

Guild of Book Workers Conference
Alexandria, Virginia
October 5 & 6, 2001

Mending Paper: Seminar Agenda
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Conservation of Art on Paper, Inc.

I. Basic Concepts

- A. Mend equal to or weaker than object
- B. Thin adhesive layer better than thick one
- C. Mending/filling mat'ls move in same way and degree as obj
- D. Paper grain
- E. Difference between Western and Jap tiss
- F. Jap tiss traditional for mending
- G. Water tears vs cutting
- H. Mat'ls w/same name/descrip not nec the same

II. Tissue/Paper Choice & Prep

- A. Paper Choice
 - e.g. paper/tissue, strength, grain or not, color, thickness, surface
- B. Toning Methods
 - Acrylic Paint
 - Dyes
 - Toasting

III. Adhesives

- A. Water-based
 - Solvent-based
- B. Traditional Method: Fresh Starch Paste and Tissue
 - 1. Wheat Starch Paste
 - Making
 - Kneading
 - Use
 - 2. Rice Starch Paste
- C. Remoistened Strips
- D. Cellulose Ethers
- E. Heat-Activated Adhesives
- F. Solvent- Activated Adhesives
- G. Pressure-Activated Adhesives
- H. Mixtures of Compatible Adhesives
- I. Unsupported Adhesive Films

IV. Mending

- A. Prep the tear line
- B. Prepare tissue
- C. Apply adhesive to strip
- D. Apply strip to object
- E. Press together and dry

- F. Alignment
- G. Mending along folds
- H. Single- or Double-sided

V. Filling

- A. Tissue laminates
- B. Fill cut to exact size
- C. Pulp
- D. Japanese ceramics technique

VI. Surface Finish

- A. Burnishing/Texturing
- B. Tengujo overlays
- C. Inlaying a Line of Pulp

VII. Hand-Outs

- Article on paste preparation
- CAP recipe
- Tools & Supplies List

WHEAT STARCH PASTE ©

A CONSERVATION BRIEF FROM CAPI PUBLICATIONS

Introduction

Pastes are generally weaker adhesives and better complements to paper artifacts than glues, which tend to be too strong. In addition, most tapes and glues are hydrophobic and do not respond to humidity changes, so they tend to cause paper to develop bulges or cockles while hygroscopic pastes, by expanding and contracting somewhat, minimize cockling. Pastes are made from vegetable sources while glues are derived from animal sources or synthesized. Flour paste contains a mixture of starch and gluten, a material which crosslinks. As a result, flour paste is difficult to remove after it ages. If gluten is removed from flour, the residual starch may provide an excellent adhesive for paper-based artifacts. Different plant starches have different characteristics: the one best suited to paper adhesion is wheat starch.

When *properly* cooked and *properly* prepared for use, wheat starch forms a paste which can be modulated from extremely strong to very delicate. People who have used it only occasionally sometimes object that wheat starch paste is not reliably strong: it is true that paste which has not been prepared properly is weak and it is unreliable if it has been kept too long. Its effectiveness depends on preparation, freshness, and the skill of the user. Good paste provides a combination of strength and reversibility and does not discolor over time. For these reasons, wheat starch paste is the standard adhesive used by paper conservators.

Rice starch makes a slightly weaker adhesive and is sometimes useful. Other starches (e.g. potato) are not sufficiently strong.

Cellulose ethers are useful when even rice starch paste would be too strong. This group of materials includes methyl cellulose, hydroxypropyl cellulose, ethylhydroxyethyl cellulose and similar materials. These adhesives are too weak for hinging.

Commercial library paste consists of dextrin, a converted form of starch, and additives such as preservative, plasticizer, fluidizer, and fragrance. Dextrin is weaker than starch, and the additives are unnecessary for adhesion and possibly damaging to valued artifacts.

The best starch paste cannot be purchased because its short shelf life (about one week) makes it commercially impractical. However, it requires almost no effort to make in an electric saucier (a pot with a paddle that continuously stirs the starch-water mixture). With more "elbow grease" it can be made in the traditional way, using a double-boiler. Its virtues in comparison to commercially available products are worth the effort.

STARCH PASTE PREPARATION

1 part wheat starch, by weight

9 parts distilled water, by volume

(Experimentation will reveal how large a volume is needed. One might begin with 20 gms of starch and 180 ml of water.)

Put the starch and water in a clean glass bowl and stir with a plastic spoon about five times over a period of three hours. The starch will absorb some of the water, so once cooking begins the tiny starch granules will burst open more readily and create a continuous, sticky gel.

