

# Basic Paper Treatments for Printed Book Materials

## Note Outline 2016

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## WORKSPACE CONSIDERATIONS FOR PAPER TREATMENTS

HUMIDITY – always a problem with wet treatments

Monitor it

- recording hygrometers (expensive, reliable?)
- thermo hygrometers (less expensive, reliable?)
- humidity indicator papers (inexpensive, reliable): cards & tape

Modify it

- air conditioners (summer)
- dehumidifiers (summer )
- humidifiers (winter)
- exhaust fans – window

LIGHT – UV considerations

Natural

- windows - shades, filtering plastics: south (sun) & north (north light)

Artificial

- fluorescent – filtering plastic sleeves
- incandescent (OK)

WATER – not just H<sub>2</sub>O

Content – test professionally

- metals (bad): iron & copper
- minerals (good): calcium & magnesium
- contaminates (bad): bacteria & particulate matter
- additives (bad): chemicals & chlorine

Source

- well water (low metals, high minerals, contaminates?)
- spring water (low metals, high minerals)
- city water (high metals, minerals?, contaminates? additives?)
- rain water (pure, but pH?)

Filters

- charcoal (contaminates? additives?)
- deionized (no bad, no good, pH?)
- Distilled (no bad, no good, pH?)

pH - monitor, titrate & adjust

## HAZARDS

Bench – tools & liquids

- in box on surface
- separate table, or below not above

Personal

- coat & apron - reserved for paper use
- jewelry (rings, bracelets, necklaces, watch clasps)
- make-up (lipstick, finger polish, face powder)
- food & drink (coffee rings)
- hands clean (grease)

Miscellaneous

- pets (cats)
- children

## FIRST STEPS: REPORTS & DOCUMENTATION

### PROPOSAL

Purpose - realistic expectations – no surprises

Written – brief, but with limiting phrases: e.g. “staining reduced if possible”

Includes:

- identification of item (title, author, place and date of publication, etc.)

- value (set by owner)

- description (size, etc.)

- treatments proposed

- estimated date of completion

- estimated costs

Collation & pagination - paginate un-paginated pages, note losses

examples:

- endpapers

- fly sheets

- blank end-leaves

- illustrations, maps, etc.

methods – pencil, reverse lower corner

- front, by letters

- back, by numbers

- in the middle, by opposite leaves

Signed by owner

### DOCUMENTATION

Purpose - to provide a record

Written – form, or prose (word processor)

Condition report

- information from examinations & tests

- paper content

- sizing

- pH

- solvent solubility & sensitivity

- complications

- mold

- tape & old repairs

- losses – pages, corners, tears

Treatment report (follows the same format)

- methods & materials used

Photographic record – before & after (in process?)

Equipment

- 35 mm slides (color) &/or prints

- tungsten or daylight (film & lights)

- copy stand or tripod

- color & size guides

Shots – views

- front & back endpapers

- title page & frontispiece

- text & illustration samples

- damages

## EXAMINATIONS & TESTS

### PURPOSE

- to analyze the papers for
  - fiber content
  - sizing
- to establish the factors that
  - contribute to the problems of deterioration
    - physical
    - chemical
- to set the parameters of treatment

BOOK PAPERS – several different types are likely – individual assessment needed  
endpapers – decorative & plain  
illustrations, frontispiece, maps, etc.  
text papers

### HISTORICAL GUIDELINES – “progress” means trouble...

- 1330's – gelatin used as a size
- 1650's – alum added to gelatin
- 1770's – chlorine bleach discovered
- 1840's – undigested ground wood pulp
- 1850's - sulfate & sulfite processes discovered
- 1870's – clay coated papers used for lithography
- 1960's – acid free paper developed

