FLORIDA INTERNATIONAL UNIVERSITY

Now What . . .

Building Content Recovery & Restoration Guide

Environmental Health & Safety & Risk Management Services
CSC 162 **348-2621** ***www.fiu.edu/~ehs***

An ounce of Prevention is Worth far more than a Pound of Cure

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Water Damage - General Information

A. Protection from Water Damage:

If there is any advance notice of potential water damage, all possible protective measures should be taken. Covering items with plastic, raising furniture up on blocks, protection of computer equipment, etc. are all viable options. Additionally, you might consider the permanent storage of certain valuable items (rare books, historical newspapers, long term archival documents, etc.) in buffered, acid free storage boxes. You must order these in advance and keep as part of your response and recover kit.

B. Minimize the Water Contact Time:

Water is extremely damaging to most common materials including but not limited to paper, wood, building materials, electronics, micrographics, and metals. Paper and wood will swell and deteriorate, electronics will short-circuit and corrode, and metals will rust when left in wet environments. The immediate removal of water from contact with the affected items will reduce the amount of damage that can occur. Many items left in standing water will continue to deteriorate until the water is removed. Paper left in partial contact with water or left in a high humidity environment will continue to absorb water.

C. Freeze all Books/Paper Items Immediately

Special Note: *"Speed is of the utmost importance, but careful planning is equally essential in the salvage effort."*[1]

Freezing paper items is the first step in the recovery process. Even if it is eventually decided to discard some of the items, it is better to freeze anything that you may want to recover. Then, when things settle down, the final decision can be made as to what goes and what's worth keeping.

D. Stabilize the Items to Prevent Mold and Mildew growth

Special Note: *"Salvage operations must be planned so that the environment of flooded areas can be stabilized and controlled both before and during the removal of the damaged materials."*[2]

Mold and mildew can cause irreparable damage to carpet, paper and building materials even after all of the standing water is removed. Fungal spores are always present and high humidity and warm temperatures create an environment conducive to fungal growth. Therefore all efforts should be made to reduce the humidity in the affected areas.

[1 And 2] *"Procedures for Salvage of Water-Damaged Library Materials" by Peter Waters, Restoration Officer -Library of Congress, Washington, DC.*

E. Security - Protection of the Affected Items

Water damage can cause the affected items to be more easily ruined. Paper, photographs, micrographics, magnetic media, and some building materials must be very carefully handled when wet. These items may be knocked to the floor by the firefighter's efforts. Security of the area must be established to prevent causing more damage.

F. Dehumidification

Objective -The objective of any dehumidification procedure is to reduce the moisture content - of the building air in order to draw excess water from the structure and contents and return the environment to pre-loss conditions. Key questions such as: HOW? HOW DRY? HOW MUCH? should be addressed to determine the most expeditious and cost effective solution for each situation.

There are two major methods of dehumidification - desiccant and refrigeration. In either case, a number of air movers are stationed inside the building to circulate the dry air from the dehumidifier into all areas and to speed the drying process. As much of the water saturated debris as possible (fallen ceiling tiles, boxes, ruined sheet rock, etc.) should be removed to minimize the water load on the dehumidification process.

Contrary to popular belief, a building cannot be dried too quickly. The least damage is caused when the building contents are dried as quickly as possible. The drying process is monitored by measuring the humidity ratio daily and by plotting the results on a chart. Individual items' moisture content should be measured with appropriate instruments to evaluate the effectiveness of the process.

Desiccant - Desiccant units pull moist air through a rotary honeycombed desiccant wheel made of a substance such as silica gel or lithium chloride which absorbs the moisture. The resulting dry air is then blown into the building space. As the moisture is removed from the air, the desiccant material in the wheel becomes saturated. The wheel surface area is divided into two parts by a divider wall. One half of the area is used for absorption of moisture and the other half passes through the reactivation chamber where heated air is blown through the wheel material to dry (reactivate) it. Once dry it then rotates back into the air dryer chamber to once again absorb moisture.

Desiccant dehumidifiers generate much drier air than refrigeration units and operate in a much wider temperature / humidity range. This method is more effective in unheated facilities, such as large warehouses, where dehumidification is more economical than air conditioning or heating the facility.