The easiest way to cook the paste is in an electric sauce-maker (available at kitchen supply stores), and anyone needing paste frequently will find this device a valuable investment. The Teflon-coated interior protects starch from contact with the metal pan, and the rotating plastic paddle makes strong adhesive while saving the worker significant time and effort. To insure pure paste, reserve the sauce-maker for paste-making. The heat should be maintained at the highest setting (usually "5") for approximately 25-30 minutes: in a dry workroom, less cooking time is required, in a humid room, more. Larger volumes require longer cooking. As the paste mixture cooks, its volume diminishes and a crust forms on the bottom and sides of the pan. Cooking is complete when the paddle pulls the paste into taffy-like formations.

Test by tapping a bit between two fingers: thoroughly cooked paste is very tacky. Immediately remove from the heat, scoop the paste from the saucepan with a plastic spoon or spatula, and discard the crust. With the spoon, force the paste through a non-metallic sieve, which can be made with an embroidery hoop and plastic window screening if necessary. Ideally, the paste is first pressed through mesh with larger openings and then through a second sieve with smaller holes. Alternatively, one can use more strength and one sieving through the finest mesh available.

Rinse a glass jar with a non-metal top in ethanol, and put in the paste. Wet two cotton dental dams (available from dental supply houses) with ethanol and lay them on the paste. Leave the top of the jar partially open for a few hours so water vapor can escape, then close the lid and store in a cool place, but not a refrigerator, for up to one week. Using a jar large enough to provide about an inch of air space above the dental dams seems to preserve paste longer, probably because the alcohol vapor can suffuse more effectively. Soak the saucepan in water and then clean it with a soft sponge or cloth to preserve the Teflon surface.

Undiluted paste should be discarded after a week-- or before if it displays any sign of degradation: spots of mold, change in odor, or loss of strength. If the paste fails any test, it should not be used even if it appears to adhere properly-- it is likely to fail with time or stress.

If an electric saucepan isn't available, cook the paste in a glass or ceramic double-boiler over medium high heat, with continuous stirring for about thirty to forty-five minutes. Doing this convinces most people of the value of the electric saucepan.

Never use tap water to make paste. Metals and micro-organisms in tap water catalyze paper degradation.

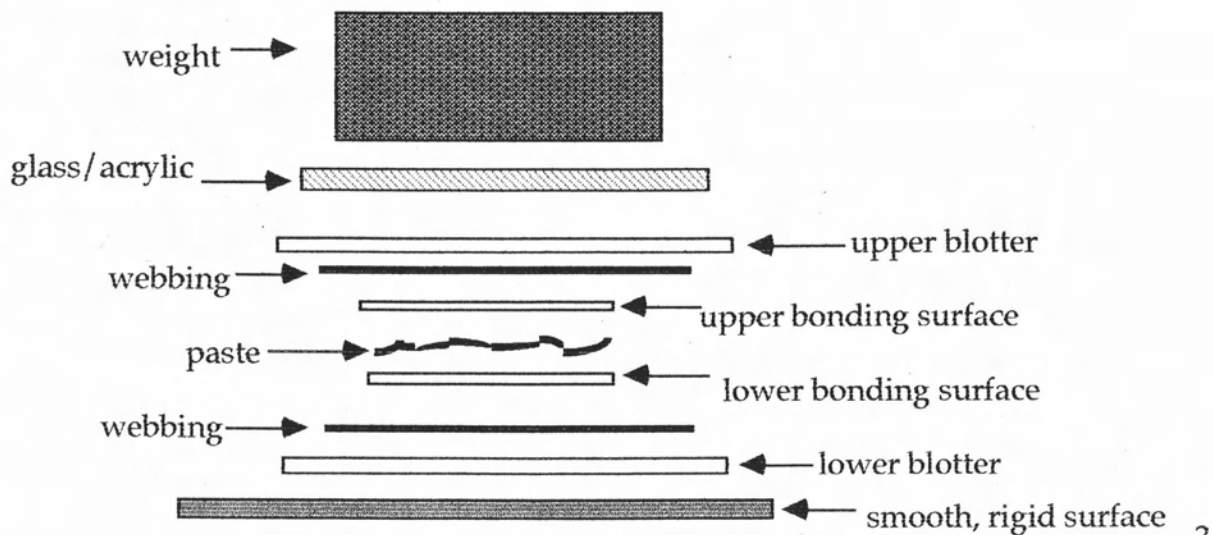
STARCH PASTE USE

When the paste is to be used, proper preparation is critical to elicit its strength. With a hog-bristle brush put some paste in a flat-bottom glass ash tray reserved for paste work. With the brush, knead the paste vigorously in all directions for about seven minutes. Its strength will increase noticeably; the brush will begin to create track marks; the paste will become transparent, almost invisible; and it will make a snapping sound as you knead. Add a few drops of distilled water and work the water into the paste. Work out any lumps immediately as they occur.

Blend a few more drops of water into the paste, and then continue to work in water gradually till the paste is the desired consistency. How liquid it should be varies with the job and can be determined only by experience. To apply tissue hinges to an object on medium-weight paper, a consistency between milk and cream is often appropriate. Most people observing paste dilution for the first time comment that the consistency is much thinner than they imagined. The paste is used thinly, just enough to pull two surfaces into contact and hold them together. Thick layers are likely to distort artifacts and crack apart within the adhesive layer.

