

Emergency Plan: Appendix B

Salvage Procedures for Water Damaged Materials

I. A number of options are available for treating water damaged materials. The choice of treatment will depend on the extent and type of damage incurred, and the manpower, expertise and facilities available.

A. Freezing

Freezing wet materials will stabilize them and provide you with time to determine your course of action. Mold will not grow and further deterioration from water will not occur when materials are in a frozen state. Books have been left in a freezer for ten years and been successfully thawed and air dried with no resultant damage. Freezing will also help to eliminate smoke odor from materials.

Rapid freezing is recommended to minimize damage from ice crystals (the faster the materials are frozen, the smaller the ice crystals will be). Temperatures below 15 degrees Fahrenheit will freeze and dry out wet materials. If freezer space is not immediately available, and the outside temperature is below 15 degrees Fahrenheit, place the materials in a secure outside area. Cover them with plastic if rain or snow is expected.

Freezing is an intermediate stage. After materials have been removed from the freezer, they must be placed in a vacuum freeze drier or air dried.

B. Vacuum Freeze Drying

Vacuum freeze drying is the safest and most successful method, although it is also the most expensive. Materials must be already frozen when they are placed in a sublimation chamber. This type of chamber operates under high vacuum and high heat, and turns the ice crystals in and on the frozen materials to water vapor. The vapor is then collected on a cold panel that has been chilled to minus 200 degrees Fahrenheit is put in the chamber, the materials will freeze on the outside and the water molecules on the inside will be forced through the frozen barrier as the vacuum is pulled. This action can cause the book or document to “explode.”

When materials are removed from the vacuum freezer, they will be very dry and should acclimate for at least one month before they are opened to avoid cracking the spine and/or binding (this is especially true for leather bindings). They may be placed in a high humidity room to accelerate the acclimation process, but must be monitored closely for signs of mold.

Materials so treated will not look like new, but will show signs of swelling and distortion. Stanford University Library staff members reported that they needed an additional 12% of shelf space for materials that had been treated in Lockheed’s chamber. Photographs will not be damaged by this treatment, but rubber cement will dissolve and stain the pages to which it has been applied.

C. Air Drying

Air drying should be performed only in a stable environment to inhibit the growth of mold. The ideal environment for air drying is 50-60 degrees F and 25-30% humidity. Instructions are outlined in 11 below. This process is not recommended for coated stock materials, such as art books. (See III Below)

D. Vacuum Drying

Vacuum drying involves the placement of wet materials in a chamber that pulls the moisture by means of a vacuum. This method is not recommended as the heat involved is damaging to paper (especially bound paper) and photographic materials. Microwave ovens should not be used for the same reason.

II. The following procedures are recommended:

A. Volumes to Be Frozen

1. Removal

- Clear the floors and aisles first.
- Begin with the wettest materials. These will usually be on the lowest shelves, unless water has come in through the ceiling.
- Dirt and mold should be removed and treated before freezing . If time does not permit these activities, dirty and/or moldy books may be frozen (mud will easily brush off when it is dry). Silt should be washed out immediately, as it is almost impossible to remove when it is dry.
- Pack materials on site, if possible. If not possible, remove by human chain.
- Keep accurate records of the locations from which materials are removed.

2. Packing

- Remove volumes from shelves in order.
- Wrap freezer paper around each volume (waxed side next to the volume) and place in plastic crates spine down.
- Pack crates one layer only, snugly enough that volumes will not slide or lean.
- Wrap open books as found and place on top of a packed container. Do not place more than one open volume in a container. Be sure there is a freezer paper barrier between the packed volumes and the open volume to prevent staining from binding eyes.
- If books are stuck together, do not attempt to separate them, but pack them as one volume.
- Pack items in the condition in which they were found. Do not attempt to close open volumes or open closed volumes that are wet.

3. Record Keeping

- Label each container with your institution's name and assign it a number.
- On a separate sheet of paper, record the box number, all numbers of the first and last volumes packed, and the total number of books in each container. If they are not in call number order, note the location where found.
- If the containers are sent to more than one freezer, note which container numbers are sent where.
- Keep records of discarded items.

4. Transporting

- Materials should be placed in a freezer facility as quickly as possible to prevent the growth of mold. Care should be taken that containers do not fall over during transport, as further damage may result.
- Materials should be placed in refrigerated trucks if they cannot be frozen within 48 hours.