The major drawback to desiccant drying is that the reactivation air stream (warm moist air) must be exhausted outside the building being dried. The butane fired reactivation may also be a problem if the unit is to be used inside the building. Therefore, the usual application of this unit is external to the building. The warm dry air is introduced through light plastic ductwork, which is custom designed for each application, or may be introduced into the HVAC system through a mixer box. These desiccant units are indispensable for large open areas such as gymnasiums and warehouses.

Refrigeration - A refrigeration unit contains a closed cycle of refrigerant that is allowed to evaporate inside copper coils. The evaporation process cools these coils. The gaseous refrigerant is then compressed to a liquid and passed through the condenser coils where the heat removed from the evaporator coils is exhausted. Refrigeration dehumidifiers operate efficiently in warm moist conditions. The warm moisture laden air is passed over the cold refrigerant coils (the evaporator) which are below the dew point temperature of the building air. As the air passes, moisture condenses on the coils so the air exhausted contains less water than the incident air. Before leaving the unit the dried air is blown across the condenser coils where it is heated and exits the unit with a net heat gain. The condensed water is collected in a pan and pumped to a drain as required.

The advantage of the refrigerated unit is that it is self-contained and can be operated inside small office spaces. It does not require an external exhaust.

Fire Damage - General Information

Preventive Measures - Minimize Fire Damage and Soot Contamination

A. Help contain the fire by ensuring that:

1. High fire-hazard areas are identified and appropriate safety procedures routinely applied.
2. Appropriate fire extinguishers are available and their locations highly visible.
3. All fire doors remain closed or will close properly in the event of a fire alarm.
4. Automatic fire-extinguishing systems are installed and operational.

Note: *There is sometimes a reluctance to install automatic sprinklers for fear that the water will damage the contents. Consider this water damaged items can usually be restored, ashes are worthless!*

B. Help minimize soot contamination by:

1. Shutting down all electronic equipment (if possible) at the end of each day.

Note: *If the cooling fan is running, it will circulate the soot contaminated air through the equipment which will then require disassembly and detail cleaning.*

2. Removing important, work-in-progress items from the desktop and place in a closed drawer.
3. Replacing floppy diskettes, etc. into their protective cases.
4. Keeping all drawers, file cabinets, doors, etc. tightly closed.

C. After a fire:

1. Evaluate the risks associated with re-energizing the HVAC system and possibly spreading the soot contamination to previously unaffected areas compared with the benefit of improving and stabilizing the environment.
2. Beware of utilizing the elevators since the shafts act like an air piston and may spread the soot contamination.

Note: *Soot is a particulate which must either be removed or sealed in place (normally with a polymer sealant) in order to eliminate its odor. If the smoke odor is fairly strong, it tends not to "air out". Further measures are often needed to remove or seal the soot particulate. Vapor barriers can be constructed out of heavy plastic sheeting to help seal off the burned area or to protect sensitive areas (i.e. computer room, clean room, etc.).*

D. Combustion By-products

1. The fuel that was consumed in the fire has a direct effect on the ease or difficulty of a restoration effort. Wood and paper soot is not as greasy or oily as soot produced from the burning of plastic furniture, carpet, insulation around electrical wires, etc.
2. Burning of plastics, Teflon, and Halon products can produce hydrochloric, hydrofluoric, and/or hydrobromic acid fumes in varying amounts as well as other reactive agents. Even a light acid exposure may cause corrosion. The higher the humidity the more active the corrosive elements will be.

E. Soot & Smoke

Other common content items also generate other acids (nitric, sulfuric) and ionic chemicals. Urethane foams degenerate to cyanate compounds. The smoke generated by a fire is a complex mixture of oxidized organics, carbon, and contaminants such as hydrochloric acid. The smoke is analogous to fog, having a dew point and condensing on objects whose temperature is below the dew point. Smoke is toxic and hazardous - it kills people. Soot left on equipment and other contents is pervasive and potentially harmful to metal components and damage continues long after the fire is out.

The byproducts formed in a fire are a result of the materials involved, and the completeness of the combustion process. During a fire the chemical bonds in long polymer chains are broken, and constituent components of the compounds are released.

