects of acid-cleaning. If removal of insoluble salts is necessary, a conservator with experience in these treatments should be contacted. Variations in the technique can minimize damage - or another treatment option may be more appropriate. Use

of any treatment on archeological collections must be a balance between short-term field processing needs, and long-term preservation for future analysis and use.

Conclusion

Acid-cleaning has been used for a long time. In many cases, it is a successful treatment that removes deposits without visibly changing the objects. If the treatment is used carelessly, however, acid-cleaning can create a fragile object that may be damaged by variations in relative humidity or simple handling.

When ceramics are accepted into collections, staff should ask if this (or any other treatment) was used on the material and record the treatment in collection management records. Ask for details such as:

- was this ceramic pre-soaked?
- what kind of acid was used?
- how long was it in the acid?
- was it soaked in water afterwards and how long was it soaked?
- was the conductivity of the water tested to identify whether salts had been removed? (see *Conserve O Gram* 6/5)

If ceramics have been treated with acid, consider having a conservator examine the material. Testing will identify if any soluble salts remain in the ceramic. They may be able to document damage or changes that have occurred in the ceramic body. They can discuss treatment and storage options that may help to better preserve ceramics.

In the future, researchers wanting to examine aspects of the ceramics need to know that this treatment was done. Without knowledge of previous treatment, the results of future analysis can be affected and rendered inaccurate.

References

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