### TESTS

- pH – acidity – test by surface contact not by extraction (destructive)
  - pH meters (expensive, complicated)
  - pH indicator strips (inexpensive, convenient)
    - 0-14 (liquid solutions)
    - 0-6,4-7 5-10, 0-14 (paper surfaces)
  - method – a strip in a solvent puddle in a Mylar sandwich
    - solvent tide lines? remove by “walking out”
- Sensitivity – to pH solutions
  - papers (especially endpapers)
  - inks (usually written, not printed)
  - colors (usually hand water colored, not printed)
- Solubility – to water or other solvents
  - types: signatures, inscriptions, or hand water colored illustrations
  - methods: Q tips or blotters
- Fixatives – to hold fragile colors temporarily while under treatment
  - historical – cellulose acetate dissolved in acetone
  - historical - paraffin dissolved in hot hexane
  - modern – cyclododecane that sublimates
- Phloroglucinol – to test for undigested work pulp & lignin
  - in newsprint
  - in book materials.
  - (the pens either for pH or phloroglucinol often leave indelible stains)

## DRY CLEANING

### PURPOSE

to remove surface dirt before it becomes embedded in the paper fibers by washing  
to be done only if necessary

TREATMENT – depends on the dirt and the paper surface

#### Materials

- bread – traditional (residues?)
- synthetic powders – Skum-X, Drafting powders (residues?)
- bags, pads – Opaline, etc. (dirty covers?)
- erasers – plastic, vinyl (abrasion?)
- grated eraser – plastic, vinyl

#### Methods

- circles – powder & pads (avoids lines)
- one direction – never scrub back and forth (wrinkles)
- off the edge – (prevents tears)
- brush thoroughly (residue)
- shield (Mylar or bristol) to protect notes, etc.
- wear gloves or use paper towel pads – no bare hands (oil)
- work on clean, white paper to see dirt
- clean both sides, work from center out

## TAPE REMOVAL

TAPE – consists of a carrier (paper? Acetate? Mylar?) & an adhesive.

Three alternative approaches as needed:

#### Freezing

- place in a freezer for 1 hour to reduce tack
- effective on new tape (double sided, etc.)

#### Heating

- use a hot spatula or tacking iron – silicone release paper
- softens old adhesive

#### Solvents

- types – check solvent on old adhesive
  - Water? With old paper tapes
  - Acetone? Most frequent on pressure sensitive tapes
  - Hexane or Toluene?
  - Contact manufacturer about possible solvents
- vapor form - avoids washing adhesive into fibers (translucency)
  - micro-climate – blotter in wide mouth jar - “bottle trick”
    - invented by Bob Futernick in California
  - poultice – blotter or Gore-tex in Mylar sandwich
  - expose tape slowly as it releases
- liquid form – tide lines? may require a quick solvent bath
  - Q tips, cotton ball, paper towel

Note: always remove a carrier at a sharp angle to break the adhesive

## MINOR REPAIRS

**PURPOSE** to repair the minor tears and losses before they become larger.

### TEARS

1. Clean the edges with an eraser or knife, then dampen the edges to reposition the fibers.
2. Make a narrow repair strip out of appropriate Japanese tissue. (Note #1)
3. Paste the repair strip using a transfer adhesive technique. (Note # 2)
4. Wrap the repair strip around a brush handle, barber pole style, pasted side out.
5. Position the brush with the repair strip over the tear and work it down into place.
6. Push it down firmly into position with soft tissue to remove any excess paste.
7. When completely dry, create a water line down the center of the repair strip with a water pen or brush to relax it.
8. To flatten it, press under a blotter and glass weight until dry.

Note #1. A Narrow Repair Strip: the repair strip should be marked off with dividers, then a line either scored with a needle awl, or drawn with a water pen or fine brush and a straight edge. With the straight edge protecting the repair strip, the body of the repair paper is pulled off of the repair strip; do NOT try to pull the repair strip off of the body of the paper, which distorts the strip.

Note #2. A Transfer Adhesive Technique: brush out a thin layer of thick paste on a paring stone or other firm surface. Lay the repair strip down on the pasted area; if more paste is needed, lay it down a second time on the pasted area. To avoid too much paste and the bunching of the water torn edges (feathers), do NOT try to paste out the repair strip with a brush, which distorts the water torn edges of the strip.