Electronic Equipment - The First 24 Hours

Warning *It is most important that the power is disconnected from all electronic equipment as soon as possible. Not only is there a continuing danger to the equipment from electrical shorts, but voltage potential within the circuitry tends to electrochemically erode metals on printed circuit boards and backplanes.*

A. Smoke Damage

Primary damage to electronic equipment is caused by smoke that contains corrosive chloride and other acidic combustion by-products. Short duration smoke exposure of time does little immediate damage. However, the particulate residue left after the smoke has dissipated contains the active by-products that will corrode metal contact surfaces in the presence of moisture and oxygen. Do the following:

1. Move the exposed equipment into a humidity-controlled environment as soon as possible. Relative humidity of 40-50% at 65-70 degrees F will generally prevent an acceleration of corrosive activity.
2. If moving the equipment is not possible, make sure the equipment area is sealed off from outside elements. (Caution: Do not wrap the individual pieces of equipment in any material that tends to trap moisture inside the chassis).
3. Follow-up with a non-petroleum lubricant spray to stabilize metal contact surfaces. This will leave a thin but easily removable coating to help prevent oxygen and moisture from activating the corrosion process.
4. After the corrosion process is stabilized, an analysis can be made of the contaminants and appropriate decontamination processes can be applied by a professional restoration organization.

B. Water Damage

Electronic equipment exposed to water and moisture is NOT necessarily permanently damaged. Water that is sprayed, splashed or dripped onto electronic equipment can be easily removed. Even equipment that has been totally submerged can be restored. However, in every case of water damage, immediate response is required. Do the following:

1. Open cabinet doors, remove side panels and covers, and pull out chassis drawers to allow water to run out of the equipment.
2. Remove standing water with wet vacuums. Use low pressure air (50 psi) to blow trapped water out of the equipment. Absorbent cotton pads can be used to blot up water. Use appropriate caution around header pins and backplane wire wrap connectors to avoid bending.
3. Vacuum and mop up water under any raised computer room floor.
4. Equipment containing open relays and transformers will require a special bake out before application of power.

In the event of a localized or regional disaster, prompt emergency action will control the damage due to contaminants and allow time for restoration of the equipment and facility. It is important to know what must be done immediately and to have materials available to implement the emergency action.

C. Storage Media

If immediate action is taken following a loss, the information may be recovered from hard disks, microfilm, optical media, magnetic tapes, and floppy diskettes containing valuable information.

A. Hard Disks - The better units are housed in a semi-sealed assembly that is normally less susceptible to soot contamination. They can be damaged by heat and, depending on the integrity of the housing, they may also incur water damage. If the information on the hard disk is not accessible, the drive unit may be removed and placed in another compatible unit to attempt retrieval of the information. If this is still not successful the hard drive may need to be opened in a clean room by a specialist and the disk cleaned and replaced into a new unit. This procedure can be expensive and painstaking. Once the information has been retrieved it should be copied onto new storage media.

B. Magnetic Tape – If these are not ruined during the loss, they should be cleaned on a special, tape cleaning machine prior to attempting to read them. This will dry and/or remove any debris that may have been deposited on the tape. Cleaning in this way will prevent damage to the read head caused by contamination from the debris on the tape and will properly re- tension the tape.

Note:

- If exposed to flood waters. keep tapes wet until they can be restored. Use zip lock bags. Pack in a plastic lined box, etc. Keep in a cool area (65 degrees F).
- Tapes must be cleaned within two weeks to avoid fungus growth.
- Do not attempt to dry with heat!!
- A 95% to 100% success ratio is possible. If response actions are taken within 72 to 96 hour response.

C. Floppy Diskette - If these have been contaminated by water or soot they should be cleaned with a special cleaning solvent prior to attempting any information retrieval. The diskette read heads are sensitive to contamination and the floppies must be carefully cleaned to prevent a "head crash". As with the other magnetic media, the information should be copied onto new floppies.

D. Microfilm - The most important thing to know about microfilm is that once the film is wet do not let it dry. The film must be processed while still wet or the gelatin coating will stick to the next layer and the document information will be torn from the film. Here again, speed is of the essence.

Note:

- For short time storage, five gallon buckets can be used to store film with enough (preferably distilled) water to cover film. Zip lock bags or plastic cellophane wrap can also be used to package the film and prevent drying
- Use gloves when handling wet materials and wash hands thoroughly to prevent infection from flood bio-contaminants

- For longer storage than a few days, a conservator must add special gelatin hardening chemicals to the water. For long term storage, the film may be frozen without damage.

