



BISHOP MUSEUM
Art Conservation Handout

TO BLEACH OR NOT TO BLEACH...

Introduction

People bleach things all the time. They do it at home in their washing machines. Clothes come out looking clean, white, great! Then they bring textiles to a conservator and are told that "bleaching won't work; bleaching isn't safe; we don't recommended bleaching your textile." Why??!

Unlike paintings, statuary, or prints, textiles often have a utilitarian history. The first three types of art are often merely decorative and rarely handled by people, resulting in a reservations by individuals about doing their own conservation work. Works of art in fiber, on the other hand, are extremely tactile.

This feature, combined with textiles' utilitarian aspects, results in a certain ease and familiarity with the media. People are more likely to attempt stabilization, repair and cosmetic treatment of textiles themselves, often with disastrous results. The chemical and physical make up of a textile is extremely complex. Age further complicates the chemical and physical problems involved.

Cleaning techniques which may give excellent visible results to every day clothing which is to be worn for a short period of time may be extremely detrimental to a textile collection item.

This article will specifically address the subject of bleaching. It will examine criteria for determining when bleaching is safe and when bleaching is necessary, the ramifications of bleaching a textile, and the various types of bleaches. It is to be hoped that by the end of this article the reader will have a better idea about why conservators are reluctant to bleach, how bleaching affects their textiles, and why bleaching sometimes will not remove a stain.

Life on a molecular level

Staining is a problem often encountered in the textile conservation field. A stain is identified by an area on a textile which has discolored contrary to the intention of the maker. Natural fibers are extremely absorbant materials. Body oils, liquids, soils, and organic substances are all readily absorbed onto the textile fibers. These soils and organic substances oxidize over time to colored stains. Bleaching does not remove stains. The substances causing coloration of the stain is merely altered so that the color of the stain is less intense or invisible.

Several molecular structures and physical phenomena give rise to color or darkening on a fiber. Molecular structures containing conjugated centers of unsaturation (double bonds) such as phenols and carbonyls all cause vibration of bonds by light wavelengths, shifting absorption of light from the invisible or colorless ultraviolet range to the visible light range. By breaking up the conjugated system, colored compounds

become colorless, i.e. stains become invisible. This can be accomplished by breaking or saturating the double bonds. The carbonyl groups can be reduced to alcohols, or oxidized to carboxylic acids, both colorless compounds.

Oxidation often results in initial color removal by creating unconjugated, but also unstable systems. This means that initially stains are removed, but eventually the unstable systems will react further, usually forming a colored compound again. This is called reversion. The chloride containing bleaches are notorious for reversion. Reduction usually results in long term whitening, as the alcohol groups formed are much more stable compounds than the carboxylic acids formed in oxidation.

Dyes also work around similar conjugated centers, although dye chemistry is much more complex. Basic knowledge about dyes is necessary to successfully determine the safety of bleaching colored materials. Dyes are also organic compounds which will react to chemical bleaches.

Pigments, on the other hand, tend to be very stable inorganic compounds. Pigments are found in many stain causing soils. Once a pigment has bonded to the fibers, bleaches have little effect. This may be one cause of non-removable stains.

When to bleach

Bleaching is considered a cosmetic treatment in textile conservation. The bleaching process runs counter to the basic tenets of conservation of stabilization and preservation in that bleaching of any type usually weakens the fiber structure. Bleaching is not a recommended procedure if only the long term stability of the textile is under consideration.

Nonetheless, bleaching for cosmetic reasons is practiced for both private clientele as well as for museum display. People viewing textiles have inherent expectations. Usually, a certain amount of yellowing and staining in an old textile is tolerated, as these are signs of age and use, and form a valid presentation for antique textiles. In certain instances, however, stains can be so numerous or dark as to be distracting. Large stains may also blot out important design features necessary to interpret the textile properly. Or, as with some linens owned privately, the intent is to use the textiles for a specific presentation; preservation is not a vital concern.

These, and other points should be considered before a decision is made to bleach. The decision to bleach should be a joint decision between the curator/owner and the conservator. The curator/owner is best able to determine the intended function of the textile and its historic and interpretive value. The conservator is best able to judge the physical condition of the textile and the possible success or failure of the bleaching procedure. Remember, too, that proper cleaning often has such a brightening and freshening effect on a textile that stains become less noticeable, perhaps making bleaching unnecessary.