### LOSSES ( See page 10)

1. On a light table (Note #3), place the object (dampened) on a piece of Mylar.
2. A second piece of Mylar supporting the repair tissue (dry) is laid on top.
3. The loss profile should be clearly visible through the repair tissue.
4. Carefully trace around the loss profile with a water pen or fine brush.
5. Tear out the loss inlay.
6. Remove the second piece of Mylar with the loss inlay
7. The loss inlay can be floated into position on the light table
8. Lightly paste the edges.
9. When the paste is dry, dampen and press to flatten.

Note #3. A simple light table can be made with a piece of translucent Plexiglas placed on top of a white sink or basin with a strong light illuminating the interior.

### DOG EARS

1. "Dog ears" are corners of pages that have been turned over as markers.
2. Do NOT try to open them dry: if they are brittle they will break off.
3. Rolling a damp Q tip along the fold may soften them but often leaves a tide-line.
4. Steam (clothes steamer? kettle?) works best.
5. Bone folder the crease between Mylar.
6. Press the corner within the book block.

## MOLD PROBLEMS

Three levels of mold involvement:

### Invisible mold

A spore filled world

Control by controlling the environment (low temperature and low humidity)

### Visible mold

Remove alive (to prevent collapse) Out of doors?

Vacuum suction into a bottle with alcohol

Q tips, toothpicks, brushes, knives, cloths, etc.

Kill? Fungicides?

Sunlight – ultraviolet (spores? discolors paper?)

Freezing (spores?)

Alcohol

Heavy mold – Kill first, then remove manually?

Thymol – chamber, crystals over light bulb? 1-3 weeks?

Traditional, but effective?

Disadvantages:

Slow

Uncertain

Degrades paper

Formaldehyde – vapor (liquid in a glass) in humidifier, 12 hours

Plenderleith mentioned in his book *The Conservation of Antiquities and Works of Art*, London, 1971

Disadvantages

Toxic

Hardener of protein (a photography fixative)

May set protein based discoloration, tide lines, stains, etc.

Do NOT use on leather or vellum

Ozone – super-oxygenated water? Stabilized Aqueous Ozone

Fast, effective, but hard on paper?

A new Lotus sanitizing system by Tersano

Developed for general “green” cleaning

Used commercially

Effective on mold, and much else

Needs study. Check the Internet.



## WASHING – NEUTRALIZATION

### PURPOSE

- to neutralize acids
- to bring pH closer to neutral 7
- to wash out degradation products
- to improve health & appearance

### EQUIPMENT

- Trays – flat bottomed, of various sizes
  - plastic – photographic (Cesco-lite) – best
    - light weight
    - white (shows discoloration)
  - stainless steel (sinks mostly)
  - glass – Pyrex pans for small items
- Supports
  - glass – traditional (breakable? Non-porous?)
  - Plexiglas (non-porous?)
  - screening, Nylon or Fiberglass (slippery?)
  - Nylon or Dacron mesh (slippery?)
  - wet strength paper (porous? historical?)
  - Remay (hairy?)
  - Pellon (stretchy?)
  - Hollytex (slippery?)
  - Mylar – non-porous, but indispensable
- Other
  - Rods – glass or plastic, 1” diameter

### GENERAL METHODS

- Wash on chosen support
- Submerge with rod
- Remove with support backing or pick up with Mylar on the front
- Change rinse water as needed – 3 times? (30 minutes?) or “until clean”
- Cold water first, then hot if needed. (iron gall ink?)

### FLOAT WASHING – optional

- Purpose
  - to observe condition of the size
  - to determine further treatment
- to clean surface areas without submersion (wicking with soft tissue)

### WETTING DOWN AGENTS – first rinse - optional

- Purpose
  - to break down size
  - to allow better penetration of fibers
- Material
  - alcohol – as needed, 1:1 (Hey) or 1:16 (1cup in 1 gallon)
  - methanol, ethanol, or isopropanol
- Method
  - spray beforehand
  - in first rinse water (remove paper first)

## ADDITIONAL TREATMENTS

### SPOT TREATMENTS

#### Purpose

To remove or reduce localized stains &/or dirt

#### Supports

Pellon or Hollytex (porous)

Screen for firmer support

#### Surfactant

To remove dirt (type?) & finger marks, etc.