B. Volumes to be Air Dried

1. Washing Procedure (To be performed off site only):

- Keep the book tightly closed and hold it under cold, clean running water
- Remove as much mud as possible from the binding by dabbing gently with a sponge. Do not rub or use brushes and do not sponge the pages or edges, as these actions can force the mud

into the spine or the wet pages, causing further damage to the volume. Let the motion of the running water clean off the dirt.

- Squeeze the book gently and with even pressure to remove excess water and to reshape the binding.
- Do not wash:
 - Open or swollen volumes
 - Vellum or parchment bindings or pages
 - Full or partial leather bindings
 - Fragile or brittle materials
 - Works of art on paper
 - Water soluble components (inks, tempura, water colors, dyes, charcoal, etc.)
 - Manuscripts
 - Non paper materials

2. Saturated Volumes

- Do not open! Wet paper tears easily!
- Set volumes on their heads on absorbent paper. Pages tend to droop within the binding when a volume is shelved upright, so setting it on its head will counteract this tendency. Plastic sheeting should be placed under the paper toweling or unprinted newsprint to protect table tops. Turn the volumes right side up when changing the paper beneath them. Their position should be reversed each time the paper is changed and the wet paper removed from the area.
- Covers may be opened to support the volume.
- Aluminum foil may be placed between the cover and the endleaf to prevent staining from the binding dyes.
- When most of the water has drained, proceed as for “damp volumes.”

3. Damp Volumes

- Very carefully open the book (not more than 30 degree angle).
- Begin interleaving from the back and keep the volume in an upright position.
- Place interleaving sheets at intervals of 25 leaves (50 pages), unless they will distort the volume.
- Change interleaving frequently. Do not reuse unless the sheets are being impregnated with fungicide. Inth-Pheny Penol (O-PP) has been found to be less toxic than thymol and is recommended. Mix one pound of O-PP to one gallon of acetone or ethanol (do not use methanol, as it will cause inks to bleed). Safety equipment (mask, eye goggles, and rubber gloves) should be worn when preparing and using this solution.
- Continue to change the paper underneath and remove from the area.

4. Slightly Damp Volumes/Volumes With Only Wet Edges

- Stand volume on its head and fan open slightly. Paperback books may support each other with a barrier between them or they may be wedged with Styrofoam pieces. Position volumes in the path of circulating air.
- When almost dry, lay the volumes flat and place weights (not other drying books) on them to minimize distortion. Do not stack wet volumes.
- Lightweight volumes (less than six pounds) may be hung on lines to dry.
- Use monofilament nylon lines, not more than 1/32” in diameter.
- Do not line dry a saturated volume, as the monofilament will cut through the wet paper.

C. Volumes With Coated Stock Paper

Wet coated stock paper should be handled with care, as the print will slide off the wet page if it is rubbed. Do not allow wet books with coated stock paper to dry in a closed state as the pages will permanently bond together. Almost all attempts to separate stuck pages by rewetting them have failed. McDonnell Douglas' Document Reclamation Service reports that vacuum, freeze drying of coated stock volumes is rarely successful. Keep volumes submerged until the pages can be separated (see IV below). The only chance of saving such materials is to interleave every page and air dry.

D. Documents/Unbound Materials

1. Freeze as Found

- Do not remove from file cabinet drawers, document cases, or folders.
- Do not turn containers upside down to empty or drain.

2. Separation of Wet Sheets

- Place a stack of polyester film on top of a stack of wet, unbound papers (or the first page of a bound volume).
- Run gently with a bone folder – surface friction will cause the wet paper to adhere to the film.
- Peel back the top sheet and place it on top of a piece of polyester web.
- Remove the polyester film.
- Place another sheet of polyester web on top of the wet sheet.
- Repeat the entire process, separating the wet sheets one at a time and interleaving them with polyester web. (Materials may be frozen at this stage).
- Air dry the sheets (supported by the polyester web) by placing them on absorbent paper on tables or on top of closely spaced monofilament lines. Air in the room should be kept circulating, but fans should not blow directly on the materials.
- The papers may be flattened when they are almost dry by placing them between two sheets of blotting paper (to remove excess moisture) and applying even pressure with weights.