Dilute paste just before using it. Afterwards, it can be covered and saved overnight, but it should be discarded at the end of the second day. And before using it on the day after dilution, inspect it carefully for any signs of mold.

To dry a pasted area, lay thin polyester web (available from conservation supply houses or as interfacing from a fabric store) above and below the bond and then white blotting paper above and below the poly web. The blotting paper withdraws water from the paste while the poly web prevents undesirable adhesion. Over the upper blotter, lay a smooth, hard block such as a piece of glass or plastic and put about four pounds of weight on the block. Weights, which can be made by filling small containers with lead or steel pellets, force the bonding surfaces into close contact as the paste dries while the block distributes pressure from the weight evenly over the pasted area. Move the pieces of web and blotter several times over the course of twenty minutes to maintain dry surfaces above and below the bond and then leave the weighted bond for at least several hours. When attaching hinges, some conservators take the precaution of leaving weights in place overnight.



Problems Working with Starch Paste

Experience is necessary to develop skill and confidence working with thinned paste, but its stature as a versatile and archival adhesive for paper artifacts repays the effort. The most common problem is cockling or deformation of one or both surfaces being joined. This can be avoided by brushing the paste onto a blotter to allow some water to wick away before the paste is used and by changing blotters several times as the bond dries.

Sometimes wheat starch paste causes pale gray shadows on thin papers. In these circumstances, wicking out more water before using the paste, substituting rice starch in the recipe, or cutting wheat starch paste about 1:1 with a viscous methyl cellulose solution should solve the problem.

Bonds may fail to form because paste is old, although usually degraded paste appears to bond-- and then fails when stress is exerted on the bond. Of course using too little or overly thinned paste prevents adhesion, but using too thick an adhesive layer can as well. A water-resistant coating (e.g. some adhesive residues, water-proofing additives, or even grease) is a possible, but infrequent, cause for bond failure. More common causes include inadequate pressure on the bonding surfaces, using weak hinging tissue, using hinging tissue with its grain running in the wrong direction (i.e. parallel to the top edge of the object rather than parallel to its height), using too few or too small hinges relative to the weight of an object. Finally, hinges will fail if an object is too weak to support its own weight as it hangs: the evidence is a break around the hinged area, with a fragment of the object still adhered to the hinge.



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TOOLS & SUPPLIES LIST*

*Items are listed in the category to which they seem most to belong: they may be needed in other areas as well.

MAKING PASTE

Wheat Starch and Other Adhesives
conservation supply houses

Balance/Scale to weigh out materials
scientific supply house

Weighing Dishes (or use paper)
scientific supply houses

Glass Bowl/Large Measuring Cup

Graduated Cylinder, e.g. 100 ml
scientific supply house

Distilled or Deionized Water

Stirring & Sieving Spoon, flat-bottomed, plastic

Electric Sauce Pan or Glass Double-Boiler
kitchen supply stores

Paste Sieve
conservation supply houses, Japanese paper importers

Glass Jars w/Plastic Caps (remove cardboard cap liner)

Dental Dams (a.k.a "Medium Cotton Rolls")
dental supply house

Ethanol
scientific supply house

MENDING

Blotters, absorbent and white

conservation, art, or specialty paper suppliers

Clear Glass Ashtrays

Synthetic Webbing, e.g. "Hollytex"

conservation supply houses, fabric stores

Hog Bristle Brushes, e.g. Grumbacher Co.'s "Gainsborough"

art supply stores

Sable Hair Watercolor Brushes w/ Fine Points

art supply stores

Pasting Surface, e.g. glass plate or ceramic tile

Tweezers / Forceps

medical, conservation, or scientific supply house

Small Scissors w/ Angled Blades

medical, conservation, or scientific supply house

Polyester Film, small pieces e.g. "Mylar"

Scalpels w/ Various Shapes & Sharpness of Blades

scientific, medical, or conservation supply house

Teflon Spatulas

conservation supply house or make your own

Head Loupe w/ Appropriate Magnification

conservation or craft suppliers

Acrylic Blocks (e.g. 3 x 5 x 3/8")

plastics company. Have edges & corners softened.

Lead Weights/Scuba Weights

e.g. lead shot in wrapped photo slide boxes

Tissues

Japanese paper importers, conservation supply houses, some art supply stores

FILLING

Dissecting Needle/ Dental Needle Probe
educational-scientific or medical supply house

Light Box, flat style (not essential for occasional work)
photo or conservation supply house

TINTING MENDING TISSUES

tinting tray(s) made by folding polyester film, 5 mil
conservation supply house

polyester film ,3 mil, to carry tissue

professional grade acrylic paints

OPTIONAL TOOLS

Hollow pen: 1, Kooh'I'Noor, for paper tearing