Orvus

Textile detergents.

#### Solvents

Alcohol, etc, depending on the stain.

#### Method

Wash on screen with a soft brush and froth

Rinse with a beaker - or tea kettle - to control force and flow

### LIGHT TABLE (See page 7)

#### Purpose

To remove old repairs and adhesives

To make inlays

#### Equipment

Translucent Plexiglass, back lighted in some manner.

A strong light focused into a white sink, or plastic tub

#### Method

Old repairs and adhesives removal, use a combination of

reflected light – overhead (repairs? carriers?)

transmitted light – back lighting (fiber loss?)

raking light – 45 degree angle (adhesive residue?)

#### Inlays

Mylar on top of wet object on Mylar

inlay paper (dry) on top

water pen to trace outline of loss profile

tear out the loss inlay

float loss inlay into position in the missing area

lineup fibers (slight overlap) with the transmitted light

### ENZYMES

#### Purpose

To soak apart laminated endpapers, etc.

To remove protein or starch sizes and adhesives.

#### Materials

Protease – dissolves protein

Amylase – dissolves starch

Method – add to warm water rinse (enzymes are denatured above 40 c.)

### ALKALIZED RINSES

#### Purpose

Add to raise the pH and to further neutralize the acids

Method: Calcium hydroxide? Magnesium bicarbonate? Ammonia?

## WASHING – ALKALIZATION

The difference between “neutralization” and “alkalization” is only a matter of degree and of the concentration of the solutions used.

### PURPOSE

- To bring the pH above neutral 7
- To provide an alkaline “reserve” or “buffer”

### MATERIALS

- Minerals, salts of minerals
  - Calcium
  - Magnesium
- Forms
  - Hydroxide – water
    - High pH in solution (dangerous?)
    - Lower pH in dried precipitate on paper
  - Bicarbonate – water & carbon dioxide
    - Lower pH in solution (carbonic acid)

### SOLUTIONS

#### Barrow Two Step

- Calcium Hydroxide (limewater) –  $\text{Ca}(\text{OH})_2$  Saturated solution
  - Calcium carbonate or calcium hydroxide (faster) powder
  - Mixed into water 2g/1 (PCC) (Hey), 4g/1 (Clapp)
  - Shake several times – let settle
    - pH 12+ in solution
    - pH 8+ dried in paper
  - Use 1:1 (Hey), 1:6, 1:16 as required or desired (ck pH)
- Calcium Bicarbonate –  $\text{Ca}(\text{HCO}_3)_2$ 
  - Calcium carbonate or calcium hydroxide (faster) powder
  - Mixed into water 7.3g/1 (PCC)
  - Bubble carbon dioxide through ‘til clear
  - (2<sup>nd</sup> step rarely used now as carbonate precipitates on drying)

#### Barrow One Step

- Magnesium Bicarbonate –  $\text{Mg}(\text{HCO}_3)_2$ 
  - Magnesium carbonate (8.4g) or magnesium hydroxide (5.8g) powder
  - Mixed into water 8.4g/1, 5.8g/1 (PCC), 2 oz./1 gallon (Clapp)
  - Bubble carbon dioxide through ‘til clear
    - pH 6.5 – 8.0 in solution
    - PH 7.5 – 8+ dried in paper
  - Use straight. 1:1, 1.8 as required or desired (check pH)

Decisions – arguments for and adherents of both

- Calcium hydroxide (easier to make)
- Magnesium bicarbonate (better stabilizer of metal particles)

#### Keyes Alternative method

- Ammonium Hydroxide ( $\text{NH}_3$  or  $\text{NH}_4\text{OH}$ )
  - Keiko Keyes in her 1982 article on Alternative Methods to reducing discoloration in works of art on paper promoted using Ammonia to raise the pH of the wash water to neutralize the acids. As the pH is extremely strong, few drops in a small tray or a capful in a large one is all that is needed. The pH must be checked often.