E. Non-Book Materials

1. Photographic Materials (prints, negatives, slides, film).

- a. Do not expect to salvage color photographs, as the colored layers will separate and the dyes will fade quickly. However, if you wish to try, freeze them immediately, or transport them (see 2 below) to a photographic laboratory.
- b. Photographic materials should not be allowed to dry out after they become wet as they will stick to their envelopes or to each other. Any attempt to separate them after they have dried together will result in damage to the emulsion or the image. Remove the materials from their protective enclosures and wash off any mud or dirt under cold, clean running water.
- c. The following options are available for salvaging photographic materials:
 - Air dry either flat or on lines of monofilament (plastic spring type clothespins may be used to hang them on lines).
 - If there are too many to air dry, they may be stored in cold water (65 degrees F or below – cold helps to preserve the emulsion). Ice may be added to the water, but do not add dry ice or allow the materials to remain under water longer than three days. Formaldehyde may be added to the water (15 milliliters to one liter) to help prevent the gelatin from swelling and softening. Black and white film could last three days in this solution before the emulsion begins to separate; color film could last 48 hours.

Transport the materials (in sealed polyethylene bags inside plastic garbage pails) to a 137

professional laboratory within 24 hours, if possible.

- If time does not permit air drying, then materials may be frozen. As the emulsion may be damaged by the formation of ice crystals, freezing as quickly as possible is recommended (smaller ice crystals will cause less damage). Negatives should be separated before freezing as they tend to stick together when thawed.
- The Eastman Kodak Company provides free emergency service for cleaning and drying its own black and white roll microfilm. Contact Don Franklin in the Chicago lab (312- 954-6000).

2. Microforms

a. Silver halide microfilm

- Keep under water (See VA 2 above)
- Send to Kodak or a professional microprocessing laboratory.

b. Vessicular and Diazo Film

- Wash off mud or dirt under cold, cleaning running water.
- Air dry or dry with cheesecloth.

c. Microfiche

- Treat the same as silver halide microfilm.
- Kodak will not treat microfiche, so send them to a professional microprocessing laboratory.

3. Tapes (audio, video, computer) and floppy disks.

Water is especially damaging to magnetic materials. The longer they have been wet, the greater the damage will be. Do not attempt to play any damaged tapes or disks, as they can damage the equipment on which they are being played.

The following procedures are recommended if you wish to attempt to salvage tapes:

- Break open the cassettes.
- Wash in clean or distilled water.
- Air dry or dry with cheesecloth.

4. Sound Recordings (Disks)

Clean water probably will not damage sound recordings, but floodwater carries silt, which will scratch a disk. Disks should be washed and dried with cheesecloth or a soft, lint-free cloth.

Record jackets or paper protective sleeves should be discarded as they can trap moisture and may develop mold. Record jackets could be photocopied to preserve the information they contain.

III. Mold

Mold and mildew are interchangeable names for fungi. They can never be killed and can remain dormant for many years. Spores are always present in the air and will grow when the environment is warm and humid. Freezing will inhibit the growth of mold and is recommended if time does not permit immediate treatment.

Mold can develop within 48 to 72 hours in an environment where the temperature is over 75 degrees

Fahrenheit and the relative humidity is over 60%.

- Separate the affected materials to prevent spreading.
- If the materials are wet and mold is beginning to develop, interleave the volumes with papers impregnated with fungicide (See IIC4).
- Keep the air circulating in the room.
- Mold is easier to remove when it is dry. Vacuum or brush it off and remove the spores from the area.
- Materials that will be fumigated should be removed from plastic crates, as plastic will absorb the fumigants. Fungicidal fogging should be done only by a professional chemist or conservator.

IV. Do Not, Under Any Circumstances:

- Enter an area until it has been declared safe.
- Attempt to open a wet book (Each tear costs to mend)
- Attempt to close an open book that is swollen
- Use mechanical presses on wet materials.
- Attempt to separate books that are stuck together.
- Write on wet paper.
- Use bleaches, detergents, water soluble fungicides, adhesive tapes (or adhesives of any kind), paper clips, or staples on wet materials.
- Use colored paper of any kind during salvage and recovery operations.
- Pack newly dried materials in boxes or leave them unattended for more than two days.