E. Optical Media

- If optical media is wet, keep wet until it can be cleaned (similar to microfilm).
- Take care not to scratch the surface of the media.

F. Prints and Negatives

- Should be treated similar to microfilm.

Books and Papers – General Information

A. Water or a Combination of Water and Fire/Soot Damage

1. Stabilize Wet Books / Papers by Freezing

    a. Freezing is the only way to stabilize the item, prevent further deterioration, and allow time for decisions to be made. The items may then be dried or discarded. Determine the largest modular unit to be frozen. Separate items with plastic film to avoid "one big ice block".

    b. Blast freezing should be considered for archival bound volumes to reduce the possibility of spine damage by minimizing water/ice expansion.

    c. A quick pack-out (i.e. no wasted time once the discovery is made) and immediate freezing is one of the most important steps to ensure an acceptable post-recovery item.

    d. Wet books must be handled carefully. They should be placed spine down or flat in milk cartons or boxes. Do not double-stack. Do not attempt to force swelled books closed. Leave spaces at the top of the box and do not pack books tightly. If using boxes remember that wet boxes cannot be stacked as high as dry boxes.

    e. If there is soot contamination, singed or burned edges - this will be dealt with after the drying of the paper.

    f. However, if there is a lot of loose debris that can be easily and quickly rinsed off, do so.

2. Drying Techniques

    a. Freeze - Drying

        1) This is generally accepted to be the least damaging of all methods of drying. Damage occurs to paper when water is present in the liquid phase. Freezing stops additional damage from occurring. Once frozen, the paper document may be stored indefinitely while decisions are being made to save or discard certain documents. Chart recorders on the chamber are required to validate the vacuum pressure inside the chamber throughout the drying process and to assure a quality recovery.

        2) If paper has been in direct contact with water (i.e. water spray or standing water) it should be freeze-dried.

        3) All wet, coated stock materials should be freeze-dried to prevent blocking.

b. Air Drying - Dehumidification

There are alternative methods to dry paper. Here in Florida you can always put a wet book out in the sun. You can put that same book into a room, turn on a dehumidifier and dry it quicker. These responses may be appropriate under the circumstances in which the materials are only "damp" and have not had direct contact with water. In general, paper with moisture content of less than 20% may be safely dehumidified.

Also, remember that during the dehumidification process damage to paper steadily occurs because water is present in it's liquid phase. This condition will exist until the item is completely dry. Depending on the amount of water absorbed, the composition of the paper, and the specifics of the dehumidification -warping, cockling, blocking, and ink bleeding may occur during the drying process.

c. Interleaving

1) Interleaving (placing clean dry blotter paper between each wet sheet as it air dries) may be attempted if there are relatively few affected materials and if personnel are available to dedicate the attention that the process requires. It is an effective way to deal with water damaged documents and books if personnel and resources are available. Note that interleaving This is often used in conjunction with dehumidification.

B. Fire / Soot Damage Only

1. Char, heavy or light soot should be gently brushed and vacuumed to remove as much loose soot as possible.
2. A natural rubber sponge can be used to further clean the item. If stains are still evident a large white vinyl or "Pink Pearl" eraser may be used. Extra care is required when using these cleaning mediums because their gripping and abrasive actions can easily tear paper.
3. Some stains are water-soluble and cleaning with a damp cloth will improve the overall appearance. When dealing with items that are not historical and long term archival it may be acceptable to use a very mild cleaning agent that incorporates a masking agent that helps in reducing the smoke odor often present in heavily soot contaminated items.
4. Ozone treatment is also effective as a method of deodorizing paper materials.
   Warning - *Ozone treatment will accelerate the paper aging process and should, not be used on archival items, also there are health and safety considerations associated with the use of Ozone.*
5. Careful cleaning of the title information on the spine of the books is necessary. This information is often applied by using a hot foil or gold leaf method. Depending of the age of and condition of the book it may be dimmed or removed by excessive rubbing during the cleaning process.

6. Soot goes into every opening and space. When dealing with loose papers it may be necessary to examine and separately clean each piece. The text block of books may have been tightly closed, enough to prevent soot contamination, but the area between the cover's spine and the text block is almost always penetrated by soot. Books will need to be carefully opened and cleaned to remove soot from this space.