Note: Small quantities of de-acidification solution may be made up relatively easily. They are useful for treating newspaper clippings, etc. Ground wood pulp papers will darken initially with the higher pH solutions unfortunately but are stable after that.

Calcium Hydroxide

Calcium hydroxide (one teaspoon or more) in a quart bottle of water (tap, distilled, or spring water).

Shake well and then let settle. A saturated solution

Magnesium Bicarbonate

(Milk of Magnesium) (one teaspoon or more) in a quart bottle of soda water

Shake until clear and then let settle

Ammonium Hydroxide

Ammonia (one quarter teaspoon) in a gallon of water (tap, or distilled, or spring)

Shake well and then let settle. A saturated solution

Check pH and adjust.

## NON – AQUEOUS ALTERNATIVES

### SPRAY DE-ACIDIFICATION

Two types

Wei T'Ö

A non-aqueous alternative developed by Richard Smith

Uses magnesium methyl carbonate in a spray solution.

Bookkeeper

A modern, popular, non-aqueous alternative

Uses magnesium oxide in a spray solution.

Two methods

Spray form – most commonly used

Liquid form – for large projects

Advantages

Neutralizes the acids in the paper

Leaves a residual buffer

Disadvantages

Does not remove the degradation bi-products.

Improves the health but not the appearance

### MYLAR ENCAPSULATION

A housing, not a treatment

Often combined with spray de-acidification treatments

## RESIZING

Resizing often is not necessary after washing and treatment. Washing alone strengthens paper.

Re-activates fiber bonding

Reactivates old size

### PURPOSE

Strength to the fibers

Protection for the surface (finger prints etc.)

Media support (feathering of the inks, colors, etc.)

### CRITERIA – compare to the rest of the book

Rattle?

Drape?

Feel? (a blotter like quality?)

### CONSIDERATIONS

Future use & housing?

Past treatments? (hot water rinses? bleaching?)

### TYPES OF SIZE

Protein

Hot animal glue - diluted (acidic)

Gelatin – food (Knox) or photo (acidic)

Vellum – parchment, vellum scraps boiled (alkaline)

Starches – dilute pastes

Wheat

Rice

Corn

Cucumber (Middle Eastern)

Cellulose ethers

Methyl cellulose, etc.

Synthetics

Soluble nylon –

Not used now

Not reversible – cross-links with age

Discolors – gray

### METHODS

Internal sizing – vat or tub sizing – modern, during paper manufacture

Surface sizing – traditional – applied afterward

Brush? (uneven?)

Spray? (uneven?)

Immersion? (dipped – even)

Should the paper be dry or wet?

Prevents? or aids penetration?

Dilutes size?

## BLEACHING

### PURPOSE

- To improve visual appearance
- To lighten overall discoloration
- To reduce stains

### LIGHT BLEACHING– aqueous light bleaching

#### Advantages

- Safest – on rag paper (no lignin, no alum rosen size)
- Easiest – on object & conservator
- Best result – natural color (not stark white)

#### Natural – sun light

##### Method

- Place in de-acidification bath (mg. bicarb.)
- Tray with Plexiglass cover, sponges at corners
- Place in sun or open shade
- Rinse thoroughly when finished to remove “degradation bi-products”
- Time – as long as required or desired, depending on
  - Latitude
  - Time of year

#### Artificial – banks of fluorescent light tubes

- Method – same as above
- Time – longer (slower)

### CHEMICAL BLEACHING

#### Disadvantages

- Complicated
- Hard on object & conservator
- Result – a dead, stark white

Methods – read Margaret Hey in *The Paper Conservator*, volume 2, 1977

### DRYING

#### Air drying – “unrestrained”

##### Method

- Remove free standing water
  - Drain
  - Paper towels
  - Blotters (expensive)
- Place on drying racks (screens)
- With or without supports (depending on racks & objects)
  - Pellon or Hollytex
  - Blotters (expensive)
- Screen on top – optional
- After air drying
  - When completely dry (warm to the touch), humidify (see following)
  - Flatten under a blotter & glass plate, or between two glass plates

## HUMIDIFICATION & FLATTENING

### PURPOSE

- To dampen and then remove the moisture from the paper
- To leave the fibers in one plane without cockling or other distortion.
- To flatten without losing type “punch” & plate lines

### HUMIDIFICATION

#### Direct water

- Spray – Dahlia sprayer, or finger pump plastic bottle
- Brush – on reverse side
- Ultrasonic humidifier

#### Vapor

##### Humidity chamber

- Double garbage can
- Tray with water (wet blotter?), rack (screen?) & Plexi on top  
(or second inverted tray?)

