Museum Textile Services

Bleaching Textiles with Sodium Borohydride

The favorite method of bleaching cellulosic textiles at Museum Textile Services employs the reductive bleaching agent sodium borohydride (NaBH4.) Wetcleaning cotton and linen fibers with the addition of a sodium borohydride bath is beneficial both visually and chemically, resulting in healthier and brighter artifacts. Sodium borohydride cannot be used on protein fibers—such as silk and wool—because they are naturally acidic and sodium borohydride is very alkaline.

How it works

As cellulose ages, hydroxyl groups (-OH) are converted to carbonyl groups (=O), which contribute to a dingy brown or yellow color. Reduction adds electrons to the cellulose, which stabilizes its molecular weight and returns carbonyl groups back to colorless hydroxyl groups. Stains are not generally removed with the addition of sodium borohydride but the overall results are better than wetcleaning with surfactant alone. Remarkably, sodium borohydride is color safe when used at its proper strength, and we have safely bleached many embroideries, patchwork quilts, and other colored cellulose textiles. Warning: we have seen color change on our clothing if we get it wet with bleach solution and do not rinse it out—the key to safe bleaching is to follow the recipe and flush with water to deactivate.

Buying Borohydride

Obtaining 98% pure granulated or powdered sodium borohydride can be challenging. Companies often do not sell small amounts and may require lengthy paperwork. Storing opened containers for a long time can result in reduced effectiveness if the product absorbs moisture from the air. In bulk, NaBH4 is a hazardous material, so you may also encounter high shipping costs. As of 2015, our supplier of choice is Boron Industries, which sells 1 kilogram that require no special shipping for $165. We encourage you to shop around to find the best price based on the quantity you need.

Setup

Wetcleaning with NaBH4 works best in a non-metal basin, such as a bath tub or photographic tray, though we have had equally good results in our regular stainless steel wash tanks. We have used this system with good success with cold deionized water, and with only cold and warm tap water. Our preferred setup is a combination of cold deionized water plus warm tap water (we do not have warm deionized water). Your work space should be set up the same as if you were doing a regular wetclean, including supplies and adequate space for drying. You will need a scale that measures to 1/10 g.

Creating the NaBH4 solution

We use the 40:1 bath ratio method taught by Susan A. Adler, who published her seminal 1998 article, *Borohydride: An Alternative to Oxidative Bleaching of Cellulosic Textiles,* in vol. 8 of the Textile Specialty Group Postprints.

1. Weight of your textile in grams _____ X 40 ml water / g = _____ ml water.
2. _____ ml water X 0.001 g NaBH4 / ml = _____ g NaBH4

To make life simpler, we measure the volume of our wash table or sink at the desired depth. We can then skip directly to step 2 above. We err on the high side, which uses more NaBH4 but can be easier to measure. More water also makes agitation easier.

Prepare your NaBH4 solution in a glass beaker or measuring cup. We prefer to use warm tap water. You will notice immediately that the solution fizzes, so keep it away from your face. Stir well. The powder/granules may need to sit before they dissolve completely.

Disclaimer: This handout is intended for use by experienced conservation professionals who know how to wetclean historic textiles.

Bleaching Steps

- Immerse the textile in a bath of cool water. Tamp gently and allow to soak for 10 minutes. If the water is discolored, empty and repeat water baths until discoloration removal ceases.

- Fill the wash tank with the amount of cool water you calculated in step 1 above. Do this using a metric measuring container or by calculating in advance how high to fill your wash tank. Yes, this requires more math!

- Slide your textile aside and add in your pre-measured NaBH4 bleach solution to the wash water. Disperse evenly and gently throughout the wash tank using gloved hands. Rearrange your textile so that it is lying flat.

- Sodium borohydride is a surface-acting agent, so you will need to gently agitate the water at 20-minute intervals to ensure even contact between your textile and the surface of the water. You need to rearrange your textile so that each section, including the back and front, spends time on the top. In rare instances, failure to agitate the textile has resulted in streaking and uneven bleaching. If this occurs, resume regular agitation and the streaking should disappear.

Before

After

- Allow the textile to soak for two to three hours. Monitor for any unforeseen problems and rinse thoroughly if necessary to stop the bleaching process. We have seen neither additional benefit nor adverse effects from bathing a textile in NaBH4 for longer than three hours.

- At the conclusion of bleaching, empty the tank and fill it with clean water. We prefer to introduce warm water at this stage. If you are bleaching an already-wetcleaned textile, do a minimum of five rinse baths until all bleach solution is out and then proceed with drying.

- If the textile has not already been wetcleaned and you wish to use a surfactant to complete the cleaning process, introduce the surfactant at this stage. For example, we would empty the first warm rinse bath and sponge on a .3% solution of Orvus WA Paste in warm water. Because the cellulosic discoloration should have been removed already, leaving the surfactant step until the end allows you to see the soil being released with the Orvus. Generally, soot and soil are visible as a greyish discoloration when they are removed, as compared to the tea-colored discoloration removed earlier.

- Thoroughly rinse the textile until all of the surfactant is removed—when there are no more suds you can feel confident that all of the sodium borohydride is also rinsed out.

- Proceed with drying as you would after a normal wetcleaning. We almost always employ a wicking cloth when drying cellulosic textiles, as this can prevent any additional cellulosic degradation or soil from depositing on the artifact as it dries. For more on drying textiles see Kathy Francis's 1992 article, Predicting the Drying Behavior of Textiles, *AIC Textile Specialty Group Postprints*, Vol. 2.