Points to consider before bleaching:

1. The first consideration should be whether or not the textile is strong enough to withstand bleaching. Will the bleaching procedure cause losses in the fabric? Will the process cause extensive immediate deterioration of the fibers? Will results obtained equal or outweigh the damage done? (To a conservator, the answer to this question is rarely 'yes'.)

2. The physical make up of the textile can also determine if bleaching is possible. The type of dyes, sizings and finishes used, the method of surface decoration and method of manufacture as well as the inclusion of metals, embroideries or trims affect the reaction of the textile to the wash solution or the bleaching chemical.

3. The nature of the textile should influence a decision about bleaching. Differing criteria exist for textiles of a utilitarian nature, of historical importance, or of a fine arts classification. Do the stains violate any of the criteria which make the textile in question valid? Remember, too, that some stains can have historic value, and should not be removed.

4. Can the original color or appearance of the textile be determined? If so, will bleaching return the textile to the original, or will bleaching alter the color, or produce an uneven or spotty appearance? The size, location, and darkness of the stain should also be considered.

5. The type of stain will help to determine if bleaching will be effective. Fresh stains of an organic nature with very little penetration into the fibers or pigmentation are usually successfully removed by cleaning methods without the use of bleach. As a rule of thumb, stains which have been in a fabric for more than three months are usually considered 'set'. This means that usually they have successfully bonded or reacted with the fibers to an extent that the substance is not removable or alterable.

6. The final point to consider is the past history of the textile. Have other attempts been made to remove or reduce this stain? What chemicals were used? What methods were used? Will your stain reduction procedure be any safer or any more effective than past efforts?

If all these points have been considered and it can be determined that bleaching will not cause loss of fabric or dye colors, a trained textile conservator should be consulted for further physical and chemical testing. The amount of reversion, damage to fibers, sizing, and finishes should also be considered. Bleaching should be carried out by the conservator under controlled conditions with an appropriate chemical and an appropriate technique.

Some types of bleaching agents

Listed below are some of the common classes of bleaches used in conservation and their advantages and drawbacks.

1. Chloride containing bleaches: Calcium hypochlorite / sodium hypochlorite

The hypochlorite bleaches have been in use since the late 1700's. A common off the shelf source of this chemical is the traditional Clorox™ bleach. The hypochlorites are oxidizing bleaches. These bleaches are rarely, if ever, used in textile conservation work. The chlorides must be rinsed out of the textile completely to prevent further chemical reactions from occurring. These substances also react with phenolic compounds, often found in dyes. This means that colors can be altered or removed as well as stains. Chlorine also reacts with protein to break down the protein molecules, resulting in weakening of silk, wool, or hair fibers. If exposed long enough and to strong enough concentrations of hypochlorites, protein will disintegrate completely. Residual chlorides can also react with metals to form corrosion products.

In their favor, chlorites will, however, reduce iron stains. The molds which cause brown foxing stains and blood stains are caused by iron residues which react to form iron oxides, better known as rust. These stains are nearly impossible to remove. Chlorites are one of the few bleaches which can remove or reduce these stains. Be aware, though, that often the result of removing iron stains with chlorites are losses, or holes.

Chlorites are a favorite component in commercial bleaches because they work quickly and give a very bright white. These very same traits make chlorites difficult to use successfully in a conservation laboratory. The fast acting substance is difficult to control and may bleach the stain to a lighter color than the surrounding fabric. The whitening effect is also not permanent. While initial bleaching results on the more common food or soil stain may be satisfactory, the stain will eventually revert over time and become visible again. In the meantime, the chemical has reacted with your fibers to causes chain shortening, thereby weakening and embrittling your textile further.

2. Peroxides: Hydrogen peroxide, Sodium Perborate

The peroxides are also oxidizing bleaches. The free radical found in the peroxide molecule tends to oxidize the colored carbonyl groups into transparent carboxyl groups. Please be aware that this same free radical mechanism is one of the main reactions found in light degradation of textiles. In theory, this could be hazardous for the textile. To date, empirical observations seem to indicate that this problem is not as acute as many textile conservators have feared if the bleaching process is properly carried out.

There are several advantages to the use of this chemical. The first is its high volatility. Decomposition products and residual chemical are mostly nonexistent, having evolved into the air or water bath in the two hour time it usually takes to complete the washing process. Residual chemicals are the main cause of continued bleaching and degradation after the textile has been rinsed and dried. Another advantage is that reversion is usually minimal. Sodium perborate has been used for many years in textile conservation. It does not bleach past the original color, meaning that if the fabric was originally an off-white, the perborate will not bleach it to a lighter color than original.