##### Humidity sandwich – a damp pack - allow to “marinate”

- Mylar
- Blotter – damp or wet
- Interleaving sheet – Pellon, Hollytex, or Gore-tex
- Object
- Interleaving sheet – Pellon, Hollytex or Gore-tex
- Blotter –damp or wet
- Mylar
- NO WEIGHT (object must expand without wrinkling)

### FLATTENING

#### Wet press – “pressure drying”

- Method – a dry sandwich, or a dry pack (built like a reverse damp pack above)
- Use “wicks” to remove moisture – blotters or felts (better)
- Change until dry (warm to touch) – three times? 1/2 hr., 2 hr., overnight?
- Weighted to keep sandwich flat “in plane” – under, or between  
Plexiglass, plate glass, litho stone, press, etc.

Note: The distortion and cockling in paper is generally due to “differential preferential” drying, i.e. one part of the paper is drying before the other. The secret to success is in uniform drying, in having the moisture dissipate and evaporate evenly though out the sheet as it dries.

The general rule is that drying paper always pulls toward the side that dries last. In a flat sheet lying on a surface, the bottom side will dry first. As moisture evaporates up through the sheet, the topside will continue to dry and to shrink, pulling the sheet in that direction. In a similar example in a damp sheet lying on a surface, the outside edges are exposed to more air and will dry sooner; meanwhile the interior of the sheet will continue to evaporate and shrink, pulling at the edges, which cockle to accommodate.

The Japanese technique of Friction Mounting (see below) is excellent at keeping the drying uniform and at producing a flat item without distortion. It can be used on Western papers as well. It is easy on the object and easy on the conservator.

## LINING

### PURPOSE

- To add strength (title pages, maps, fly leaves, etc.)
- To add dimensional stability (board papers, end leaves)

### ADHESIVE

- Starch
  - Wheat
  - Rice
- Cooked & thinned down
  - Thin - skim milk
  - Medium – heavy cream
  - Thick – sour cream

### LINING

- Silk – no longer used
- Lens tissue – by some
- Japanese issue – by most, depending on
  - Weight
  - Color
    - Kozo – longest fiber
    - Mitsumata
    - Gampi – thin, but too much pull

### METHOD

- Dampen both object & lining tissue until relaxed
- Paste lining tissue
  - Object face down on drying board, or Arborite (protective facing tissue?)
  - Lining tissue paste down on top (entry portal?)
  - Brush air bubbles out
  - Let air dry – if pulling occurs, slow down drying with blotter or Goretex
  - Note: Can be done face up to create a hinge
- Friction Mounting... ie. Stretch drying for flattening
  - Dampen both object & mounting tissue until relaxed
  - Object face down on drying board or Arborite (protective facing tissue?)
  - Mounting tissue face down on top
  - Fold edges back and paste down, include entry portal
  - Let air dry – if pulling occurs, slow down drying with blotter.
  - Next day, remove and release

## URAZURI BEADING

### PURPOSE

- To soften the adhesive in a lined object
- To improve flatness and flexibility in the lined sheet

### METHOD

- An 18 inch string of Urazuri beads (traditionally glass beads or soapberry seeds) is coiled under the flat of the hand and rolled firmly over the back of the lined sheet in a circular motion. To prevent burnishing it can be done through a protective sheet.



## SOURCES OF USEFUL INFORMATION

### THE BOOK AND PAPER GROUP ANNUAL

The Book and Paper Group

The American Institute for Conservation of Historic and Artistic Works

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[info@conservation-us.org](mailto:info@conservation-us.org) [www.conservation-us.org](http://www.conservation-us.org)

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