The peroxides are also a very slow working and easily controllable bleach. There are several cautions in the use of this chemical. Hydrogen peroxide tends to react with metals, releasing free oxygen. The gas evolves as air bubbles, which may cause physical damage to the fibers as the bubbles form and rise to the surface. The free oxygen can also begin further oxidation reactions, leading to chemical weakening of the fibers. This chemical should not be used with weighted silks, textiles with metallic threads or attachments, or natural dyes using metal mordants.

Peroxides are a fairly safe bleach when used with an alkaline pH. pH 10-11 is the optimum working range. This is fine for cellulosics, such as cotton, linen, ramie etc., but the high pH will affect silk, which is susceptible to degradation at pH above 7.5, and wool, which is acidic by nature. The optimum working temperature for sodium perborate is also a little too warm to risk on wool. There is a chance of wool felting at high temperatures.

Peroxides are explosive. Care should be taken in handling.

3. Borohydrides: Sodium Borohydride, tetramethylammonium borohydride, tetraethylammonium borohydride

This substance is a reducing bleach, meaning that the colored carbonyl compounds are reduced to the more stable alcohols. Of all the bleaches discussed in this article, the borohydrides have been found to give the least amount of color reversion when used correctly. The substance is on the alkaline side, and deteriorates rapidly in acidic conditions. Again, use with silks, wools, or other materials which are acidic by nature is cautioned against.

Advantages of this chemical are similar to those of the peroxides. Color reversion is low, optimum working pH is lower than other bleaches, the substance does not bleach past the original color, and it is fairly safe to use. In addition, the borohydrides are less damaging to the fibers.

One draw back to the use of this bleach is that it tends to release hydrogen gas on contact with water. This results in tiny bubbles, as in carbonated drinks. This bubbles can be an extremely strong force, physically lifting and breaking apart weak fibers. In the same manner, it is sometimes minimally effective on foxing stains, physically lifting the rust spots off the surface of the textile. The borohydrides can also be used in alcohol.

There are several advantages. Alcohol tends to swell fibers less, resulting in less mechanical damage. The borohydrides react slower in alcohol, and do not emit as many bubbles of hydrogen gas.

The use of this bleach is fairly new in the textile conservation field. Research is still being carried out.

4. The sulfites: Sodium bisulfite, Sodium metabisulfite, Sodium thiosulfite, Sodium Dithionite (hydrosulfite)

Sodium bisulfite, Sodium metabisulfite and Sodium thiosulfate are all reducing bleaches. These substances are difficult to rinse out of the fibers. Residues will continue to bleach the textile for awhile, then will reverse, bringing stains back up. Very little research has been done on this class of bleach. It is rarely used in textile conservation.

Hydrosulfite is a reducing agent which converts ferric oxide to ferrous oxide, a water soluble material. The hydrosulfite is pH neutral to acidic, is not known to degrade cellulose, and is effective in removing iron. However, it has very little bleaching action and reverts easily, especially if not well rinsed. There is also an extremely unpleasant sulfur odor.

5. Ultraviolet light

Light bleaching is also an oxidative process having a working mechanism of a free peroxy radical like that found in peroxide bleaches. Light, especially long wave ultraviolet light, is a very strong source of energy. This energy is a major source of deterioration of fabrics, evinced by color fading, embrittlement, and weakening of fibers. The old home remedies of laying linens on the lawn or using lemon juice to bleach stains may result in temporary brightening of the fabric, but the trade is in years off the lifespan of the textile. As with all oxidative procedures, this temporary brightening usually reverts to yellow once the textile is replaced in storage or on display. In addition to being discolored, your textile is now also weakened and brittle.

In summary, the decision to bleach requires much forethought and consideration. It is not a procedure which should be lightly undertaken. Bleaching runs counter to the preservation of a textile, in that most chemicals and procedures used hasten the degradation of the fibers. Results are often unsatisfactory, leading to little or spotty reduction of the stain. Results are often temporary when viewed over the long span of a textile's lifetime. If, after much deliberation, the choice is made to have a textile bleached, the procedure should be carried out by a trained conservator under controlled conditions. So the next time a conservator says to you, "Hey, do you really want to bleach this?", think about it.

For Further Reading

Preservation of Library & Archival Materials: A Manual.
Available from University Products (see below) or
Northeast Document Conservation Center (NEDCC)
100 Brickstone Square
Andover, MA 01818-1494
TEL 508.470.1010
FAX 508.475.6021

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Bulletin of IIC-AG, Vol. II, No. 2 (1971).
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Textile Conservation
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London; 1972

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